INSTRUCTION MANUAL

FEEDER MANAGER

GRD150

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TOSHIBA CORPORATION

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(Ver. 0.6)

Safety Precautions

Before using this product, please read this chapter carefully.

This chapter describes the safety precautions recommended when using the GRD150. Before installing and using the equipment, this chapter must be thoroughly read and understood.

Explanation of symbols used

Signal words such as DANGER, WARNING, and two kinds of CAUTION, will be followed by important safety information that must be carefully reviewed.

⚠ DANGER	Indicates an imminently hazardous situation which will result in death or serious injury if you do not follow the instructions.
⚠WARNING	Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow the instructions.
⚠CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in minor injury or moderate injury.
CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in property damage.

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⚠ DANGER

- Current transformer circuit

Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

⚠WARNING

- Exposed terminals

Do not touch the terminals of this equipment while the power is on, as the high voltage generated is dangerous.

- Residual voltage

Hazardous voltage can be present in the DC circuit just after switching off the DC power supply. It takes approximately 30 seconds for the voltage to discharge.

- Fiber optic

When connecting this equipment via an optical fiber, do not look directly at the optical signal.

⚠CAUTION

- Earth

The earthing terminal of the equipment must be securely earthed.

CAUTION

- Operating environment

The equipment must only used within the range of ambient temperature, humidity and dust detailed in the specification and in an environment free of abnormal vibration.

- Ratings

Before applying AC voltage and current or the DC power supply to the equipment, check that they conform to the equipment ratings.

- Printed circuit board

Do not attach and remove printed circuit boards when the DC power to the equipment is on, as this may cause the equipment to malfunction.

- External circuit

When connecting the output contacts of the equipment to an external circuit, carefully check the supply voltage used in order to prevent the connected circuit from overheating.

- Connection cable

Carefully handle the connection cable without applying excessive force.

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- Modification

Do not modify this equipment, as this may cause the equipment to malfunction.

- Disposal

When disposing of this equipment, do so in a safe manner according to local regulations.

环保使用期限标识是根据《电子信息产品污染控制管理办法》以及《电子信息产品污染控制标识要求》(SJ/T11364-2006)、《电子信息产品环保使用期限通则》制定的，适用于中国境内销售的电子信息产品的标识。只要按照安全及使用说明内容在正常使用电子信息产品情况下，从生产日期算起，在此期限内产品中含有的有毒有害物质不致发生外泄或突变，不致对环境造成严重污染或对其人身、财产造成严重损害。

产品正常使用后，要废弃在环保使用年限内或者刚到年限的产品，请根据国家标准采取适当的方法进行处置。

另外，此期限不同于质量/功能的保证期限。

The Mark and Information are applicable for People's Republic of China only.

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1. Introduction

GRD150 feeder manager relay is designed for protection, control, monitoring and metering of medium voltage networks.

The GRD150 series provides the following protection functions.

- Non-directional and directional overcurrent and earth-fault protections
- Non-directional and directional sensitive earth fault protection (depending on the relay models)
- Non-directional and directional negative phase sequence overcurrent protection
- Undercurrent protection
- Thermal overload protection
- Broken conductor detection
- Circuit breaker failure protection
- Cold load pick-up feature
- Overvoltage and undervoltage protection
- Zero phase sequence overvoltage protection
- Negative phase sequence overvoltage protection
- Frequency protection (over-/under-frequency and frequency rate-of-change)
- Autoreclose function (depending on the relay models)

The GRD150 series provides the following control functions.

- Indication of the status of switching devices, i.e. circuit breakers and disconnectors
- Open and close commands for switching devices
- Synchronism check function (depending on the relay models)
- MIMIC configuration picture

The GRD150 series provides the following monitoring and metering functions.

- Circuit breaker condition monitoring
- Trip circuit supervision
- Metering: three-phase currents and voltages, residual current and voltage, frequency, active and reactive power, power factor, and max. demand values.

The GRD150 series provides the following recording function.

- Event record: 480 most recent events
- Alarm record: 32 most recent alarms
- Fault record: 8 most recent faults
- Disturbance record: 9 analog and 32 binary signals

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The GRD150 series provides the following I/F and communication functions.

- Menu-based HMI system
- PLC function
- Configurable binary inputs and outputs
- Configurable LED indication
- Front mounted RS232 serial port for local PC communications
- Rear mounted RS485 serial port for remote PC, IEC60870-5-103, DNP3.0 or ModBus communications

The GRD150 has four model series as follows:

Type and Model

Type:
- Type GRD150; Feeder Manager
Model:
- Model 100 series; Standard Model • Model 101; 10 programmable binary inputs / 8 programmable binary outputs • Model 102; 21 programmable binary inputs / 16 programmable binary outputs • Model 103; 32 programmable binary inputs / 24 programmable binary outputs • Model 104; 43 programmable binary inputs / 32 programmable binary outputs
- Model 200 series; With sensitive earth fault protection • Model 201; 10 programmable binary inputs / 8 programmable binary outputs • Model 202; 21 programmable binary inputs / 16 programmable binary outputs • Model 203; 32 programmable binary inputs / 24 programmable binary outputs • Model 204; 43 programmable binary inputs / 32 programmable binary outputs
- Model 300 series; With synchronism check, autoreclose function • Model 301; 10 programmable binary inputs / 8 programmable binary outputs • Model 302; 21 programmable binary inputs / 16 programmable binary outputs • Model 303; 32 programmable binary inputs / 24 programmable binary outputs • Model 304; 43 programmable binary inputs / 32 programmable binary outputs
- Model 400 series; With sensitive earth fault protection, synchronism check, autoreclose function • Model 401; 10 programmable binary inputs / 8 programmable binary outputs • Model 402; 21 programmable binary inputs / 16 programmable binary outputs • Model 403; 32 programmable binary inputs / 24 programmable binary outputs • Model 404; 43 programmable binary inputs / 32 programmable binary outputs

Table 1.1.1 shows the members of the GRD150 series and identifies the functions to be provided by each member.

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Table 1.1.1 Series Members and Functions

Model Number	GRD150-			
	100 series	200 series	300 series	400 series
Non-directional overcurrent OC (IDMT, DT, INST)	✓	✓	✓	✓
Non-directional earth fault EF (IDMT, DT, INST)	✓	✓	✓	✓
Non-directional sensitive earth fault SEF (IDMT, DT, INST)		✓		✓
Directional overcurrent DOC (IDMT, DT, INST)	✓	✓	✓	✓
Directional earth fault DEF (IDMT, DT, INST)	✓	✓	✓	✓
Directional sensitive earth fault DSEF (IDMT, DT, INST)		✓		✓
Undercurrent UC	✓	✓	✓	✓
Thermal over load THM	✓	✓	✓	✓
Non-directional negative phase overcurrent NOC (IDMT, DT, INST)	✓	✓	✓	✓
Directional negative phase overcurrent DNOC (IDMT, DT, INST)	✓	✓	✓	✓
Broken conductor detection BCD	✓	✓	✓	✓
Circuit breaker failure protection CBF	✓	✓	✓	✓
Cold load pick-up feature	✓	✓	✓	✓
Overvoltage OV (IDMT, DT, INST)	✓	✓	✓	✓
Undervoltage UV (IDMT, DT, INST)	✓	✓	✓	✓
Zero phase sequence overvoltage ZOV (IDMT, DT, INST)	✓	✓	✓	✓
Negative phase sequence overvoltage NOV (IDMT, DT, INST)	✓	✓	✓	✓
Frequency FRQ, DFRQ	✓	✓	✓	✓
Autoreclose function			✓	✓
Fault locator	✓	✓	✓	✓
Indication of the status of switching devices	✓	✓	✓	✓
Open and close commands for switching devices	✓	✓	✓	✓
Synchronism check function			✓	✓
MIMIC configuration picture	✓	✓	✓	✓
PLC function	✓	✓	✓	✓
CT supervision	✓	✓	✓	✓
VT supervision	✓	✓	✓	✓
Trip circuit supervision	✓	✓	✓	✓
Self supervision	✓	✓	✓	✓
CB state monitoring	✓	✓	✓	✓
Trip counter alarm	✓	✓	✓	✓
∑Iy alarm	✓	✓	✓	✓
CB operate time alarm	✓	✓	✓	✓
Multiple settings groups	✓	✓	✓	✓
Metering	✓	✓	✓	✓
Fault records	✓	✓	✓	✓
Alarm records	✓	✓	✓	✓
Event records	✓	✓	✓	✓
Disturbance records	✓	✓	✓	✓
Communication	✓	✓	✓	✓

IDMT: inverse definite minimum time
DT: definite time
INST: instantaneous

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2. Application Notes

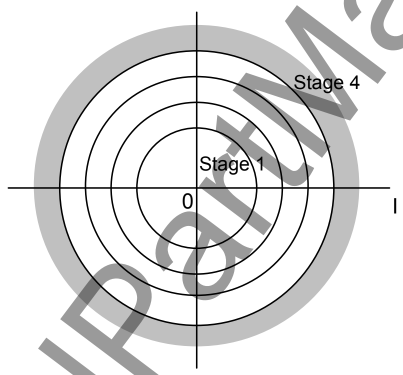
2.1 Overcurrent and Undercurrent Protection

2.1.1 Non-directional Overcurrent Protection

GRD150 provides distribution network protection with four-stage phase fault and earth fault overcurrent elements OC1 to OC4, EF1 to EF4, sensitive earth fault elements SEF1 to SEF4, and two-stage negative sequence overcurrent elements NOC1 and NOC2 which can be enabled or disabled by scheme switch setting. The OC1, OC2, EF1, EF2, SEF1, SEF2 and NOC1 elements have selective inverse time and definite time characteristics. The protection of local and downstream terminals is coordinated with the current setting, time setting, or both.

Note: OC1, OC2, EF1, EF2, SEF1, SEF2 and NOC1 elements that have inverse time or definite time characteristics are discriminated with OC1-I, OC2-I, EF1-I, EF2-I, SEF1-I, SEF2-I and NOC-I or OC1-D, OC2-D, EF1-D, EF2-D, SEF1-D, SEF2-D and NOC1-D respectively.

The characteristic of overcurrent elements are as follows:



Note: NOC provides two stage overcurrent elements.

Figure 2.1.1 Characteristic of Overcurrent Elements

2.1.1.1 Inverse Time Overcurrent Protection

In a system for which the fault current is practically determined by the fault location, without being substantially affected by changes in the power source impedance, it is advantageous to use inverse definite minimum time (IDMT) overcurrent protection. This protection provides reasonably fast tripping, even at a terminal close to the power source where the most severe faults can occur.

Where ZS (the impedance between the relay and the power source) is small compared with that of the protected section ZL, there is an appreciable difference between the current for a fault at the far end of the section (ES/(ZS+ZL), ES: source voltage), and the current for a fault at the near end (ES/ZS). When operating time is inversely proportional to the current, the relay operates faster for a fault at the end of the section nearer the power source, and the operating time ratio for a fault at the near end to the far end is ZS/(ZS + ZL).

The resultant time-distance characteristics are shown in Figure 2.1.2 for radial networks with several feeder sections. With the same selective time coordination margin TC as the download section, the operating time can be further reduced by using a more inverse characteristic.

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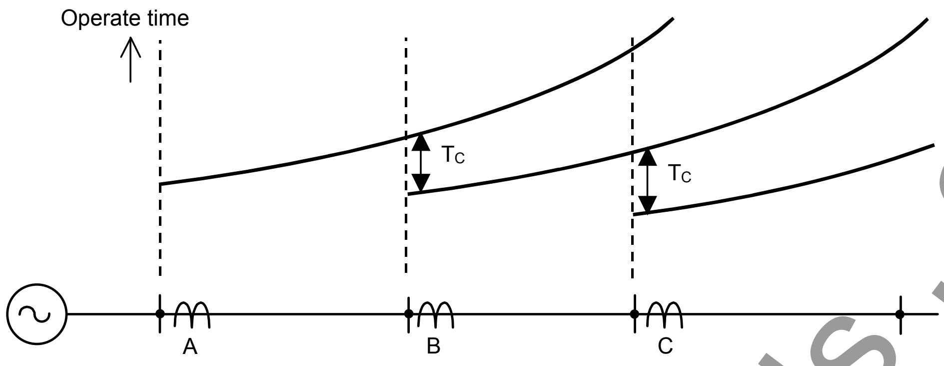

Figure 2.1.2 Time-distance Characteristics of Inverse Time Protection

The inverse time overcurrent protection elements have the IDMT characteristics defined by equation (1):

$$t = TMS \times \left\{ \left[\frac{k}{\left(I/Is \right)^{a} - 1} \right] + c \right\} \qquad (1)$$

where:

t = operating time for constant current I (seconds),

I = energising current (amps),

Is = overcurrent setting (amps),

TMS = time multiplier setting,

k, a, c = constants defining curve.

Nine curve types are available as defined in Table 2.1.1. They are illustrated in Figure 2.1.3. Detail curves for each IDMT are shown in Appendix N.

Any one curve can selected for each IDMT element by scheme switches [M∗∗∗] and [M∗∗∗C-∗∗].

Table 2.1.1 Specification of IDMT Curves

Curve Description	Operating characteristic			Resetting characteristic	
	k	a	c	kr	b
IEC Normal Inverse (NI)	0.14	0.02	0	-	-
IEC Very Inverse (VI)	13.5	1	0	-	-
IEC Extremely Inverse (EI)	80	2	0	-	-
UK Long Time Inverse (LTI)	120	1	0	-	-
IEEE Moderately Inverse (MI)	0.0515	0.02	0.114	4.85	2
IEEE Very Inverse (VI)	19.61	2	0.491	21.6	2
IEEE Extremely Inverse (EI)	28.2	2	0.1217	29.1	2
US CO8 Inverse	5.95	2	0.18	5.95	2
US CO2 Short Time Inverse	0.02394	0.02	0.01694	2.261	2

Note: kr, b are used to define the reset characteristic. Refer to equation (2).

In addition to above nine curve types, GRD150 can provides user configurable IDMT curve. If required, set the scheme switch [M∗∗∗] to “CON” and set the curve defining constants k, a, c, kr

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and b. The following table shows the setting ranges of the curve defining constants.

Curve defining constants	Range	Step	Remarks
k	0.000 – 30.000	0.001	Operating characteristic
a	0.00 – 5.00	0.01	([M∗∗∗]=CON setting)
c	0.000 – 5.000	0.001	
kr	0.000 – 30.000	0.001	Resetting characteristic
b	0.00 – 5.00	0.01	([M∗∗∗]=CON, and [∗∗∗R]=DEP setting)

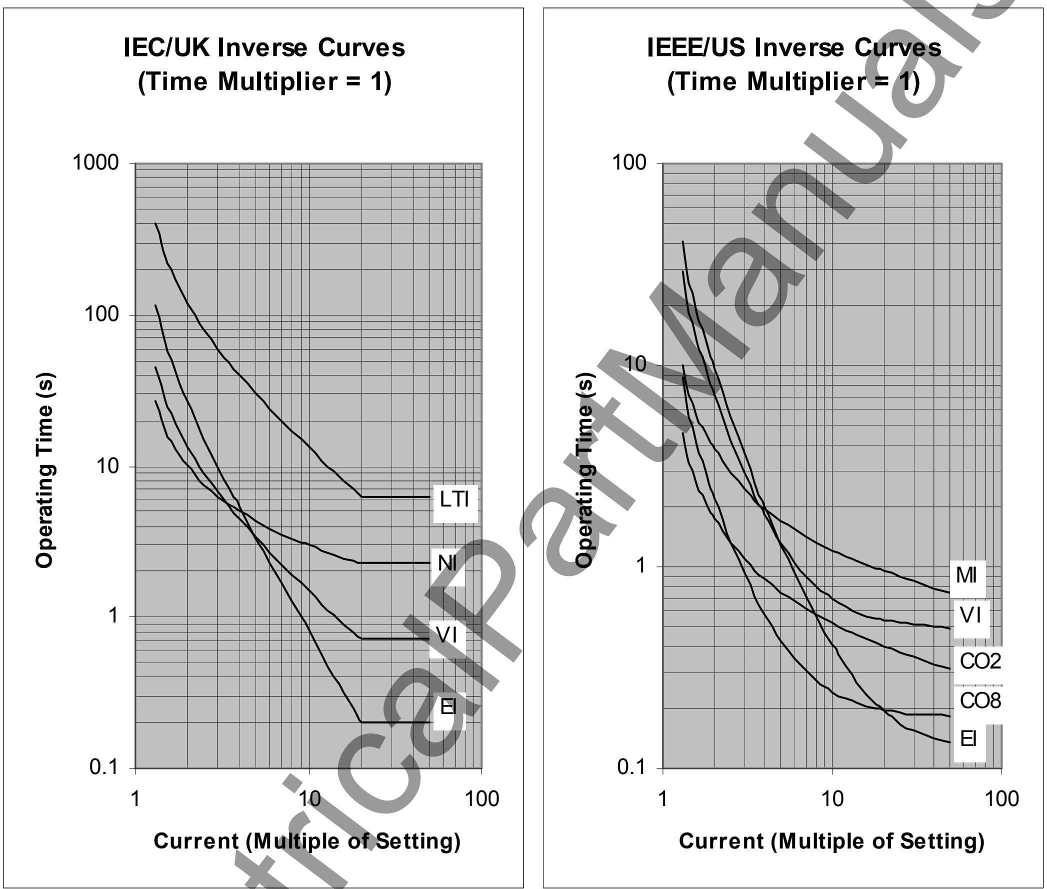

Figure 2.1.3 IDMT Characteristics

Programmable Reset Characteristics

OC1-I, OC2-I, EF1-I, EF2-I, SEF1-I, SEF2-I and NOC1-I have a programmable reset feature: instantaneous, definite time delayed, or dependent time delayed reset. (Refer to Appendix A for a more detailed description.)

Instantaneous resetting is normally applied in multi-shot auto-reclosing schemes, to ensure correct grading between relays at various points in the scheme.

The inverse reset characteristic is particularly useful for providing correct coordination with an upstream induction disc type overcurrent relay.

The definite time delayed reset characteristic may be used to provide faster clearance of intermittent ('pecking' or 'flashing') fault conditions.

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Definite time reset

The definite time resetting characteristic is applied to the IEC/IEEE/US operating characteristics.

If definite time resetting is selected, and the delay period is set to instantaneous, then no intentional delay is added. As soon as the energising current falls below the reset threshold, the element returns to its reset condition.

If the delay period is set to some value in seconds, then an intentional delay is added to the reset period. If the energising current exceeds the setting for a transient period without causing tripping, then resetting is delayed for a user-definable period. When the energising current falls below the reset threshold, the integral state (the point towards operation that it has travelled) of the timing function (IDMT) is held for that period.

This does not apply following a trip operation, in which case resetting is always instantaneous.

Dependent time reset

The dependent time resetting characteristic is applied only to the IEEE/US operate characteristics, and is defined by the following equation:

$$t = RTMS \times \left[\frac{kr}{1 - \left({}^{I}\!/_{I_S} \right)^{b}} \right] \qquad (2)$$

where:

t = time required for the element to reset fully after complete operation (seconds),

I = energising current (amps),

Is = overcurrent setting (amps),

kr = time required to reset fully after complete operation when the energising current is zero (see Table 2.1.1),

RTMS = reset time multiplier setting.

b = constants defining curve.

Figure 2.1.4 illustrates the dependent time reset characteristics.

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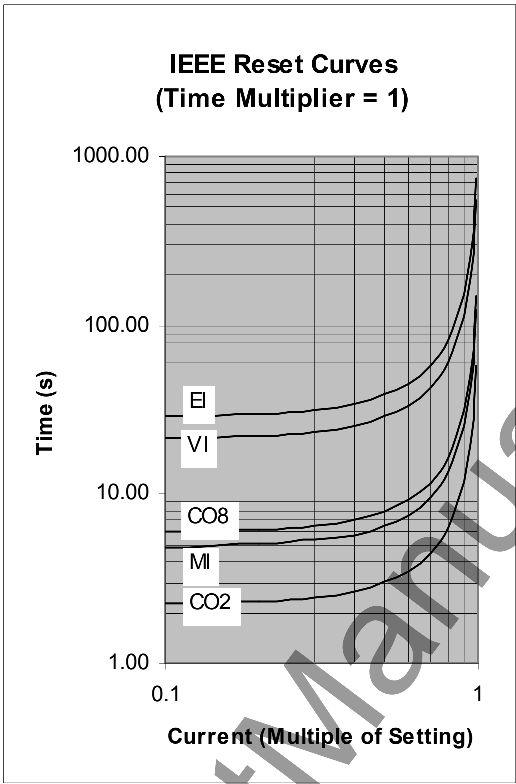

Figure 2.1.4 Dependent Time Reset Characteristics

2.1.1.2 Definite Time Overcurrent Protection

In a system in which the fault current does not vary a great deal in relation to the position of the fault, that is, the impedance between the relay and the power source is large, the advantages of the IDMT characteristics are not fully utilised. In this case, definite time overcurrent protection is applied. The operating time can be constant irrespective of the magnitude of the fault current.

The definite time overcurrent protection consists of instantaneous overcurrent measuring elements and delayed pick-up timers started by the elements, and provides selective protection with graded setting of the delayed pick-up timers. Thus, the constant time coordination with the downstream section can be maintained as shown in Figure 2.1.5. As is clear in the figure, the nearer to the power source a section is, the greater the delay in the tripping time of the section. This is undesirable particularly where there are many sections in the series.

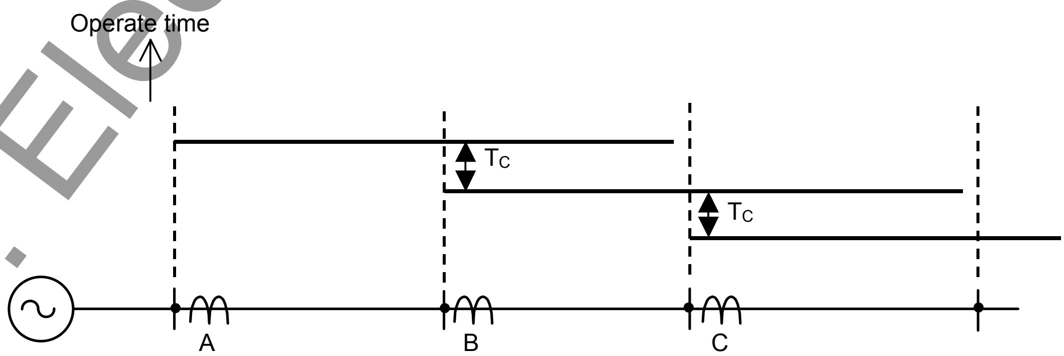

Figure 2.1.5 Definite Time Overcurrent Protection

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2.1.1.3 Instantaneous Overcurrent Protection

In conjunction with inverse time overcurrent protection, definite time overcurrent elements provide instantaneous overcurrent protection.

OC1 to OC4 and EF1 to EF4 are phase fault and earth fault protection elements, respectively. Each element is programmable for instantaneous or definite time delayed operation. (In case of instantaneous operation, the delayed pick-up timer is set to 0.00.) The phase fault elements operate on a phase segregated basis, although tripping is for three phase only.

Selective Instantaneous Overcurrent Protection

When they are applied to radial networks with several feeder sections where ZL (impedance of the protected line) is large enough compared with ZS (the impedance between the relay and the power source), and the magnitude of the fault current in the local end fault is much greater (3 times or more, or (ZL+ZS)/ZS≧3, for example) than that in the remote end fault under the condition that ZS is maximum, the pick-up current can be set sufficiently high so that the operating zone of the elements do not reach the remote end of the feeder, and thus instantaneous and selective protection can be applied.

This high setting overcurrent protection is applicable and effective particularly for feeders near the power source where the setting is feasible, but the longest tripping times would otherwise have to be accepted.

As long as the associated inverse time overcurrent protection is correctly coordinated, the instantaneous protection does not require setting coordination with the downstream section.

Figure 2.1.6 shows operating times for instantaneous overcurrent protection in conjunction with inverse time overcurrent protection. The shaded area shows the reduction in operating time by applying the instantaneous overcurrent protection. The instantaneous protection zone decreases as ZS increases.

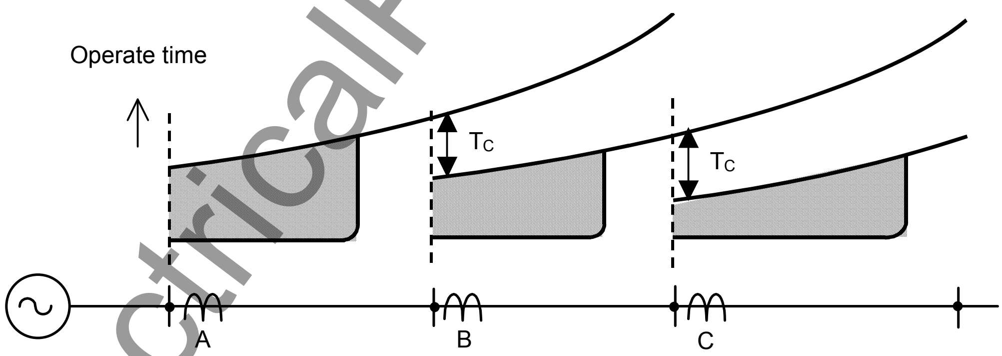

Figure 2.1.6 Conjunction of Inverse and Instantaneous Overcurrent Protection

The current setting is set 1.3 to 1.5 times higher than the probable maximum fault current in the event of a fault at the remote end. The maximum fault current for elements OC1 to OC4 is obtained in case of three-phase faults, while the maximum fault current for elements EF1 to EF4 is obtained in the event of single phase earth faults.

2.1.1.4 Staged Definite Time Overcurrent Protection

When applying inverse time overcurrent protection for a feeder system as shown in Figure 2.1.7, well coordinated protection with the fuses in branch circuit faults and high-speed protection for the feeder faults can be provided by adding staged definite time overcurrent protection with time-graded OC2 and OC3 or EF2 and EF3 elements.

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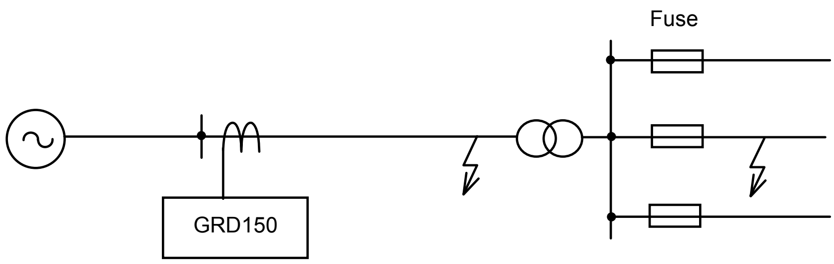

Figure 2.1.7 Feeder Protection Coordinated with Fuses

Configuring the inverse time element OC1 (and EF1) and time graded elements OC2 and OC3 (or EF2 and EF3) as shown in Figure 2.1.8, the characteristic of overcurrent protection can be improved to coordinate with the fuse characteristic.

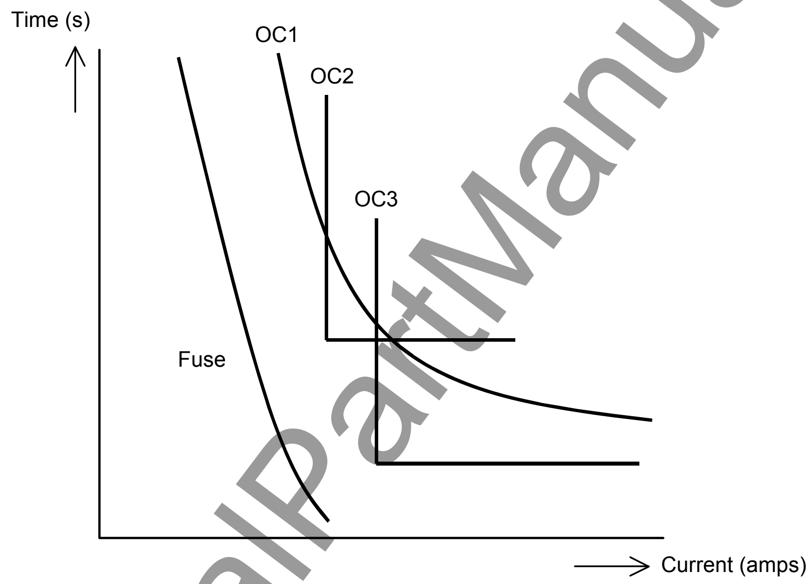

Figure 2.1.8 Staged Definite Time Protection

2.1.1.5 Scheme Logic

Phase overcurrent protection

Figure 2.1.9 and Figure 2.1.10 show the scheme logic of the phase overcurrent protection OC1 and OC2 with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [MOC1] and [MOC2] to "DT". Definite time overcurrent elements OC1D and OC2D are enabled for OC1 and OC2 phase protection respectively, and trip signal OC1 TRIP and OC2 TRIP are given through the delayed pick-up timer TOC1 and TOC2.

The inverse time protection is selected by setting [MOC1] and [MOC2] to any one of "IEC", "IEEE", "US" or "CON" according to the IDMT characteristic to employ. Inverse time overcurrent elements OC1I and OC2I are enabled for OC1 and C2 phase fault protection respectively, and trip signal OC1 TRIP and OC2 TRIP are given.

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the OC1D and OC2D elements by the scheme switches [OC1-2F] and [OC2-2F] respectively. See Section 2.1.7.

OCHS element is used for blocked overcurrent protection. See Section 2.1.1.9.

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The OC1 and OC2 protections can be disabled by the scheme switches [OC1EN] and [OC2EN] or PLC logic signals OC1 BLOCK and OC2 BLOCK.

Figure 2.1.11 and Figure 2.1.12 show the scheme logic of the definite time phase overcurrent protection OC3 and OC4. The OC3 and OC4 give trip and alarm signals OC3 TRIP and OC4 ALARM through delayed pick-up timers TOC3 and TOC4.

The OC3 and OC4 protections can be disabled by the scheme switches [OC3EN] and [OC4EN] or PLC logic signals OC3 BLOCK and OC4 BLOCK.

The OC3 and OC4 can also be blocked by the ICD.

Note: For the symbols used in the scheme logic, see Appendix L.

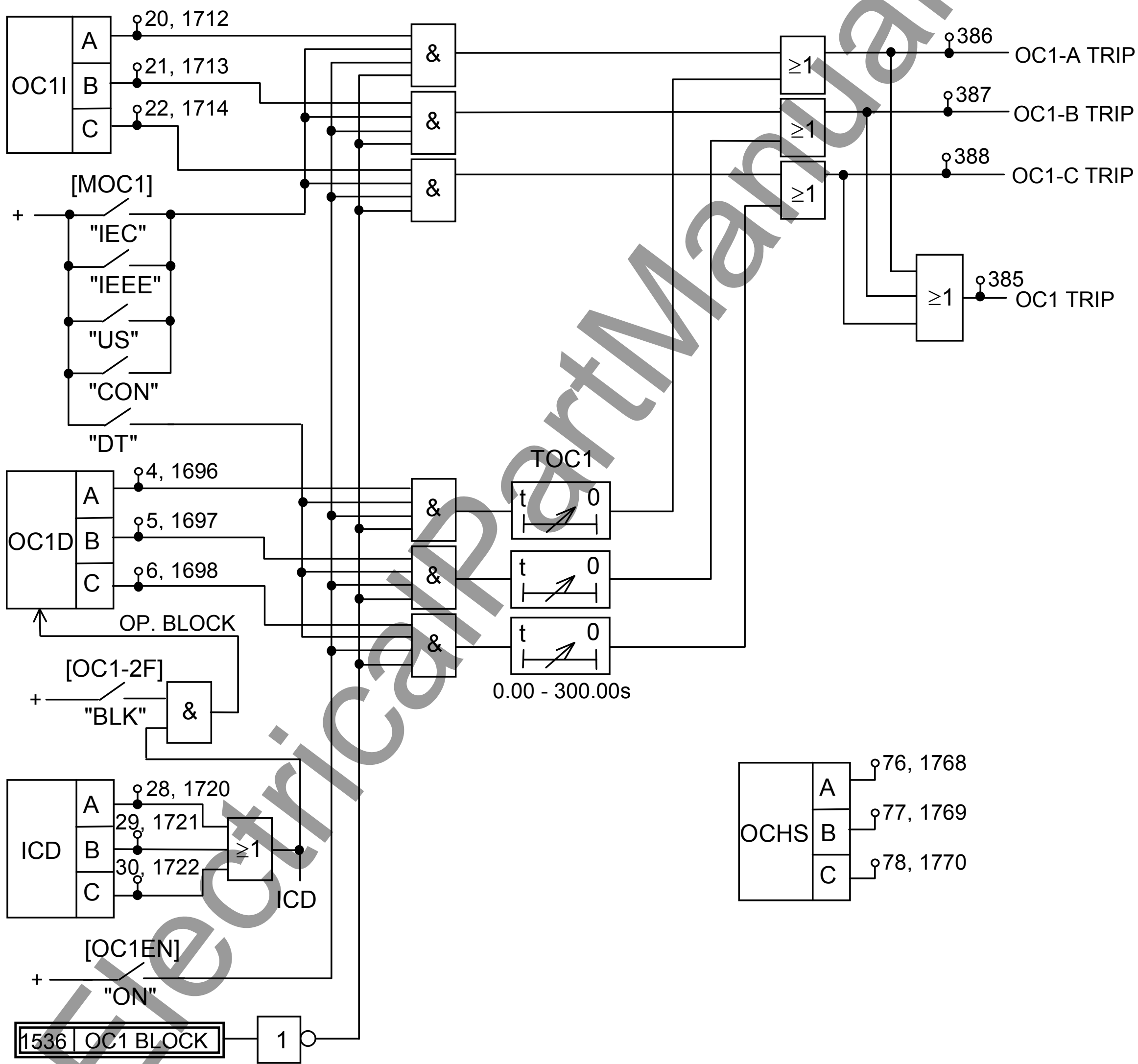

Figure 2.1.9 OC1 Phase Fault Overcurrent Protection

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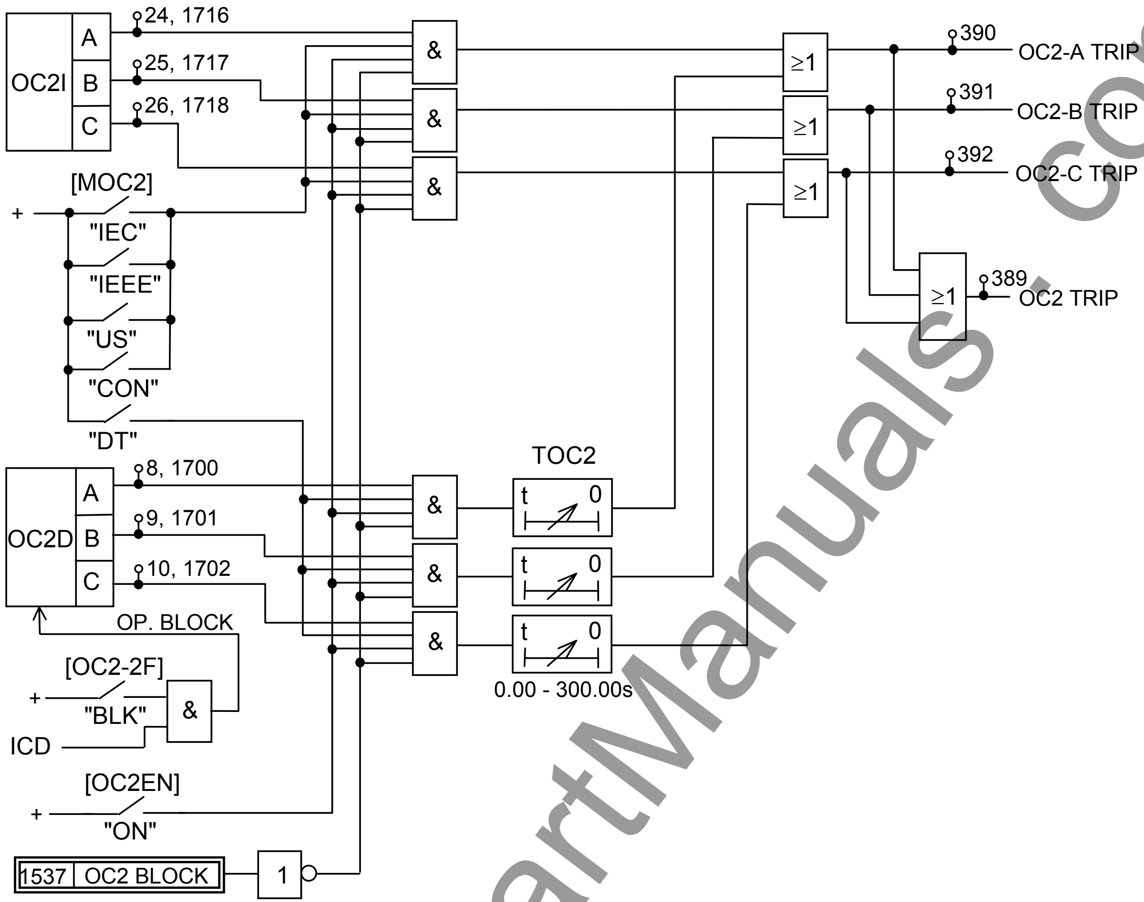

Figure 2.1.10 OC2 Phase Fault Overcurrent Protection

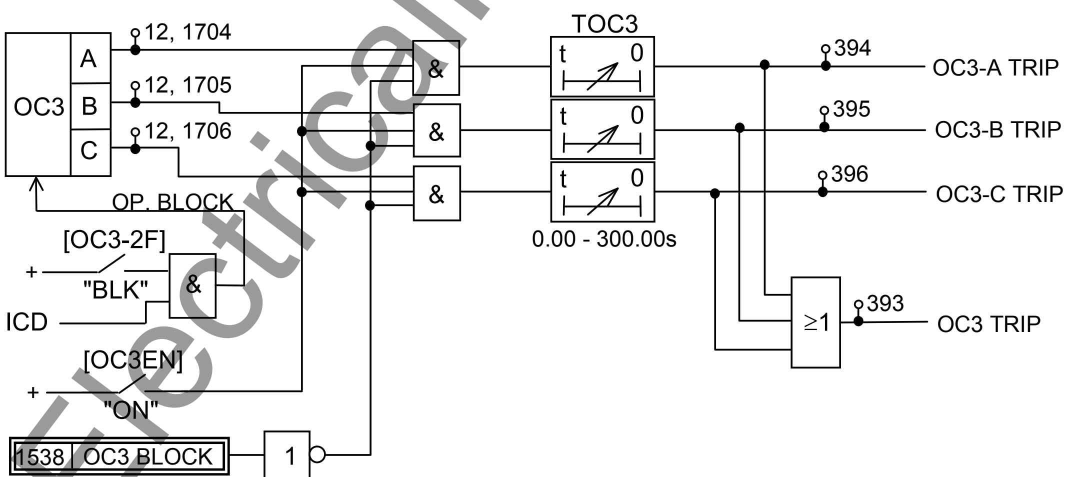

Figure 2.1.11 OC3 Definite Time Phase Overcurrent Protection

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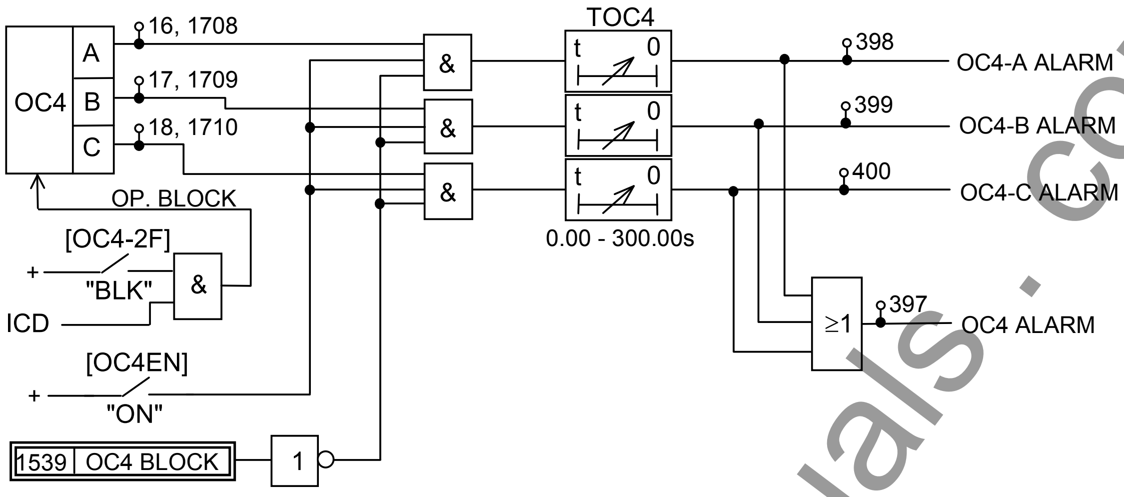

Figure 2.1.12 OC4 Definite Time Phase Overcurrent Protection

Earth fault overcurrent protection

Figure 2.1.13 and Figure 2.1.14 show the scheme logic of the earth fault overcurrent protection EF1 and EF2 with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [MEF1] and [MEF2] to "DT". Definite time overcurrent elements EF1D and EF2D are enabled for EF1 and EF2 earth fault protection respectively, and trip signal EF1 TRIP and EF2 TRIP are given through the delayed pick-up timer TEF1 and TEF2.

The inverse time protection is selected by setting [MEF1C] and [MEF2C] to any one of "IEC", "IEEE", "US" or "CON" according to the IDMT characteristic to employ. Inverse time overcurrent elements EF1I and EF2I are enabled for EF1 and EF2 earth fault protection respectively, and trip signal EF1 TRIP and EF2 TRIP are given.

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the EF1D and EF2D elements by the scheme switches [EF1-2F] and [EF2-2F] respectively. See Section 2.1.7.

EFHS element is used for blocked overcurrent protection. See Section 2.1.1.9.

The EF1 and EF2 protections can be disabled by the scheme switches [EF1EN] and [EF2EN] or PLC logic signals EF1 BLOCK and EF2 BLOCK.

Figure 2.1.15 and Figure 2.1.16 show the scheme logic of the definite time earth fault protection EF3 and EF4. The EF3 and EF4 give trip and alarm signals EF3 TRIP and EF4 ALARM through delayed pick-up timers TEF3 and TEF4.

The EF3 and EF4 protections can be disabled by the scheme switches [EF3EN] and [EF4EN] or PLC logic signals EF3 BLOCK and EF4 BLOCK.

The EF3 and EF4 can also be blocked by the ICD.

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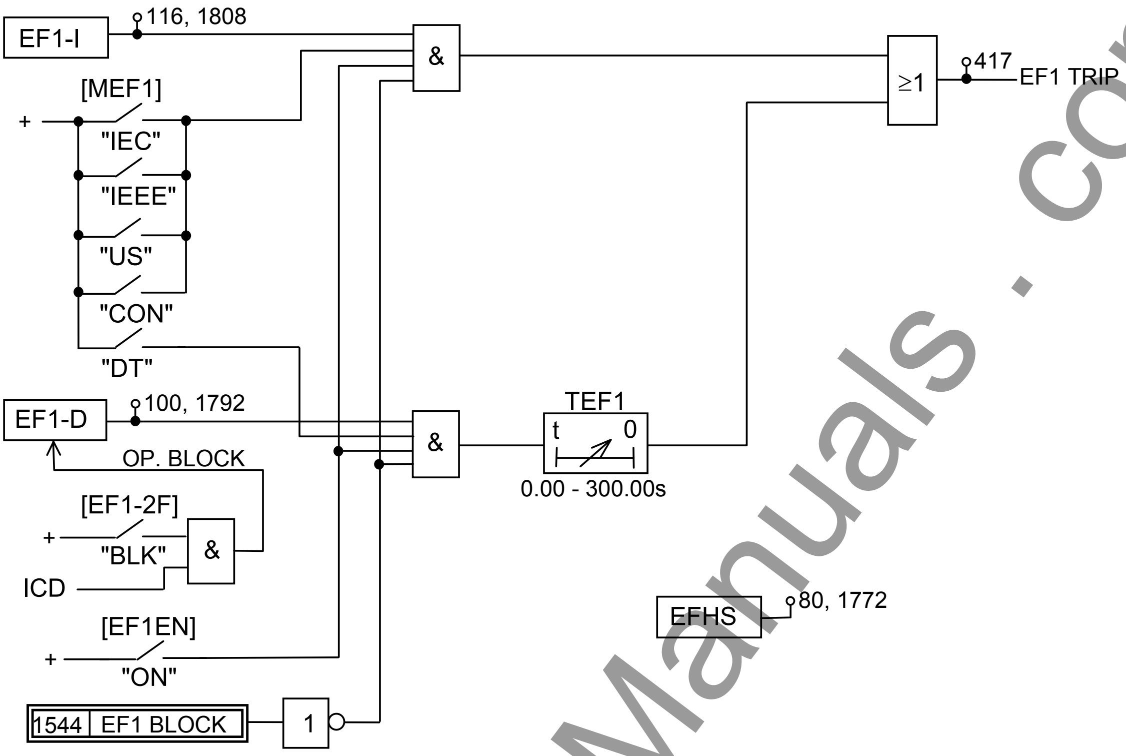

Figure 2.1.13 EF1 Earth Fault Protection

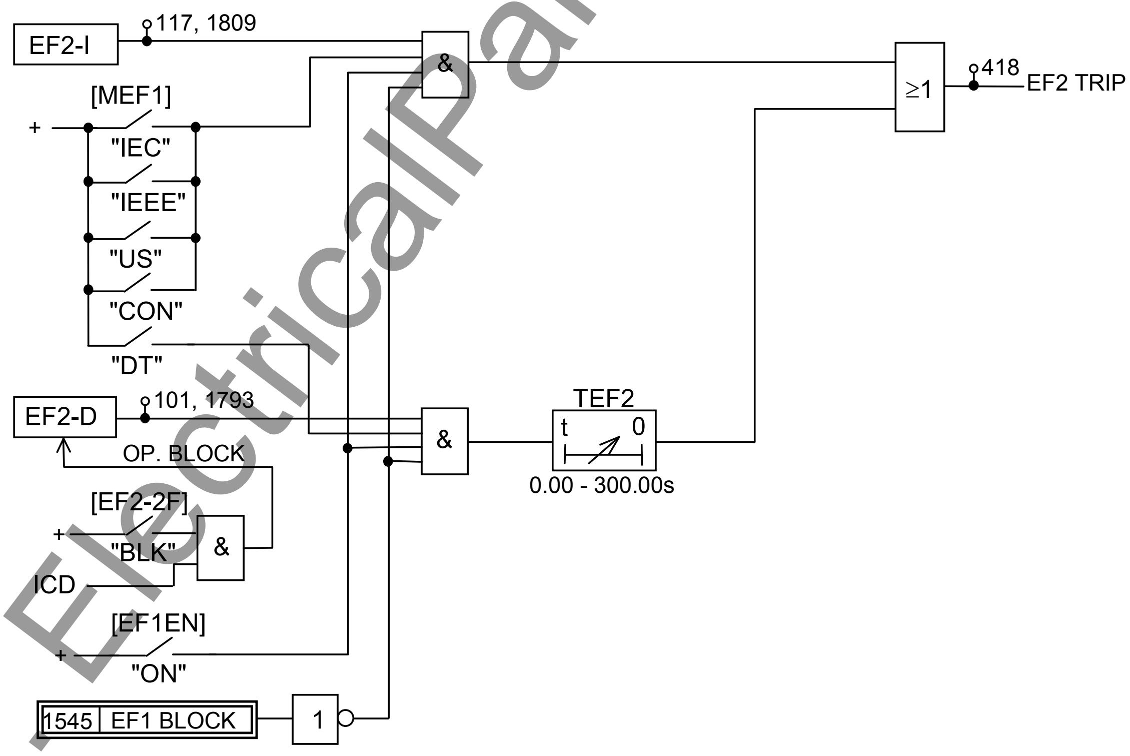

Figure 2.1.14 EF2 Earth Fault Protection

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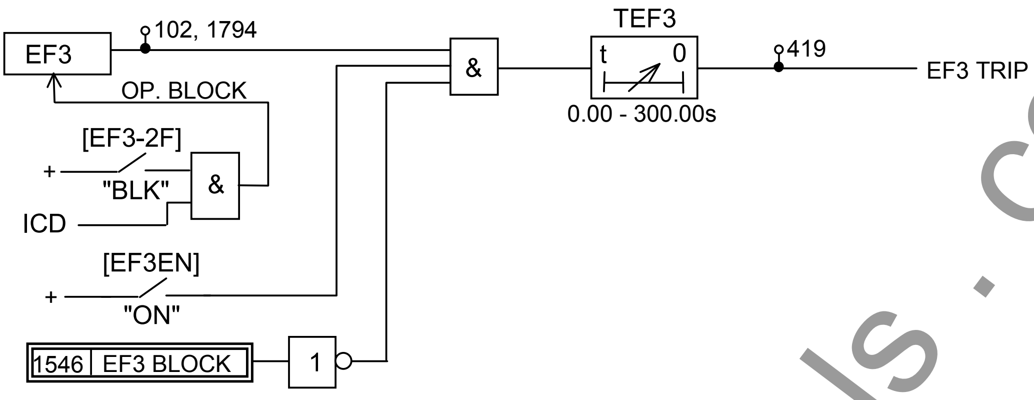

Figure 2.1.15 EF3 Definite Time Earth Fault Protection

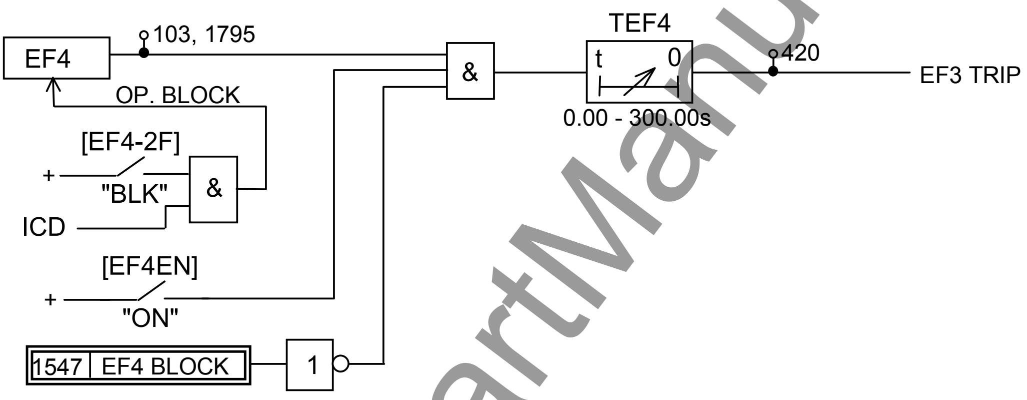

Figure 2.1.16 EF4 Definite Time Earth Fault Protection

2.1.1.6 Setting

The table shows the setting elements necessary for the phase overcurrent and earth fault protection and their setting ranges.

Element	Range	Step	Default	Remarks
OC1	0.2 – 25.0 A (0.04 – 5.00 A)(*1)	0.1 A (0.01 A)	5.0 A (1.00 A)	OC1I and OC1D threshold setting
TOC1P (TMS)	0.010 – 1.500	0.001	1.000	OC1I time multiplier setting. Required if [MOC1] = IEC, IEEE, US or CON.
TOC1D	0.00 – 300.00 s	0.01 s	1.00 s	OC1-D definite time setting. Required if [MOC1] = DT.
TOC1RD	0.0 – 300.0 s	0.1 s	0.0 s	OC1I definite time delayed reset. Required if [MOC1] = IEC or [OC1R] = DEF.
TOC1RP (RTMS)	0.010 – 1.500	0.001	1.000	OC1I dependent time delayed reset time multiplier. Required if [OC1R] = DEP.
OC2	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	25.0 A (5.00 A)	OC2I and OC2D threshold setting
TOC2P (TMS)	0.010 – 1.500	0.001	1.000	OC2I time multiplier setting. Required if [MOC2] = IEC, IEEE, US or CON.
TOC2D	0.00 – 300.00 s	0.01 s	1.00 s	OC2D definite time setting. Required if [MOC2] = DT.
TOC2RD	0.0 – 300.0 s	0.1 s	0.0 s	OC2I definite time delayed reset. Required if [MOC2] = IEC or [OC2R] = DEF.

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Element	Range	Step	Default	Remarks
TOC2RP (RTMS)	0.010 – 1.500	0.001	1.000	OC2-I dependent time delayed reset time multiplier. Required if [OC2R] = DEP.
OC3	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	50.0 A (10.00 A)	OC3D threshold setting
TOC3	0.00 – 300.0 s	0.01 s	1.00 s	OC3D definite time setting
OC4	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	100.0 A (20.00 A)	OC4D threshold setting
TOC4	0.0 – 300.0 s	0.01 s	1.00 s	OC4D definite time setting
EF1	0.05 – 25.00 A (0.01 – 5.00 A)(*1)	0.01 A (0.01 A)	1.50 A (0.30 A)	EF1 threshold setting
TEF1P (TMS)	0.010 – 1.500	0.001	1.000	EF1I time multiplier setting. Required if [MEF1] = IEC, IEEE, US or CON.
TEF1D	0.00 – 300.00 s	0.01 s	1.00 s	EF1D definite time setting. Required if [MEF1] = DT.
TEF1RD	0.0 – 300.0 s	0.1 s	0.0 s	EF1I definite time delayed reset. Required if [MEF1] = IEC or [EF1R] = DEF.
TEF1RP (RTMS)	0.010 – 1.500	0.001	1.000	EF1I dependent time delayed reset time multiplier. Required if [EF1R] = DEP.
EF2	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.1 A (0.01 A)	15.0 A (3.00 A)	EF2 threshold setting
TEF2P (TMS)	0.010 – 1.500	0.001	1.000	EF2I time multiplier setting. Required if [MEF2] = IEC, IEEE, US or CON.
TEF2D	0.00 – 300.00 s	0.01 s	1.00 s	EF2D definite time setting. Required if [MEF2] = DT.
TEF2RD	0.0 – 300.0 s	0.1 s	0.0 s	EF2I definite time delayed reset. Required if [MEF2] = IEC or [EF2R] = DEF.
TEF2RP (RTMS)	0.010 – 1.500	0.001	1.000	EF2I dependent time delayed reset time multiplier. Required if [EF2R] = DEP.
EF3	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.1 A (0.01 A)	25.0 A (5.00 A)	EF3D threshold setting
TEF3	0.00 – 300.00 s	0.01 s	1.00 s	EF3D definite time setting
EF4	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.1 A (0.01 A)	50.0 A (10.00 A)	EF4D threshold setting
TEF4	0.00 – 300.00 s	0.01 s	1.00 s	EF4D definite time setting
[OC1EN]	Off / On		Off	OC1 Enable
[MOC1]	DT/IEC/IEEE/US/CON		DT	OC1 characteristic
[MOC1C]				OC1I inverse curve type.
MOC1C-IEC	NI / VI / EI / LTI		NI	Required if [MOC1] = IEC.
MOC1C-IEEE	MI / VI / EI		MI	Required if [MOC1] = IEEE.
MOC1C-US	CO2 / CO8		CO2	Required if [MOC1] = US.
[OC1R]	DEF / DEP (*2)		DEF	OC1I reset characteristic. Required if [MOC1] = IEEE, US or CON.
[OC1-2F]	NA / BLK		NA	Blocked by ICD
[OC2EN]	Off / On		Off	OC2 Enable
[MOC2]	DT/IEC/IEEE/US/CON		DT	OC2 characteristic
[MOC2C]				OC2I inverse curve type.
MOC2C-IEC	NI / VI / EI / LTI		NI	Required if [MOC2] = IEC.

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Element	Range	Step	Default	Remarks
MOC2C-IEEE	MI / VI / EI		MI	Required if [MOC2] = IEEE.
MOC2C-US	CO2 / CO8		CO2	Required if [MOC2] = US.
[OC2R]	DEF / DEP (*2)		DEF	OC2I reset characteristic. Required if [MOC2] = IEEE, US or CON.
[OC2-2F]	NA / BLK		NA	Blocked by ICD
[OC3EN]	Off / On		Off	OC3 Enable
[OC3-2F]	NA / BLK		NA	Blocked by ICD
[OC4EN]	Off / On		Off	OC4 Enable
[OC4-2F]	NA / BLK		NA	Blocked by ICD
[EF1EN]	Off / On		Off	EF1 Enable
[MEF1]	DT/IEC/IEEE/US/CON		DT	EF1 characteristic
[MEF1C]				EF1I inverse curve type.
MEF1C-IEC	NI / VI / EI / LTI		NI	Required if [MEF1] = IEC.
MEF1C-IEEE	MI / VI / EI		MI	Required if [MEF1] = IEEE.
MEF1C-US	CO2 / CO8		CO2	Required if [MEF1] = US.
[EF1R]	DEF / DEP (*2)		DEF	EF1I reset characteristic. Required if [MEF1] = IEEE, US or CON.
[EF1-2F]	NA / BLK		NA	Blocked by ICD
[EF2EN]	Off / On		Off	EF2 Enable
[MEF2]	DT/IEC/IEEE/US/CON		DT	EF2 characteristic
[MEF2C]				EF2I inverse curve type.
MEF2C-IEC	NI / VI / EI / LTI		NI	Required if [MEF2] = IEC.
MEF2C-IEEE	MI / VI / EI		MI	Required if [MEF2] = IEEE.
MEF2C-US	CO2 / CO8		CO2	Required if [MEF2] = US.
[EF2R]	DEF / DEP (*2)		DEF	EF2I reset characteristic. Required if [MEF2] = IEEE, US or CON.
[EF2-2F]	NA / BLK		NA	Blocked by ICD
[EF3EN]	Off / On		Off	EF3 Enable
[EF3-2F]	NA / BLK		NA	Blocked by ICD
[EF4EN]	Off / On		Off	EF4 Enable
[EF4-2F]	NA / BLK		NA	Blocked by ICD

(*1) Current values shown in the parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

(*2) DEF: Instant or Definite time, DEP: Inverse time

(1) Settings for Inverse Time Overcurrent Protection

Current setting

In Figure 2.1.17, the current setting at terminal A is set lower than the minimum fault current in the event of a fault at remote end F1. Furthermore, when also considering backup protection for a fault on the next feeder section, it is set lower than the minimum fault current in the event of a fault at remote end F3.

To calculate the minimum fault current, phase-to-phase faults are assumed for the phase overcurrent element, and phase to earth faults for residual overcurrent element, assuming the probable maximum source impedance. When considering the fault at F3, the remote end of the next section is assumed to be open.

The higher the current setting, the more effective the inverse characteristic. On the other hand, the lower the setting, the more dependable the operation. The setting is normally 1 to 1.5 times or less

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of the minimum fault current.

For grading of the current settings, the terminal furthest from the power source is set to the lowest value and the terminals closer to the power source are set to a higher value.

The minimum setting of the phase overcurrent element is restricted so as not to operate for the maximum load current, and that of the residual overcurrent element is restricted so as to not operate on false zero-sequence current caused by an unbalance in the load current, errors in the current transformer circuits, or zero-sequence mutual coupling of parallel lines.

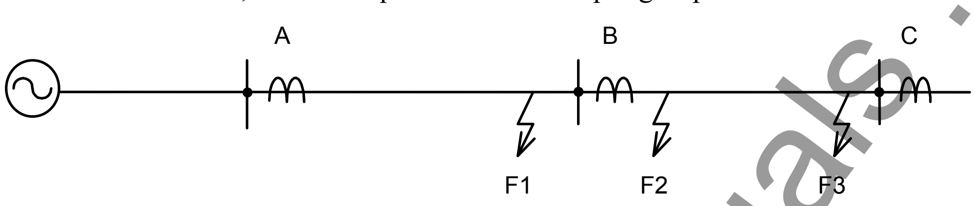

Figure 2.1.17 Current Settings in Radial Feeder

Time setting

Time setting is performed to provide selectivity in relation to the relays on adjacent feeders. Consider the minimum source impedance when the current flowing through the relay reaches a maximum. In Figure 2.1.17, in the event of a fault at F2, the operating time is set so that terminal A may operate by time grading Tc behind terminal B. The current flowing in the relays may sometimes be greater when the remote end of the adjacent line is open. At this time, time coordination must also be kept.

The reason why the operating time is set when the fault current reaches a maximum is that if time coordination is obtained for a large fault current, then time coordination can also be obtained for the small fault current as long as relays with the same operating characteristic are used for each terminal.

The grading margin Tc of terminal A and terminal B is given by the following expression for a fault at point F2 in Figure 2.1.17.

$T_c = T_1 + T_2 + T_m$

where, T_1: circuit breaker clearance time at B

T_2: relay reset time at A

T_m: time margin

(2) Settings of Definite Time Overcurrent Protection

Current setting

The current setting is set lower than the minimum fault current in the event of a fault at the remote end of the protected feeder section. Furthermore, when also considering backup protection for a fault in a next feeder section, it is set lower than the minimum fault current, in the event of a fault at the remote end of the next feeder section.

Identical current values can be set for terminals, but graded settings are better than identical settings, in order to provide a margin for current sensitivity. The farther from the power source the terminal is located, the higher the sensitivity (i.e. the lower setting) that is required.

The minimum setting of the phase overcurrent element is restricted so as not to operate for the maximum load current, and that of the residual overcurrent element is restricted so as to not operate on false zero-sequence current caused by an unbalance in the load current, errors in the current transformer circuits, or zero-sequence mutual coupling of parallel lines. Taking the selection of instantaneous operation into consideration, the settings must be high enough not to

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operate for large motor starting currents or transformer inrush currents.

Time setting

When setting the delayed pick-up timers, the time grading margin Tc is obtained in the same way as explained in "Settings for Inverse Time Overcurrent Protection".

2.1.1.7 Sensitive Earth Fault Protection

The sensitive earth fault (SEF) protection is applied for distribution systems earthed through high impedance, where very low levels of fault current are expected in earth faults. Furthermore, the SEF elements of GRD150 are also applicable to the "standby earth fault protection" and the "high impedance restricted earth fault protection of transformers".

The SEF elements provide 20 times more sensitive setting ranges (25 mA to 125 mA in 5A rating) than the regular earth fault protection.

Since very low levels of current setting may be applied, there is a danger of unwanted operation due to harmonics of the power system frequency, which can appear as residual current. Therefore the SEF elements operate only on the fundamental component, rejecting all higher harmonics.

The SEF protection is provided in Model 200 and 400 series which have a dedicated earth fault input circuit.

The element SEF1 provides inverse time or definite time selective two-stage earth fault protection. Stage 2 of the two-stage earth fault protection is used only for the standby earth fault protection. The SEF2 provides inverse time or definite time selective earth fault protection. The SEF3 and SEF4 provide definite time earth fault protection.

Note: The element SEF1 and SEF2 is discriminated into SEF1-I and SEF2-I or SEF1-D and SEF2-D depending on inverse time or definite time characteristic selected.

When SEF-I employs IEEE or USA inverse time characteristics, two reset modes are available: definite time or dependent time resetting. If the IEC inverse time characteristic is employed, definite time resetting is provided. For other characteristics, refer to Section 2.1.1.1.

Standby earth fault protection

The SEF is energised from a CT connected in the power transformer low voltage neutral, and the standby earth fault protection trips the transformer to backup the low voltage feeder protection, and ensures that the neutral earthing resistor is not loaded beyond its rating. Stage 1 trips the transformer low voltage circuit breaker, then stage 2 trips the high voltage circuit breaker(s) with a time delay after stage 1 operates.

The time graded tripping is valid for transformers connected to a ring bus, banked transformers and feeder transformers. If the transformer has an individual circuit breaker at the high and low voltage side, time graded tripping is not required.

Restricted earth fault protection

The SEF elements can be applied in a high impedance restricted earth fault scheme (REF), for protection of a star-connected transformer winding whose neutral is earthed directly or through impedance.

As shown in Figure 2.1.18, the differential current between the residual current derived from the three-phase feeder currents and the neutral current in the neutral conductor is introduced into the SEF elements. Two external components, a stabilising resistor and a varistor, are connected as shown in the figure. The former increases the overall impedance of the relay circuit and stabilises the differential voltage, and the latter suppresses any overvoltage in the differential circuit.

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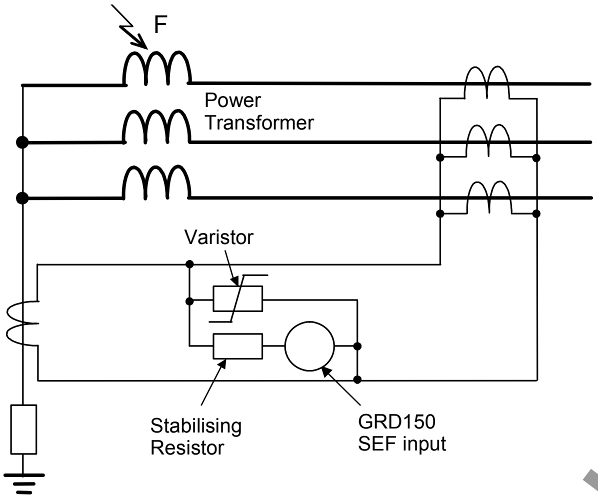

Figure 2.1.18 High Impedance REF

In applications of SEF protection, it must be ensured that any erroneous zero-phase current is sufficiently low compared to the fault current, so that a highly sensitive setting is available.

The erroneous current may be caused with load current due to unbalanced configuration of the distribution lines, or mutual coupling from adjacent lines. The value of the erroneous current during normal conditions can be acquired on the metering screen of the relay front panel.

The earth fault current for SEF may be fed from a core balance CT, but if it is derived from three phase CTs, the erroneous current may be caused also by the CT error in phase faults. Transient false functioning may be prevented by a relatively long time delay.

Scheme Logic

Figure 2.1.19 shows the scheme logic of sensitive earth fault protection SEF1 with inverse time or definite time selective two-stage earth fault protection.

In Figure 2.1.19, the definite time protection is selected by setting [MSE1] to “DT”. The element SEF1D is enabled for sensitive earth fault protection and stage 1 trip signal SEF1 TRIP is given through the delayed pick-up timer TSE1.

The inverse time protection is selected by setting [MSE1] to either “IEC”, “IEEE”, “US” or “CON” according to the inverse time characteristic to employ. The element SEF1I is enabled and stage 1 trip signal SEF1 TRIP is given.

Both protection provide stage 2 trip signal SEF1-S2 through a delayed pick-up timer TSE12.

When the standby earth fault protection is applied by introducing earth current from the transformer low voltage neutral circuit, stage 1 trip signals are used to trip the transformer low voltage circuit breaker. If SEF1D or SEF1I continues operating after stage 1 has operated, the stage 2 trip signal can be used to trip the transformer high voltage circuit breaker(s).

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the SEF1D element by the scheme switches [SEF1-2F]. See Section 2.1.7.

SEFHS element is used for blocked overcurrent protection. See Section 2.1.1.9.

The SEF protection can be disabled by the scheme switch [SE1EN] or binary input signal SEF1 BLOCK. Stage 2 trip of standby earth fault protection can be disabled by the scheme switch [SE1S2].

The SEF2 protection provides the same logic of SEF1 except for the stage 2 trip as shown in Figure 2.1.20.

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Figure 2.1.21 and Figure 2.1.22 show the scheme logic of the definite time sensitive earth fault protection SEF3 and SEF4. SEF3 and SEF4 give trip and alarm signals SEF3 TRIP and SEF4 ALARM through delayed pick-up timers TSE3 and TSE4.

The SEF3 and SEF4 protections can be disabled by the scheme switches [SE3EN] and [SE4EN] or PLC logic signals SEF3 BLOCK and SEF4 BLOCK.

The SEF3 and SEF4 can also be blocked by the ICD.

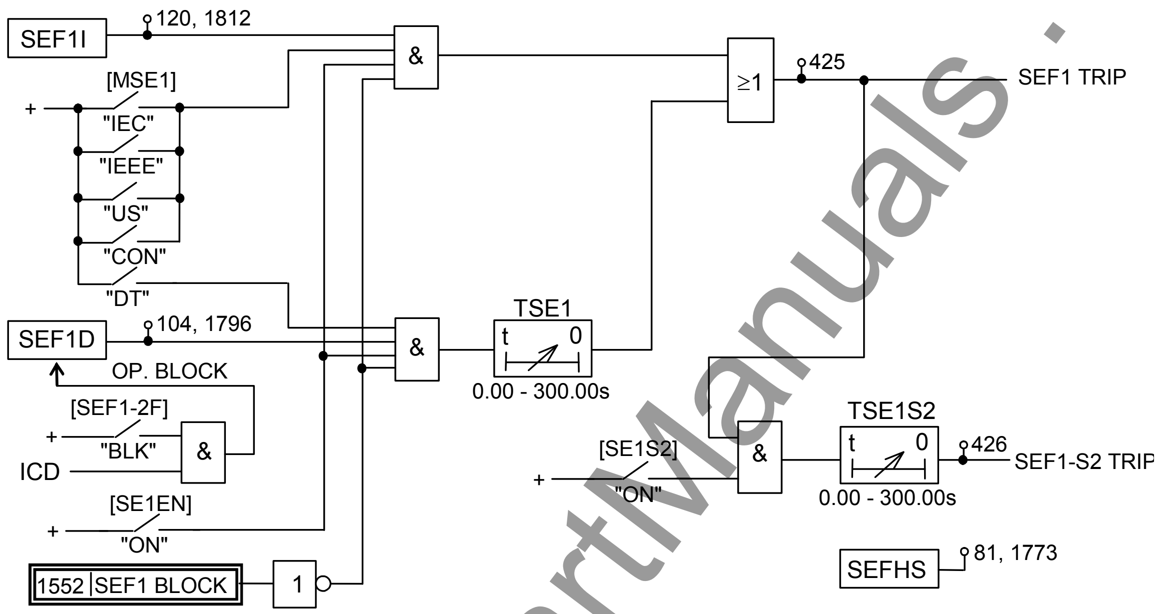

Figure 2.1.19 SEF1 Sensitive Earth Fault Protection Scheme Logic

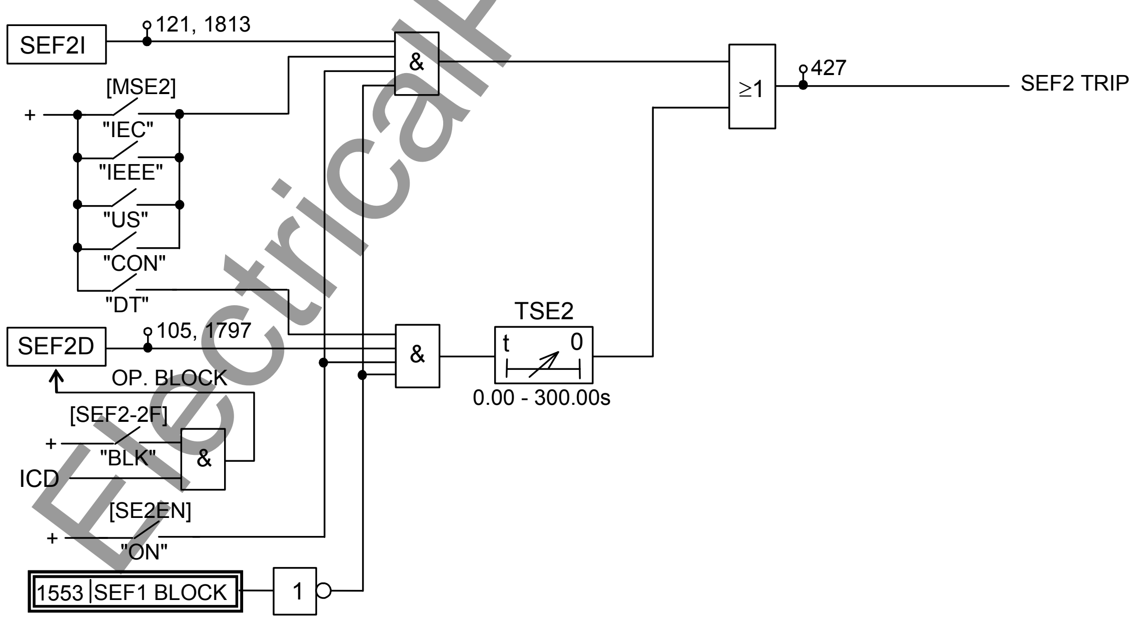

Figure 2.1.20 SEF2 Sensitive Earth Fault Protection Scheme Logic

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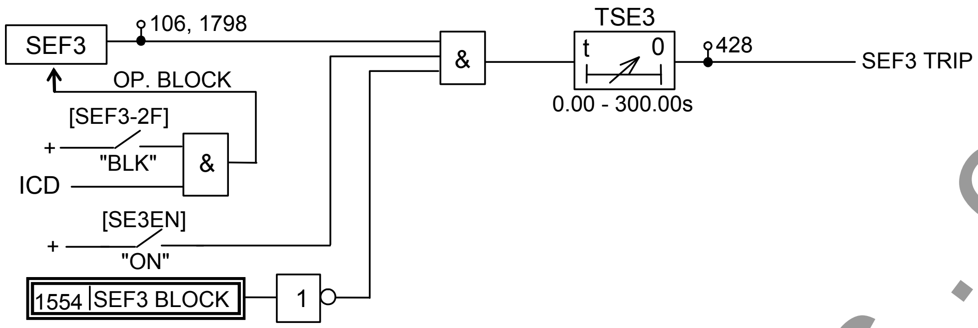
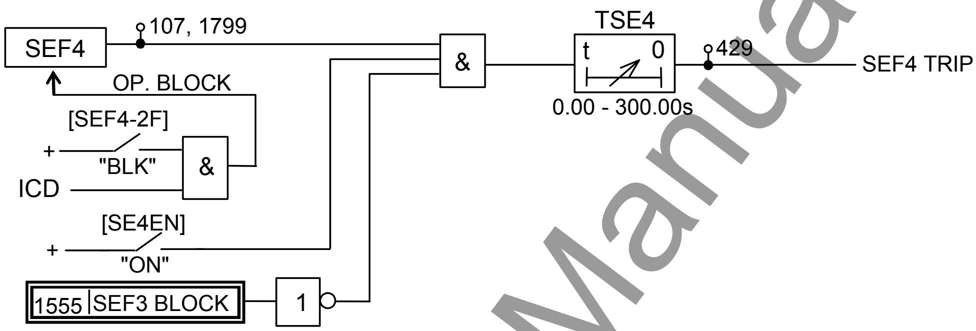


2.1.21 SEF3 Sensitive Definite Time Earth Fault Protection Scheme Logic



2.1.22 SEF4 Sensitive Definite Time Earth Fault Protection Scheme Logic

Setting

The table below shows the setting elements necessary for the sensitive earth fault protection and their setting ranges.

Element	Range	Step	Default	Remarks
SE1	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	SEF1-I and SEF1-D threshold setting
TSE1P (TMS)	0.010 – 1.500	0.001	1.000	SEF1-I inverse time multiplier setting. Required if [MSE1] = IEC, IEEE, US or CON.
TSE1D	0.00 – 300.00 s	0.01 s	1.00 s	SEF1-D definite time setting. Required if [MSE1] = DT.
TSE1RD	0.0 – 300.0 s	0.1 s	0.0 s	SEF1-I definite time delayed reset. Required if [MSE1] = IEC or [SE1R] = DEF.
TSE1RP (RTMS)	0.010 – 1.500	0.001	1.000	SEF1-I dependent time delayed reset time multiplier. Required if [SE1R] = DEP.
TSE1S2	0.00 – 300.00 s	0.01 s	1.00 s	SEF1 stage 2 definite time setting
SE2	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	SEF2 threshold setting
TSE2P (TMS)	0.010 – 1.500	0.001	1.000	SEF2-I inverse time multiplier setting. Required if [MSE2] = IEC, IEEE, US or CON.
TSE2D	0.00 – 300.00 s	0.01 s	1.00 s	SEF2-D definite time setting. Required if [MSE2] = DT.
TSE2RD	0.0 – 300.0 s	0.1 s	0.0 s	SEF2-I definite time delayed reset. Required if [MSE2] = IEC or [SE2R] = DEF.
TSE2RP	0.010 – 1.500	0.001	1.000	SEF2-I dependent time delayed reset time

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Element	Range	Step	Default	Remarks
(RTMS)				multiplier. Required if [SE2R] = DEP.
SE3	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	SEF3 threshold setting
TSE3	0.00 – 300.00 s	0.01 s	1.00 s	SEF3 definite time setting.
SE4	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	SEF4 threshold setting
TSE4	0.00 – 300.00 s	0.01 s	1.00 s	SEF4 definite time setting.
[SE1EN]	Off / On		Off	SEF1 Enable
[MSE1]	DT/IEC/IEEE/US/CON		DT	SEF1 characteristic
[MSE1C]				SE1-I inverse curve type.
MSE1C-IEC	NI / VI / EI / LTI		NI	Required if [MSE1] = IEC.
MSE1C-IEEE	MI / VI / EI		MI	Required if [MSE1] = IEEE.
MSE1C-US	CO2 / CO8		CO2	Required if [MSE1] = US.
[SE1R]	DEF / DEP (*2)		DEF	SEF1-I reset characteristic. Required if [MSE1] = IEEE, US or CON.
[SE1S2]	Off / On		Off	SEF1 stage 2 timer enable
[SEF1-2F]	NA / BLK		NA	Blocked by ICD
[SE2EN]	Off / On		Off	SEF2 Enable
[MSE2]	DT/IEC/IEEE/US/CON		DT	SEF2 characteristic
[SE2C]				SE2-I inverse curve type.
MSE2C-IEC	NI / VI / EI / LTI		NI	Required if [MSE2] = IEC.
MSE2C-IEEE	MI / VI / EI		MI	Required if [MSE2] = IEEE.
MSE2C-US	CO2 / CO8		CO2	Required if [MSE2] = US.
[SE2R]	DEF / DEP (*2)		DEF	SEF2-I reset characteristic. Required if [MSE2] = IEEE, US or CON.
[SEF2-2F]	NA / BLK		NA	Blocked by ICD
[SE3EN]	Off / On		Off	SEF3 Enable
[SEF3-2F]	NA / BLK		NA	Blocked by ICD
[SE4EN]	Off / On		Off	SEF4 Enable
[SEF4-2F]	NA / BLK		NA	Blocked by ICD

(*1) Current values shown in parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

(*2) DEF: Instant or Definite time, DEP: Inverse time

SEF

SEF is set smaller than the available earth fault current and larger than the erroneous zero-phase current. The erroneous zero-phase current exists under normal conditions due to the unbalanced feeder configuration. The zero-phase current is normally fed from a core balance CT on the feeder, but if it is derived from three phase CTs, the erroneous current may be caused also by the CT error in phase faults.

The erroneous steady state zero-phase current can be acquired on the metering screen of the relay front panel.

High impedance REF protection

CT saturation under through fault conditions results in voltage appearing across the relay circuit. The voltage setting of the relay circuit must be arranged such that it is greater than the maximum voltage that can occur under through fault conditions. The worst case is considered whereby one CT of the balancing group becomes completely saturated, while the others maintain linear

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operation. The excitation impedance of the saturated CT is considered to approximate a short-circuit.

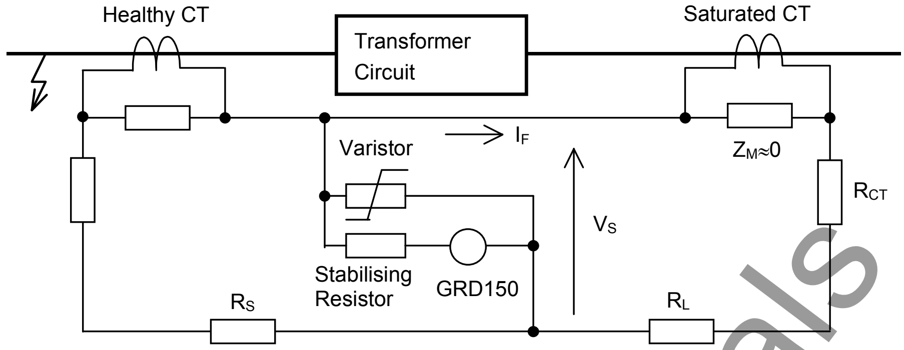

Figure 2.1.23 Maximum Voltage under Through Fault Condition

The voltage across the relay circuit under these conditions is given by the equation:

$V_S = I_F \times (R_{CT} + R_L)$

where:

V_S = critical setting voltage (rms)

I_F = maximum prospective secondary through fault current (rms)

R_{CT} = CT secondary winding resistance

R_L= Lead resistance (total resistance of the loop from the saturated CT to the relaying point)

A series stabilising resistor is used to raise the voltage setting of the relay circuit to V_S. No safety margin is needed since the extreme assumption of unbalanced CT saturation does not occur in practice. The series resistor value, Rs, is selected as follows:

$R_S = V_S / I_S$

Is is the current setting (in secondary amps) applied to the GRD150 relay. However, the actual fault setting of the scheme includes the total current flowing in all parallel paths. That is to say that the actual primary current for operation, after being referred to the secondary circuit, is the sum of the relay operating current, the current flowing in the varistor, and the excitation current of all the parallel connected CTs at the setting voltage. In practice, the varistor current is normally small enough that it can be neglected. Hence:

$I_S \leqq I_P / N - 4I_{mag}$

where:

I_S = setting applied to GRD150 relay (secondary amps)

I_P = minimum primary current for operation (earth fault sensitivity)

N = CT ratio

I_{mag} = CT magnetising (excitation) current at voltage V_S

More sensitive settings for Is allow for greater coverage of the transformer winding, but they also require larger values of Rs to ensure stability, and the increased impedance of the differential circuit can result in high voltages being developed during internal faults. The peak voltage, Vpk, developed may be approximated by the equation:

$$V_{pk} = 2 \times \sqrt{2 \times V_k \times (I_F R_S - V_k)}$$

where:

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V_k = CT knee point voltage

I_F = maximum prospective secondary current for an internal fault

When a Metrosil is used for the varistor, it should be selected with the following characteristics:

$V = CI^{\beta}$

where:

V = instantaneous voltage

I = instantaneous current

β = constant, normally in the range 0.20 - 0.25

C = constant.

The C value defines the characteristics of the metrosil, and should be chosen according to the following requirements:

1. The current through the metrosil at the relay voltage setting should be as low as possible, preferably less than 30mA for a 1Amp CT and less than 100mA for a 5Amp CT.
2. The voltage at the maximum secondary current should be limited, preferably to 1500Vrms.

Restricted earth fault schemes should be applied with high accuracy CTs whose knee point voltage V_k is chosen according to the equation:

$V_k \geqq 2 \times V_S$

where V_S is the differential stability voltage setting for the scheme.

2.1.1.8 Negative Sequence Overcurrent Protection

The negative sequence overcurrent protection (NOC) is used to detect asymmetrical faults (phase-to-phase and phase-to-earth faults) with high sensitivity in conjunction with phase overcurrent protection and residual overcurrent protection. It also used to detect load unbalance conditions.

Phase overcurrent protection is forced to be set to lower sensitivity when the load current is large but NOC sensitivity is not affected by magnitude of the load current, except in the case of erroneous negative sequence current due to the unbalanced configuration of the distribution lines.

For some earth faults, small zero sequence current is fed while the negative sequence current is comparatively larger. This is probable when the fault occurs at the remote end with a small reverse zero sequence impedance and most of the zero sequence current flows to the remote end.

In these cases, NOC backs up the phase overcurrent and residual overcurrent protection. The NOC also protects the rotor of a rotating machine from over heating by detecting a load unbalance. Unbalanced voltage supply to a rotating machine due to a phase loss can lead to increases in the negative sequence current and in machine heating.

Two independent negative sequence overcurrent elements NOC1 and NOC2 are provided for tripping and alarm. The NOC1 has selective inverse time and definite time characteristics. The NOC2 has definite time characteristic only.

Note: NOC1 element that has inverse time or definite time characteristics is discriminated with NOC1I and NOC1D respectively.

The tripping outputs can be blocked by scheme switches or PLC signals.

Scheme Logic

Figure 2.1.24 and 2.1.25 show the scheme logic of the NOC protection. Two negative sequence

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overcurrent elements NOC1 and NOC2 with independent thresholds output trip signals NOC1 TRIP and NOC2 ALARM through delayed pick-up timers TNC1 and TNC2.

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the NOC1D element by the scheme switches [NC1-2F]. See Section 2.1.7.

The tripping and alarming can be disabled by the scheme switches [NC1EN], [NC2EN], [APPL-CT] or PLC logic signals NOC1 BLOCK and NOC2 BLOCK.

The scheme switch [APPL-CT] is available in which three-phase overcurrent protection can be selected. The NOC protection is enabled when three-phase current is introduced and [APPL-CT] is set to "3P".

Note: The [APPL-CT] setting can be set only from the LCD screen because it is concerned in hardware configuration.

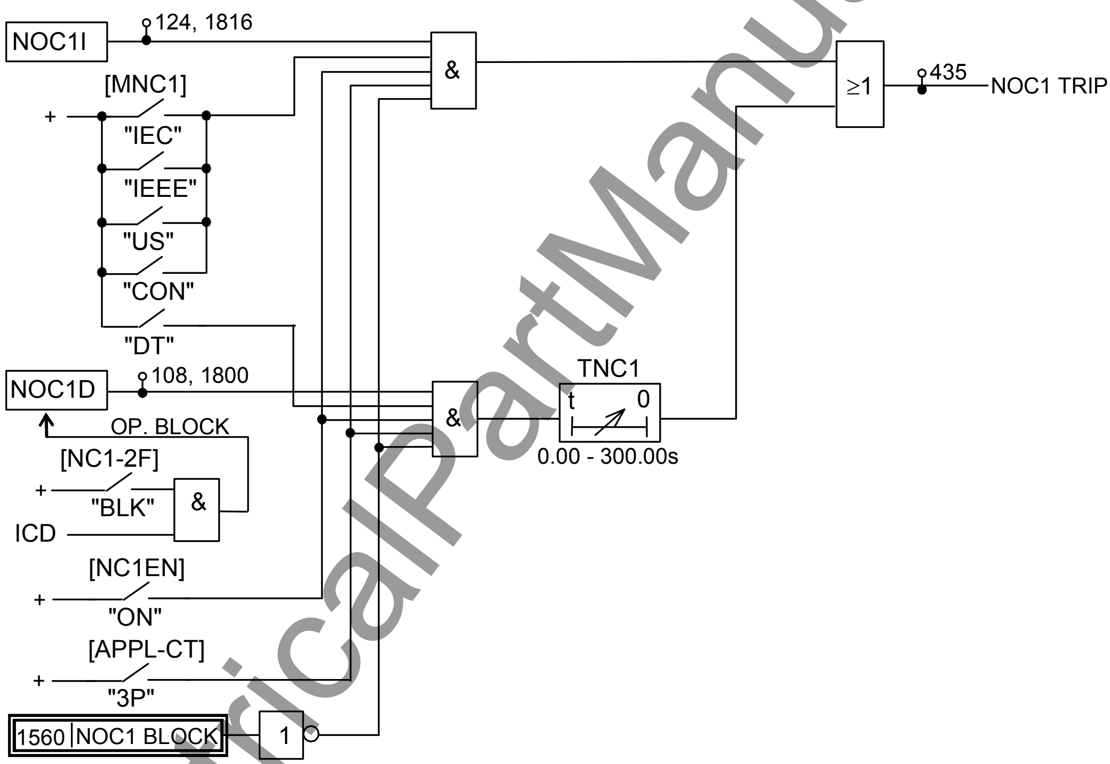

Figure 2.1.24 Negative Sequence Overcurrent Protection NOC1 Scheme Logic

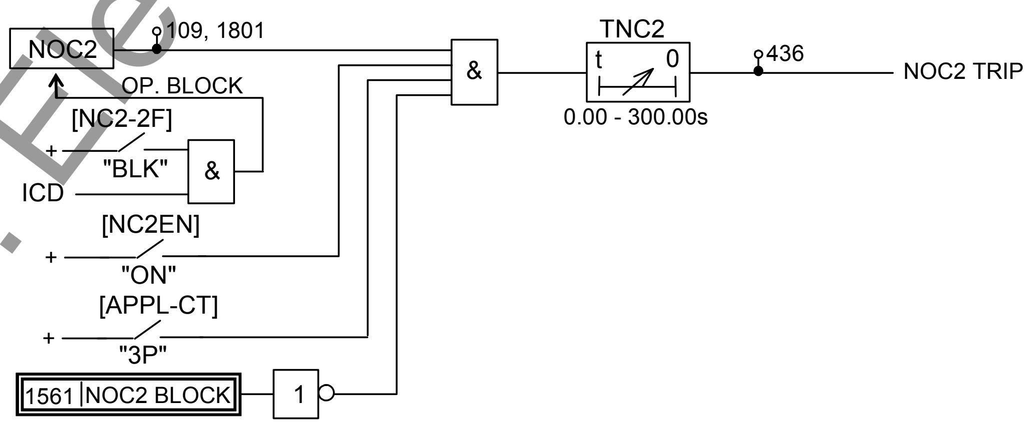

Figure 2.1.25 Negative Sequence Overcurrent Protection NOC2 Scheme Logic

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Setting

The table below shows the setting elements necessary for the NOC protection and their setting ranges.

Element	Range	Step	Default	Remarks
NC1	0.5 – 10.0 A (0.10 – 2.00 A)(*1)	0.1 A (0.01 A)	2.0 A (0.40 A)	NOC1 threshold setting.
TNC1P (TMS)	0.010 – 1.500	0.001	1.000	NOC1-I time multiplier setting. Required if [MNC1] = IEC, IEEE, US or CON.
TNC1D	0.00 – 300.00 s	0.01 s	1.00 s	NOC1-D definite time setting. Required if [MNC1] = DT.
TNC1RD	0.0 – 300.0 s	0.1 s	0.0 s	NOC1-I definite time delayed reset. Required if [MNC1] = IEC or [NC1R] = DEF.
TNC1RP (RTMS)	0.010 – 1.500	0.001	1.000	NOC1-I dependent time delayed reset time multiplier. Required if [NC1R] = DEP.
NC2	0.5 - 10.0 A (0.10 – 2.00 A)(*1)	0.1 A (0.01 A)	1.0 A (0.20 A)	NOC2 threshold setting.
TNC2	0.00 – 300.00 s	0.01 s	1.00 s	NOC2 definite time setting
[MNC1]	DT/IEC/IEEE/US/CON		DT	NOC1 characteristic
[MNC1C]				NOC1-I inverse curve type.
MNC1C-IEC	NI / VI / EI / LTI		NI	Required if [MNC1] = IEC.
MNC1C-IEEE	MI / VI / EI		MI	Required if [MNC1] = IEEE.
MNC1C-US	CO2 / CO8		CO2	Required if [MNC1] = US.
[NC1R]	DEF / DEP (*2)		DEF	NOC1-I reset characteristic. Required if [MNC1] = IEEE, US or CON.
[NC1EN]	Off / On		Off	NOC1 Enable
[NC1-2F]	NA / BLK		NA	Blocked by ICD
[NC2EN]	Off / On		Off	NOC2 Enable
[NC2-2F]	NA / BLK		NA	Blocked by ICD
[APPL-CT]	3P / 2P / 1P		3P	Three-phase current input

(*1) Current values shown in the parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

(*2) DEF: Instant or Definite time, DEP: Inverse time

Sensitive setting of NOC1 and NOC2 thresholds is restricted by the negative phase sequence current normally present on the system. The negative phase sequence current is measured in the relay continuously and displayed on the metering screen of the relay front panel along with the maximum value. It is recommended to check the display at the commissioning stage and to set NOC1 and NOC2 to 130 to 150% of the maximum value displayed.

The delay time setting TNC1 and TNC2 is added to the inherent delay of the measuring elements NOC1 and NOC2. The minimum operating time of the NOC elements is around 200ms.

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2.1.1.9 Application of Protection Inhibits

All GRD150 protection elements can be blocked by a binary input signal. This feature is useful in a number of applications.

Blocked Overcurrent Protection

Conventional time-graded definite time overcurrent protection can lead to excessive fault clearance times being experienced for faults closest to the source. The implementation of a blocked overcurrent scheme can eliminate the need for grading margins and thereby greatly reduce fault clearance times. Such schemes are suited to radial feeder circuits, particularly where substations are close together and pilot cables can be economically run between switchboards.

Figure 2.1.26 shows the operation of the scheme.

Instantaneous phase fault and earth fault pick-up signals OCHS, EFHS and SEFHS of OC1, EF1 and SEF1 elements are allocated to any of the binary output relays and used as a blocking signal. OC2, EF2 and SEF2 protections are set with a short delay time. (For pick-up signals, refer to Figure 2.1.9, 2.1.13 and 2.1.19.)

For a fault at F as shown, each relay sends the blocking signal to its upstream neighbor. The signal is input as a binary input signal OC2 BLOCK, EF2 BLOCK and SEF2 BLOCK at the receiving end, and blocks the OC2, EF2 and SEF2 protection. Minimum protection delays of 50ms are recommended for the OC2, EF2 and SEF2 protection, to ensure that the blocking signal has time to arrive before protection operation.

Inverse time graded operation with elements OC1I, EF1I and SEF1I are available with the scheme switch [MOC1], [MEF1] and [MSE1] setting, thus providing back-up protection in the event of a failure of the blocked scheme.

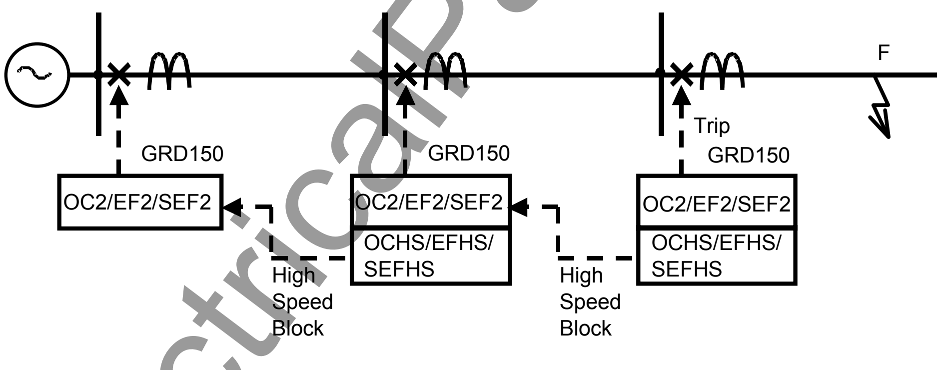

Figure 2.1.26 Blocked Overcurrent Protection

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Blocked Busbar Protection

Non-directional overcurrent protection can be applied to provide a busbar zone scheme for a simple radial system where a substation has only one source, as illustrated in Figure 2.1.27.

For a fault on an outgoing feeder F1, the feeder protection sends a hardwired blocking signal to inhibit operation of the incomer, the signal OCHS, EFHS and SEFHS being generated by the instantaneous phase fault, and earth fault pick-up outputs of OC1, EF1 and SEF1 allocated to any of the binary output relays. Meanwhile, the feeder is tripped by the OC1, EF1 and SEF1 elements, programmed with inverse time or definite time delays and set to grade with downstream protections.

The incomer protection is programmed to trip via its instantaneous elements OC2, EF2 and SEF2 set with short definite time delay settings (minimum 50ms), thus providing rapid isolation for faults in the busbar zone F2.

At the incomer, inverse time graded operation with elements OC1I, EF1I and SEF1I are available with the scheme switch [MOC1], [MEF1] and [MSE1] setting, thus providing back-up protection in the event of failure of the blocked scheme.

GRD150 integrated circuit breaker failure protection can be used to provide additional back-trips from the feeder protection to the incomer, and from the incomer to the HV side of the power transformer, in the event of the first trip failing to clear the earth fault.

In the case of more complex systems where the substation has two incomers, or where power can flow into the substation from the feeders, then directional protection must be applied (refer to Section 2.1.2 Directional Overcurrent Protection).

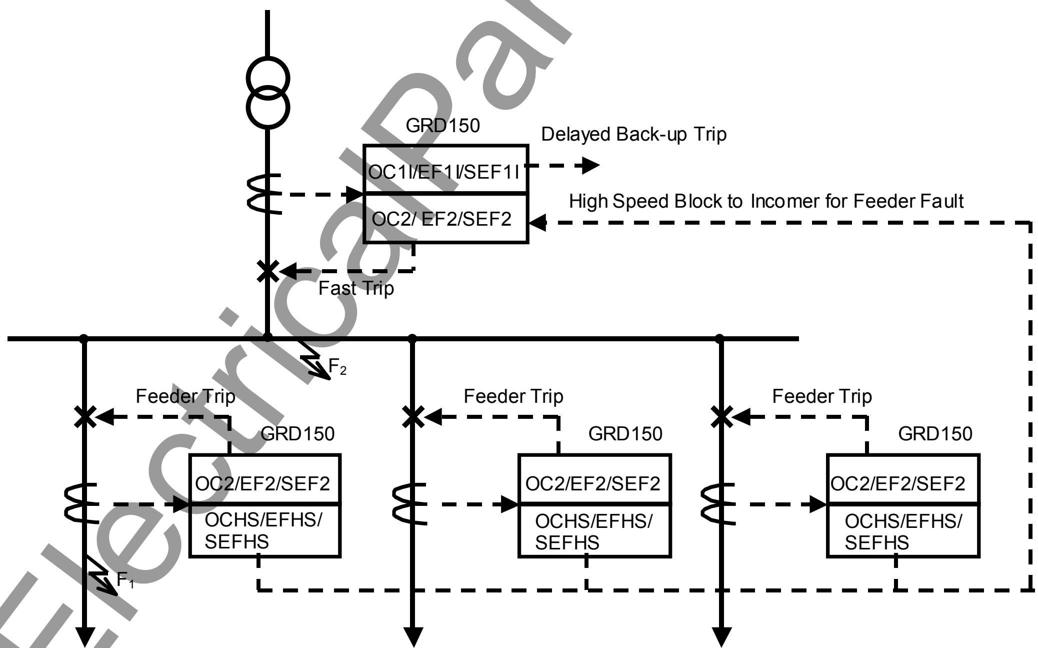

Figure 2.1.27 Blocked Busbar Protection

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2.1.2 Directional Overcurrent Protection

In a system including parallel feeder circuits, ring main circuits or sources at both line terminals, the fault current at the relay location can flow in any direction. In such a case, directional control elements should be added to overcurrent elements.

GRD150 has directional phase fault and earth fault overcurrent elements DOC1 to DOC4, DEF1 to DEF4, DSEF1 to DSEF4, DNOC1 and DNOC2 which can be enabled or disabled by scheme switch setting. The directional characteristic can be selected to "Forward" or "Reverse" by scheme switch setting. The DOC1, DOC2, DEF1, DEF2, DSEF1, DSEF2 and DNOC1 elements have selective inverse time and definite time characteristics.

Note: DOC1 to DOC4, DEF1 to DEF4, DSEF1 to DSEF4, DNOC1 and DNOC2 elements that have forward or reverse direction characteristic are discriminated with DOCF1 to DOCF4, DEFF1 to DEFF4, DSEFF1 to DSEFF4, DNOCF1, DNOCF2 or DOCR1 to DOCR4, DEFR1 to DEFR4, DSEFR1 to DSEFR4, DNOCR1, DNOCR2 respectively.
Further, DOC1, DOC2, DEF1, DEF2, DSEF1, DSEF2 and DNOC1 elements that have inverse time overcurrent characteristics are discriminated with DOC1I, DOC2I, DEF1I, DEF2I. DSEF1I, DSEF2I and DNOC1I respectively.

2.1.2.1 Application of Directional Overcurrent Protection

Parallel Feeder Circuits

If non-directional protection were applied to the circuit shown in Figure 2.1.28, then a fault at F would result in both feeders being tripped at points A and B, and total loss of supply to the load.

Directional relays can be applied to look back into the feeder, thereby ensuring that only the faulty feeder is disconnected. The relays at A and B would normally be set to operate at 50% of the full load current of the circuit, via their inverse time elements DOC1 and DEF1, with a directional characteristic looking in the direction shown by the arrows.

The various overcurrent elements of GRD150 are independently programmable for directional operation. Therefore, elements OC2 and EF2 could be set for non-directional operation to provide time-delayed back-up protection for the load.

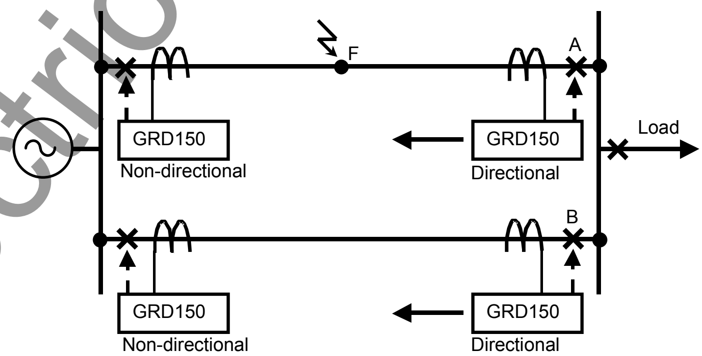

Figure 2.1.28 Application of GRD150 to Parallel Feeders

Ring Main Circuits

A ring main circuit is commonly protected by directional overcurrent relays, since current may flow in either direction past the relaying points. The normal grading procedure is applied separately in both the clockwise and anti-clockwise directions. Conventionally, two directional relays would be required at each load connection point, one for each direction.

A simple system is illustrated in Figure 2.1.29 showing definite time grading, although inverse time can also be applied. Non-directional relays are applied at the in-feeds to the ring. All other protections are directional relays. It can be seen that a fault at F is cleared by tripping at A in 1.0s and at B in 0.4s.

Alternatively, since GRD150 provides multiple, independent bi-directional overcurrent stages, a scheme could be implemented in which a single relay can perform the necessary protection functions in both directions at each load connection point. Each GRD150 overcurrent element can be programmed with different settings for forward and reverse direction, thus allowing correct grading to be achieved in both the clockwise and anti-clockwise directions.

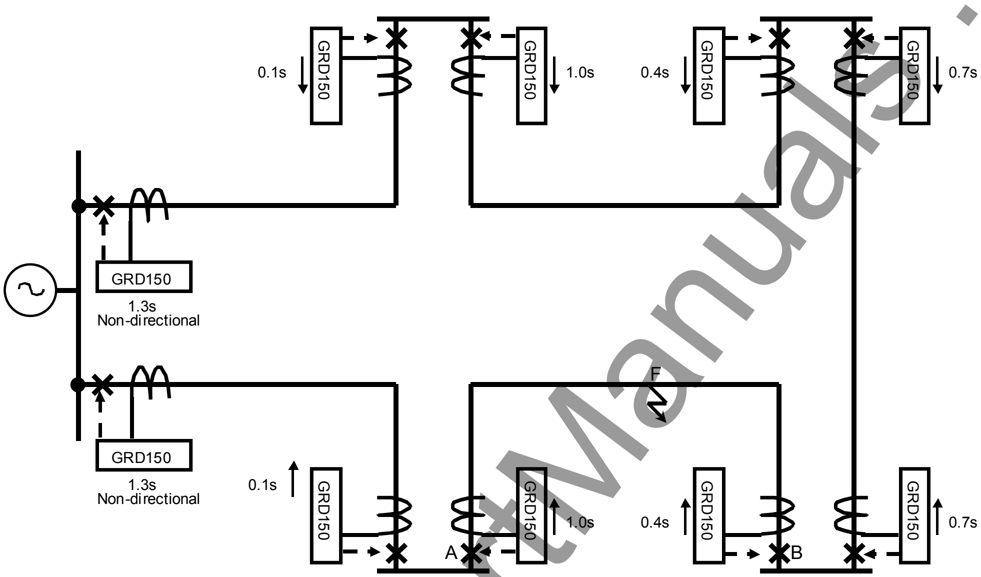

Figure 2.1.29 Protection of a Ring Main Circuit

Power Systems with Sources at both Line Terminals

In power systems with sources at both line terminals as shown in Figure 2.1.30, the fault current flows in from the both terminals.

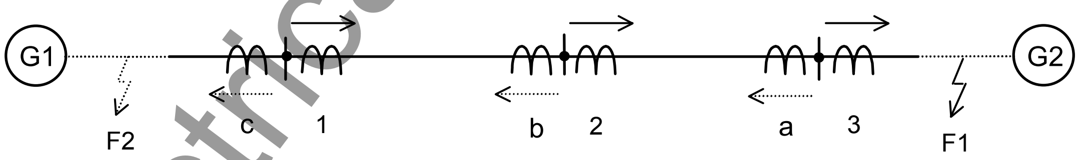

Figure 2.1.30 Protection of a power system with sources at both line terminals

The protection is performed by setting the directional element at points 1, 2 and 3 which operates only when the fault current (F1: solid lines) flows in from source G1 and at points a, b and c which operates only when the fault current (F2: dotted lines) flows in from source G2, and combining it with TOC.

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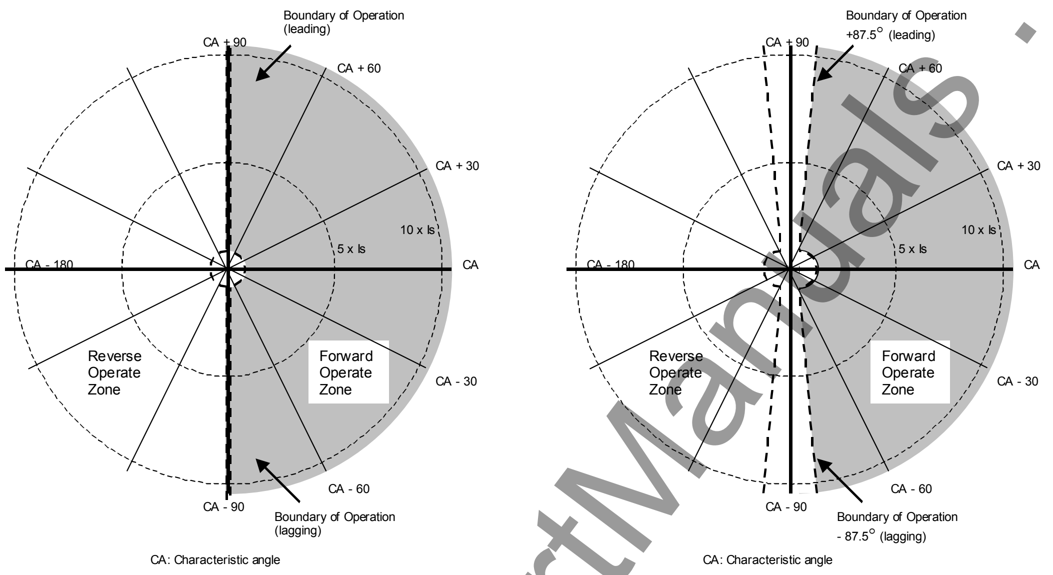
2.1.2.2 Directional Characteristics

Figure 2.1.31 illustrates the directional characteristic, with the forward operate zone shaded. The reverse zone is simply a mirror image of the forward zone. The forward operate zone or reverse operate zone is selectable by the scheme switch [DOC-DIR], [DEF-DIR], [DSE-DIR] and [DNC-DIR]. As shown in Figure 2.1.32, the each directional characteristic is composed of forward directional characteristic, reverse directional characteristic and overcurrent thresholds.



(a) Characteristic of DOC, DEF and DNOC (b) Characteristic of DSEF

Figure 2.1.31 Directional Operate Characteristic

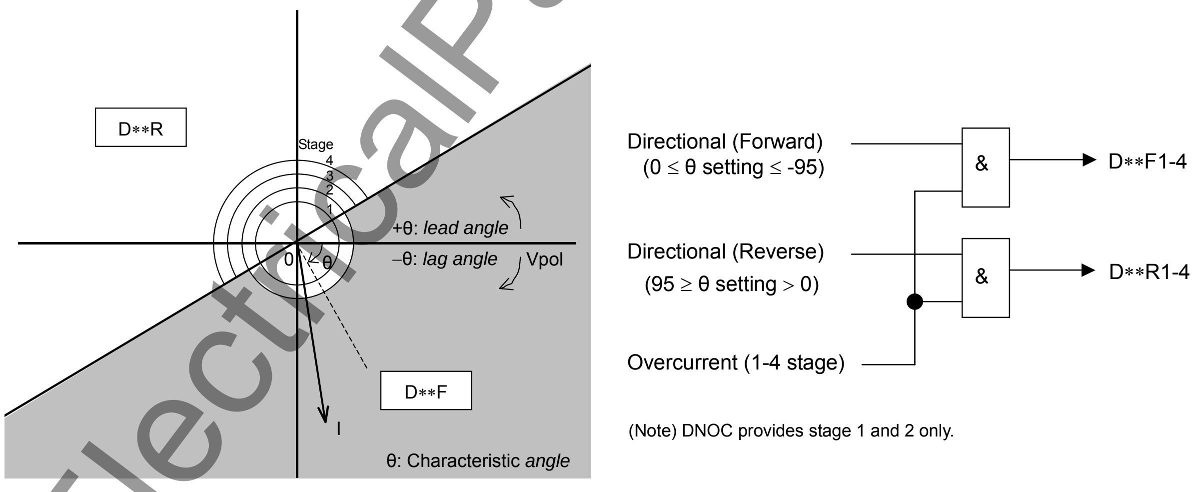


Figure 2.1.32 Directional element

Polarising signals of directional elements are shown in Figure 2.1.33. Polarisation for DOC is achieved by the 90° quadrature method, whereby each current's phase angle is compared with the phase to phase voltage between the other two phases. Since the voltage inputs to the relay will normally be connected phase to neutral, the polarising phase to phase voltages are derived internally. The polarizing negative sequence voltage is also derived internally. The polarizing zero sequence voltage is derived from a residual voltage or internally depending on the model. Direction is determined in each case by measuring the phase angle of the current with respect to a suitable polarising quantity. Table 2.1.2 summarises the current inputs and their respective polarising signals. For details of the relationship between directional earth fault protection and power system earthing, see Appendix B.

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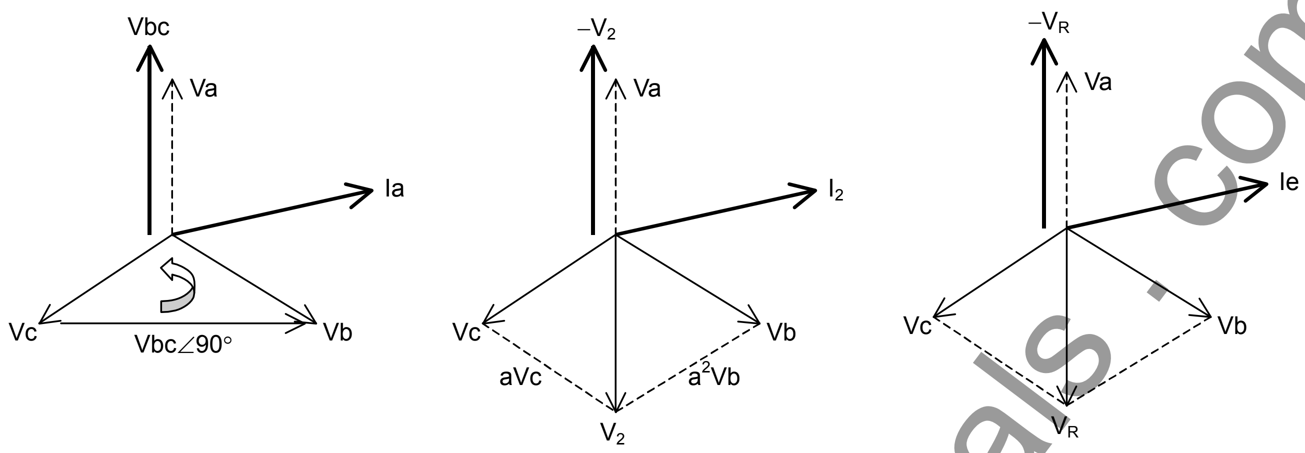
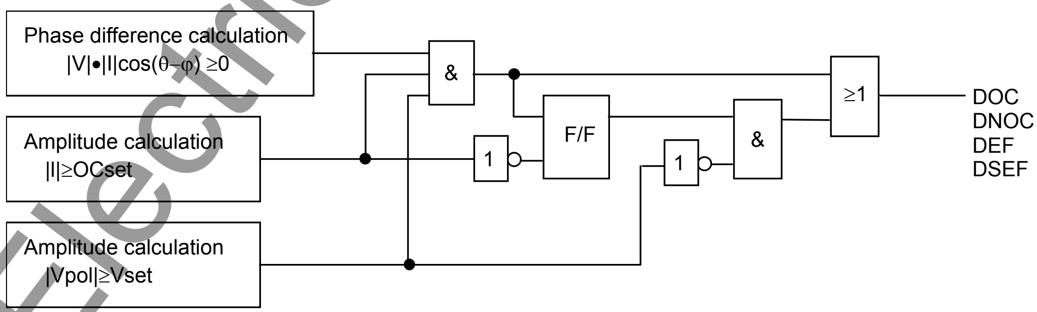


Figure 2.1.33 Relationship between Current Input and Polarising signal

Table 2.1.2 Directional polarising signals

Directional element	Current Input	Polarising Signal
DOC-A	I_A	$V_{BC}\angle 90°$
DOC-B	I_B	$V_{CA}\angle 90°$
DOC-C	I_C	$V_{AB}\angle 90°$
DEF	I_E	$-V_R$
DSEF	I_{SE}	$-V_R$
DNOC	I_2	$-V_2$

In the event of a close up three phase fault, all three polarising signals will collapse below the minimum threshold. Voltage memory provides a temporary polarising signal in these circumstances. GRD150 maintains the polarising signal for a short period by reconstructing the pre-fault voltages and judges the fault direction. After the voltage memory has disappeared, the direction judgement is effective while the fault current flows as shown in Figure 2.1.34.



(Note) OCset: Current setting
Vset : Voltage setting. In the case of DOC and DNOC, Vset = 1V fixed.

Figure 2.1.34 Direction Judgement after Disappearance of Voltage Memory

To cover applications where a 2:1:1 current distribution(*) may be experienced, it is possible to programme the directional phase fault protection such that a trip output will only be given if two or more phases detect fault current in the same operate zone.

Note (*): Only one-phase is in heavy load condition.

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2.1.2.2 Scheme Logic

Directional phase overcurrent protection

Figure 2.1.35 and Figure 2.1.36 show the scheme logic of the directional phase overcurrent protection DOC1 and DOC2 with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [MDOC1] and [MDOC2] to “DT”. Definite time overcurrent elements are enabled for the DOC1 and DOC2 phase overcurrent protection respectively, and trip signal DOC1 TRIP and DOC2 TRIP are given through the delayed pick-up timer TOC1 and TOC2.

The inverse time protection is selected by setting [MDOC1] and [MDOC2] to any one of “IEC”, “IEEE”, “US” or “CON” according to the IDMT characteristic to employ. Inverse time overcurrent elements DOC1I and DOC2I are enabled for DOC1 and DOC2 protection respectively, and trip signal DOC1 TRIP and DOC2 TRIP are given. The trip mode of DOC1 TRIP and DOC2 TRIP can be selected by setting [DOCTP] to “3POR”(any one of 3 phases) or “2OUTOF3”(2 out of 3 phases) gate. When the “2OUTOF3” selected, the trip signal is not issued during single-phase fault. The switch [DOCTP] is common for DOC1 to DOC4 protection.

The forward operate zone (DOC1F and DOC2F) or reverse operate zone (DOC1R and DOC2R) is selectable by the scheme switches [DOC1-DIR] and [DOC2-DIR].

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the DOC1 and DOC2 protection by the scheme switches [DOC1-2F] and [DOC2-2F] respectively. See Section 2.1.7.

The DOC1 and DOC2 protection can be disabled by the scheme switches [DOC1EN] and [DOC2EN] or PLC logic signals DOC1 BLOCK and DOC2 BLOCK.

Figure 2.1.37 and Figure 2.1.38 show the scheme logic of the definite time phase overcurrent protection DOC3 and the DOC4. DOC3 and DOC4 give trip and alarm signals DOC3 TRIP and DOC4 ALARM through delayed pick-up timers TDOC3 and TDOC4. The trip mode of DOC3 TRIP and DOC4 ALARM can be selected by setting [DOCTP] to “3POR”(any one of 3 phases) or “2OUTOF3”(2 out of 3 phases) gate. When the “2OUTOF3” selected, the trip signal is not issued during single-phase fault.

The forward operate zone (DOC3F and DOC4F) or reverse operate zone (DOC3R and DOC4R) is selectable by the scheme switches [DOC3-DIR] and [DOC4-DIR].

The DOC3 and DOC4 protection can be disabled by the scheme switches [DOC3EN] and [DOC4EN] or PLC logic signals DOC3 BLOCK and DOC4 BLOCK.

The DOC3 and DOC4 can also be blocked by the ICD.

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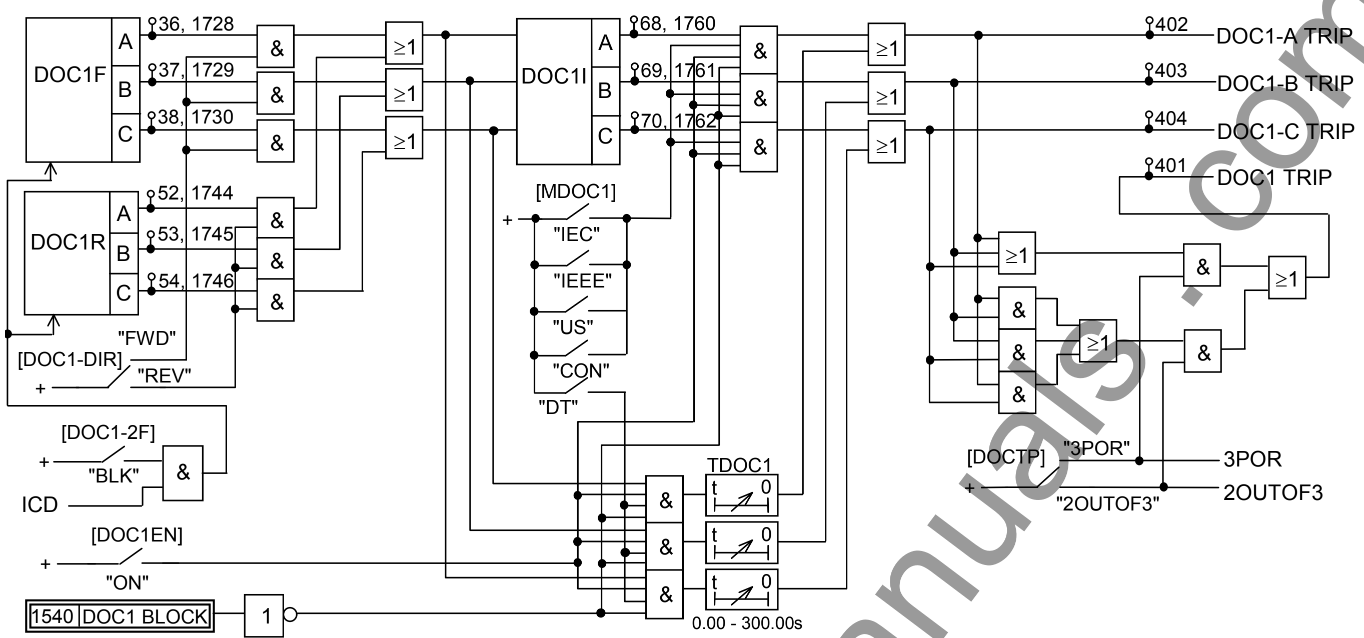

Figure 2.1.35 Directional Overcurrent Protection DOC1

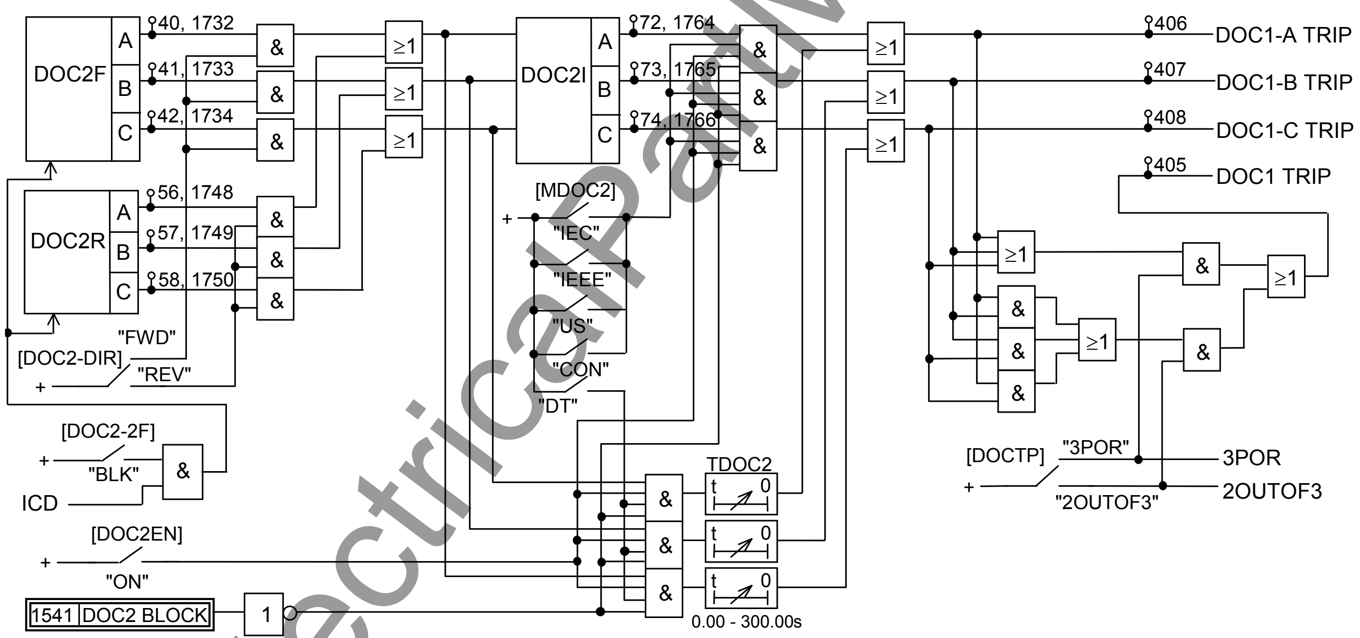

Figure 2.1.36 Directional Earth Fault Protection DOC2

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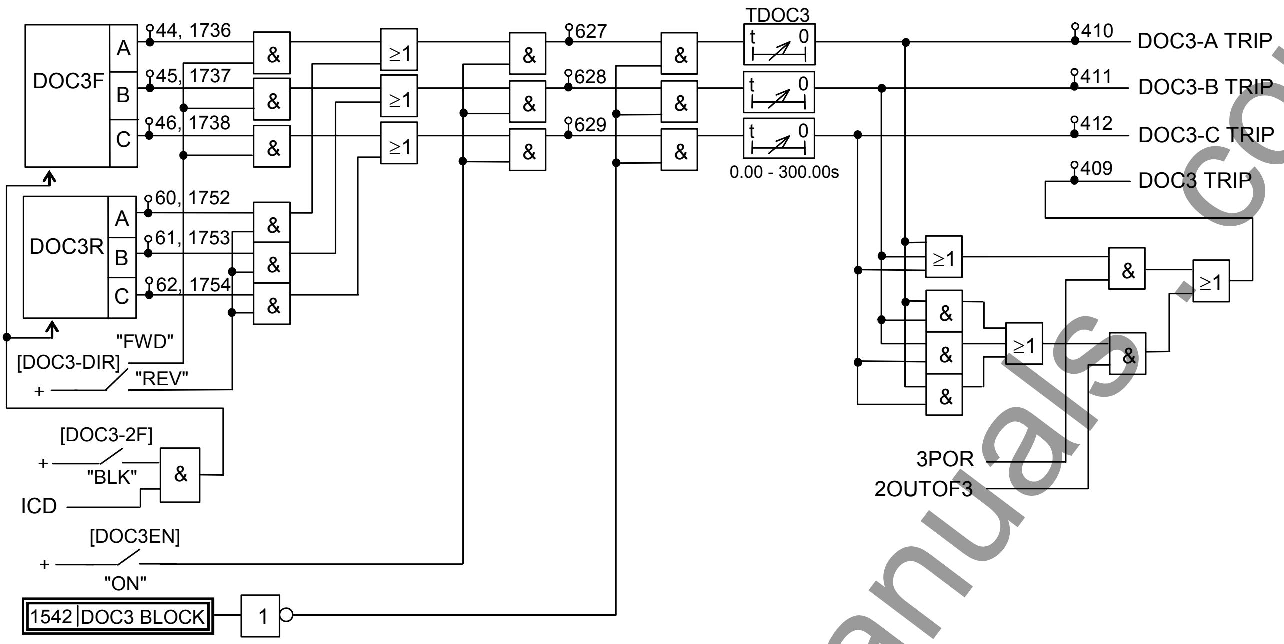

Figure 2.1.37 Definite Time Directional Overcurrent Protection DOC3

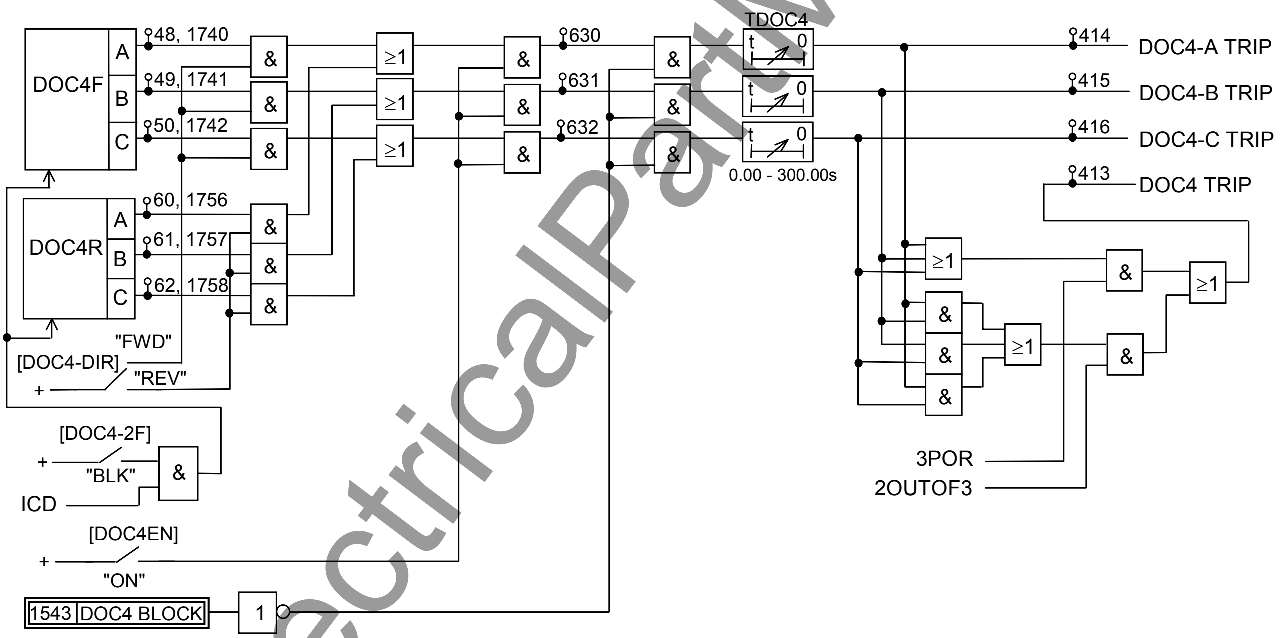

Figure 2.1.38 Definite Time Directional Overcurrent Protection DOC4

Directional earth fault protection

Figure 2.1.39 and Figure 2.1.40 show the scheme logic of the directional earth fault protection DEF1 and DEF2 with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [MDEF1] and [MDEF2] to "DT". Definite time overcurrent elements are enabled for the DEF1 and DEF2 phase overcurrent protection respectively, and trip signal DEF1 TRIP and DEF2 TRIP are given through the delayed pick-up timer TEF1 and TEF2.

The inverse time protection is selected by setting [MDEF1] and [MDEF2] to any one of "IEC", "IEEE", "US" or "CON" according to the IDMT characteristic to employ. Inverse time

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overcurrent elements DEF1I and DEF2I are enabled for DEF1 and DEF2 protection respectively, and trip signal DEF1 TRIP and DEF2 TRIP are given.

The forward operate zone (DEF1F and DEF2F) or reverse operate zone (DEF1R and DEF2R) is selectable by the scheme switches [DEF1-DIR] and [DEF2-DIR].

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the DEF1 and DEF2 protection by the scheme switches [DEF1-2F] and [DEF2-2F] respectively. See Section 2.1.7.

The DEF1 and DEF2 protection can be disabled by the scheme switches [DEF1EN] and [DEF2EN] or PLC logic signals DEF1 BLOCK and DEF2 BLOCK.

Figure 2.1.41 and Figure 2.1.42 show the scheme logic of the definite time earth fault protection DEF3 and the DEF4. DEF3 and DEF4 give trip and alarm signals DEF3 TRIP and DEF4 ALARM through delayed pick-up timers TDEF3 and TDEF4.

The forward operate zone (DEF3F and DEF4F) or reverse operate zone (DEF3R and DEF4R) is selectable by the scheme switches [DEF3-DIR] and [DEF4-DIR].

The DEF3 and DEF4 protection can be disabled by the scheme switches [DEF3EN] and [DEF4EN] or PLC logic signals DEF3 BLOCK and DEF4 BLOCK.

The DEF3 and DEF4 can also be blocked by the ICD.

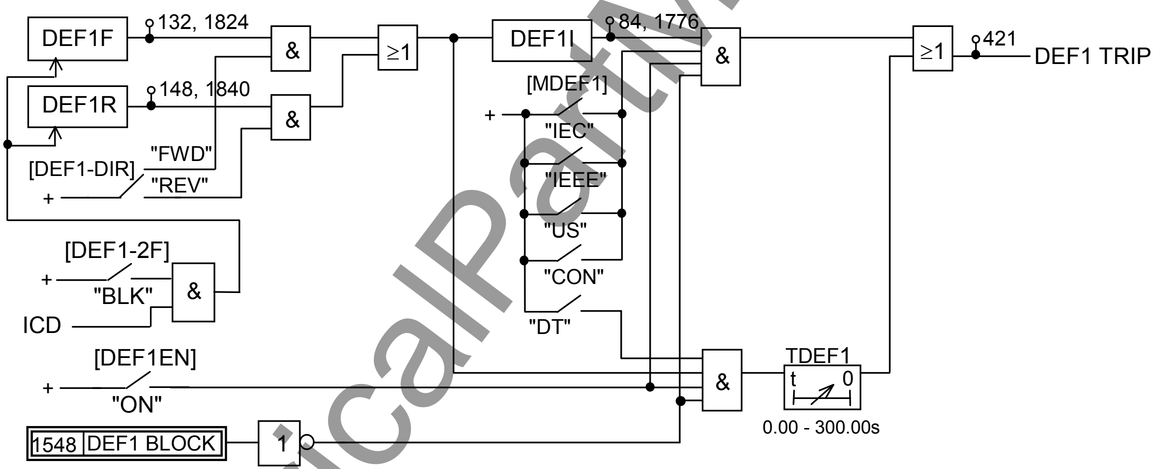

Figure 2.1.39 Directional Earth Fault Protection DEF1

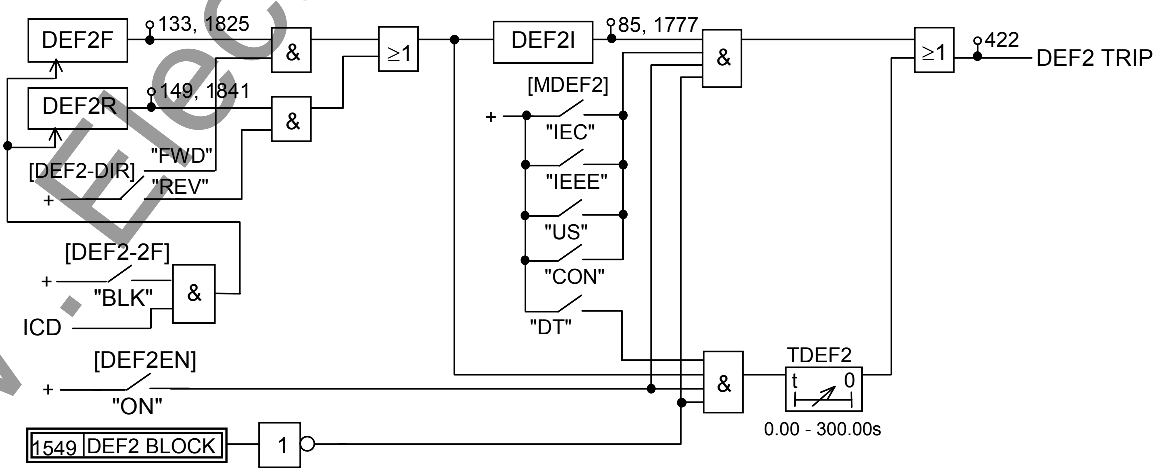

Figure 2.1.40 Directional Earth Fault Protection DEF2

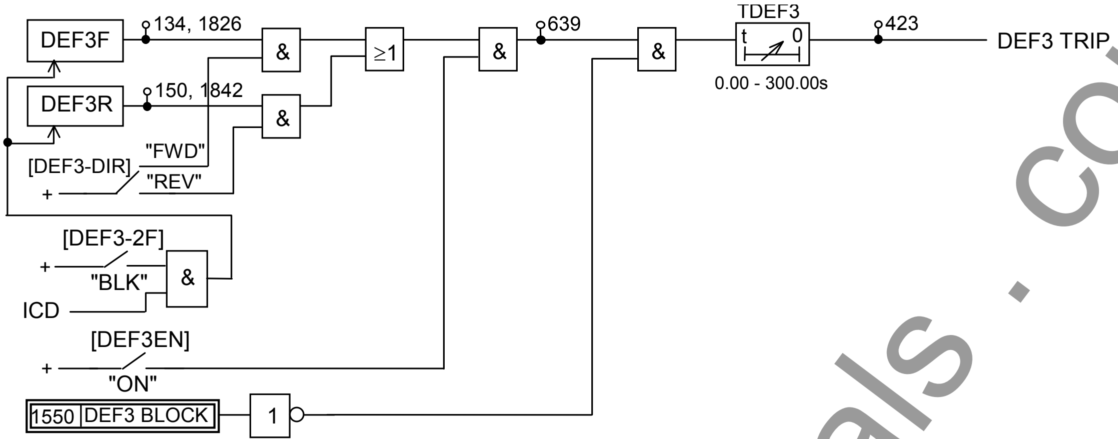

Figure 2.1.41 Definite Time Directional Earth Fault Protection DEF3

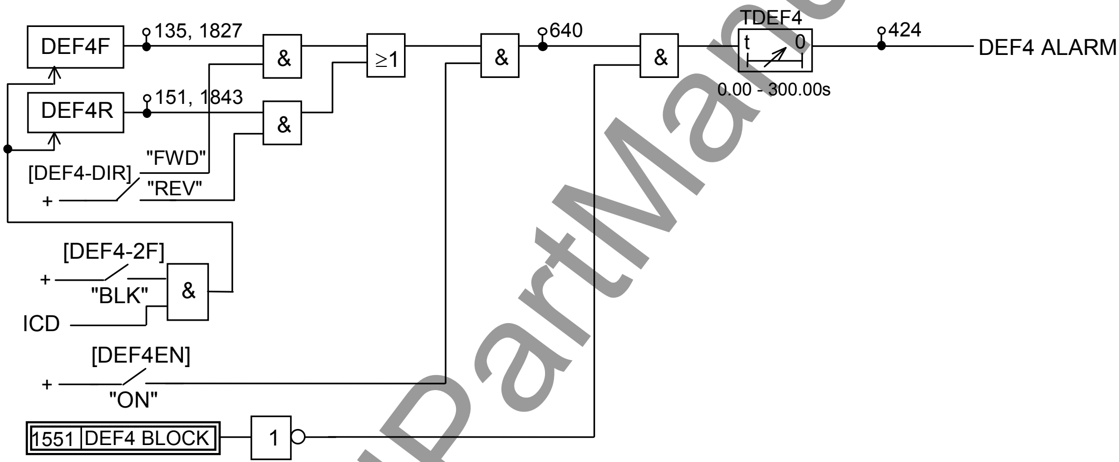

Figure 2.1.42 Definite Time Directional Earth Fault Protection DEF4

2.1.2.3 Setting

The table shows the setting elements necessary for the directional overcurrent protection and their setting ranges.

Element	Range	Step	Default	Remarks
DOC1	0.2 – 25.0 A (0.04 – 5.00 A)(*1)	0.1 A (0.01 A)	5.0 A (1.00 A)	DOC1 threshold setting
TDOC1P (TMS)	0.010 – 1.500	0.001	1.000	DOC1I time multiplier setting. Required if [MDOC1] = IEC, IEEE, US or CON.
TDOC1D	0.00 – 300.00 s	0.01 s	1.00 s	DOC1 definite time setting. Required if [MDOC1] = DT.
TDOC1RD	0.0 – 300.0 s	0.1 s	0.0 s	DOC1 definite time delayed reset. Required if [MDOC1] = IEC or [DOC1R] = DEF.
TDOC1RP (RTMS)	0.010 – 1.500	0.001	1.000	DOC1 dependent time delayed reset time multiplier. Required if [DOC1R] = DEP.
DOCθ	–95° – 95°	1°	–45°	DOC1 to DOC4 characteristic angle
DOC2	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	25.0 A (5.00 A)	DOC2 threshold setting
TDOC2P (TMS)	0.010 – 1.500	0.001	1.000	DOC2I time multiplier setting. Required if [MDOC2] = IEC, IEEE, US or CON.

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Element	Range	Step	Default	Remarks
TDOC2D	0.00 – 300.00 s	0.01 s	1.00 s	DOC2 definite time setting. Required if [MDOC2] = DT.
TDOC2RD	0.0 – 300.0 s	0.1 s	0.0 s	DOC2 definite time delayed reset. Required if [MDOC2] = IEC or [DOC2R] = DEF.
TDOC2RP (RTMS)	0.010 – 1.500	0.001	1.000	DOC2 dependent time delayed reset time multiplier. Required if [DOC2R] = DEP.
DOC3	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	50.0 A (10.00 A)	DOC3 threshold setting
TDOC3	0.00 – 300.00 s	0.1 s	1.00 s	DOC3 definite time setting
DOC4	0.5 – 250.0 A (0.10 – 50.00 A)(*1)	0.1 A (0.01 A)	100.0 A (20.00 A)	DOC4 threshold setting
TDOC4	0.00 – 300.00 s	0.01 s	1.00 s	DOC4 definite time setting
DEF1	0.05 – 25.00 A (0.01 – 5.00 A)(*1)	0.01 A (0.01 A)	1.50 A (0.30 A)	DEF1 threshold setting
TDEF1P (TMS)	0.010 – 1.500	0.001	1.000	DEF1I time multiplier setting. Required if [MDEF1] = IEC, IEEE, US or CON.
TDEF1D	0.00 – 300.00 s	0.01 s	1.00 s	DEF1 definite time setting. Required if [MDEF1] = DT.
TDEF1RD	0.0 – 300.0 s	0.1 s	0.0 s	DEF1I definite time delayed reset. Required if [MDEF1] = IEC or [DEF1R] =DEF.
TDEF1RP (RTMS)	0.010 – 1.500	0.001	1.000	DEF1I dependent time delayed reset time multiplier. Required if [DEF1R] = DEP.
DEF2	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.1 A (0.01 A)	15.0 A (3.00 A)	DEF2 threshold setting
TDEF2P (TMS)	0.010 – 1.500	0.001	1.000	DEF2I time multiplier setting. Required if [MDEF2] = IEC, IEEE, US or CON..
TDEF2D	0.00 – 300.00 s	0.01 s	1.00 s	DEF2 definite time setting. Required if [MDEF2] = DT.
TDEF2RD	0.0 – 300.0 s	0.1 s	0.0 s	DEF2I definite time delayed reset. Required if [MDEF1] = IEC or [DEF2R] = DEF.
TDEF2RP (RTMS)	0.010 – 1.500	0.001	1.000	DEF2I dependent time delayed reset time multiplier. Required if [DEF2R] = DEP.
DEFθ	–95° – 95°	1°	–45°	DEF1 to DEF4 characteristic angle
DEFV	0.5 – 100.0V	0.1V	3.0V	V0 threshold setting for DEF1 to DEF4
DEF3	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.01 A (0.01 A)	25.0 A (5.00 A)	DEF3 threshold setting
TDEF3	0.00 – 300.00 s	0.01 s	1.00 s	DEF3 definite time setting
DEF4	0.2 – 250.0 A (0.04 – 50.00 A)(*1)	0.01 A (0.01 A)	50.0 A (10.00 A)	DEF4 threshold setting
TDEF4	0.00 – 300.00 s	0.01 s	1.00 s	DEF4 definite time setting
[DOC1EN]	Off / On		On	DOC1 Enable
[MDOC1]	DT/IEC/IEEE/US/CON		DT	DOC1 characteristic
[MDOC1C]				DOC1I inverse curve type.
MDOC1C-IEC	NI / VI / EI / LTI		NI	Required if [MDOC1] = IEC.
MDOC1C-IEEE	MI / VI / EI		MI	Required if [MDOC1] = IEEE.
MDOC1C-US	CO2 / CO8		CO2	Required if [MDOC1] = US.

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Element	Range	Step	Default	Remarks
[DOC1R]	DEF / DEP (*2)		DEF	DOC1I reset characteristic. Required if [MDOC1] = IEEE, US or CON.
[DOC1-DIR]	FWD / REV		FWD	DOC1 directional characteristic
[DOC1-2F]	NA / BLK		NA	Blocked by ICD
[DOC2EN]	Off / On		Off	DOC2 Enable
[MDOC2]	DT/IEC/IEEE/US/CON		DT	DOC2 characteristic
[MDOC2C]				DOC2I inverse curve type.
MDOC2C-IEC	NI / VI / EI / LTI		NI	Required if [MDOC2] = IEC.
MDOC2C-IEEE	MI / VI / EI		MI	Required if [MDOC2] = IEEE.
MDOC2C-US	CO2 / CO8		CO2	Required if [MDOC2] = US.
[DOC2R]	DEF / DEP (*2)		DEF	DOC2I reset characteristic. Required if [MDOC2] = IEEE, US or CON.
[DOC2-DIR]	FWD / REV		FWD	DOC2 directional characteristic
[DOC2-2F]	NA / BLK		NA	Blocked by ICD
[DOC3EN]	Off / On		Off	DOC3 Enable
[DOC3-2F]	NA / BLK		NA	Blocked by ICD
[DOC4EN]	Off / On		Off	DOC4 Enable
[DOC4-2F]	NA / BLK		NA	Blocked by ICD
[DOCTP]	3POR / 2OUTOF3		3POR	Trip mode selection
[DEF1EN]	Off / On		On	DEF1 Enable
[MDEF1]	DT/IEC/IEEE/US/CON		DT	DEF1 characteristic
[MDEF1C]				DEF1I inverse curve type.
MDEF1C-IEC	NI / VI / EI / LTI		NI	Required if [MDEF1] = IEC.
MDEF1C-IEEE	MI / VI / EI		MI	Required if [MDEF1] = IEEE.
MDEF1C-US	CO2 / CO8		CO2	Required if [MDEF1] = US.
[DEF1R]	DEF / DEP (*2)		DEF	DEF1I reset characteristic. Required if [MDEF1] = IEEE, US or CON.
[DEF1-DIR]	FWD / REV		FWD	DEF1 directional characteristic
[DEF1-2F]	NA / BLK		NA	Blocked by ICD
[DEF2EN]	Off / On		Off	DEF2 Enable
[MDEF2]	DT/IEC/IEEE/US/CON		DT	DEF2 characteristic
[MDEF2C]				DEF2I inverse curve type.
MDEF2C-IEC	NI / VI / EI / LTI		NI	Required if [MDEF2] = IEC.
MDEF2C-IEEE	MI / VI / EI		MI	Required if [MDEF2] = IEEE.
MDEF2C-US	CO2 / CO8		CO2	Required if [MDEF2] = US.
[DEF2R]	DEF / DEP (*2)		DEF	DEF2-I reset characteristic. Required if [MDEF2] = IEEE, US or CON.
[DEF2-DIR]	FWD / REV		FWD	DEF2 directional characteristic
[DEF2-2F]	NA / BLK		NA	Blocked by ICD
[DEF3EN]	Off / On		Off	DEF3 Enable
[DEF3-2F]	NA / BLK		NA	Blocked by ICD
[DEF4EN]	Off / On		Off	DEF4 Enable
[DEF4-2F]	NA / BLK		NA	Blocked by ICD

(*1) Current values shown in the parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

(*2) DEF: Instant or Definite time, DEP: Inverse time

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2.1.2.4 Directional Sensitive Earth Fault Protection

GRD150-200 and 400 series provide directional earth fault protection with more sensitive settings for use in applications where the fault current magnitude may be very low. A 4-stage directional sensitive earth fault function is provided, with the first and second stage programmable for inverse time or definite time operation. The third and fourth stages provide definite time operation.

The sensitive earth fault element includes a digital filter which rejects all harmonics other than the fundamental power system frequency.

The sensitive earth fault quantity is measured directly, using a dedicated core balance earth fault CT.

This input can also be used in transformer restricted earth fault applications, by the use of external metrosils and setting resistors.

The directional sensitive earth fault elements can be configured for directional operation in the same way as the standard earth fault pole, by polarising against the residual voltage. An additional restraint on operation can be provided by a Residual Power element RP, for use in protection of power systems which utilise resonant (Petersen coil) earthing methods.

Scheme Logic

Figure 2.1.43 shows the scheme logic of inverse time or definite time selective two-stage directional sensitive earth fault protection DSEF1.

In Figure 2.1.43, the definite time protection is selected by setting [MDSE1] to “DT”. The definite time element is enabled for sensitive earth fault protection and stage 1 trip signal DSEF1 TRIP is given through the delayed pick-up timer TDSE1.

The inverse time protection is selected by setting [MDSE1] to either “IEC”, “IEEE”, “US” or “CON” according to the inverse time characteristic to employ. The element SEF1I is enabled and stage 1 trip signal DSEF1 TRIP is given.

Both protection provide stage 2 trip signal DSEF1-S2 through a delayed pick-up timer TDSE12.

When the standby earth fault protection is applied by introducing earth current from the transformer low voltage neutral circuit, stage 1 trip signals are used to trip the transformer low voltage circuit breaker. If the definite time or inverse time element continues operating after stage 1 has operated, the stage 2 trip signal can be used to trip the transformer high voltage circuit breaker(s).

The forward operate zone or reverse operate zone is selectable by the scheme switch [DSE1-DIR].

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the DSEF1 protection by the scheme switch [DSE1-2F]. See Section 2.1.7.

SEF protection can be disabled by the scheme switch [DSE1EN] or PLC logic signal DSEF1 BLOCK. Stage 2 trip of standby earth fault protection can be disabled by the scheme switch [DSE1S2]. Residual element RP also can be disabled by the scheme switch [RPEN]. The switch [RPEN] is common for DSEF1 to DSEF4 protection.

Figure 2.2.44 shows DSEF2 protection. The DSEF2 provides the same logic of DSEF1 except for the stage 2 trip.

Figure 2.1.45 and Figure 2.1.46 show the scheme logic of the definite time sensitive earth fault protection DSEF3 and the DSEF4. The DSEF3 and DSEF4 give trip and alarm signals DSEF3 TRIP and DSEF4 ALARM through delayed pick-up timers TDSE3 and TDSE4.

The forward operate zone (DSEF3F and DSEF4F) or reverse operate zone (DSEF3R and DSEF4R) is selectable by the scheme switches [DSE3-DIR] and [DSE4-DIR].

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The DSEF3 and DSEF4 protection can be disabled by the scheme switches [DSE3EN] and [DSE4EN] or PLC logic signals DSEF3 BLOCK and DSEF4 BLOCK. Residual element RP also can be disabled by the scheme switch [RPEN].

The DSEF3 and DSEF4 can also be blocked by the ICD.

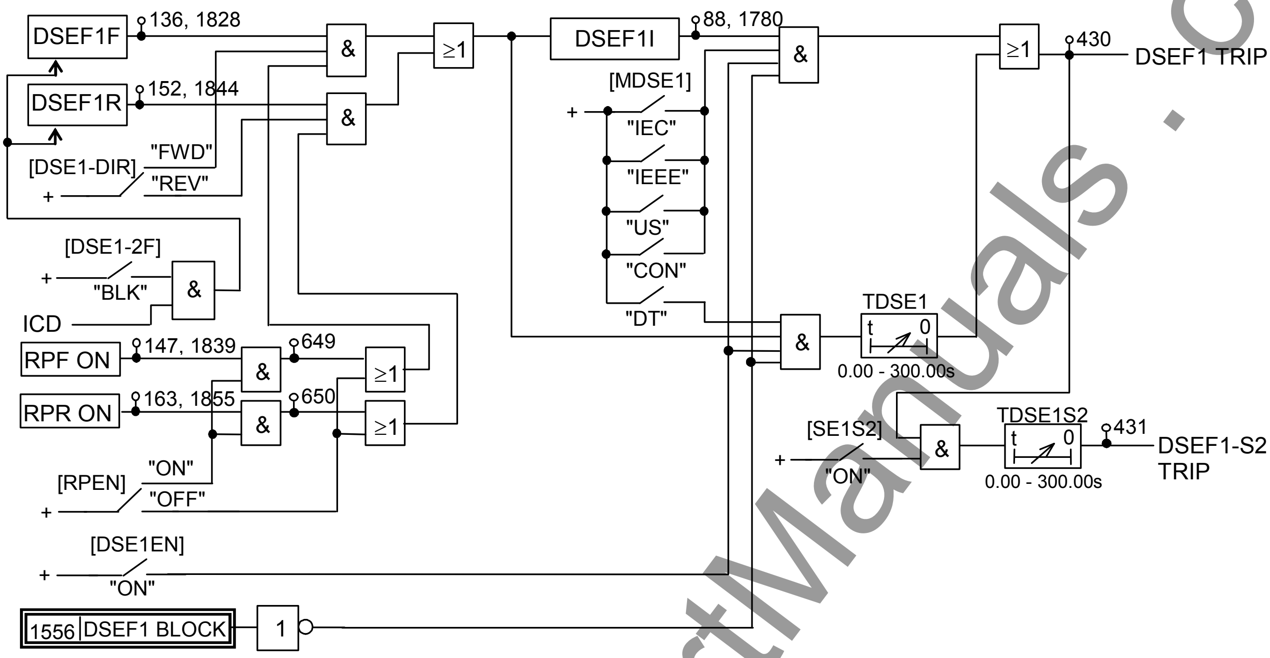

Figure 2.1.43 Directional Sensitive Earth Fault Protection SEF1

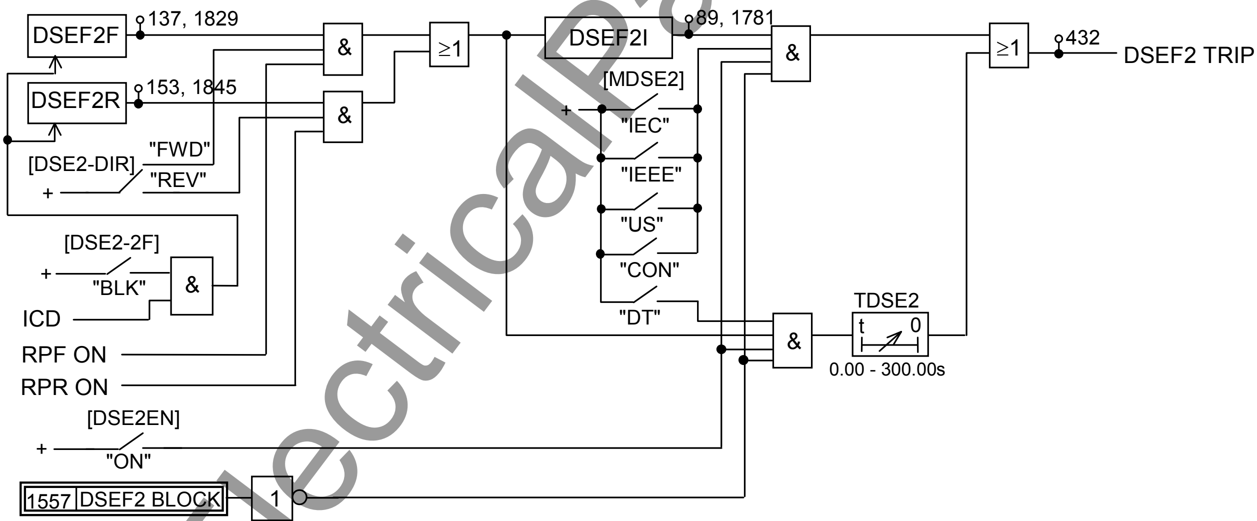

Figure 2.1.44 Directional Sensitive Earth Fault Protection SEF2

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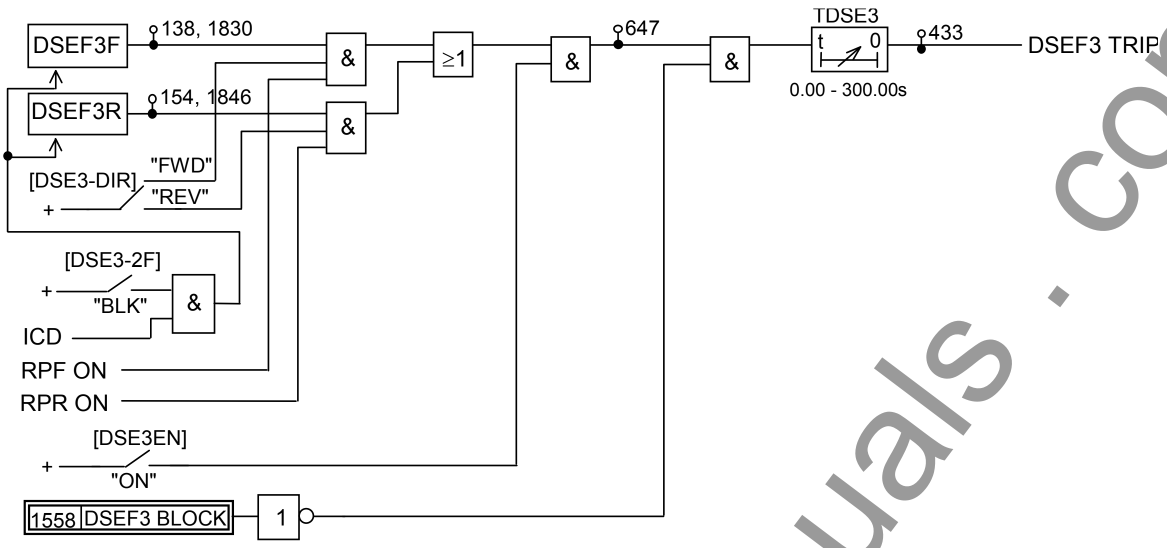
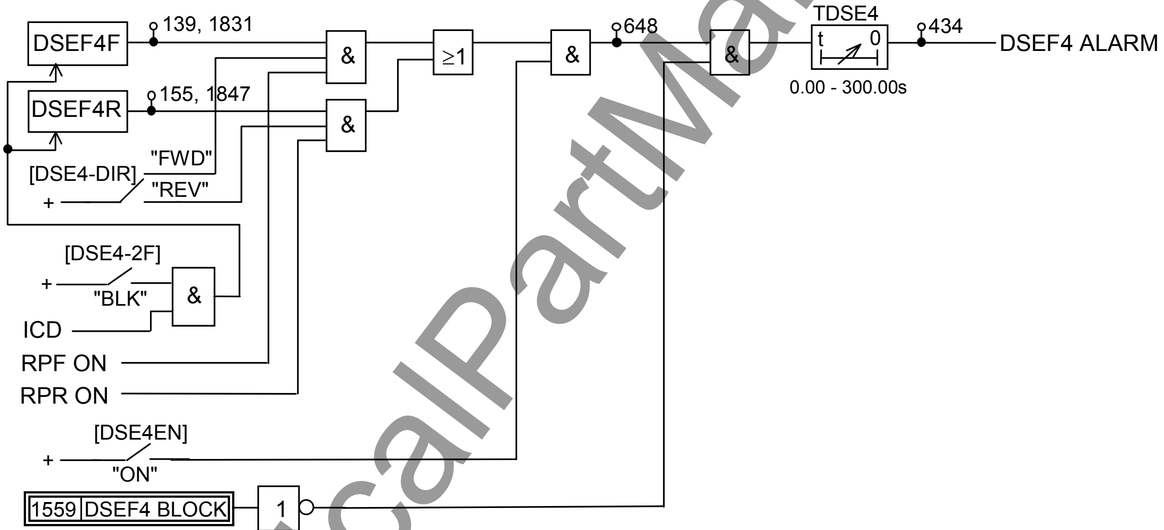


2.1.45 Definite Time Directional Sensitive Earth Fault Protection DSEF3



2.1.46 Definite Time Directional Sensitive Earth Fault Protection DSEF4

Setting

The table below shows the setting elements necessary for the directional sensitive earth fault protection and their setting ranges.

Element	Range	Step	Default	Remarks
DSE1	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	DSEF1 threshold setting
TDSE1P (TMS)	0.010 – 1.500	0.001	1.000	DSEFI1 inverse time multiplier setting. Required if [MDSE1] = IEC, IEEE, US or CON.
TDSE1D	0.00 – 300.00 s	0.01 s	1.00 s	DSEF1 definite time setting. Required if [MDSE1] = DT.
TDSE1RD	0.0 – 300.0 s	0.1 s	0.0 s	DSEF1I definite time delayed reset. Required if [MDSE1] = IEC or [DSE1R] = DEF.
TDSE1RP (RTMS)	0.010 – 1.500	0.001	1.000	DSEF1I dependent time delayed reset time multiplier. Required if [DSE1R] = DEP.
DSEθ	–95° – 95°	1°	0°	DSE1 to DSE4 characteristic angle

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Element	Range	Step	Default	Remarks
TDSE1S2	0.00 – 300.00 s	0.01 s	1.00 s	DSEF1 stage 2 definite time setting
DSE2	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	DSEF2 threshold setting
TDSE2P (TMS)	0.010 – 1.500	0.001	1.000	DSEF2I inverse time multiplier setting. Required if [MDSE2] = IEC, IEEE, US or CON.
TDSE2D	0.00 – 300.00 s	0.01 s	1.00 s	DSEF2 definite time setting. Required if [MDSE2] = DT.
TDSE2RD	0.0 – 300.0 s	0.1 s	0.0 s	DSEF2I definite time delayed reset. Required if [MDSE1] = IEC or [DSE2R] = DEF.
TDSE2RP (RTMS)	0.010 – 1.500	0.001	1.000	DSEF2I dependent time delayed reset time multiplier. Required if [DSE2R] = DEP.
DSE3	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	DSEF3 threshold setting
TDSE3	0.00 – 300.00 s	0.01 s	1.00 s	DSEF3 definite time setting.
DSE4	0.025 – 0.125 A (0.005 – 0.025 A)(*1)	0.001 A (0.001 A)	0.050 A (0.010 A)	DSEF4 threshold setting
TDSE4	0.00 – 300.00 s	0.01 s	1.00 s	DSEF4 definite time setting.
[DSE1EN]	Off / On		On	DSEF1 Enable
[MDSE1]	DT/IEC/IEEE/US/CON		DT	DSEF1 characteristic
[MDSE1C] MDSE1C-IEC MDSE1C-IEEE MDSE1C-US	 NI / VI / EI / LTI MI / VI / EI CO2 / CO8		 NI MI CO2	DSE1-I inverse curve type. Required if [MDSE1] = IEC. Required if [MDSE1] = IEEE. Required if [MDSE1] = US.
[DSE1R]	DEF / DEP (*2)		DEF	DSEF1-I reset characteristic. Required if [MDSE1] = IEEE, US or CON.
[DSE1S2]	Off / On		Off	DSEF1 stage 2 timer enable
[DSE1-DIR]	FWD / REV		FWD	DSEF1 directional characteristic
[DSE1-2F]	NA / BLK		NA	Blocked by ICD
[DSE2EN]	Off / On		Off	DSEF2 Enable
[MDSE2]	DT/IEC/IEEE/US/CON		DT	DSEF2 characteristic
[MDSE2C] MDSE2C-IEC MDSE2C-IEEE MDSE2C-US	 NI / VI / EI / LTI MI / VI / EI CO2 / CO8		 NI MI CO2	DSE2-I inverse curve type. Required if [MDSE2] = IEC. Required if [MDSE2] = IEEE. Required if [MDSE2] = US.
[DSE2R]	DEF / DEP (*2)		DEF	DSEF2-I reset characteristic. Required if [MDSE2] = IEEE, US or CON.
[DSE2-DIR]	FWD / REV		FWD	DSEF2 directional characteristic
[DSE2-2F]	NA / BLK		NA	Blocked by ICD
[DSE3EN]	Off / On		Off	DSEF3 Enable
[DSE3-2F]	NA / BLK		NA	Blocked by ICD
[DSE4EN]	Off / On		Off	DSEF4 Enable
[DSE4-2F]	NA / BLK		NA	Blocked by ICD
RPEN	Off / On		Off	Residual power block enable

(*1) Current values shown in parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

(*2) DEF: Instant or Definite time, DEP: Inverse time

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2.1.2.5 Directional Negative Sequence Overcurrent Protection

GRD150 provides the directional negative sequence overcurrent protection with inverse time and definite time characteristics.

Two independent elements DNOC1 and DNOC2 are provided for tripping and alarming. The DNOC1 has selective inverse time and definite time characteristics. The DNOC2 has definite time characteristic only. These elements can be directionalised by polarising against the negative sequence voltage.

The DNOC protection is enabled when three-phase current is introduced and the scheme switch [APPL-CT] is set to "3P".

Scheme Logic

Figure 2.1.47 shows the scheme logic of inverse time or definite time selective directional negative sequence inverse time overcurrent protection and definite time overcurrent protection.

In Figure 2.1.47, the definite time protection is selected by setting [MDNC1] to "DT". The definite time element is enabled for directional negative sequence overcurrent protection and trip signal DNOC1 TRIP is given through the delayed pick-up timer TDNC1.

The inverse time protection is selected by setting [MDNC1] to either "IEC", "IEEE", "US" or "CON" according to the inverse time characteristic to employ. The element DNOCI1 is enabled and trip signal DNOC1 TRIP is given.

The forward operate zone or reverse operate zone is selectable by the scheme switch [DNC1-DIR].

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the DNOC1 protection by the scheme switch [DNC1-2F]. See Section 2.1.7.

The DNOC1 protection can be disabled by the scheme switch [DNC1EN] or PLC logic signal DNOC1 BLOCK.

Figure 2.1.48 shows the scheme logic of DNOC2 protection with definite time delayed operation. The DNOC2 gives an alarm signal DNOC2 ALARM through delayed pick-up timer TDNC2.

The forward operate zone or reverse operate zone is selectable by the scheme switch [DNC2-DIR].

The DNOC2 protection can be disabled by the scheme switch [DNC2EN] or PLC logic signal DNOC2 BLOCK. The DNOC2 can also be blocked by the ICD.

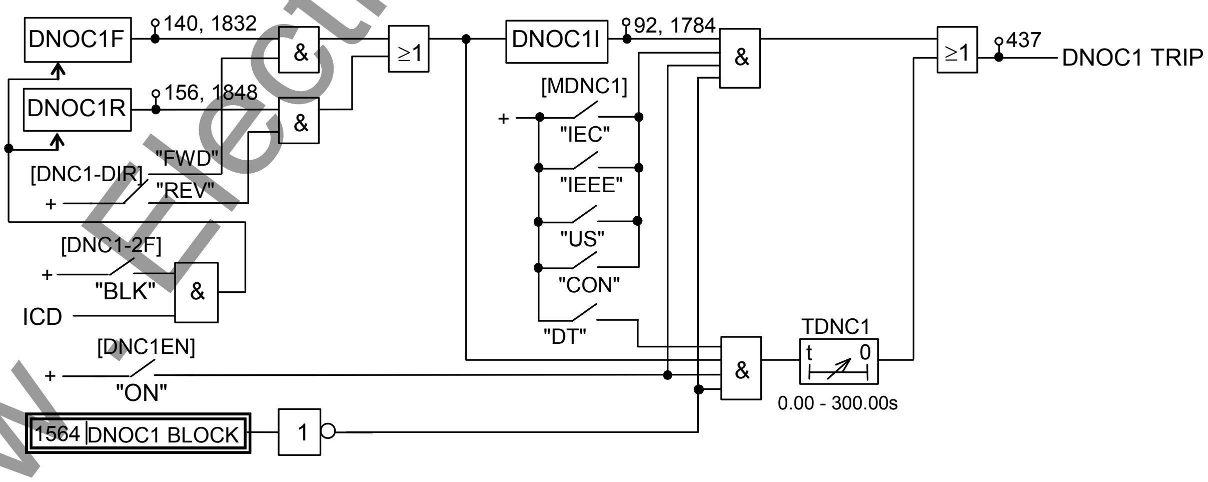

Figure 2.1.47 Directional Negative Sequence Overcurrent Protection Scheme Logic

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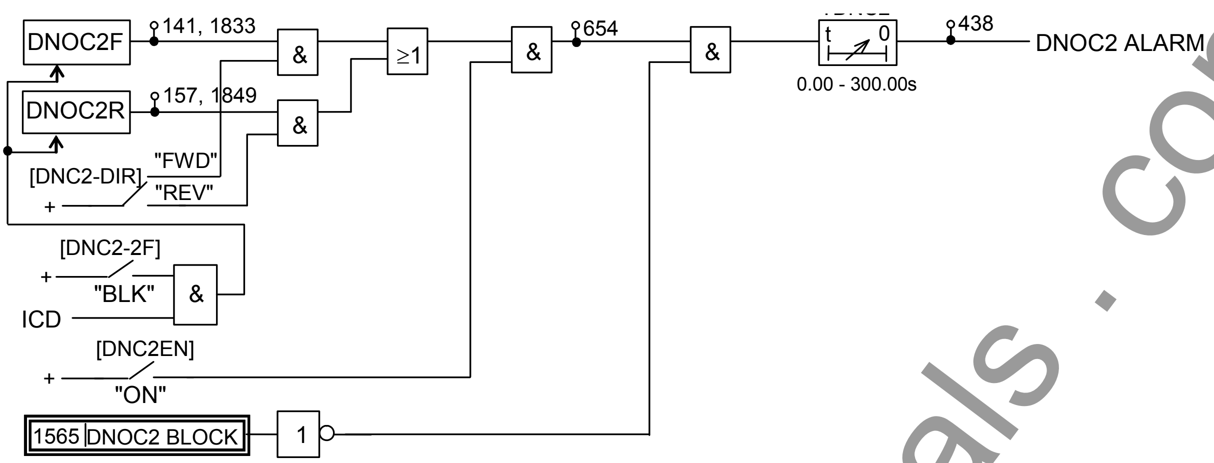

Figure 2.1.48 Negative Sequence Overcurrent Protection DNOC2 Scheme Logic

Settings

The table below shows the setting elements necessary for the DNOC protection and their setting ranges.

Element	Range	Step	Default	Remarks
DNC1	0.5 - 10.0 A (0.10 – 2.00 A)(*1)	0.1 A (0.01 A)	2.0 A (0.40 A)	DNOC1 threshold setting.
TDNC1P (TMS)	0.010 – 1.500	0.001	1.000	DNOCI1 time multiplier setting. Required if [MNC1] = IEC, IEEE, US or CON.
TDNC1D	0.00 – 300.00 s	0.01 s	1.00 s	NOC1 definite time setting. Required if [MNC1] = DT.
TDNC1RD	0.0 – 300.0 s	0.1 s	0.0 s	NOCI1 definite time delayed reset. Required if [MNC1] = IEC or [NC1R] = DEF.
TDNC1RP (RTMS)	0.010 – 1.500	0.001	1.000	NOCI1 dependent time delayed reset time multiplier. Required if [NC1R] = DEP.
DNCθ	–95° – 95°	1°	–45°	DNOC1 and DNOC2 characteristic angle
DNC2	0.5 - 10.0 A (0.10 – 2.00 A)(*1)	0.1 A (0.01 A)	1.0 A (0.20 A)	DNOC2 threshold setting.
TDNC2	0.00 – 300.00 s	0.01 s	1.00 s	DNOC2 definite time setting
[MDNC1]	DT/IEC/IEEE/US/CON		DT	DNOC1 characteristic
[MDNC1C]				DNOCI1 inverse curve type.
MDNC1C-IEC	NI / VI / EI / LTI		NI	Required if [MDNC1] = IEC.
MDNC1C-IEEE	MI / VI / EI		MI	Required if [MDNC1] = IEEE.
MDNC1C-US	CO2 / CO8		CO2	Required if [MDNC1] = US.
[DNC1R]	DEF / DEP (*2)		DEF	DNOCI1 reset characteristic. Required if [MDNC1] = IEEE, US or CON.
[DNC1-DIR]	FWD / REV		FWD	DNOC1 directional characteristic
[DNC1-2F]	NA / BLK		NA	Blocked by ICD
[DNC1EN]	Off / On		Off	DNOC1 Enable
[DNC2-DIR]	FWD / REV		FWD	DNOC2 directional characteristic
[DNC2-2F]	NA / BLK		NA	Blocked by ICD
[DNC2EN]	Off / On		Off	DNOC2 Enable
[APPL-CT]	3P / 2P / 1P		3P	Three-phase current input

(*1) Current values shown in the parenthesis are in the case of a 1 A rating. Other current

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values are in the case of a 5 A rating.
(*2) DEF: Instant or Definite time, DEP: Inverse time

Sensitive setting of DNOC1 and DNOC2 thresholds is restricted by the negative phase sequence current normally present on the system. The negative phase sequence current is measured in the relay continuously and displayed on the metering screen of the relay front panel along with the maximum value. It is recommended to check the display at the commissioning stage and to set DNOC1 and DNOC2 to 130 to 150% of the maximum value displayed.

The delay time setting TDNC1 and TDNC2 is added to the inherent delay of the measuring elements DNOC1 and DNOC2. The minimum operating time of the DNOC elements is around 200ms.

2.1.2.6 Blocked Busbar Protection

GRD150 can be applied to provide busbar zone schemes. For a simple radial system where a substation has only one power source, then non-directional overcurrent relays are suitable. In the case of more complex systems where the substation has multiple incomers, or where power can flow into the substation from the feeders, then the directional protection must be applied. Figure 2.1.49 shows one half of a two-incomer station. A directional overcurrent relay protects the incomer, with non-directional overcurrent units on the feeders.

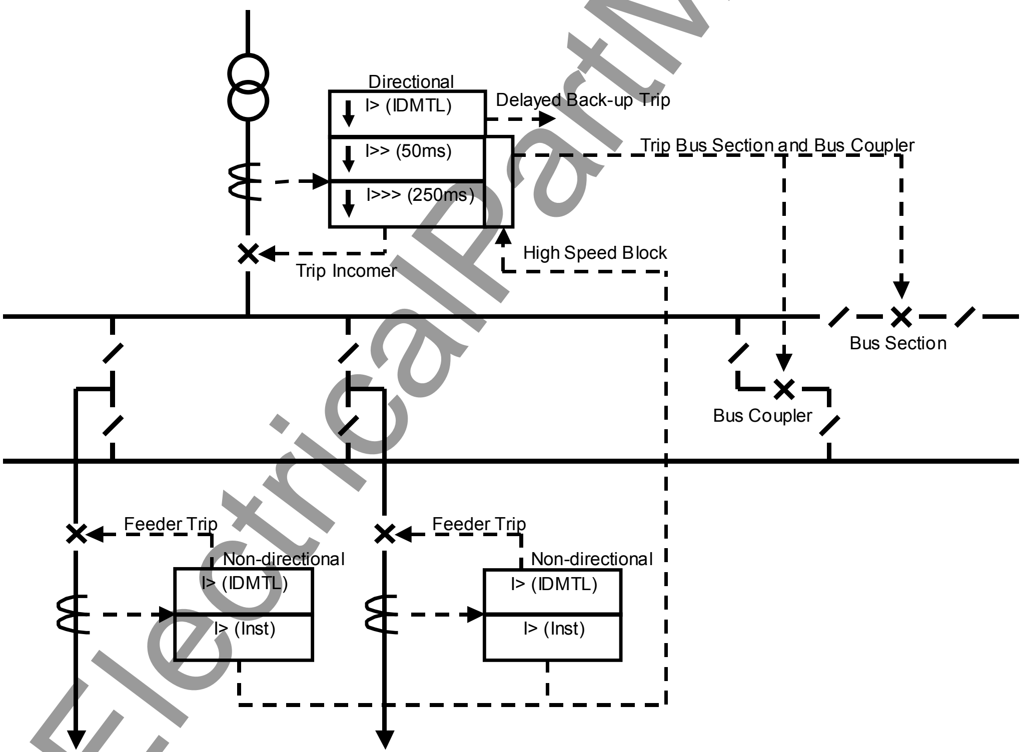

Figure 2.1.49 Blocked Busbar Protection Scheme

For a fault on an outgoing feeder, the non-directional feeder protection sends a hardwired blocking signal to inhibit operation of both incomers, the signal being generated by the instantaneous phase fault and earth fault alarm outputs. Meanwhile, the feeder is tripped by the OC1 and EF1 elements, programmed with inverse time delays and set to grade with downstream protections.

The incomer protection is programmed for directional operation such that it will only trip for faults on the busbar side of its CTs. Hence, although a fault on the HV side may be back-fed from the busbars, the relay does not trip.

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For a fault in the busbar zone, the GRD150 is programmed to trip the bus section and bus coupler circuit breakers via its instantaneous elements OC2 and EF2 set with short definite time delay settings (minimum 50ms). This first stage trip maintains operation of half the substation in the event of a busbar fault or incomer fault in the other half.

If the first stage trip fails to clear the fault, a second stage trip is given to the local incomer circuit breaker via instantaneous elements OC3 and EF3 after a longer delay, thus isolating a fault on the local busbar.

GRD150 integrated circuit breaker fail protection can be used to provide additional back-trips from the feeder protection to the incomer, and from the incomer to the HV side of the power transformer, in the event of the main trip failing to clear the fault.

A further development of this scheme might see directional relays being applied directly to the bus section and bus coupler circuit breakers, to speed up operation of the scheme.

This scheme assumes that a busbar fault cannot be fed from the outgoing feeder circuits. In the case of an interconnected system, where a remote power source may provide a back-feed into the substation, directional relays must also be applied to protect the feeders.

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2.1.3 Phase Undercurrent Protection

The phase undercurrent protection provides is used to detect a decrease in current caused by a loss of load, typically motor load. Two stage undercurrent protection UC1 and UC2 are available.

The undercurrent element operates for current falling through the threshold level. But the operation is blocked when the current falls below 4 % of CT secondary rating to discriminate the loss of load from the feeder tripping by other protection. Figure 2.4.50 shows the undercurrent element characteristic.

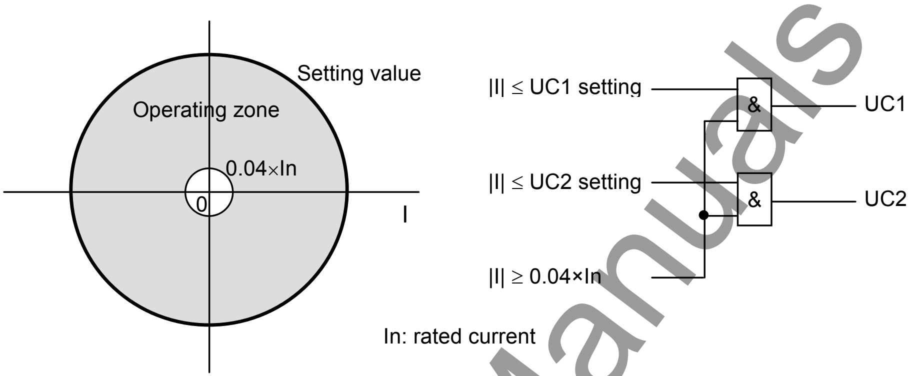

Figure 2.1.50 Undercurrent Element Characteristic

Each phase has two independent undercurrent elements for tripping and alarming. The elements are programmable for instantaneous or definite time delayed operation.

The undercurrent element operates on per phase basis, although tripping and alarming is three-phase only.

Scheme Logic

Figure 2.1.51 shows the scheme logic of the phase undercurrent protection.

The undercurrent elements UC1 and UC2 output UC1 TRIP and UC2 ALARM through delayed pick-up timers TUC1 and TUC2.

This protection can be disabled by the scheme switch [UC1EN] and [UC2EN] or PLC logic signal UC1 BLOCK and UC2 BLOCK.

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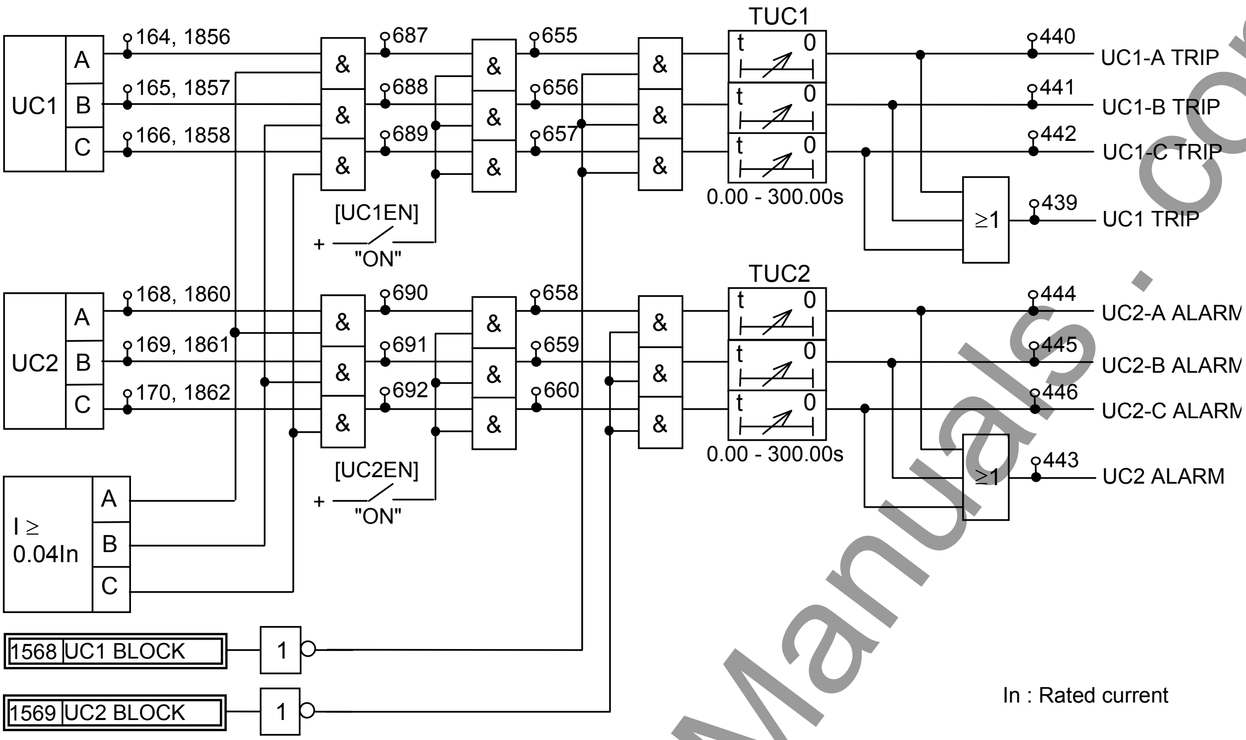

Figure 2.1.51 Undercurrent Protection Scheme Logic

Setting

The table below shows the setting elements necessary for the undercurrent protection and their setting ranges.

Element	Range	Step	Default	Remarks
UC1	0.5 – 10.0 A (0.10 – 2.00 A)(*)	0.1 A (0.01 A)	1.0 A (0.20 A)	UC1 threshold setting
TUC1	0.00 – 300.00 s	0.01 s	1.00 s	UC1 definite time setting
UC2	0.5 – 10.0 A (0.10 – 2.00 A)	0.1 A (0.01 A)	2.0 A (0.40 A)	UC2 threshold setting
TUC2	0.00 – 300.00 s	0.01 s	1.00 s	UC2 definite time setting
[UC1EN]	Off / On		Off	UC1 Enable
[UC2EN]	Off / On		Off	UC2 Enable

(*) Current values shown in parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

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2.1.4 Thermal Overload Protection

The temperature of electrical plant rises according to an I^2t function and the thermal overload protection in GRD150 provides a good protection against damage caused by sustained overloading. The protection simulates the changing thermal state in the plant using a thermal model.

The thermal state of the electrical system can be shown by equation (1).

$$\theta = \frac{I^2}{I_{AOL}^2}\left(1 - e^{-t/\tau}\right) \times 100\% \qquad (1)$$

where:

θ = thermal state of the system as a percentage of allowable thermal capacity,

I = applied load current,

I_{AOL} = allowable overload current of the system,

τ = thermal time constant of the system.

The thermal state 0% represents the cold state and 100% represents the thermal limit, which is the point at which no further temperature rise can be safely tolerated and the system should be disconnected. The thermal limit for any given system is fixed by the thermal setting I_{AOL}. The relay gives a trip output when $\theta = 100\%$.

The thermal overload protection measures the largest of the three phase currents and operates according to the characteristics defined in IEC60255-8. (Refer to Appendix A for the implementation of the thermal model for IEC60255-8.)

Time to trip depends not only on the level of overload, but also on the level of load current prior to the overload - that is, on whether the overload was applied from 'cold' or from 'hot'.

Independent thresholds for trip and alarm are available.

The characteristic of thermal overload element is defined by equation (2) and equation (3) for 'cold' and 'hot'. The cold curve is a special case for the hot curve where prior load current Ip is zero, catering to the situation where a cold system is switched on to an immediate overload.

$$t = \tau \cdot Ln\left[\frac{I^2}{I^2 - I_{AOL}^2}\right] \qquad (2)$$

$$t = \tau \cdot Ln\left[\frac{I^2 - I_P^2}{I^2 - I_{AOL}^2}\right] \qquad (3)$$

where:

t = time to trip for constant overload current I (seconds)

I = overload current (largest phase current) (amps)

I_{AOL} = allowable overload current (amps)

I_P = previous load current (amps)

τ = thermal time constant (seconds)

Ln = natural logarithm

Figure 2.1.52 illustrates the IEC60255-8 curves for a range of time constant settings. The left-hand chart shows the 'cold' condition where an overload has been switched onto a previously un-loaded system. The right-hand chart shows the 'hot' condition where an overload is switched onto a

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system that has previously been loaded to 90% of its capacity.

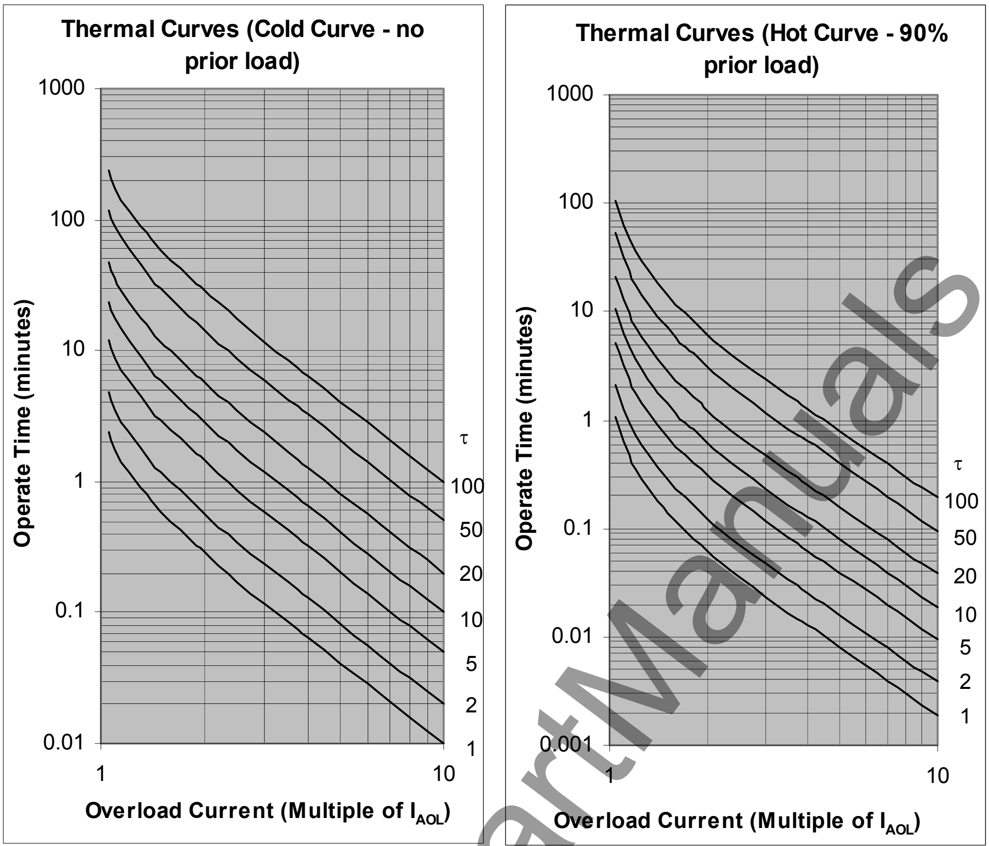

Figure 2.1.52 Thermal Curves

Scheme Logic

Figure 2.1.53 shows the scheme logic of the thermal overload protection.

The thermal overload element THM has independent thresholds for alarm and trip, and outputs alarm signal THM ALARM and trip signal THM TRIP. The alarming threshold level is set as a percentage of the tripping threshold.

The alarming and tripping can be disabled by the scheme switches [THMAEN] and [THMTEN] respectively or binary input signal THM BLOCK.

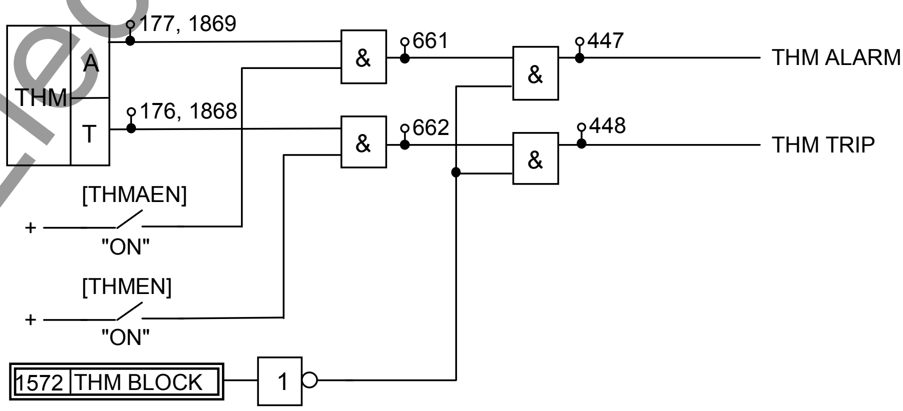

Figure 2.1.53 Thermal Overload Protection Scheme Logic

Setting

The table below shows the setting elements necessary for the thermal overload protection and their setting ranges.

Element	Range	Step	Default	Remarks
THM	0.1 – 10.0 A (0.02 – 2.00 A)(*)	0.1 A (0.01 A)	5.0 A (1.00 A)	Thermal overload setting. (THM = I_{AOL}: allowable overload current)
THMIP	0.0 – 5.0 A (0.00 – 1.00 A)(*)	0.1 A (0.01 A)	0.0 A (0.00 A)	Previous load current for testing
TTHM	0.5 - 100.0 min	0.1 min	10.0 min	Thermal time constant
THMA	50 – 99 %	1 %	80 %	Thermal alarm setting. (Percentage of THM setting.)
[THMEN]	Off / On		Off	Thermal OL enable
[THMAEN]	Off / On		Off	Thermal alarm enable
[THMRST]	Off / On		Off	Thermal element test

(*) Current values shown in the parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

Note: THMIP sets a minimum level of previous load current to be used by the thermal element, and is only active when testing ([THMRST] = “ON”).

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2.1.5 Broken Conductor Protection

Series faults or open circuit faults which do not accompany any earth faults or phase faults are caused by broken conductors, breaker contact failure, operation of fuses, or false operation of single-phase switchgear.

Figure 2.1.54 shows the sequence network connection diagram in the case of a single-phase series fault assuming that the positive, negative and zero sequence impedance of the left and right side system of the fault location is in the ratio of k_1 to $(1 - k_1)$, k_2 to $(1 - k_2)$ and k_0 to $(1 - k_0)$.

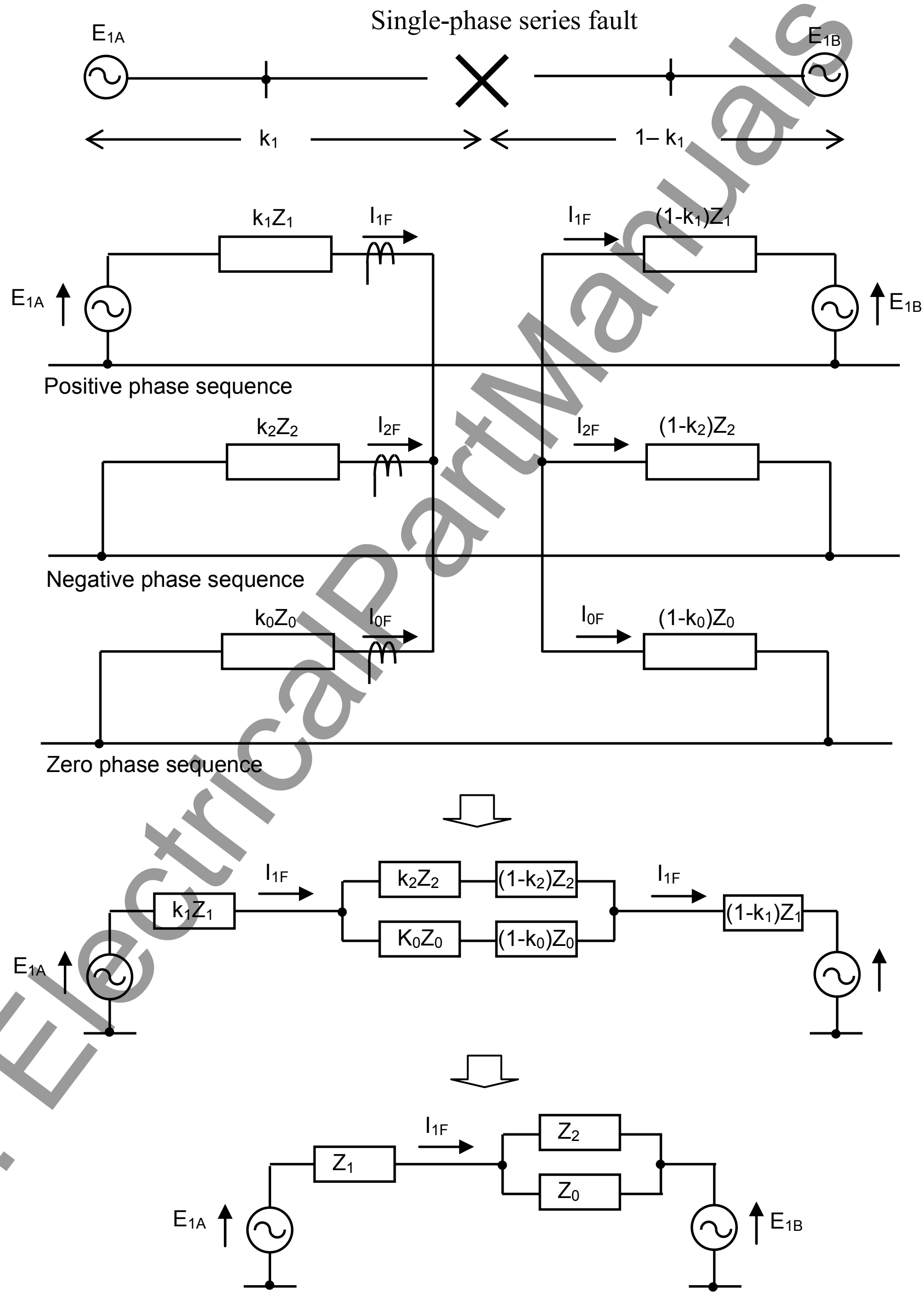

Figure 2.1.54 Equivalent Circuit for a Single-phase Series Fault

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Positive phase sequence current I_{1F}, negative phase sequence current I_{2F} and zero phase sequence current I_{0F} at fault location in an single-phase series fault are given by:

$I_{1F} + I_{2F} + I_{0F} = 0$ (1)

$Z_{2F}I_{2F} - Z_{0F}I_{0F} = 0$ (2)

$E_{1A} - E_{1B} = Z_{1F}I_{1F} - Z_{2F}I_{2F}$ (3)

where,

E_{1A}, E_{1B}: power source voltage

Z_1: positive sequence impedance

Z_2: negative sequence impedance

Z_0: zero sequence impedance

From the equations (1), (2) and (3), the following equations are derived.

$$I_{1F} = \frac{Z_2 + Z_0}{Z_1Z_2 + Z_1Z_0 + Z_2Z_0}(E_{1A} - E_{1B})$$

$$I_{2F} = \frac{-Z_0}{Z_1Z_2 + Z_1Z_0 + Z_2Z_0}(E_{1A} - E_{1B})$$

$$I_{0F} = \frac{-Z_2}{Z_1Z_2 + Z_1Z_0 + Z_2Z_0}(E_{1A} - E_{1B})$$

The magnitude of the fault current depends on the overall system impedance, difference in phase angle and magnitude between the power source voltages behind both ends.

Broken conductor protection element BCD detects series faults by measuring the ratio of negative to positive phase sequence currents (I_{2F} / I_{1F}). This ratio is given with negative and zero sequence impedance of the system:

$$\frac{I_{2F}}{I_{1F}} = \frac{|I_{2F}|}{|I_{1F}|} = \frac{Z_0}{Z_2 + Z_0}$$

The ratio is higher than 0.5 in a system when the zero sequence impedance is larger than the negative sequence impedance. It will approach 1.0 in a high-impedance earthed or a one-end earthed system.

The characteristic of BCD element is shown in Figure 2.1.55 to obtain the stable operation.

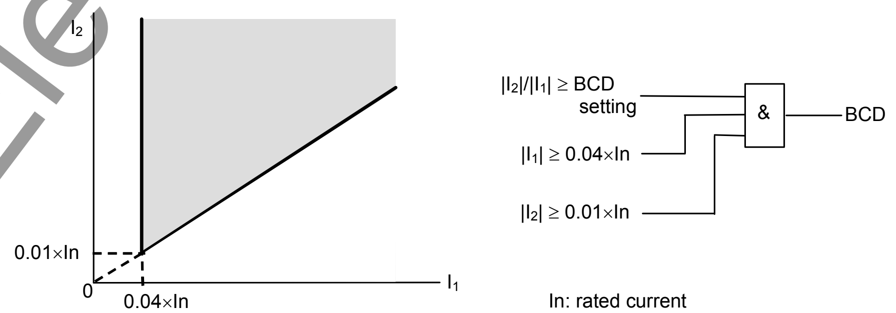

Figure 2.1.55 BCD Element Characteristic

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Scheme Logic

Figure 2.1.56 shows the scheme logic of the broken conductor protection. BCD element outputs trip signals BCD TRIP through a delayed pick-up timer TBCD.

The BCD protection can be disabled by the scheme switch [BCDEN] or PLC logic signal BCD BLOCK.

ICD is the inrush current detector ICD, which detects second harmonic inrush current during transformer energisation, and can block the BCD protection by the scheme switch [BCD-2F]. See Section 2.1.7.

The broken conductor protection is enabled when three-phase current is introduced and [APPL-CT] is set to "3P".

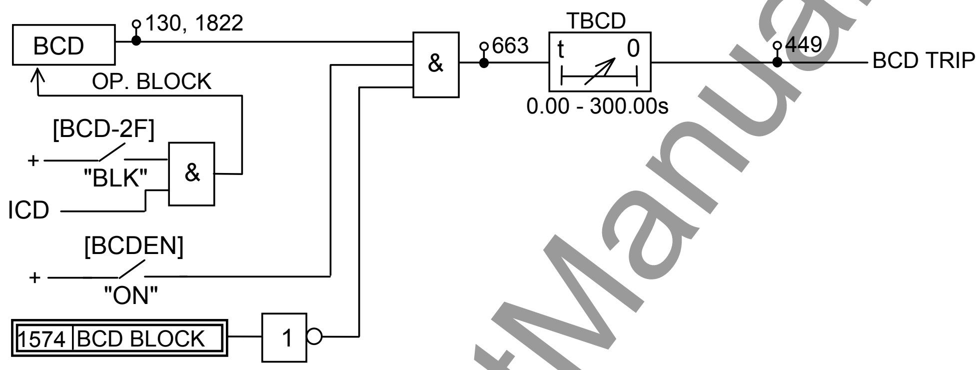

Figure 2.1.56 Broken Conductor Protection Scheme Logic

Settings

The table below shows the setting elements necessary for the broken conductor protection and their setting ranges.

Element	Range	Step	Default	Remarks
BCD	0.10 – 1.00	0.01	0.20	I_2 / I_1
TBCD	0.00 – 300.00s	0.01s	1.00 s	BCD definite time setting
[BCDEN]	Off / On		Off	BCD Enable
[BCD-2F]	NA / BLK		NA	Blocked by ICD
[APPL-CT]	3P / 2P / 1P		3P	Three-phase current input.

Minimum setting of the BC threshold is restricted by the negative phase sequence current normally present on the system. The ratio I_2 / I_1 of the system is measured in the relay continuously and displayed on the metering screen of the relay front panel, along with the maximum value of the last 15 minutes I_{21} max. It is recommended to check the display at the commissioning stage. The BCD setting should be 130 to 150% of I_2 / I_1 displayed.

Note: It must be noted that I_2 / I_1 is displayed only when the positive phase sequence current (or load current) in the secondary circuit is larger than 2 % of the rated secondary circuit current.

TBCD should be set to more than 1 cycle to prevent unwanted operation caused by a transient operation such as CB closing.

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2.1.6 Breaker Failure Protection

When fault clearance fails due to a breaker failure, the breaker failure protection (BFP) clears the fault by backtripping adjacent circuit breakers.

If the current continues to flow even after a trip command is output, the BFP judges it as a breaker failure. The existence of the current is detected by an overcurrent element CBF provided for each phase. For high-speed operation of the BFP, a high-speed reset overcurrent element is used. The CBF element resets when the current falls below 80% of the operating value as shown in Figure 2.1.57.

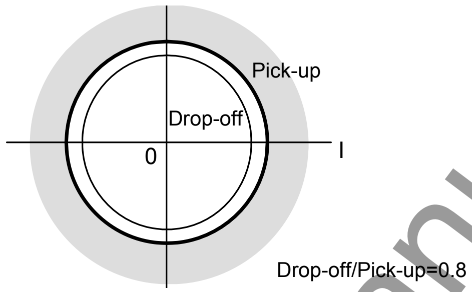

Figure 2.1.57 CBF element Characteristic

In order to prevent the BFP from starting by accident during maintenance work and testing, and thus tripping adjacent breakers, the BFP has the optional function of retripping the original breaker. To make sure that the breaker has actually failed, a trip command is made to the original breaker again before tripping the adjacent breakers to prevent unnecessary tripping of the adjacent breakers following the erroneous start-up of the BFP. It is possible to choose not to use retripping at all, or use retripping with trip command plus delayed pick-up timer, or retripping with trip command plus overcurrent detection plus delayed pick-up timer.

An overcurrent element and delayed pick-up timer are provided for each phase which also operate correctly during the breaker failure routine in the event of an evolving fault.

Scheme logic

The BFP initiation is performed on per-phase basis. Figure 2.1.58 shows the scheme logic for the BFP. The BFP can be initialized by the PLC logic signals [CBF_INIT-A] to [CBF_INIT-C] and [CBF_INIT]. The BFP can be disabled by the PLC logic signal [CBF_BLOCK].

The BFP is started by per-phase base trip signals or three-phase base trip signal as shown in Figure 2.1.58. These trip signals must continuously exist as long as the fault is present.

The backtripping signal to the adjacent breakers CBF TRIP is output if the overcurrent element CBF operates continuously for the setting time of the delayed pick-up timer TBTC after initiation. Tripping of adjacent breakers can be blocked with the scheme switch [BTC].

There are two kinds of modes of the retrip signal to the original breaker CBF RETRIP, the mode in which retrip is controlled by the overcurrent element CBF, and the direct trip mode in which retrip is not controlled. The retrip mode together with the trip block can be selected with the scheme switch [RTC].

Figure 2.1.59 shows a sequence diagram for the BFP when a retrip and backup trip are used. If the circuit breaker trips normally, the CBF is reset before timer TRTC or TBTC is picked up and the BFP is reset.

If the CBF continues to operate, a retrip command is given to the original breaker after the setting time of TRTC. Unless the breaker fails, the CBF is reset by retrip. TBTC does not time-out and the BFP is reset. This sequence of events may happen if the BFP is initiated by mistake and unnecessary tripping of the original breaker is unavoidable.

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If the original breaker fails, retrip has no effect and the CBF continues operating and the TBTC finally picks up. A trip command CBF TRIP is given to the adjacent breakers and the BFP is completed.

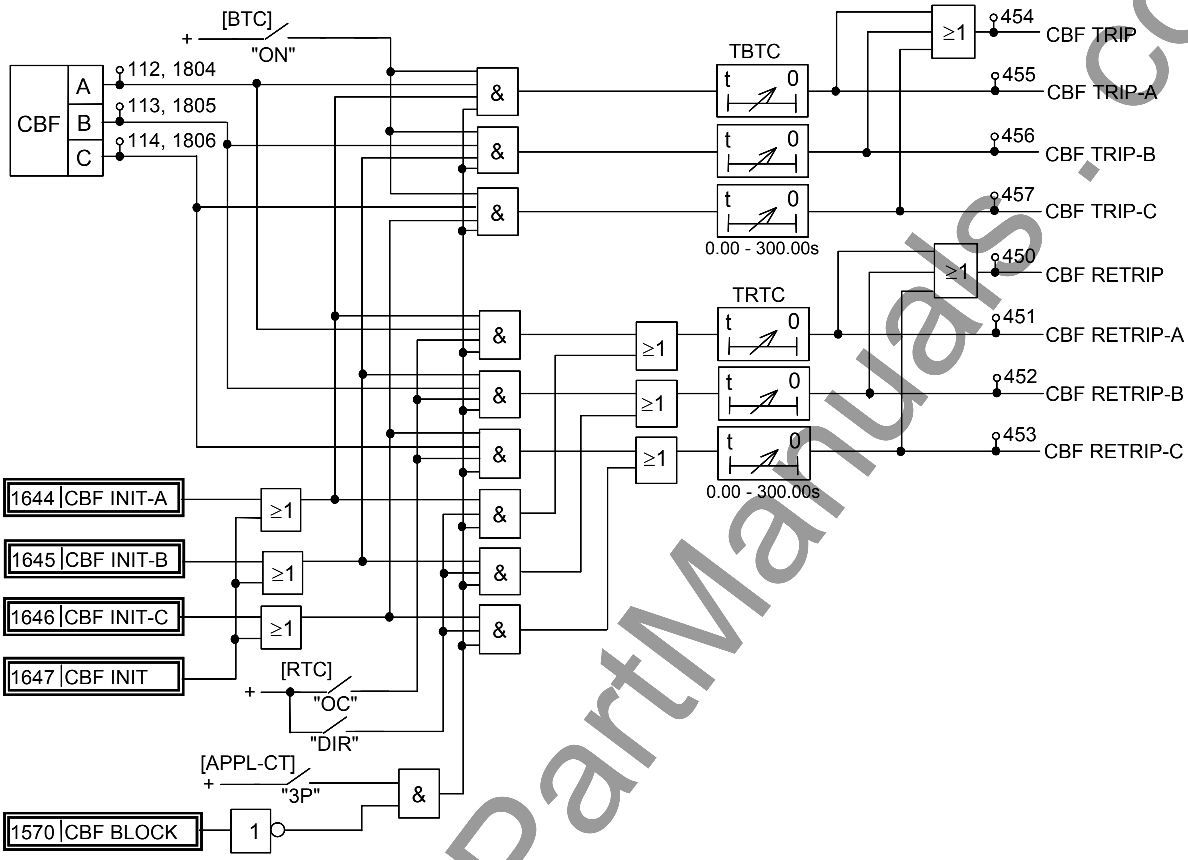

Figure 2.1.58 Breaker Failure Protection Scheme Logic

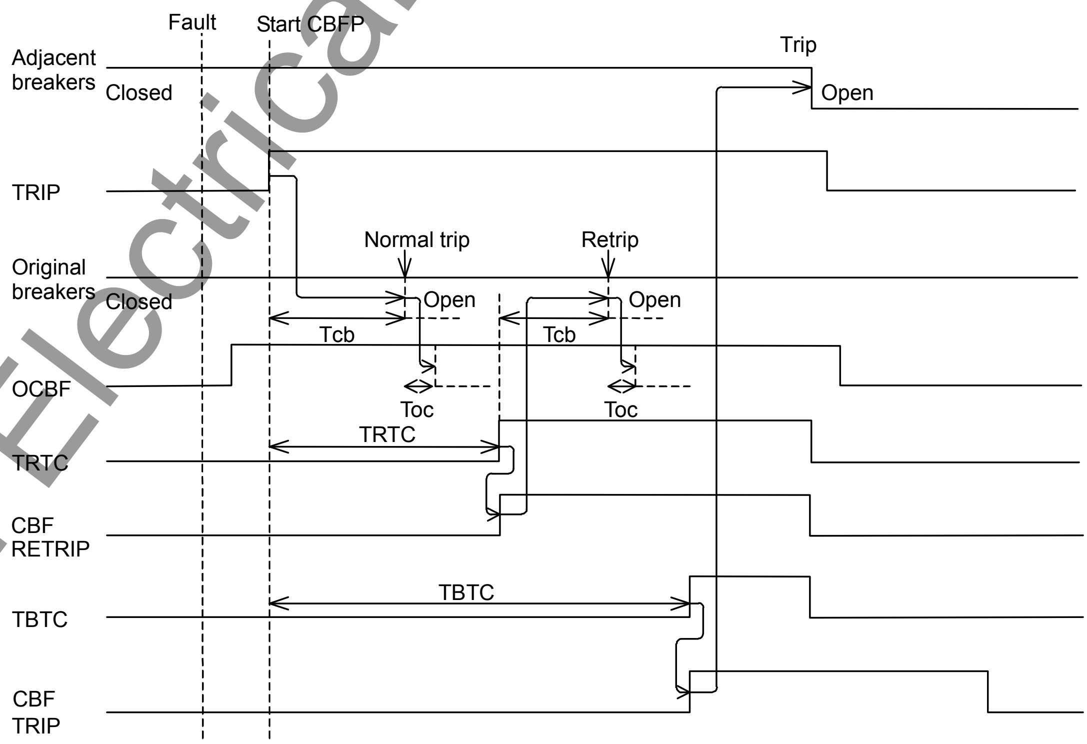

Figure 2.1.59 Sequence Diagram

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Setting

The setting elements necessary for the breaker failure protection and their setting ranges are as follows:

Element	Range	Step	Default	Remarks
CBF	0.5 – 10.0 A (0.10 - 2.00 A)(*)	0.1 A (0.01 A)	2.5 A (0.50 A)	Overcurrent setting
TRTC	0.00 – 300.00 s	0.01 s	0.40 s	Retrip time setting
TBTC	0.00 – 300.00 s	0.01 s	0.50 s	Back trip time setting
[RTC]	Off / DIR / OC		Off	Retrip control
[BTC]	Off / On		Off	Back trip control

(*) Current values shown in the parentheses are in the case of 1 A rating. Other current values are in the case of 5 A rating.

The overcurrent element CBF checks that the circuit breaker has opened and that the current has disappeared. Therefore, since it is allowed to respond to load current, it can be set to 10 to 200% of the rated current.

The settings of TRTC and TBTC are determined by the opening time of the original circuit breaker (Tcb in Figure 2.1.59) and the reset time of the overcurrent element (Toc in Figure 2.1.59). The timer setting example when using retrip can be obtained as follows.

Setting of TRTC = Breaker opening time + CBF reset time + Margin

= 40ms + 10ms + 20ms

= 70ms

Setting of TBTC = TCBF1 + Output relay operating time + Breaker opening time + CBF reset time + Margin

= 70ms + 10ms + 40ms + 10ms + 10ms

= 140ms

If retrip is not used, the setting of the TBTC can be the same as the setting of the TRTC.

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2.1.7 Countermeasures for Magnetising Inrush

GRD150 provides the following two schemes to prevent incorrect operation from a magnetising inrush current during transformer energisation.

- Protection block by inrush current detector
- Cold load protection

2.1.7.1 Inrush Current Detector

Inrush current detector ICD detects second harmonic inrush current during transformer energisation and blocks the following definite time overcurrent protections.

- OC1 to OC4
- DOC1 to DOC4
- EF1 to EF4
- DEF1 to DEF4
- SEF1 to SEF4
- DSEF1 to DSEF4
- NOC1 and NOC2
- DNOC1 and DNOC2
- BCD

The blocking can be enabled or disabled by setting the scheme switches [∗∗∗∗-2F].

The ICD detects the ratio ICD-2f between a second harmonic current I2f and a fundamental current I1f in each phase current, and outputs if its ratio is larger than the setting value. Figure 2.1.60 shows the characteristic of ICD element and Figure 2.1.61 shows ICD block scheme.

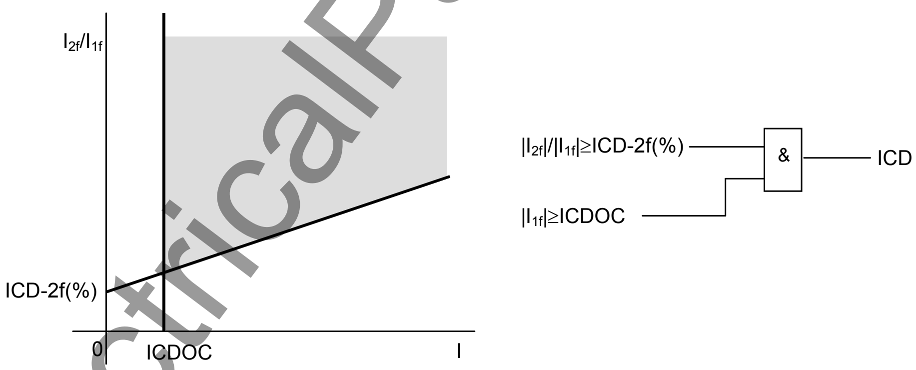

Figure 2.1.60 ICD Element Characteristic

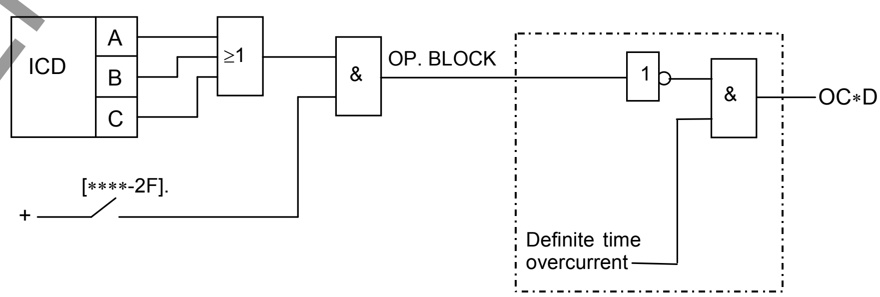

Figure 2.1.61 ICD Block Scheme

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Setting

The setting elements necessary for the ICD and their setting ranges are as follows:

Element	Range	Step	Default	Remarks
ICD-2f	10 – 50%	1%	15%	Second harmonic detection
ICDOC	0.5 – 25.0 A (0.10 - 2.00 A)(*)	0.1 A (0.01 A)	0.5 A (0.10 A)	ICD threshold setting

(*) Current values shown in the parentheses are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

2.1.7.2 Cold Load Protection

In normal operation, the load current on the distribution line is smaller than the sum of the rated loads connected to the line. But it amounts to several times the maximum load current for a moment when all of the loads are energised at once after a long interruption, and decreases to 1.5 times normal peak load after three or four seconds.

To protect those lines with overcurrent element, it is necessary to use settings to discriminate the inrush current in cold load restoration and the fault current.

This function modifies the overcurrent protection settings for a period after closing on to the type of load that takes a high level of load on energisation. This is achieved by a 'Cold Load Setting', in which the user can program alternative setting. Normally the user will choose higher current settings and/or longer time delays and/or disable elements altogether within this setting.

A state transition diagram and its scheme logic are shown in Figure 2.1.62 and Figure 2.1.63 for the cold load protection. Note that the scheme requires the use of two binary inputs assigned by PLC function, one each for CB OPEN and CB CLOSED.

Under normal conditions, where the circuit breaker has been closed for some time, the scheme is in STATE 0, and the normal default setting is applied to the overcurrent protection.

If the circuit breaker opens then the scheme moves to STATE 1 and runs the Cold Load Enable timer TCLE. If the breaker closes again while the timer is running, then STATE 0 is re-entered. Alternatively, if TCLE expires then the load is considered cold and the scheme moves to STATE 2, and stays there until the breaker closes, upon which it goes to STATE 3.

In STATE 2 and STATE 3, the 'Cold Load Setting' is applied.

In STATE 3 the Cold Load Reset timer TCLR runs. If the circuit breaker re-opens while the timer is running then the scheme returns to STATE 2. Alternatively, if TCLR expires then it goes to STATE 0, the load is considered warm and normal settings can again be applied.

Accelerated reset of the cold load protection is also possible. In STATE 3, the phase currents are monitored by overcurrent element ICLDO and if all phase currents drop below the ICLDO threshold for longer than the cold load drop off time (TCLDO) then the scheme automatically reverts to STATE 0. The accelerated reset function can be enabled with the scheme switch [CLDOEN] setting.

Cold load protection can be disabled by setting [CLEN] to "Off".

To test the cold load protection function, the switch [CLPTST] is provided to set the STATE 0 or STATE 3 condition forcibly.

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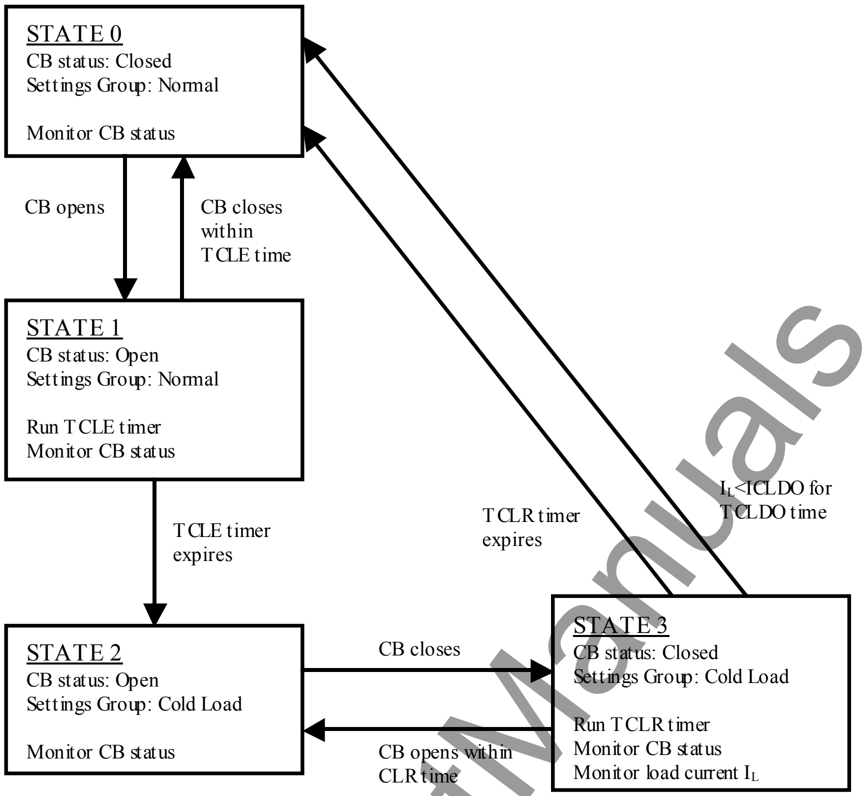

Figure 2.1.62 State Transition Diagram for Cold Load Protection

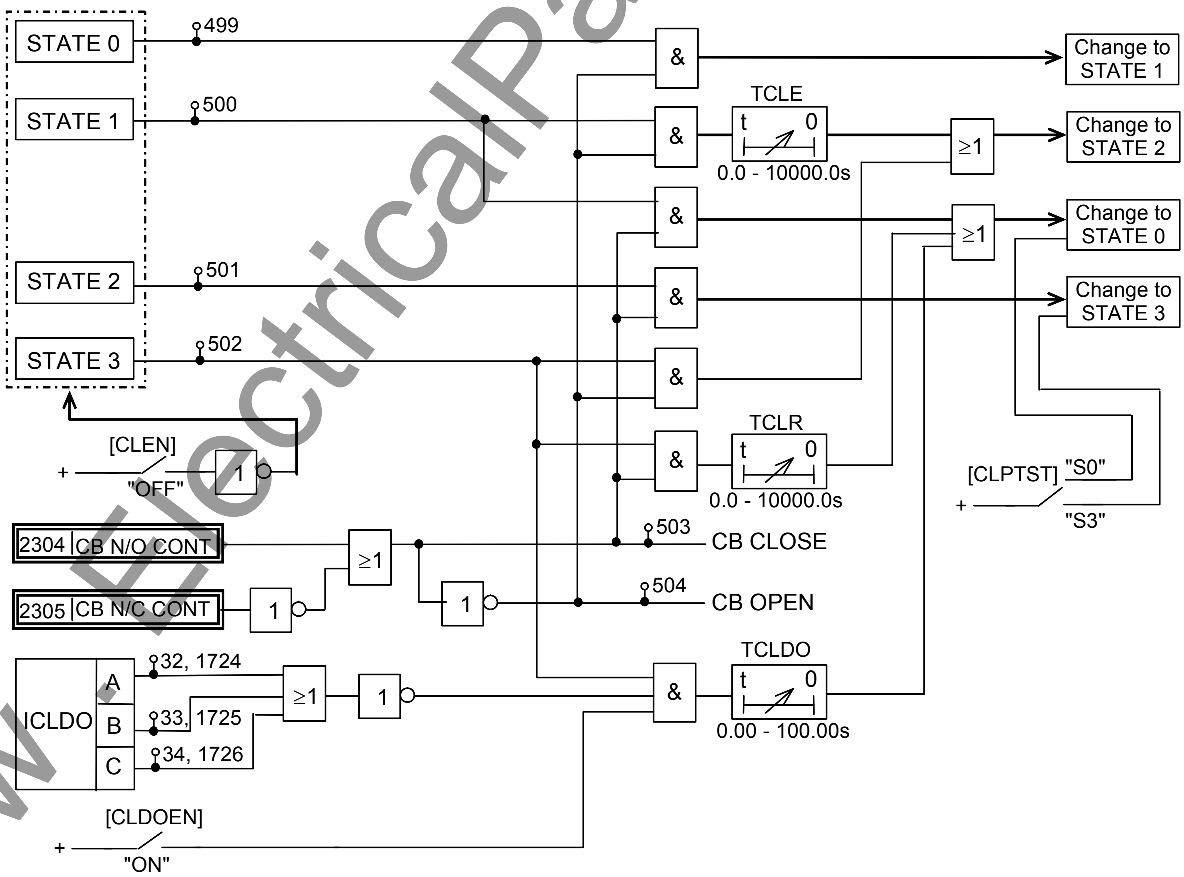

Figure 2.1.63 Scheme Logic for Cold Load Protection

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Setting

The setting elements necessary for the cold load protection and their setting ranges are as follows:

Element	Range	Step	Default	Remarks
ICLDO	0.5 – 10.0 A (0.10 - 2.00 A)(*)	0.1 A (0.01 A)	2.5 A (0.50 A)	Cold load drop-off threshold setting
TCLE	0-10000 s	1 s	100 s	Cold load enable timer
TCLR	0-10000 s	1 s	100 s	Cold load reset timer
TCLDO	0.00-100.00 s	0.01 s	0.00 s	Cold load drop-off timer
[CLEN]	Off / On		Off	Cold load protection enable
[CLDOEN]	Off / On		Off	Cold load drop-off enable

(*) Current values shown in the parentheses are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

Further, other element settings (OC1 to OC4, DOC1 to DOC4, EF1 to EF4, DEF1 to DEF4, SEF1 to SEF4, DSEF1 to DSEF4, NOC1, NOC2 DNOC1, DNOC2 and BCD) are required for the cold load protection.

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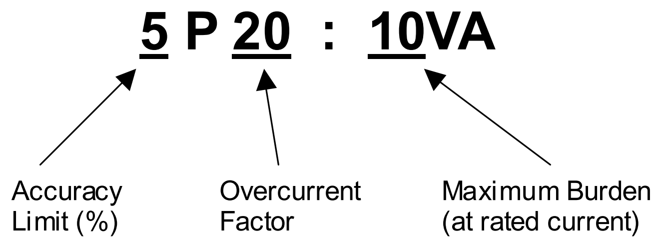
2.1.8 CT Requirements

2.1.8.1 Phase Fault and Earth Fault Protection

Protection class current transformers are normally specified in the form shown below. The CT transforms primary current within the specified accuracy limit, for primary current up to the overcurrent factor, when connected to a secondary circuit of the given burden.



Accuracy limit : Typically 5 or 10%. In applications where current grading is to be applied and small grading steps are desirable, then a 5% CT can assist in achieving the necessary accuracy. In less onerous applications, a limit of 10% may be acceptable.

Overcurrent factor : The multiple of the CT rating up to which the accuracy limit is claimed, typically 10 or 20 times. A value of 20 should be specified where maximum fault current is high and accurate inverse time grading is required. In applications where fault current is relatively low, or where inverse time grading is not used, then an overcurrent factor of 10 may be adequate.

Maximum burden : The total burden calculated at rated secondary current of all equipment connected to the CT secondary, including relay input burden, lead burden, and taking the CT's own secondary resistance into account. GRD150 has an extremely low AC current burden, typically less than 0.1VA for a 1A phase input, allowing relatively low burden CTs to be applied. Relay burden does not vary with settings.

If a burden lower than the maximum specified is connected, then the practical overcurrent factor may be scaled accordingly. For the example given above, at a rated current of 1A, the maximum value of CT secondary resistance plus secondary circuit resistance (RCT + R2) should be 10Ω. If a lower value of, say, (RCT + R2) = 5Ω is applied, then the practical overcurrent factor may be increased by a factor of two, that is, to 40A.

In summary, the example given of a 5P20 CT of suitable rated burden will meet most applications of high fault current and tight grading margins. Many less severe applications may be served by 5P10 or 10P10 transformers.

2.1.8.2 Minimum Knee Point Voltage

An alternative method of specifying a CT is to calculate the minimum knee point voltage, according to the secondary current which will flow during fault conditions:

$V_k \geq I_f (R_{CT} + R_2)$

where:

V_k = knee point voltage

I_f = maximum secondary fault current

R_{CT} = resistance of CT secondary winding

R_2 = secondary circuit resistance, including lead resistance.

When using this method, it should be noted that it is often not necessary to transform the maximum fault current accurately. The knee point should be chosen with consideration of the settings to be applied and the likely effect of any saturation on protection performance. Further,

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care should be taken when determining R2, as this is dependent on the method used to connect the CTs (E.g. residual connection, core balanced CT connection, etc).

2.1.8.3 Sensitive Earth Fault Protection

A core balance CT should be applied, with a minimum knee point calculated as described above.

2.1.8.4 Restricted Earth Fault Protection

High accuracy CTs should be selected with a knee point voltage Vk chosen according to the equation:

$$V_k \geq 2\times V_s$$

where Vs is the differential stability voltage setting for the scheme.

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2.2 Overvoltage and Undervoltage Protection

2.2.1 Phase Overvoltage Protection

GRD150 provides two independent phase overvoltage elements with programmable dropoff/pickup(DO/PU) ratio. OV1 is programmable for inverse time (IDMT) or definite time (DT) operation. OV2 has definite time characteristic only.

Note: OV1 element that has inverse time or definite time characteristics is discriminated with OV1-I or OV1-D respectively.

Figure 2.2.1 shows the characteristic of overvoltage elements.

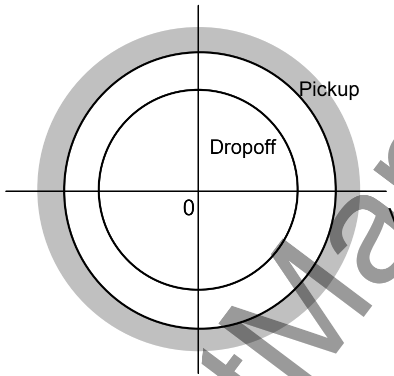

Figure 2.2.1 Characteristic of Overvoltage Elements

2.2.1.1 Inverse Time Overvoltage Protection

The inverse time overvoltage protection element OV1-I has the IDMT characteristic defined by equation (1):

$$t = TMS \times \left[\frac{1}{\left(V/Vs \right) - 1} \right] \qquad (1)$$

where:

t = operating time for constant voltage V (seconds),

V = energising voltage (V),

Vs = overvoltage setting (V),

TMS = time multiplier setting.

The IDMT characteristic is illustrated in Figure 2.2.2.

Definite time reset

The definite time resetting characteristic is applied to the OV1 element when the inverse time delay is used.

If definite time resetting is selected, and the delay period is set to instantaneous, then no intentional delay is added. As soon as the energising voltage falls below the reset threshold, the element returns to its reset condition.

If the delay period is set to some value in seconds, then an intentional delay is added to the reset period. If the energising voltage exceeds the setting for a transient period without causing tripping, then resetting is delayed for a user-definable period. When the energising voltage falls below the

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reset threshold, the integral state (the point towards operation that it has travelled) of the timing function (IDMT) is held for that period.

This does not apply following a trip operation, in which case resetting is always instantaneous.

The OV1 has a programmable dropoff/pickup(DO/PU) ratio.

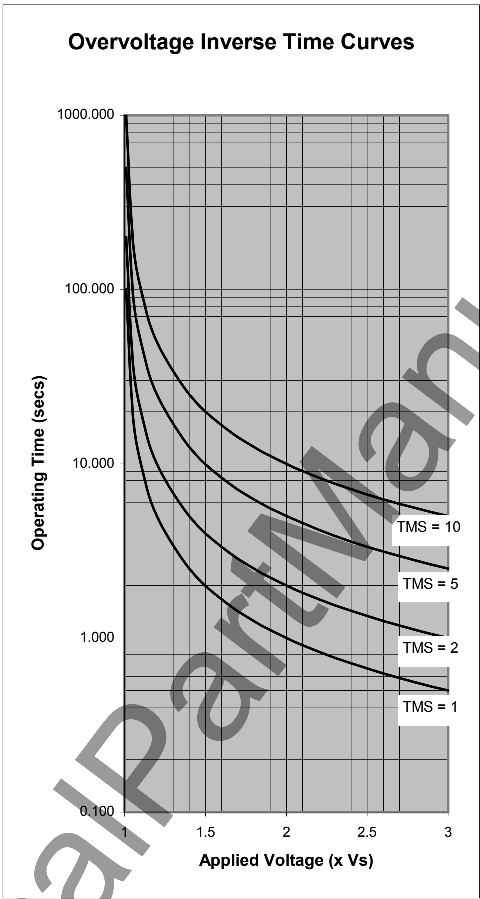

Figure 2.2.2 IDMT Characteristic

Scheme Logic

Figure 2.2.3 shows the scheme logic of the overvoltage protection with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [OV1EN] to "DT". Definite time element OV1-D is enabled for overvoltage protection, and trip signal OV1 TRIP is given through the delayed pick-up timer TOV1.

The inverse time protection is selected by setting [OV1EN] to "IDMT". Inverse time element OV1-I is enabled for overvoltage protection, and trip signal OV1 TRIP is given.

These protections can be disabled by the scheme switch [OV1EN] or PLC logic signal OV1 BLOCK.

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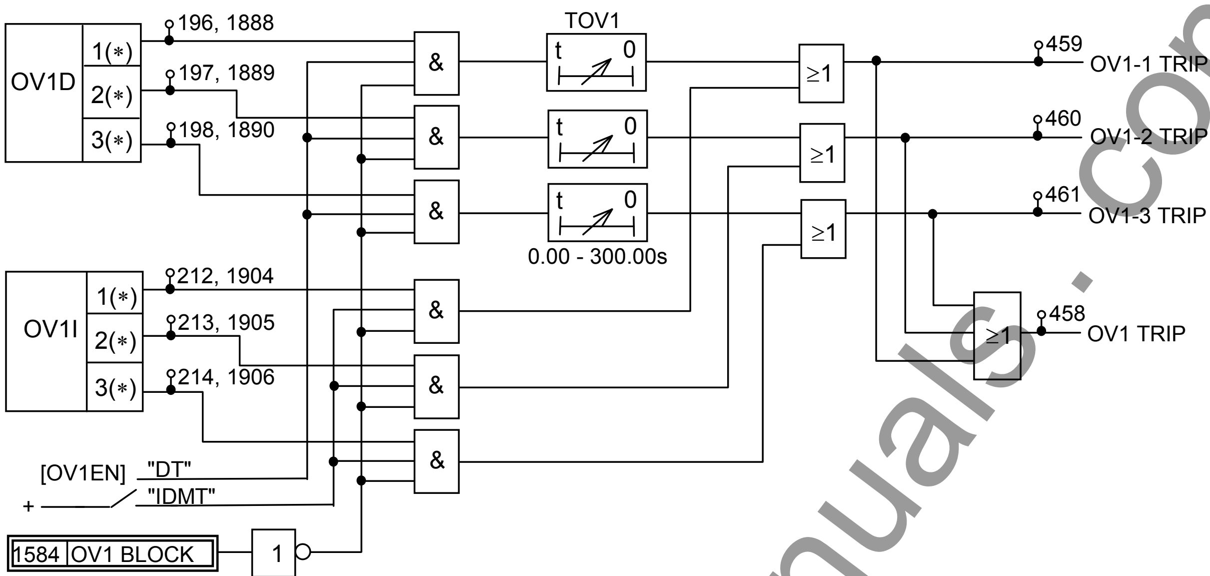

(∗)Note : Phases 1, 2 and 3 are replaced with the followings:

Phase	[APPL-VT] setting		
	2PP	3PN, 3PV	3PP
1	A - B phase	A phase	A - B phase
2	B - C phase	B phase	B - C phase
3	—	C phase	C - A phase

Figure 2.2.3 Overvoltage Protection (OV1)

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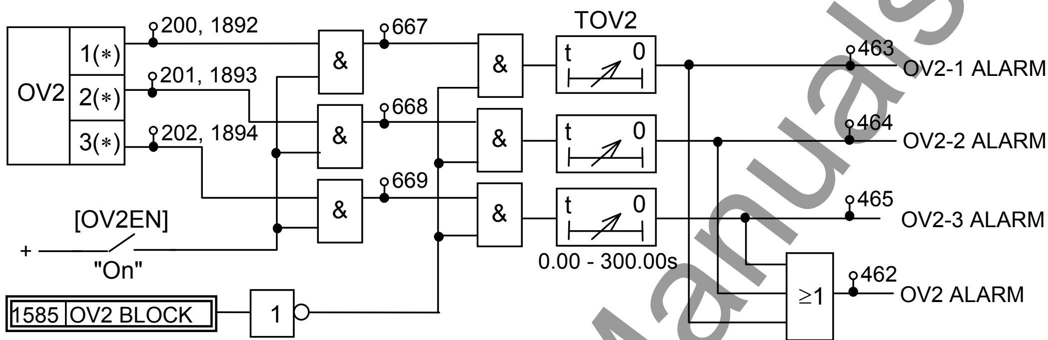
2.2.1.2 Definite Time Overvoltage Protection

OV2 element is used for definite time overvoltage protection.

This element has a programmable DO/PU ratio.

Scheme Logic

As shown in Figure 2.2.4, OV2 gives trip signal OV2 through delayed pick-up timer TOV2. The OV2 trip can be blocked by incorporated scheme switch [OV2EN] and PLC logic signal OV2 BLOCK.



(∗)**Note :** Phases 1, 2 and 3 are replaced with the followings:

Phase	[APPL-VT] setting		
	2PP	3PN, 3PV	3PP
1	A - B phase	A phase	A - B phase
2	B - C phase	B phase	B - C phase
3	—	C phase	C - A phase

Figure 2.2.4 Definite Time Overvoltage Protection (OV2, OV3)

2.2.1.3 Setting

The table shows the setting elements necessary for the overvoltage protection and their setting ranges.

Element	Range	Step	Default	Remarks
OV1	10.0 – 200.0 V	0.1 V	120.0 V	OV1-I and OV1-D threshold setting
TOV1P	0.05 – 100.00	0.01	1.00	OV1-I time multiplier setting. Required if [OV1EN] = IDMT.
TOV1D	0.00 – 300.00 s	0.01 s	1.00 s	OV1-D definite time setting. Required if [OV1EN] = DT.
TOV1R	0.0 – 300.0 s	0.1 s	0.0 s	OV1-I definite time delayed reset.
OV1DPR	10 – 98 %	1 %	95 %	OV1 DO/PU ratio setting.
OV2	10.0 – 200.0 V	0.1 V	140.0 V	OV2 threshold setting.
TOV2	0.00 – 300.00 s	0.01 s	1.00 s	OV2 definite time setting.
OV2DPR	10 - 98 %	1 %	95 %	OV2 DO/PU ratio setting.
[OV1EN]	Off / DT / IDMT		Off	OV1 Enable
[OV2EN]	Off / On		Off	OV2 Enable

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2.2.2 Phase Undervoltage Protection

GRD150 provides two independent phase undervoltage elements. UV1 programmable for inverse time (IDMT) or definite time (DT) operation. UV2 has definite time characteristic only.

Note: UV1 element that has inverse time or definite time characteristics is discriminated with UV1-I or UV1-D respectively.

Figure 2.2.5 shows the characteristic of undervoltage elements.

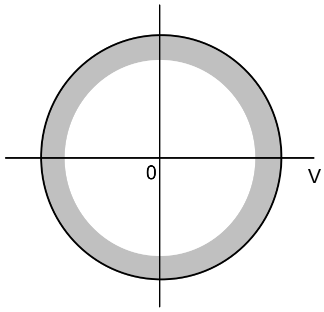

Figure 2.2.5 Characteristic of Undervoltage Elements

2.2.2.1 Inverse Time Undervoltage Protection

The inverse time undervoltage protection element UV1-I has the IDMT characteristic defined by equation (2):

$$t = TMS \times \left[\frac{1}{1 - \left(V / Vs \right)} \right] \qquad (2)$$

where:

t = operating time for constant voltage V (seconds),

V = energising voltage (V),

Vs = undervoltage setting (V),

TMS = time multiplier setting.

The IDMT characteristic is illustrated in Figure 2.2.6.

Definite time reset

The definite time resetting characteristic is applied to the UV1 element when the inverse time delay is used.

If definite time resetting is selected, and the delay period is set to instantaneous, then no intentional delay is added. As soon as the energising voltage rises above the reset threshold, the element returns to its reset condition.

If the delay period is set to some value in seconds, then an intentional delay is added to the reset period. If the energising voltage is below the undercurrent setting for a transient period without causing tripping, then resetting is delayed for a user-definable period. When the energising voltage rises above the reset threshold, the integral state (the point towards operation that it has travelled) of the timing function (IDMT) is held for that period.

This does not apply following a trip operation, in which case resetting is always instantaneous.

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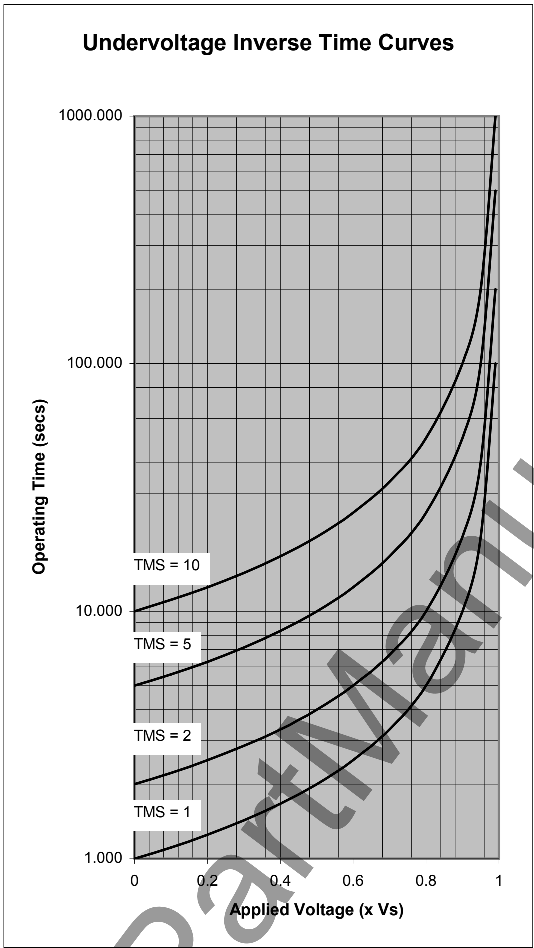

Figure 2.2.6 IDMT Characteristic

Scheme Logic

Figure 2.2.7 shows the scheme logic of the undervoltage protection with selective definite time or inverse time characteristic.

The definite time protection is selected by setting [UV1EN] to "DT". Definite time element UV1-D is enabled for undervoltage protection, and trip signal UV1 TRIP is given through the delayed pick-up timer TUV1.

The inverse time protection is selected by setting [UV1EN] to "IDMT". Inverse time element UV1-I is enabled for undervoltage protection, and trip signal UV1 TRIP is given.

These protections can be disabled by the scheme switch [UV1EN] or PLC logic signal UV1 BLOCK.

In addition, there is a user programmable voltage threshold VBLK. If all measured phase voltages drop below this setting, then the undervoltage protection is prevented from operating. This function can be blocked by the scheme switch [VBLKEN]. The [VBLKEN] should be set to "OFF" (no use) when the UV elements are used as fault detectors, and set to "ON" (use) when used for load shedding.

Note: The VBLK must be set lower than any other UV setting values.

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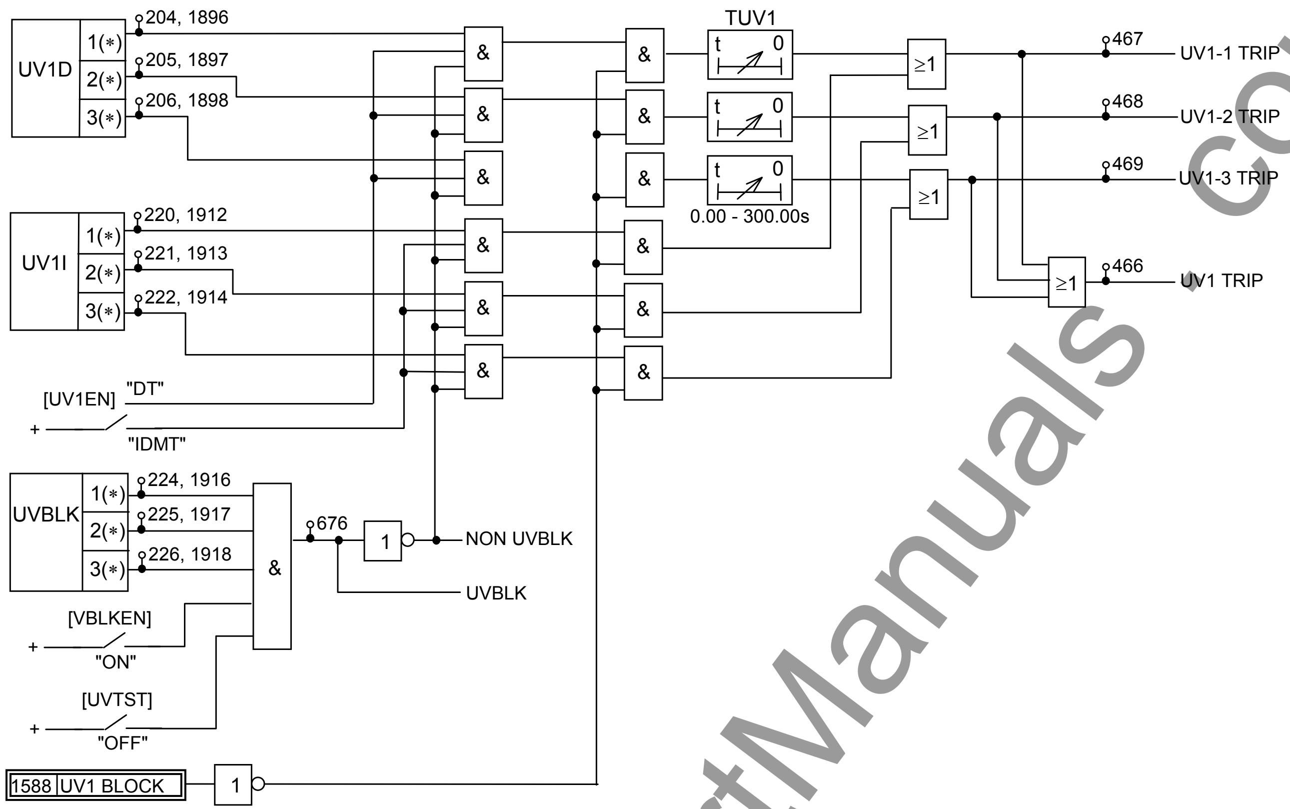

(∗)Note : Phases 1, 2 and 3 are replaced with the followings:

Phase	[APPL-VT] setting		
	2PP	3PN, 3PV	3PP
1	A - B phase	A phase	A - B phase
2	B - C phase	B phase	B - C phase
3	—	C phase	C - A phase

Figure 2.2.7 Undervoltage Protection (UV1)

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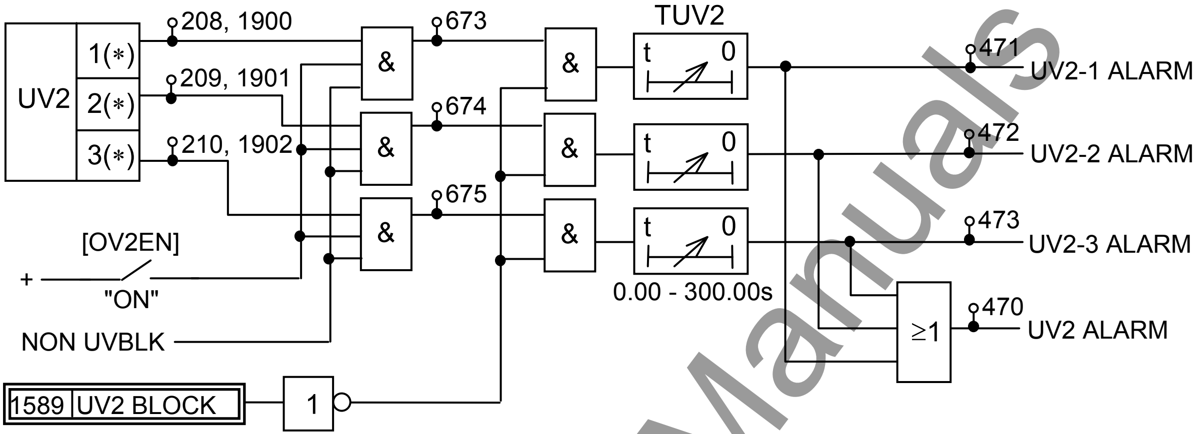
2.2.2.2 Definite Time Undervoltage Protection

UV2 element is used for definite time undervoltage protection.

Scheme Logic

As shown in Figure 2.2.8, UV2 gives trip signal UV2 through delayed pick-up timer TUV2. The UV2 trip can be blocked by incorporated scheme switch [UV2EN] and PLC logic signal UV2 BLOCK.



(∗)Note : Phases 1, 2 and 3 are replaced with the followings:

Phase	[APPL-VT] setting		
	2PP	3PN, 3PV	3PP
1	A - B phase	A phase	A - B phase
2	B - C phase	B phase	B - C phase
3	—	C phase	C - A phase

Figure 2.2.8 Definite Time Undervoltage Protection (UV2)

2.2.2.3 Setting

The table shows the setting elements necessary for the undervoltage protection and their setting ranges.

Element	Range	Step	Default	Remarks
UV1	5.0 – 130.0 V	0.1 V	60.0 V	UV1 threshold setting
TUV1P	0.05– 100.00	0.01	1.00	UVI-I time multiplier setting. Required if [UV1EN] = IDMT.
TUV1D	0.00 – 300.00 s	0.01 s	1.00 s	UV1-D definite time setting. Required if [UV1EN] = DT.
TUV1R	0.0 – 300.0 s	0.1 s	0.0 s	UV1-I definite time delayed reset.
UV2	5.0 – 130.0 V	0.1 V	40.0 V	UV2 threshold setting.
TUV2	0.00 – 300.00 s	0.01 s	1.00 s	UV2 definite time setting.
VBLK	5.0 - 20.0 V	0.1 V	10.0 V	Undervoltage block threshold setting.
[UV1EN]	Off / DT / IDMT		DT	UV1 Enable
[VBLKEN]	Off / On		Off	UV block Enable
[UV2EN]	Off / On		Off	UV2 Enable

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2.2.3 Zero Phase Sequence Overvoltage Protection

The zero phase sequence overvoltage protection is applied to earth fault detection on unearthed, resistance-earthed system or on ac generators.

The zero phase sequence overvoltage (ZOV) element is available for the following models and their [APPL-VT] settings:

Model	100 and 200 series				300 and 400 series		
[APPL-VT] setting	3PN	3PV	3PP	2PP	3PN	3PP	2PP
ZOV	✓(∗1)	✓(∗2)	✓(∗2)	✓(∗2)	✓(∗1)	—	—

Note: (∗1) V_0 is calculated from the three measured phase voltages.
(∗2) V_0 is measured directly in the form of the system residual voltage.

The low voltage settings which may be applied make the ZOV element susceptible to any 3rd harmonic component which may be superimposed on the input signal. Therefore, a 3rd harmonic filter is provided to suppress such superimposed components.

For the earth fault detection, following two methods are in general use.

- Measuring the zero sequence voltage produced by VT residual connection (broken-delta connection) as shown in Figure 2.2.9.
- Measuring the residual voltage across the earthing transformers as shown in Figure 2.2.10.

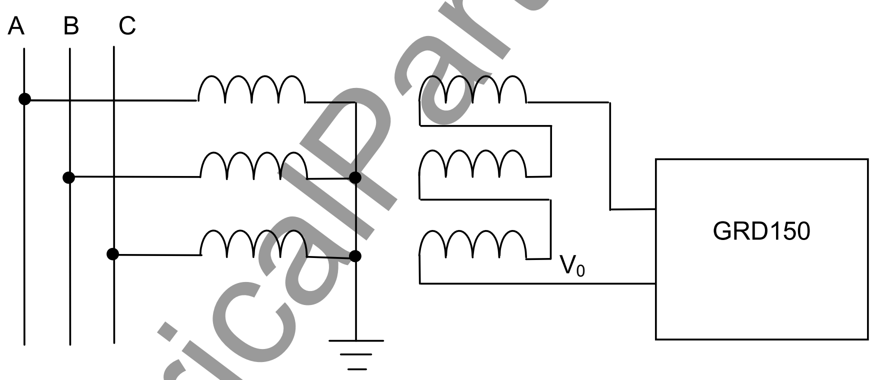

Figure 2.2.9 Earth Fault Detection on Unearthed System

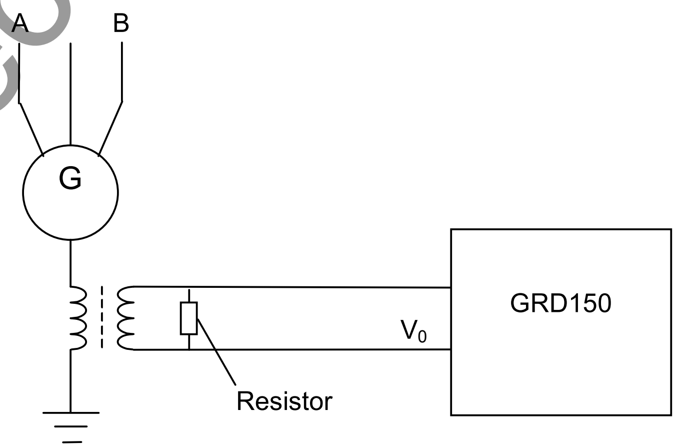

Figure 2.2.10 Earth Fault Detection on Generator

Two independent elements ZOV1 and ZOV2 are provided. The ZOV1 element is programmable for definite time delayed or inverse time delayed (IDMT) operation, and the ZOV2 element for definite time delayed operation only.

The inverse time characteristic is defined by equation (3).

$$t = TMS \times \left[\frac{1}{\left(V_0 / V_s \right) - 1} \right] \qquad (3)$$

where:

t = operating time for constant voltage V_0 (seconds),

V_0 = Zero sequence voltage (V),

Vs = Zero sequence overvoltage setting (V),

TMS = time multiplier setting.

The IDMT characteristic is illustrated in Figure 2.2.11.

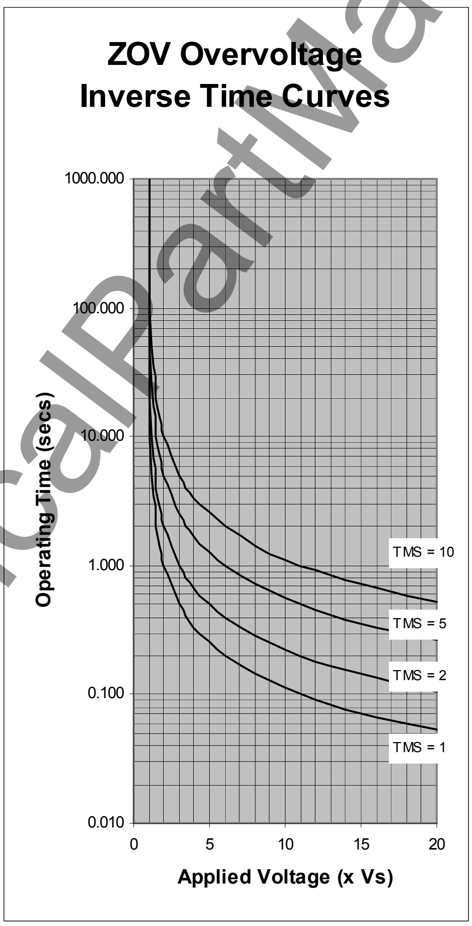

Figure 2.2.11 IDMT Characteristic of ZOV

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Definite time reset

A definite time reset characteristic is applied to the ZOV1 element when the inverse time delay is used. Its operation is identical to that for the phase overvoltage protection.

Scheme Logic

Figure 2.2.12 shows the scheme logic of the zero sequence overvoltage protection. Two negative sequence overvoltage elements ZOV1 and ZOV2 with independent thresholds output trip signals ZOV1 TRIP and ZOV2 TRIP through delayed pick-up timers TZOV1 and TZOV2.

The tripping can be disabled by the scheme switches [ZOV1EN] and [ZOV2EN] or PLC logic signals ZOV1 BLOCK and ZOV2 BLOCK.

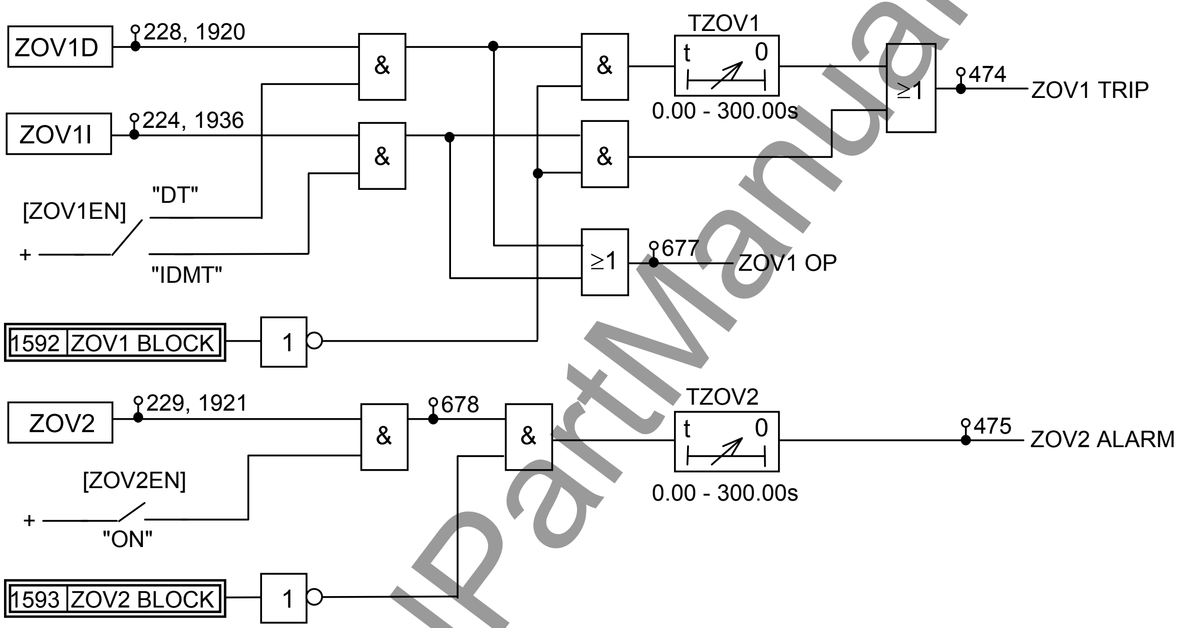

Figure 2.2.12 Zero Sequence Overvoltage Protection

Setting

The table below shows the setting elements necessary for the zero sequence overvoltage protection and their setting ranges.

Element	Range	Step	Default	Remarks
ZOV1	5.0 - 130.0 V	0.1V	20.0 V	ZOV1 threshold setting (V_0) for tripping.
ZOV2	5.0 - 130.0 V	0.1V	40.0 V	ZOV2 threshold setting (V_0) for alarming.
TZOV1P	0.05 – 100.00	0.01	1.00	ZOV1-I time multiplier setting. Required if [ZOV1EN]=IDMT.
TZOV1D	0.00 – 300.00 s	0.01 s	1.00 s	ZOV1-D definite time setting. Required if [ZOV1EN]=DT.
TZOV1R	0.0 – 300.0 s	0.1 s	0.0 s	ZOV1-I definite time delayed reset.
TZOV2	0.00 – 300.00 s	0.01 s	1.00 s	ZOV2 definite time setting
[ZOV1EN]	Off / DT/IDMT		DT	ZOV1 Enable
[ZOV2EN]	Off / On		Off	ZOV2 Enable

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2.2.4 Negative Phase Sequence Overvoltage Protection

The negative phase sequence overvoltage protection is used to detect voltage unbalance conditions such as reverse-phase rotation, unbalanced voltage supplying etc.

The NOV protection is applied to protect three-phase motors from the damage which may be caused by the voltage unbalance. Unbalanced voltage supply to motors due to a phase loss can lead to increases in the negative sequence voltage.

The NOV protection is also applied to prevent the starting of the motor in the wrong direction, if the phase sequence is reversed.

Two independent elements NOV1 and NOV2 are provided. The NOV1 element is programmable for definite time delayed or inverse time delayed (IDMT) operation, and the NOV2 element for definite time delayed operation only.

The inverse time characteristic is defined by equation (4).

$$t = TMS \times \left[\frac{1}{\left(V_2 / V_S \right) - 1} \right] \qquad (4)$$

where:

t = operating time for constant voltage V_2 (seconds),

V_2 = Negative sequence voltage (V),

Vs = Negative sequence overvoltage setting (V),

TMS = time multiplier setting.

The IDMT characteristic is illustrated in Figure 2.2.13.

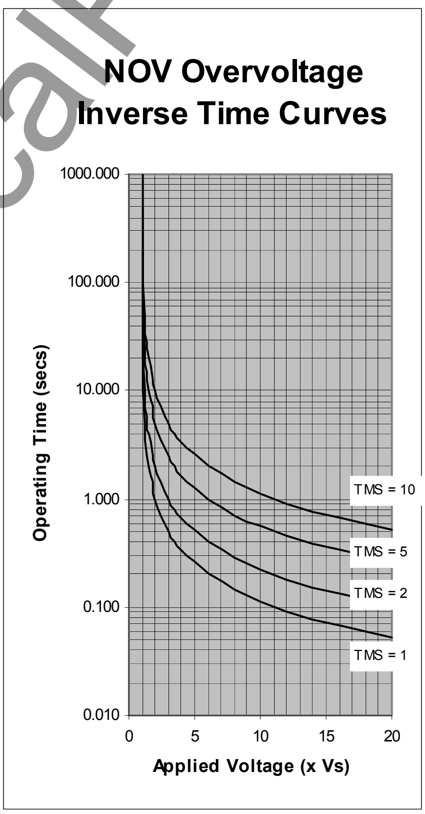

Figure 2.2.13 IDMT Characteristic of NOV

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Definite time reset

A definite time reset characteristic is applied to the NOV1 element when the inverse time delay is used. Its operation is identical to that for the phase overvoltage protection.

Scheme Logic

Figure 2.2.14 shows the scheme logic of the negative sequence overvoltage protection. Two negative sequence overvoltage elements NOV1 and NOV2 with independent thresholds output trip signals NOV1 TRIP and NOV2 TRIP through delayed pick-up timers TNOV1 and TNOV2.

The tripping can be disabled by the scheme switches [NOV1EN] and [NOV2EN] or PLC logic signals NOV1 BLOCK and NOV2 BLOCK.

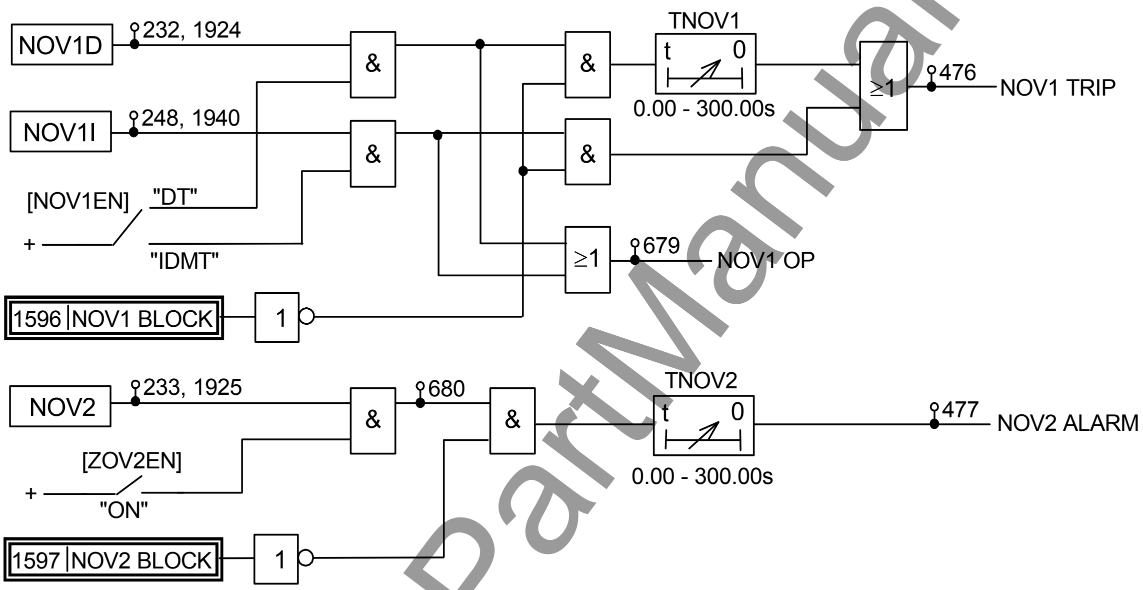

Figure 2.2.14 Negative Sequence Overvoltage Protection

Settings

The table below shows the setting elements necessary for the negative sequence overvoltage protection and their setting ranges.

Element	Range	Step	Default	Remarks
NOV1	5.0 - 130.0 V	0.1V	20.0 V	NOV1 threshold setting for tripping.
NOV2	5.0 - 130.0 V	0.1V	40.0 V	NOV2 threshold setting for alarming.
TNOV1P	0.05 – 100.00	0.01	1.00	NOV1-I time multiplier setting. Required if [NOV1EN]=IDMT.
TNOV1D	0.00 – 300.00 s	0.01 s	1.00 s	NOV1-D definite time setting. Required if [NOV1EN]=DT.
TNOV1R	0.0 – 300.0 s	0.1 s	0.0 s	NOV1-I definite time delayed reset.
TNOV2	0.00 – 300.00 s	0.01 s	1.00 s	NOV2 definite time setting
[NOV1EN]	Off / DT/IDMT		Off	NOV1 Enable
[NOV2EN]	Off / On		Off	NOV2 Enable

The delay time setting TNOV1 and TNOV2 is added to the inherent delay of the measuring elements NOV1 and NOV2. The minimum operating time of the NOV elements is around 200ms.

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2.3 Frequency Protection

For a six-stage frequency protection, GRD150 incorporates dedicated frequency measuring elements and scheme logic for each stage. Each stage is programmable for underfrequency, overfrequency or frequency rate-of-change protection.

Underfrequency protection is provided to maintain the balance between the power generation capability and the loads. It is also used to maintain the frequency within the normal range by load shedding.

Overfrequency protection is provided to protect synchronous machines from possible damage due to overfrequency conditions.

Frequency rate of change protection is applied to ensure that load shedding occurs very quickly when the frequency change is very rapid.

A-phase to B-phase voltage is used to detect frequency.

Frequency element

Underfrequency element UF operates when a power system frequency stays under the setting value.

Overfrequency element OF operates when a power system frequency stays over the setting value.

These elements measure the frequency and check the underfrequency or overfrequency every 5 ms. They operate when the underfrequency or overfrequency condition is detected 16 consecutive times.

Both UF and OF elements output is invalidated by undervoltage block element (FVBLK) operation during undervoltage condition.

Figure 2.3.1 shows characteristics of UF and OF elements.

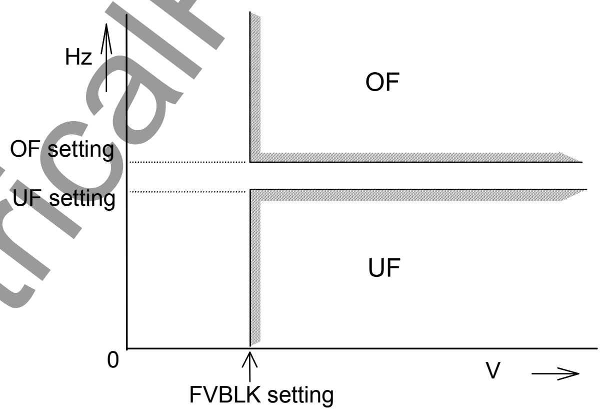

Figure 2.3.1 Underfrequency and Overfrequency Element

Frequency rate-of-change element

The frequency rate-of-change element calculates the gradient of frequency change (df/dt). GRD150 provides two rate-of-change elements, a frequency decay rate element (D) and a frequency rise rate element (R). These elements measure the change in frequency (Δf) over a time interval (Δt=100ms), as shown Figure 2.3.2 and calculate the $\Delta f/\Delta t$ every 5 ms. They operate when the frequency change exceeds the setting value 50 consecutive times.

Both D and R elements output is invalidated by undervoltage block element (FVBLK) operation during undervoltage condition.

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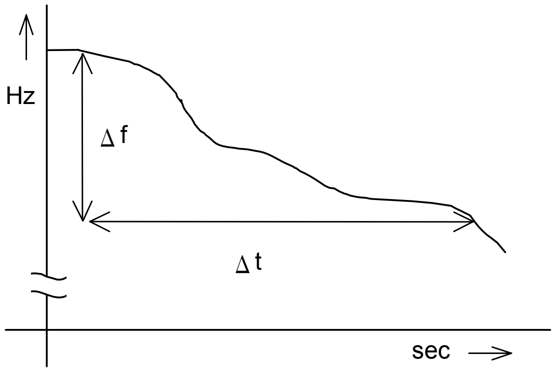

Figure 2.3.2 Frequency Rate-of-Change Element

Scheme Logic

Figure 2.3.3 shows the scheme logic of frequency protection in stage 1. The frequency element FRQ1 can output a trip command under the condition that the system voltage is higher than the setting of the undervoltage element FVBLK (FVBLK=1). The FRQ1 element is programmable for underfrequency or overfrequency operation by the scheme switch [FRQ1EN].

The tripping can be disabled by the scheme switches [FRQ1EN] or PLC logic signal FRQ1 BLOCK.

The stage 2 (FRQ2) to stage 6 (FRQ6) are the same logic of FRQ1.

Figure 2.3.4 shows the scheme logic of frequency rate-of-change protection in stage 1. The frequency rate-of-change element DFRQ1 can output a trip command under the condition that the system voltage is higher than the setting of the undervoltage element FVBLK (FVBLK=1). The DFRQ1 element is programmable for frequency decay rate or frequency rise rate operation by the scheme switch [DFRQ1EN].

The tripping can be disabled by the scheme switches [DFRQ1EN] or PLC logic signal DFRQ1 BLOCK.

The stage 2 (DFRQ2) to stage 6 (DFRQ6) are the same logic of DFRQ1.

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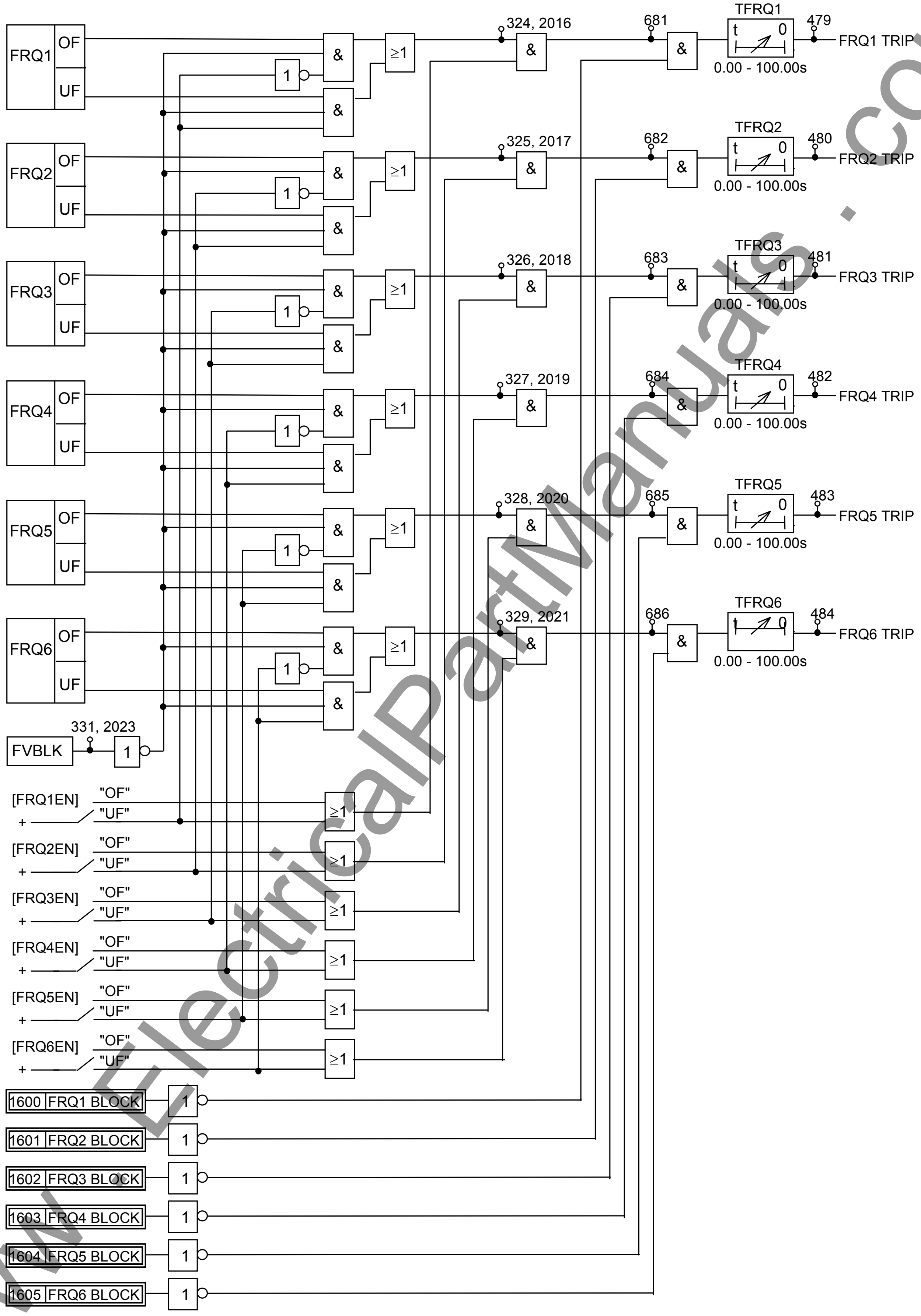

Figure 2.3.3 Scheme Logic of Frequency Protection

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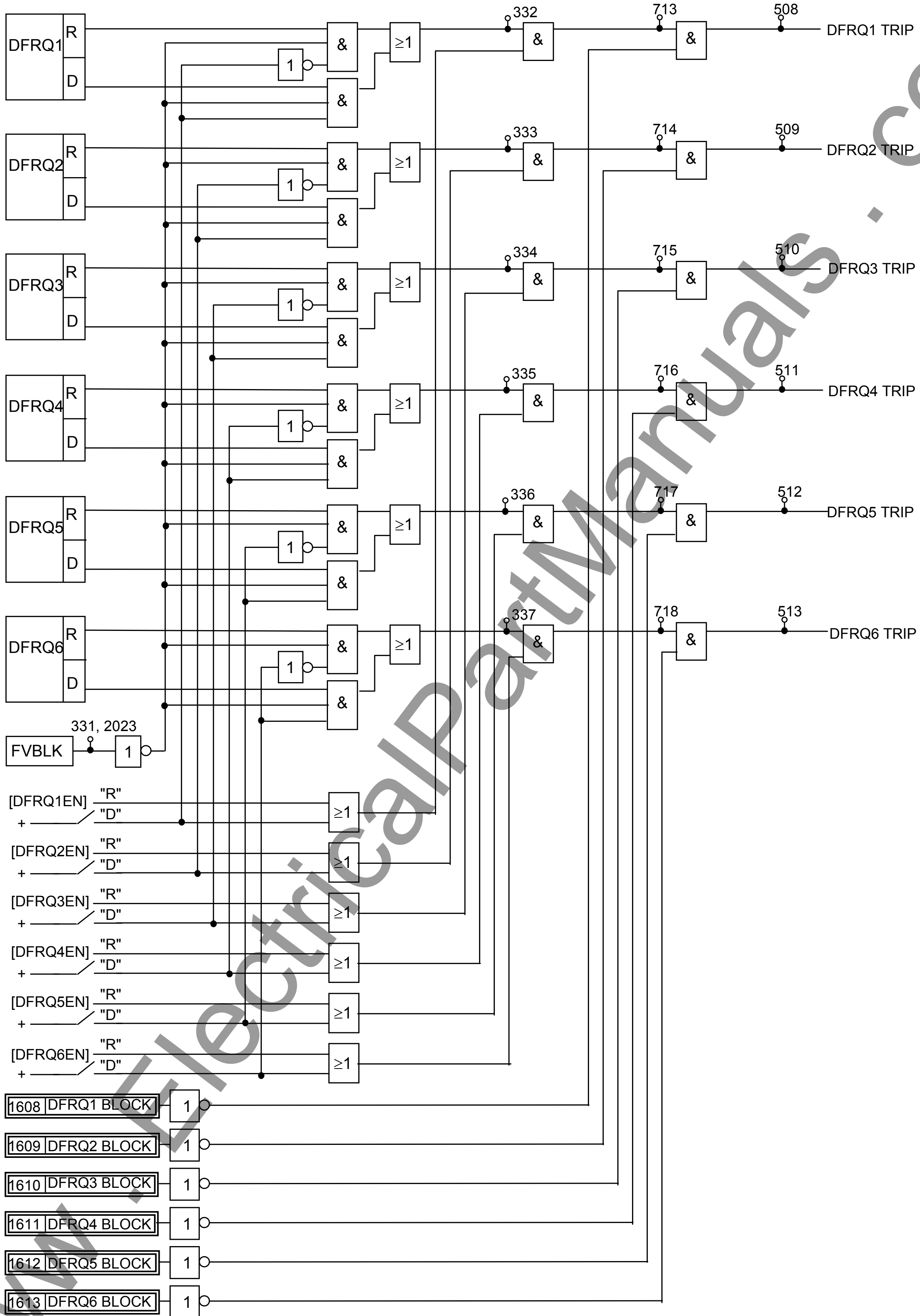

Figure 2.3.4 Scheme Logic of Frequency Rate-of-change Protection

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Setting

The setting elements necessary for the frequency protection and their setting ranges are shown in the table below.

Element	Range	Step	Default	Remarks
FRQ1	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ1 frequency element setting
TFRQ1	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ1
FRQ2	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ2 frequency element setting
TFRQ2	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ2
FRQ3	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ3 frequency element setting
TFRQ3	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ3
FRQ4	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ4 frequency element setting
TFRQ4	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ4
FRQ5	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ5 frequency element setting
TFRQ5	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ5
FRQ6	25.00 – 75.00 Hz	0.01 Hz	49.00 Hz	FRQ6 frequency element setting
TFRQ6	0.00 – 300.00 s	0.01 s	1.00 s	Timer setting of FRQ6
DFRQ1	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ1 element setting
DFRQ2	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ2 element setting
DFRQ3	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ3 element setting
DFRQ4	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ4 element setting
DFRQ5	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ5 element setting
DFRQ6	0.1 – 15.0 Hz/s	0.1 Hz/s	0.5 Hz/s	DFRQ6 element setting
FVBLK	40.0 – 100.0 V	0.1 V	40.0 V	UV block setting
FRQ1EN	Off / OF / UF		Off	FRQ1 Enable
FRQ2EN	Off / OF / UF		Off	FRQ2 Enable
FRQ3EN	Off / OF / UF		Off	FRQ3 Enable
FRQ4EN	Off / OF / UF		Off	FRQ4 Enable
FRQ5EN	Off / OF / UF		Off	FRQ5 Enable
FRQ6EN	Off / OF / UF		Off	FRQ6 Enable
DFRQ1EN	Off / R / D		Off	DFRQ1 Enable
DFRQ2EN	Off / R / D		Off	DFRQ2 Enable
DFRQ3EN	Off / R / D		Off	DFRQ3 Enable
DFRQ4EN	Off / R / D		Off	DFRQ4 Enable
DFRQ5EN	Off / R / D		Off	DFRQ5 Enable
DFRQ6EN	Off / R / D		Off	DFRQ6 Enable

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2.4 Trip Signal Output

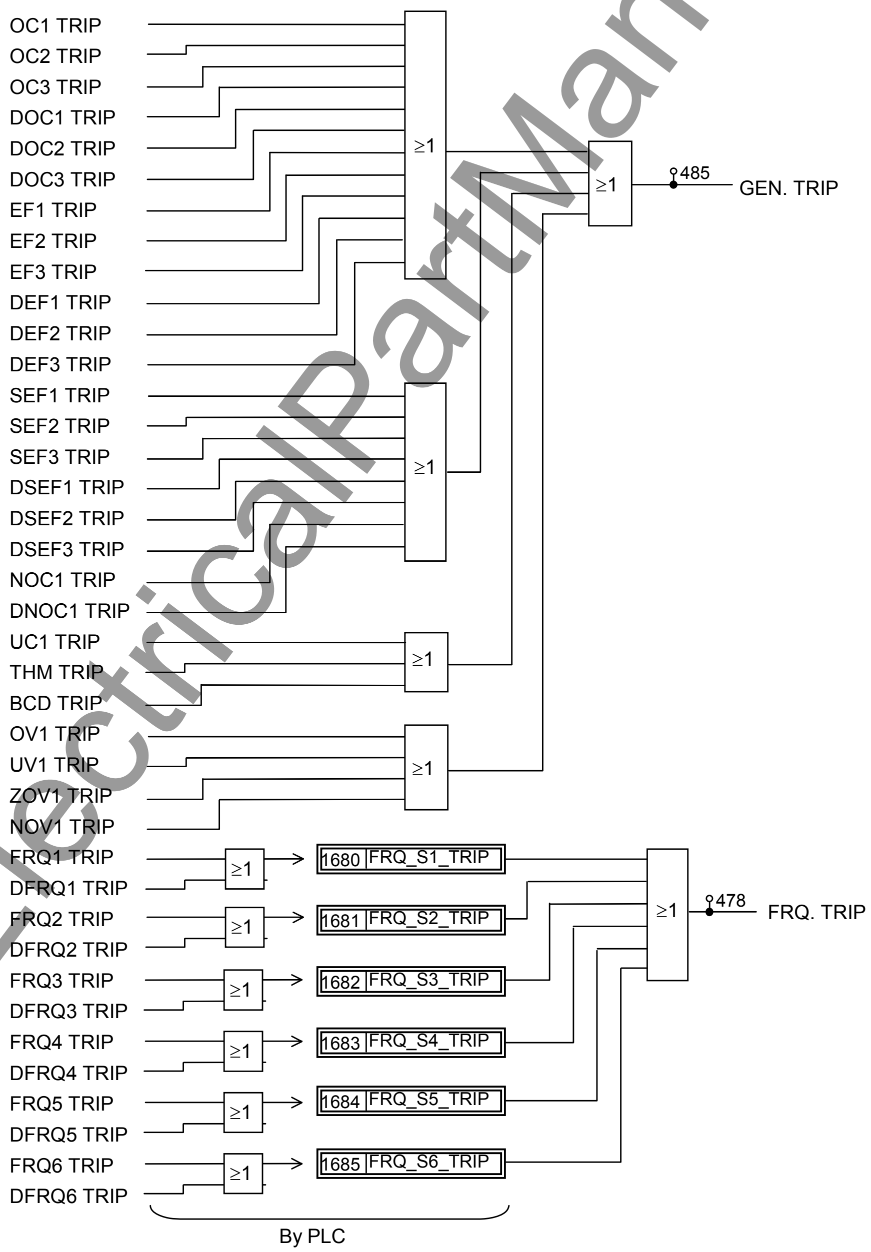
GRD150 provides various trip and alarm signal outputs such as three-phase and single-phase trip and alarm of each protection. Figures 2.4.1 to 2.4.3 show gathered trip and alarm signals of each protection.

GRD150 provides 8 to 32 auxiliary relays for binary outputs as described in Section 3.2. These auxiliary relays can be assigned to any protection outputs by PLC function. (Refer to Section 2.7.)

After the trip signal disappears by clearing the fault, the reset time of the tripping output relay can be programmed by PLC function. The setting is respective for each output relay.

When the relay is latched, it can be reset with the RESET key on the relay front panel or a binary input by PLC signal. This resetting resets all the output relays collectively.

In the tripping output relay, it must be checked that the tripping circuit is opened with a circuit breaker auxiliary contact prior to the tripping output relay resetting, in order to prevent the tripping output relay from directly interrupting the circuit breaker tripping coil current.



2.4.1 Three-phase Tripping Output

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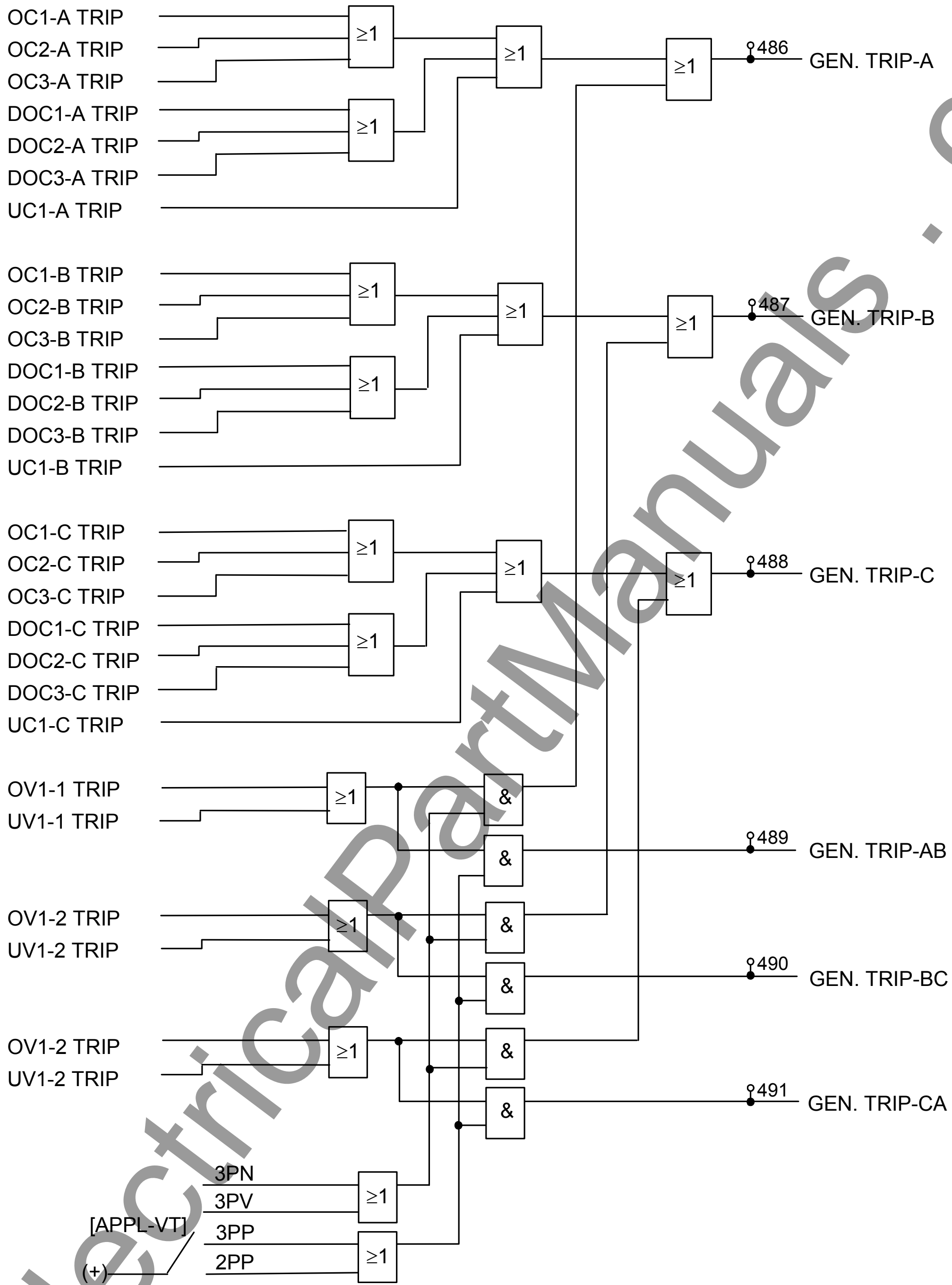

Figure 2.4.2 Single-phase Tripping

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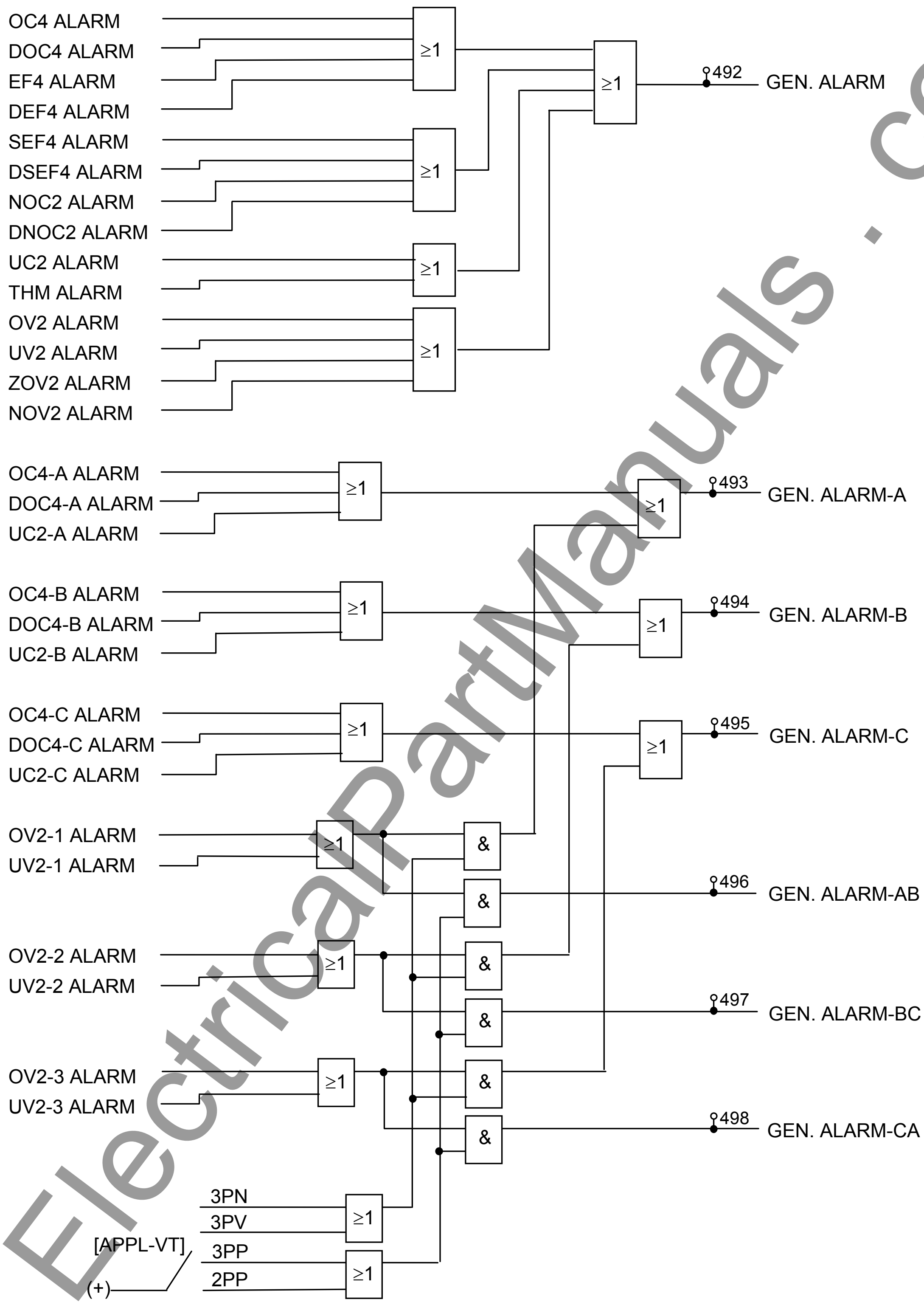

Figure 2.4.3 Alarm Outputs

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2.5 Autoreclose

The GRD150 model 300 and 400 series provide two-stage and multi-shot (five shots) autoreclosing scheme and are applied for one-circuit breaker:

- Two-stage autoreclosing scheme (ARC1, ARC2)
- Single phase or three phase autoreclosing scheme for the first shot
- Three phase autoreclosing scheme for the second to fifth shot
- Integrated synchronism check function for autoreclosing
- Autoreclosing counter

The autoreclosing can be initialized by OC1 to OC4, EF1 to EF4, SEF1 to SEF4, DOC1 to DOC4, DEF1 to DEF4, DSEF1 to DSEF4 trip signals or external trip signals which are set by scheme switches [∗∗∗∗-INIT] or PLC function. When a trip signal is not used, is used for ARC1, and used for ARC2, set [∗∗∗∗-INIT] to “NA”, “ARC1” and “ARC2” respectively. If a trip signal is used to block the autoreclose, set [∗∗∗∗-INIT] to “BLK”.

The GRD150 model 300 and 400 series also provide the manual close function. For the manual close function, refer to Section 2.6.3.

2.5.1 Autoreclosing Scheme

Two-stage autoreclosing ARC1 and ARC2 are provided. The scheme logic of both schemes are same. When the different setting against a phase fault and an earth fault is required for the dead time setting, for instance, the ARC1 for phase fault and the ARC2 for earth fault is applied.

First-shot autoreclose

Three types of first-shot autoreclose modes are provided: three-phase autoreclose, single-phase autoreclose, and user configurable autoreclose. An optimal mode is selected by the autoreclose mode selection switch [ARCEN], [ARCEN-S] and [ARCEN-C]. When autoreclose is disabled, all switches above are set to "Off".

Three-phase autoreclose:

In this autoreclose mode, three phases are tripped, and then reclosed regardless of the fault mode, whether single-phase fault or multi-phase fault. A shorter dead time can be set in this mode when compared to the single-phase autoreclose. For the three-phase autoreclose, synchronism check and voltage check between the busbar and the line are required. The voltage condition is set by PLC function.

This reclosing mode is simply expressed as "T" in the following descriptions.

Single-phase autoreclose:

In this mode, only the faulty phase is tripped, and then reclosed if a single-phase earth fault occurs. Since power can be transmitted through healthy phases even during dead time, this mode is convenient for maintaining power system stability. On the other hand, the capacitive coupling effect between the healthy phase and faulty phase may cause a longer de-ionization time when compared to a three-phase autoreclose. As a result, a longer dead time is required.

In case of a multi-phase fault, three phases are tripped, but reclosing is not made.

For single-phase autoreclose, each phase of the circuit breaker must be segregated.

This reclosing mode is simply expressed as "S" in the following descriptions.

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Configurable autoreclose:

User can configure the autoreclose condition by using the PLC function.

Two- to five-shot autoreclose

Any of two- to five-shot reclosing can be selected. In any case, the first shot is selected from three types of autoreclose modes as described in the above first-shot autoreclose. All successive shots (up to five times), which are applied if the first shot fails, are three-phase tripping and reclosing.

The autoreclose can also be activated from an external line protection. At this time, all autoreclose modes described above are effective.

2.5.2 Scheme Logic

Figure 2.5.1 shows the simplified scheme logic for the first-shot autoreclose. Autoreclose for a further fault incident becomes ready when the circuit breaker is closed and ready for autoreclose (CB READY=1) and the on-delay timer TRDY is picked up, the [ARCEN], [ARCEN-S] or [ARCEN-C] is set to "ON". The TRDY is used to determine the reclaim time.

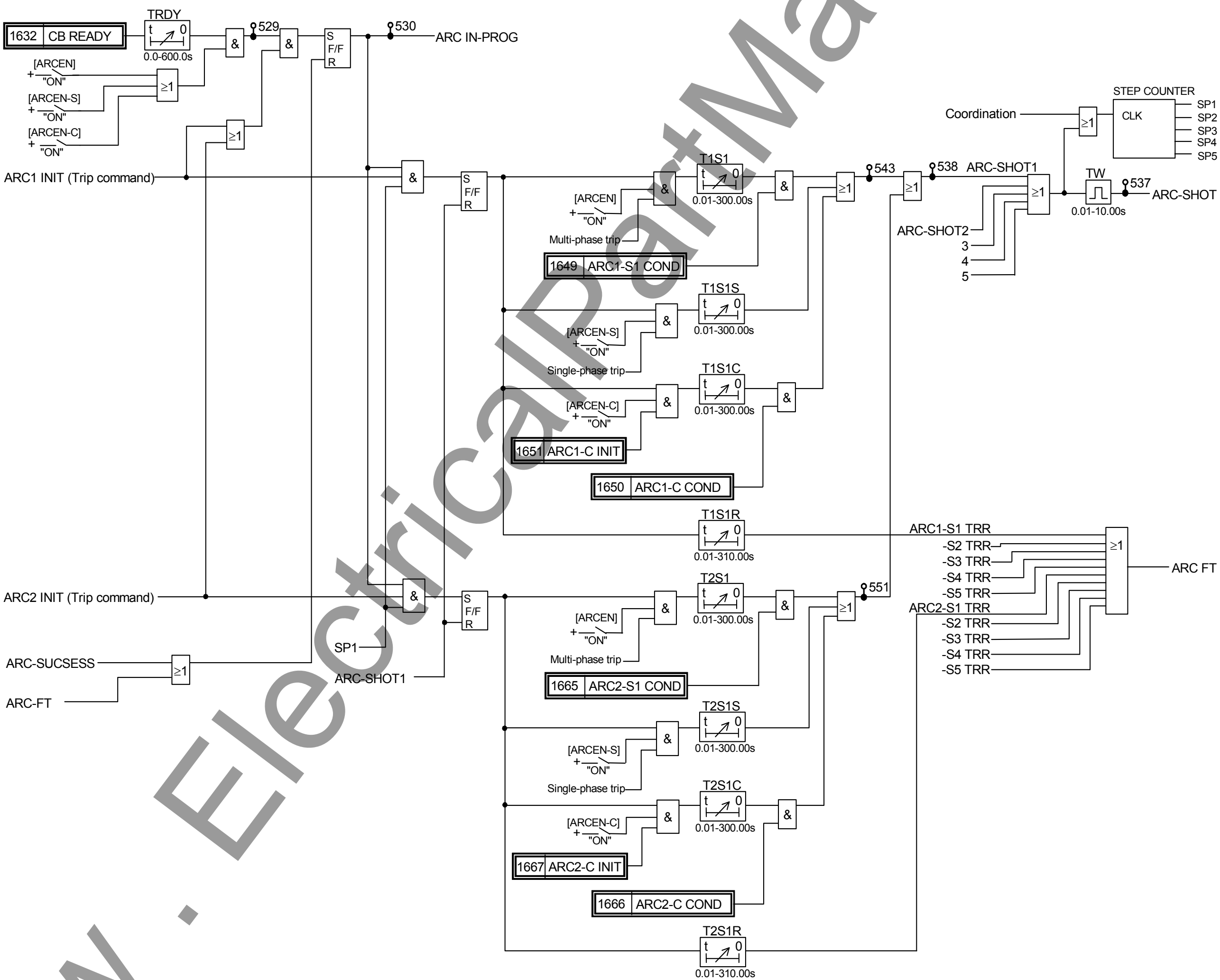

Figure 2.5.1 Autoreclose Scheme Logic

If the autoreclose is ready, the autoreclose is activated by ARC1 INIT or ARC2 INIT. The ARC1 INIT and ARC2 INIT are programmed from tripping commands of various protection by PLC function. Further the external tripping command signal EXT.TRIPA, EXT.TRIPB, EXT.TRIPC

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for each phase of the breakers can also activate the autoreclose. These signals are also programmed by PLC function.

Once this autoreclose is activated, it is maintained by a flip-flop circuit until one reclosing cycle is completed.

Final trip

If a fault occurs under the following conditions, three-phase final tripping is performed and autoreclose is blocked.

- Reclosing block signal is applied.
- Throughout the reclaim time

For evolving faults which occur after the set time, three-phase final tripping is performed, and reclosing is not performed.

If an evolving fault occurs when [ARCEN-S] is selected (="On"), three-phase final tripping is performed, and reclosing is not performed.

Autoreclose for a single-phase fault

If the switch [ARCEN-S] is set to "On" in the first shot, the dead time counter T1S1S or T2S1S for single-phase reclosing is started by any of the tripping signals ARC∗ INIT-A to ARC∗ INIT-C or EXT.TRIPA to EXT.TRIPC. After the dead time has elapsed, reclosing command ARC-SHOT1 is initiated.

If all the [ARCEN], [ARCEN-S] and [ARCEN-C] are set to "Off", the autoreclose is not started.

Autoreclose for a multi-phase fault

Regardless of the reclosing mode, three-phase tripping is performed. If the [ARCEN] is set to "On", the dead time counter T1S1 or T2S1 for three-phase reclosing is started. After the dead time has elapsed, reclosing command ARC-SHOT is initiated based on the operating conditions of the voltage and synchronism check elements programmed by PLC function.

If the operating conditions of the voltage and synchronism check elements are not satisfied during three-phase reclosing, the T1S1R or T2S1R is then picked up and reclosing is reset.

User-configurable autoreclose

If the [ARCEN-C] is set to "On" and the operating conditions programmed by PLC function are satisfied, the dead time counter T1S1C or T2S1C for three-phase reclosing is started. After the dead time has elapsed, reclosing command ARC-SHOT1 is initiated.

Voltage and synchronism check

There are four voltage modes as shown below when all three phases of the circuit breaker are open. The voltage and synchronism check is applicable to voltage modes 1 to 4 and controls the energising process of the lines and busbars in the three-phase autoreclose mode.

Voltage Mode	1	2	3	4
Running (Busbar) voltage (V_R)	live	live	dead	dead
Incoming (Line) voltage (V_I)	live	dead	live	dead

The synchronism check is performed for voltage mode 1 while the voltage check is performed for voltage modes 2 to 4.

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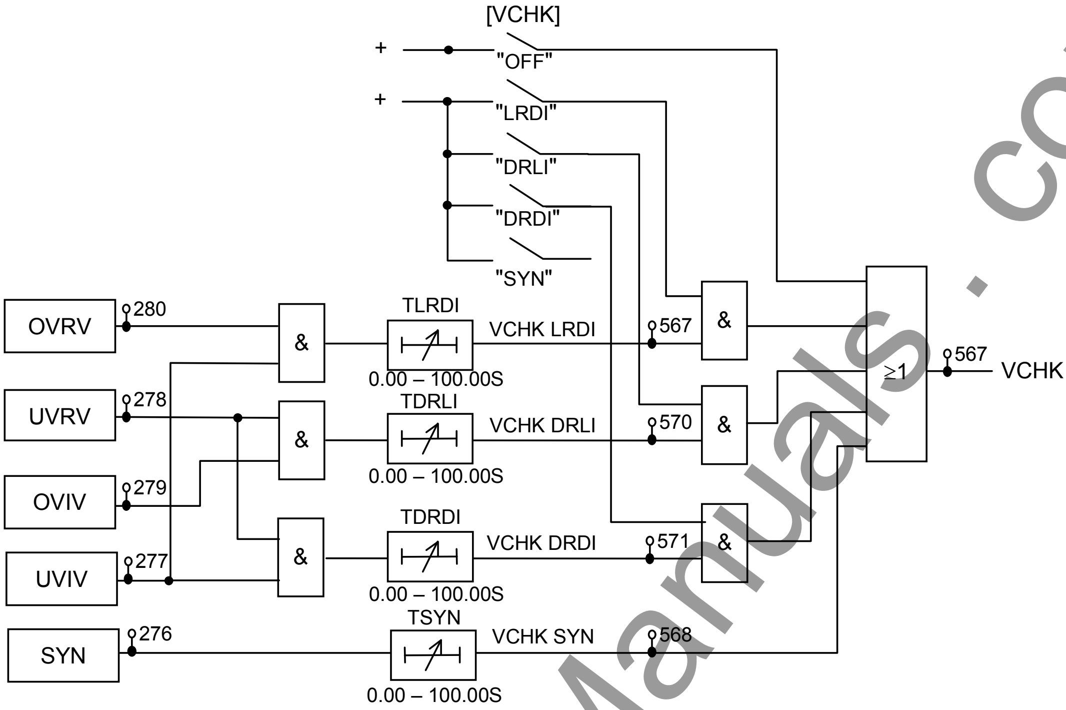

Figure 2.5.2 Energising Control Scheme

Figure 2.5.2 shows the energising control scheme. The voltage and synchronism check output signal VCHK is generated when the following conditions have been established;

- Synchronism check element SYN operates and on-delay timer TSYN is picked up.
- Overvoltage detector for running voltage OVRV and undervoltage detector for incoming voltage UVIV operate, and on-delay timer TLRDI is picked up. (This detects live bus and dead line condition.)
- Undervoltage detector for running voltage UVRV and overvoltage detector for incoming voltage OVIV operate, and on-delay timer TDRLI is picked up. (This detects dead bus and live line condition.)
- Undervoltage detector for running voltage UVRV and undervoltage detector for incoming voltage UVIV operate, and on-delay timer TDRDI is picked up. (This detects dead bus and dead line condition.)

Using the scheme switch [VCHK], the energising direction can be selected.

Setting of [VCHK]	Energising control
LRDI	Reclosed under "live bus and dead line" condition or with synchronism check
DRLI	Reclosed under "dead bus and live line" condition or with synchronism check
DRDI	Reclosed under "dead bus and dead line" condition or with synchronism check
SYN	Reclosed with synchronism check only.
OFF	Reclosed without voltage and synchronism check.

When [VCHK] is set to "LRDI", the line is energised in the direction from the busbar to line under "live bus and dead line" condition. When [VCHK] is set to "DRLI", the lines are energised in the direction from the line to busbar under "dead bus and live line" condition.

When a synchronism check output exists, autoreclose is executed regardless of the scheme switch position.

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When [VCHK] is set to "SYN, a three-phase autoreclose is performed with the synchronism check only.

When [VCHK] is set to "OFF", three-phase autoreclose is performed without voltage and synchronism check.

The voltage and synchronism check requires a single-phase voltage from the busbar and the line as a reference voltage. User can select one reference voltage from A phase, B phase, C phase, A-B phase, B-C phase and C-A phase by the scheme switch [APPL-VTS].

Permanent fault

When reclose-onto-a-fault is activated, when a permanent fault exists, three-phase final tripping is performed. However, this operation is performed only in the single-shot autoreclose mode. In the multi-shot autoreclose mode, reclosing is retried as described below.

Note: The SOTF (Switch-on-to-fault) function is required to be programmed by PLC function, because the DOC element cannot operate when the above fault is a fault such as a three-phase close-up fault.

Two- to five shot autoreclose

Multi-shot autoreclose can be executed up to four times after the first-shot autoreclose fails. Figure 2.5.3 shows the simplified scheme logic for the multi-shot autoreclose of the second to fifth shot.

The multi-shot mode, two to five shots, is set with the scheme switch [ARC∗-NUM].

In low-speed autoreclose, the dead time counter T1S2 or T2S2 for the second shot is activated if the first shot autoreclose is performed, but tripping occurs again. Second shot autoreclose is performed only when the voltage and synchronism check element operates (VCHK = 1) after a period of time set on the T1S2 or T2S2 has elapsed. At this time, outputs of the step counter are: SP1 = 1, SP2 = 0, SP3 = 0, SP4 = 0 and SP5 = 0.

Autoreclose is completed at this step if the two shots mode is selected for the multi-shot mode. Therefore, the tripping following the "reclose-onto-a-fault" becomes the final tripping (ARC FT = 1).

If the voltage and synchronism check element does not operate within the period of time set on the timer T1S2R or T2S2R which is started at the same time as T1S2 is started, the multi-shot autoreclose is cancelled (ARC FT = 1).

When the three shots mode is selected for the multi-shot mode, autoreclose is further retried after the above tripping occurs. At this time, the T1S3 and T1S3R, or T2S3 and T2S3R are started. The third shot autoreclose is performed only when the voltage and synchronism check element operates after the period of time set on the T1S3 or T2S3 has elapsed. At this time, outputs of the step counter are: SP1 = 0, SP2 = 1, SP3 = 0, SP4 = 0 and SP5 = 0.

The three shots mode of autoreclose is then completed. Therefore, the tripping following the "reclose-onto-a-fault" becomes the final tripping (ARC FT = 1).

If the voltage and synchronism check element does not function within the period of time set on the T1S3R or T2S3R, multi-shot autoreclose is cancelled.

When the four or five shot autoreclose is selected, autoreclose is further retried once again for tripping that occurs after the "reclose-onto-a-fault". This functions in the same manner as the three shot autoreclose.

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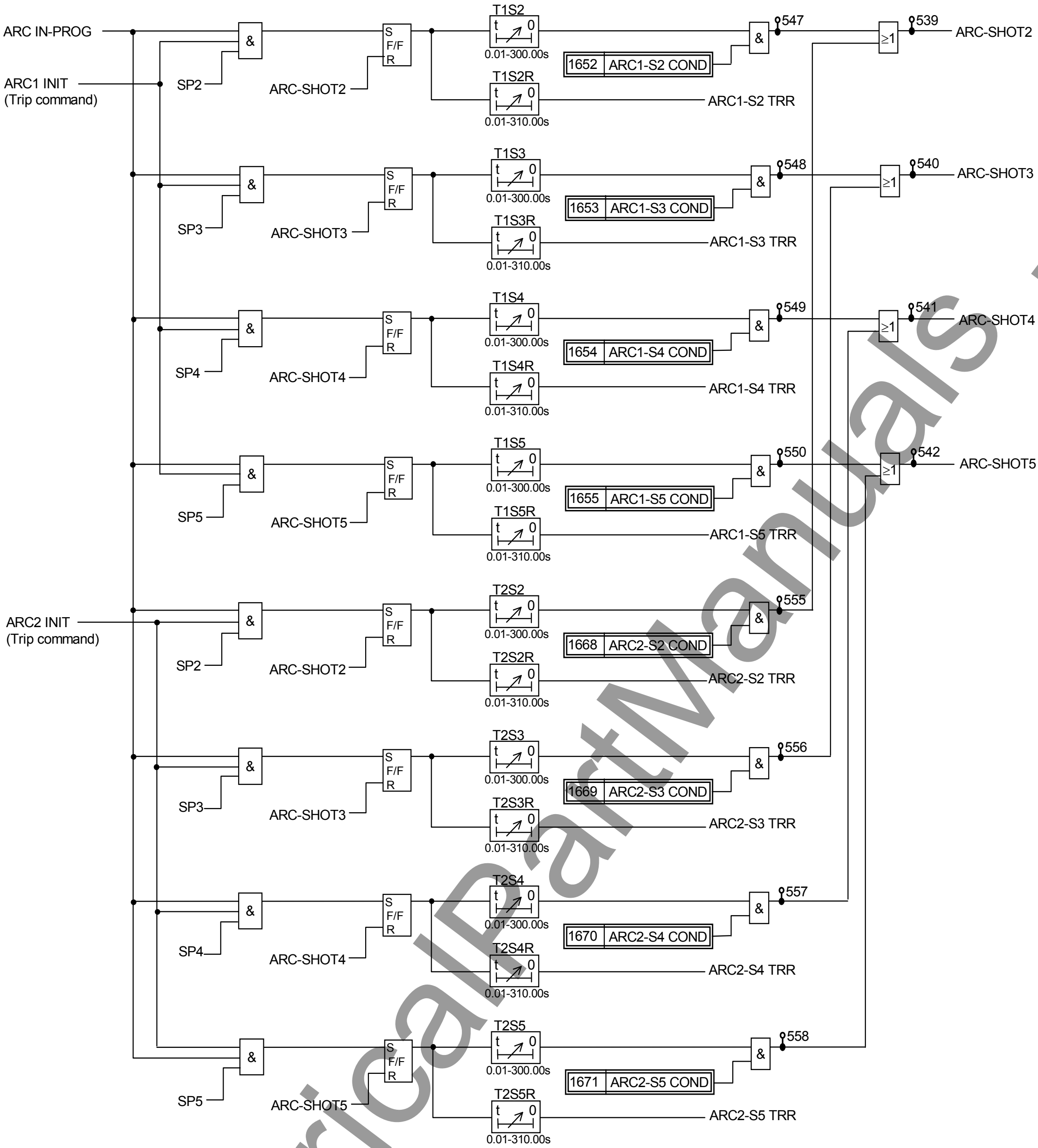

Figure 2.5.3 Scheme Logic of Second to Fifth Shot Autoreclose

Sequence coordination

Co-ordination is maintained between the autoreclose sequences of adjacent relays on a feeder. This means that a relay will register the flow of fault current and increment through its autoreclose sequence even if another relay actually carries out the tripping and reclosing operations. This function is initiated by the operation of OC, EF or SEF element, and can be disabled by the scheme switch [COORD-OC], [COORD-EF] or [COORD-SE].

The reclose shot number at the local terminal A is coordinated with that at the adjacent terminal B as shown in Figure 2.5.4.

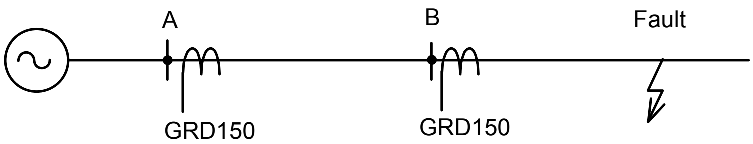

Figure 2.5.4 Sequence Coordination

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2.5.3 Setting

The setting elements necessary for the autoreclose and their setting ranges are shown in the table below.

Element	Range	Step	Default	Remarks
ARC				
TRDY	0.0 – 600.0 s	0.1 s	60.0 s	Reclaim time
T1S1	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 1
T1S1S	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 1 (single-phase ARC)
T1S1C	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 1 (configurable ARC)
T1S1R	0.01 – 310.00 s	0.01 s	20.00 s	1st shot reset time for Stage 1
T1S2	0.01 – 300.00 s	0.01 s	10.00 s	2nd shot dead time for Stage 1
T1S2R	0.01 – 310.00 s	0.01 s	20.00 s	2nd shot reset time for Stage 1
T1S3	0.01 – 300.00 s	0.01 s	10.00 s	3rd shot dead time for Stage 1
T1S3R	0.01 – 310.00 s	0.01 s	20.00 s	3rd shot reset time for Stage 1
T1S4	0.01 – 300.00 s	0.01 s	10.00 s	4th shot dead time for Stage 1
T1S4R	0.01 – 310.00 s	0.01 s	20.00 s	4th shot reset time for Stage 1
T1S5	0.01 – 300.00 s	0.01 s	10.00 s	5th shot dead time for Stage 1
T1S5R	0.01 – 310.00 s	0.01 s	20.00 s	5th shot reset time for Stage 1
T2S1	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 2
T2S1S	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 2 (single-phase ARC)
T2S1C	0.01 – 300.00 s	0.01 s	10.00 s	1st shot dead time for Stage 2 (configurable ARC)
T2S1R	0.01 – 310.00 s	0.01 s	20.00 s	1st shot reset time for Stage 2
T2S2	0.01 – 300.00 s	0.01 s	10.00 s	2nd shot dead time for Stage 2
T2S2R	0.01 – 310.00 s	0.01 s	20.00 s	2nd shot reset time for Stage 2
T2S3	0.01 – 300.00 s	0.01 s	10.00 s	3rd shot dead time for Stage 2
T2S3R	0.01 – 310.00 s	0.01 s	20.00 s	3rd shot reset time for Stage 2
T2S4	0.01 – 300.00 s	0.01 s	10.00 s	4th shot dead time for Stage 2
T2S4R	0.01 – 310.00 s	0.01 s	20.00 s	4th shot reset time for Stage 2
T2S5	0.01 – 300.00 s	0.01 s	10.00 s	5th shot dead time for Stage 2
T2S5R	0.01 – 310.00 s	0.01 s	20.00 s	5th shot reset time for Stage 2
TW	0.01 – 10.00 s	0.01 s	2.00 s	Output pulse time
TSUC	0.1 – 600.0 s	0.1 s	3.0 s	Autoreclose succeed judgement time
TRCOV	0.1 – 600.0 s	0.1 s	10.0 s	Autoreclose recovery time after final trip
TARCP	0.1 – 600.0 s	0.1 s	10.0 s	Autoreclose pause time after manually closing
TEVLV	0.01 – 300.00 s	0.01 s	0.30 s	Dead time reset for evolving fault
TRSET	0.01 – 300.00 s	0.01 s	3.00 s	Autoreclose reset time
VCHK				Sync. check
OVR	5.0 – 150.0 V	0.1 V	50.8 V	Live check for running voltage
UVR	5.0 – 150.0 V	0.1 V	12.7 V	Dead check for running voltage
OVI	5.0 – 150.0 V	0.1 V	50.8 V	Live check for incoming voltage
UVI	5.0 – 150.0 V	0.1 V	12.7 V	Dead check for incoming voltage
SYNOV	5.0 – 150.0 V	0.1 V	50.8 V	Synchronism check
SYNUV	5.0 – 150.0 V	0.1 V	82.6 V	Synchronism check
SYN θ	5 – 75°	1 °	30 °	Synchronism check

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Element	Range	Step	Default	Remarks
SYNDf	0.02 – 0.50 Hz	0.01 Hz	0.50 Hz	Synchronism check
TLRDI	0.00 – 100.00 s	0.01 s	0.05 s	Voltage check time
TDRLI	0.00 – 100.00 s	0.01 s	0.05 s	Voltage check time
TDRDI	0.00 – 100.00 s	0.01 s	0.05 s	Voltage check time
TSYN	0.00 – 100.00 s	0.01 s	1.00 s	Synchronism check time
[ARCEN]	Off/On		On	Autoreclose enable
[ARCEN-S]	Off/On		Off	Single-phase autoreclose enable
[ARCEN-C]	Off/On		Off	Configurable autoreclose enable
[ARC-NUM]	S1/S2/S3/S4/S5		S1	Autoreclosing shot number
[OC1-INIT]	NA/A1/A2/BLK		A1	Autoreclose initiation by OC1
[OC2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by OC2
[OC3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by OC3
[OC4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by OC4
[DOC1-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DOC1
[DOC2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DOC2
[DOC3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DOC3
[DOC4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DOC4
[EF1-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by EF1
[EF2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by EF2
[EF3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by EF3
[EF4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by EF4
[DEF1-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DEF1
[DEF2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DEF2
[DEF3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DEF3
[DEF4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DEF4
[SE1-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by SE1
[SE2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by SE2
[SE3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by SE3
[SE4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by SE4
[DSE1-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DSE1
[DSE2-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DSE2
[DSE3-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DSE3
[DSE4-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by DSE4
[EXT-INIT]	NA/A1/A2/BLK		NA	Autoreclose initiation by external trip command
[APPL-VTS]	A/B/C/AB/BC/CA			Phase setting for Synchronism and voltage check
[VCHK]	Non/LRDI/DRLI/DRDI/SYN		Non	Synchronism and voltage check
[COORD-OC]	Off/On		Off	OC relay for Co-ordination
[COORD-EF]	Off/On		Off	EF relay for Co-ordination
[COORD-SE]	Off/On		Off	SE relay for Co-ordination
OC	0.2 – 250.0 A (0.04 – 50.00 A) (*)	0.1 A (0.01 A)	5.0 A (1.00 A)	OC for co-ordination
EF	0.2 – 250.0 A (0.04 – 50.00 A) (*)	0.1 A (0.01 A)	1.5 A (0.30 A)	EF for co-ordination
SEF	0.025 – 0.125 A (0.005 – 0.025 A)	0.01 A (0.01 A)	0.050 A (0.010 A)	SEF for co-ordination

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(*) Current values shown in the parenthesis are in the case of a 1 A rating. Other current values are in the case of a 5 A rating.

To determine the dead time, it is essential to find an optimal value while taking factors, de-ionization time and power system stability, into consideration which normally contradict each other.

Normally, a longer de-ionization time is required as for a higher line voltage or larger fault current. For three-phase autoreclose, the dead time is generally 15 to 30 cycles. In single-phase autoreclose, the secondary arc current induced from the healthy phases may affect the de-ionization time. Therefore, it is necessary to set a longer dead time for single-phase autoreclose compared to that for three-phase autoreclose.

In three-phase autoreclosing, if the voltage and synchronism check does not operate within the period of time set on the delayed pickup timer T∗S∗R which is started at the same time as the dead time counter T∗S∗ is started, reclosing is not performed and three-phase autoreclose is reset to its initial state. Therefore, for example, TRR is set to the time setting of the T∗S∗ plus 100 ms.

The TEVLV determines the possibility of three-phase reclosing for an evolving fault.

When the TEVLV is set to the same setting as the T∗S∗S, three-phase reclosing is performed for all evolving faults. As the setting for the TEVLV is made shorter, the possibility of three-phase reclosing for an evolving fault becomes small and that of three-phase final tripping becomes large.

2.5.4 Characteristics of Measuring Elements

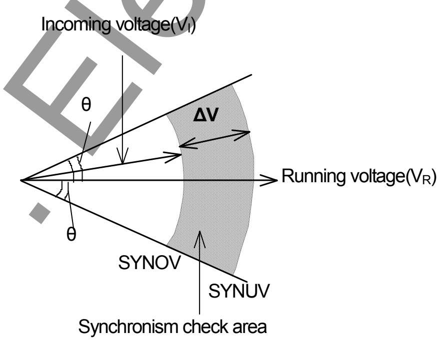
Voltage and Synchronism Check Elements OVI, UVI, OVR, UVR, and SYN

The voltage check and synchronism check elements are used for autoreclose.

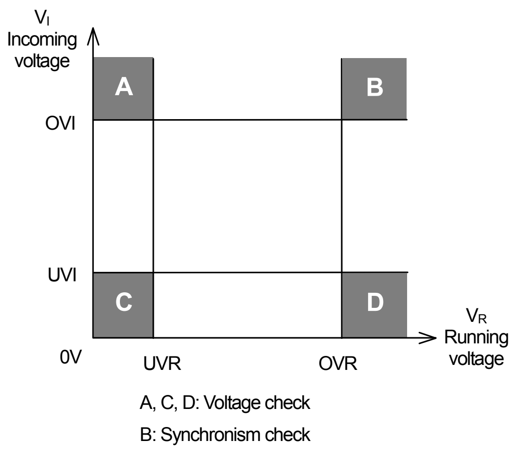
The output of the voltage check element is used to check whether the line and busbar are dead or live. The voltage check element has undervoltage detectors UVI and UVR, and overvoltage detectors OVI and OVR for the line (incoming) voltage and busbar (running) voltage check. The under voltage detector checks that the line or busbar is dead while the overvoltage detector checks that it is live. These detectors function in the same manner as other level detectors described later.

Figure 2.5.5 shows the characteristics of the synchronism check element used for the autoreclose if the line and busbar are live.

The synchronism check element operates if both the voltage difference and phase angle difference are within their setting values.



(a) Synchronism check zone



(b) Voltage and synchronism check zone

Figure 2.5.5 Voltage and Synchronism Check Element

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For the element SYN, the voltage difference is checked by the following equations.

$SYNOV \leq VR \leq SYNUV$

$SYNOV \leq VI \leq SYNUV$

where,

VR = busbar (running) voltage

VI = line (incoming) voltage

SYNOV = lower voltage setting

SYNUV = upper voltage setting

The phase difference is checked by the following equations.

$VR \cdot VI \cos\theta \geq 0$

$VR \cdot VI \sin(SYN\theta) \geq VR \cdot VI \sin\theta$

where,

θ = phase difference between VR and VI

$SYN\theta$ = phase difference setting

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2.6 Control Function

GRD150 provides the following bay level control functions:

- MIMIC configuration
- Control of switchgears, circuit breakers, disconnectors (open/close command)
- Monitoring of switchgears, circuit breakers, disconnectors
- Display and monitoring of metering values
- Synchronism check

2.6.1 MIMIC Configuration

The object status indicators are used to indicate the switching devices such as circuit breakers and disconnectors via the MIMIC configuration picture on the HMI. The MIMIC configuration picture is produced by PC software “MIMIC editor tool” via RS232C port. For MMIC editor tool, refer to the MIMIC editor instruction manual.

Table 2.6.1 shows the user-configurable objects and Figure 2.6.1 shows a MIMIC drawing screen of the MIMIC editor

Table 2.6.1 User-configurable Object

Object	Use	Maximum Number of object
CB (Circuit breaker)	Control & indication	1
DS (Disconnectorswitch)	Control & indication	5
EDS (3 state disconnector switch)	Control & indication	2
COS (On/Off switch)	Control & indication	4
IND (Indicator)	Indication	8
Meter (Digital meter)	Indication	-- (no limit)

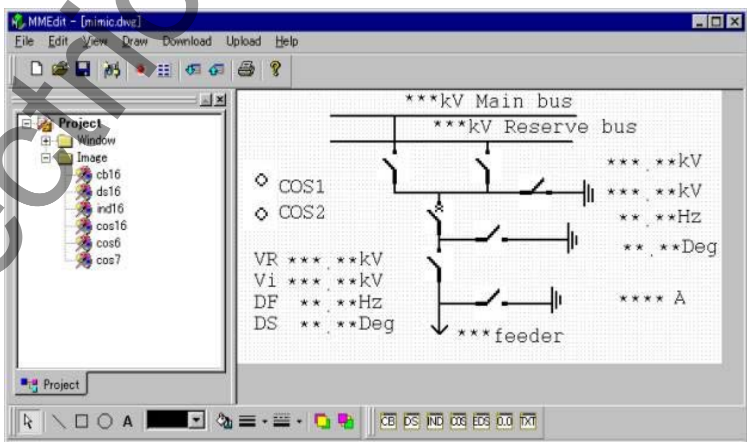

Figure 2.6.1 Sample Screen of MIMIC Editor

Table 2.6.2 and Figure 2.6.2 show the setting range of power system quantity for the digital meter and its setting screen of MIMIC editor tool.

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Table 2.6.2 Setting range of Digital Meter

Data ID	Width	Precision	Max	Min	M	B	Unit
Ia (A-phase current)	6	0	999999	0	1	0	A
Ib (B-phase current)	6	0	999999	0	1	0	A
Ic (C-phase current)	6	0	999999	0	1	0	A
Ie (Residual current)	6	0	999999	0	1	0	A
Ise (zero-sequence current for SEF)	6	1	9999.9	0	1	0	A
Va (A-phase voltage)	6	2	999.99	0.00	1	0	kV
Vb (B-phase voltage)	6	2	999.99	0.00	1	0	kV
Vc (C-phase voltage)	6	2	999.99	0.00	1	0	kV
Ve (Residual voltage)	6	2	999.99	0.00	1	0	kV
Vab (A- to B-phase voltage)	6	2	999.99	0.00	1	0	kV
Vbc (B- to C-phase voltage)	6	2	999.99	0.00	1	0	kV
Vca (C- to A-phase voltage)	6	2	999.99	0.00	1	0	kV
Vs (residual voltage)	6	2	999.99	0.00	1	0	kV
f (Power system frequency)	5	2	75.00	20.00	1	0	Hz
PF (Power factor)	6	3	1.000	-1.000	1	0	-
P (Active power)	6	0	999999	0	1	0	kW
Q (Reactive power	6	0	999999	0	1	0	kvar
Wh_p (Watt hour: positive)	6	0	999999	0	1	0	kWh
Wh_n (Watt hour: negative)	6	0	999999	0	1	0	kWh
varh_p (var hour: positive)	6	0	999999	0	1	0	kvarh
varh_n (var hour: negative)	6	0	999999	0	1	0	kvarh
Vr (Voltage for synchro. check)	6	2	999.99	0.00	1	0	kV
Df (Frequency difference)	4	2	9.99	0.00	1	0	Hz
Dtheta (Phase difference)	4	1	99.9	0.0	1	0	degree
f/t (Frequency rate-of-change)	6	2	99999	-99999	1	0	Hz/s
THM (Thermal overload)	5	1	99999	-99999	1	0	%

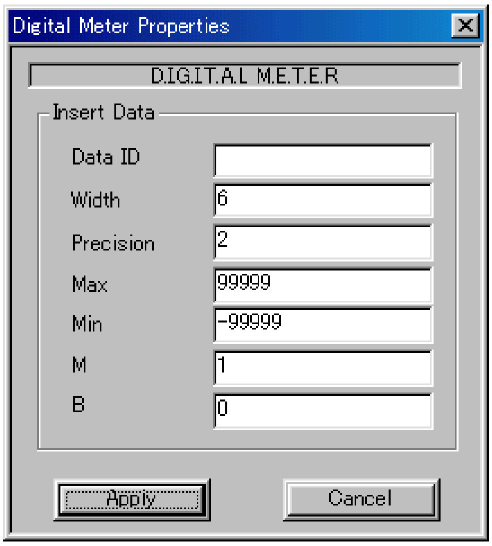

Figure 2.6.2 Digital Meter Setting Screen

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2.6.2 Control

The GRD150 can indicate the status of circuit breakers and disconnectors via the MIMIC configuration picture on the graphical LCD display (HMI) and the status information from them can be transmitted to the remote control system. The GRD150 can also control switchgears such as circuit breakers or disconnectors opened and closed over the remote control system. The status information and control signals are transmitted over the serial bus. Binary inputs and outputs for control are configured by PLC function.

On the MIMIC picture, the object device is selected and its open/close control is locally performed via the push-button keys on the front panel.

The following devices are controlled:

Object device	Input / output	Max. number of device
Circuit breaker (CB)	2State / 2Control	1
Disconnector switch (DS)	2State / 2Control	5
3 State disconnector switch (EDS)	3State / 4Control	2
On / Off switch (COS)	1 output	4

Furthermore the maximum 8 devices are indicated as indication only.

Figure 2.6.3 shows the overview of select and control operation logic. The GRD150 selects an object device according to the remote, local or PLC command signal and controls the object device by the remote, local or PLC control output. The control output is performed by a binary output (BO) assigned by PLC function.

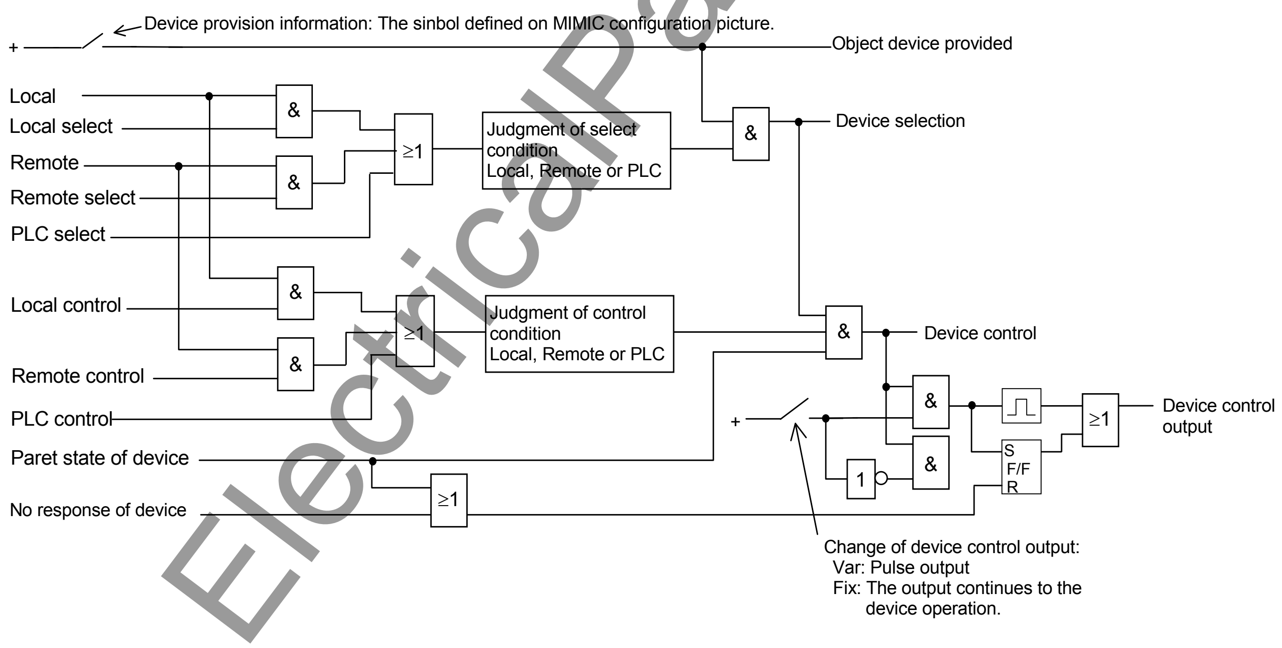

Figure 2.6.3 Overview of Select and Control Operation Logic

Scheme logic

Figure 2.6.4 shows the typical scheme logic of CB close select and control operation. The scheme logic of CB open operation and other device's operation (DS, EDS, etc.) is similar to it.

CB_ENABLE shows CB is on the MIMIC diagram.

CB_SELECTED is given by CB_ENABLE and select command from PLC/panel/remote system

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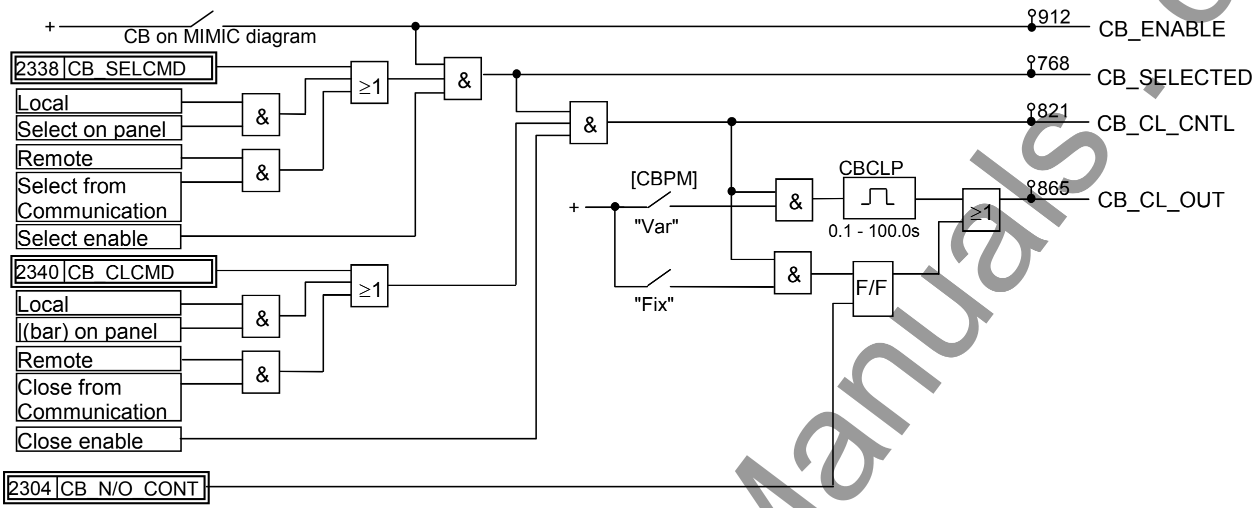
and select enable signal which made in internal logic.

CB_CL_CNTL is given by CB_SELECTED and close command from PLC/panel/remote system and close enable signal which made in internal logic. In addition, CB_CL_OUT is given for device control. It is kept till the timer "CBCLP" count up in case of [CBPM] "Var", or till changed device status. CB_CL_OUT must be assign to BO by PLC function.



(Note) CB_SELCMD: CB select command assigned by PLC.
CB_CLCMD: CB close command assigned by PLC.
CB_N/O CONT: CB N/O contact assigned by PLC

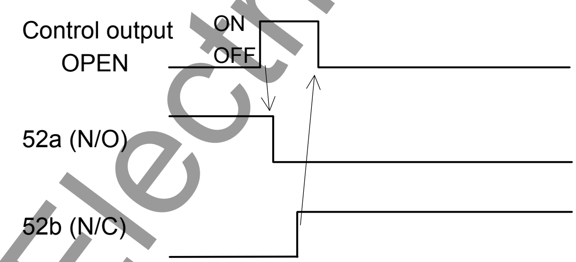
Figure 2.6.4 Scheme Logic of CB Close and Control Operation

CB pulse mode [CBPM] is as follows:

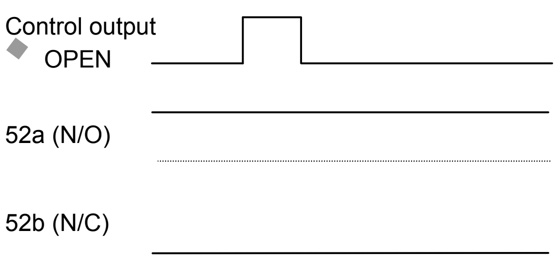
The pulse mode can be set to "Fix" or "Var". When "Fix" selected, the control output turns OFF automatically after the device responds. If the device does not respond, the control output turns off after the setting time of CB response check timer CBRSPT has passed. When "Var" selected, the control output is ON during the setting time of CBCLP or CBOPP. (For the setting range, see 2.6.2.7.)

When CBPM = Fix selected,

1) If the device responds,



2) If the device does not respond,



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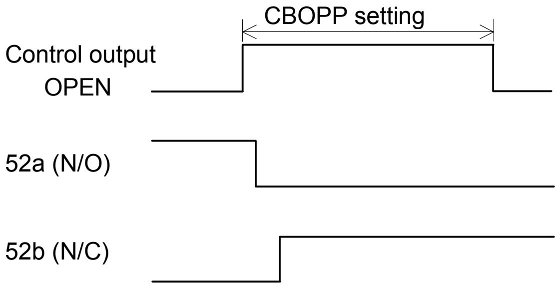
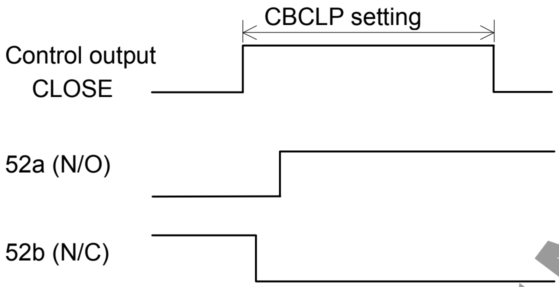
When CBPM = Var selected,

1) OPEN control

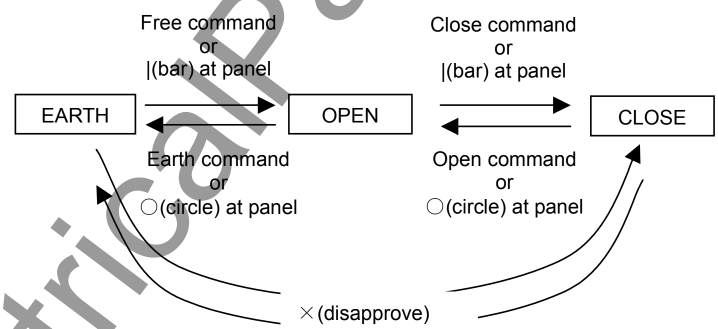


2) CLOSE control



COS has pulse mode "Latch" or "Pulse". In case of "Latch" the COS output is kept till other command. In case of "Pulse" the COS output is kept 5 seconds.

EDS has 3 state "OPEN", "CLOSE", "EARTH". Then the control method is as follows:



The GRD150 provides the following three control method:

- Local control
- Remote control
- PLC control

These details are described after.

2.6.2.1 Control Right

The control right, which is possessed by local or remote, is selected by the [L/R] push-button key on the front panel.

Password protection is provided. The password is required to change from "Remote" to "Local" control. The changing from "Local" to "Remote" requires no password. If the changing from "Local" to "Remote" has been forgotten and the state of local control operation is left, the state is automatically changed to the remote control operation after the panel turns off.

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Local control

Local control means the control operation from the relay front panel (MIMIC panel). In local control the device to control can be selected using cursor keys and press [SELECT] key to fix the object, then press [|] or [○] key to output control signal.

Control right selection		Object device selection		Fix the Object		Control operation
[L/R]	→	▼, ▲	→	[SELECT]	→	[|], [○]

Figure 2.6.5 Key Operation for Local Control

At pressed [SELECT] key GRD150 checks control right, operation lock, device status, and so on to the selected device. If the select operation is valid, then the object symbol reverses and displays a guidance 'Object fixed…'. If the select operation is invalid, then display guidance of the factor as shown in Table 2.6.3. Press [ENTER] key to delete the error guidance.

Table 2.6.3 Guidance Message

Guidance message	Notes
–	Device selection is completed, or the device has responded.
OPEN interlock failed	
CLOSE interlock failed	
EARTH interlock failed	
FREE interlock failed	
Control right failed	
Synchronisation not established	
Under control blocking	
No response returned	No response of device
Pallet undefined	
Under double command blocking	
– (status unchanged)	During the device response or defining the device

At pressed [|] or [○] key GRD150 checks interlock condition, control direction and synchronous. If control the open operation to the device of open status, it is mistake and GRD150 cancels the selected status.

More than 60 seconds passed until pressed [|] or [○] key , then GRD150 cancels the selected status.

Remote control

Remote control means the control operation from remote control center via communication. It can be provided for both direct operation control and select & operation control. The object mapping, response of control and events, etc. depend on the communication protocol such as IEC60870-5-103, etc.. See communication profile about them.

PLC function

PLC control means the control operation signal assigned by PLC function. It is valid both local and remote. PLC control function is provided for automatic control, control by the switch of other local control panel, etc. Any control logics can be programmed by PLC function. Table 2.6.4 shows a sample of control logic by PLC.

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Table 2.6.4 Control logic by PLC

Input or Output	Information	Signal assign
Input signal to control function from PLC logic	Status of device	N/O and N/C contact information introduced by BI(Binary input) is assigned to a device status signal.
	Select & operation control	In case of automatic control or local control panel a control switch signal (BI signal) is assigned to a select & operation control signal.
	Interlock condition	Interlock condition programmed by BI signals, etc. is assigned to a non-established signal of the interlock.
	Configurable counter	Signal introduced by BI signal such as 30F and Pulse WH, etc. is assigned to a configurable counter.
	Synchronism check	Synchronism check execution signal is assigned to “1” signal continuously when CB closed by synchronism check.
	Δf check	Δf check execution signal is assigned to “1” signal continuously if Δf check is included during synchronism check above.
Output signal to PLC logic from control function	Control output	Control output signal for each device is assigned to a binary output signal (BO signal).
	Events	Events of select & operation control, select completion, select fail, interlock fail, etc. are outputted.

2.6.2.2 Double Command Blocking

Double command blocking function can be provided. This function prevents from control multiple devices. It is to block select command while the previous control is in progress to realize secure control. The control operation is blocked during device selection, control execution and device operating.

Double command blocking occurs during selected device, the selected device is canceled.

Double command blocking occurs during operating device, the operation is continues.

2.6.2.3 Control inhibition

The whole control operation except trip command by relay scheme can be blocked to prevent incorrect operation when system testing or inspection, etc. The control operation is blocked by setting the switch [OPLOCK] to “LOCK”. This status is not indicated anything in default setting.

“OPELOCK” signal is for block the trip command or status indication using by PLC function.

2.6.2.4 Software Interlock

Software interlock is to block control output when the interlock condition is failure. It can be provided by using the PLC function for any control direction of every device.

Software interlock is valid when the signal for interlock (i.e. CB_OPILOCK) is on. It is given from device status, device alarm, etc. from BI using PLC function.

2.6.2.5 Interlock bypass

Interlock bypass mode can be provided. This function is to control the switchgear devices forcibly and is available when the interlock condition is not valid caused by communication failure or unavailable, etc.. The interlock bypass mode can be set from the MIMIC and the upper systems. This mode is retained until reset or DC supply “OFF”.

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2.6.2.6 Supervision of device control

GRD150 check the device status of 2 status input (CB, DS, IND) or 3 status input (EDS) on MIMIC diagram. GRD150 make the signal (i.e. CB_PLT_FAIL, CB_UNDEF) after the device status is invalid more than setting time.

GRD150 check the response time from control output to change device status. GRD150 make the signal (i.e. CB_NORESP) after the device status unchanged more than setting time.

2.6.2.7 Setting

The setting ranges to perform above control functions are as follows:

Element	Range	Step	Default	Remarks
CBPM	Fix / Var		Fix	CB pulse mode
DS1PM – DS5PM	Fix / Var		Fix	DS1 – DS5 pulse mode
EDS1PM, EDS2PM	Fix / Var		Fix	EDS1,EDS2 pulse mode
CBOPP	0.1 – 100.0 s	0.1 s	5.0 s	CB open pulse width
CBCLP	0.1 – 100.0 s	0.1 s	5.0 s	CB close pulse width
DS1OPP – DS5OPP	0.1 – 100.0 s	0.1 s	5.0 s	DS1 – DS5 open pulse width
DS1CLP – DS5CLP	0.1 – 100.0 s	0.1 s	5.0 s	DS1 – DS5 close pulse width
EDS1OPP, EDS2OPP	0.1 – 100.0 s	0.1 s	5.0 s	EDS1, EDS2 open pulse width
EDS1CLP, EDS2CLP	0.1 – 100.0 s	0.1 s	5.0 s	EDS1, EDS2 close pulse width
EDS1EAP, EDS2EAP	0.1 – 100.0 s	0.1 s	5.0 s	EDS1, EDS2 earth pulse width
EDS1FRP, EDS2FRP	0.1 – 100.0 s	0.1 s	5.0 s	EDS1, EDS2 free pulse width
COS1PM – COS4PM	Latch / Pulse		Latch	COS1 – COS4 pulse mode
CBRSPT	0.1 – 100.0 s	0.1 s	20.0 s	CB response check timer
DS1RSPT – DS5RSPT	0.1 – 100.0 s	0.1 s	20.0 s	DS1 – DS5 response check timer
EDS1RSPT, EDS2RSPT	0.1 – 100.0 s	0.1 s	20.0 s	EDS1, EDS2 response check timer
CBPLT	0.1 – 100.0 s	0.1 s	20.0 s	CB palette check timer
DS1PLT- DS5PLT	0.1 – 100.0 s	0.1 s	20.0 s	DS1 – DS5 palette check timer
EDS1PLT, EDS2PLT	0.1 – 100.0 s	0.1 s	20.0 s	EDS1, EDS2 palette check timer
IND1PLT – IND8PLT	0.1 – 100.0 s	0.1 s	20.0 s	IND1- IND8 palette check timer
[OPLOCK]	Unlock / Lock		Unlock	Operation lock

2.6.3 Synchronism and Voltage Check

When a circuit breaker is closed, the GRD150 executes a synchronism and voltage check using the voltages on both ends of the circuit breaker. The circuit breaker is closed when either of the checks is satisfactory.

Synchronism Check

Synchronism check is performed when voltages are live on both ends of the circuit breaker and closing of the breaker is permitted when the following conditions are fulfilled.

- Running voltage (VR) and incoming voltage (VI) are higher than the set value Vov.
- The differences in amplitude and phase angle of VR and VI are smaller than the set value ΔV and $\Delta\theta$ respectively.
- The difference in frequency of VR and VI is smaller than the set value Δf.

The condition for synchronism check such as CB, DS condition is programmed by PLC function.

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Voltage Check

Voltages are checked and closing of the circuit breaker is permitted only when the following conditions are fulfilled.

- Voltage is higher than the set value Vov (live condition) on one end of the circuit breaker and lower than the set value Vuv (dead condition) on the other end.
- Voltages are dead on both ends.

The synchronism check zone is shown in Figure 2.5.5 (a) and in Figure 2.5.5 (b), A, C and D are voltage check zones and B is a synchronism check zone.

2.6.4 Metering and Counter Function

The GRD150 measures current and demand values of phase currents, phase and phase-to-phase voltages, residual current, residual voltage, symmetrical component currents and voltages, frequency, power factor, active and reactive power, and energy. The measurement data shown below is displayed on the LCD of the relay front panel or on the local or remote PC.

Current

The following quantities are measured and updated every second.

- Magnitude and phase angle of phase current (I_a, I_b, I_c)
- Magnitude and phase angle of zero sequence current from residual circuit (I_e)
- Magnitude and phase angle of zero sequence current from core balance CT (Ise) for model 200 and 400 series
- Magnitude and phase angle of symmetrical component current (I_1, I_2, I_0)
- Magnitude and phase angle of phase voltage (V_a, V_b, V_c)
- Magnitude and phase angle of phase-to-phase voltage (V_{ab}, V_{bc}, V_{ca})
- Magnitude and phase angle of zero sequence voltage which is measured directly in the form of the system residual voltage (Ve) for model 100 and 300 series
- Magnitude and phase angle of voltage for synchronism check (V_s) for model 300 and 400 series
- Magnitude and phase angle of symmetrical component voltage (V_1, V_2, V_0)
- Active power (P)
- Reactive power (Q)
- Active energy (Wh)
- Reactive energy (varh)
- Power factor (PF)
- Frequency (f)
- Frequency rate-of-change (Hz/s)
- Percentage of thermal capacity (THM%)

Demand

- Maximum, minimum and average of phase voltage (V_a, V_b, V_c: max, min, av)
- Maximum, minimum and average of phase-to-phase voltage (V_{ab}, V_{bc}, V_{ca}: max, min, av)

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- Maximum of zero sequence voltage which is measured directly in the form of the system residual voltage (Ve: max) for model 100 and 300 series
- Maximum of phase current (I_a, I_b, I_c: max.)
- Maximum of zero sequence current from residual circuit (I_e: max)
- Maximum of zero sequence current from core balance CT (Ise: max) for model 200 and 400 series
- Maximum, minimum and average of frequency (f: max, min, av)

The displayed quantities depend on [APPL-CT] and [APPL-VT] setting as shown in Table 2.6.5. The input current and voltage more than 0.01×In(rated current) and 0.06V at secondary side are required for the measurement.

The above system quantities are displayed in values on the primary side or on the secondary side as determined by a setting. Max, min, and av values in Demand show maximum, minimum and average values in the terms of demand time setting (1 to 60 minutes). The updated cycle of demand value is the time of the demand time setting. To display accurate values, it is necessary to set the CT ratio as well. For the setting method, see "Setting the Status" in 4.2.6.5.

Phase angles above are expressed taking the positive sequence voltage as a reference phase angle, where leading phase angles are expressed as positive, (+).

The signing of active and reactive power flow direction can be set positive for either power sending or power receiving. The signing of reactive power can be also set positive for either lagging phase or leading phase.

The values of active energy (Wh) and reactive energy (varh) can be changed by setting.

A-phase to B-phase voltage is used to measure frequency (f).

Table 2.6.5 Displayed Quantity Depends on APPL setting

APPL setting / Quantity	APPL-CT			APPL-VT			
	3P	2P	1P	3PN	3PV	3PP	2PP
Ia	✓	✓					
Ib	✓						
Ic	✓	✓					
Ie	✓	✓	✓				
Ise	✓	✓	✓				
I1	✓						
I2	✓						
I0	✓						
Va				✓	✓		
Vb				✓	✓		
Vc				✓	✓		
Vab				✓	✓	✓	✓
Vbc				✓	✓	✓	✓
Vca				✓	✓	✓	
Ve					✓	✓	✓
Vs				✓	--	✓	✓
V1				✓	✓	✓	✓
V2				✓	✓	✓	✓

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Quantity \ APPL setting	APPL-CT			APPL-VT			
	3P	2P	1P	3PN	3PV	3PP	2PP
V0				✓	✓		
P	✓	✓		✓	✓	✓	
Q	✓	✓		✓	✓	✓	
Wh	✓	✓		✓	✓	✓	
varh	✓	✓		✓	✓	✓	
PF	✓	✓		✓	✓	✓	
f				✓	✓	✓	✓
THM	✓	✓					

The GRD150 can monitor the upper or lower limit value of power system quantities and issue an alarm or record an event if the measured value is exceed the upper or lower limit value set. Two stage limits for the upper and lower limit value can be set respectively:

- Upper: High warning limit, High alarm limit
- Lower: Low warning limit, Low alarm limit

The hysteresis setting for the upper or lower limit value can be set as shown in Figure 2.6.6.

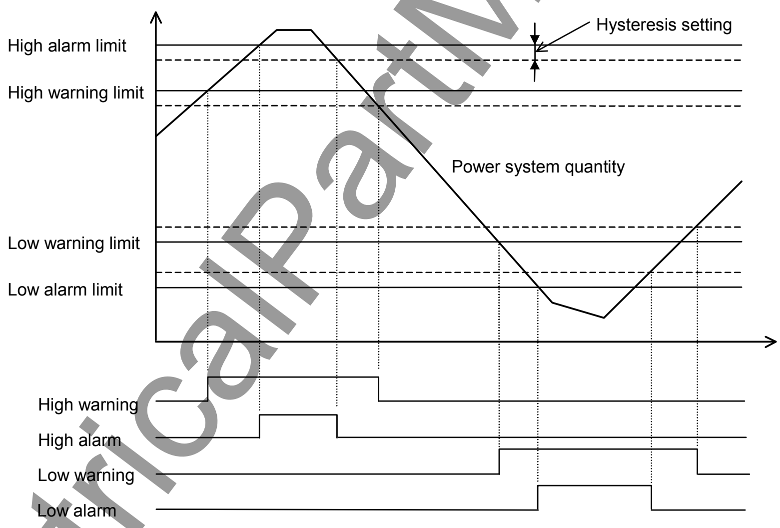

Figure 2.6.6 Monitoring of Upper and Lower Limit

The setting ranges for metering and monitoring the upper or lower limit value are as follows:

Element	Range	Step	Default	Remarks
Display value	Primary/Secondary		Primary	Metering
Wh^+	0 - 999999	1	0	
Wh^-	0 - 999999	1	0	
$varh^+$	0 - 999999	1	0	
$varh^-$	0 - 999999	1	0	
[IHALMEN]	Off / On		Off	Current I high alarm enable
[IHWAMEN]	Off / On		Off	Current I high warning enable
[ILALMEN]	Off / On		Off	Current I low alarm enable
[ILWAMEN]	Off / On		Off	Current I low warning enable
[VHALMEN]	Off / On		Off	Voltage V high alarm enable

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Element	Range	Step	Default	Remarks
[VHWAMEN]	Off / On		Off	Voltage V high warning enable
[VLALMEN]	Off / On		Off	Voltage V low alarm enable
[VLWAMEN]	Off / On		Off	Voltage V low warning enable
[PHALMEN]	Off / On		Off	Active power P high alarm enable
[PHWAMEN]	Off / On		Off	Active power P high warning enable
[QHALMEN]	Off / On		Off	Reactive power Q high alarm enable
[QHWAMEN]	Off / On		Off	Reactive power Q high warning enable
[QLALMEN]	Off / On		Off	Reactive power Q low alarm enable
[QLWAMEN]	Off / On		Off	Reactive power Q low warning enable
[fHALMEN]	Off / On		Off	Frequency f high alarm enable
[fHWAMEN]	Off / On		Off	Frequency f high warning enable
[fLALMEN]	Off / On		Off	Frequency f low alarm enable
[fLWAMEN]	Off / On		Off	Frequency f low warning enable
[IeHALMEN]	Off / On		Off	Current Ie high alarm enable
[IeHWAMEN]	Off / On		Off	Current Ie high warning enable
[IeLALMEN]	Off / On		Off	Current Ie low alarm enable
[IeLWAMEN]	Off / On		Off	Current Ie low warning enable
[VeHALMEN]	Off / On		Off	Voltage Ve high alarm enable
[VeHWAMEN]	Off / On		Off	Voltage Ve high warning enable
[VeLALMEN]	Off / On		Off	Voltage Ve low alarm enable
[VeLWAMEN]	Off / On		Off	Voltage Ve low warning enable
IHALM	0.0 – 999.9 kA	0.1	0.0 kA	Current I high alarm
IHWAR	0.0 – 999.9 kA	0.1	0.0 kA	Current I high warning
ILALM	0.0 – 999.9 kA	0.1	0.0 kA	Current I low alarm
ILWAR	0.0 – 999.9 kA	0.1	0.0 kA	Current I low warning
IHYST	0.00 – 0.10 kA	0.01	0.00 kA	Current I hysteresis setting
VHALM	0.0 – 999.9 kV	0.1	0.0 kV	Voltage V high alarm
VHWAR	0.0 – 999.9 kV	0.1	0.0 kV	Voltage V high warning
VLALM	0.0 – 999.9 kV	0.1	0.0 kV	Voltage V low alarm
VLWAR	0.0 – 999.9 kV	0.1	0.0 kV	Voltage V low warning
VHYST	0.0 – 20.0 kV	0.1	0.0 kV	Voltage V hysteresis setting
PHALM	–999.9 – 999.9 MW	0.1	0.0 MW	Active power P high alarm
PHWAR	–999.9 – 999.9 MW	0.1	0.0 MW	Active power P high warning
PLALM	–999.9 – 999.9 MW	0.1	0.0 MW	Active power P low alarm
PLWAR	–999.9 – 999.9 MW	0.1	0.0 MW	Active power P low warning
PHYST	0.0 – 20.0 MW	0.1	0.0 MW	Active power P hysteresis setting
QHALM	–999.9 – 999.9 Mv	0.1	0.0 Mv	Active power P high alarm
QHWAR	–999.9 – 999.9 Mv	0.1	0.0 Mv	Reactive power Q high warning
QLALM	–999.9 – 999.9 Mv	0.1	0.0 Mv	Reactive power Q low alarm
QLWAR	–999.9 – 999.9 Mv	0.1	0.0 Mv	Reactive power Q low warning
QHYST	0.0 – 20.0 Mv	0.1	0.0 Mv	Reactive power Q hysteresis setting
fHALM	25.0 – 75.0 Hz	0.1	25.0 Hz	Frequency Q high alarm
fHWAR	25.0 – 75.0 Hz	0.1	25.0 Hz	Frequency Q high warning

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Element	Range	Step	Default	Remarks
fLALM	25.0 – 75.0 Hz	0.1	25.0 Hz	Frequency Q low alarm
fLWAR	25.0 – 75.0 Hz	0.1	25.0 Hz	Frequency Q low warning
fHYST	0.00 – 0.10 Hz	0.1	0.00 Hz	Frequency Q hysteresis setting
IeHALM	0.00 – 99.99 kA	0.01	0.00 kA	Current Ie high alarm
IeHWAR	0.00 – 99.99 kA	0.01	0.00 kA	Current Ie high warning
IeLALM	0.00 – 99.99 kA	0.01	0.00 kA	Current Ie low alarm
IeLWAR	0.00 – 99.99 kA	0.01	0.00 kA	Current Ie low warning
IeHYST	0 – 100 A	1	0 A	Current Ie hysteresis setting
VeHALM	0.0 – 999.9 kV	0.1	0.0 kV	Voltage Ve high alarm
VeHWAR	0.0 – 999.9 kV	0.1	0.0 kV	Voltage Ve high warning
VeLALM	0.0 – 999.9 kV	0.1	0.0 kV	Voltage Ve low alarm
VeLWAR	0.0 – 999.9 kV	0.1	0.0 kV	Voltage Ve low warning
VeHYST	0.0 – 20.0 kV	0.1	0.0 kV	Voltage Ve hysteresis setting
Demand time	1/5/10/15/30/60 min		10 min	Demand time

Counter, in-service and operation time monitor function

This counter function counts the following items:

- Trip and autoreclosing
- $\sum I^y$
- Operating devices on MIMIC diagram (CB, DS, EDS)
- Configurable counts (max. 8)

The counted values can be reset or set to any values manually.

The counter counts the number of trip and autoreclosing ARC.

The following $\sum I^y$ counter are also provided:

The $\sum I^y$ counter increments the value of current to the power 'y', recorded at the time of issue of the tripping signal, on a phase by phase basis. An alarm is issued when the count for any phase exceeds a user-defined setting $\sum I^y$ALM.

The $\sum I^y$ count alarm can be enabled or disabled by setting the scheme switch [$\sum I^y$AEN].

The count-up timing of devices can be selected one from among the "OFF" to "ON" status, "ON" to "OFF" status, both "ON" and "OFF", and a cycle. The cycle is for counting operation times. It counts up a whole cycle as follows:

Close control -> Close status -> Open control -> Open status

(Earth control -> Earth status -> Free control -> Free status in case of EDS)

The contact conditions of above devices are input to binary input circuits configured by PLC function. (Refer to Section 3.2.2.)

An alarm is issued when the count exceeds a user-defined setting of each device i.e. CBCTALM. The device count alarm can be enabled or disabled by setting the scheme switch of each device i.e. [CBCTAEN].

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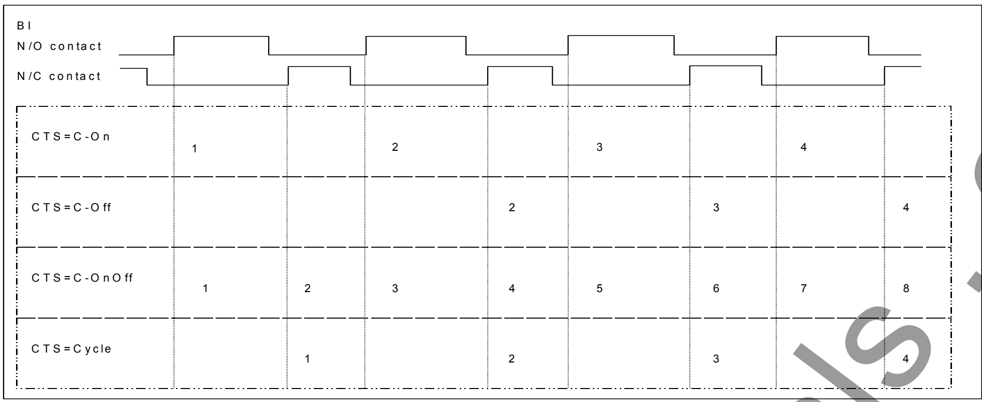


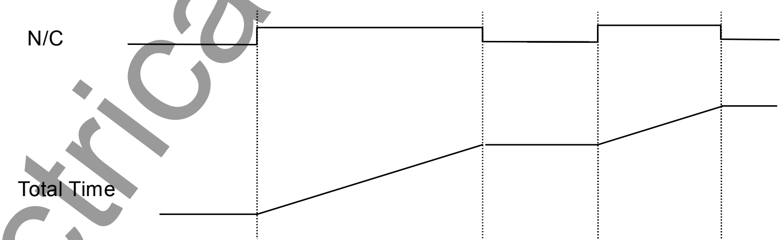
Configurable counter can work by using PLC function and setting count status. The signal for input counter is CNT1_SIG, , CNT8_SIG. The count-up timing can be selected one from among the “OFF” to “ON”, “ON” to “OFF” and both “ON” and “OFF”.

An alarm is issued when the count exceeds a user-defined setting of each counter i.e. CT1ALM. The count alarm can be enabled or disabled by setting the scheme switch of each counter i.e. [CT1AEN].

The accumulated in-service time of the following devices can be monitored

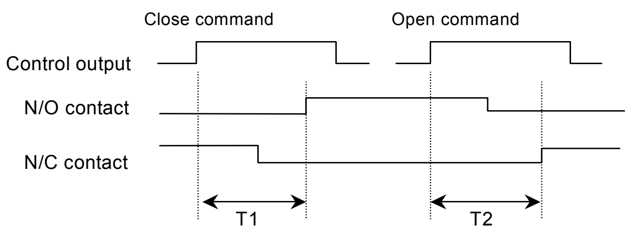
- Circuit breaker (CB)
- Configurable timer (max. 7)

Configurable timer can work by using PLC function. The signal for input timer is ONTIM1_SIG, , ONTIM7_SIG. An alarm is issued when the time exceeds a user-defined setting of each timer i.e. CBCTTALM. The timer alarm can be enabled or disabled by setting the scheme switch of each timer i.e. [CBCTTAEN]. The maximum accumulated time is 30,000 days. If it exceeds 30,000 days, automatically resets to “0”.



Further, the operation time of the following devices can be monitored

- Circuit breaker (CB)
- Disconnector switch (DS1 to DS5)
- 3 State disconnector switch (EDS1 Close, EDS1 Earth, EDS2 Close, EDS2 Earth)



The operation time show the maximum operation time and the last operation time for each device of control direction. If the operation did not succeed (i.e. no response), the time was not recorded.

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The maximum operation time can be cleared manually.

Note: The error of measured operation time is within ±5ms. If a binary output for tripping is applied, the error will be larger.

The setting ranges for counter and timer are as follows:

Element	Range	Step	Default	Remarks
CBCTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	CB count status
DS1CTS – DS5CTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	DS1 – DS5 count status
EDS1CLOSECTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	EDS1 close count status
EDS1EARTHCTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	EDS1 earth count status
EDS2CLOSECTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	EDS2 close count status
EDS2EARTHCTS	NA/C-On/C-Off/C-OnOff/Cycle		NA	EDS2 earth count status
CT1S – CT8S	NA/On/Off/OnOff		NA	Counter1 – Counter8 status
[CBCTAEN]	Off/On		Off	CB count alarm enable
CBCTALM	0 - 29999		0	CB count alarm
[DS1CTAEN] - [DS5CTAEN]	Off/On		Off	DS1 – DS5 count alarm enable
DS1CTALM - DS5CTALM	0 - 29999	1	0	DS1 – DS5 count alarm
[EDS1CLOSECTAEN]	Off/On		Off	EDS1 close count alarm enable
EDS1CLOSECTALM	0 - 29999	1	0	EDS1 close count alarm
[EDS1EARTHCTAEN]	Off/On		Off	EDS1 earth count alarm enable
EDS1EARTHCTALM	0 - 29999	1	0	EDS1 earth count alarm
[EDS2CLOSECTAEN]	Off/On		Off	EDS2 close count alarm enable
EDS2CLOSECTALM	0 - 29999	1	0	EDS2 close count alarm
[EDS2EARTHCTAEN]	Off/On		Off	EDS2 earth count alarm enable
EDS2EARTHCTALM	0 - 29999	1	0	EDS2 earth count alarm
[CT1AEN] - [CT8AEN]	Off/On		Off	Counter1 – Counter8 alarm enable
CT1ALM - CT8ALM	0 - 29999	1	0	Counter1 – Counter8 alarm
[CBCTTAEN]	Off/On		Off	CB close total time alarm enable
CBCTT ALM	0 – 29999 day	1	0	CB close total time
CBCTT ALM	0 – 1439 min	1	0	CB close total time
CBCTT ALM	0 – 59 s	1	0	CB close total time
[TT1AEN] - [TT7AEN]	Off/On		Off	Total time 1 - 7 alarm enable
TT1 ALM - TT7 ALM	0 – 29999 day	1	0	Total time 1 - 7 alarm
TT1 ALM - TT7 ALM	0 – 1439 min	1	0	Total time 1 - 7 alarm
TT1 ALM - TT7 ALM	0 – 59 s	1	0	Total time 1 - 7 alarm
[TripAEN]	Off/On		Off	Trip alarm enable
Trips ALM	1 - 30000	1	0	Trip alarm
[∑I^yA EN]	Off/On		Off	∑ I^y alarm enable
∑ I^yA LM	10 – 30000 E6	E6	10000	∑ I^y alarm threshold setting
Y Value	1.0 – 2.0	0.1	2.0	y value setting
Trips	0 - 99999	1	0	Trip counts for setting
ARCs	0 - 99999	1	0	ARC counts for setting
ΣI^yA, ΣI^yB, ΣI^yC	0 - 99999	1	0	ΣI^y counts for setting

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Element	Range	Step	Default	Remarks
CBCT	0 - 29999	1	0	CB operation counts
DS1CT – DS5CT	0 - 29999	1	0	DS1 – DS5 operation counts
EDS1CLOSECT	0 - 29999	1	0	EDS1 close counts
EDS1EARTHCT	0 - 29999	1	0	EDS1 earth counts
EDS2CLOSECT	0 - 29999	1	0	EDS2 close counts
EDS2EARTHCT	0 - 29999	1	0	EDS2 earth counts
CT1 – CT8	0 - 29999	1	0	Counter1 – Counter8 counts
CBCTT	0 – 29999 day	1	0	CB close total time
CBCTT	0 – 1439 min	1	0	CB close total time
CBCTT	0 – 59 s	1	0	CB close total time
TT1 – TT7	0 – 29999 day	1	0	Total timer 1 - 7
TT1 – TT7	0 – 1439 min	1	0	Total timer 1 - 7
TT1 – TT7	0 – 59 s	1	0	Total timer 1 - 7

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2.7 PLC (Programmable Logic Controller) Function

GRD150 is provided with PLC function allowing user-configurable sequence logics on binary signal. The sequence logics (e.g. trip, interlock and alarm) with timers, flip-flops, AND, OR, NOT logics, etc. can be produced by using the PC software "PLC editor tool" and linked to the signal corresponding to element or binary circuit.

The PLC function is available to produce the following logics and signals and to assign them to BI and BO:

- select & operation control condition, interlock condition
- tripping logic circuit
- protection logic circuit, protection block circuit
- external alarm circuit
- initiation trigger of disturbance record
- etc.

Configurable binary inputs, binary outputs and LEDs are programmed by the PLC function to perform above. And the temporary signals (No.2816 to No.3071) are provided for complicated logics or using user-configured signal in many logics.

For example, when "GEN.TRIP" signal of protection is linked to the binary output auxiliary relay TRP1 of IO1 module (IO1-TP1), the PLC logic is assigned to the signal No. 485 of GEN.TRIP for PLC input and the signal No. 2560 of IO1-TP1 for PLC output as shown in Figure 2.7.1 by the PLC editor tool. For PLC editor tool, refer to PLC tool instruction manual.

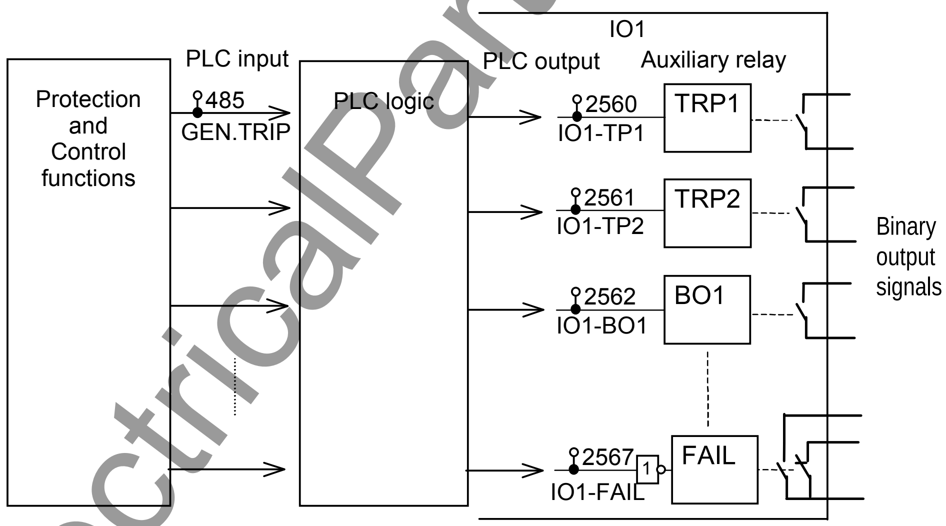

Figure 2.7.1 Binary Output Circuit

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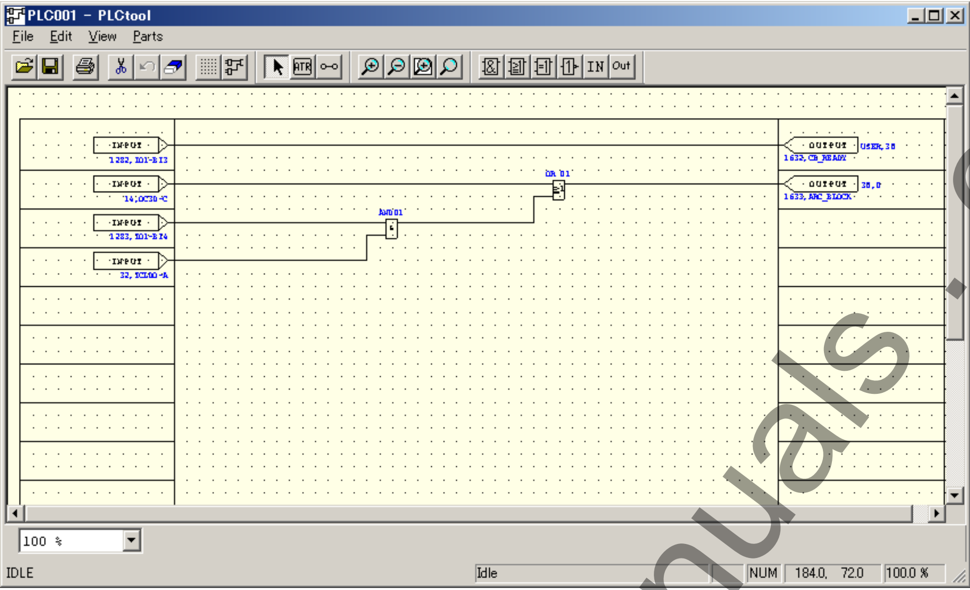
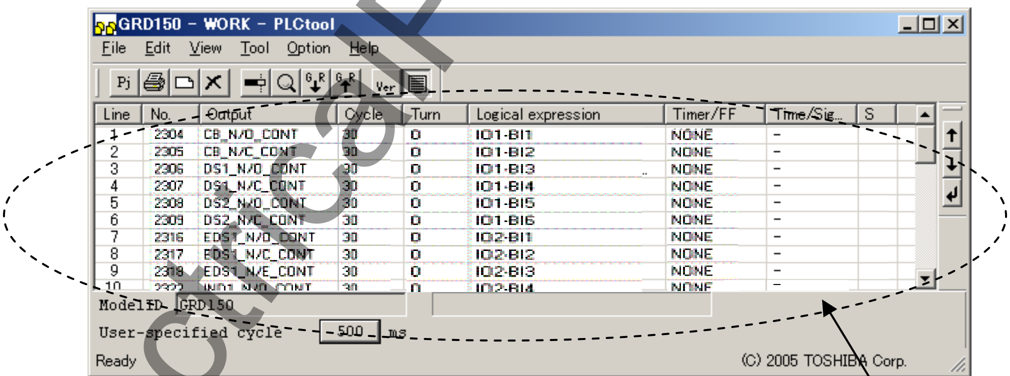


Figure 2.7.2 Sample Screen of Producing Logic by PLC Tool

GRD150 provides 8 user-configurable timers and 8 user-configurable switches with three-positions to be programmed by using the PLC function. Refer to Section 4.2.6.2 'Setting the PLC setting'.

The followings show a sample of signal assigned and control condition produced for control by PLC tool.

Assign status signals of device to BIs.



Status signal of device is assigned to BI.

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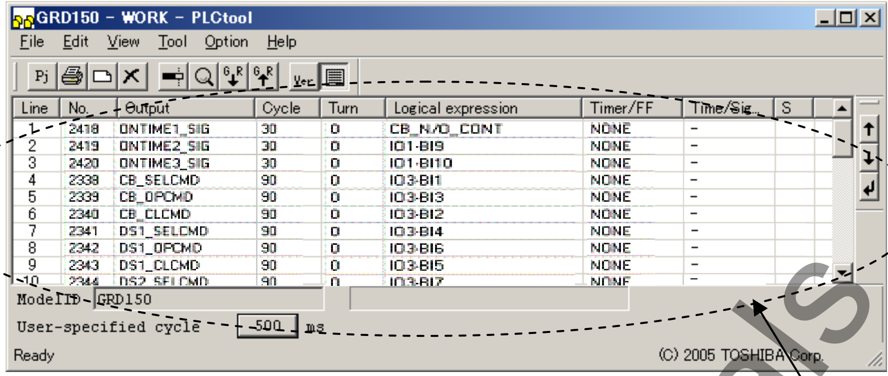
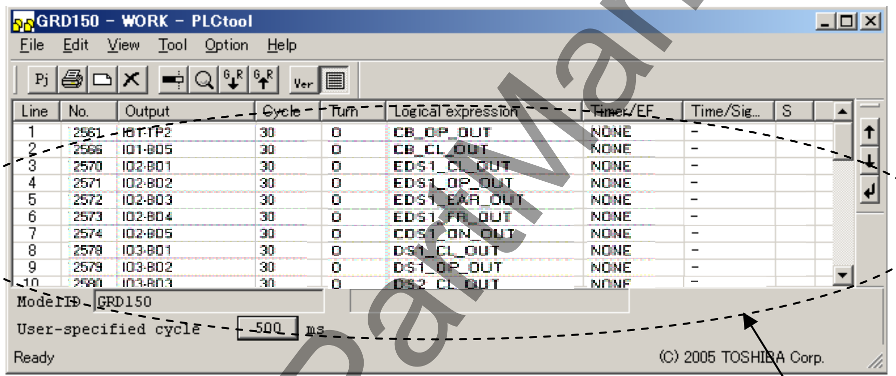
Enter select & operation control condition from PLC.



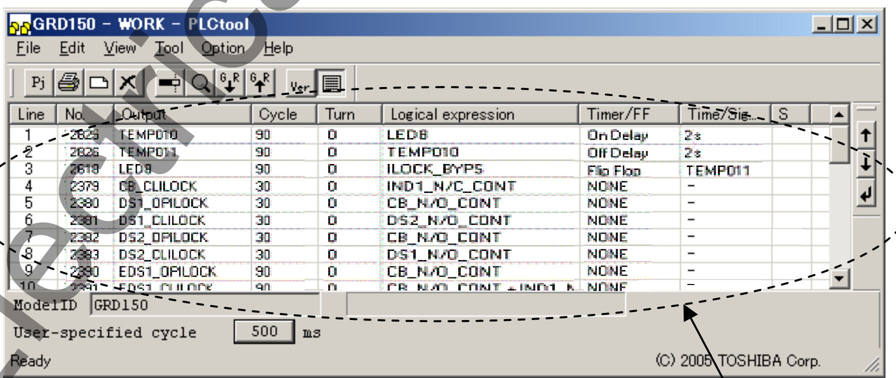
Select & operation control condition from PLC is entered.

Assign control outputs to BOs.



Control output is assigned to BO.

Produce interlock condition and assign it to signal.



Interlock condition is produced and assigned.

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3. Technical Description

3.1 Hardware Description

3.1.1 Outline of Hardware Modules

The outline of GRD150 is shown in Figure 3.1.1.

The detail case outline and dimension of GRD150 is shown in Appendix F.

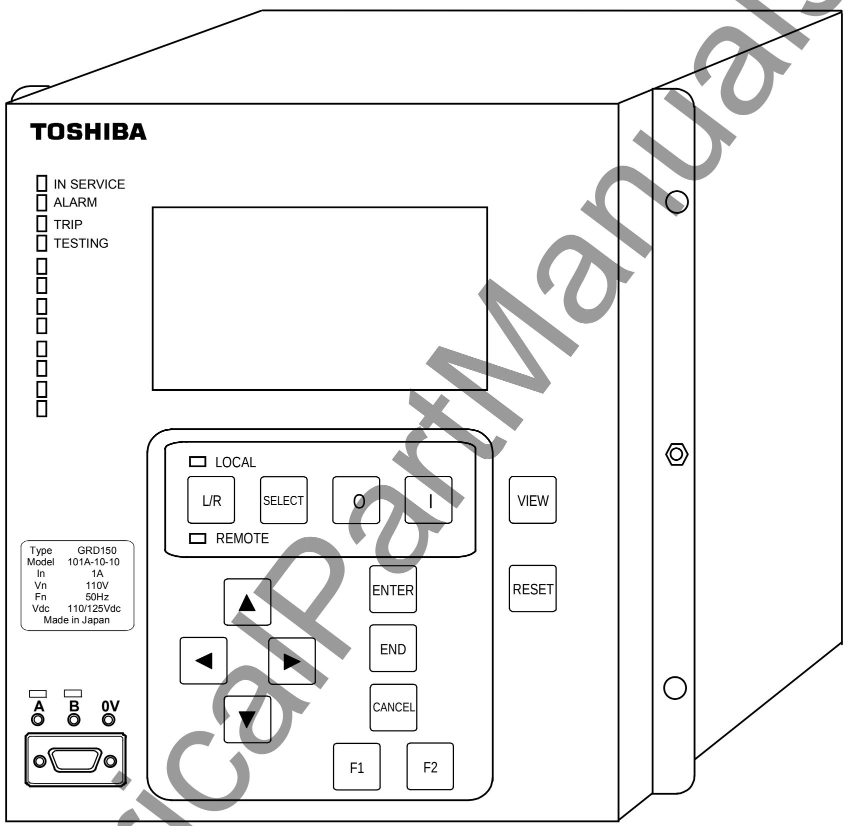

Figure 3.1.1 Outline of GRD150 without Cover

The GRD150 relay unit consists of the following hardware modules.

- Human machine interface module (HMI)
- Transformer module (VCT)
- Signal processing module (SPMM)
- Binary input and output module 1 (IO1)

The following modules are added depending on the model.

- Binary input and output module 2 (IO2) : model ∗∗2, ∗∗3, ∗∗4
- Binary input and output module 3 (IO3) : model ∗∗3, ∗∗4
- Binary input and output module 4 (IO4) : model ∗∗4

The human machine interface module is provided with the front panel. Other modules are behind the human machine interface module. Figure 3.1.2 shows their module location.

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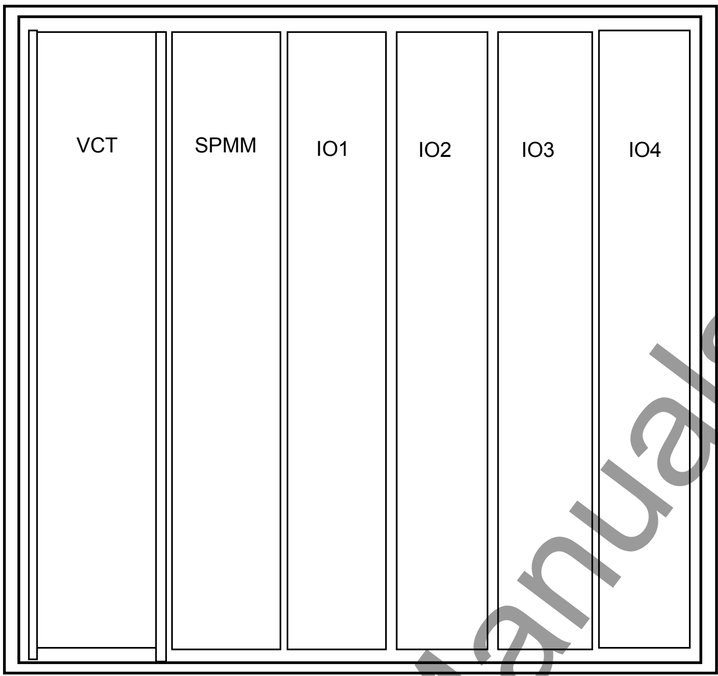

Figure 3.1.2 Hardware structure

The hardware block diagram of GRD150 is shown in Figure 3.1.3.

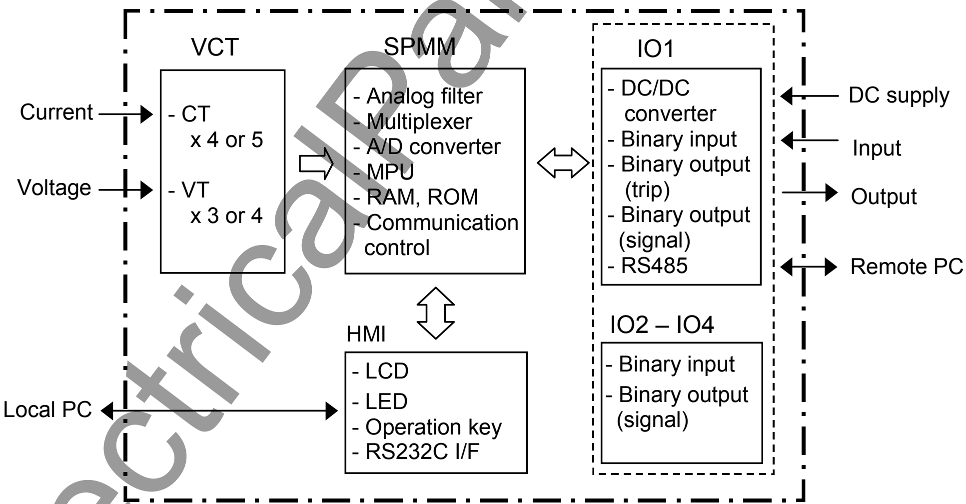

Figure 3.1.3 Hardware Block Diagram

Transformer Module

The transformer module (VCT) insulates between the internal and external circuits through an auxiliary transformer and transforms the magnitude of AC input signals to suit the electronic circuits. The AC input signals are as follows:

- three-phase currents (I_a, I_b and I_c)
- residual current (I_o) and zero-sequence current for models 200 and 400 series
- three-phase voltages (V_a, V_b and V_c)
- residual voltage (V_0) for model 100 and 200 series, or phase voltage or phase-to-phase voltage for synchronism check of model 300 and 400 series

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This module incorporates 4 or 5 auxiliary CTs and 3 or 4 auxiliary VTs depending on the relay model. (The reference between the relay model and number of AC input signal is given in Table 3.2.1.)

SPMM Module

The SPMM module consists of analogue filter, analogue to digital (A/D) converter, multiplexer, main processing unit (MPU), random access memory (RAM) and read only memory (ROM) and executes all kinds of processing such as protection, control, measurement, recording, communication and display.

The SPMM module also incorporates an RS485 transceiver. The RS485 transceiver is used for communications such as link with the relay setting and monitoring (RSM) system, IEC60870-5-103, DNP3.0 and ModBus.

IO1 Module

The IO1 module consists of a DC/DC converter for DC power supply, 10 photo-coupler circuits for binary input signals and 8 auxiliary relays for binary output circuits.

The available input voltage ratings of the DC/DC converter are 48V, 110V/125V or 220/250V. The normal range of input voltage is −20% to +20%.

In 8 auxiliary relays, two heavy load and high-speed auxiliary relays TRP1 and TRP2 have one normally open contact and are mainly used for tripping. The auxiliary relay BO6 has one normally open and one normally closed contact, and operates when a relay failure or abnormality in the DC circuit is detected. Other auxiliary relays BO1 to BO5 have one normally open contact. Refer to Appendix G.

IO2 to IO4 Modules

These modules consist of 11 photo-coupler circuits for binary input signals, 8 auxiliary relays for binary output circuits.

In 8 auxiliary relays, two heavy load and high-speed auxiliary relays TRP1 and TRP2 have one normally open contact and are mainly used for tripping. Auxiliary relays BO1 to BO5 have one normally open contact. The auxiliary relay BO6 has one normally open and one normally closed contact.

Human Machine Interface (HMI) Module

The operator can access the GRD150 via the human machine interface (HMI) module. As shown in Figure 3.1.4, the HMI panel has a graphical liquid crystal display (LCD), light emitting diodes (LED), view and reset keys, operation keys and an RS232C connector on the front panel.

The LCD consists of 240 × 128 dots and 16 × 40 characters with a backlight and displays recording, metering, status, setting data and MIMIC configuration picture.

There are a total of 14 LED indicators and their signal labels and LED colors are defined as follows:

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Label	Color	Remarks
IN SERVICE	Green	Lit when the relay is in service and flickered when the relay is in "Test" menu.
ALARM	Red	Lit when a failure is detected.
TRIP	Red	Lit when a trip command is issued.
TESTING	Red	Lit when test condition is set.
(LED1) to (LED8)	Multi-color (Green/Yellow/Red)	User-configurable
LOCAL	Red	Lit when local control mode is selected.
REMOTE	Green	Lit when remote control mode is selected.

LED1 to LED8 are user-configurable, whose color can be selected from green, yellow and red by MIMIC editor. Each is driven via a logic gate which can be programmed by PLC function.

The TRIP, ALARM and an operated LED if latching operation is selected, must be reset by user, either by pressing the RESET key, by energising a binary input which has been programmed for 'Remote Reset' operation, or by a communications command. Other LEDs operate as long as a signal is present. The RESET key is ineffective for these LEDs.

The VIEW key starts the LCD indication and switches between windows. The RESET key clears the LCD indication and turns off the LCD backlight.

The operation keys are used to display the record, status and setting data on the LCD, input the settings or change the settings.

The RS232C connector is a 9-way D-type connector for serial RS232C connection. This connector is used for connection with a local personal computer.

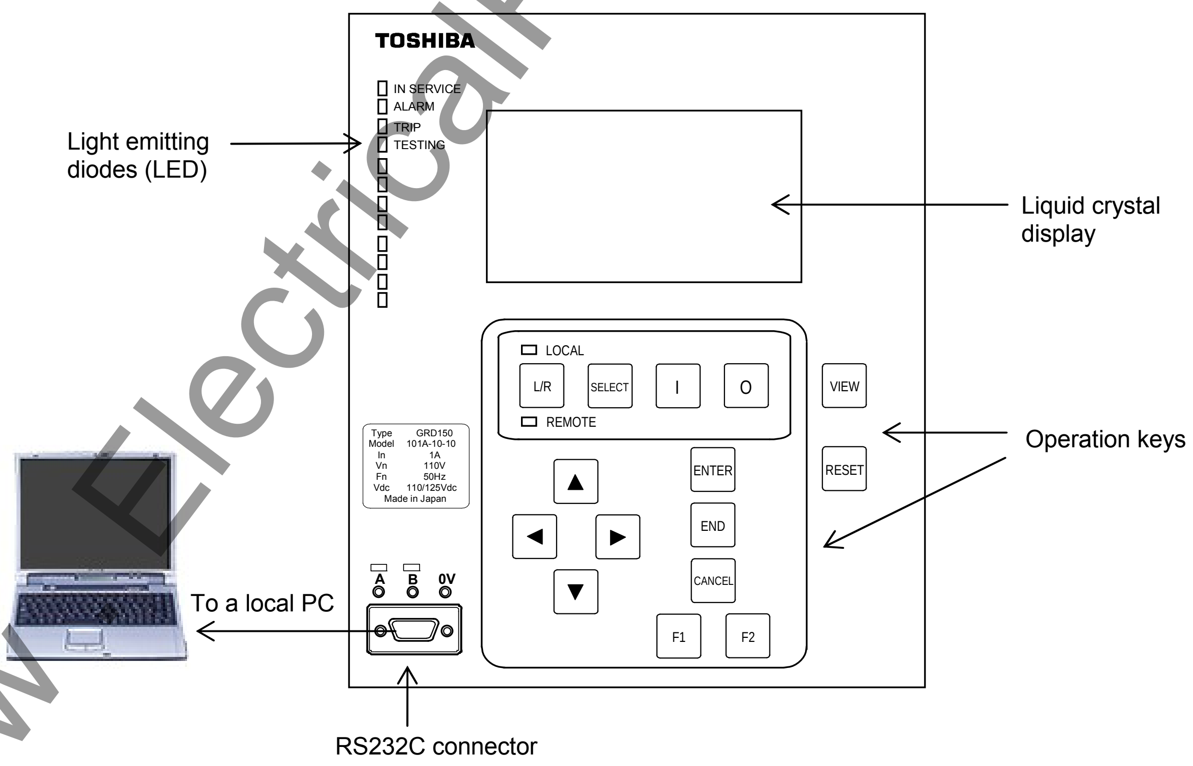

Figure 3.1.4 Front Panel

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3.2 Input and Output Signals

3.2.1 AC Input Signals

Table 3.2.1 shows the AC input signals necessary for the GRD150 model and their respective input terminal numbers.

Table 3.2.1 AC Input Signals

Term. No. of TB1	[APPL-CT] setting			[APPL-VT] setting			
	3P	2P	1P	3PN	3PV	3PP	2PP
1-2	A phase current	A phase current	---	---	---	---	---
3-4	B phase current	---	---	---	---	---	---
5-6	C phase current	C phase current	---	---	---	---	---
7-8	Residual current	Residual current	Residual current	---	---	---	---
9-10	Zero sequence current (*)	Zero sequence current (*)	Zero sequence current (*)	---	---	---	---
11-12	---	---	---	A phase voltage	A phase voltage	A-B phase voltage	A-B phase voltage
13-14	---	---	---	B phase voltage	B phase voltage	B-C phase voltage	B-C phase voltage
15-16	---	---	---	C phase voltage	C phase voltage	C-A phase voltage	---
17-18	---	---	---	---	Residual voltage or phase voltage (**)	Residual voltage or phase voltage (**)	Residual voltage or phase voltage (**)

(*): Required for Model 200 and 400 series with SEF elements.
(**): Phase voltage is required for Model 300 and 400 series with autoreclose function.

3.2.2 Binary Input, Output Signals

The GRD150 provides 10 to 43 user-configurable binary inputs and 8 to 32 user-configurable binary outputs mounted on IO1 to IO4 modules depending on its model. All inputs and outputs, except the relay failure signal FAIL, are programmable by PLC function.

Figures 3.2.1 shows binary input circuits of IO1 and IO2. IO3 and IO4 have the same circuit of IO2. For these signal number, see Appendix C.

Figures 3.2.2 shows binary output circuits of IO1 and IO2. IO3 and IO4 have the same circuit of IO2. For these signal number, see Appendix C.

The relay failure contact closes when a relay defect or abnormality in the DC power supply circuit is detected.

The operating voltage of binary input signal is typical 74V DC at 110V/125V DC rating and 138V DC at 220/250V DC. The minimum operating voltage is 70V DC at 110/125V DC rating and 125V DC at 220/250V DC.

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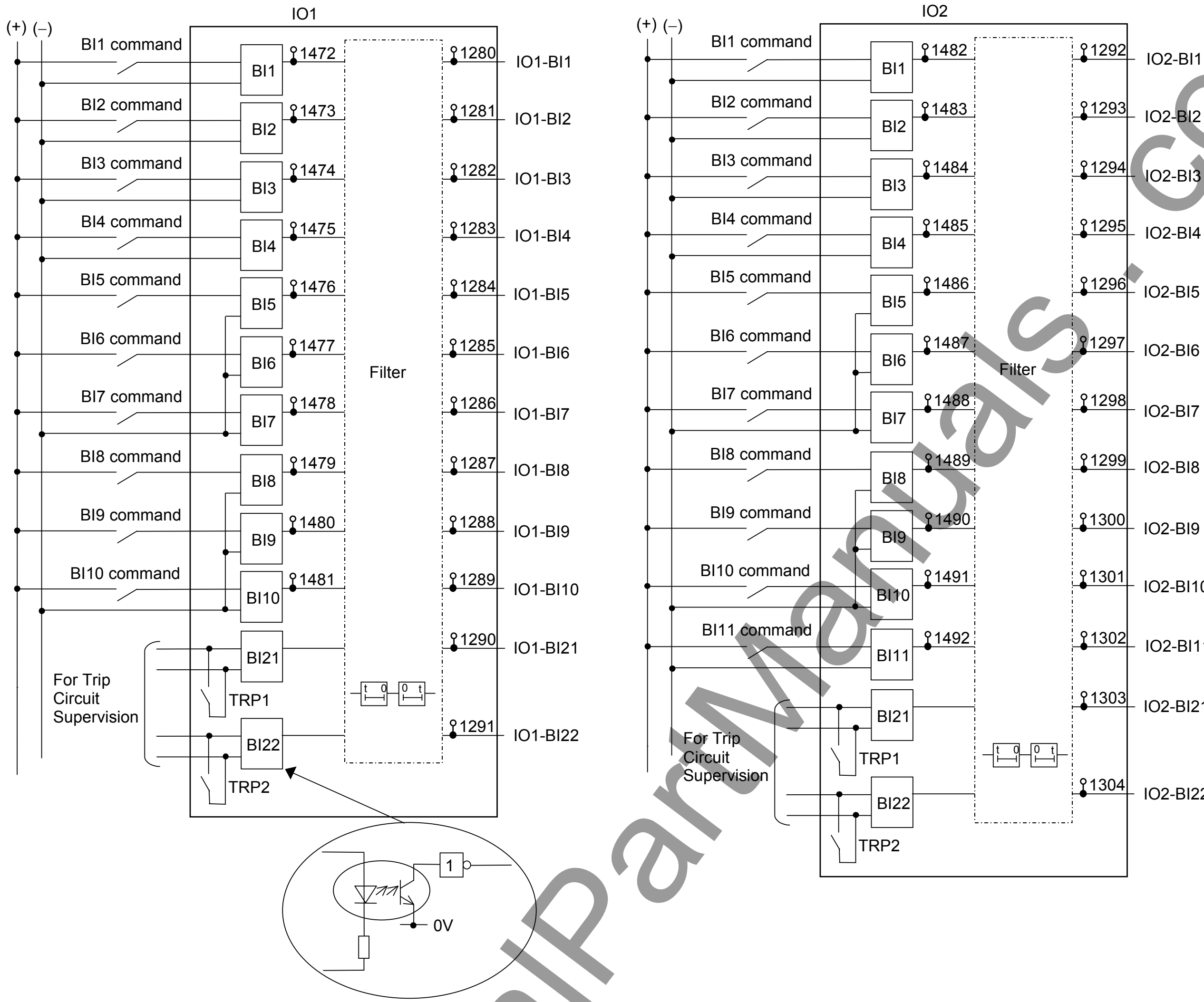

3.2.1 Binary Input Circuit

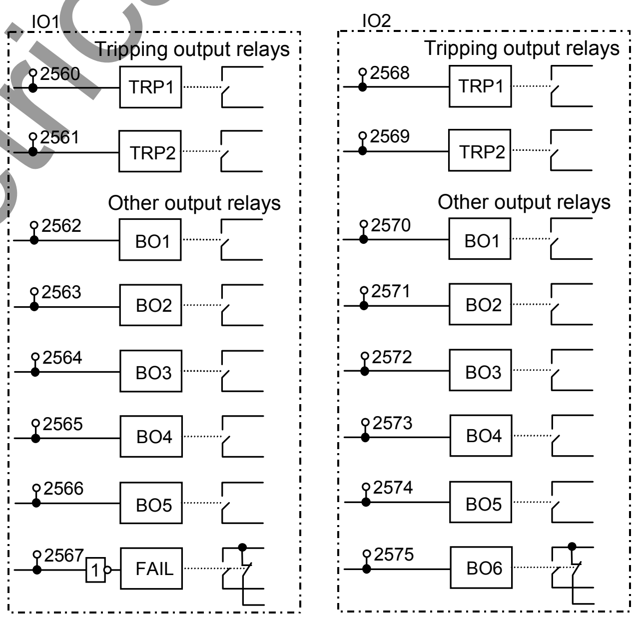

Figure 3.2.2 Binary Output Circuit

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3.3 Automatic Supervision

3.3.1 Basic Concept of Supervision

Though the protection system is in a non-operating state under normal conditions, it waits for a power system fault to occur at any time, and must operate for the fault without fail. Therefore, the automatic supervision function, which checks the health of the protection system during normal operation, plays an important role. The GRD150 implements an automatic supervision function, based on the following concepts:

- The supervising function should not affect the protection performance.
- Perform supervision with no omissions wherever possible.
- When a failure occurs, it is recorded as Alarm record, the user should be able to easily identify the location of the failure.

3.3.2 Relay Monitoring

The relay is supervised by the following functions.

AC input imbalance monitoring

The AC current input is monitored to check that the following equation is satisfied and the health of the AC input circuit is checked.

- CT circuit current monitoring for [APPL-CT] = "3P" setting

  $\mathrm{Max}(|I_a|, |I_b|, |I_c|) - 4 \times \mathrm{Min}(|I_a|, |I_b|, |I_c|) \geq k_0$

  where,

  $\mathrm{Max}(|I_a|, |I_b|, |I_c|)$ = Maximum amplitude among I_a, I_b and I_c
  $\mathrm{Min}(|I_a|, |I_b|, |I_c|)$ = Minimum amplitude among I_a, I_b and I_c
  k_0 = 20% of rated current

- Zero sequence voltage monitoring for [APPL-VT]= "3PN" setting

  $|V_a + V_b + V_c| / 3 \leq 6.35$ (V)

- Negative sequence voltage monitoring for [APPL-VT]= "3PN" and "3PV" setting

  $|V_a + a^2V_b + aV_c| / 3 \leq 6.35$ (V)

  where, a = Phase shifter of 120°, a^2 = Phase shifter of 240°

The CT circuit current monitoring allows high sensitivity detection of failures that have occurred in the AC input circuit.

The zero sequence monitoring and negative sequence monitoring allow high sensitivity detection of failures that have occurred in the AC input circuits.

The negative sequence voltage monitoring allows high sensitivity detection of failures in the voltage input circuit, and it is effective for detection particularly when cables have been connected with the incorrect phase sequence.

A/D accuracy checking

An analog reference voltage is input to a prescribed channel in the analog-to-digital (A/D) converter, and it is checked that the data after A/D conversion is within a prescribed range, and that the A/D conversion characteristics are correct.

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Memory monitoring

Memory is monitored as follows, depending on the type of memory, and checks are done to verify that memory circuits are healthy:

- Random access memory monitoring: Writes/reads prescribed data and checks the storage function.
- Program memory monitoring: Checks the checksum value of the written data.
- Setting value monitoring: Checks discrepancies between the setting values stored in duplicate.

Watchdog Timer

A hardware timer that is cleared periodically by the software is provided, which checks that the software is running normally.

DC Supply Monitoring

The secondary voltage level of the built-in DC/DC converter is monitored, and is checked to see that the DC voltage is within a prescribed range.

LCD Panel Connection Monitoring

The connection between LCD panel (HMI module) and SPMM module is monitored.

3.3.3 CT Failure Supervision

This function is available for [APPL-CT] = “3P” setting only.

Figure 3.3.1 shows the scheme logic of the CT failure supervision (CTFS). If the residual overcurrent element EFF(EFCF) operates and the residual overvoltage element ZOVF(ZOVCF) does not operate, CT failure (CTF) is detected. When the CTFS detects a CTF, can alarm and block various protections by PLC function.

The CTF signal is reset 100 ms after the CT failure condition has reset. When the CTF continues for 10s or more, an alarm signal “CTF alarm” is output.

Further, the CT failure is detected when the binary input signal (external CTF) by PLC function is received.

This function can be enabled or disabled by the scheme switch [CTFEN] and has a programmable reset characteristic. For latching operation, set to “ON”, and for automatic reset after the recover, set to “OPT-ON”.

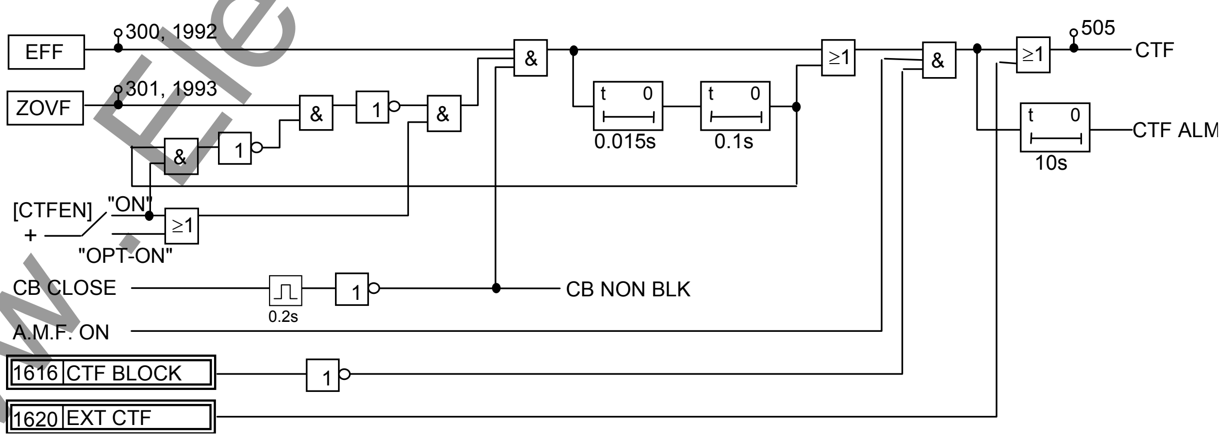

Figure 3.3.1 CT Failure Supervision

3.3.4 VT Failure Supervision

This function is available for [APPL-VT] = "3PN" and "3PV" settings.

When a fault occurs in the secondary circuit of the voltage transformer (VT), the voltage dependent measuring elements may operate incorrectly. GRD150 incorporates a VT failure supervision function (VTFS) as a measure against such incorrect operation. When the VTFS detects a VT failure, it can alarm and block the following voltage dependent protections by PLC function.

- Directional overcurrent protection
- Directional earth fault protection
- Directional sensitive earth fault protection
- Directional negative overcurrent protection

A binary input signal (external VTF) to indicate a miniature circuit breaker trip in the VT circuits is also available for the VTFS.

Scheme logic

Figure 3.3.2 shows the scheme logic for the VTFS. VT failure is detected by the following two schemes.

VTF1: The residual overcurrent element EFF(EFVF) does not operate (EFF=0), the residual overvoltage element ZOVF(ZOVVF) operates (ZOVF=1) and the phase current change detection element OCDF(OCDVF) does not operate (OCDF=0).

VTF2: The phase undervoltage element UVF(UVVF) operates (UVF=1) when the three phases of the circuit breaker are closed (CB CLOSE=1) and the phase current change detection element OCDF(OCDVF) does not operate (OCDF=0).

In order to prevent detection of false VT failures due to unequal pole closing of the circuit breaker, the VTFS is blocked for 200 ms after line energization.

The VTF signal is reset 100 ms after the VT failure condition has reset. When the VTF continues for 10s or more, an alarm signal "VTF1 alarm" or "VTF2 alarm" is output.

Further, the VT failure is detected when the binary input signal (external VTF) by PLC function is received.

This function can be enabled or disabled by the scheme switch [VTF1EN] or [VTF2EN] and has a programmable reset characteristic. For latching operation, set to "ON", and for automatic reset after the recover, set to "OPT-ON".

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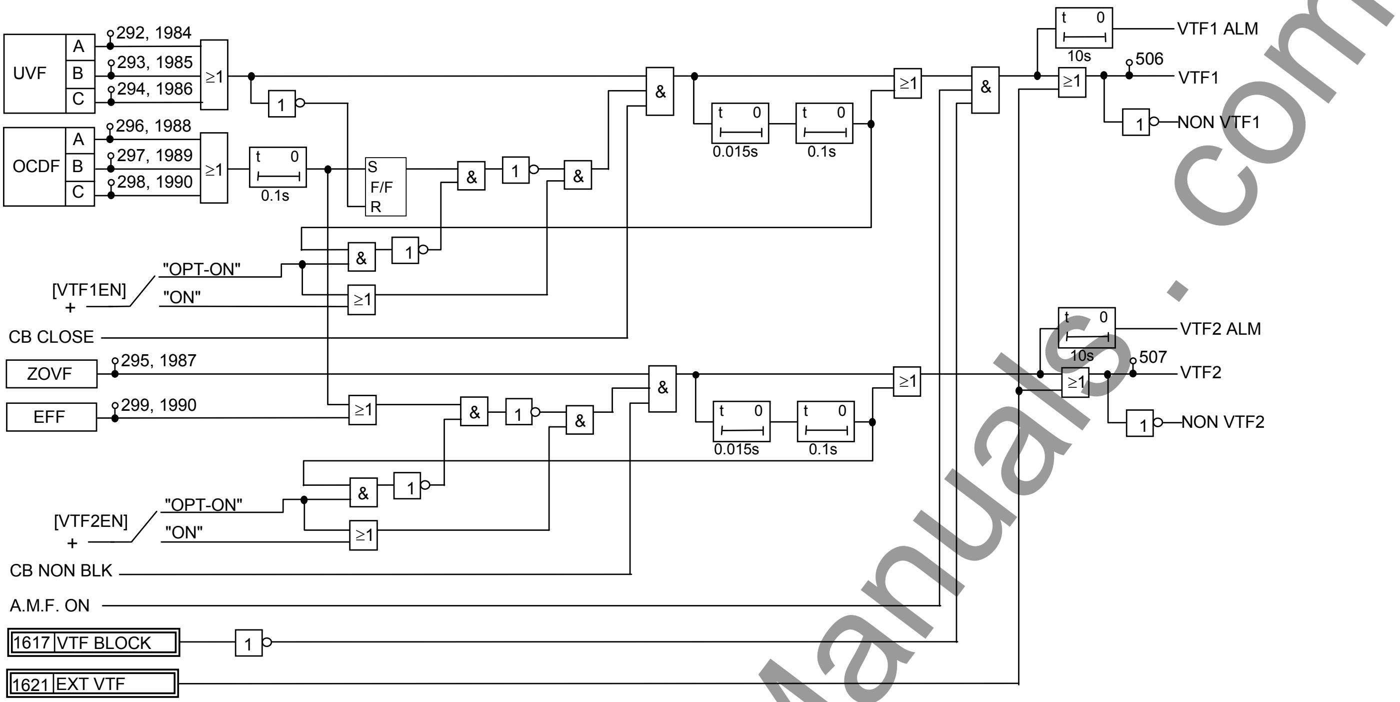

Figure 3.3.2 VT Failure Supervision

3.3.5 Trip Circuit Supervision

The circuit breaker tripping control circuit can be monitored by a binary input. Figure 3.3.3 shows a typical scheme. When the trip circuit is complete, a small current flows through the binary input and the trip circuit. Then logic signal of the binary input circuit BI21 is "1".

If the trip supply is lost or if a connection becomes an open circuit, then the binary input resets and the BI21 output is "0". A trip circuit fail alarm TCSV1 is output when the BI21 output is "0".

This function is provided with each tripping circuit TRP1 and TRP2 of IO modules.

If the trip circuit failure is detected, then “ALARM” LED is lit and “TC∗ fail” is displayed in LCD message and alarm record message respectively.

The monitoring is enabled by setting the scheme switch [TCSVEN∗] to "ON" or "OPT-ON". When "OPT-ON" is selected, the monitoring is enabled only while CB is closed.

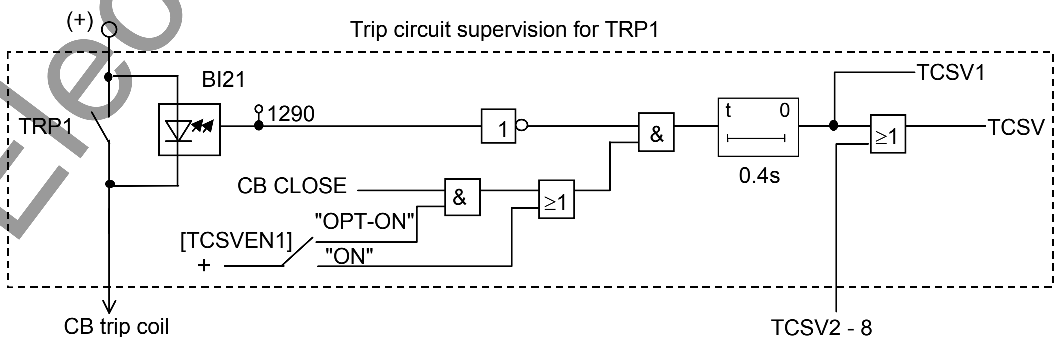

Figure 3.3.3 Trip Circuit Supervision Scheme Logic

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3.3.4 Circuit Breaker State Monitoring

The relay provides the circuit breaker state monitoring function.

If two binary inputs are programmed to the functions ‘CB OPEN’ and ‘CB CLOSED’ by PLC, then the CB state monitoring function becomes active. In normal circumstances these inputs are in opposite states. If both show the same state during one second, then “ALARM” LED is lit and “CB err” are displayed in LCD message and alarm record message respectively.

3.3.5 Failure Alarms

When a failure is detected by the automatic supervision, it is followed with an LCD message, LED indication, external alarm and alarm recording. Table 3.3.1 summarizes the supervision items and alarms.

The LCD messages are shown on the "Alarm view" screen, which is displayed automatically when a failure is detected or displayed by pressing the VIEW key. The alarm record messages are shown on the "Record-Alarm record" screen.

The alarms are retained until the failure is recovered.

The AC input imbalance monitoring alarms can be disabled collectively by setting the scheme switches [CTSVEN], [V0SVEN] and [V2SVEN] to "OFF". The setting is used to block unnecessary alarms during commissioning, test or maintenance.

When the Watchdog Timer detects that the software is not running normally, LCD display and alarm recording of the failure may not function normally.

Table 3.3.1 Supervision Items and Alarms

Supervision Item	Alarm view Message	LED "RUN"	LED "ALARM"	External alarm (28F)	Alarm record Message
AC input imbalance monitoring	CT err, V0 err, V2 err	On/Off (2)	On	(4)	CT err, V0 err, V2 err
A/D accuracy check	A/D err, Relay fail	Off	On	(4)	A/D err, Relay fail
Memory monitoring	SUM err, SRAM err, BU-RAM err, EEPROM err				SUM err, SRAM err, BU-RAM err, EEPROM err
Watchdog Timer	----	Off	On	(4)	----
DC supply monitoring	DC err	Off	(3)	Off	Relay fail-A
LCD panel connection monitoring	PANEL err	On	On	Off	Relay fail-A
Trip circuit supervision	TC1 fail, TC2 fail, TC3 fail, TC4 fail	On	On	Off	TC1 fail, TC2 fail, TC3 fail, TC4 fail
CB state monitoring	CB err	On	On	Off	CB err

(1): Diverse messages are provided as expressed with "--- err" in the table in Section 6.7.2.
(2): The LED is on when the scheme switch [CTSVEN], [V0SVEN] or [V2SVEN] is set to "ALM" and off when set to "ALM & BLK" (refer to Section 3.3.6).
(3): Whether the LED is lit or not depends on the degree of the voltage drop.
(4): The binary output relay "FAIL" operates.

The relationship between the LCD message and the location of the failure is shown in Table 6.7.1 in Section 6.7.2.

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3.3.6 Trip Blocking

When a failure is detected by the following supervision items, the trip function is blocked as long as the failure exists, and is restored when the failure is removed.

- A/D accuracy check
- Memory monitoring
- Watchdog Timer

When a fault is detected by the AC input imbalance monitoring, the scheme switches [CTSVEN], [V0SVEN] and [V2SVEN] setting can be used to determine if both tripping is blocked and an alarm is output, or if only an alarm is output.

3.3.7 Setting

The setting element necessary for the automatic supervision and its setting range are shown in the table below.

Element	Range	Step	Default	Remarks
CTF supervision				
EFF	0.05 - 25.00 A (0.01 - 5.00 A	0.01 A 0.01 A	1.00 A 0.20 A) (*)	Residual overcurrent threshold setting
ZOVF	5.0 – 130.0 V	0.1 V	20.0 V	Residual overvoltage threshold setting
VTF supervision				
UVF	5.0 – 130.0 V	0.1 V	51.0 V	Undervoltage threshold setting
OCDF	0.5 A (Fixed) (0.1 A (Fixed))			Phase current change detection
[CTFEN]	Off/On/OPT-On		Off	CTF supervision
[VTF1EN]	Off/On/OPT-On		Off	VTF1 supervision
[VTF2EN]	Off/On/OPT-On		Off	VTF2 supervision
[CTSVEN]	Off/ALM&BLK/ALM		ALM	AC input imbalance monitoring (current)
[V0SVEN]	Off/ALM&BLK/ALM		ALM	AC input imbalance monitoring (Vo)
[V2SVEN]	Off/ALM&BLK/ALM		ALM	AC input imbalance monitoring (V2)
[TCSVEN1]	Off/On/OPT-On		Off	Trip circuit supervision for IO1-TRP1
[TCSVEN2]	Off/On/OPT-On		Off	Trip circuit supervision for IO1-TRP2
[TCSVEN3]	Off/On/OPT-On		Off	Trip circuit supervision for IO2-TRP1
[TCSVEN4]	Off/On/OPT-On		Off	Trip circuit supervision for IO2-TRP2
[TCSVEN5]	Off/On/OPT-On		Off	Trip circuit supervision for IO3-TRP1
[TCSVEN6]	Off/On/OPT-On		Off	Trip circuit supervision for IO3-TRP2
[TCSVEN7]	Off/On/OPT-On		Off	Trip circuit supervision for IO4-TRP1
[TCSVEN8]	Off/On/OPT-On		Off	Trip circuit supervision for IO4-TRP2
[CBSVEN]	Off/On		Off	CB condition supervision

(*) Current values shown in the parentheses are in the case of 1 A rating. Other current values are in the case of 5 A rating.

When setting the ZOVF and EFF, the maximum detection sensitivity of each element should be set with a margin of 15 to 20% taking account of variations in the system voltage, the asymmetry of the primary system and CT and VT error.

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3.4 Recording Function

The GRD150 is provided with the following recording functions:

Fault recording

Alarm recording

Event recording

Disturbance recording

Counters

These records are displayed on the LCD of the relay front panel or on the local or remote PC.

3.4.1 Fault Recording

Fault recording is started by any of a tripping command of the GRD150 and start commands "2624:F.RECOD1" to "2627:FRECORD4" by PLC, and the following items are recorded for one fault:

Date and time
Trip mode
Operating phase
Fault location
Relevant events
Power system quantities

Up to the 8 most-recent faults are stored as fault records. If a new fault occurs when 8 faults have been stored, the record of the oldest fault is deleted and the record of the latest fault is then stored.

Date and time occurrence

This is the time at which a tripping command or a start command by PLC has been initiated.

The time resolution is 1 ms using the relay internal clock.

Trip mode

This shows the protection scheme such as DOC1, DEF1, OC1 etc. that output the tripping command.

Operating phase

This is the phase to which a tripping command is output.

Fault location

The distance to the fault point calculated by the fault locator is recorded.
The distance is expressed in km and as a percentage (%) of the line length.

Relevant events

Such events as autoreclose, re-tripping following the reclose-on-to-a fault or autoreclose and tripping for evolving faults are recorded with time-tags.

Power system quantities

The following power system quantities in pre-faults and post-faults are recorded.

- Magnitude and phase angle of phase voltage (V_a, V_b, V_c)

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- Magnitude and phase angle of phase-to-phase voltage (V_{ab}, V_{bc}, V_{ca})
- Magnitude and phase angle of symmetrical component voltage (V_1, V_2, V_0)
- Magnitude and phase angle of zero sequence voltage which is measured directly in the form of the system residual voltage (Ve) for model 100 and 300 series
- Magnitude and phase angle of voltage for synchronism check (V_S) for model 300 and 400 series
- Magnitude and phase angle of phase current (I_a, I_b, I_c)
- Magnitude and phase angle of symmetrical component current (I_1, I_2, I_0)
- Magnitude and phase angle of zero sequence current from residual circuit (I_e)
- Magnitude and phase angle of zero sequence current from core balance CT (Ise) for model 200 and 400 series
- Percentage of thermal capacity (THM%) only recorded at post-fault
- Frequency (f)

The displayed power system quantities depend on [APPL-CT] and [APPL-VT] setting as shown in Table 3.4.1.

The zero sequence current I_e in "3P" setting of the model 420 is calculated from the three phase input currents and the calculated I_e (I_0) is displayed. The I_e in other settings and models is displayed the current fed from CT.

Table 3.4.1 Displayed Power System Quantities

Power system quantities	[APPL-CT]			[APPL-VT]			
	3P	2P	1P	3PN	3PV	3PP	2PP
Phase voltage	—	—	—	V_a, V_b, V_c	V_a, V_b, V_c	—	—
Phase-to-phase voltage	—	—	—	—	—	V_{ab}, V_{bc}, V_{ca}	V_{ab}, V_{bc}
Symmetrical component voltage	—	—	—	V_1, V_2, V_0			
Phase current	I_a, I_b, I_c	I_a, I_c	—	—	—	—	—
Zero sequence current from residual circuit	I_e	I_e	I_e	—	—	—	—
Symmetrical component current	I_1, I_2, I_0			—	—	—	—
Percentage of thermal capacity	THM	THM	—	—	—	—	—

3.4.2 Alarm Recording

The alarms in the automatic supervision are recorded with the 1 ms resolution time-tag when the alarm occurs.

Up to the 32 alarms can be stored. If an additional alarm occurs when 32 records have been stored, the oldest alarm record is deleted and the latest alarm record is then stored. The record during alarming can not be deleted.

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3.4.3 Event Recording

The events are recorded with the 1 ms resolution time-tag when the status changes. The user can set the maximum 128 recording items and their status change mode by RSM100. The event recording is initiated by PLC function. The event item and name is set by RSM100. The event items can be assigned to a signal number in the signal list. The status change mode is set to “On” (only recording when On.) or “On/Off”(recording when both On and Off.) mode by setting. The items of “On/Off” mode are specified by “Bi-trigger events” setting. If the “Bi-trigger events” is set to “100”, No.1 to 100 events are “On/Off” mode and No.101 to 128 events are “On” mode.

The elements necessary for event recording and their setting ranges are shown in the table below.

Element	Range	Step	Default	Remarks
Bi-trigger events	0 - 128	1	100	Number of bi-trigger(on/off) events
EVENT1 – EVENT128	0 - 3071			Assign the signal number

Up to 480 records can be stored. If an additional event occurs when 480 records have been stored, the oldest event record is deleted and the latest event record is then stored.

3.4.4 Disturbance Recording

Disturbance recording is started when a start command by PLC is initiated. User can configure eight disturbance record triggers (Signal No.:2632 to 2639) by PLC editor, and can set them “use (=ON)” or “no use (=OFF)” respectively, as shown in Figure 3.4.1. OC, EF, SEF, NOC, OV, UV, ZOV, and NOV elements are provided as a starter element. The signal number of desired starting element is connected to the disturbance record trigger by PLC function.

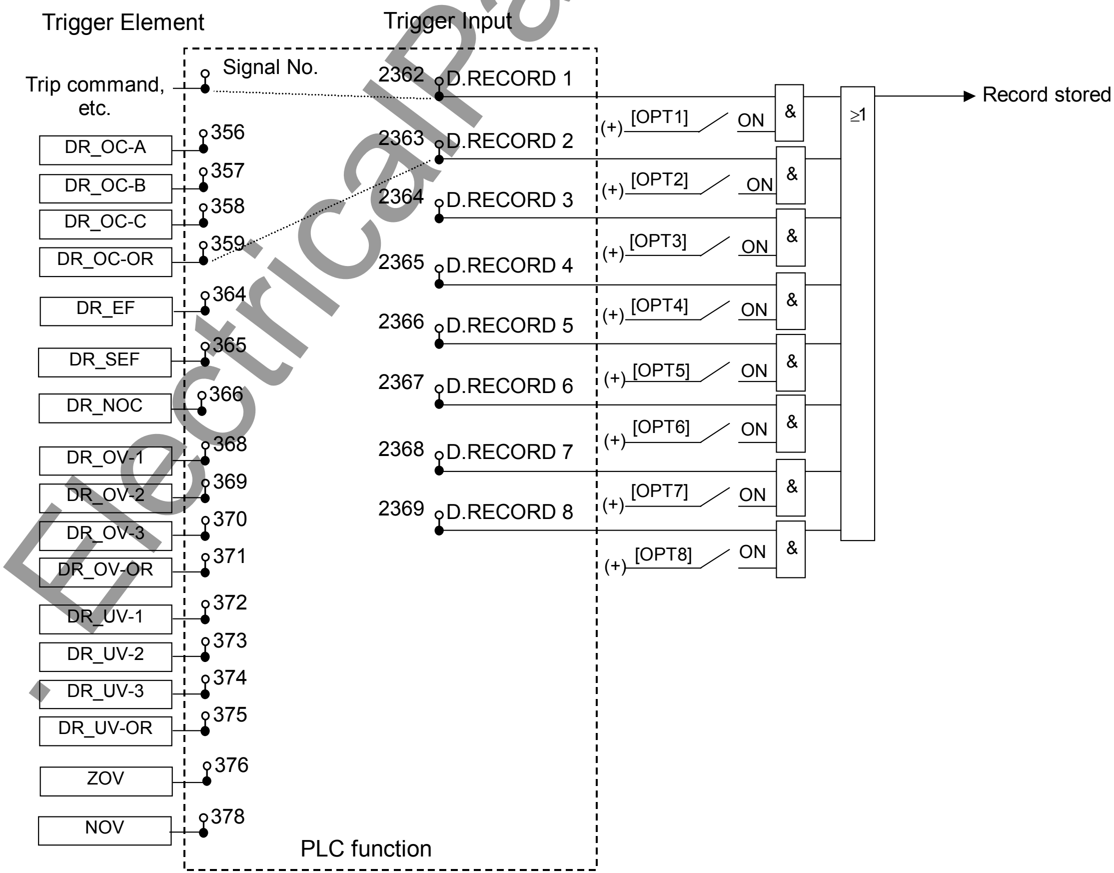

Figure 3.4.1 Disturbance Record Initiation

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The records include maximum 9 analogue signals (I_a, I_b, I_c, I_e, I_{se}, V_a, V_b, V_c, $V_{0(e)}$), 32 binary signals and the dates and times at which recording started. The binary signals and their names can be set by RSM100.

The LCD display only shows the dates and times of disturbance records stored. Details can be displayed on a PC. For how to obtain disturbance records on the PC, see the PC software (RSM100) instruction manual.

The recording time is can be set between 0.1 and 60.0s. If the setting value more than maximum recording time is input, the time is set the maximum recording time. The pre-fault recording time (pre-trigger time position) can be set 0 to 100% of the recording time setting. After trigger, the next trigger is not set during the pre-trigger time.

When the memory for disturbance recording will be full, user can select either "OW" (overwrite) or "SAT" (saturation: do not overwrite). In the "OW" mode, when the memory is full, new disturbance record is overwritten on the oldest one. If "SAT" mode is selected. The recording is stopped and the signal "D.REC_FULL" (Signal No.:1456) becomes ON.

The number of records stored depends on the recording time. The approximate relationship between the recording time and the number of records stored is shown in Table 3.4.2.

Sampling number of analog input can be set 24 or 48 per cycle. When 48 selected, the number of records stored will be a half in comparison with 24.

Note: If the recording time setting is changed, the records stored so far are deleted.

Table 3.4.2 Recording Time and Number of Disturbance Records Stored ("SAT" mode)

Recording time	Sampling number	0.1s	1.0s	2.0s	3.0s	5.0s
50Hz	24	40	18	9	6	3
	48	40	9	4	3	1
60Hz	24	40	15	7	5	3
	48	40	7	3	2	1

Settings

The elements necessary for disturbance recording and their setting ranges are shown in the table below.

Element	Range	Step	Default	Remarks
AI sampling	24 / 48		24	Analogue input sampling number
OP Mode	OW / SAT		OW	Overwrite or saturation selection
Record time	0.1-60.0s	0.1s	1.0	Recording time
Trig pos	0-100%	1%	50%	Pre-trigger position
OC	0.5-250.0 A (0.10-50.00 A	0.1 A 0.01 A	10.0 A 2.00 A) (*)	Overcurrent detection
EF	0.5-125.0 A (0.10-25.00 A	0.1 A 0.01 A	3.0 A 0.60A)	Earth fault detection
SE	0.025-0.125 A (0.005-0.025 A	0.001 A 0.001 A	0.100 A 0.020 A)	Sensitive earth fault detection
NOC	0.5-10.0 A (0.10-2.00 A	0.1 A 0.01 A	2.0 A 0.40 A)	Negative sequence overcurrent detection
OV	10.0-200.0V	0.1 V	120.0 V	Overvoltage detection
UV	1.0-130.0V	0.1 V	60.0 V	Undervoltage detection
ZOV	1.0-130.0V	0.1 V	20.0 V	Zero sequence overvoltage detection

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Element	Range	Step	Default	Remarks
NOV	1.0-130.0V	0.1 V	20.0 V	Negative sequence overvoltage detection

(*) Current values shown in the parentheses are for the case of a 1A rating. Other current values are for the case of a 5A rating.

Starting the disturbance recording by a PLC command is enabled or disabled by setting the following scheme switches.

Element	Range	Step	Default	Remarks
[OPT1]	Off/On		On	Start by OPT1 operation by PLC
[OPT2]	Off/On		On	Start by OPT2 operation by PLC
[OPT3]	Off/On		On	Start by OPT3 operation by PLC
[OPT4]	Off/On		On	Start by OPT4 operation by PLC
[OPT5]	Off/On		On	Start by OPT5 operation by PLC
[OPT6]	Off/On		On	Start by OPT6 operation by PLC
[OPT7]	Off/On		On	Start by OPT7 operation by PLC
[OPT8]	Off/On		On	Start by OPT8 operation by PLC

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3.5 Fault locator

3.5.1 Application

The fault locator incorporated in the GRD150 measures the distance to fault on the protected line using local voltages and currents. The measurement result is expressed as a percentage (%) of the line length and the distance (km) and is displayed on the LCD on the relay front panel. It is also output to a local PC or RSM (relay setting and monitoring) system.

To measure the distance to fault, the fault locator requires minimum 3 cycles as fault duration time.

In distance to fault calculations, the change in the current before and after the fault has occurred is used as a reference current, alleviating influences of the load current and arc voltage. As a result, the location error is a maximum of ±2.5 km for faults at a distance of up to 100 km, and a maximum of ±2.5% for faults at a distance between 100 km and 250 km.

Note: If abnormal settings far from actual transmission line impedance, e.g. resistance value so larger than reactance value, etc., are done, the location error will be larger.

The fault locator is available for [APPL-CT]= "3P" and [APPL-VT]= "3PN" or "3PV" setting.

The fault locator cannot correctly measure the distance to fault during a power swing.

3.5.2 Distance to Fault Calculation

The distance to fault x_1 is calculated from equation (1) and (2) using the voltage and current of the fault phase and a current change before and after the fault occurrence. The current change before and after the fault occurrence represented by Iβ" and Iα" is used as the reference current. The impedance imbalance compensation factor is used to maintain high measuring accuracy even when the impedance of each phase has great variations.

Distance calculation for phase fault (in the case of BC-phase fault)

$$x_1 = \frac{I_m(V_{bc} \cdot I\beta'') \times L}{\{I_m(R_1 \cdot I_{bc} \times I\beta'') + R_e(X_1 \cdot I_{bc} \cdot I\beta'')\} \times K_{bc}} \qquad (1)$$

where,

V_{bc} = fault voltage between faulted phases = $V_b - V_c$

I_{bc} = fault current between faulted phases = $I_b - I_c$

$I\beta''$ = change of fault current before and after fault occurrence = $(I_b\text{-}I_c) - (I_{Lb}\text{-}I_{Lc})$

I_{Lb}, I_{Lc} = load current

R_1 = resistance component of line positive sequence impedance

X_1 = reactance component of line positive sequence impedance

K_{bc} = impedance imbalance compensation factor

$I_m(\ )$ = imaginary part in parentheses

$R_e(\ )$ = real part in parentheses

L = line length (km)

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Distance calculation for earth fault (in the case of A-phase earth fault)

$$x_1 = \frac{I_m(V_a \cdot I_\alpha'') \times L}{\{I_m(R_1 \cdot I_\alpha \cdot I_\alpha'' + R_0 \cdot I_{0S} \cdot I_\alpha'') + R_e(X_1 \cdot I_\alpha \cdot I_\alpha'' + X_0 \cdot I_{0S} \cdot I_\alpha'')\} \times K_a} \qquad (2)$$

where,

V_a = fault voltage

I_α = fault current = $(2I_a - I_b - I_c)/3$

I_α'' = change of fault current before and after fault occurrence

$$= \frac{2I_a - I_b - I_c}{3} - \frac{2I_{La} - I_{Lb} - I_{Lc}}{3}$$

I_a, I_b, I_c = fault current

I_{La}, I_{Lb}, I_{Lc} = load current

I_{0s} = zero sequence current

R_1 = resistance component of line positive sequence impedance

X_1 = reactance component of line positive sequence impedance

R_0 = resistance component of line zero sequence impedance

X_0 = reactance component of line zero sequence impedance

K_a = impedance imbalance compensation factor

$I_m(\ )$ = imaginary part in parentheses

$R_e(\ )$ = real part in parentheses

L = line length (km)

Equations (1) and (2) are general expressions when lines are treated as having lumped constants and these expressions are sufficient for lines within 100 km. For lines exceeding 100 km, influences of the distributed capacitance must be considered. For this fault locator, the following equation is used irrespective of line length to find the compensated distance x_2 with respect to distance x_1 which was obtained in equation (1) or (2).

$$x_2 = x_1 - k^2 \cdot \frac{x_1^{\,3}}{3} \qquad (3)$$

where,

k = propagation constant of the protected line = 0.001km^{-1} (fixed)

3.5.3 Starting Calculation

Calculation of the fault location is initiated by tripping signals.

3.5.4 Displaying Location

The measurement result is stored in the "Fault record" and displayed on the LCD of the relay front panel or on the local or remote PC. For displaying on the LCD, see Section 4.2.3.1.

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3.5.5 Setting

The setting items necessary for the fault location and their setting ranges are shown in the table below. The reactance and resistance values are input in expressions on the secondary side.

When there are great variations in the impedance of each phase, equation (4) is used to find the positive sequence impedance, zero sequence impedance and zero sequence mutual impedance, while equation (5) is used to find imbalance compensation factors K_{ab} to K_a.

When variations in impedance of each phase can be ignored, the imbalance compensation factor is set to 100%.

$$\left.\begin{aligned} Z_1 &= \{(Z_{aa} + Z_{bb} + Z_{cc}) - (Z_{ab} + Z_{bc} + Z_{ca})\}/3 \\ Z_0 &= \{(Z_{aa} + Z_{bb} + Z_{cc}) + 2(Z_{ab} + Z_{bc} + Z_{ca})\}/3 \end{aligned}\right\} \quad (4)$$

$$\left.\begin{aligned} K_{ab} &= \{(Z_{aa} + Z_{bb})/2 - Z_{ab}\}/Z_1 \\ K_{bc} &= \{(Z_{bb} + Z_{cc})/2 - Z_{bc}\}/Z_1 \\ K_{ca} &= \{(Z_{cc} + Z_{aa})/2 - Z_{ca}\}/Z_1 \\ K_a &= \{Z_{aa} - (Z_{ab} + Z_{ca})/2\}/Z_1 \\ K_b &= \{Z_{bb} - (Z_{bc} + Z_{ab})/2\}/Z_1 \\ K_c &= \{Z_{cc} - (Z_{ca} + Z_{ab})/2\}/Z_1 \end{aligned}\right\} \quad (5)$$

Item	Range	Step	Default	Remarks
R_1	0.0 - 199.99 Ω	0.01 Ω	0.20Ω	
	(0.0 - 999.9 Ω	0.1 Ω	1.0Ω) (*)	
X_1	0.0 - 199.99 Ω	0.01 Ω	2.00Ω	
	(0.0 - 999.9 Ω	0.1 Ω	10.0Ω)	
R_0	0.0 - 999.99 Ω	0.01 Ω	0.70Ω	
	(0.0 - 999.9 Ω	0.1 Ω	3.5Ω)	
X_0	0.0 - 199.99 Ω	0.01 Ω	6.80Ω	
	(0.0 - 999.9 Ω	0.1 Ω	34.0Ω)	
K_{ab}	80 - 120%	1%	100%	
K_{bc}	80 - 120%	1%	100%	
K_{ca}	80 - 120%	1%	100%	
K_a	80 - 120%	1%	100%	
K_b	80 - 120%	1%	100%	
K_c	80 - 120%	1%	100%	
Line	0 - 399.9 km	0.1 km	50.0km	

(*) Ohmic values shown in the parentheses are in the case of 1 A rating. Other ohmic values are in the case of 5A rating.

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4. User Interface

4.1 Outline of User Interface

The user can access the relay from the front panel.

Local communication with the relay is also possible using a personal computer (PC) via an RS232C port. Furthermore, remote communication is also possible using RSM (Relay Setting and Monitoring) via an RS485 port.

This section describes the front panel configuration and the basic configuration of the menu tree of the local human machine communication ports and HMI (Human Machine Interface).

4.1.1 Front Panel

As shown in Figure 4.1.1, the front panel is provided with a liquid crystal display (LCD), light emitting diodes (LED), operation keys, and RS-232C connector.

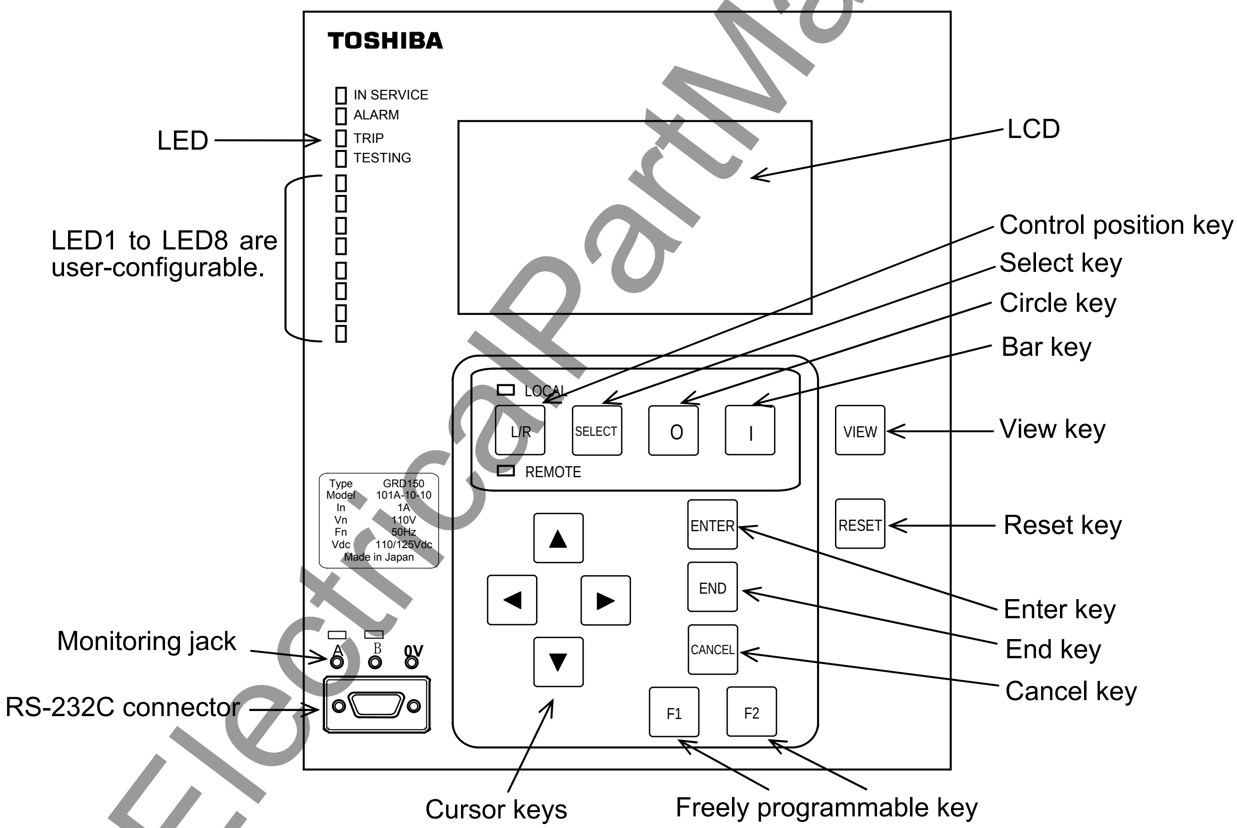

Figure 4.1.1 Front Panel

LCD

The LCD screen, provided with a 16-line, 40-character display and backlight, provides the user with information such as records, statuses and settings. The LCD screen is normally unlit, but pressing the VIEW key will display the digest screen (MIMIC screen) and pressing any key other than VIEW and RESET will display the menu screen.

These screens are turned off by pressing the RESET key or END key. If any display is left for

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the time (BLOFFT setting time) or longer without operation, the backlight will go off. The setting range of the BLOFFT time is 1 to 60min and the default setting is 3min.

Further, the LCD panel state reset function is provided. This function is the LCD screen turns to the blank screen if any display is left for the predetermined STARSTT time or longer without operation. If the screen left is a test setting, the test setting is reset to the default. The setting range of the STARSTT time is 0 to 24hrs and the default setting is 24hrs. When the STARSTT is set 0, this function is disabled.

LED

There are 14 LED displays. For details, refer to Section 3.1.1.

LED1 to LED8 are user-configurable. These LEDs indicate each status of the elements assigned by PLC editor. The color of them can be selected from green, yellow and red by MIMIC editor as shown in Figure 4.1.2. For PLC editor and MIMIC Editor, refer to the PLC editor instruction manual and the MIMIC Editor instruction manual. The signals are LED1(No.2611) to LED8(No.2618).

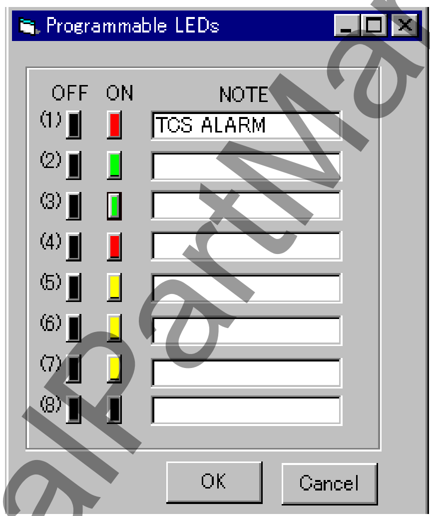


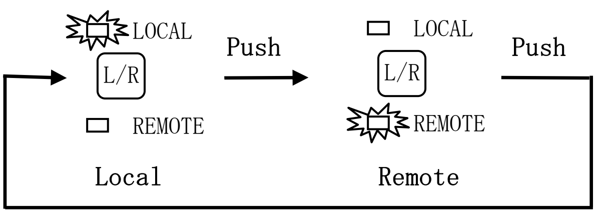
Figure 4.1.2 Sample Screen of MIMIC Editor

The TRIP and ALARM LED if operated, must be reset by user, either by pressing the RESET key, by energising a binary input which has been programmed for the signal 'LED RST'(No.2609) operation, or by a communications command. The ALARM LED cannot be reset if any failure continues. Other LEDs operate as long as a signal is present. The RESET key is ineffective for these LEDs.

MIMIC operation keys

The MIMIC operation keys are used to change the control position and to select and control objects. The function of each MIMIC operation key is as follows:

- ① L/R: Used to change the operation position. The L/R key sequence is as follows:



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② SELECT: Used to select the target object. Push ▼, ▲, ◀, or ▶ key until the object is enclosed. The object keeps highlighted until the control operation is completed.

③ | : Used to close (or free) the selected object.

④ ○ : Used to open (or earth) the selected object.

Operation keys

The operation keys are used to display records, status, and set values on the LCD, as well as to input or change set values. The function of each operation key is as follows:

① ▼, ▲, ◀, ▶: Used to move between lines displayed on a screen and to enter numerical values (◀: down, ▶: up).

② CANCEL: Used to cancel entries and return to the upper screen.

③ END: Used to end the entering operation, return to the upper screen or turn off the display.

④ ENTER: Used to store or establish entries.

VIEW and RESET keys

Pressing VIEW key displays digest screens such as "MIMIC view", "Metering view", "Fault view", "Alarm view" and "Event view".

Pressing RESET key turns off the LCD.

Freely programmable keys

F1 F2 keys can be freely programmed for various operations.

The signals of the key status are KEY-F1(No.1428) and KEY-F2(No.1429).

Monitoring jacks

The two monitoring jacks A and B and their respective LEDs can be used when the test mode is selected on the LCD screen. By selecting the signal to be observed from the "Signal List" and setting it on the screen, the signal can be displayed on LED A or LED B, or output to an oscilloscope via a monitoring jack.

RS232C connector

The RS-232C connector is a 9-way D-type connector for serial RS232C connection with a local personal computer.

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4.1.2 Communication Ports

The following interfaces can be mounted as communication ports:

- RS232C port
- RS485 port
- IRIG-B port

RS232C port

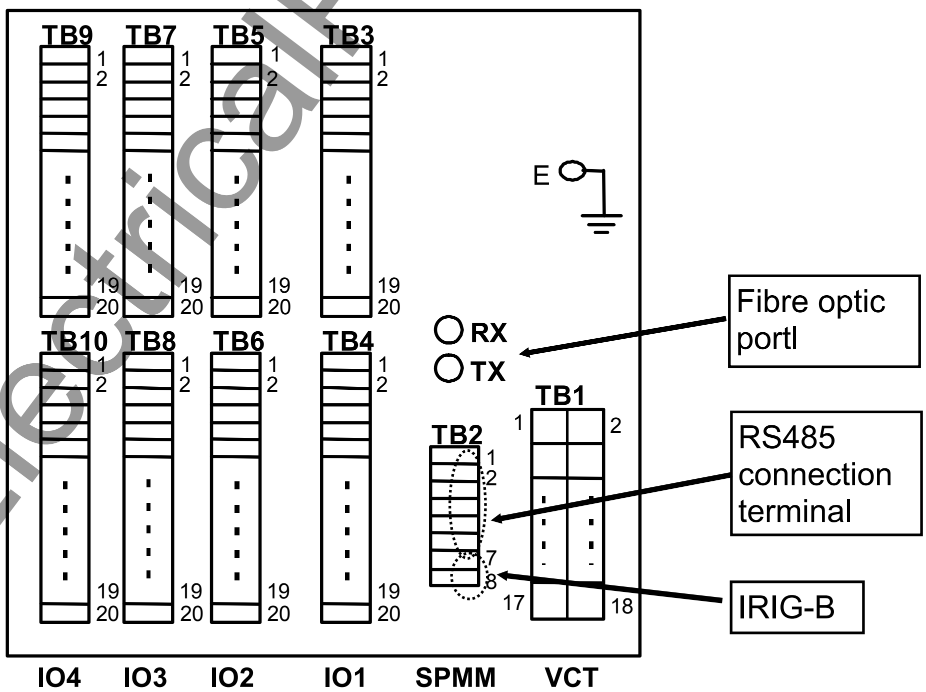
This connector is a standard 9-way D-type connector for serial port RS232C transmission and is mounted on the front panel. By connecting a personal computer to this connector, setting operation and display functions can be performed from the personal computer. This port is provided on the front of the relay.

RS485, Fibre optic port

The RS485 port is used for communication interface such as IEC60870-5-103, DNP 3.0 or Modbus RTU etc., to connect a PC or a substation control system and to construct a network communication system. (See Figure 4.4.1 in Section 4.4.) The GRD150 can provide two RS485 serial ports (RS485-1 and RS485-2). RS485-1 (CH1) is available for RSM100 or Modbus, and RS485-2 (CH2: option) for IEC60850-5-103 or DNP3.0. These ports are provided on the back of the relay, as shown in Figure 4.1.3 and Appendix G. Screw terminal for RS485 and/or ST connector for fibre optic are provided on the back of the relay.

IRIG-B port

The IRIG-B port collects serial IRIG-B format data from the external clock to synchronize the relay calendar clock. This port is provided on the back of the relay, as shown in Figure 4.1.3.



Model ∗∗1: IO1 only   Model ∗∗2: IO1, IO2
Model ∗∗3:IO1, IO2, IO3   Model ∗∗4: IO1, IO2, IO3, IO4

Rear view

Figure 4.1.3 Location of Communication Port

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4.2 Operation of the User Interface

The user can access such functions as recording, measurement, relay setting and testing with the LCD display and operation keys.

4.2.1 LCD and LED Displays

Note: The contents of LCD screens depend on the relay model.

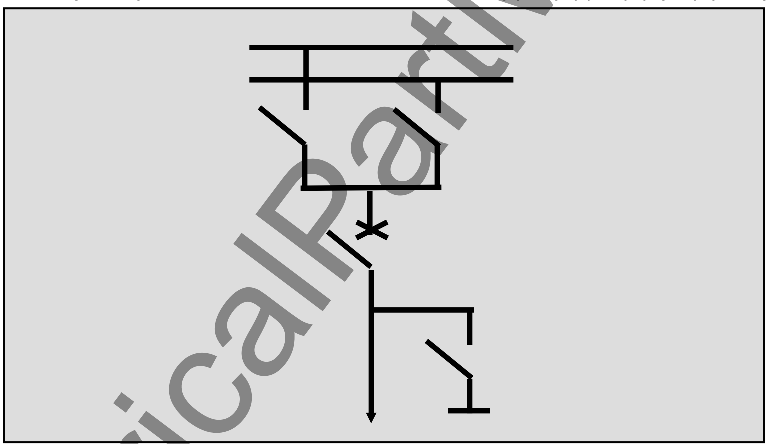
Displays during normal operation

When the GRD150 is operating normally, the green "RUN" LED is lit and the LCD is off.

Press the VIEW key when the LCD is off to display the "MIMIC", "Metering view", "Fault view", "Alarm view" and "Event view" screens in turn. "Fault view", "Alarm view" and "Event view" screens are displayed only when there is some data. The "Fault view" and "Alarm view" screens are automatically displayed when a fault event and an alarm event occur and the "TRIP" and "ALARM" LEDs are lit. The following are the digest screens and can be displayed without entering the menu screens.

MIMIC view

MIMIC view 25/Feb/2003 09:45



Made by MIMIC editor

Metering view

```
Metering view                          25/Feb/2003 09:45
Measurement
Va   ***.**kV -***.*°     Ia    ******A -***.*°
Vb   ***.**kV -***.*°     Ib    ******A -***.*°
Vc   ***.**kV -***.*°     Ic    ******A -***.*°
Ve   ***.**kV -***.*°     Ie    ******A -***.*°
Vs   ***.**kV -***.*°     Ise   ****. *A -***.*°
Vab  ***.**kV -***.*°     THM   ***.*%
Vbc  ***.**kV -***.*°
Vca  ***.**kV -***.*°     f/t   -**.**Hz/s
f    **.**Hz              PF    -*.***
P      -******kW          Q       -******kvar
Wh+    ****.**kWh         varh+   ****.**kvarh
Wh-    ****.**kWh         varh-   ****.**kvarh
```

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Fault view

```
Fault view                    25/Feb/2003 09:45
Fault#1      19/Oct/2002   09:32:50.091
Phase A                    FL ***.*km  (***%)
OC1
```

Trip mode and Autoreclose information

Alarm view

```
Alarm view                    25/Feb/2003 09:45

#  1   10/Feb/2003   11:22:33.987
       ***************          On
```

Event view

```
Event view                    25/Feb/2003 09:45

#   1  10/Feb/2003   11:22:33.987
 OC1                               ON
```

Press the RESET key to turn off the LCD.

To clear the latched indications (TRIP and ALARM LEDs, LCD screens), press RESET key.

For any display, the backlight is automatically turned off after the predetermined time.

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Displays in tripping

If a fault occurs and a tripping command is output when the LCD is off, the "Fault view" screen is displayed on the LCD automatically and the red "TRIP" LED lights.

Press the VIEW key to display the digest screens in turn including the "MIMIC" and "view" screens.

Press the RESET key to turn off the LCD.

If the tripping command is output when any of the screens is displayed, the current screen remains displayed and the red "TRIP" LED lights.

When displaying the Fault View screen, Press the RESET key to turn off the "TRIP" LED.

While any of the menu screens is displayed, the RESET keys do not function. To return to the digest screen, do the following:

- Return to the top screen of the menu by repeatedly pressing the END key or the ◀ key.
- Press the END key to turn off the LCD.
- Press the VIEW key to change the screen pages.
- Press the RESET key to turn off the "TRIP" LED and LCD.

Displays in automatic supervision operation

If the automatic supervision function detects a failure while the LCD is off, the "Alarm view" screen is displayed automatically, showing the location of the failure, and the "ALARM" LED lights.

Press the VIEW key to display other digest screens in turn including the "Metering view", "Fault view", "Alarm view" and "Event view" screens.

Press the RESET key to turn off the LCD display. The "ALARM" LED remains lit if the failure continues.

After recovery from a failure and press the RESET key, the "ALARM" LED turns off.

If a failure is detected while any of the screens is displayed, the current screen remains displayed and the "ALARM" LED lights.

While any of the menu screens is displayed, the VIEW and RESET keys do not function. To return to the digest "Alarm view" screen, do the following:

- Return to the top screen of the menu by repeatedly pressing the END key or the ◀ key.
- Press the END key to turn off the LCD.
- Press the VIEW key to change the screen pages.
- Press the RESET key to turn off the LCD.

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4.2.2 Relay Menu

Figure 4.2.1 shows the menu hierarchy in the GRD150. The menu has five sub-menus, "MIMIC", "Record", "Status", "Settings" and "Test".

- Main Menu
  - MIMIC
  - Record
    - Fault Record
    - Alarm Record
    - Event Record
    - Disturbance Record
    - Counters
    - Clear records
  - Status
    - Metering
    - Relay element
    - Condition monitoring
    - Binary I/O
    - Information
  - Settings
    - Protection
    - Control
    - Record
    - Status
    - Time
    - Communication
    - Password
    - Panel
    - Others
  - Test
    - Switch
    - Binary O/P
    - Logic circuit

Figure 4.2.1 Relay Menu

MIMIC

The "MIMIC" menu is used to view the MIMIC configuration and control (open or close) the device status in local mode. It has password security protection for control operation. The MIMIC configuration is created by MIMIC Editor tool.

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Record

In the "Record" menu, the fault records, alarm records, event records, disturbance records and counts such as trip count and ΣIy count can be displayed or erased.

Status

The "Status" menu displays the metering of power system quantities, relay measuring element status, condition monitoring status, binary input and output status and information such as relay version.

Settings

The "Settings" menu is used to view and change the settings of protection, control, record, metering, signal source for time synchronisation or clock adjustment, communication, password, LCD contrast and others.

Since this is an important menu and is used to change settings related to relay tripping, it has password security protection for changing.

Test

The "Test" menu is used to set testing switches, to forcibly operate binary output relays, and to monitor signals of logic circuits.

Since this is an important menu and is used to change settings related to relay tripping, it has password security protection for changing.

When the LCD is off, press any key other than the VIEW, RESET, L/R, SELECT, |, O, F1 and F2 keys to display the top "MENU" screen and then proceed to the relay menus.

```
Main Menu                          25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test
```

In case of selecting "Settings" or "Test", display guidance as follows. If one of them is selected on the top "Main Menu" screen, the password trap line "Password" is displayed. If the password is not entered correctly, it is not possible to move to the "Settings" or "Test" sub-menu screens. When inputting nothing and pressing the ENTER key, "Settings" menu or "Test" menu are only view mode that can not change values. (For details of password, see Section 4.2.6 and 4.2.7.)

```
Main Menu                          25/Feb/2003 09:45
MIMIC
Record
```

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```
Status
Settings
Test









Password [          ]              <0123456789
```

To display the "Main Menu" screen when the digest screen is displayed, press the RESET key to turn off the LCD, then press any key other than the VIEW, RESET, L/R, SELECT, |, O, F1 and F2 keys.

Press the END key when the top screen is displayed to turn off the LCD.

An example of the sub-menu screen is shown below.

<Common page style displays>

```
      Status-Cond. monitoring            25/Feb/2003 09:45  <-(2)
(1)-> Operating time                                  1/2   <-(3)
      CB     OPEN T    last **.***s   max **.***s
      CB     CLOSE T   last **.***s   max **.***s
      DS1    OPEN T    last **.***s   max **.***s
      DS1    CLOSE T   last **.***s   max **.***s
      DS2    OPEN T    last **.***s   max **.***s
      DS2    CLOSE T   last **.***s   max **.***s
      DS3    OPEN T    last **.***s   max **.***s
      DS3    CLOSE T   last **.***s   max **.***s
      DS4    OPEN T    last **.***s   max **.***s
      DS4    CLOSE T   last **.***s   max **.***s
      DS5    OPEN T    last **.***s   max **.***s
      DS5    CLOSE T   last **.***s   max **.***s

      [                                              ]  <-(4)
```

```
Status-Cond. monitoring            25/Feb/2003 09:45
Operating time                                  2/2
EDS1   OPEN T    last **.***s   max **.***s
EDS1   CLOSE T   last **.***s   max **.***s
EDS1   EARTH T   last **.***s   max **.***s
EDS1   FREE T    last **.***s   max **.***s
EDS2   OPEN T    last **.***s   max **.***s
EDS2   CLOSE T   last **.***s   max **.***s
EDS2   EARTH T   last **.***s   max **.***s
EDS2   FREE T    last **.***s   max **.***s
```

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(1) Title area: showing the hierarchical layer of the screen. The level of menu is shown division with "-".

(2) Date and time: showing the current date and time.

(3) Page number (only for the plural pages of the menu): showing Current page number / Total page number. To shift the next page, press the VIEW key.

(4) Guidance message area: showing the guidance message if needed. Any item is not displayed in the line even if no message is occurred.

<Common list style displays>

```
(1) → Record-Disturbance              25/Feb/2003 09:45 ← (2)
                                                  1/15 ← (3)
      # 1      19/Oct/2002   09:32:50.091
      # 2      20/Sep/2002   10:33:55.091
      # 3      21/Jan/2002   11:34:57.091
      # 4      22/Jun/2001   12:35:58.091
      # 5      23/Mar/2001   13:36:59.091
      # 6      24/Dec/2000   14:37:10.091
      # 7      25/Nov/2000   15:38:20.091
      # 8      26/Aug/2000   16:39:30.091
      # 9      27/May/2000   17:40:40.091
      # 10     28/Feb/2000   18:41:50.091
      # 11     29/Dec/1999   19:42:05.091
      # 12     30/Oct/1999   20:43:06.091
      # 13     01/Jul/1999   21:44:07.091
      Print? Y=No&ENTER/N=CANCEL       No:      ← (4)
      # 14     02/Apr/1999   22:45:08.091
      # 15     03/Nov/1998   23:46:09.091
```

(1) Title area: showing the hierarchical layer of the screen. The level of menu is shown division with "-".

(2) Date and time: showing the current date and time.

(3) Item indicator: showing Current item position / Number of total item.

(4) Guidance message area: showing the guidance message if needed. Any item is not displayed in the line even if no message is occurred.

In both screens, to move the cursor downward or upward for setting or viewing other lines not displayed on the window, use the ▼ and ▲ keys.

To move to the lower hierarchical layer of the screen menu, select the appropriate menu on the screen by the ▼ and ▲ keys and press the ENTER key. To return to the higher hierarchical layer of the screen menu, press the END key or the ◀ key.

The CANCEL key can also be used to return to the higher screen but it must be used carefully because it may cancel entries made so far.

To move between screens of the same hierarchical depth, first return to the higher screen and then move to the lower screen.

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4.2.3 MIMIC Menu

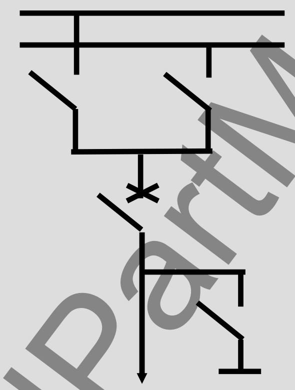
The sub-menu of "MIMIC" is used for MIMIC view and MIMIC control. MIMIC control is available only in "Local" control mode.

4.2.3.1 Displaying MIMIC menu

To display the MIMIC menu, do the following:

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, O, F1 and F2 keys.
- Select "MIMIC" to display the "MIMIC" sub-menu. Then the following screen is displayed. All functions are available in "LOCAL" control mode, while MIMIC view is only available in "REMOTE" control mode or out of service status. The default setting is "REMOTE" control mode.

MIMIC 25/Feb/2003 09:45



Made by MIMIC editor

4.2.3.2 Changing the MIMIC control mode

To change the MIMIC control mode, do the following:

- To change the MIMIC control mode from "REMOTE" to "LOCAL", push the L/R-button to light the local mode indicator. Then the following screen is displayed.

MIMIC 25/Feb/2003 09:45

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Password [ ] <0123456789

- Input password correctly to enter into "LOCAL" control mode.

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- After selecting the setting device by using ▶, ◀, ▼ and ▲ keys, push the "SELECT" button. Push the (O) button key to open the device and push the (|) button key to close the device.
- To change the MIMIC control mode from "LOCAL" to "REMOTE", push the (L/R) button key to light the remote mode indicator. In this case, password is not required.

4.2.4 Displaying Records

The sub-menu of "Record" is used to display fault records, alarm records, event records, disturbance records and counts such as trip count and ΣIy count.

4.2.4.1 Displaying Fault Records

To display fault records, do the following:

- Open the top "Main Menu" screen by pressing any keys other than the (VIEW), (RESET), (L/R), (SELECT), (|), (O), (F1) and (F2) keys.
- Select "Record" to display the "Record" sub-menu. If the selected menu has no item, "No data" message is displayed in the bottom line.

```
Record menu                  25/Feb/2003 09:45
Fault record
Alarm record
Event record
Disturbance record
Counters
Clear records
```

- Select "Fault record" to display the "Fault record" screen. The fault records are displayed from the top in new-to-old sequence.

```
Record-Fault record          25/Feb/2003 09:45

#1  19/Oct/2002  09:32:50.091
#2  20/Sep/2002  10:33:55.091
#3  21/Jan/2002  11:34:57.091
#4  22/Jun/2001  12:35:58.091
#5  23/Mar/2001  13:36:59.091
#6  24/Dec/2000  14:37:10.091
#7  25/Nov/2000  15:39:20.091
#8  26/Aug/2000  16:40:30.091

Print? Y=No&ENTER/N=CANCEL      No:
```

Enter No.

(∗)

(∗) : This message is only displayed in the model mounting the printer interface.

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- If the printer interface is mounted, printing guidance is displayed as above. When printing a fault record, enter No. by ◀ or ▶ key and press the ENTER key. Then the confirm message is displayed as follows.

```
Print? #∗ ? Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to print the selected record.

- Move the cursor to the fault record line, for example Fault#1, to be displayed using the ▲ and ▼ keys and press the ENTER key to display the details of the fault record.

```
Record-Fault record              25/Feb/2003 09:45
Fault#1     19/Oct/2002   09:32:50.091        1/4
Phase A                        FL ∗∗∗.∗km (∗∗∗%)
OC1                                                  (∗1)

19/Oct/2002   09:32:51.816
ARC1-S1
19/Oct/2002   09:32:52.900
OC1
                                                     (∗2)
```

```
Record-Fault record              25/Feb/2003 09:45
Fault#1     19/Oct/2002   09:32:50.091        2/4

                                                     (∗2)
```

```
Record-Fault record              25/Feb/2003 09:45
Fault#1     19/Oct/2002   09:32:50.091        3/4
Fault values
Va   ∗∗∗.∗∗kV –∗∗∗.∗°    Ia   ∗∗∗∗∗∗A –∗∗∗.∗°
Vb   ∗∗∗.∗∗kV –∗∗∗.∗°    Ib   ∗∗∗∗∗∗A –∗∗∗.∗°
Vc   ∗∗∗.∗∗kV –∗∗∗.∗°    Ic   ∗∗∗∗∗∗A –∗∗∗.∗°
Ve   ∗∗∗.∗∗kV –∗∗∗.∗°    Ie   ∗∗∗∗∗∗A –∗∗∗.∗°
Vs   ∗∗∗.∗∗kV –∗∗∗.∗°    Ise  ∗∗∗∗.∗A –∗∗∗.∗°
Vab  ∗∗∗.∗∗kV –∗∗∗.∗°    THM ∗∗∗.∗%
Vbc  ∗∗∗.∗∗kV –∗∗∗.∗°
Vca  ∗∗∗.∗∗kV –∗∗∗.∗°
f    ∗∗.∗∗Hz             f/t  –∗∗.∗∗Hz/s
V1   ∗∗∗.∗∗kV –∗∗∗.∗°    I1   ∗∗∗∗∗∗A –∗∗∗.∗°
```


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```
V2   ***.**kV -***.*°    I2   ******A -***.*°
V0   ***.**kV -***.*°    I0   ******A -***.*°
```

```
Record-Fault record               25/Feb/2003 09:45
Fault#1      19/Oct/2002   09:32:50.091         4/4
Prefault values
Va   ***.**kV -***.*°    Ia   ******A -***.*°
Vb   ***.**kV -***.*°    Ib   ******A -***.*°
Vc   ***.**kV -***.*°    Ic   ******A -***.*°
Ve   ***.**kV -***.*°    Ie   ******A -***.*°
Vs   ***.**kV -***.*°    Ise  ****.*A -***.*°
Vab  ***.**kV -***.*°    THM ***.*%
Vbc  ***.**kV -***.*°
Vca  ***.**kV -***.*°
f    **.**Hz             f/t  -**.**Hz/s
V1   ***.**kV -***.*°    I1   ******A -***.*°
V2   ***.**kV -***.*°    I2   ******A -***.*°
V0   ***.**kV -***.*°    I0   ******A -***.*°
```

(∗ 1) : "-"is displayed if the fault location is not available.

(∗ 2) : ARC information is available if the relay model is GRD150-3∗∗ or 4∗∗ .

The pages which are not displayed in the window can be displayed by pressing the VIEW key.

In this screen, if press the ▶ key, the next detail fault record (in this case, Fault#2) is displayed.

4.2.4.2 Displaying Alarm Records

To display event records, do the following:

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, O, F1 and F2 keys.
- Select "Record" to display the "Record" sub-menu.
- Select "Alarm record" to display the "Alarm record" screen. The alarm records are displayed from the top in new-to-old sequence.

```
Record-Alarm record               25/Feb/2003 09:45
                                            ***/***
# 1  10/Feb/2003 11:22:33.456
     ************                       Off
# 2  10/Feb/2003 11:22:31.987
     ************                       On
```

The lines which are not displayed in the window can be displayed by pressing the ▲and ▼ keys.

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4.2.4.3 Displaying Event Records

To display event records, do the following:

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, ○, F1 and F2 keys.
- Select "Record" to display the "Record" sub-menu.
- Select "Event record" to display the "Event record" screen. The event records are displayed from the top in new-to-old sequence.

```
Record-Event record              25/Feb/2003 09:45
                                           ***/***
#1  10/Feb/2003 11:22:33.456
    ************                        Off
#2  10/Feb/2003 11:22:31.987
    ************                        On
```

The lines which are not displayed in the window can be displayed by pressing the ▲and ▼ keys.

4.2.4.4 Displaying Disturbance Records

Details of disturbance records can be displayed on the PC screen only (*); the LCD displays only the recorded date and time for all disturbances stored in the relay. They are displayed in the following sequence.

(*) For the display on the PC screen, refer to RSM100 manual.

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, ○, F1 and F2 keys.
- Select "Record" to display the "Record" sub-menu.
- Select "Disturbance record" to display the "Disturbance record" screen. The disturbance records are displayed from the top in new-to-old sequence.

```
Record-Disturbance record       25/Feb/2003 09:45
                                             1/**
#1  15/Jan/2003  16:45:12.345
#2  24/Apr/2002  21:56:22.345
#3  03/Sep/2001  02:07:32.345
#4  07/Nov/2000  10:18:42.345
```

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```
Print? Y=No&ENTER/N=CANCEL          No:
```
(∗)

(∗) : This message is only displayed in the model mounting the printer interface.

- If the printer interface is mounted, printing guidance is displayed as above. When printing a disturbance record, enter No. by ◀ or ▶ key and press the ENTER key. Then the confirm message is displayed as follows.

```
Print? #∗ ? Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to print the selected record.

The lines which are not displayed in the window can be displayed by pressing the ▲ and ▼ keys.

4.2.4.5 Displaying Counters

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, ○, F1 and F2 keys.
- Select "Record" to display the "Record" sub-menu.
- Select "Counters" to display the "Counters" screen.

```
Record-Counters                 25/Feb/2003 09:45
                                              1/2
Trips      *****      ΣI^yA      *******E6
ARCs       *****      ΣI^yB      *******E6
                      ΣI^yC      *******E6
CBCT       *****
DS1CT      *****      EDS1 CLOSECT   *****
DS2CT      *****           EARTHCT   *****
DS3CT      *****      EDS2 CLOSECT   *****
DS4CT      *****           EARTHCT   *****
DS5CT      *****
CT1        *****      CT5        *****
CT2        *****      CT6        *****
CT3        *****      CT7        *****
CT4        *****      CT8        *****
```

```
Record-Counters                 25/Feb/2003 09:45
                                              2/2
CB CLOSE Total T      *****day  ****min  **s
Total T1              *****day  ****min  **s
Total T2              *****day  ****min  **s
Total T3              *****day  ****min  **s
Total T4              *****day  ****min  **s
Total T5              *****day  ****min  **s
Total T6              *****day  ****min  **s
Total T7              *****day  ****min  **s
```

(*) Note: ARCs is displayed for the model 3∗∗ and 4∗∗.

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The pages which are not displayed in the window can be displayed by pressing the VIEW key.

4.2.4.6 Clear records

To clear records, do the following:

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, ○, F1 and F2 keys.
- Select "Clear records" to display the "Clear records" sub-menu.

```
Record-Clear records                25/Feb/2003 09:45
Clear all records
Clear fault records
Clear alarm records
Clear event records
Clear disturbance records
Clear all counters
```

Note: The values of counters can be changed. Refer to Section 4.2.6.4.
The alarm record continuing a failure cannot be cleared.

- Select the appropriate menu to clear the records.
- The confirm message is displayed as follows.

```
Clear records? Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to clear the records stored in non-volatile memory.

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4.2.5 Displaying the Status

From the sub-menu of "Status", the following status condition can be displayed on the LCD:

Metering data of the protected line
Status of measuring elements output
Condition monitoring of apparatus such as circuit breaker, disconnector, etc.
Status of binary inputs and outputs
Relay model information

The data are updated every second.

4.2.5.1 Displaying Metering Data

To display metering data on the LCD, do the following:

- Select "Status" on the top "Main Menu" screen to display the "Status" screen.

```
Status menu                    25/Feb/2003 09:45
Metering
Relay element
Condition monitoring
Binary I/O
Information
```

- Select "Metering" to display the "Metering" screen.

```
Status-Metering                25/Feb/2003 09:45
Current
Demand
```

To display the current data, do the following:

- Select "Current" to display the "Current" screen.

```
Status-Metering                25/Feb/2003 09:45
Current                                      1/2
Va   ***.**kV -***.*°    Ia    ******A -***.*°
```

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```
Vb    ***.**kV -***.*°     Ib     ******A -***.*°
Vc    ***.**kV -***.*°     Ic     ******A -***.*°
Ve    ***.**kV -***.*°     Ie     ******A -***.*°   (*1)
Vs    ***.**kV -***.*°     Ise    ****.*A -***.*°   (*2)(*3)
Vab   ***.**kV -***.*°     THM    ***.*%
Vbc   ***.**kV -***.*°
Vca   ***.**kV -***.*°     f/t    -**.**Hz/s
f     **.**Hz              PF     -*.***
P       -******kW          Q        -******kvar
Wh+     ******kWh          varh+    ******kvarh
Wh-     ******kWh          varh-    ******kvarh
```

```
Status-Metering                    25/Feb/2003 09:45
Current                                           2/2
V1   ***.**kV  -***.*°     I1   ******A  -***.*°
V2   ***.**kV  -***.*°     I2   ******A  -***.*°
V0   ***.**kV  -***.*°     I0   ******A  -***.*°
```

(* 1) : "Ve" is not displayed if the model is GRD150-300 or 400 series.

(* 2) : "Ise" is not displayed if the model is GRD150-100 or 300 series.

(* 3) : "Vs" is not displayed if the model is GRD150-100 or 200 series.

To display the demand data, do the following:

- Select "Demand" to display the "Demand" screen.

```
Status-Metering                     25/Feb/2003 09:45
Demand
Ia   max ******A
Ib   max ******A        Ie   max ******A
Ic   max ******A        Ise  max ****.*A                 (*1)
Va   max ***.**kV  min ***.**kV   avr ***.**kV
Vb   max ***.**kV  min ***.**kV   avr ***.**kV
Vc   max ***.**kV  min ***.**kV   avr ***.**kV
Ve   max ***.**kV                                        (*2)
Vab  max ***.**kV  min ***.**kV   avr ***.**kV
Vbc  max ***.**kV  min ***.**kV   avr ***.**kV
Vca  max ***.**kV  min ***.**kV   avr ***.**kV
f    max  **.**Hz  min  **.**Hz   avr  **.**Hz
```

(* 1) : "Ise" is not displayed if the model is GRD150-100 or 300 series.

(* 2) : "Ve" is not displayed if the model is GRD150-300 or 400 series.

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4.2.5.2 Displaying the Status of Measuring Relay Elements

To display the status of measuring relay elements on the LCD, do the following:

- Select "Status" on the top "Main Menu" screen to display the "Status" screen.
- Select "Relay element" to display the status of the relay elements.

```
Status-Relay element            25/Feb/2003 09:45
                                              1/2
A OC     [0000        ]    A DOC   [0000        ]
B OC     [0000        ]    B DOC   [0000        ]
C OC     [0000        ]    C DOC   [0000        ]
EF       [0000        ]    DEF     [0000        ]
SEF      [0000        ]    DSEF    [0000  00    ]    (*1)
NOC      [00          ]    DNOC    [00          ]
A UC     [00          ]    THM     [00          ]
B UC     [00          ]    BC      [0           ]
C UC     [00          ]    CBF     [000         ]
CTF      [00          ]    VTF     [0000  0000]      (*3)
CLP      [0000  000   ]                              (*3)
```

```
Status-Relay element            25/Feb/2003 09:45
                                              2/2
AN OV    [00          ]    AN UV   [00          ]
BN OV    [00          ]    BN UV   [00          ]    (*4)
CN OV    [00          ]    CN UV   [00          ]
ZOV      [00          ]    NOV     [00          ]
FRQ      [0000  00    ]    DFRQ    [0000  00    ]
ARC      [0000  0     ]                              (*2)
```

(∗ 1) : These items are only displayed if the model is GRD150-200 or 400 series.

(∗ 2) : This item is only displayed if the model is GRD150-300 or 400 series.

(∗ 3) : In the RSM100, the CTF, VTF, and CLP is displayed as their elements such as EFCF, ZOVCF, UVVF, OCDVF, ZOVVF, EFVF, CLP, and CLP-ICD.

The displayed items are changed in accordance with APPL VT setting. (∗ 4)

In case of [APPL-VT] = “Off” or “3PN” or “3PV”

```
AN OV    [00          ]    AN UV   [00          ]
BN OV    [00          ]    BN UV   [00          ]
CN OV    [00          ]    CN UV   [00          ]
```

In case of [APPL-VT] = “3PP” or “2PP”

```
AB OV    [00          ]    AB UV   [00          ]
BC OV    [00          ]    BC UV   [00          ]
CA OV    [00          ]    CA UV   [00          ]
```

The displayed elements depend on relay model. (See Table 1.1.1 in Section 1.)

The operation status of phase and residual overcurrent elements are shown as below:

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Elements	[■	■	■	■	■	■	■	■]	
A OC	OC1	OC2	OC3	OC4	-	-	-	-	A phase OC elements
B OC	OC1	OC2	OC3	OC4	-	-	-	-	B phase OC elements
C OC	OC1	OC2	OC3	OC4	-	-	-	-	C phase OC elements
EF	EF1	EF2	EF3	EF4	-	-	-	-	
SEF	SEF1	SEF2	SEF3	SEF4	-	-	-	-	
NOC	NOC1	NOC2	-	-	-	-	-	-	
A UC	UC1	UC2	-	-	-	-	-	-	A phase UC elements
B UC	UC1	UC2	-	-	-	-	-	-	B phase UC elements
C UC	UC1	UC2	-	-	-	-	-	-	C phase UC elements
CTF	EFCF	ZOVCF	-	-	-	-	-	-	
CLP	S0	S1	S2	S3	ICD-A	ICD-B	ICD-C	-	Cold Load state & 2f detect
A DOC	DOC1	DOC2	DOC3	DOC4	-	-	-	-	A phase DOC elements
B DOC	DOC1	DOC2	DOC3	DOC4	-	-	-	-	B phase DOC elements
C DOC	DOC1	DOC2	DOC3	DOC4	-	-	-	-	C phase DOC elements
DEF	DEF1	DEF2	DEF3	DEF4	-	-	-	-	
DSEF	DSEF1	DSEF2	DSEF3	DSEF4	RPF	RPR	-	-	
DNOC	DNOC1	DNOC2	-	-	-	-	-	-	
THM	THMA	THMT	-	-	-	-	-	-	
BC	BC		-	-	-	-	-	-	
CBF	OCBFA	OCBFB	OCBFC	-	-	-	-	-	
VTF	UVVF-A	UVVF-B	UVVF-C	OCDVF-A	OCDVF-B	OCDVF-C	ZOVVF	EFVF	

Elements	[■	■	■	■	■	■	■	■]	
AN OV	OV1	OV2	-	-	-	-	-	-	A phase OV elements
BN OV	OV1	OV2	-	-	-	-	-	-	B phase OV elements
CN OV	OV1	OV2	-	-	-	-	-	-	C phase OV elements
AB OV	OV1	OV2	-	-	-	-	-	-	AB phase OV elements
BC OV	OV1	OV2	-	-	-	-	-	-	BC phase OV elements
CA OV	OV1	OV2	-	-	-	-	-	-	CA phase OV elements
ZOV	ZOV1	ZOV2	-	-	-	-	-	-	
FRQ	FRQ1	FRQ2	FRQ3	FRQ4	FRQ5	FRQ6	-	-	
ARC	OVB	UVB	OVL	UVL	SYN	-	-	-	
AN UV	UV1	UV2	-	-	-	-	-	-	A phase UV elements
BN UV	UV1	UV2	-	-	-	-	-	-	B phase UV elements
CN UV	UV1	UV2	-	-	-	-	-	-	C phase UV elements
AB UV	UV1	UV2	-	-	-	-	-	-	AB phase UV elements
BC UV	UV1	UV2	-	-	-	-	-	-	BC phase UV elements
CA UV	UV1	UV2	-	-	-	-	-	-	CA phase UV elements
NOV	NOV1	NOV2	-	-	-	-	-	-	
DFRQ	DFRQ1	DFRQ2	DFRQ3	DFRQ4	DFRQ5	DFRQ6	-	-	

The status of each element is expressed with logical level "1" or "0". Status "1" means the element is in operation.

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4.2.5.3 Displaying the Status of Condition monitoring

To display the status of condition monitoring, do the following:

- Select "Status" on the top "Main Menu" screen to display the "Status" screen.
- Select "Condition monitoring" to display the status of condition monitoring.

```
Status-Cond. monitoring          25/Feb/2003 09:45
Operation time
Clear operation time
```

To display the operation time, do the following:

- Select "Operation time" to display the "Operation time" screen.

```
Status-Cond. monitoring          25/Feb/2003 09:45
Operation time                                 1/2
CB    OPEN T    last **.***s   max **.***s
CB    CLOSE T   last **.***s   max **.***s
DS1   OPEN T    last **.***s   max **.***s
DS1   CLOSE T   last **.***s   max **.***s
DS2   OPEN T    last **.***s   max **.***s
DS2   CLOSE T   last **.***s   max **.***s
DS3   OPEN T    last **.***s   max **.***s
DS3   CLOSE T   last **.***s   max **.***s
DS4   OPEN T    last **.***s   max **.***s
DS4   CLOSE T   last **.***s   max **.***s
DS5   OPEN T    last **.***s   max **.***s
DS5   CLOSE T   last **.***s   max **.***s
```

```
Status-Cond. monitoring          25/Feb/2003 09:45
Operation time                                 2/2
EDS1  OPEN T    last **.***s   max **.***s
EDS1  CLOSE T   last **.***s   max **.***s
EDS1  EARTH T   last **.***s   max **.***s
EDS1  FREE T    last **.***s   max **.***s
EDS2  OPEN T    last **.***s   max **.***s
EDS2  CLOSE T   last **.***s   max **.***s
EDS2  EARTH T   last **.***s   max **.***s
EDS2  FREE T    last **.***s   max **.***s
```

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The pages which are not displayed in the window can be displayed by pressing the VIEW key.

To clear the operation time, do the following:

- Select "Clear operation time" to display the guidance message as follows.

```
Status-Cond. monitoring          25/Feb/2003 09:45
Operation time
Clear operation time











Clear operation time?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to clear all.

4.2.5.4 Displaying the Status of Binary Inputs and Outputs

To display the binary input and output status, do the following:

- Select "Status" on the top "Main Menu" screen to display the "Status" screen.
- Select "Binary I/O" to display the binary input and output status.

```
Status-Binary I/O              25/Feb/2003 09:45

Input   IO1           [0000  0000  00   ]
Input   IO2           [0000  0000  000  ]   For IO2 to IO4
Input   IO3           [0000  0000  000  ]
Input   IO4           [0000  0000  000  ]
Output  IO1           [0000  0000       ]
Output  IO2           [0000  0000       ]   For IO2 to IO4
Output  IO3           [0000  0000       ]
Output  IO4           [0000  0000       ]
```

The display format is shown below.

	[■	■	■	■	■	■	■	■	■	■	■]
Input IO1	BI1	BI2	BI3	BI4	BI5	BI6	BI7	BI8	BI9	BI10	
Input IO2-4	BI1	BI2	BI3	BI4	BI5	BI6	BI7	BI8	BI9	BI10	BI11
Output IO1	BO1	BO2	BO3	BO4	BO5	FAIL	TRP1	TRP2			
Output IO2-4	BO1	BO2	BO3	BO4	BO5	BO6	TRP1	TRP2			

Line 1 and 2 shows the binary input status. BI1 to BI11 correspond to each binary input signal.

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The binary input signal is user configurable by PLC function. The status is expressed with logical level "1" or "0" at the photo-coupler output circuit.

Line 3 and 4 shows the binary output status. All binary outputs BO1 to BO6 are configurable by PLC function. The status of these outputs is expressed with logical level "1" or "0" at the input circuit of the output relay driver. That is, the output relay is energised when the status is "1".

4.2.5.5 Displaying the Relay model information

To display the relay model information such as relay type, serial No., software version PLC data and IEC103 data, do the following:

- Select "Status" on the top "Main Menu" screen to display the "Status" screen.
- Select "Information" to display the information.

```
Status-Information              25/Feb/2003 09:45

Relay version
  Relay type :          GRD150-101A-30-10
  Serial NO. :          1234567890
  Main software :       GS1FM1-01-A
  PLC data:             PLCDefault10 (12E05A78)
  IEC103 data:          **********  (000AE309)
```

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4.2.6 Viewing and Changing the Settings

The "Settings" sub-menu is used to view, make or change settings for the following items:

Protection
Control
Record
Status
Time
Communication
Password
Panel
Others

View mode or Setting change mode

- Select "Settings" on the top "Main Menu" screen to display the "Settings" screen.

Then the following password screen is displayed when the password is set.

```
Main Menu                          25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test










Password [          ]            <0123456789
```

- When changing the settings, input password correctly to enter the setting change sub-menu and the ENTER key.
- When viewing the settings, no input password and press the ENTER key.

Then the following "Settings" screen is displayed.

```
Settings menu                      25/Feb/2003 09:45
Protection
Control
Record
Status
Time
Communication
Password
Panel
Others
```

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- Select the setting item to enter a setting sub-menu and press the ENTER key.

In view mode, the input column of each setting sub-menu and the cursor are not displayed.

CAUTION

Modification of settings : Care should be taken when modifying settings for "active group", "scheme switch" and "protection element" in the "Protection" menu. Dependencies exist between the settings in the various menus, with settings in one menu becoming active (or inactive) depending on the selection made in another menu. Therefore, it is recommended that all necessary setting changes be made while the circuit breaker tripping circuit is disconnected.

Alternatively, if it is necessary to make setting changes with the tripping circuit active, then it is recommended to enter the new settings into a different settings group, and then change the "active group" setting, thus ensuring that all new settings become valid simultaneously.

4.2.6.1 Setting Method

There are two setting methods as follows:

- To enter into a selected item
- To select numerical values

To enter into a selected item

If a screen as shown below is displayed, perform settings as follows.

The cursor (underbar) can be moved to upper or lower lines within the screen by pressing the ▲ and ▼ keys. If setting change is not required, skip the line with the ▲ and ▼ keys.

```
Settings menu                   25/Feb/2003 09:45
Protection
Control
Record
Status
Time
Communication
Password
Panel
Others
```

- Move the cursor to a setting item.
- Press the ENTER key.

To select letter settings

If a screen as shown below is displayed, perform settings as follows.

The cursor can be moved to upper or lower lines within the screen by pressing the ▲ and ▼ key. If setting change is not required, skip the line with the ▲ and ▼ keys.

```
Settings-Protection             25/Feb/2003 09:45
```

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```
Common                                      1/2
APPL CT    Off     Off
APPL VT    ***     ***
APPL VTS    ***     ***

CTFEN    ******    ******
VTF1EN   ******    ******
VTF2EN   ******    ******
CTSVEN   *******   *******
V0SVEN   *******   *******
V2SVEN   *******   *******
CBSVEN      ***       ***
```

- Move the cursor to a setting line and item by the ▲ or ▼ key.
- Press the ◀ or ▶ key to set a desired letter (for example, "Off", "On", etc.).
- Press the [ENTER] key.

To select numerical setting values

When the screen shown below is displayed, perform settings as follows:

The number to the left of the cursor shows the current setting or default setting set at shipment. The cursor can be moved to upper or lower lines within the screen by pressing the ▲ and ▼ keys. If setting change is not required, skip the line with the ▲ and ▼ keys.

```
Settings-Protection             25/Feb/2003 09:45
Group*-FL
X1   ###.## ###.##Ω        R1  ###.## ###.##Ω
X0   ###.## ###.##Ω        R0  ###.## ###.##Ω
Kab     ###    ###%        Ka     ###    ###%
Kbc     ###    ###%        Kb     ###    ###%
Kca     ###    ###%        Kc     ###    ###%
Line  ###.#  ###.#km
```

Enter new setting

Current or default setting

- Move the cursor to a setting line.
- Press the ◀ or ▶ key to set a desired value. The value is up or down by pressing the ▶ or ◀ key.
- Press the [ENTER] key to enter the value.
- After completing the settings on the screen, press the [END] key to return to the upper screen.

To correct the entered numerical value, do the following.

- If it is before pressing the [ENTER] key, press the ▲ or ▼ key to shift other item and then the setting value recovers. And shift the original item and enter the new numerical value.

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- If it is after pressing the ENTER key, move the cursor to the correcting line by pressing the ▲ and ▼ keys and enter the new numerical value.

  Note: If the CANCEL key is pressed after any entry is confirmed by pressing the ENTER key, all the entries made so far on the screen concerned are canceled and screen returns to the upper one.

To complete the settings

Enter after making entries on each setting screen by pressing the ENTER key, the new settings are not yet used for operation, though stored in the memory. To validate the new settings, take the following steps.

- Press the END key to return to the upper screen. Repeat this until the confirmation message shown below is displayed. The guidance message is displayed just before returning to the "Settings" sub-menu.

```
Settings-#####                          25/Feb/2003 09:45

   (Each sub menu display)




Change settings?  Y=ENTER/N=CANCEL
```

- When the message is displayed, press the ENTER key to start operation using the new settings, or press the CANCEL key to correct or cancel entries. In the latter case, the guidance message disappears and enable re-entries.

  To quit the settings without changing value, press the END key and then the message “Change settings?” appears. In this screen, press the CANCEL key and then the message “Cancel settings?” appears and press the ENTER key to the upper menu.

4.2.6.2 Protection

The GRD150 can have 8 setting groups for protection in order to accommodate changes in the operation of the power system, one setting group is assigned active. To set the protection, do the following:

- Select "Settings" on the top "Main Menu" screen to display the "Settings" screen.

Then the following password screen is displayed when the password is set.

```
Main Menu                               25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test
```

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```
Password [          ]          <0123456789
```

- Input password correctly to enter the setting change sub-menu.

Then the following "Settings" screen is displayed.

```
Settings menu                    25/Feb/2003 09:45
Protection
Control
Record
Status
Time
Communication
Password
Panel
Others
```

- Select "Protection" on the "Settings" screen to display the "Protection" screen.

```
Settings-Protection              25/Feb/2003 09:45
Change active group
Change settings
Copy group
```

Changing the active group

- Select "Change active group" to display the "Change active group" screen.

```
Settings-Protection              25/Feb/2003 09:45
Change active group
 Active group No.  #   #
```

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- Enter the group number (1 - 8) and press the ENTER key.

Active group can also be changed by assigning the signals to SET.GROUP1(No.2640) to SET.GROUP8(No.2647) by PLC function.

Changing the settings

Almost all the setting items have default values that are set when the product is shipped. For the default values, see Appendix H. To change the settings, do the following:

- Select "Change settings" to display the "Change settings" screen.

```
Settings-Protection              25/Feb/2003 09:45
Change settings   (Active group=1)
  Common
  Group1
  Group2
  Group3
  Group4
  Group5
  Group6
  Group7
  Group8
```

Copy group

To copy the settings of one group and overwrite them to another group, do the following:

- Select "Copy group" to display the "Copy group" screen.

```
Settings-Protection              25/Feb/2003 09:45
Copy group A to B  (Active group=1)
  Group A   #
  Group B   #

     Execute
```

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- Enter the group number (1 - 8) to be copied in Group A and enter the group number (1 - 8) to be overwritten by the copy in Group B, and move the cursor to "Execute" button and press the ENTER key.

Setting the common

Enter the common settings as follows:

- Select "Common" on the "Change settings" screen to display the "Common" screen.

```
Settings-Protection                25/Feb/2003 09:45
Common                                           1/2
APPL CT    ***   ***
APPL VT    ***   ***                                    (*1)
APPL VTS    ***   ***

CTFEN   ******   ******
VTF1EN  ******   ******
VTF2EN  ******   ******
CTSVEN  *******  *******
V0SVEN  *******  *******
V2SVEN  *******  *******
CBSVEN     ***      ***
```

```
Settings-Protection                25/Feb/2003 09:45
Common                                           2/2
TCSVEN1   *****   *****
TCSVEN2   *****   *****
TCSVEN3   *****   *****
TCSVEN4   *****   *****                                 (*2)
TCSVEN5   *****   *****
TCSVEN6   *****   *****
TCSVEN7   *****   *****
TCSVEN8   *****   *****
```

< APPL CT>

To set the current input state (CT connection), do the following.

- Enter "Off" or "3P"(=3 phase) or "2P"(=2 phase) or "1P"(=1 pole) by pressing the ◀ or ▶ key and press the ENTER key.

<APPL VT, APPL VTS>

- The setting items are changed in accordance with the relay type. (*1)

In case of GRD150-100 or 200 series

```
APPL CT    ***   ***
APPL VT    ***   ***
```

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In case of GRD150-300 or 400 series

```
APPL CT    ***    ***
APPL VT    ***    ***
APPL VTS    ***    ***
```

<APPL VT>

To set the voltage input state (VT connection), do the following.

- If relay type is GRD150-100 or 200 series, enter Off" or "3PN" or "3PV" or "3PP" or "2PP" by pressing the ◀ or ▶ key and press the [ENTER] key.
- If relay type is GRD150-300 or 400 series, Enter "Off" or "3PN" or "3PP" or "2PP" by pressing the ◀ or ▶ key and press the [ENTER] key.

<APPL VTS>

To set the voltage input state for synchronism check of autoreclose function, do the following.

- Enter "A" or "B" or "C" or "AB" or "BC" or "CA" phase by pressing the ◀ or ▶ key and press the [ENTER] key.

<CTFEN, VTF1EN, VTF2EN>

To set CT failure function and VT failure function enable, do the following.

- Enter "Off" or "On" or "OPT-On" by pressing the ◀ or ▶ key and press the [ENTER] key.

< CTSVEN, V0SVEN, V2SVEN>

To set AC input imbalance supervision enable, do the following.

- Enter "Off" or "ALM&BLK" or "ALM" by pressing the ◀ or ▶ key and press the [ENTER] key.

< CBSVEN>

To set circuit breaker supervision enable, do the following.

- Enter "Off" or "On" by pressing the ◀ or ▶ key and press the [ENTER] key.

<TCSVEN>

- These settings are displayed only equipped IO card by the relay type: TCSVEN1 or 2 for IO1, TCSVEN3 or 4 for IO2, TCSVEN5 or 6 for IO3, TCSVEN7 or 8 for IO4. (∗2)

To set trip circuit supervision enable, do the following.

- Enter "Off" or "On" or "OPT-On" by pressing the ◀ or ▶ key and press the [ENTER] key.

After complete settings, press the [END] key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the [ENTER] (= Y) key to change settings and return to the "Protection" screen.

Setting the group

Enter the group settings as follows:

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- Select the group to change the settings on the "Change settings" screen to display the "Group∗ " (∗ = 1 – 8) screen.

```
Settings-Protection                  25/Feb/2003 09:45
Group∗
  Line name                     NOC
  VT/CT ratio                   DNOC
  FL                            UC/Thermal/BCD
  OC                            CBF
  DOC                           Cold Load / Inrush
  EF                            OV/UV
  DEF                           FRQ
  SEF                           CTF/VTF
  DSEF                          ARC
                                Sync CHK
                                PLC setting
```

(∗1) (SEF, DSEF); (∗2) (ARC, Sync CHK)

(∗ 1) : "SEF" and "DSEF" are only displayed if the model is GRD150-200 or 400 series.

(∗ 2) : "ARC" and "Sync CHK" are only displayed if the model is GRD150-300 or 400 series.

Displaying the Line name

The line name cannot be changed on LCD and can be viewed only. To set or change the line name, the PC software RSM100 is used.

To display the line name, do the following.

- Select "Line name" on the "Group∗" screen to display the "Line name" screen.

```
Settings-Protection                  25/Feb/2003 09:45
Group∗-Line name
Line name     ∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗
```

Setting the VT/CT ratio

To set the VT/CT ratio, do the following.

- Select "VT/CT ratio" on the "Group∗" screen to display the "VT/CT ratio" screen.

```
Settings-Protection                  25/Feb/2003 09:45
Group∗-VT/CT ratio
VT ratio        ####  ####
CT ratio      ##### #####
VTS ratio       ####   ####               (∗1)
EFCT ratio    ##### #####
SEFCT ratio ##### #####                   (∗2)
```


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(∗ 1) : "VTS ratio" is only displayed if the model is GRD150-300 or 400 series.
(∗ 2) : "SEFCT ratio" is only displayed if the model is GRD150-200 or 400 series.

- The range of settings is as follows:

  VT ratio, VTS ratio: 1 – 8000

  CT ratio, EFCT ratio, SEFCT ratio: 1 – 10000

- Enter the VT/CT ratio by pressing the ◀ or ▶ key and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the FL

To set the FL settings, do the following.

- Select "FL" on the "Group∗" screen to display the "FL" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-FL
X1   ###.##Ω  ###.##Ω     R1  ###.##Ω  ###.##Ω
X0   ###.##Ω  ###.##Ω     R0  ###.##Ω  ###.##Ω
Kab    ###%     ###%      Ka    ###%     ###%
Kbc    ###%     ###%      Kb    ###%     ###%
Kca    ###%     ###%      Kc    ###%     ###%
Line   ###.#km ###.#km
```

- The ranges of settings are as follows:

  X1, X0, R1,R0: 0.0 - 999.9 (1A rating) 0.00 - 199.99 (5A rating)

  Kab, Kbc, Kca, Ka, Kb, Kc: 80 - 120

  Line: 0.0 - 399.9

- Enter the above parameters of the fault locator by pressing the ◀ or ▶ key and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

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- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the OC

To set the OC settings, do the following.

- Select "OC" on the "Group∗" screen to display the "OC" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-OC                                      1/5
OC1EN        ∗∗∗   ∗∗∗   OC1       ##.#A   ##.#A
MOC1        ∗∗∗∗  ∗∗∗∗   TOC1D  ###.##s ###.##s
MOC1-IEC     ∗∗∗   ∗∗∗   TOC1P    #.###   #.###
MOC1C-IEEE    ∗∗    ∗∗   TOC1RD  ###.# s  ###.#s
MOC1C-US     ∗∗∗   ∗∗∗   TOC1RP  #.###    #.###
OC1R         ∗∗∗   ∗∗∗
OC1-2F       ∗∗∗   ∗∗∗

OC1-TP1     ∗∗∗∗ ∗∗∗∗    OC1-TP4     ∗∗∗∗ ∗∗∗∗
OC1-TP2     ∗∗∗∗ ∗∗∗∗    OC1-TP5     ∗∗∗∗ ∗∗∗∗     (∗1)
OC1-TP3     ∗∗∗∗ ∗∗∗∗    OC1-TP6     ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-OC                                      2/5
OC2EN        ∗∗∗   ∗∗∗   OC2     ###.#A  ###.#A
MOC2        ∗∗∗∗  ∗∗∗∗   TOC2D  ###.##s ###.##s
MOC2-IEC     ∗∗∗   ∗∗∗   TOC2P    #.###   #.###
MOC2C-IEEE    ∗∗    ∗∗   TOC2RD  ###.# s  ###.#s
MOC2C-US     ∗∗∗   ∗∗∗   TOC2RP  #.###    #.###
OC2R         ∗∗∗   ∗∗∗
OC2-2F       ∗∗∗   ∗∗∗

OC2-TP1     ∗∗∗∗ ∗∗∗∗    OC2-TP4     ∗∗∗∗ ∗∗∗∗
OC2-TP2     ∗∗∗∗ ∗∗∗∗    OC2-TP5     ∗∗∗∗ ∗∗∗∗     (∗1)
OC2-TP3     ∗∗∗∗ ∗∗∗∗    OC2-TP6     ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-OC                                      3/5
OC3EN         ∗∗∗ ∗∗∗    OC3     ###.#A  ###.#A
OC3-2F        ∗∗∗ ∗∗∗    TOC3  ###.##s ###.##s

OC3-TP1     ∗∗∗∗ ∗∗∗∗
OC3-TP2     ∗∗∗∗ ∗∗∗∗
OC3-TP3     ∗∗∗∗ ∗∗∗∗                              (∗1)
OC3-TP4     ∗∗∗∗ ∗∗∗∗
OC3-TP5     ∗∗∗∗ ∗∗∗∗
OC3-TP6     ∗∗∗∗ ∗∗∗∗
```

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```
Settings-Protection            25/Feb/2003 09:45
Group*-OC                                    4/5
OC4EN         *** ***   OC4      ###.#A  ###.#A
OC4-2F        *** ***   TOC4   ###.##s ###.##s

OC4-TP1     **** ****
OC4-TP2     **** ****
OC4-TP3     **** ****                            (*1)
OC4-TP4     **** ****
OC4-TP5     **** ****
OC4-TP6     **** ****
```

```
Settings-Protection            25/Feb/2003 09:45
Group*-OC                                    5/5
OC1-k     ##.### ##.###
OC1-a       #.##    #.##
OC1-C      #.###   #.###
OC1-kr    ##.### ##.###
OC1-b       #.##    #.##
OC2-k     ##.### ##.###
OC2-a       #.##    #.##
OC2-C      #.###   #.###
OC2-kr    ##.### ##.###
OC2-b       #.##    #.##
```

(∗ 1) : "OC∗ -TP∗ " is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<OC∗EN>

To set the OC∗ enable, do the following.

- Enter "On" to enable the OC∗ and press the ENTER key. If disabling the OC∗, enter "Off" and press the ENTER key.

<MOC∗>

To set the OC∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

<MOC∗C-IEC>

To set the OC∗ Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

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<MOC∗C-IEEE>

To set the OC∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the [ENTER] key.

<MOC∗C-US>

To set the OC∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the [ENTER] key.

< OC∗R >

To set the reset characteristic [OC∗R], do the following.

- Enter "DEF" or "DEP" and press the [ENTER] key.

<OC∗-2F>

To set the 2f block enable of OC∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the [ENTER] key. If disabling it, enter "NA" and press the [ENTER] key.

<OC∗-TP∗>

To set the trip mode of OC∗, do the following.

- Enter "Off" (OC∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay settings) and press the [ENTER] key.

<<Element>>

- The ranges of settings are as follows:

OC1:	0.2 - 25.0 (5A rating)	0.04 - 5.00 (1A rating)
TOC1D, TOC2D:	0.00 - 300.00	
TOC1RD, TOC2RD:	0.0 - 300.0	
TOC1P, TOC1RP, TOC2P, TOC2RP:		0.010 - 1.500
OC2, OC3, OC4:	0.5 - 250.0 (5A rating)	0.10 - 50.00 (1A rating)
TOC3, TOC4:	0.00 - 300.00	
OC1-k, OC2-k:	0.000 - 30.000	
OC1-a, OC2-a:	0.00 - 5.00	
OC1-C, OC2-C:	0.000 - 5.000	
OC1-kr, OC2-kr:	0.000 - 30.000	
OC1-b, OC2-b:	0.00 - 5.00	

- Enter the numerical value by pressing the ◀ or ▶ key and press the [ENTER] key.
- After setting, press the [END] key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the [ENTER] (= Y) key to change settings and return to the "Settings menu" screen.

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Setting the DOC

To set the DOC settings, do the following.

- Select "DOC" on the "Group∗" screen to display the "DOC" screen.

```
Settings-Protection             25/Feb/2003 09:45
Group∗-DOC                                    1/5
DOCθ         −##˚  −##˚

DOC1EN         *** ***   DOC1      ##.##A ##.##A
DOC1-DIR       *** ***   TDOC1D ###.##s ###.##s
MDOC1        **** ****   TDOC1P   #.###  #.###
MDOC1C-IEC     *** ***   TDOC1RD  ###.#s ###.#s
MDOC1C-IEEE     **  **   TDOC1RP  #.###  #.###
MDOC1C-US      *** ***
DOC1R          *** ***   DOCTP******* *******
DOC1-2F        *** ***
DOC1-TP1     **** ****   DOC1-TP4   **** ****
DOC1-TP2     **** ****   DOC1-TP5   **** ****    (∗1)
DOC1-TP3     **** ****   DOC1-TP6   **** ****
```

```
Settings-Protection             25/Feb/2003 09:45
Group∗-DOC                                    2/5
DOC2EN         *** ***   DOC2      ##.##A ##.##A
DOC2-DIR       *** ***   TDOC2D ###.##s ###.##s
MDOC2        **** ****   TDOC2P   #.###  #.###
MDOC2C-IEC     *** ***   TDOC2RD  ###.#s ###.#s
MDOC2C-IEEE     **  **   TDOC2RP  #.###  #.###
MDOC2C-US      *** ***
DOC2R          *** ***
DOC2-2F        *** ***

DOC2-TP1     **** ****   DOC2-TP4   **** ****
DOC2-TP2     **** ****   DOC2-TP5   **** ****    (∗1)
DOC2-TP3     **** ****   DOC2-TP6   **** ****
```

```
Settings-Protection             25/Feb/2003 09:45
Group∗-DOC                                    3/5
DOC3EN         *** ***   DOC3     ##.##A  ##.##A
DOC3-DIR       *** ***   TDOC3   ###.##s ###.##s
DOC3-2F        *** ***

DOC3-TP1     **** ****
DOC3-TP2     **** ****
DOC3-TP3     **** ****                           (∗1)
DOC3-TP4     **** ****
DOC3-TP5     **** ****
DOC3-TP6     **** ****
```

```
Settings-Protection             25/Feb/2003 09:45
```

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```
Group∗-DOC                                  4/5
DOC4EN        *** ***   DOC4    ##.##A  ##.##A
DOC4-DIR      *** ***   TDOC4  ###.##s ###.##s
DOC4-2F       *** ***

DOC4-TP1   **** ****
DOC4-TP2   **** ****
DOC4-TP3   **** ****
DOC4-TP4   **** ****
DOC4-TP5   **** ****
DOC4-TP6   **** ****
```

(∗1)

```
Settings-Protection           25/Feb/2003 09:45
Group∗-DOC                                  5/5
DOC1-k    ##.### ##.###
DOC1-a     #.##     #.##
DOC1-C    #.###   #.###
DOC1-kr   ##.### ##.###
DOC1-b     #.##     #.##
DOC2-k    ##.### ##.###
DOC2-a     #.##     #.##
DOC2-C    #.###   #.###
DOC2-kr   ##.### ##.###
DOC2-b     #.##     #.##
```

(∗1)

(∗ 1) : "DOC∗ -TP∗ " is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<DOC∗EN>

To set the DOC∗ enable, do the following.

- Enter "On" to enable the DOC∗ and press the ENTER key. If disabling the DOC∗, enter "Off" and press the ENTER key.

<DOC∗-DIR>

To set the DOC∗ directional characteristic, do the following.

- Enter "FWD" or "REV" and press the ENTER key.

<MDOC∗>

To set the DOC∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

<MDOC∗C-IEC>

To set the DOC∗ Inverse Curve Type of IEC, do the following.

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- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

<MDOC∗C-IEEE>

To set the DOC∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI or "VI" or "EI" and press the ENTER key.

<MDOC∗C-US>

To set the DOC∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

< DOC∗R>

To set the reset characteristic, do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<DOC∗-2F>

To set the 2f block enable of DOC∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<DOC∗-TP∗>

To set the trip mode of OC∗, do the following.

- Enter "Off" (DOC∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay settings) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

DOC θ :	– 95 - 95	
DOC1:	0.2 - 25.0 (5A rating)	0.04 - 5.00 (1A rating)
TDOC1D, TDOC2D:	0.00 - 300.00	
TDOC1RD, TDOC2RD:	0.0 - 300.0	
TDOC1P, TDOC1RP, TDOC2P, TDOC2RP:	0.010 - 1.500	
DOC2, DOC3, DOC4:	0.5 - 250.0 (5A rating)	0.10 - 50.00 (1A rating)
TDOC3, TDOC4:	0.00 - 300.00	
DOC1-k, DOC2-k:	0.000 - 30.000	
DOC1-a, DOC2-a:	0.00 - 5.00	
DOC1-C, DOC2-C:	0.000 - 5.000	
DOC1-kr, DOC2-kr:	0.000 - 30.000	
DOC1-b, DOC2-b:	0.00 - 5.00	

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings? Y=ENTER/N=CANCEL
```

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- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the EF

To set the EF settings, do the following.

- Select "EF" on the "Group∗" screen to display the "EF" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-EF                                      1/5
EF1EN         ∗∗∗   ∗∗∗    EF1      ##.##A  ##.##A
MEF1         ∗∗∗∗  ∗∗∗∗    TEF1D  ###.##s ###.##s
MEF1-IEC      ∗∗∗   ∗∗∗    TEF1P    #.###    #.###
MEF1C-IEEE     ∗∗    ∗∗    TEF1RD  ###.# s  ###.#s
MEF1C-US      ∗∗∗   ∗∗∗    TEF1RP  #.###    #.###
EF1R          ∗∗∗   ∗∗∗
EF1-2F        ∗∗∗   ∗∗∗

EF1-TP1      ∗∗∗∗ ∗∗∗∗     EF1-TP4     ∗∗∗∗ ∗∗∗∗
EF1-TP2      ∗∗∗∗ ∗∗∗∗     EF1-TP5     ∗∗∗∗ ∗∗∗∗      (∗1)
EF1-TP3      ∗∗∗∗ ∗∗∗∗     EF1-TP6     ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-EF                                      2/5
EF2EN         ∗∗∗   ∗∗∗    EF2      ###.#A  ###.#A
MEF2         ∗∗∗∗  ∗∗∗∗    TEF2D  ###.##s ###.##s
MEF2-IEC      ∗∗∗   ∗∗∗    TEF2P    #.###    #.###
MEF2C-IEEE     ∗∗    ∗∗    TEF2RD  ###.#s   ###.#s
MEF2C-US      ∗∗∗   ∗∗∗    TEF2RP  #.###    #.###
EF2R          ∗∗∗   ∗∗∗
EF2-2F        ∗∗∗   ∗∗∗

EF2-TP1      ∗∗∗∗ ∗∗∗∗     EF2-TP4     ∗∗∗∗ ∗∗∗∗
EF2-TP2      ∗∗∗∗ ∗∗∗∗     EF2-TP5     ∗∗∗∗ ∗∗∗∗      (∗1)
EF2-TP3      ∗∗∗∗ ∗∗∗∗     EF2-TP6     ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-EF                                      3/5
EF3EN          ∗∗∗ ∗∗∗     EF3     ###.#A  ###.#A
EF3-2F         ∗∗∗ ∗∗∗     TEF3  ###.##s ###.##s

EF3-TP1      ∗∗∗∗ ∗∗∗∗
EF3-TP2      ∗∗∗∗ ∗∗∗∗
EF3-TP3      ∗∗∗∗ ∗∗∗∗                                (∗1)
EF3-TP4      ∗∗∗∗ ∗∗∗∗
EF3-TP5      ∗∗∗∗ ∗∗∗∗
EF3-TP6      ∗∗∗∗ ∗∗∗∗
```

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```
Settings-Protection                 25/Feb/2003 09:45
Group∗-EF                                         4/5
EF4EN         *** ***    EF4     ###.#A  ###.#A
EF4-2F        *** ***    TEF4   ###.##s ###.##s

EF4-TP1     **** ****
EF4-TP2     **** ****
EF4-TP3     **** ****       (∗1)
EF4-TP4     **** ****
EF4-TP5     **** ****
EF4-TP6     **** ****
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-EF                                         5/5
EF1-k      ##.### ##.###
EF1-a       #.##    #.##
EF1-C      #.###   #.###
EF1-kr     ##.### ##.###
EF1-b       #.##    #.##
EF2-k      ##.### ##.###
EF2-a       #.##    #.##
EF2-C      #.###   #.###
EF2-kr     ##.### ##.###
EF2-b       #.##    #.##
```

(∗ 1) : "EF∗ -TP∗ " is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<EF∗EN>

To set the EF∗ enable, do the following.

- Enter "On" to enable the EF∗ and press the ENTER key. If disabling the EF∗, enter "Off" and press the ENTER key.

<MEF∗>

To set the EF∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

<MEF∗C-IEC>

To set the EF∗ Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

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<MEF∗C-IEEE>

To set the EF∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MEF∗C-US>

To set the EF∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

< EF∗R>

To set the reset characteristic, do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<EF∗-2F>

To set the 2f block enable of EF∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<EF∗-TP∗>

To set the trip mode of EF∗, do the following.

- Enter "Off" (EF∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay setting) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

EF1: 0.05 - 25.00 (5A rating) 0.01 - 5.00 (1A rating)
TEF1D, TEF2D: 0.00 - 300.00
TEF1RD, TEF2RD: 0.0 - 300.0
TEF1P, TEF1RP, TEF2P, TEF2RP: 0.010 - 1.500
EF2, EF3, EF4: 0.20 - 250.00 (5A rating) 0.04 - 50.00 (1A rating)
TEF3, TEF4: 0.00 - 300.00
EF1-k, EF2-k: 0.000 - 30.000
EF1-a, EF2-a: 0.00 - 5.00
EF1-C, EF2-C: 0.000 - 5.000
EF1-kr, EF2-kr: 0.000 - 30.000
EF1-b, EF2-b: 0.00 - 5.00

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings? Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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Setting the DEF

To set the DEF setting, do the following.

- Select "DEF" on the "Group∗" screen to display the "DEF" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-DEF                                    1/5
DEFθ        –##˚  –##˚    DEFV     ###.#V ###.#V

DEF1EN         *** ***    DEF1      ##.##A ##.##A
DEF1-DIR       *** ***    TDEF1D ###.##s ###.##s
MDEF1        **** ****    TDEF1P    #.###  #.###
MDEF1C-IEC     *** ***    TDEF1RD  ###.#s ###.#s
MDEF1C-IEEE     **  **    TDEF1RP  #.###  #.###
MDEF1C-US      *** ***
DEF1R          *** ***
DEF1-2F        *** ***
DEF1-TP1     **** ****    DEF1-TP4   **** ****
DEF1-TP2     **** ****    DEF1-TP5   **** ****      (∗1)
DEF1-TP3     **** ****    DEF1-TP6   **** ****
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-DEF                                    2/5
DEF2EN         *** ***    DEF2      ###.#A ###.#A
DEF2-DIR       *** ***    TDEF2D ###.##s ###.##s
MDEF2        **** ****    TDEF2P    #.###  #.###
MDEF2C-IEC     *** ***    TDEF2RD  ###.#s ###.#s
MDEF2C-IEEE     **  **    TDEF2RP  #.###  #.###
MDEF2C-US      *** ***
DEF2R          *** ***
DEF2-2F        *** ***

DEF2-TP1     **** ****    DEF2-TP4   **** ****
DEF2-TP2     **** ****    DEF2-TP5   **** ****      (∗1)
DEF2-TP3     **** ****    DEF2-TP6   **** ****
```

```
Settings-Protection              25/Feb/2003 09:45
Group∗-DEF                                    3/5
DEF3EN         *** ***    DEF3     ###.#A  ###.#A
DEF3-DIR       *** ***    TDEF3  ###.##s ###.##s
DEF3-2F        *** ***

DEF3-TP1     **** ****
DEF3-TP2     **** ****
DEF3-TP3     **** ****                              (∗1)
DEF3-TP4     **** ****
DEF3-TP5     **** ****
DEF3-TP6     **** ****
```

```
Settings-Protection              25/Feb/2003 09:45
```

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```
Group∗-DEF                                        4/5
DEF4EN        *** ***   DEF4    ###.#A  ###.#A
DEF4-DIR      *** ***   TDEF4  ###.##s ###.##s
DEF4-2F       *** ***

DEF4-TP1    **** ****
DEF4-TP2    **** ****
DEF4-TP3    **** ****                               (∗1)
DEF4-TP4    **** ****
DEF4-TP5    **** ****
DEF4-TP6    **** ****
```

```
Settings-Protection                  25/Feb/2003 09:45
Group∗-DEF                                        5/5
DEF1-k    ##.### ##.###
DEF1-a     #.##     #.##
DEF1-C    #.###    #.###
DEF1-kr   ##.### ##.###
DEF1-b     #.##     #.##
DEF2-k    ##.### ##.###
DEF2-a     #.##     #.##
DEF2-C    #.###    #.###
DEF2-kr   ##.### ##.###
DEF2-b     #.##     #.##
```

(∗ 1) : "DEF∗ -TP∗ " is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<DEF∗EN>

To set the DEF∗ enable, do the following.

- Enter "On" to enable the DEF∗ and press the ENTER key. If disabling the DEF∗, enter 0 "Off" and press the ENTER key.

<DEF∗-DIR>

To set the DEF∗ directional characteristic, do the following.

- Enter "FWD" or "REV" and press the ENTER key.

<MDEF∗>

To set the DEF∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

<MDEF∗C-IEC>

To set the DEF∗ Inverse Curve Type of IEC, do the following.

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- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

<MDEF∗C-IEEE>

To set the DEF∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MDEF∗C-US>

To set the DEF∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

<DEF∗-R>

To set the Reset Characteristic [DEF∗R], do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<DEF∗-2F>

To set the 2f block enable of DEF∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<DEF∗-TP∗>

To set the trip mode of DEF∗, do the following.

- Enter "Off" (DEF∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay setting) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

DEF θ :	– 95 - 95	
DEFV:	0.5 - 100.0	
DEF1:	0.05 - 25.00 (5A rating)	0.01 - 5.00 (1A rating)
TDEF1D, TDEF2D:	0.00 - 300.00	
TDEF1RD, TDEF2RD:	0.0 - 300.0	
TDEF1P, TDEF1RP, TDEF2P, TDEF2RP:	0.010 - 1.500	
DEF2, DEF3, DEF4:	0.2 - 250.0 (5A rating)	0.04 - 50.00 (1A rating)
TDEF3, TDEF4:	0.00 - 300.00	
DEF1-k, DEF2-k:	0.000 - 30.000	
DEF1-a, DEF2-a:	0.00 - 5.00	
DEF1-C, DEF2-C:	0.000 - 5.000	
DEF1-kr, DEF2-kr:	0.000 - 30.000	
DEF1-b, DEF2-b:	0.00 - 5.00	

- Enter the numerical value and press the ENTER key.

- After setting, press the END key to display the following confirmation message.

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```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the SEF

To set the SEF setting, do the following.

- Select "SEF" on the "Group∗" screen to display the "SEF" screen.

```
Settings-Protection           25/Feb/2003 09:45
Group∗-SEF                                  1/5
SE1EN        ∗∗∗   ∗∗∗   SE1     #.###A  #.###A
MSE1        ∗∗∗∗  ∗∗∗∗   TSE1D  ###.##s ###.##s
MSE1-IEC     ∗∗∗   ∗∗∗   TSE1P   #.###   #.###
MSE1C-IEEE    ∗∗    ∗∗   TSE1RD  ###.# s  ###.#s
MSE1C-US     ∗∗∗   ∗∗∗   TSE1RP #.###   #.###
SE1R         ∗∗∗   ∗∗∗   TSE1S2 ##.###s ##.###s
SE1-2F       ∗∗∗   ∗∗∗
SE1S2        ∗∗∗   ∗∗∗

SE1-TP1     ∗∗∗∗ ∗∗∗∗   SE1-TP4    ∗∗∗∗ ∗∗∗∗
SE1-TP2     ∗∗∗∗ ∗∗∗∗   SE1-TP5    ∗∗∗∗ ∗∗∗∗     (∗1)
SE1-TP3     ∗∗∗∗ ∗∗∗∗   SE1-TP6    ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection           25/Feb/2003 09:45
Group∗-SEF                                  2/5
SE2EN        ∗∗∗   ∗∗∗   SE2     #.###A  #.###A
MSE2        ∗∗∗∗  ∗∗∗∗   TSE2D  ###.##s ###.##s
MSE2-IEC     ∗∗∗   ∗∗∗   TSE2P   #.###   #.###
MSE2C-IEEE    ∗∗    ∗∗   TSE2RD  ###.# s  ###.#s
MSE2C-US     ∗∗∗   ∗∗∗   TSE2RP #.###   #.###
SE2R         ∗∗∗   ∗∗∗
SE2-2F       ∗∗∗   ∗∗∗

SE2-TP1     ∗∗∗∗ ∗∗∗∗   SE2-TP4    ∗∗∗∗ ∗∗∗∗
SE2-TP2     ∗∗∗∗ ∗∗∗∗   SE2-TP5    ∗∗∗∗ ∗∗∗∗     (∗1)
SE2-TP3     ∗∗∗∗ ∗∗∗∗   SE2-TP6    ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection           25/Feb/2003 09:45
Group∗-SEF                                  3/5
SE3EN         ∗∗∗ ∗∗∗   SE3    ###.#A  ###.#A
SE3-2F        ∗∗∗ ∗∗∗   TSE3  ###.##s ###.##s

SE3-TP1     ∗∗∗∗ ∗∗∗∗
SE3-TP2     ∗∗∗∗ ∗∗∗∗
SE3-TP3     ∗∗∗∗ ∗∗∗∗
SE3-TP4     ∗∗∗∗ ∗∗∗∗                              (∗1)
SE3-TP5     ∗∗∗∗ ∗∗∗∗
SE3-TP6     ∗∗∗∗ ∗∗∗∗
```

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```
Settings-Protection                    25/Feb/2003 09:45
Group∗-SEF                                           4/5
SE4EN         ∗∗∗ ∗∗∗   SE4     ###.#A  ###.#A
SE4-2F        ∗∗∗ ∗∗∗   TSE4   ###.##s ###.##s

SE4-TP1     ∗∗∗∗ ∗∗∗∗
SE4-TP2     ∗∗∗∗ ∗∗∗∗
SE4-TP3     ∗∗∗∗ ∗∗∗∗                                     (∗1)
SE4-TP4     ∗∗∗∗ ∗∗∗∗
SE4-TP5     ∗∗∗∗ ∗∗∗∗
SE4-TP6     ∗∗∗∗ ∗∗∗∗
```

```
Settings-Protection                    25/Feb/2003 09:45
Group∗-SEF                                           5/5
SE1-k      ##.### ##.###
SE1-a       #.##    #.##
SE1-C      #.###   #.###
SE1-kr     ##.### ##.###
SE1-b       #.##    #.##
SE2-k      ##.### ##.###
SE2-a       #.##    #.##
SE2-C      #.###   #.###
SE2-kr     ##.### ##.###
SE2-b       #.##    #.##
```

(∗ 1) : "SE∗ TP∗ " is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<SE∗EN>

To set the SE∗ enable, do the following.

- Enter "On" to enable the SE∗ and press the ENTER key. If disabling the SE∗, enter "Off" and press the ENTER key.

<MSE∗>

To set the SE∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

<MSE∗C-IEC>

To set the SE∗ Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

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<MSE∗C-IEEE>

To set the SE∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MSE∗C-US>

To set the SE∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

<SE∗R>

To set the Reset Characteristic [SE∗R], do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<SE1S2>

To set the SEF1 stage 2 timer enable, do the following.

- Enter "On" to enable the SEF1 stage 2 timer and press the ENTER key. If disabling it, enter "Off" and press the ENTER key.

<SE∗-2F>

To set the 2f block enable of SE∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<SE∗-TP∗>

To set the trip mode of SE∗, do the following.

- Enter "Off" (SE∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay setting) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

SE1, SE2, SE3, SE4:	0.025 - 0.125A (5A rating)	0.005 - 0.025A (1A rating)
TSE1D, TSE1S2, TSE2D:	0.00 - 300.00	
TSE1RD, TSE2RD:	0.0 - 300.0	
TSE1P, TSE1RP, TSE2P, TSE2RP:	0.010 - 1.500	
TSE3, TSE4:	0.00 - 300.00	
SE1-k, SE2-k:	0.000 - 30.000	
SE1-a, SE2-a:	0.00 - 5.00	
SE1-C, SE2-C:	0.000 - 5.000	
SE1-kr, SE2-kr:	0.000 - 30.000	
SE1-b, SE2-b:	0.00 - 5.00	

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

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```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the [ENTER] (= Y) key to change settings and return to the "Settings menu" screen.

Setting the DSEF

To set the DSEF setting, do the following.

- Select "DSEF" on the "Group∗" screen to display the "DSEF" screen.

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-DSEF                                       1/5
DSEθ          −##°  −##°    DSEV     ###.#V ###.#V
DSE1EN           *** ***    DSE1      #.###A #.###A
DSE1-DIR         *** ***    TDSE1D ###.##s ###.##s
MDSE1          **** ****    TDSE1P   #.###  #.###
MDSE1C-IEC       *** ***    TDSE1RD  ###.#s ###.#s
MDSE1C-IEEE       **  **    TDSE1RP  #.###  #.###
MDSE1C-US        *** ***    TDSE1S2
DSE1R            *** ***             ###.##s ###.##s
DSE1-2F          *** ***
DSE1S2           *** ***
DSE1-TP1       **** ****    DSE1-TP4     **** ****   ⎫
DSE1-TP2       **** ****    DSE1-TP5     **** ****   ⎬ (∗1)
DSE1-TP3       **** ****    DSE1-TP6     **** ****   ⎭
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-DSEF                                       2/5
DSE2EN           *** ***    DSE2      #.###A #.###A
DSE2-DIR         *** ***    TDSE2D ###.##s ###.##s
MDSE2          **** ****    TDSE2P   #.###  #.###
MDSE2C-IEC       *** ***    TDSE2RD  ###.#s ###.#s
MDSE2C-IEEE       **  **    TDSE2RP  #.###  #.###
MDSE2C-US        *** ***
DSE2R            *** ***
DSE2-2F          *** ***

DSE2-TP1       **** ****    DSE2-TP4     **** ****   ⎫
DSE2-TP2       **** ****    DSE2-TP5     **** ****   ⎬ (∗1)
DSE2-TP3       **** ****    DSE2-TP6     **** ****   ⎭
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-DSEF                                       3/5
DSE3EN           *** ***    DSE3    #.###A  #.###A
DSE3-DIR         *** ***    TDSE3  ###.##s ###.##s
DSE3-2F          *** ***

DSE3-TP1       **** ****                             ⎫
DSE3-TP2       **** ****                             ⎪
DSE3-TP3       **** ****                             ⎬ (∗1)
DSE3-TP4       **** ****                             ⎪
DSE3-TP5       **** ****                             ⎪
DSE3-TP6       **** ****                             ⎭
```

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```
Settings-Protection           25/Feb/2003 09:45
Group∗-DSEF                                 4/5
DSE4EN        *** ***   DSE4    #.###A  #.###A
DSE4-DIR      *** ***   TDSE4  ###.##s ###.##s
DSE4-2F       *** ***

DSE4-TP1   **** ****                          ⎫
DSE4-TP2   **** ****                          ⎪
DSE4-TP3   **** ****                          ⎬ (∗1)
DSE4-TP4   **** ****                          ⎪
DSE4-TP5   **** ****                          ⎪
DSE4-TP6   **** ****                          ⎭

RPEN        ***   ***   RP    ###.##W ###.##W
```

```
Settings-Protection           25/Feb/2003 09:45
Group∗-DSEF                                 5/5
DSE1-k   ##.### ##.###
DSE1-a     #.##    #.##
DSE1-C   #.###   #.###
DSE1-kr  ##.### ##.###
DSE1-b     #.##    #.##
DSE2-k   ##.### ##.###
DSE2-a     #.##    #.##
DSE2-C   #.###   #.###
DSE2-kr  ##.### ##.###
DSE2-b     #.##    #.##
```

(∗ 1) : "DSE∗-TP∗" is only displayed if the model is GRD150-300 or 400 series.

<<Scheme switch>>

<DSE∗EN>

To set the DSE∗ enable, do the following.

- Enter "On" to enable the DSE∗ and press the ENTER key. If disabling the DSE∗, enter "Off" and press the ENTER key.

<DSE∗-DIR>

To set the DSE∗ directional characteristic, do the following.

- Enter "FWD" or "REV" and press the ENTER key.

<MDSE∗>

To set the DSE∗ time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

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<MDSE∗C-IEC>

To set the DEF∗ Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

<MDSE∗C-IEEE>

To set the DEF∗ Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MDSE∗C-US>

To set the DEF∗ Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

<DSE∗R>

To set the Reset Characteristic, do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<DSE1S2>

To set the DSEF1 stage 2 timer enable, do the following.

- Enter "On" to enable the DSEF1 stage 2 timer and press the ENTER key. If disabling it, enter "Off" and press the ENTER key.

<DSE∗-2F>

To set the 2f block enable of DSE∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<DSE∗-TP∗>

To set the trip mode of DSE∗, do the following.

- Enter "Off" (DSE∗ disable) or "INST" (Instantaneous action) or "SET" (Action by time delay setting) and press the ENTER key.

<RPEN>

To set the residual power to enable, do the following.

- Enter "On" to enable the residual power and press the ENTER key. If disabling it, enter "Off" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

DSE θ :	– 95 - 95
DSEV:	0.5 - 100.0
DSE1 DSE2, DSE3, DSE4:	0.025 - 0.125A (5A rating) 0.005 - 0.025A (1A rating)

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TDSE1D, TDSE2D, TDSE1S2: 0.00 - 300.00
TDSE1RD, TDSE2RD: 0.0 - 300.0
TDSE1P, TDSE1RP, TDSE2P, TDSE2RP: 0.010 - 1.500
TDSE3, TDSE4: 0.00 - 300.00
RP: 0.00 – 100.00W (5A rating) 0.00 – 20.00W (1A rating)
DSE1-k, DSE2-k: 0.000 - 30.000
DSE1-a, DSE2-a: 0.00 - 5.00
DSE1-C, DSE2-C: 0.000 - 5.000
DSE1-kr, DSE2-kr: 0.000 - 30.000
DSE1-b, DSE2-b: 0.00 - 5.00

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "settings menu" screen.

Setting the NOC

To set the NOC setting, do the following.

- Select "NOC" on the "Group∗" screen to display the "NOC" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-NOC
NC1EN        ***  ***    NC2EN        ***   ***
MNC1        **** ****    NC2-2F       ***   ***
MNC1C-IEC    ***  ***    NC2         #.#A   #.#A
MNC1C-IEEE   ***  ***    TNC2    ###.##s ###.##s
MNC1C-US     ***  ***
NC1R         ***  ***
NC1-2F       ***  ***
NC1       #.#A    #.#A   NC1-k   ##.###  ##.###
TNC1D  ###.##s ###.##s   NC1-a     #.##    #.##
TNC1P   #.###   #.###    NC1-C    #.###   #.###
TNC1RD  ###.#s  ###.#s   NC1-kr  ##.###  ##.###
TNC1RP  #.###   #.###    NC1-b     #.##    #.##
```

<<Scheme switch>>

<NC∗EN>

To set the NC∗ enable, do the following.

- Enter "On" to enable the NC∗ and press the ENTER key. If disabling the NC∗, enter "Off" and press the ENTER key.

<MNC1>

To set the NC1 time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

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<MNC1C-IEC>

To set the NC1 Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

<MNC1C-IEEE>

To set the NC1 Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MNC1C-US>

To set the NC1 Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

< NC1R>

To set the Reset Characteristic, do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<NC∗-2F>

To set the 2f block enable of NC∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

NC1, NC2:	0.5 - 10.0 (5A rating) 0.10 - 2.00 (1A rating)
TNC1D, TNC2:	0.00 - 300.00
TNC1RD:	0.0 - 300.0
TNC1P, TNC1RP:	0.010 - 1.500
NC1-k:	0.000 - 30.000
NC1-a:	0.00 - 5.00
NC1-C:	0.000 - 5.000
NC1-kr:	0.000 - 30.000
NC1-b:	0.00 - 5.00

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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Setting the DNOC

To set the DNOC setting, do the following.

- Select "DNOC" on the "Group∗" screen to display the "DNOC" screen.

```
Settings-Protection                    25/Feb/2003 09:45
Group∗-DNOC                                          1/2
DNCθ         −##˚  −##˚    DNCV       ##.#V  ##.#V

DNC1EN         *** ***     DNC1       #.##A  #.##A
DNC1-DIR       *** ***     TDNC1D ###.##s ###.##s
MDNC1        **** ****     TDNC1P   #.###  #.###
MDNC1C-IEC     *** ***     TDNC1RD  ###.#s ###.#s
MDNC1C-IEEE     **  **     TDNC1RP #.###  #.###
MDNC1C-US      *** ***
DNC1R          *** ***     DNC2EN       ***  ***
DNC1-2F        *** ***     DNC2-DIR     ***  ***
                           DNC2-2F      ***  ***
                           DNC2       #.##A  #.##A
                           TDNC2  ###.##s ###.##s
```

```
Settings-Protection                    25/Feb/2003 09:45
Group∗-DNOC                                          2/2
DNC1-k    ##.### ##.###
DNC1-a     #.##     #.##
DNC1-C    #.###   #.###
DNC1-kr   ##.### ##.###
DNC1-b     #.##     #.##
```

<<Scheme switch>>

<DNC∗EN>

To set the DNC∗ enable, do the following.

- Enter "On" to enable the DNC∗ and press the ENTER key. If disabling the DNC∗, enter "Off" and press the ENTER key.

<DNC∗-DIR>

To set the DNC∗ directional characteristic, do the following.

- Enter "FWD" or "REV" and press the ENTER key.

<MDNC1>

To set the DNC1 time delay characteristic type, do the following.

- Enter "DT" or "IEC" or "IEEE" or "US" or "CON" and press the ENTER key.

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<MDNC1C-IEC>

To set the DNC1 Inverse Curve Type of IEC, do the following.

- Enter "NI" or "VI" or "EI" or "LTI" and press the ENTER key.

<MDNC1C-IEEE>

To set the DNC1 Inverse Curve Type of IEEE, do the following.

- Enter "MI" or "VI" or "EI" and press the ENTER key.

<MDNC1C-US>

To set the DNC1 Inverse Curve Type of US, do the following.

- Enter "CO2" or "CO8" and press the ENTER key.

< DNC1R>

To set the Reset Characteristic, do the following.

- Enter "DEF" or "DEP" and press the ENTER key.

<DNC∗-2F>

To set the 2f block enable of DNC∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

DNC θ :	– 95 - 95
DNCV:	0.5 - 25.0
DNC1, DNC2:	0.5 - 10.0 (5A rating) 0.10 - 2.00 (1A rating)
TDNC1D, TDNC2:	0.00 - 300.00
TDNC1RD:	0.0 - 300.0
TDNC1P, TDNC1RP:	0.010 - 1.500
DNC1-k:	0.000 - 30.000
DNC1-a:	0.00 - 5.00
DNC1-C:	0.000 - 5.000
DNC1-kr:	0.000 - 30.000
DNC1-b:	0.00 - 5.00

- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the UC / Thermal / BCD

To set the UC / Thermal / BCD settings, do the following.

- Select "UC / Thermal / BCD" on the "Group∗" screen to display the "UC / Thermal / BCD"

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screen.

```
Settings-Protection               25/Feb/2003 09:45
Group∗-UC/Thermal/BCD
UC1EN       ∗∗∗  ∗∗∗     BCDEN      ∗∗∗  ∗∗∗
UC1      ##.#A   ##.#A   BCD-2F     ∗∗∗  ∗∗∗
TUC1  ###.##s ###.##s   BCD      #.##A   #.##A
UC2EN       ∗∗∗  ∗∗∗     TBCD   ###.##s ###.##s
UC2      ##.#A   ##.#A
TUC2  ###.##s ###.##s

THMEN       ∗∗∗  ∗∗∗
THMAEN      ∗∗∗  ∗∗∗
THM      ##.#A   ##.#A
THMIP    ##.#A   ##.#A
TTHM  ###.#min ###.#min
THMA       ##%    ##%
```

<<Scheme switch>>

< UC∗EN>

To set the UC∗ enable, do the following.

- Enter "On" to enable the UC∗ and press the ENTER key. If disabling the UC∗, enter "Off" and press the ENTER key.

<THMEN>

To set the Thermal OL enable, do the following.

- Enter "On" to enable the Thermal OL and press the ENTER key. If disabling the Thermal OL, enter "Off" and press the ENTER key.

<THMAEN>

To set the Thermal alarm enable, do the following.

- Enter "On" to enable the Thermal Alarm and press the ENTER key. If disabling the Thermal Alarm, enter "Off" and press the ENTER key.

<BCDEN>

To set the BCD enable, do the following.

- Enter "On" to enable the Broken Conductor and press the ENTER key. If disabling the Broken Conductor, enter "Off" and press the ENTER key.

<BCD∗-2F>

To set the 2f block enable of BCD∗, do the following.

- Enter "BLK" to enable "Trip block" by the 2f element and press the ENTER key. If disabling it, enter "NA" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

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UC∗:	0.5 - 10.0 (5A rating)	0.10 - 2.00 (1A rating)
TUC∗:	0.00 - 300.00	
THM:	0.1 - 10.0 (5A rating)	0.02 - 2.00 (1A rating)
THMIP:	0.0 - 5.0 (5A rating)	0.00 - 1.00 (1A rating)
TTHM:	0.5 - 100.0	
THMA:	50 - 99	
BCD:	0.10 - 1.00	
TBCD:	0.00 - 300.00	

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the CBF

To set the Circuit Breaker failure tripping setting, do the following.

- Select "CBF" on the "Group∗" screen to display the "CBF" screen.

```
Settings-Protection          25/Feb/2003 09:45
Group∗-CBF
CBF      ##.#A   ##.#A

BTC        ***   ***
TBTC   ##.###s ##.###s

RTC        ***   ***
TRTC   ##.###s ##.###s
```

<<Scheme switch>>

<BTC>

To set the Back-trip control, do the following.

- Enter "On" to set the Back-trip control and press the ENTER key. If not setting the Back-trip control, enter "Off" and press the ENTER key.

<RTC>

To set the Re-trip control, do the following.

- Enter "Off" or "DIR" (Direct) or "OC" (OC controlled) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

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CBF:	0.5 - 10.0 (5A rating) 0.10 - 2.00 (1A rating)
TBTC, TRTC:	0.00 - 300.00

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Cold load / Inrush

To set the Cold load / Inrush setting, do the following.

- Select "Cold load / Inrush" on the "Group∗" screen to display the "Cold load / Inrush" screen.

```
Settings-Protection                    25/Feb/2003 09:45
Group∗-Cold load/Inrush                              1/2
CLEN         ∗∗∗ ∗∗∗        OC1      ##.#A   ##.#A
CLDOEN       ∗∗∗ ∗∗∗        OC2     ###.#A  ###.#A
TCLE     #####s  #####s     OC3     ###.#A  ###.#A
TCLR     #####s  #####s     OC4     ###.#A  ###.#A
ICLDO      ##.#A   ##.#A    DOC1     ##.#A   ##.#A
TCLDO ###.##s  ###.##s      DOC2    ###.#A  ###.#A
                            DOC3    ###.#A  ###.#A
                            DOC4    ###.#A  ###.#A

                            EF1      ##.#A   ##.#A
                            EF2     ###.#A  ###.#A
                            EF3     ###.#A  ###.#A
                            EF4     ###.#A  ###.#A
```

```
Settings-Protection                    25/Feb/2003 09:45
Group∗-Cold load/Inrush                              2/2
DEF1    ##.##A  ##.##A      NC1        #.#A    #.#A
DEF2    ###.#A  ###.#A      NC2        #.#A    #.#A
DEF3    ###.#A  ###.#A      DNC1       #.#A    #.#A
DEF4    ###.#A  ###.#A      DNC2       #.#A    #.#A

SE1     ###.#A  ###.#A      BCD        #.##    #.##
SE2     ###.#A  ###.#A
SE3     ###.#A  ###.#A      ICD-2F      ##%     ##%
SE4     ###.#A  ###.#A      ICDOC    ##.#A   ##.#A
DSE1    ###.#A  ###.#A
DSE2    ###.#A  ###.#A
DSE3    ###.#A  ###.#A
DSE4    ###.#A  ###.#A
```

<<Scheme switch>>

<CLEN>

To set the Cold load function enable, do the following.

- Enter "On" to enable the Cold Load function and press the ENTER key. If disabling the Cold Load, enter "Off" and press the ENTER key.

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<CLDOEN>

To set the Cold load drop-off enable, do the following.

- Enter "On" to enable the Cold Load drop-off and press the ENTER key. If disabling the Cold Load drop-off, enter "Off" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

TCLE, TCLR:	0 - 10000
ICLDO:	0.5 - 10.0 (5A rating) 0.10 - 2.00 (1A rating)
TCLDO:	0.00 - 100.00
OC1, DOC1:	0.2 - 25.0 (5A rating) 0.04 - 5.00 (1A rating)
OC2 - 4, DOC2 - 4:	0.5 - 250.0 (5A rating) 0.10 - 50.00 (1A rating)
EF1, DEF1:	0.05 - 25.00 (5A rating) 0.01 - 5.00 (1A rating)
EF2 - 4, DEF2 - 4:	0.2 - 250.0 (5A rating) 0.04 - 50.00 (1A rating)
SE1 - 4, DSE1 - 4:	0.025 - 0.125 (5A rating) 0.005 - 0.025 (1A rating)
NC1, 2 , DNC1, 2:	0.5 - 5.0 (5A rating) 0.10 - 2.00 (1A rating)
BCD:	0.10 - 1.00
ICD-2F:	10 - 50
ICDOC:	0.5 - 25.0 (5A rating) 0.10 - 2.00 (1A rating)

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the OV / UV

To set the overvoltage and undervoltage setting, do the following.

- Select "OV/UV" on the "Group∗" screen to display the "OV/UV" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-OV/UV                                  1/2
OV1EN    ∗∗∗∗  ∗∗∗∗      UV1EN    ∗∗∗∗  ∗∗∗∗
OV1     ###.#V  ###.#V    UV1    ###.#V  ###.#V
TOV1D ###.##s ###.##s    TUV1D ###.##s ###.##s
TOV1P ###.##s ###.##s    TUV1P ###.##s ###.##s
TOV1R  ###.#s   ###.#s    TUV1R  ###.#s   ###.#s
OV1DPR    ##%     ##%
OV2EN     ∗∗∗  ∗∗∗       UV2EN     ∗∗∗  ∗∗∗
OV2     ###.#V  ###.#V    UV2    ###.#V  ###.#V
TOV2  ###.##s ###.##s    TUV2  ###.##s ###.##s
OV2DPR    ##%     ##%
                          VBLKEN    ∗∗∗  ∗∗∗
                          VBLK     ##.#V   ##.#V
```


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```
Settings-Protection          25/Feb/2003 09:45
Group*-OV/UV                               2/2
ZOV1EN  ****  ****       NOV1EN  ****  ****
ZOV1    ###.#V  ###.#V   NOV1    ###.#V  ###.#V
TZOV1D                   TNOV1D
     ###.##s ###.##s          ###.##s ###.##s
TZOV1P                   TNOV1P
      ###.##  ###.##           ###.##  ###.##
TZOV1R  ###.#s  ###.#s   TNOV1R ###.#s  ###.#s

ZOV2EN  ****  ****       NOV2EN  ****  ****
ZOV2    ###.#V  ###.#V   NOV2    ###.#V  ###.#V
TZOV2                    TNOV2
     ###.##s ###.##s          ###.##s ###.##s
```

<<Scheme switch>>

<OV1EN>

To set the OV1 scheme enable, do the following.

- Enter "Off" or "DT" or "IDMT" and press the ENTER key.

<OV2EN>

To set the OV2 scheme enable, do the following.

- Enter "On" to enable the OV2 scheme and press the ENTER key. If disabling the OV2 scheme, enter "Off" and press the ENTER key.

<UV1EN>

To set the UV1 scheme enable, do the following.

- Enter "Off" or "DT" or "IDMT" and press the ENTER key.

<UV2EN>

To set the UV2 scheme enable, do the following.

- Enter "On" to enable the UV2 scheme and press the ENTER key. If disabling the UV2 scheme, enter "Off" and press the ENTER key.

<VBLKEN>

To set the UV block enable, do the following.

- Enter "On" to enable the UV block and press the ENTER key. If disabling the UV block, enter "Off" and press the ENTER key.

<ZOV1EN>

To set the ZOV1 scheme enable, do the following.

- Enter "Off" or "DT" or "IDMT" and press the ENTER key.

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<ZOV2EN>

To set the ZOV2 scheme enable, do the following.

- Enter "On" to enable the ZOV2 scheme and press the ENTER key. If disabling the ZOV2 scheme, enter "Off" and press the ENTER key.

<NOV1EN>

To set the NOV1 scheme enable, do the following.

- Enter "Off" or "DT" or "IDMT" and press the ENTER key.

<NOV2EN>

To set the NOV2 scheme enable, do the following.

- Enter "On" to enable the NOV2 scheme and press the ENTER key. If disabling the NOV2 scheme, enter "Off" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

OV1, OV2:	10.0 - 200.0
TOV1D, TOV2:	0.00 - 300.00
TOV1P:	0.05 - 100.00
TOV1R:	0.0 - 300.0
OV1DPR, OV2DPR:	10 - 98
UV1, UV2:	5.0 - 130.0
TUV1D, TUV2:	0.00 - 300.00
TUV1P:	0.05 - 100.00
TUV1R:	0.0 - 300.0
VBLK:	5.0 - 20.0
ZOV1, ZOV2:	5.0 - 130.0
TZOV1D, TZOV2:	0.00 - 300.00
TZOV1P:	0.05 - 100.00
TZOV1R:	0.0 - 300.0
NOV1, NOV2:	5.0 - 130.0
TNOV1D, TNOV2:	0.00 - 300.00
TNOV1P:	0.05 - 100.00
TNOV1R:	0.0 - 300.0

- Enter the numerical value and press the ENTER key.

- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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Setting the FRQ / DFRQ

To set the Over/Under Frequency setting, do the following.

- Select "FRQ" on the "Group∗" screen to display the "FRQ" screen.

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-FRQ                                        1/2
FRQ1EN    ***   ***      FRQ4EN    ***   ***
FRQ1  ##.##Hz ##.##Hz    FRQ4  ##.##Hz ##.##Hz
TFRQ1 ###.##s ###.##s    TFRQ4 ###.##s ###.##s

FRQ2EN    ***   ***      FRQ5EN    ***   ***
FRQ2  ##.##Hz ##.##Hz    FRQ5  ##.##Hz ##.##Hz
TFRQ2 ###.##s ###.##s    TFRQ5 ###.##s ###.##s

FRQ3EN    ***   ***      FRQ6EN    ***   ***
FRQ3  ##.##Hz ##.##Hz    FRQ6  ##.##Hz ##.##Hz
TFRQ3 ###.##s ###.##s    TFRQ6 ###.##s ###.##s

                         FVBLK  ###.#V  ###.#V
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-FRQ                                        2/2
DFRQ1EN   ***   ***      DFRQ4EN   ***   ***
DFRQ1                    DFRQ4
 ##.#Hz/s  ##.#Hz/s        ##.#Hz/s  ##.#Hz/s

DFRQ2EN   ***   ***      DFRQ5EN   ***   ***
DFRQ2                    DFRQ5
 ##.#Hz/s  ##.#Hz/s        ##.#Hz/s  ##.#Hz/s

DFRQ3EN   ***   ***      DFRQ6EN   ***   ***
DFRQ3                    DFRQ6
 ##.#Hz/s  ##.#Hz/s        ##.#Hz/s  ##.#Hz/s
```

<<Scheme switch>>

<FRQ∗EN>

To set the FRQ∗ scheme enable, do the following.

- Enter "Off" or "OF" or "UF" and press the ENTER key.

<DFRQ∗EN>

To set the FRQ∗ scheme enable, do the following.

- Enter "Off" or "R" or "D" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

FRQ1 - 6:	25.00 - 75.00
TRQ1 - 6:	0.00 - 300.00

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FVBLK: 40.0 - 100.0
DFRQ1 – 6: 0.1 – 15.0

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the ARC

To set the Autoreclosing setting, do the following.

- Select "ARC" on the "Group∗" screen to display the "ARC" screen.

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-ARC                                        1/4
ARCEN        ∗∗∗  ∗∗∗
ARCEN-S      ∗∗∗  ∗∗∗
ARCEN-C      ∗∗∗  ∗∗∗
ARC-NUM       ∗∗   ∗∗

OC1-INIT     ∗∗∗  ∗∗∗    DOC1-INIT    ∗∗∗  ∗∗∗
OC2-INIT     ∗∗∗  ∗∗∗    DOC2-INIT    ∗∗∗  ∗∗∗
OC3-INIT     ∗∗∗  ∗∗∗    DOC3-INIT    ∗∗∗  ∗∗∗
OC4-INIT     ∗∗∗  ∗∗∗    DOC4-INIT    ∗∗∗  ∗∗∗
EF1-INIT     ∗∗∗  ∗∗∗    DEF1-INIT    ∗∗∗  ∗∗∗
EF2-INIT     ∗∗∗  ∗∗∗    DEF2-INIT    ∗∗∗  ∗∗∗
EF3-INIT     ∗∗∗  ∗∗∗    DEF3-INIT    ∗∗∗  ∗∗∗
EF4-INIT     ∗∗∗  ∗∗∗    DEF4-INIT    ∗∗∗  ∗∗∗
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-ARC                                        2/4
SE1-INIT     ∗∗∗  ∗∗∗    DSE1-INIT    ∗∗∗  ∗∗∗   ⎫
SE2-INIT     ∗∗∗  ∗∗∗    DSE2-INIT    ∗∗∗  ∗∗∗   ⎬ (∗1)
SE3-INIT     ∗∗∗  ∗∗∗    DSE3-INIT    ∗∗∗  ∗∗∗   ⎪
SE4-INIT     ∗∗∗  ∗∗∗    DSE4-INIT    ∗∗∗  ∗∗∗   ⎭
EXT-INIT     ∗∗∗  ∗∗∗

VCHK        ∗∗∗∗ ∗∗∗∗
COORD-OC     ∗∗∗  ∗∗∗    OC     ###.#A    ###.#A
COORD-EF     ∗∗∗  ∗∗∗    EF    ###.##A  ###.##A
COORD-SE     ∗∗∗  ∗∗∗    SEF   ##.###A  ##.###A   (∗1)
```

```
Settings-Protection                 25/Feb/2003 09:45
Group∗-ARC                                        3/4
TRDY   ###.#s   ###.#s
T1S1   ###.##s ###.##s   T2S1   ###.##s ###.##s
T1S1S  ###.##s ###.##s   T2S1S  ###.##s ###.##s
T1S1C  ###.##s ###.##s   T2S1C  ###.##s ###.##s
T1S1R  ###.##s ###.##s   T2S1R  ###.##s ###.##s
```

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```
T1S2   ###.##s ###.##s  T2S2   ###.##s ###.##s
T1S2R  ###.##s ###.##s  T2S2R  ###.##s ###.##s
T1S3   ###.##s ###.##s  T2S3   ###.##s ###.##s
T1S3R  ###.##s ###.##s  T2S3R  ###.##s ###.##s
T1S4   ###.##s ###.##s  T2S4   ###.##s ###.##s
T1S4R  ###.##s ###.##s  T2S4R  ###.##s ###.##s
T1S5   ###.##s ###.##s  T2S5   ###.##s ###.##s
T1S5R  ###.##s ###.##s  T2S5R  ###.##s ###.##s
```

```
Settings-Protection              25/Feb/2003 09:45
Group*-ARC                                     4/4
TW       ##.##s   ##.##s
TSUC   ###.#s   ###.#s
TRCOV  ###.#s   ###.#s
TARCP  ###.#s   ###.#s
TEVLV  ###.##s ###.##s
TRSET  ###.##s ###.##s
```

<<Scheme switch>>

<ARCEN>

To set the Autoreclosing enable, do the following.

- Enter "On" to enable the three phase autoreclose and press the ENTER key. If disabling the three phase autoreclose, enter "Off" and press the ENTER key.

<ARCEN-S>

To set the Single phase autoreclosing mode, do the following.

- Enter "On" to enable the Single phase autoreclose mode and press the ENTER key. If disabling the Single phase autoreclosong mode, enter "Off" and press the ENTER key.

<ARCEN-C>

To set the Configurable autoreclosing mode, do the following.

- Enter "On" to enable the Configurable autoreclosing mode and press the ENTER key. If disabling the Configurable autoreclosing mode, enter "Off" and press the ENTER key.

<ARC-NUM>

To set the number of shot, do the following.

- Enter "S1" or "S2" or "S3" or "S4" or "S5" and press the ENTER key.

  Enter "S1" to perform the one-shot autoreclosing.

  Enter "S2" to perform the two-shot autoreclosing.

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Enter "S3" to perform the three-shot autoreclosing.

Enter "S4" to perform the four-shot autoreclosing.

Enter "S5" to perform the five-shot autoreclosing.

<OC∗-INIT, DOC∗-INIT, EF∗-INIT, DEF∗-INIT, SE∗-INIT, DSE∗-INIT, EXT-INIT>

To set the Autoreclosing initiation enable, do the following.

- Enter "NA" or "A1" or "A2" or "BLK" and press the ENTER key.

  Enter "NA" not to initiate the autoreclosing.

  Enter "A1" to initiate the Stage 1.

  Enter "A2" to initiate the Stage 2.

  Enter "BLK" to block the autoreclosing.

<COORD-OC, COORD-EF, COORD-SE>

To set the Co-ordination enable, do the following.

- Enter "On" to enable the Co-ordination and press the ENTER key. If disabling the Co-ordination, enter "Off" and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

OC:	0.2 - 250.0 (5A rating)	0.04 - 50.00 (1A rating)
EF:	0.2 - 250.0 (5A rating)	0.04 - 50.00 (1A rating)
SEF:	0.025 - 0.125 (5A rating)	0.005 - 0.025 (1A rating)
TRDY:	0.0 - 600.0	
T∗S∗:	0.01 - 300.00	
T∗S∗S, T∗S∗C:	0.01 - 300.00	
T∗S∗R:	0.01 - 310.00	
TW:	0.01 - 10.00	
TSUC, TRCOV, TARCP:	0.1 – 600.0	
TEVLV, TRSET:	0.01 - 300.00	

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Sync CHK

To set the synchronism check setting, do the following.

- Select "Sync CHK" on the "Group∗" screen to display the "Sync CHK" screen.

```
Settings-Protection                25/Feb/2003 09:45
Group∗-Sync CHK
OVR      ###.#V ###.#V
URB      ###.#V ###.#V
```

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```
OVI      ###.#V ###.#V
UVI      ###.#V ###.#V
SYNOV    ###.#V ###.#V
SYNUV    ###.#V ###.#V
SYNθ        ##°     ##°
SYNDf     #.##Hz #.##Hz
TLRDI   ###.##s ###.##s
TDRLI   ###.##s ###.##s
TDRDI   ###.##s ###.##s
TSYN    ###.##s ###.##s
```

<<Element>>

- The ranges of settings are as follows:

OVR, UVR, OVI, UVI, SYNOV, SYNUV:	5.0 - 150.0
SYN θ:	5 - 75
SYNDf:	0.02 - 0.50
TLRDI, TDRLI, TDRDI, TSYN:	0.00 - 100.00

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the CTF/VTF

To set the CT/VT Failure Supervision tripping setting, do the following.

- Select "CTF/VTF" on the "Group∗" screen to display the "CTF/VTF" screen.

```
Settings-Protection                25/Feb/2003 09:45
Group∗-CTF/VTF
EFF      ##.##A  ##.##A
ZOVF     ###.#V  ###.#V
UVF      ###.#V  ###.#V
```

<<Element>>

- The ranges of settings are as follows:

EFF:	0.05 - 25.00 (5A rating)	0.01 - 5.00 (1A rating)
ZOVF, UVF:	5.0 - 130.0	

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- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the PLC setting

The relay provides 8 user configurable timers (UTM1 to UTM8) and 8 user configurable switches with three-positions (USW1 to USW8) to be programmed by using PLC function.

To set the PLC setting, do the following.

- Select "PLC setting" on the "Group∗" screen to display the "PLC setting" screen.

```
Settings-Protection              25/Feb/2003 09:45
Group∗-PLC setting
UTM1   ∗∗∗.∗∗s ∗∗∗.∗s   USW1  ##   ##
UTM2   ∗∗∗.∗∗s ∗∗∗.∗s   USW2  ##   ##
UTM3   ∗∗∗.∗∗s ∗∗∗.∗s   USW3  ##   ##
UTM4   ∗∗∗.∗∗s ∗∗∗.∗s   USW4  ##   ##
UTM5   ∗∗∗.∗∗s ∗∗∗.∗s   USW5  ##   ##
UTM6   ∗∗∗.∗∗s ∗∗∗.∗s   USW6  ##   ##
UTM7   ∗∗∗.∗∗s ∗∗∗.∗s   USW7  ##   ##
UTM8   ∗∗∗.∗∗s ∗∗∗.∗s   USW8  ##   ##
```

<<Element>>

- The ranges of settings are as follows:

UTM1 – UTM8:	0.00 - 300.00 s
USW1 – USW8:	P0 / P1 / P2

- Enter the numerical value for UTM1 – 8 and enter the position P0 or P1 or P2 for USW1 – USW8, and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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4.2.6.3 Setting the Control

To set the control, do the following:

- Select "Settings menu" on the top "Main Menu" screen to display the "Settings menu" screen.
- Select "Control" on the "Settings menu" screen to display the "Control" screen.

```
Settings-Control                    25/Feb/2003 09:45
Switch
Pulse width
Alarm setting
```

Setting the Device

To change the Device settings, do the following:

- Select "Switch" on the "Control" screen to display the "Switch" screen.

```
Settings-Control                   25/Feb/2003 09:45
Switch
OPLOCK   ****** ******
```

<<Scheme switch>>

<OPLOCK>

To set the operation lock, do the following.

- Enter "Unlock" or "Lock" and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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Setting the Pulse width

To change the Pulse width settings, do the following:

- Select "Pulse width" on the "Control" screen to display the "Pulse width" screen.

```
Settings-Control              25/Feb/2003 09:45
Pulse width                                  1/2
CBPM       ***   ***     DS3PM     ***   ***
CBOPP   ###.#s  ###.#s   DS3OPP ###.#s  ###.#s
CBCLP   ###.#s  ###.#s   DS3CLP ###.#s  ###.#s

DS1PM      ***   ***     DS4PM      ***   ***
DS1OPP  ###.#s  ###.#s   DS4OPP  ###.#s  ###.#s
DS1CLP  ###.#s  ###.#s   DS4CLP  ###.#s  ###.#s

DS2PM      ***   ***     DS5PM      ***   ***
DS2OPP  ###.#s  ###.#s   DS5OPP  ###.#s  ###.#s
DS2CLP  ###.#s  ###.#s   DS5CLP  ###.#s  ###.#s
```

```
Settings-Control              25/Feb/2003 09:45
Pulse width                                  2/2
EDS1PM     ***   ***     COS1PM    ***** *****
EDS1OPP ###.#s  ###.#s COS2PM    ***** *****
EDS1CLP ###.#s  ###.#s COS3PM    ***** *****
EDS1EAP ###.#s  ###.#s COS4PM    ***** *****
EDS1FRP ###.#s  ###.#s

EDS2PM     ***   ***
EDS2OPP ###.#s  ###.#s
EDS2CLP ###.#s  ###.#s
EDS2EAP ###.#s  ###.#s
EDS2FRP ###.#s  ###.#s
```

<<Scheme switch>>

<CBPM, DS∗ PM, EDS∗ PM>

To set the CB, DS and EDS pulse mode, do the following.

- Enter "Fix" to set the Pulse width to a fixed value or enter "Var" to set it variable value and press the [ENTER] key.

<COS∗ PM>

To set the COS pulse mode, do the following.

- Enter "Latch" or "Pulse" and press the [ENTER] key.

<<Element>>

- The range of settings is as follows:

∗∗∗∗∗P:	0.1 - 100.0

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- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Alarm setting

To change the Alarm setting, do the following:

- Select "Alarm setting" on the "Control" screen to display the "Alarm setting" screen.

```
Settings-Control                  25/Feb/2003 09:45
Alarm setting                                   1/2
CBPLT    ###.#s ###.#s    CBRSPT  ###.#s ###.#s

DS1PLT   ###.#s ###.#s    DS1RSPT ###.#s ###.#s
DS2PLT   ###.#s ###.#s    DS2RSPT ###.#s ###.#s
DS3PLT   ###.#s ###.#s    DS3RSPT ###.#s ###.#s
DS4PLT   ###.#s ###.#s    DS4RSPT ###.#s ###.#s
DS5PLT   ###.#s ###.#s    DS5RSPT ###.#s ###.#s

EDS1PLT ###.#s ###.#s     EDS1RSPT ###.#s ###.#s
EDS2PLT ###.#s ###.#s     EDS2RSPT ###.#s ###.#s
```

```
Settings-Control                  25/Feb/2003 09:45
Alarm setting                                   2/2
IND1PLT   ###.#s  ###.#s
IND2PLT   ###.#s  ###.#s
IND3PLT   ###.#s  ###.#s
IND4PLT   ###.#s  ###.#s
IND5PLT   ###.#s  ###.#s
IND6PLT   ###.#s  ###.#s
IND7PLT   ###.#s  ###.#s
IND8PLT   ###.#s  ###.#s
```

<<Element>>

- The range of settings is as follows:

  All items: 0.1 - 100.0

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

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- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

4.2.6.4 Setting the Recording

To set the recording function as described in Section 4.2.4, do the following:

- Select "Settings" on the top "Main Menu" screen to display the "Settings" screen.
- Select "Record" on the "Settings" screen to display the "Record" screen.

```
Settings-Record                    25/Feb/2003 09:45
Fault Record
Disturbance Record
Counter
```

Setting the Fault Record

To change the Fault Record settings, do the following:

- Select "Fault Record" on the "Record" screen to display the "Fault Record" screen.

```
Settings-Record                     25/Feb/2003 09:45
Fault Record
Fault locator   ***   ***
```

- Enter "On" to use the fault locator. If not to be used, enter "Off". Enter the number and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Disturbance Record" screen.

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Setting the Disturbance Record

To change the Disturbance Record setting, do the following:

- Select "Disturbance Record" on the "Record" screen to display the "Disturbance Record" screen.

```
Settings-Record                    25/Feb/2003 09:45
Disturbance Record
AI sampling                  ***   ***
Operation mode               ***   ***
Record time                ##.#s  ##.#s
Pre-trig POS               ###%  ###%

OPT1        ***   ***    OC       ###.#A   ###.#A
OPT2        ***   ***    EF       ###.#A   ###.#A
OPT3        ***   ***    SEF       #.##A    #.##A   (∗1)
OPT4        ***   ***    NOC       ##.#A    ##.#A
OPT5        ***   ***    OV       ###.#V   ###.#V
OPT6        ***   ***    UV       ###.#V   ###.#V
OPT7        ***   ***    ZOV      ###.#V   ###.#V
OPT8        ***   ***    NOV      ###.#V   ###.#V
```

(∗ 1) : "SEF" is only displayed if the model is GRD150-200 or 400 series.

<<Scheme switch>>

<AI sampling>

To set the, do the following.

- Enter "24" or "48" and press the ENTER key.

<Operation mode Mode>

To set the, do the following.

- Enter "OW" (Overwrite) or "SAT" (Saturation) and press the ENTER key.

<OPT∗>

- Enter "On" to use as a starter. If not to be used as a starter, enter "Off".

  Note: Starter elements OPT1- OPT8 are set by PLC function.

<<Element>>

- The ranges of settings are as follows:

Record time:	0.1 - 60.0	
Pre-trig POS:	0 - 100	
OC:	0.5 – 250.0 (5A rating)	0.10 - 50.00 (1A rating)
EF:	0.5 – 125.0 (5A rating)	0.10 - 25.00 (1A rating)
SEF:	0.025 – 0.125 (5A rating)	0.005 - 0.025 (1A rating)
NOC:	0.5 – 10.0 (5A rating)	0.10 - 2.00 (1A rating)
OV:	10.0 - 200.0	
UV, ZOV, NOV:	1.0 - 130.0	

- Enter the numerical value and press the ENTER key.

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- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Counter

To change the Counter setting, do the following:

- Select "Counter" on the "Record" screen to display the "Counter" screen.

```
Settings-Record                 25/Feb/2003 09:45
Counter
Switch
Alarm setting
Change value
```

To set each counter to use or not to use, do the following:

- Select "Switch" on the "Counter" screen to display the "Switch" screen.

```
Settings-Record                 25/Feb/2003 09:45
Counter-Switch                                1/2
CBCTS          *******  *******
DS1CTS         *******  *******
DS2CTS         *******  *******
DS3CTS         *******  *******
DS4CTS         *******  *******
DS5CTS         *******  *******
EDS1CLOSECTS           *******  *******
EDS1EARTHCTS           *******  *******
EDS2CLOSECTS           *******  *******
EDS2EARTHCTS           *******  *******
```

```
Settings-Record                 25/Feb/2003 09:45
Counter-Switch                                2/2
CT1S           *****  *****
CT2S           *****  *****
CT3S           *****  *****
CT4S           *****  *****
CT5S           *****  *****
CT6S           *****  *****
CT7S           *****  *****
CT8S           *****  *****
```

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<<Scheme switch>>

To set counters in page 1/2, do the following.

- Enter "NA" or "C-On" or "C-Off" or "C-OnOff" or "Cycle" and press the ENTER key.

To set counters in page 2/2, do the following.

- Enter "NA" or "On" or "Off" or "OnOff" and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

To set Alarm setting, do the following:

- Select "Alarm setting" on the "Counter" screen to display the "Alarm setting" screen.

```
Settings-Record                 25/Feb/2003 09:45
Counter-Alarm setting                         1/4
Trip AEN     ***  ***   Trips ALM #####   #####
ΣI^y AEN     ***  ***   ΣI^y ALM #####E6 #####E6
Y VALUE      #.#  #.#

CBCTAEN      ***  ***    CBCTALM  #####   #####
DS1CTAEN     ***  ***    DS1CTALM #####   #####
DS2CTAEN     ***  ***    DS2CTALM #####   #####
DS3CTAEN     ***  ***    DS3CTALM #####   #####
DS4CTAEN     ***  ***    DS4CTALM #####   #####
DS5CTAEN     ***  ***    DS5CTALM #####   #####
EDS1CLOSECTAEN           EDS1CLOSECTALM
             ***  ***             #####   #####
EDS1EARTHCTAEN           EDS1EARTHCTALM
             ***  ***             #####   #####
```

```
Settings-Record                 25/Feb/2003 09:45
Counter-Alarm setting                         2/4
EDS2CLOSECTAEN           EDS2CLOSECTALM
             ***  ***             #####   #####
EDS2EARTHCTAEN           EDS2EARTHCTALM
             ***  ***             #####   #####

CT1AEN       ***  ***     CT1ALM  #####   #####
CT2AEN       ***  ***     CT2ALM  #####   #####
CT3AEN       ***  ***     CT3ALM  #####   #####
CT4AEN       ***  ***     CT4ALM  #####   #####
CT5AEN       ***  ***     CT5ALM  #####   #####
CT6AEN       ***  ***     CT6ALM  #####   #####
CT7AEN       ***  ***     CT7ALM  #####   #####
CT8AEN       ***  ***     CT8ALM  #####   #####
```

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```
Settings-Record                        25/Feb/2003 09:45
Counter-Alarm setting                                3/4
CBCTTAEN ∗∗∗  ∗∗∗ CBCTALM #####day #####day
                          #####min #####min
                           #####s   #####s

TT1AEN   ∗∗∗  ∗∗∗  TT1ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
TT2AEN   ∗∗∗  ∗∗∗  TT2ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
TT3AEN   ∗∗∗  ∗∗∗  TT3ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
```

```
Settings-Record                        25/Feb/2003 09:45
Counter-Alarm setting                                4/4
TT4AEN   ∗∗∗  ∗∗∗  TT4ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
TT5AEN   ∗∗∗  ∗∗∗  TT5ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
TT6AEN   ∗∗∗  ∗∗∗  TT6ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
TT7AEN   ∗∗∗  ∗∗∗  TT7ALM  #####day #####day
                          #####min #####min
                           #####s   #####s
```

<<Scheme switch>>

<∗∗∗AEN>

To set the counter alarm disable or enable, do the following.

- Enter "Off"(disable) or "On"(enable) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

Y VALUE:	1.0 - 2.0
Trips ALM:	0 - 30000
ΣI^y ALM:	1E6 – 30000E6
∗∗CTALM, CT∗ ALM:	0 - 29999
∗∗∗∗ALM day:	0 - 29999
∗∗∗∗ALM min:	0 - 1439
ALM s:	0 - 59

- Enter the numerical value and press the ENTER key.

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- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

To set Change value setting, do the following:

- Select "Change value" on the "Counter" screen to display the "Change value" screen.

```
Settings-Record                  25/Feb/2003 09:45
Counter-Change value                           1/4
Trips      #####  #####
ARCs       #####  #####
ΣI^yA      ######E6  ######E6
ΣI^yB      ######E6  ######E6
ΣI^yC      ######E6  ######E6
```

```
Settings-Record                  25/Feb/2003 09:45
Counter-Change value                           2/4
CBCT       #####  #####  CT1    #####  ####
DS1CT      #####  #####  CT2    #####  ####
DS2CT      #####  #####  CT3    #####  ####
DS3CT      #####  #####  CT4    #####  ####
DS4CT      #####  #####  CT5    #####  ####
DS5CT      #####  #####  CT6    #####  ####
EDS1                      CT7   #####  ####
 CLOSECT #####  #####    CT8    #####  ####
 EARTHCT #####  #####
EDS2
 CLOSECT #####  #####
 EARTHCT #####  #####
```

```
Settings-Record                  25/Feb/2003 09:45
Counter-Change value                           3/4

CBCTT #####  #####day
        ####    ####min
          ##      ##s
TT1   #####  #####day
        ####   ####min
          ##     ##s
TT2   #####  #####day
        ####   ####min
          ##     ##s
TT3   #####  #####day
        ####   ####min
```

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```
         ##      ##s
```

```
Settings-Record                        25/Feb/2003 09:45
Counter-Change value                                 4/4

TT4   #####  #####day
        ####    ####min
          ##       ##s
TT5   #####  #####day
       ####   ####min
         ##      ##s
TT6   #####  #####day
       ####   ####min
         ##      ##s
TT7   #####  #####day
       ####   ####min
         ##      ##s
```

<<Element>>

- The ranges of settings are as follows:

Trips, ARCs, ∗∗∗ CT:	0 - 99999
ΣI^yA, B, C:	0 – 99999E6
∗∗∗TT day:	0 - 29999
∗∗∗TT min:	0 - 1439
∗∗∗TT s:	0 - 59

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

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4.2.6.5 Setting the Status

To set the status function as described in Section 4.2.5, do the following:

- Select "Settings menu" on the top "Main Menu" screen to display the "Settings menu" screen.
- Select "Status" on the "Settings menu" screen to display the "Status" screen.

```
Settings-Status                         25/Feb/2003 09:45
Metering Switch
Alarm/Warning
Change value
```

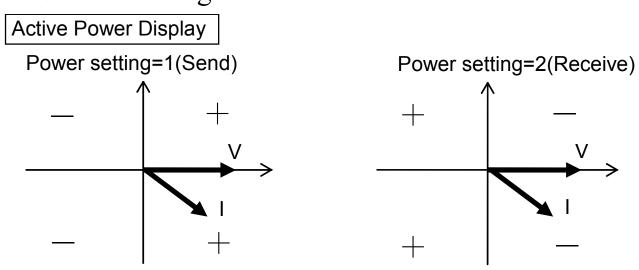
Setting the Metering Switch

To change the metering switch setting, do the following:

- Select "Metering Switch" on the "Status" screen to display the "Metering Switch" screen.

```
Settings-Status                         25/Feb/2003 09:45
Metering Switch
Display value     *********    *********
Power             *******      *******
Current           ****         ****
Demand time       *****        *****
```

Note: Power and Current setting



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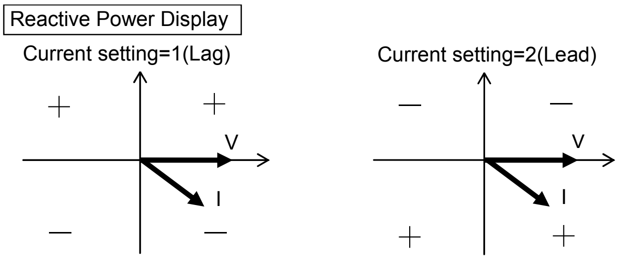

<<Scheme switch>>

<Display value>

To set the display value, do the following.

- Enter "Primary" or "Secondary" and press the ENTER key.

<Power>

To set the power, do the following.

- Enter "Send" or "Receive" and press the ENTER key.

<Current>

To set the current lag or lead, do the following.

- Enter "Lag" or "Lead" and press the ENTER key.

<Demand time>

To set the demand time, do the following.

- Enter "1min" or "5min" or "10min" or "15min" or "30min" or "60min" and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Alarm/Warning

Note: When setting the Alarm/Warning by using the RSM100, the "Alarm/Warning" screen is placed in the “Settings – Control” menu.

- Select "Alarm/Warning" on the "Status" screen to display the "Alarm/Warning" screen.

```
Settings-Status                      25/Feb/2003 09:45
Alarm/Warning                                      1/4
IHALMEN    ***  ***   IHALM    ###.#kA  ###.#kA
IHWAREN    ***  ***   IHWAR    ###.#kA  ###.#kA
ILALMEN    ***  ***   ILALM    ###.#kA  ###.#kA
ILWAREN    ***  ***   ILWAR    ###.#kA  ###.#kA
                      IHYST    ###.#kA  ###.#kA

VHALMEN    ***  ***   VHALM    ###.#kV  ###.#kV
VHWAREN    ***  ***   VHWAR    ###.#kV  ###.#kV
VLALMEN    ***  ***   VLALM    ###.#kV  ###.#kV
VLWAREN    ***  ***   VLWAR    ###.#kV  ###.#kV
```


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```
                    VHYST     ##.#kV    ##.#kV
```

```
Settings-Status                    25/Feb/2003 09:45
Alarm/Warning                                    2/4
PHALMEN   ***  ***   PHALM -###.#MW -###.#MW
PHWAREN   ***  ***   PHWAR-###.#MW -###.#MW
PLALMEN   ***  ***   PLALM -###.#MW -###.#MW
PLWAREN   ***  ***   PLWAR-###.#MW -###.#MW
                     PHYST    ##.#kW    ##.#kW

QHALMEN   ***  ***   QHALM -###.#Mv -###.#Mv
QHWAREN   ***  ***   QHWAR -###.#Mv -###.#Mv
QLALMEN   ***  ***   QLALM  -###.#Mv -###.#Mv
QLWAREN   ***  ***   QLWAR -###.#Mv -###.#Mv
                     QHYST    ##.#kv    ##.#kv
```

```
Settings-Status                    25/Feb/2003 09:45
Alarm/Warning                                    3/4
fHALMEN   ***  ***   fHALM   ##.#Hz    ##.#Hz
fHWAREN   ***  ***   fHWAR   ##.#Hz    ##.#Hz
fLALMEN   ***  ***   fLALM   ##.#Hz    ##.#Hz
fLWAREN   ***  ***   fLWAR   ##.#Hz    ##.#Hz
                     fHYST    ##.#Hz    ##.#Hz

IeHALMEN  ***  ***   IeHALM  ##.##kA   ##.##kA
IeHWAREN  ***  ***   IeHWAR ##.##kA    ##.##kA
IeLALMEN  ***  ***   IeLALM  ##.##kA   ##.##kA
IeLWAREN  ***  ***   IeLWAR  ##.##kA   ##.##kA
                     IeHYST    ###kA     ###kA
```

```
Settings-Status                    25/Feb/2003 09:45
Alarm/Warning                                    4/4
VeHALMEN   ***  ***   VeHALM  ###.#kV  ###.#kV
VeHWAREN   ***  ***   VeHWAR  ###.#kV  ###.#kV
VeLALMEN   ***  ***   VeLALM  ###.#kV  ###.#kV
VeLWAREN   ***  ***   VeLWAR  ###.#kV  ###.#kV
                      VeHYST    ##.#kV    ##.#kV
```

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<<Scheme switch>>

<∗∗∗ALMEN, WAREN>

To set the alarm or warning enable, do the following.

- Enter "Off"(disable) or "On"(enable) and press the ENTER key.

<<Element>>

- The ranges of settings are as follows:

I ALM, WAR:	0.0 - 999.9kA
V, Ve ALM, WAR:	0.0 - 999.9kV
P ALM, WAR:	–999.9 - 999.9MW
Q ALM, WAR:	–999.9 - 999.9Mv
f ALM, WAR:	25.0 - 75.0Hz
le ALM, WAR:	0.00 - 99.99kA
I, Ie HYST:	0.00 - 0.10kA
f HYST:	0.00 - 0.10Hz
V, Ve HYST:	0.0 - 20.0kV
P HYST:	0.0 - 20.0MW
Q HYST:	0.0 - 20.0Mv

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Change value

To change values, do the following:

- Select "Change value" on the "Status" screen to display the "Change value" screen.

```
Settings-Status                    25/Feb/2003 09:45
Change value
Wh+        ######kWh     ######kWh
Wh–        ######kWh     ######kWh
varh+      ######kvh     ######kvh
varh–      ######kvh     ######kvh
```

<<Element>>

- The range of settings is as follows:

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All items: 0 - 999999

- Enter the numerical value and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

4.2.6.6 Setting the Time

The calendar clock can run locally or be synchronised with IRIG, GPS, the binary input signal or by the communication cannel. This is selected by setting as follows.

- Select "Settings menu" on the top "Main Menu" screen to display the "Settings menu" screen.
- Select "Time" on the "Settings menu" screen to display the "Time" screen.

```
Settings-Time                      25/Feb/2003 09:45

Time sync source             *******  *******
Sync adjustment              -####ms  -####ms

Time sync status             Time zone
BI           :Inactive       GMT   -##hrs   -##hrs      (*1)
IRIG         :Active
GPS          :Inactive         Clock adjustment         (*2)
Com. CH1     :Inactive           Year  ####
Com. CH2     :Inactive           Month   ##
Com. CH3     :Inactive           Day     ##
                                 Hour    ##
                                 Minute  ##
```

(* 1) : This item, GMT, is used for IRIG/GPS setting.
(* 2) : GPS is displayed if provided.

< Time sync. source>

To set the Time sync. source, do the following.

- Enter "Local", "IRIG", "GPS", "BI", "Com.CH1", "Com.CH2" or "Com.CH3" and press the ENTER key.

  Enter "Local" to use the internal clock, not to be synchronised with any external signals.

  Enter "IRIG" to be synchronised with the IRIG-B time standard signal.

  Enter "GPS" to be synchronised with the GPS time standard signal.

  Enter "BI" to be synchronised with the binary input signal.

  ◆Note: The SYNC-CLOCK(No.2648) must be connected the BI signal by using PLC function.

  Enter "Com.CH1" to be synchronised by the communication channel 1.

  Enter "Com.CH2" to be synchronised by the communication channel 2.

  Enter "Com.CH3" to be synchronised by the communication channel 3.

< Sync adjustment>

To set the Sync adjustment, do the following.

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- Enter the delay time (–9999 - 9999) and press the ENTER key.

< GMT>

When the calendar clock is synchronized with the IRIG-B time standard, it is possible to transform GMT to the local time. To set the time zone, do the following.

- Enter the difference between GMT (– 12 - 12) and local time and press the ENTER key.

< Clock adjustment>

To adjust the clock when the internal clock is running locally, do the following:

- The range of settings is as follows:

Minute:	0 - 59
Hour:	0 - 23
Day:	1 - 31
Month:	1 - 12
Year:	1990 - 2089

- Enter a numerical value for each item and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

4.2.6.7 Communication

If the relay is linked with a communication such as RSM (relay setting and monitoring system) or IEC60870-5-103 communication, etc., the communication setting must be configured. Do this as follows:

- Select "Settings" on the main "Main Menu" screen to display the " Settings" screen.
- Select "Communication" to display the "Communication" screen.

```
Settings-Communication          25/Feb/2003 09:45
Front port
Rear port
Protocol
```

Setting the Front port

- Select "Front port" on the "Communication" screen to enter the port setting.

```
Settings-Communication          25/Feb/2003 09:45
```

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```
Front port
Baud rate            ****      ****
```

<232C>

This line is to select the RS-232C baud rate when the RSM system applied.

- Enter "9.6" or "19.2" or "38.4" or "57.6" and press the ENTER key.

Note: The default setting of the 232C is 9.6kbps. The 57.6kbps setting, if possible, is recommended to serve user for comfortable operation. The setting of RSM100 is also set to the same baud rate.

- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Rear port

- Select "Rear port" on the "Communication" screen to enter the port setting.

```
Settings-Communication          25/Feb/2003 09:45
Rear port                                     1/2
CH1  Protocol        ******    ******
     Baud rate         ****      ****
     Stop bit          ****      ****
     Parity            ****      ****
CH2  Protocol        ******    ******
     Baud rate         ****      ****
     Stop bit          ****      ****
     Parity            ****      ****
CH3  Protocol        ******    ******
     Baud rate         ****      ****
     Stop bit          ****      ****
     Parity            ****      ****
```

```
Settings-Communication          25/Feb/2003 09:45
Rear port                                     2/2
ETHCH1  Protocol  ******    ******
  IP    ###.###.###.###    ###.###.###.###
  SM    ###.###.###.###    ###.###.###.###
  GW    ###.###.###.###    ###.###.###.###
ETHCH2  Protocol  ******    ******
  IP    ###.###.###.###    ###.###.###.###
```

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```
  SM   ###.###.###.###   ###.###.###.###
  GW   ###.###.###.###   ###.###.###.###
```

Note: CH2, CH3, ETHCH1 and ETHCH2 are optional ports. If not provided, the message as ‘not equipped’ is displayed as follows:

```
Settings-Communication       25/Feb/2003 09:45
Rear port                                  1/2
CH1  Protocol      ******   ******
     Baud rate       ****     ****
     Stop bit        ****     ****
     Parity          ****     ****
CH2  not equipped



CH3  not equipped
```

<CH∗ Protocol>

- CH1: Enter "Modbus" or "RSM-X" and press the ENTER key.
- CH2: Enter "IEC103" or "DNP3.0" and press the ENTER key.
- CH3: Enter "PRN" (printer) or "Modbus" or "IEC103" or "DNP3.0" and press the ENTER key.

<Baud rate>

- CH1, 2: Enter "9.6" or "19.2" and press the ENTER key.
- CH3: Enter "4.8" or "9.6" or "19.2" and press the ENTER key.

<Stop bit>

- Enter "1bit" or "2bit" and press the ENTER key.

<Parity>

- Enter "Non" or "Odd" or "Even" and press the ENTER key.

<ETHCH∗ Protocol >

- These lines are to set protocols used in the Ethernet ports of CH1 and CH2.

  Enter "NA" or "DNP3.0" and press the ENTER key.

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<IP, SM, GW>

These lines are to set IP(Internet Protocol Address), SM(Subnet Mask) and GW(Gateway Address).

- Enter the address number (000.000.000.000 - 255.255.255.255) and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

Setting the Protocol

- Select "Protocol" on the "Communication" screen to select the protocol and the communication address, etc., of each protocol.

```
Settings-Communication        25/Feb/2003 09:45
Protocol
Modbus
RSM-X
IEC103
DNP3.0
```

Modbus

- Select "Modbus" on the "Protocol" screen to display the "Modbus" screen..

```
Settings-Communication        25/Feb/2003 09:45
Protocol-Modbus
Address         ###   ###
Address2        ###   ###
```

<Address>

- Enter the address number (1 - 247) and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

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```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

RSM-X

- Select "RSM-X" on the "Protocol" screen to display the "RSM-X" screen..

```
Settings-Communication          25/Feb/2003 09:45
Protocol-RSM-X
Address        ##   ##
```

<Address>

- Enter the address number (1 - 32) and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

IEC103

- Select "IEC103" on the "Protocol" screen to display the "IEC103" screen..

```
Settings-Communication          25/Feb/2003 09:45
Protocol-IEC103
Address           ###        ###
Address2          ###        ###
M.D.BLK    *******  *******
```

<Address>

- Enter the address number (0 - 254) and press the ENTER key.

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<M.D.BLK>

M.D.BLK is used to block the monitor direction in IEC103 communication. If the blocking of the direction is activated, all indications and measurands are no longer transmitted.

- Enter "Normal" or "Blocked" and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

DNP3.0

- Select "DNP3.0" on the "Protocol" screen to display the "DNP3.0" screen..

```
Settings-Communication          25/Feb/2003 09:45
Protocol-DNP3.0
Address          #####   #####
Address2         #####   #####
```

<Address>

- Enter the address number (0 - 30000) and press the ENTER key.
- After setting, press the END key to display the following confirmation message.

```
Change settings?  Y=ENTER/N=CANCEL
```

- Press the ENTER (= Y) key to change settings and return to the "Settings menu" screen.

4.2.6.8 Password

For the sake of security of MIMIC operation, setting changes and test setting, etc., password protection can be set as follows:

- Select "Settings" on the main "MENU" screen to display the "Settings menu" screen.
- Select "Password" to display the "Password" screen.

```
Settings-Password               25/Feb/2003 09:45

Input new MIMIC password        :****
Input new Setting password      :****
Input new Test password         :****
```

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- Select the item to change, and then the following message are displayed.

```
Password [    ]                  <0123456789
```

- Enter a 4-digit number within the bracket and press the ENTER key. Then the following message are displayed.

```
Press ENTER and retype new password
```

- Press the ENTER key.

```
Password [    ]                  <0123456789
```

- Retype the password and press the ENTER key.
- If the retyped password is different from that first entered, the following message is displayed on the bottom of the "Password" screen before returning to the upper screen.

```
Password incorrect
```

Re-entry is then requested.

Password trap

After the password has been set, the password must be entered in order to enter the control operation on MIMIC screen, the Setting change screen and the Test screen.

Note: The password of the settings includes the password of PLC editor and MIMIC editor tools.

If the password is not entered correctly, it is not possible to set any.

Changing the password

The password can be changed by entering a new 4-digit number on the "Password" screen in the same way as the first password setting.

If you forget the password

Press the RESET and CANCEL keys together more than one second on the top "Main Menu" screen. The screen goes off, and the password protection of the GRD150 is canceled. Set the password again.

4.2.6.9 Panel

To enter LCD contrast and other data for LCD, do the following. The settings are available by the front panel.

- Select "Settings" on the main "Main Menu" screen to display the "Settings menu" screen.
- Select "Panel" to display the "Panel" screen.

```
Settings-Panel                  25/Feb/2003 09:45

LCD contrast   [************               ]
BLOFFT                ##min  ##min
```

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```
STARSTT                ##hrs   ##hrs
```

<LCD contrast>

- Press the ◀ or ▶ key to adjust the contrast. The characters on the screen become thin by pressing the ◀ key and deep by pressing the ▶ key.

<BLOFFT>

- Enter the timer value (1 - 60) to turn off the LCD backlight and press the ENTER key.

<STARSTT>

- Enter the timer value (0 - 24) to reset a state that is clearing all operation and the test switch setting to return the blank screen and the default of the test setting, and press the ENTER key. If set "0", the state reset timer is not available.

4.2.6.10 Others

The plant name and description cannot be changed on LCD and can be viewed only.

To display the plant name and other data, do the following.

- Select "Settings" on the main "Main Menu" screen to display the "Settings menu" screen.
- Select "Others" to display the "Others" screen.

```
Settings-Others                      25/Feb/2003 09:45

Plant name        [**********************]
Description       [**********************]
```

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4.2.7 Testing

View mode or Testing mode

- Open the top "Main Menu" screen by pressing any keys other than the VIEW, RESET, L/R, SELECT, |, ○, F1 and F2 keys.
- Select "Test" on the top "Main Menu" screen to display the "Test" screen.

Then the following password screen is displayed if the password is set.

```
Main Menu                           25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test










Password [          ]               <0123456789
```

- When Testing, input password correctly to enter the Test sub-menu and the ENTER key.
- When viewing the test setting, no input password and press the ENTER key.

Then the following "Test" screen is displayed.

```
Test Menu                        25/Feb/2003 09:45
Switch
Binary O/P
Logic circuit
```

- Select the test item to enter a test sub-menu and press the ENTER key.

The sub-menu "Test" provides such functions as disabling the automatic monitoring function and forced operation of binary outputs.

Note: When changing the default value on the "Test" menu, the "TEST" LED lights.

⚠CAUTION

If settings are changed for testing, remember to reset them to the original settings.

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4.2.7.1 Switch

To display "Switch" screen to set the setting for testing, do the following:

- Select "Test" to display the "Test" sub-menu.

Then the following password screen is displayed if the password is set.

```
Main Menu                              25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test

Password [          ]            <0123456789
```

- When Testing, input password correctly to enter the Test sub-menu and the ENTER key.

Then the following "Test" screen is displayed.

```
Test Menu                          25/Feb/2003 09:45
Switch
Binary O/P
Logic circuit
```

- Select "Switch" to display the "Switch" screen. If any value is changed and different from default value, "TEST" LED is turned on. If all values of Switch are same as default value, "TEST" LED is turned off.

```
Test-Switch                            25/Feb/2003 09:45

A.M.F.          ***
UVTEST          ***
THMRST          ***
SHOTNUM         ***
CLPTST          ***

Test mode       ******
Interlock       ******

IEC103 test     ***
```

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The automatic monitor function (A.M.F.) can be disabled by setting the switch [A.M.F] to "OFF".

Disabling the A.M.F. inhibits trip blocking even in the event of a failure in the items being monitored by this function. It also prevents failures from being displayed on the "ALARM" LED and LCD described in Section 4.2.1. No events related to A.M.F. are recorded, either.

Disabling the A.M.F. is useful for blocking the output of unnecessary alarms during testing.

<A.M.F.>

- Enter "Off" or "On" to disable the A.M.F. or not and press the ENTER key.

<CLP TST>

- Enter "Off" or "S0" (State0) or "S3" (=State3) to set forcibly the test condition of the Cold Load Protection and press the ENTER key.

<UVTEST>

- Enter "On" or "Off" to disable the UV block when testing UV elements or not and press the ENTER key.

<THMRST>

- Enter "On" or "Off" to set the Reset relay time to instantaneous reset or not and to test the hot curve characteristic of THM when testing THM and press the ENTER key.

<SHOTNUM>

- Enter "Off" or "S1" or "S2" or "S3" or "S4" or "S5" or "S6" to set shot number for autoreclose test and press the ENTER key.

<Test mode>

- Enter "Test" or "Normal" to test the Control function or not and press the ENTER key. "Test" is used not to disturb other GRD150s or bay control units when testing the local GRD150.

<Interlock>

- Enter "Bypass" or "Normal" to bypass the Interlock function or not and press the ENTER key.

<IEC103 test>

This setting is used to transmit 'test mode' to the control system by IEC60870-5-103 communication when testing the local relay.

- Enter "On" or "Off" and press the ENTER key.

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4.2.7.2 Binary Output Relay

It is possible to forcibly operate all binary output relays for checking connections with the external devices. Forced operation can be performed on one or more binary outputs at a time.

- Select "Binary O/P" on the "Test" screen to display the "Binary O/P" screen.

```
Test-Binary O/P                     25/Feb/2003 09:45
                                                  1/2
IO1                           IO2
TRP1:TB3 - 19, 20   ***      TRP1:TB5 - 19, 20   ***
TRP2:TB4 -  1,  2   ***      TRP2:TB6 -  1,  2   ***
BO1 :TB4 -  5,  6   ***      BO1 :TB6 -  5,  6   ***
BO2 :TB4 -  7,  8   ***      BO2 :TB6 -  7,  8   ***
BO3 :TB4 -  9, 10   ***      BO3 :TB6 -  9, 10   ***
BO4 :TB4 - 11, 12   ***      BO4 :TB6 - 11, 12   ***
BO5 :TB4 - 13, 14   ***      BO5 :TB6 - 13, 14   ***
28F :TB4 - 15, 17   ***      BO6 :TB6 - 15, 17   ***
```

```
Test-Binary O/P                     25/Feb/2003 09:45
                                                  2/2
IO3                           IO4
TRP1:TB7 - 19, 20   ***      TRP1:TB9 - 19, 20   ***
TRP2:TB8 -  1,  2   ***      TRP2:TB10 - 1,  2   ***
BO1 :TB8 -  5,  6   ***      BO1 :TB10 - 5,  6   ***
BO2 :TB8 -  7,  8   ***      BO2 :TB10 - 7,  8   ***
BO3 :TB8 -  9, 10   ***      BO3 :TB10 - 9, 10   ***
BO4 :TB8 - 11, 12   ***      BO4 :TB10 -11, 12   ***
BO5 :TB8 - 13, 14   ***      BO5 :TB10 -13, 14   ***
BO6 :TB8 - 15, 17   ***      BO6 :TB10 -15, 17   ***
```

Note: IO2, IO3 and IO4 are provided dependent on the model. If IO3 and IO3 are not provided, the message as 'not equipped' is displayed as follows:

```
Test-Binary O/P                     25/Feb/2003 09:45
                                                  2/2
IO3 not equipped              IO4 not equipped
```

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- Enter "ENA" (Enable) and press the ENTER key to operate the output relays forcibly.
- After completing the entries, press the END key to display the following confirmation message on the bottom line.

```
Operate?  Y=Pressing ENTER   N=CANCEL
```

- Keep pressing the ENTER (= Y) key to operate the assigned output relays.
- Release pressing the ENTER key to reset the operation.
- Press the CANCEL key to return to the upper "Test" screen.

4.2.7.3 Logic circuit

It is possible to observe the binary signal level on the signals listed in Appendix C with monitoring jacks A and B.

To display logic circuit, do the following:

- Select "Logic circuit" to display the "Logic circuit" screen.

```
Test-Logic circuit            25/Feb/2003 09:45

TermA        ####
TermB        ####
```

- Enter a signal number (0 - 3071) to be observed at monitoring jack A and press the ENTER key.
- Enter the other signal number (0 - 3071) to be observed at monitoring jack B and press the ENTER key.

After completing the setting, the signals can be observed by the binary logic level at monitoring jacks A and B or by the LEDs above the jacks.

On screens other than the above screen, observation with the monitoring jacks is disabled.

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4.3 Local Communication

The following functions can be operated from a personal computer using an RS232C port on the front panel.

(1) Relay Setting and Monitoring (RSM100) function

On the personal computer, the following analysis and display of the fault currents and voltages are available in addition to the items available on the LCD screen.

- Display of current and voltage waveform: Oscillograph display
- Symmetrical component analysis: On arbitrary time span
- Harmonic analysis: On arbitrary time span
- Frequency analysis: On arbitrary time span

(2) PLC function

- Program of sequence logic: Setting and change
- Installing and reading the PLC logic on a relay

(3) MIMIC function

- MIMIC configuration Creation and change
- Installing the MIMIC configuration on a relay

For the details, see the separate instruction manuals "PC INTERFACE RSM100", "PLC TOOL" and "MIMIC EDITOR TOOL".

4.4 Remote Communication

Remote communication is available via RS485 port. The GRD150 can be provided for communication interface such as Relay Setting and Monitoring system(RSM), IEC 60870-5-103, DNP 3.0 or Modbus RTU etc., to connect a PC or a substation control system and to construct a network communication.

The RSM system is a system that retrieves and analyses the data on power system quantities, fault and event records and views or changes settings in individual relays via a telecommunication network using a remote PC.

Figure 4.4.1 shows the typical configuration of the RSM system via a protocol converter G1PR2. The relays are connected through twisted pair cables, and the maximum 256 relays can be connected since the G1PR2 can provide up to 8 ports. The total length of twisted pair wires should not exceed 1200 m. Relays are mutually connected using an RS485 port on the relay rear panel and connected to a PC RS232C port via G1PR2. Terminal resistor (150 ohms) is connected the last relay. The transmission rate used is 64 kbits/s.

Relays are mutually connected using an RS485 port and connected to a PC RS232C port via the protocol converter G1PR2 or the RS485/232 level converter. When the G1PR2 is used, the switching setting [CH1 Protocol] is set to “RSM-X” and the transmission rate used is 64 kbits/s. In case of the RS485/232 level converter, the switch [CH1 Protocol] is set to “Modbus” and the transmission rate is selected by the switch [Baud rate] setting.

For setting the communication interface, refer to Section 4.2.6.7.

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IEC 60870-5-103 Interface

The GRD150 can support the IEC60870-5-103 communication protocol. This protocol is mainly used when the relay communicates with a control system and is used to transfer the following measurand and status data from the relay to the control system. (For details, see Appendix M.)

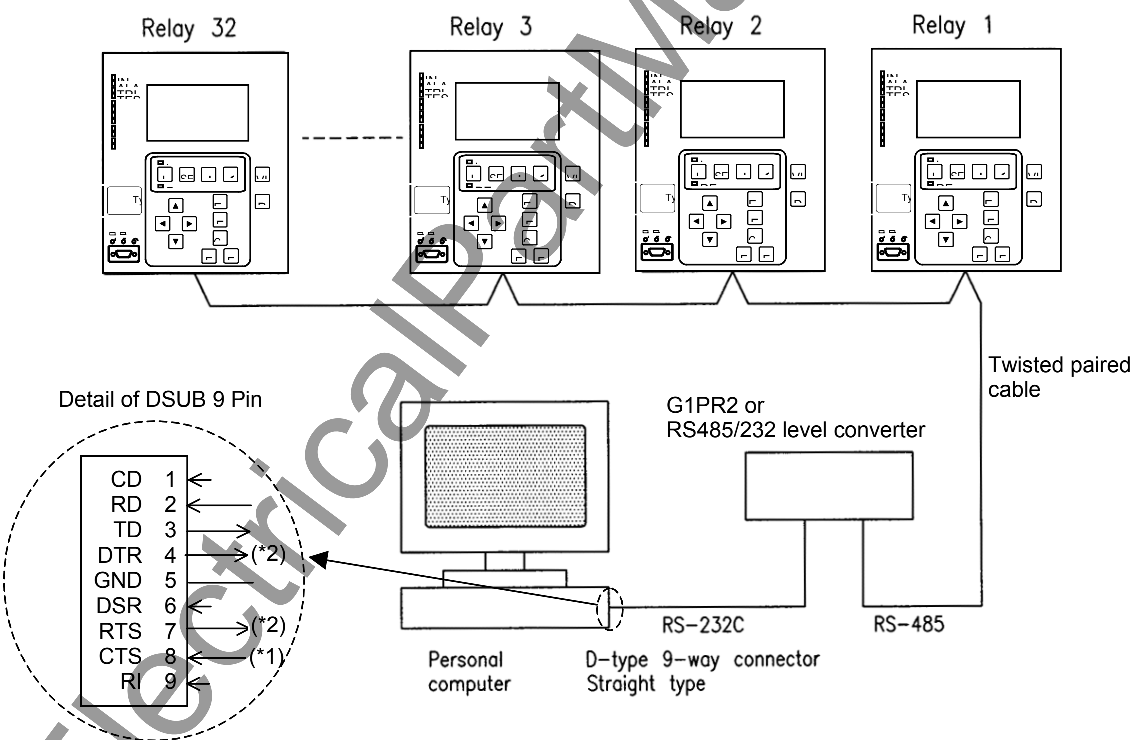
- Measurand data: current, voltage, active power, reactive power, frequency, latest fault record data, counts such as trip, CB, DS etc., operation time of devices, etc.
- Status data: events, fault indications, etc.

The IEC60870-5-103 function in the relay can be customized with the original software "IEC103 configurator". It runs on a personal computer (PC) connected to the relay, and can help setting of Time-tagged messages, General command, Metering, etc. For details of the setting method, refer to "IEC103 configurator" manual.

The protocol can be used through the RS485 port on the rear panel.

The relay supports two baud-rates 9.6kbps and 19.2kbps.

The data transfer from the relay can be blocked by the setting.



Note (*1): The CTS of the converter must be set to "Mark" state because the CTS of PC becomes a "Mark" state during communication. If not, the transmission from PC is suspended.
(*2): The CTS of PC becomes a "Mark" state during communication.

Figure 4.4.1 Communication System

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4.5 Clock Function

The clock function (Calendar clock) is used for time-tagging for the following purposes:

- Event records
- Disturbance records
- Fault records
- Alarm records
- Metering
- Display of the system quantities on the digest screen
- Display of the fault records on the digest screen
- Display of the automatic monitoring results on the digest screen

The calendar clock can run locally or be synchronized with the external IRIG-B time standard signal, RSM or IEC clock. This can be selected by setting.

If it is necessary to synchronise with the IRIG-B time standard signal, it is possible to transform GMT to the local time by setting.

When the relays are connected to the RSM system as shown in Figure 4.4.1, the calendar clock of each relay is synchronized with the RSM clock. If the RSM clock is synchronized with the external time standard (GPS clock etc.), then all the relay clocks are synchronized with the external time standard.

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5. Installation

5.1 Receipt of Relays

When relays are received, carry out the acceptance inspection immediately. In particular, check for damage during transportation, and if any is found, contact the vendor.

Always store the relays in a clean, dry environment.

5.2 Relay Mounting

A flush mounting relay is included. Appendix F shows the case outlines.

5.3 Electrostatic Discharge

⚠CAUTION

Do not take out the relay unit outside the relay case since electronic components on the modules are very sensitive to electrostatic discharge. If it is absolutely essential to take the modules out of the case, do not touch the electronic components and terminals with your bare hands. Additionally, always put the module in a conductive anti-static bag when storing it.

5.4 Handling Precautions

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage. This damage often may not be immediately apparent, but the reliability of the circuit will have been reduced.

The electronic circuits are completely safe from electrostatic discharge when housed in the case. Do not expose them to risk of damage by withdrawing the relay unit unnecessarily.

The relay unit incorporates the highest practical protection for its semiconductor devices. However, if it becomes necessary to withdraw the relay unit, precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

⚠CAUTION

- Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
- Handle the module by its front plate, frame or edges of the printed circuit board. Avoid touching the electronic components, printed circuit board or connectors.
- Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.
- Place the module on an anti-static surface, or on a conducting surface which is at the same potential as yourself.
- Do not place modules in polystyrene trays.

It is strongly recommended that detailed investigations on electronic circuitry should be carried out in a Special Handling Area such as described in the IEC 60747.

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5.5 External Connections

External connections for each relay model are shown in Appendix G.

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6. Commissioning and Maintenance

6.1 Outline of Commissioning Tests

The GRD150 is fully numerical and the hardware is continuously monitored.

Commissioning tests can be kept to a minimum and need only include hardware tests and the conjunctive tests. The function tests are at the user's discretion.

In these tests, user interfaces on the front panel of the relay or local PC can be fully applied.

Test personnel must be familiar with general relay testing practices and safety precautions to avoid personal injuries or equipment damage.

Hardware tests

These tests are performed for the following hardware to ensure that there is no hardware defect. Defects of hardware circuits other than the following can be detected by monitoring which circuits function when the DC power is supplied.

User interfaces
Binary input circuits and output circuits
AC input circuits

Function tests

These tests are performed for the following functions that are fully software-based.

Measuring elements
Metering and recording

Conjunctive tests

The tests are performed after the relay is connected with the primary equipment and other external equipment.

The following tests are included:

On load test: phase sequence check and polarity check
Tripping circuit test
Reclosing circuit test
Control circuit test

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6.2 Cautions

6.2.1 Safety Precautions

⚠CAUTION

- The relay rack is provided with an earthing terminal.
  Before starting the work, always make sure the relay rack is earthed.
- When connecting the cable to the back of the relay, firmly fix it to the terminal block and attach the cover provided on top of it.
- Before checking the interior of the relay, be sure to turn off the power.

Failure to observe any of the precautions above may cause electric shock or malfunction.

6.2.2 Cautions on Tests

⚠CAUTION

- While the power is on, do not drawout/insert the relay unit.
- Before turning on the power, check the following:
  - Make sure the polarity and voltage of the power supply are correct.
  - Make sure the CT circuit is not open.
  - Make sure the VT circuit is not short-circuited.
- Be careful that the relay is not damaged due to an overcurrent or overvoltage.
- If settings are changed for testing, remember to reset them to the original settings.

Failure to observe any of the precautions above may cause damage or malfunction of the relay.

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6.3 Preparations

Test equipment

The following test equipment is required for the commissioning tests.

1 Single-phase current source
1 Three-phase current source
1 Single-phase voltage source
1 Three-phase voltage source
1 DC power supply
3 Phase angle meter
3 AC ammeter
3 AC voltmeter
1 Time counter, precision timer
1 PC (not essential)

Relay settings

Before starting the tests, it must be specified whether the tests will use the user's settings or the default settings.

For the default settings, see the following appendixes:

Appendix H Relay Setting Sheet

Visual inspection

After unpacking the product, check for any damage to the relay case. If there is any damage, the internal module might also have been affected. Contact the vendor.

Relay ratings

Check that the items described on the nameplate on the front of the relay conform to the user's specification. The items are: relay type and model, AC current and frequency ratings, and auxiliary DC supply voltage rating.

Local PC

When using a local PC, connect it with the relay via the RS232C port on the front of the relay. RSM100 software is required to run the PC.

For the details, see the separate volume "PC INTERFACE RSM100".

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6.4 Hardware Tests

The tests can be performed without external wiring, but a DC power supply and AC current and voltage sources are required.

6.4.1 User Interfaces

This test ensures that the LCD, LEDs and keys function correctly. LCD and LEDs are checked in blank status.

LCD display

- Apply the rated DC voltage and check that the LCD is off.

  Note: If there is a failure, the LCD will display the "Alarm " screen when the DC voltage is applied.

- Press the RESET key for one second or more and check that black dots appear on the whole screen.

LED display

- Apply the rated DC voltage and check that the "RUN" LED is lit in green.
- Press the RESET key for one second or more and check that remaining 12 LEDs are lit in green, red or yellow. (Though the programmable LEDs are depending on the setting, the default setting is yellow.)

"VIEW" and "RESET" keys

- Press the VIEW key when the LCD is off and check that the "MIMIC", "Metering", "Fault", "Alarm" and "Event" screens are sequentially displayed on the LCD. "Fault", "Alarm" and "Event" screens appears if there is some data.
- Press the RESET key and check that the LCD is turned off.

"L/R", "SELECT", "I" and "O" keys

These check is performed by checking the control function.

"F1" and "F2" keys

These check are left to user’s discretion because above keys are user-programmable keys.

Other operation keys

- Press any key when the LCD is off and check that the LCD displays the "MENU" screen. Press the END key to turn off the LCD.
- Repeat this for all keys.

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6.4.2 Binary Input Circuit

The testing circuit is shown in Figure 6.4.1.

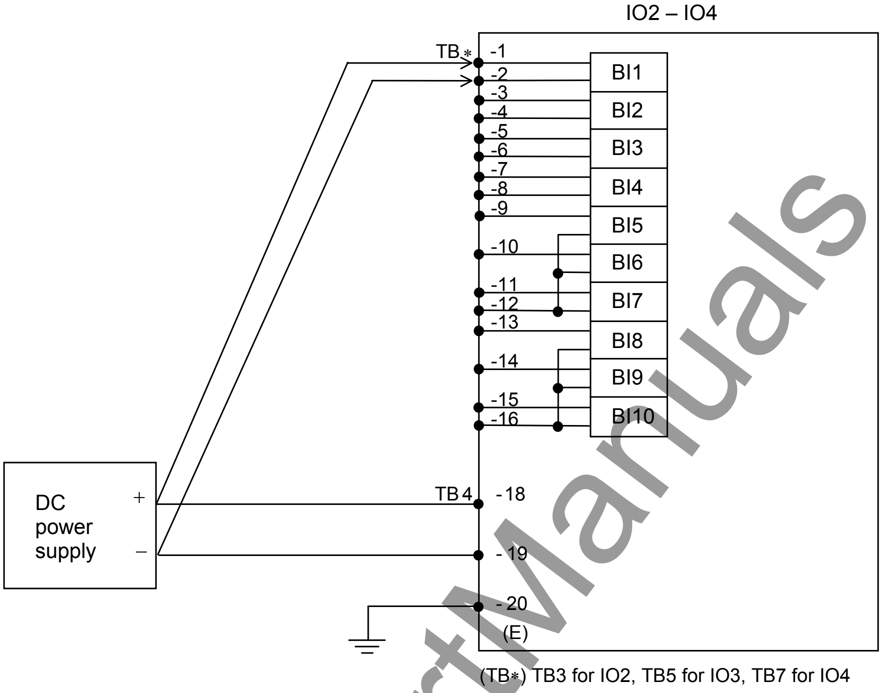

Figure 6.4.1 Testing Binary Input Circuit

- Display the "Binary I/O" screen from the "Status" sub-menu.

```
Status-Binary I/O              25/Feb/2003 09:45

Input   IO1          [0000  0000  00   ]
Input   IO2          [0000  0000  000  ]
Input   IO3          [0000  0000  000  ]
Input   IO4          [0000  0000  000  ]
Output  IO1          [0000  0000       ]
Output  IO2          [0000  0000       ]
Output  IO3          [0000  0000       ]
Output  IO4          [0000  0000       ]
```

- Apply the rated DC voltage to terminal 1-2, 3-4, 5-6, 7-8, 9-12, 10-12, 11-12, 13-16,14-16, 15-16 of terminal block TB3, TB5 and TB7.
  Check that the status display corresponding to the input signal changes from 0 to 1. (For details of the binary input status display, see Section 4.2.4.2.)

The user will be able to perform this test for one terminal to another or for all the terminals at once.

6.4.3 Binary Output Circuit

This test can be performed by using the "Test" sub-menu and forcibly operating the relay drivers

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and output relays. Operation of the output contacts is monitored at the output terminal. The output contact and corresponding terminal number are shown in Appendix G.

```
Test Menu                          25/Feb/2003 09:45
Switch
Binary O/P
Logic circuit
```

- Select "Binary O/P" on the "Test" screen to display the "Binary O/P" screen. The LCD displays the output modules installed depending on the model.

```
Test-Binary O/P                   25/Feb/2003 09:45
                                                1/2
IO1                         IO2
TRP1:TB3 - 19, 20   ***     TRP1:TB5 - 19, 20   ***
TRP2:TB4 -  1,  2   ***     TRP2:TB6 -  1,  2   ***
BO1 :TB4 -  5,  6   ***     BO1 :TB6 -  5,  6   ***
BO2 :TB4 -  7,  8   ***     BO2 :TB6 -  7,  8   ***
BO3 :TB4 -  9, 10   ***     BO3 :TB6 -  9, 10   ***
BO4 :TB4 - 11, 12   ***     BO4 :TB6 - 11, 12   ***
BO5 :TB4 - 13, 14   ***     BO5 :TB6 - 13, 14   ***
28F :TB4 - 15, 17   ***     BO6 :TB6 - 15, 17   ***
```

- Enter the selected number corresponding to each module to be operated. The LCD will display the name of the module, the name of the output relay, the name of the terminal block and the terminal number to which the relay contact is connected.
- Enter "ENA" (Enable) and press the ENTER key to operate the output relays forcibly.
- After completing the entries, press the END key to display the following confirmation message on the bottom line.

```
Operate?  Y=Pressing ENTER   N=CANCEL
```

- Keep pressing the ENTER (= Y) key to operate the assigned output relays.
- Release pressing the ENTER key to reset the operation.
- Check that the output contacts operate at the terminal.

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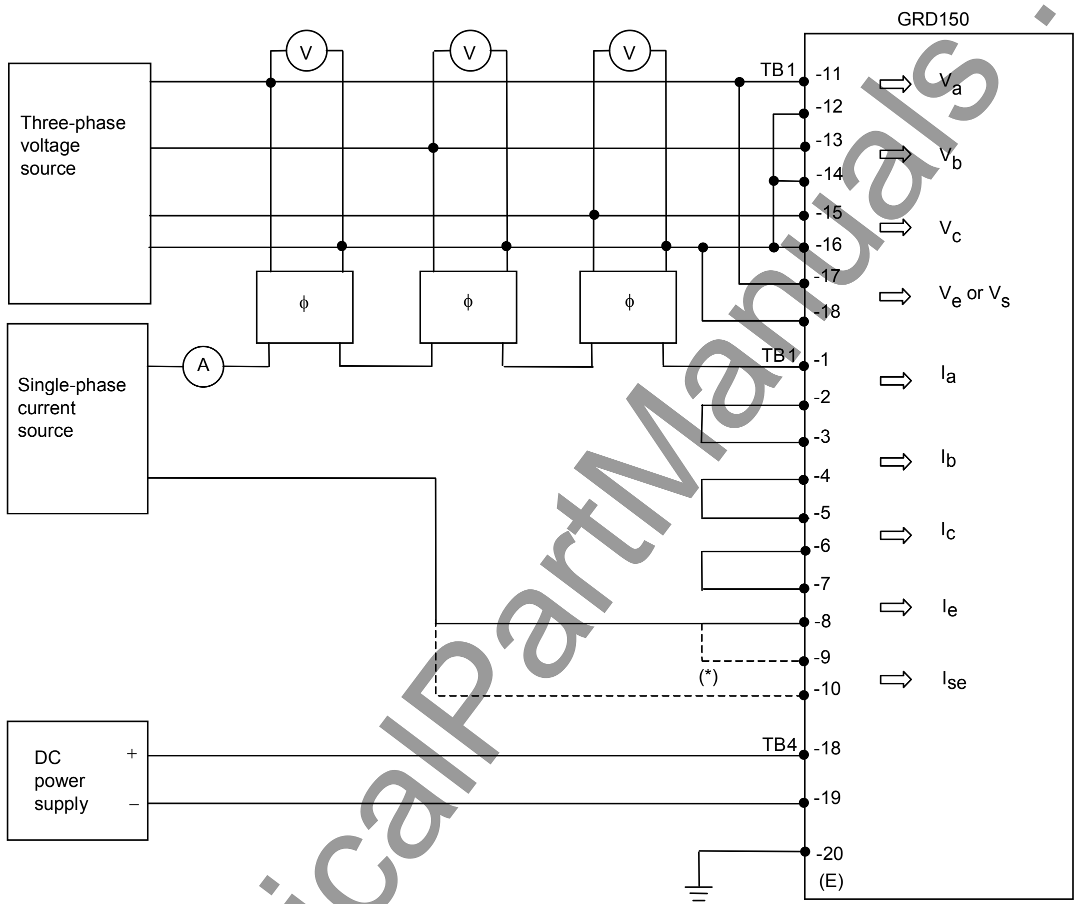
6.4.4 AC Input Circuits

This test can be performed by applying known values of voltage and current to the AC input circuits and verifying that the values applied coincide with the values displayed on the LCD screen.

The testing circuit is shown in Figure 6.4.2. A three-phase voltage source and a single-phase current source are required.



(*) : This connection is added for Model 200 and 400 series.

Figure 6.4.2 Testing AC Input Circuit

- Check that the metering data is set to be expressed as secondary values on the "Metering switch" screen.

  "Settings" sub-menu → "Status" screen → "Metering switch" screen

If the setting is “Display Value = Primary”, change the setting in the "Metering switch". Remember to reset it to the initial setting after the test is finished.

- Open the "Metering" screen in the "Status" sub-menu.

  "Status" sub-menu → "Metering" screen

- Apply AC rated voltages and currents and check that the displayed values are within ± 5% of the input values.

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6.5 Function Test

CAUTION

The function test may cause the output relays to operate including the tripping output relays. Therefore, the test must be performed with tripping circuits disconnected.

6.5.1 Measuring Relay Element

Measuring relay element characteristics are realized by software, so it is possible to verify the overall characteristics by checking representative points.

Operation of the element under test is observed by the binary output signal at monitoring jacks A or B or by the LED indications above the jacks. In any case, the signal number corresponding to each element output must be set on the "Logic circuit" screen of the "Test" sub-menu.

```
Test-Logic circuit              25/Feb/2003 09:45

TermA        ####
TermB        ####
```

When a signal number is entered for the TermA line, the signal is observed at monitoring jack A and when entered for the TermB line, observed at monitoring jack B. See Section 4.2.7.3.

Note: The voltage level at the monitoring jacks is +5V ±1V for logic level "1" when measured by an instrument with 10kΩ input impedance, and less than 0.1V for logic level "0".

CAUTION

- Use test equipment with more than 1 kΩ of internal impedance when observing the output signal at the monitoring jacks.
- Do not apply an external voltage to the monitoring jacks.

In case of a three-phase element, it is enough to test a representative phase. A-phase and AB-phase elements are selected for the earth fault element and phase fault element respectively hereafter. Further, the [APPL-CT] and [APPL-VT] settings are selected “3P” and “3PV”.

Note: Operating time test of measuring relay elements at monitoring jack A or B is not including the operation of binary output. Whole the operating time test, if required, should be measured at a binary output relay.

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6.5.1.1 Overcurrent and undercurrent element OC1 to OC4, UC1, UC2 and CBF and Earth fault element EF1 to EF4 and SEF1 to SEF4

The overcurrent element is checked on the operating current value and operating time for IDMT curve.

Operating current check

Figure 6.5.1 shows a testing circuit. The operating current value is checked by increasing or decreasing the magnitude of the current applied.

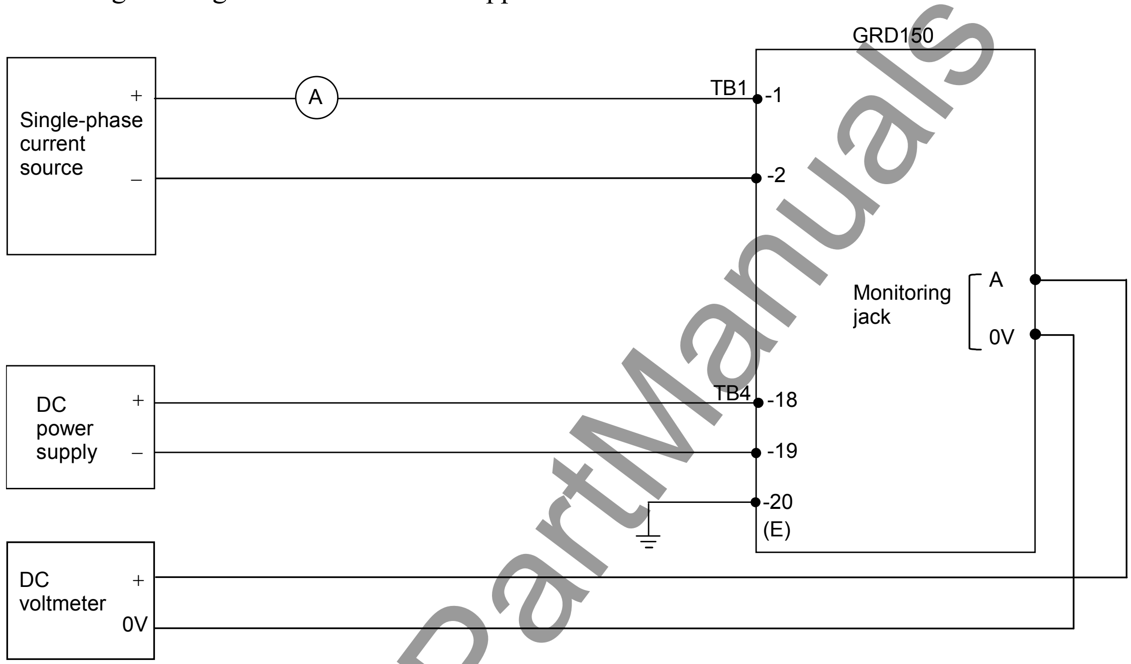

Figure 6.5.1 Operating Current Value Test

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.	Element	Signal No.
OC1D-A	4	UC1-A	164
OC2D-A	8	UC2-A	168
OC3D-A	12	CBF-A	112
OC4D-A	16		

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and change the magnitude of the current applied and measure the value at which the element operates.
  Check that the measured value is within 5% of the setting value.

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Operating time check for IDMT curve

The testing circuit is shown in Figure 6.5.2.

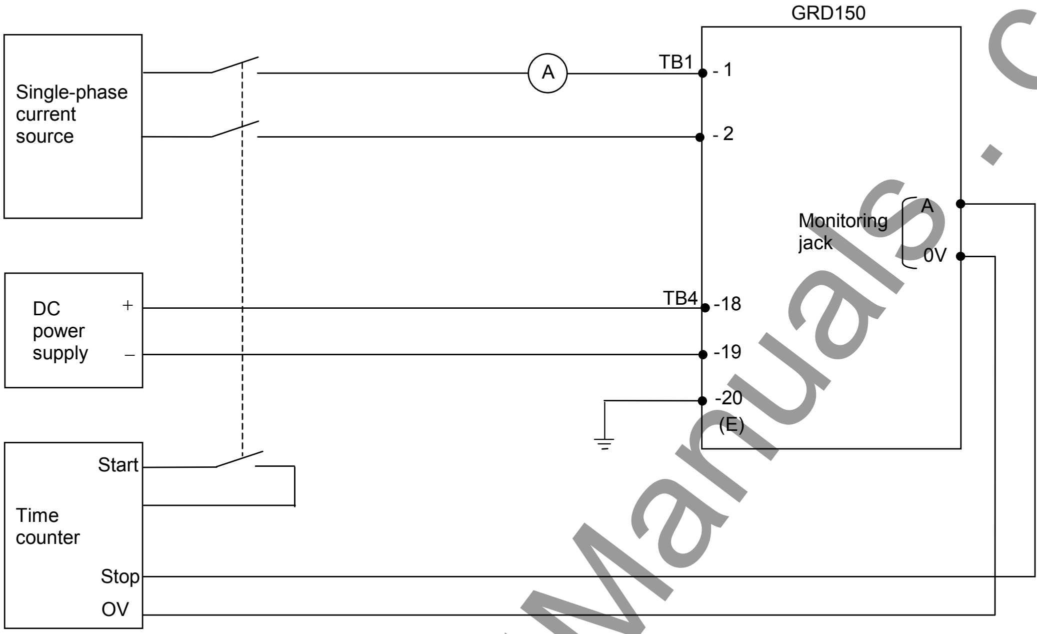

Figure 6.5.2 Testing IDMT

One of the inverse time characteristics can be set, and the output signal numbers of the IDMT elements are as follows:

Element	Signal No.
OC1I-A	20
OC2I-A	24

Fix the time characteristic to test by setting the scheme switch MOC1 or MOC2 on the "OC" screen.

"Settings" sub-menu → "Protection" screen → "Group∗" screen → "OC" screen

The test procedure is as follows:

- Enter the signal number to observe the operating time at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and measure the operating time. The magnitude of the test current should be between 1.2 × I_S to 20 × I_S, where I_S is the current setting.
- Calculate the theoretical operating time using the characteristic equations shown in Section 2.1.1. Check that the measured operating time is within IEC 60255-3 class 5.

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6.5.1.2 Earth fault element EF1 to EF4 and SEF1 to SEF4

The earth fault element is checked on the operating current value and operating time for IDMT curve.

Operating current check

The testing circuit is shown in Figure 6.5.3.

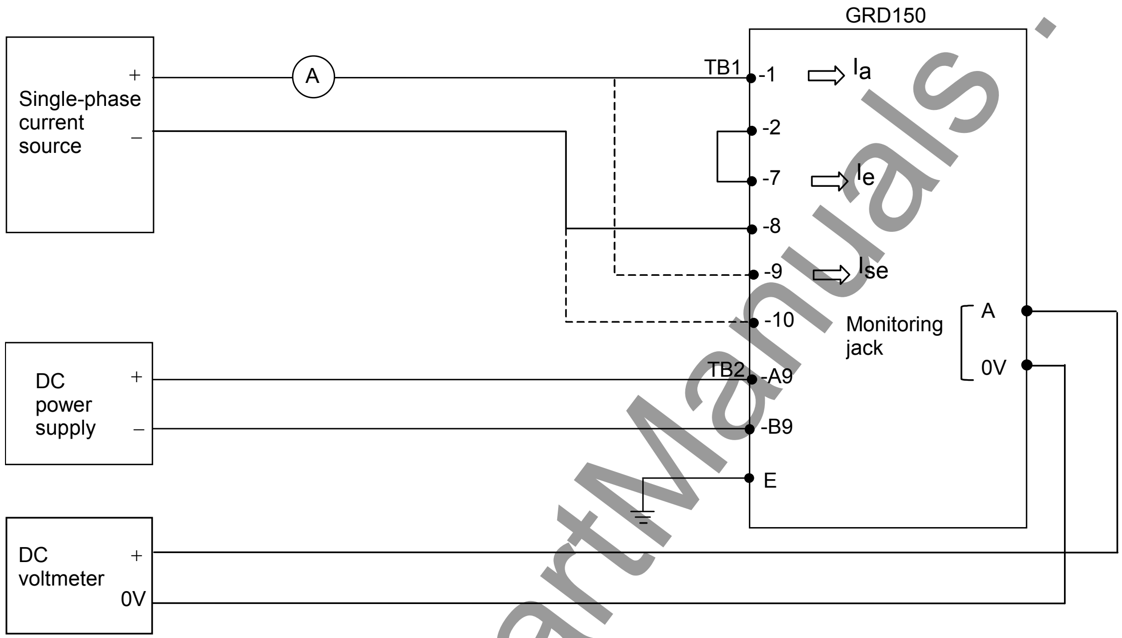

Figure 6.5.3 Operating Current Value Test

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.	Element	Signal No.
EF1D	100	SEF1D	104
EF2D	101	SEF2D	105
EF3D	102	SEF3D	106
EF4D	103	SEF4D	107

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and change the magnitude of the current applied and measure the value at which the element operates.
  Check that the measured value is within 5% of the setting value.

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Operating time check for IDMT curve

The testing circuit is shown in Figure 6.5.4.

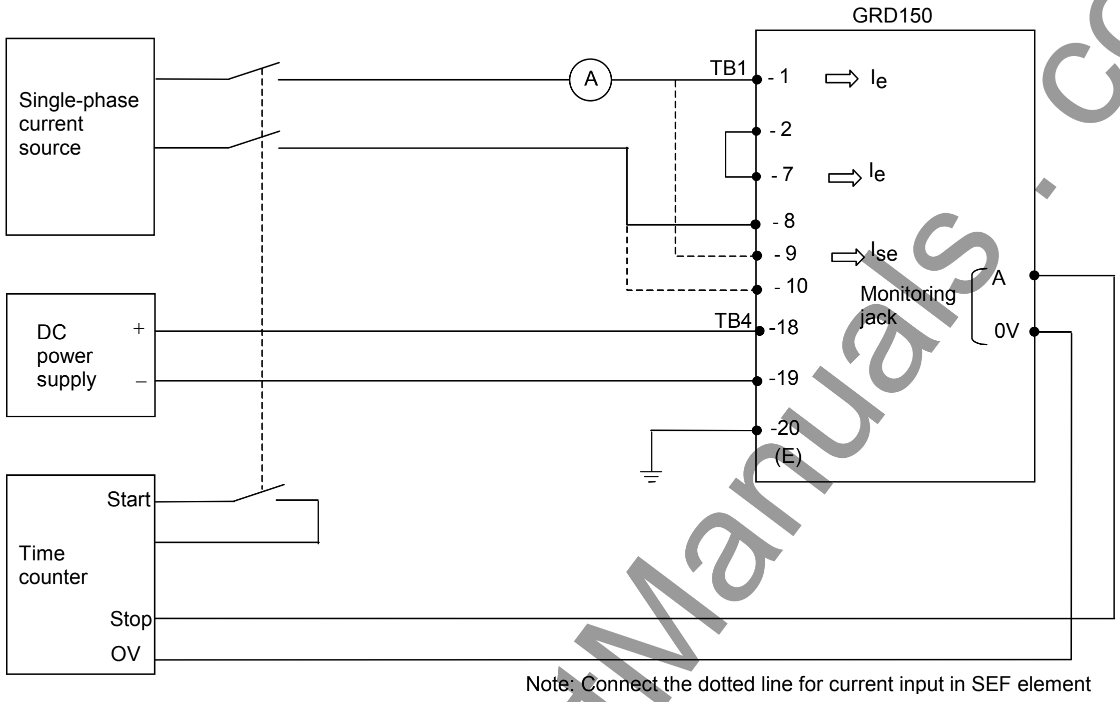

Figure 6.5.4 Testing IDMT

One of the inverse time characteristics can be set, and the output signal numbers of the IDMT elements are as follows:

Element	Signal No.	Element	Signal No.
EF1I	116	SEF1I	120
EF2I	117	SEF2I	121

Fix the time characteristic to test by setting the scheme switch MEF1, MEF2, MSE1 or MSE2 on the "EF" or "SEF" screen.

"Settings" sub-menu → "Protection" screen → "Group∗" screen → "EF" or "SEF" screen

The test procedure is as follows:

- Enter the signal number to observe the operating time at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and measure the operating time. The magnitude of the test current should be between 1.2 × I_S to 20 × I_S, where I_S is the current setting.
- Calculate the theoretical operating time using the characteristic equations shown in Section 2.1.1. Check that the measured operating time is within IEC 60255-3 class 5.

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6.5.1.3 Directional elements DOC, DEF, DSEF

The directional elements are checked on the directional characteristic.

DOC element

The test circuit is shown in Figure 6.5.5.

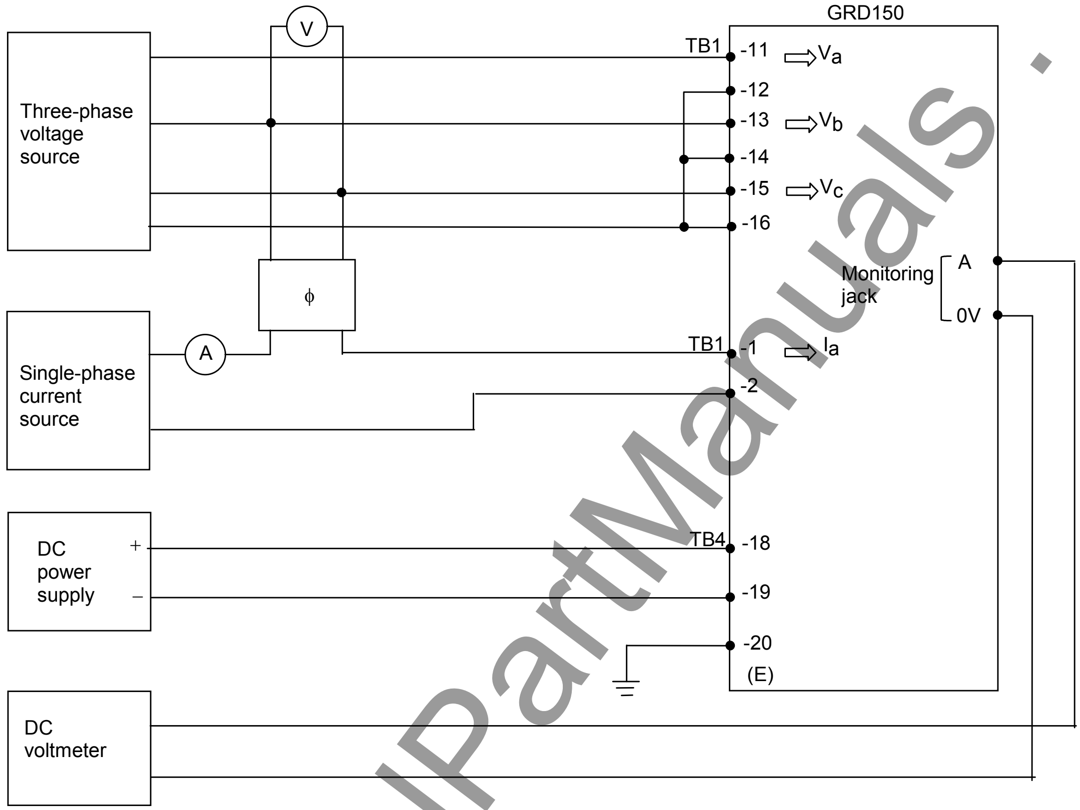

Figure 6.5.5 Testing DOC Element

DOC elements and their output signal number are listed below.

Measuring element	Signal number
DOC1F-A (FWD)	36
DOC1R-A (REV)	52

The following shows the case when testing DOC1F.

- Select "Logic circuit" on the Test screen to display the "Logic circuit" screen.
- Enter the signal number to be observed at monitoring jack as shown in Section 6.5.1.
- Apply three-phase rated voltage and single-phase test current IT (= I_a).
  Set IT to lag V_{bc} by DOC characteristic angle DOC θ. (The default setting of DOC θ is -45°.)
- Changing the magnitude of IT while retaining the phase angle with the voltages, and measure the current at which the element operates. Check that the measured current magnitude is within ± 5% of the current setting.

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DEF element

The test circuit is shown in Figure 6.5.6.

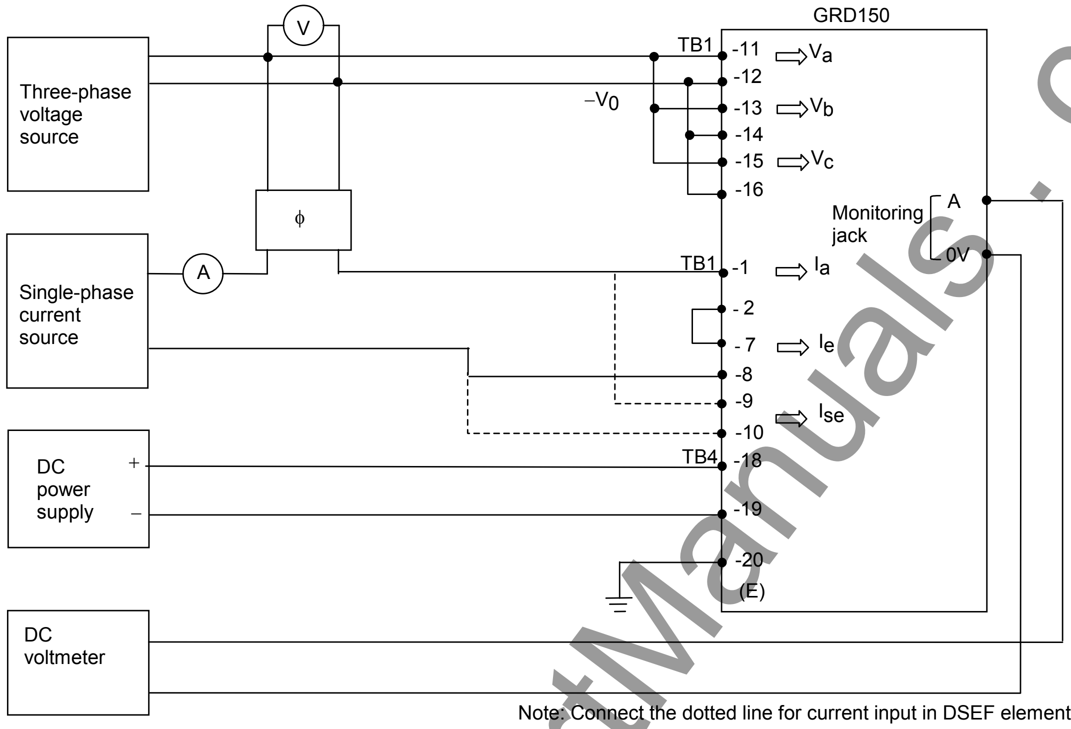

Figure 6.5.6 Testing DEF Elements

DEF elements and their output signal number are listed below.

Measuring element	Signal number
DEF1F (FWD)	132
DEF1R (REV)	148

The following shows the case when testing DEF1F.

- Select "Logic circuit" on the "Test menu" screen to display the "Logic circuit" screen.
- Enter the signal number to be observed at monitoring jack A as shown in Section 6.5.1.
- Apply the rated voltage VT (= V_0) and single-phase test current IT.
  Set IT to lag V_0 by DEF characteristic angle DEF θ. (The default setting of DEF θ is -45°.)
- Changing the magnitude of IT while retaining the phase angle with the voltages, and measure the current at which the element operates. Check that the measured current magnitude is within ± 5% of the current setting.

DSEF element

The test circuit is shown in Figure 6.5.6.

DSEF elements and their output signal number are listed below.

Measuring element	Signal number
DSEF1F (FWD)	136
DSEF1R (REV)	152

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The following shows the case when testing DSEF1F.

- Select “Logic circuit” on the “Test menu” screen to display the “Logic circuit” screen.
- Enter the signal number to be observed at monitoring jack A as shown in Section 6.5.1.
- Apply the rated voltage VT (= V_0) and single-phase test current IT (= I_{se}).
  Set IT to lag V_0 by DSE characteristic angle DSE θ. (The default setting of DSE θ is 0°.)
- Changing the magnitude of IT while retaining the phase angle with the voltages, and measure the current at which the element operates. Check that the measured current magnitude is within ± 5% of the current setting.

6.5.1.4 Thermal overload element THM-A and THM-T

The testing circuit is same as the circuit shown in Figure 6.5.2.

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.
THM-A	177
THM-T	176

To test easily the thermal overload element, the scheme switch [THMRST] in the "Switch" screen on the "Test" menu is used.

- Set the scheme switch [THMRST] to "ON".
- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and measure the operating time. The magnitude of the test current should be between 1.2 × I_S to 10 × I_S, where I_S is the current setting.

CAUTION

After the setting of a test current, apply the test current after checking that the THM% has become 0 on the "Metering" screen.

- Calculate the theoretical operating time using the characteristic equations shown in Section 2.1.4. Check that the measured operating time is within 5%.

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6.5.1.5 Negative sequence overcurrent element NOC1 and NOC2

The testing circuit is shown in Figure 6.5.7.

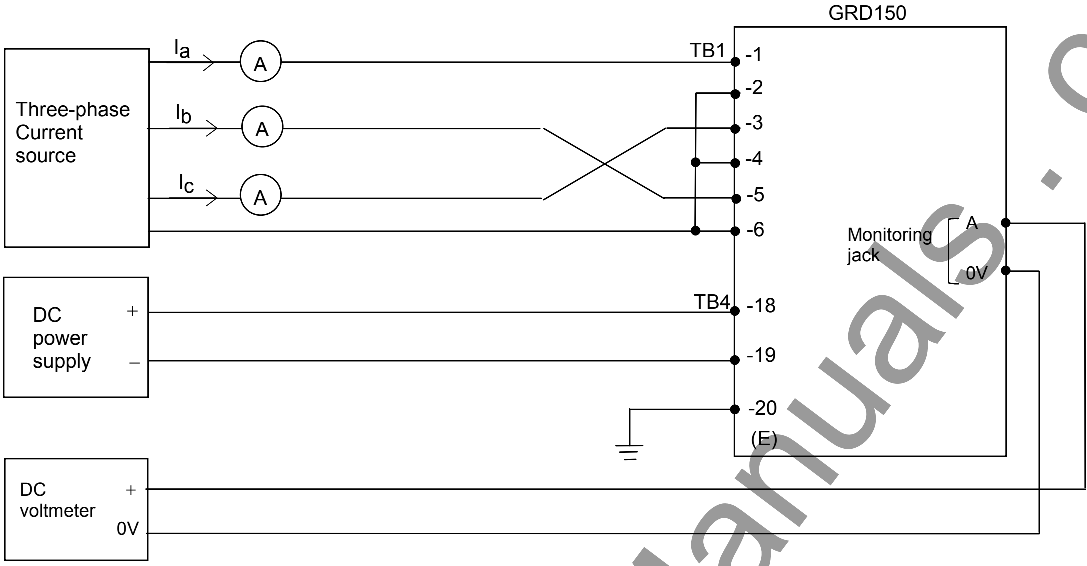

Figure 6.5.7 Testing NOC elements

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.
NOC1D	108
NOC2D	109

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply the three-phase balance current and the operating current value is checked by increasing the magnitude of the current applied.

Check that the measured value is within 5% of the setting value.

Operating Time Check For Inverse Time (IDMT) Curve, NOC1I

One of the inverse time characteristics can be set, and the output signal numbers of the IDMT elements are as follows:

Element	Signal No.
NOC1I	124

Fix the time characteristic to test by setting the scheme switch MNC1 on the "NOC" screen.

"Settings" sub-menu → "Protection" screen → "Group∗" screen → "NOC" screen

The test procedure is as follows:

- Enter the signal number to observe the operating time at the monitoring jack A as shown in Section 6.5.1.
- Apply a test current and measure the operating time. The magnitude of the test current should

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be between 1.2 × I_S to 20 × I_S, where I_S is the current setting.

- Calculate the theoretical operating time using the characteristic equations shown in Section 2.1.1. Check that the measured operating time is within IEC 60255-3 class 5.

6.5.1.6 DNOC element

The test circuit is shown in Figure 6.5.8.

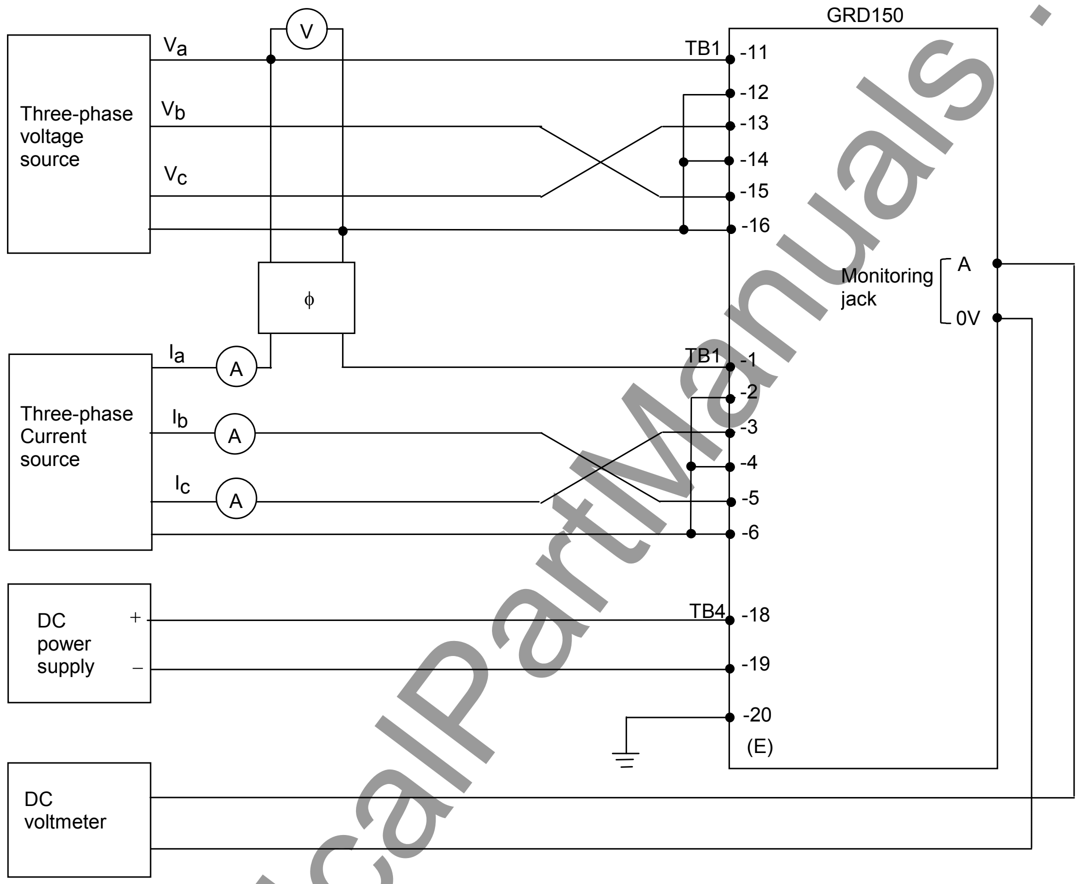

Figure 6.5.8 Testing DNOC Element

DNOC element and their output signal number are listed below.

Measuring element	Signal number
DNOC1F (FWD)	140
DNOC1R (REV)	156

The following shows the case when testing DNOC1F.

- Select "Logic circuit" on the Test screen to display the "Logic circuit" screen.
- Enter the signal number to be observed at monitoring jack as shown in Section 6.5.1.
- Apply three-phase balance voltage (=30V) and three-phase balance current.
  Set I_a to lag V_a by DNC characteristic angle DNC θ. (The default setting of DNC θ is -45°.)
- Changing the magnitude of three-phase balance current while retaining the phase angle with the voltages, and measure the current I_a at which the element operates. Check that the measured current magnitude is within ± 5% of the current setting.

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6.5.1.7 Broken conductor detection element BCD

The testing circuit is shown in Figure 6.5.9.

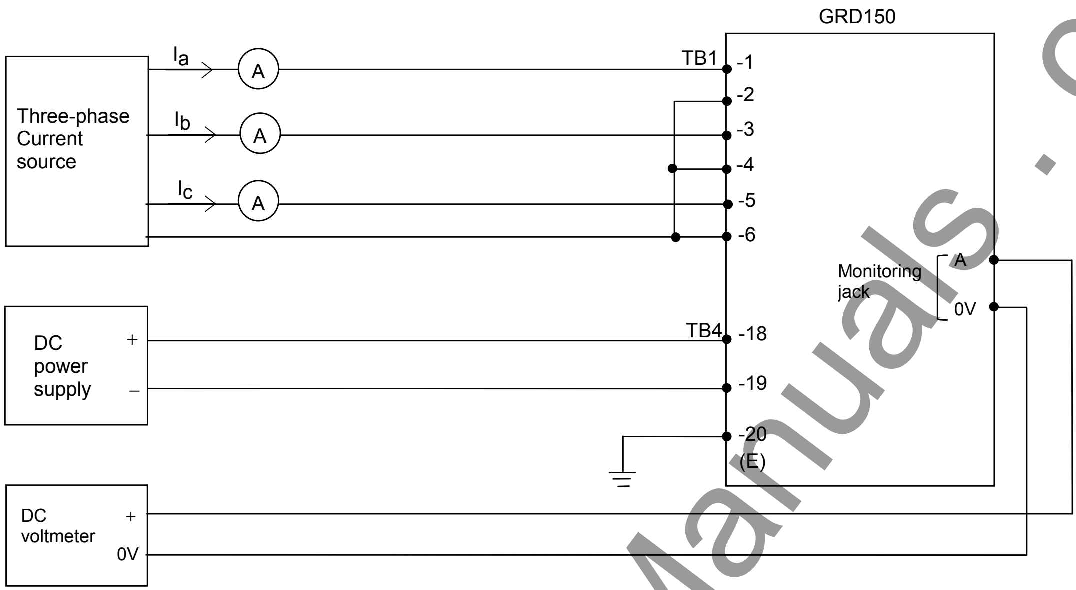

Figure 6.5.9 Testing BCD element

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.
BCD	130

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply the three-phase balance current at 10% of the rated current and interrupt a phase current.

Then, check the BCD element operates.

6.5.1.8 Cold load protection

The testing circuit is same as the circuit shown in Figure 6.5.1.

To check the cold load protection function, the scheme switch [CLPTST] in the "Switch" screen on the "Test" menu is used. Test the item of OC1 shown in Section 6.5.1.1.

- Set the scheme switch [CLPTST] to "S0".

  Check that the OC1 operates at the setting value of normal setting group.
- Next, set the scheme switch [CLPTST] to "S3".

  Check that the OC1 operates at the setting value of cold load setting group [CLSG].

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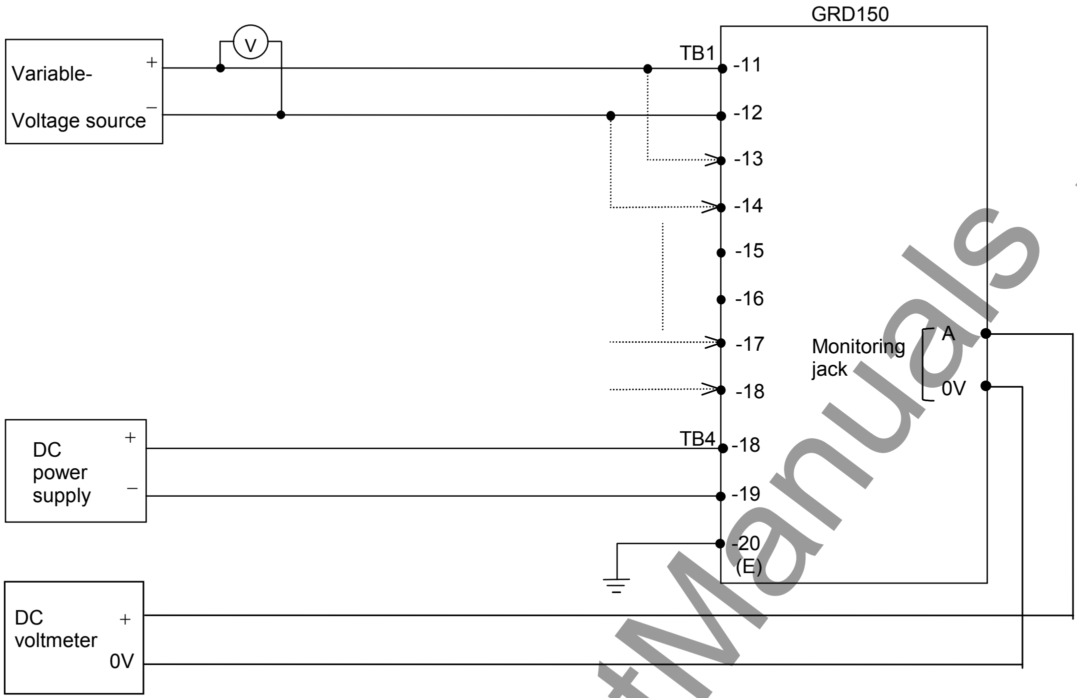
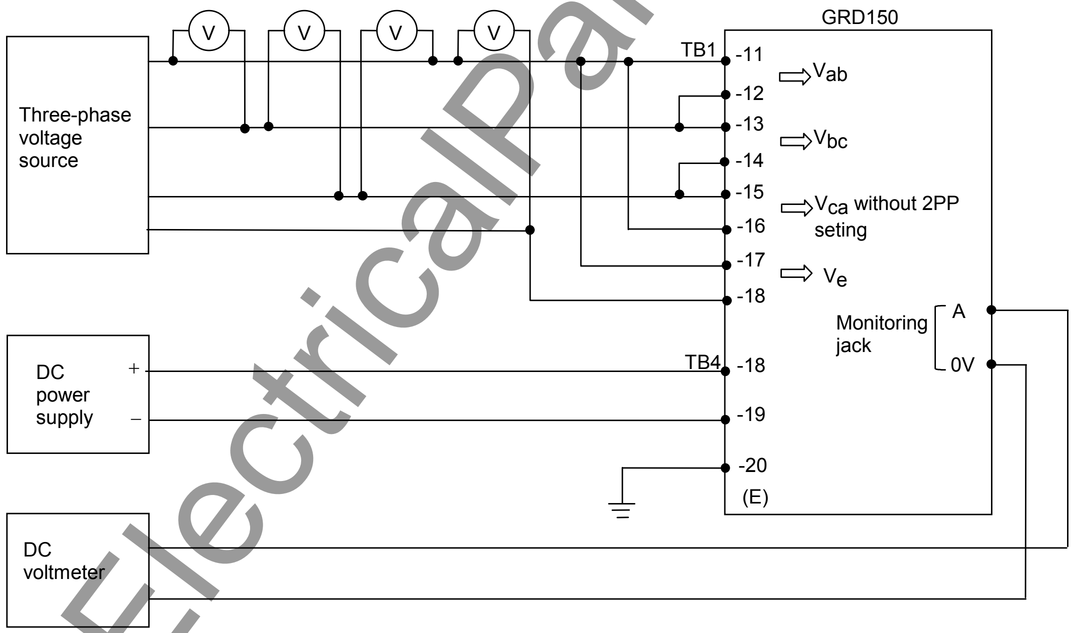
6.5.1.9 Overvoltage and Undervoltage Elements

The testing circuit is shown in Figure 6.5.10.



(a) For [APPL-VT]=3PN and 3PV setting



(b) For [APPL-VT]=3PP and 2PP setting

Figure 6.5.10 Operating Value Test Circuit

The output signal of testing element is assigned to the monitoring jack A.

Overvoltage and undervoltage elements and their output signal number are listed below.

Measuring element	Signal number
OV1D-1	196
OV2D-1	200

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UV1D-1	204
UV2D-1	208
ZOV1D	228
ZOV2D	229
OV1I-1	212
UV1I-1	220
ZOV1I	244

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.

Operating Value Test

Overvoltage element OV1D, OV2D, ZOV1D, ZOV2D

- Apply a rated voltage as shown in Figure 6.5.10.
- Increase the voltage and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

Undervoltage element UV1D, UV2D

- Apply a rated voltage and frequency as shown Figure 6.5.10.
- Decrease the voltage and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

Operating Time Check For Inverse Time (IDMT) Curve, OV1I, UV1I, ZOV1I

- Change the voltage from the rated voltage to the test voltage quickly and measure the operating time.
- Calculate the theoretical operating time using the characteristic equations shown in Section 2.2.1 and 2.2.2. Check the measured operating time.

6.5.1.10 Negative sequence overvoltage element NOV1 and NOV2

The testing circuit is shown in Figure 6.5.11.

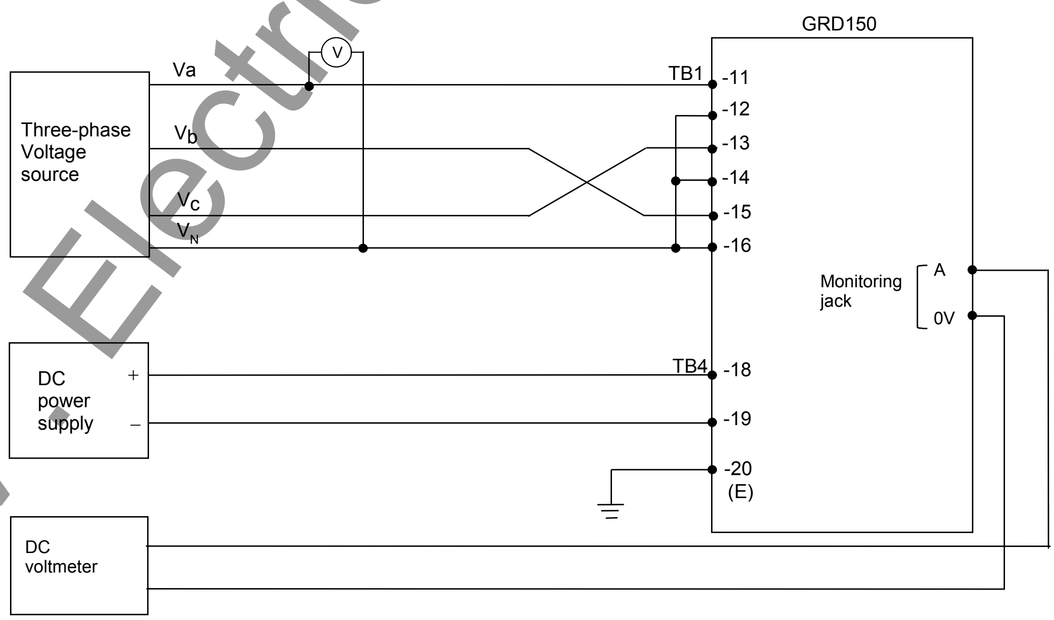

Figure 6.5.11 Testing NOV elements

The output signal of testing element is assigned to the monitoring jack A.

The output signal numbers of the elements are as follows:

Element	Signal No.
NOV1D	232
NOV2D	233

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply the three-phase balance voltage and the operating voltage value is checked by increasing the magnitude of the voltage applied.

Check that the measured value is within 5% of the setting value.

Operating Time Check For Inverse Time (IDMT) Curve, NOV1I

- Change the voltage from the rated voltage to the test voltage quickly and measure the operating time.
- Calculate the theoretical operating time using the characteristic equations shown in Section 2.2.4. Check the measured operating time.

6.5.1.11 Frequency Elements

The testing circuit is shown in Figure 6.5.12.

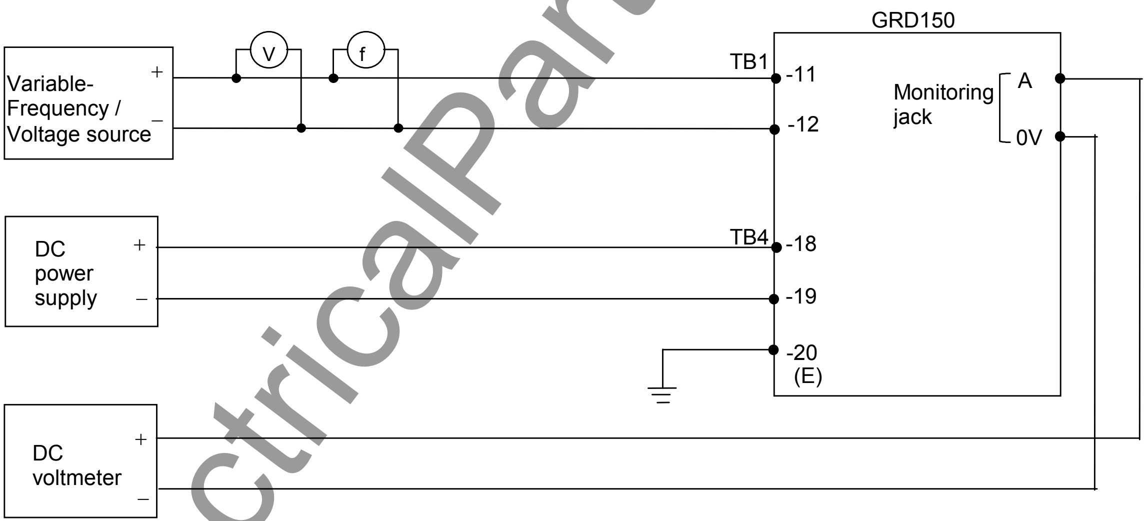

Figure 6.5.12 Operating Value Test Circuit

The output signal of testing element is assigned to the monitoring jack A.

Frequency elements and their output signal number are listed below.

Measuring element	Signal number
FRQ1	324
FRQ2	325
FRQ3	326
FRQ4	327
FRQ5	328
FRQ6	329
FRQBLK	331

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Overfrequency or underfrequency elements FRQ1 to FRQ6

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply a rated voltage and frequency as shown in Figure 6.5.12.

In case of overfrequency characteristic,

- Increase the frequency and measure the value at which the element operates. Check that the measured value is within ± 0.005Hz of the setting.

In case of underfrequency characteristics,

- Decrease the frequency and measure the value at which the element operates. Check that the measured value is within ± 0.005Hz of the setting.

Undervoltage block test, FRQBLK

- Apply a rated voltage and change the magnitude of frequency to operate an element.
- Keep the frequency that the element is operating, and change the magnitude of the voltage applied from the rated voltage to less than FRQBLK setting voltage. And then, check that the element resets.

6.5.1.12 Voltage and Synchronism Check Elements

The testing circuit is shown in Figure 6.5.13.

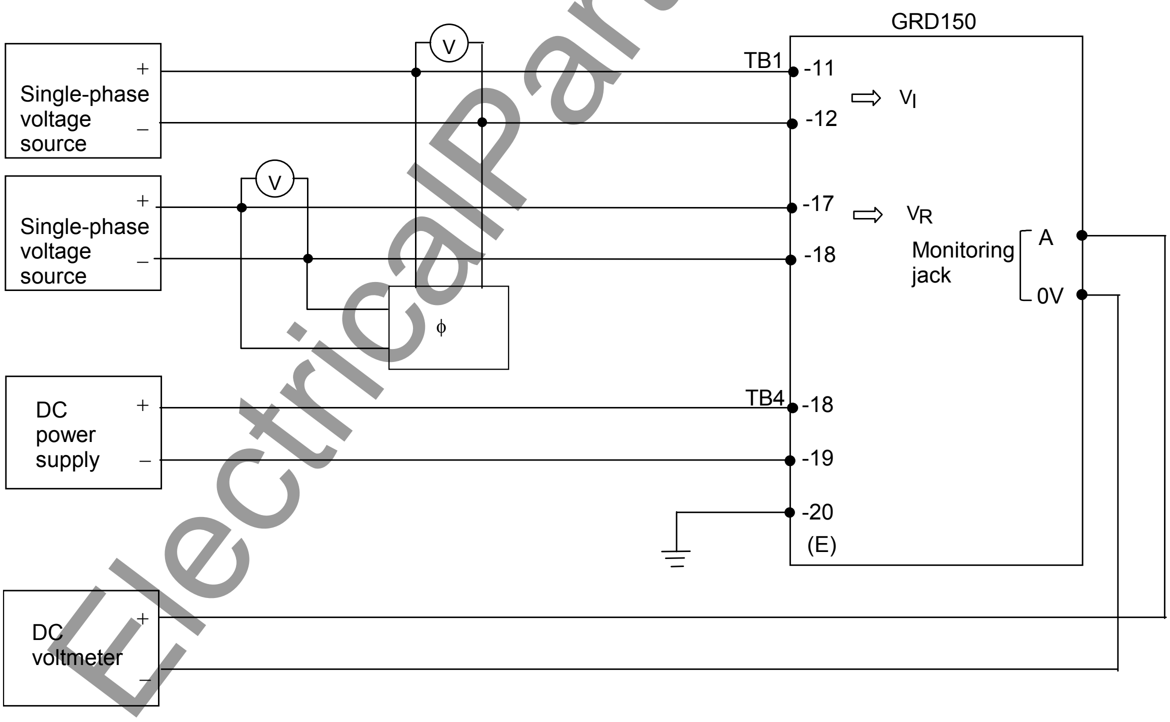

Figure 6.5.13 Voltage and Synchronism Check Element Test Circuit

The output signal of testing element is assigned to the monitoring jack A.

Voltage and synchronism check elements and their output signal number are listed below.

Measuring element	Signal number
OVR	280
UVR	278

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OVI	279
UVI	277
SYN	276

Voltage check element OVR, UVR, OVI and UVI

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply a rated voltage as shown in Figure 6.5.1.

OVR and UVR :

- Adjust the magnitude of the voltage applied and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

OVI and UVI :

- Adjust the magnitude of the voltage applied and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

Synchronism check element SYN

- Enter the signal number to observe the operation at the monitoring jack A as shown in Section 6.5.1.
- Apply rated voltages VR and VI as shown Figure 6.5.1.

Voltage check:

- Set the voltage to any value over the SYNOV setting. (The default setting of SYNOV is 51 V.)

  Whilst keeping V_I in-phase with V_R, increase the single-phase voltage V_I from zero volt. Measure the voltage at which the element operates. Check that the measured voltage is within ± 5% of the SYNUV setting.
- Further increase V_I and measure the voltage at that the element resets. Check that the measured voltage is within ±5% of the SYNOV setting.

Phase angle check:

- Set V_R and V_I to any value between the SYNOV and SYNUV settings keeping V_R in-phase with V_I. Then the SYN element operates.
- Shift the angle of V_I from that of V_R, and measure the angle at which the element resets.
- Check that the measured angle is within ±5% of the SYN θ setting. (The default setting of SYN θ is 30°.)
- Change V_R and V_I, and repeat the above.

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6.5.2 Protection Scheme

In the protection scheme tests, a dynamic test set is required to simulate power system pre-fault, fault and post-fault conditions.

Tripping is observed with the tripping command output relays.

Circuit Breaker failure tripping

- Set the scheme switch [BTC] to "ON" and [RTC] to "DIR" or "OC".
- Apply a fault, retain it and input an external trip signal. Check that the retrip output relays operate after the time setting of the TRTC and the adjacent breaker tripping output relay operates after the time setting of the TBTC.

6.5.3 Metering and Recording

The metering function can be checked while testing the AC input circuit. See Section 6.4.4.

Fault recording can be checked while testing the protection schemes. Open the "Fault record" screen and check that the descriptions are correct for the fault concerned.

Recording events are listed in Appendix C. There are internal events and external events by binary input commands. Event recording on the external event can be checked by changing the status of binary input command signals. Change the status in the same way as the binary input circuit test (see Section 6.4.2) and check that the description displayed on the "Event record" screen is correct. Some of the internal events can be checked in the protection scheme tests.

Disturbance recording can be checked while testing the protection schemes. The LCD display only shows the date and time when a disturbance is recorded. Open the "Disturbance record" screen and check that the descriptions are correct.

Details can be displayed on the PC. Check that the descriptions on the PC are correct. For details on how to obtain disturbance records on the PC, see the RSM100 Manual.

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6.6 Conjunctive Tests

6.6.1 On Load Test

To check the polarity of the current and voltage transformers, check the load current, system voltage and their phase angle with the metering displays on the LCD screen.

- Open the "Auto-supervision" screen check that no message appears.
- Open the following "Metering" screen from the "Status" sub-menu to check the above.

```
Status-Metering                       25/Feb/2003 09:45
Current                                              1/2
Va   ***.**kV -***.*°     Ia    ******A -***.*°
Vb   ***.**kV -***.*°     Ib    ******A -***.*°
Vc   ***.**kV -***.*°     Ic    ******A -***.*°
Ve   ***.**kV -***.*°     Ie    ******A -***.*°     (*1)
Vs   ***.**kV -***.*°     Ise   ****.*A -***.*°     (*2)(*3)
Vab  ***.**kV -***.*°     THM   ***.*%
Vbc  ***.**kV -***.*°
Vca  ***.**kV -***.*°     f/t   -**.**Hz/s
f    **.**Hz              PF    -*.***
P     -******kW           Q      -******kvar
Wh+    ******kWh          varh+   ******kvarh
Wh-    ******kWh          varh-   ******kvarh
```

```
Status-Metering                      25/Feb/2003 09:45
Current                                             2/2
V1  ***.**kV  -***.*°     I1   ******A  -***.*°
V2  ***.**kV  -***.*°     I2   ******A  -***.*°
V0  ***.**kV  -***.*°     I0   ******A  -***.*°
```

(∗1) : "Ise" is not displayed if the model is GRD150-100 or 300 series.
(∗2) : "Ise" is not displayed if the model is GRD150-100 or 300 series.
(∗3) : "Vs" is not displayed if the model is GRD150-100 or 200 series.

Note: The magnitude of current can be set in values on the primary side or on the secondary side by the setting. (The default setting is the secondary side.)

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6.6.2 Tripping, Reclosing and Control Circuit Test

The tripping circuit including the circuit breaker is checked by forcibly operating the output relay and monitoring the circuit breaker to confirm that it is tripped. Forcible operation of the output relay is performed on the "Binary O/P " screen of the "Test" sub-menu as described in Section 6.4.3.

Tripping circuit

- Set the breaker to be closed.
- Select "Binary O/P" on the "Test" sub-menu screen to display the "Binary O/P" screen.

```
Test-Binary O/P                 25/Feb/2003 09:45
                                              1/2
IO1                         IO2
TRP1:TB3 - 19, 20   ***     TRP1:TB5 - 19, 20   ***
TRP2:TB4 -  1,  2   ***     TRP2:TB6 -  1,  2   ***
BO1 :TB4 -  5,  6   ***     BO1 :TB6 -  5,  6   ***
BO2 :TB4 -  7,  8   ***     BO2 :TB6 -  7,  8   ***
BO3 :TB4 -  9, 10   ***     BO3 :TB6 -  9, 10   ***
BO4 :TB4 - 11, 12   ***     BO4 :TB6 - 11, 12   ***
BO5 :TB4 - 13, 14   ***     BO5 :TB6 - 13, 14   ***
28F :TB4 - 15, 17   ***     BO6 :TB6 - 15, 17   ***
```

TRP1 and TRP2 are output relays with one normally open contact.

- Enter "ENA" (Enable) for TRP1 and press the ENTER key to operate the output relay forcibly.
- After completing the entries, press the END key to display the following confirmation message on the bottom line.

```
Operate? Y=Pressing ENTER   N=CANCEL
```

- Keep pressing the ENTER (= Y) key to operate the assigned output relays. Check that the breaker is tripped.
- Release pressing the ENTER key to reset the operation.
- Press the CANCEL key to return to the upper "Test" screen.
- Repeat for TRP2 and other BOs.

Reclosing circuit

The test is applied to Model 200s and 400s with autoreclose function.

- Ensure that the circuit breaker is open.
- Select "Binary O/P" on the "Test" sub-menu screen to display the "Binary O/P" screen. The LCD displays the output modules mounted.
- Select the BO number which is an autoreclose command output relay with one normally open contact.

Note: The autoreclose command is assigned to any of the output relays by the user setting

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- Enter "ENA" (Enable) for the assigned BO and press the ENTER key to operate the output relay forcibly.
- After completing the entries, press the END key to display the following confirmation message on the bottom line.

```
Operate? Y=Pressing ENTER  N=CANCEL
```

- Keep pressing the ENTER (= Y) key to operate the assigned output relays. Check that the BO operates.
- Release pressing the ENTER key to reset the operation.
- Press the CANCEL key to return to the upper "Test" screen.

Control circuit

The control function is checked by MIMIC operation.

- Enter "Test" on the "Test-switch" screen not to disturb other GRD150s or bay control units.
- Open the "MIMIC" view screen and set the local control mode by L/R key. Select a device (e.g. CB, DS, etc.) and open (press ○ key) or close (pres | key) the device. Check the device is open or close, or the assigned BO operates. See Section 4.1.1 and 4.2.3.

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6.7 Maintenance

6.7.1 Regular Testing

The relay is almost completely self-supervised. The circuits that can not be supervised are binary input and output circuits and human interfaces.

Therefore, regular testing is minimised to checking the unsupervised circuits. The test procedures are the same as described in Sections 6.4.1, 6.4.2 and 6.4.3.

6.7.2 Failure Tracing and Repair

Failures will be detected by automatic supervision or regular testing.

When a failure is detected by supervision, a remote alarm is issued with the binary output relay of FAIL and the failure is indicated on the front panel with LED indicators or LCD display. It is also recorded in the alarm record.

Failures detected by supervision are traced by checking the message on the LCD “Alarm record” screen. Table 6.7.1 shows LCD messages and failure locations.

This table shows the relationship between message displayed on the LCD and estimated failure location. The location marked with (1) has a higher probability than the location marked with (2).

As shown in the table, some of the messages cannot identify the fault location definitely but suggest plural possible failure locations. In these cases, the failure location is identified by replacing the suggested failed modules with spare modules one by one or investigating and restoring the monitored external circuits (that is CT, VT circuit, communication circuit and isolator circuit) until the "ALARM" LED is turned off.

The replacement or investigation should be performed first for the module or circuit with higher probability in the table.

If there is a failure and the LCD is not working such as a screen is frozen or not displayed, the failure location is any one of SPMM and HMI module.

If no message is shown on the LCD, this means that the failure location is either in the DC power supply circuit or in the microprocessors mounted on the SPMM module. Then check the "ALARM" LED. If it is off, the failure is in the DC power supply circuit. In this case, check if the correct DC voltage and polarity is applied to the relay and if the DC supply is connected to the correct terminals.

If so, replace the IO1 module mounting the DC/DC converter and confirm that the "ALARM" LED is turned off.

In the latter case, replace the SPMM module mounting the processors and confirm that the "ALARM" LED is turned off.

When a failure is detected during regular testing, it will not be difficult to identify the failed module.

◆ Note: When a failure or an abnormality is detected during the regular test, confirm the following first:
- Test circuit connections are correct.
- Modules are securely inserted in position.
- Correct DC power voltage is applied.
- Correct AC inputs are applied.
- Test procedures comply with those stated in the manual.

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Table 6.7.1 LCD Message and Failure Location

Message	Failure location									
	VCT	SPMM	IO1	IO2	IO3	IO4	HMI	AC cable (CT, VT)	External trip circuit	CB
SUM err		X								
SRAM err		X								
BU-RAM err		X								
EEPROM err		X								
ROM data err		X								
A/D err		X								
DC err			X							
CT err	X	X						X		
V0 err	X	X						X		
V2 err	X	X						X		
TC1 fail			X						X	
TC2 fail			X						X	
TC3 fail				X					X	
TC4 fail				X					X	
TC5 fail					X				X	
TC6 fail					X				X	
TC7 fail						X			X	
TC8 fail						X			X	
PANEL err							X			
DIO1 err			X							X
DIO2 err				X						X
DIO3 err					X					X
DIO4 err						X				X
CTF ALARM	X							X		
VTF1 ALARM	X							X		
VTF2 ALARM	X							X		
CB err										X
No-working of LCD		X					X			

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6.7.3 Replacing Failed Relay Unit

If the failure is identified to be in the relay unit and the user has a spare relay unit, the user can recover the protection by replacing the failed relay unit.

Repair at the site should be limited to relay unit replacement. Maintenance at the component level is not recommended.

Check that the replacement relay unit has an identical Model Number and relay version (software type form) as the removed relay.

The Model Number is indicated on the front of the relay. For the relay version, see Section 4.2.5.5.

Replacing the relay unit

CAUTION After replacing the relay unit, check the settings.

The procedure of relay withdrawal and insertion is as follows:

- Switch off the DC power supply.

  ⚠ WARNING Hazardous voltage may remain in the DC circuit just after switching off the DC power supply. It takes about 30 seconds for the voltage to discharge.

- Disconnect the trip outputs, BI, BO, communication circuits, etc.
- Short-circuit all AC current inputs. Open all AC voltage inputs.
- Unscrew the relay front cover.
- Unscrew the binding screw on the panel.
- To remove the relay unit.
- Install the (spare) relay unit in the reverse procedure.

6.7.4 Resumption of Service

After replacing the failed relay unit or repairing failed external circuits, take the following procedures to restore the relay to the service.

- Switch on the DC power supply and confirm that the "RUN" green LED is lit and the "ALARM" red LED is not lit.
- Supply the AC inputs and reconnect the trip outputs, other circuits.

6.7.5 Storage

The spare relay should be stored in a dry and clean room. Based on IEC Standard 60255-6 the storage temperature should be –25°C to +70°C, but the temperature of 0°C to +40°C is recommended for long-term storage.

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7. Putting Relay into Service

The following procedure must be adhered to when putting the relay into service after finishing the commissioning tests or maintenance tests.

- Check that all the external connections are correct.
- Check the settings of all measuring elements, timers, scheme switches, recordings and clock are correct.

  In particular, when settings are changed temporarily for testing, be sure to restore them.
- Clear any unnecessary records on faults, alarms, events, disturbances and counters which are recorded during the tests.
- Press the VIEW key and check that no failure message is displayed on the "Alarm view" screen.
- Check that the green "IN SERVICE" LED is lit and no other LEDs are lit on the front panel.

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Appendix A

Programmable Reset Characteristics and Implementation of Thermal Model to IEC60255-8

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Programmable Reset Characteristics

The overcurrent stages for phase and earth faults, OC1 and EF1, each have a programmable reset feature. Resetting may be instantaneous, definite time delayed, or, in the case of IEEE/US curves, inverse time delayed.

Instantaneous resetting is normally applied in multi-shot auto-reclosing schemes, to ensure correct grading between relays at various points in the scheme. On the other hand, the inverse reset characteristic is particularly useful to provide correct co-ordination with an upstream induction disc type overcurrent relay.

The definite time delayed reset characteristic may be used to provide faster clearance of intermittent ('pecking' or 'flashing') fault conditions. An example of where such phenomena may be experienced is in plastic insulated cables, where the fault energy melts the cable insulation and temporarily extinguishes the fault, after which the insulation again breaks down and the process repeats.

An inverse time overcurrent protection with instantaneous resetting cannot detect this condition until the fault becomes permanent, thereby allowing a succession of such breakdowns to occur, with associated damage to plant and danger to personnel. If a definite time reset delay of, for example, 60 seconds is applied, on the other hand, the inverse time element does not reset immediately after each successive fault occurrence. Instead, with each new fault inception, it continues to integrate from the point reached during the previous breakdown, and therefore operates before the condition becomes permanent. Figure A-1 illustrates this theory.

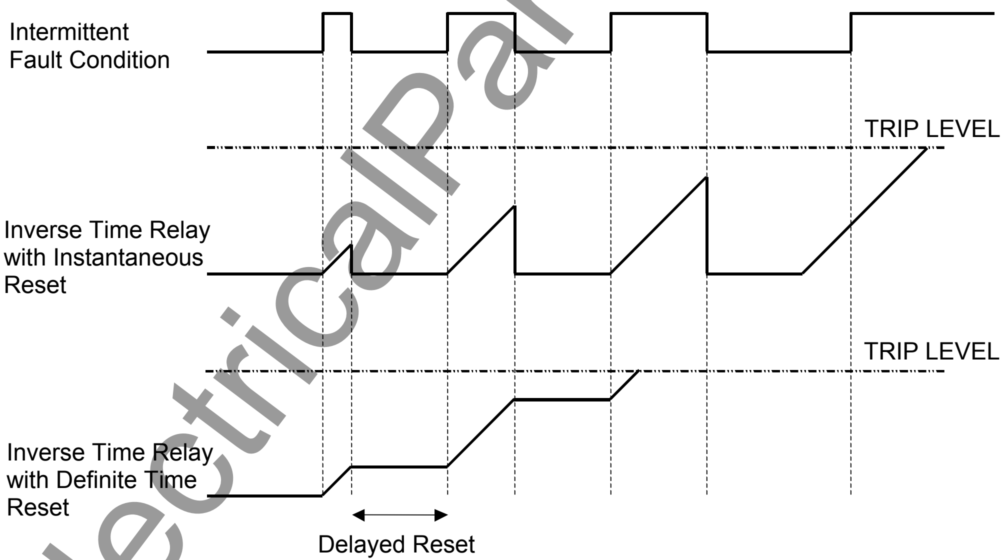

Figure A-1

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Implementation of Thermal Model to IEC60255-8

Heating by overload current and cooling by dissipation of an electrical system follow exponential time constants. The thermal characteristics of the electrical system can be shown by equation (1).

$$\theta = \frac{I^2}{I_{AOL}^2}\left(1 - e^{-t/\tau}\right) \times 100\% \qquad (1)$$

where:

θ = thermal state of the system as a percentage of allowable thermal capacity,

I = applied load current,

I_{AOL} = allowable overload current of the system,

τ = thermal time constant of the system.

The thermal state θ is expressed as a percentage of the thermal capacity of the protected system, where 0% represents the cold state and 100% represents the thermal limit, that is the point at which no further temperature rise can be safely tolerated and the system should be disconnected. The thermal limit for any given electrical plant is fixed by the thermal setting I_{AOL}. The relay gives a trip output when θ = 100%.

If current I is applied to a cold system, then θ will rise exponentially from 0% to ($I^2/I_{AOL}^2 \times 100\%$), with time constant τ, as in Figure A-2. If θ = 100%, then the allowable thermal capacity of the system has been reached.

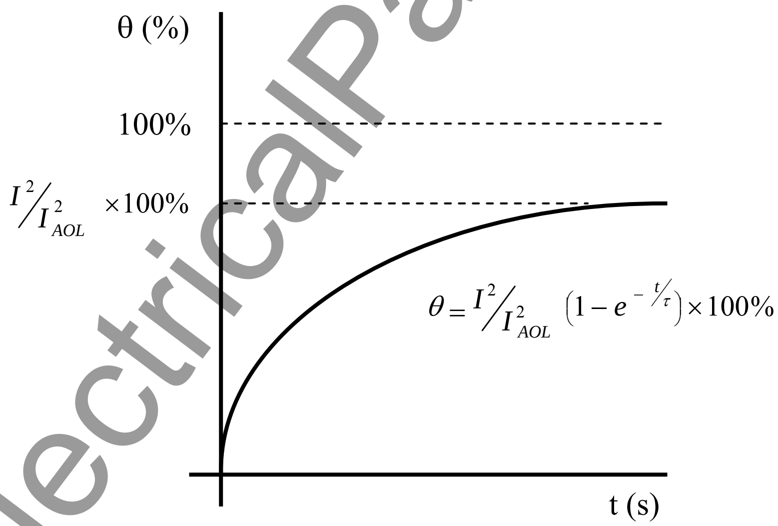

Figure A-2

A thermal overload protection relay can be designed to model this function, giving tripping times according to the IEC60255-8 'Hot' and 'Cold' curves.

$$t = \tau \cdot Ln\left[\frac{I^2}{I^2 - I_{AOL}^2}\right] \qquad (1) \quad \cdots\cdots \text{Cold curve}$$

$$t = \tau \cdot Ln\left[\frac{I^2 - I_P{}^2}{I^2 - I_{AOL}^2}\right] \qquad (2) \quad \cdots\cdots \text{Hot curve}$$

where:

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I_P = prior load current.

In fact, the cold curve is simply a special case of the hot curve where prior load current $I_P = 0$, catering for the situation where a cold system is switched on to an immediate overload.

Figure A-3 shows a typical thermal profile for a system which initially carries normal load current, and is then subjected to an overload condition until a trip results, before finally cooling to ambient temperature.

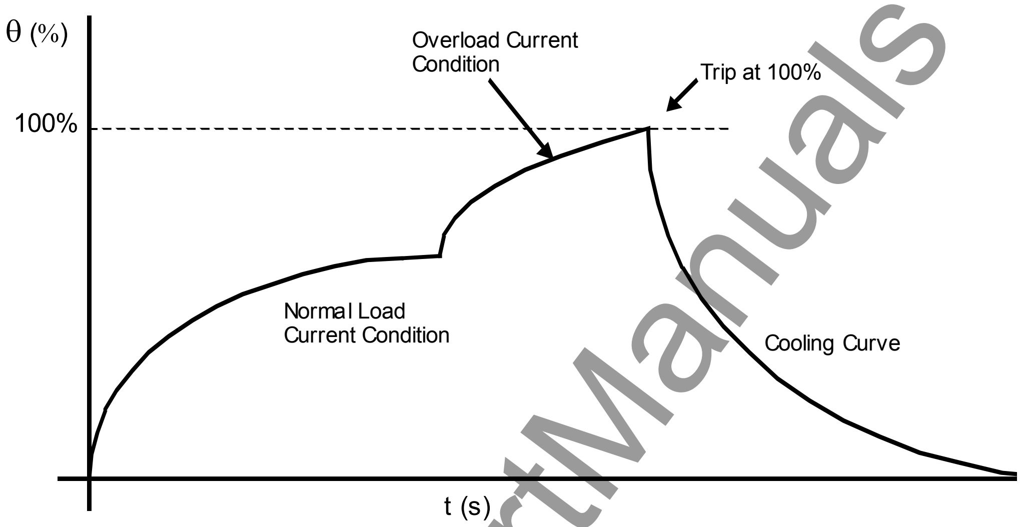

Figure A-3

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Appendix B

Directional Earth Fault Protection and Power System Earthing

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Directional Earth Fault Protection and Power System Earthing

Power systems may be solidly earthed, impedance earthed or unearthed (insulated). Depending on the method used, faults to earth have widely differing characteristics, and so methods of earth fault protection differ greatly between the various types of system.

1. Solidly earthed systems

In a solidly earthed system the neutral points of the power transformers are connected directly to earth, for the purposes of reducing overvoltages and facilitating fault detection. The disadvantage of solid earthing is that fault currents can be very high, and must be disconnected quickly.

Since the impedance of the source is normally very low, fault current varies greatly in magnitude depending on the location of the fault. Selective isolation of a faulty section is therefore possible via time/current graded earth fault overcurrent protection. Fault current is detected by measuring the system residual current.

On an interconnected system, where fault current can flow in either direction, then directional earth fault relays are applied. The fault causes a residual voltage to be generated, and this can be used for directional polarization. Residual current and voltage can be measured as shown in Figure B1.

Residual current I_R is equal in magnitude and direction to the fault current. It typically lags the faulted phase voltage by a considerable angle due to the reactance of the source. Directional control is achieved by polarising against the system residual voltage, which may be found either by summating the phase voltages, or it may be extracted from the open delta connected secondary (or tertiary) winding of a five limb VT, as shown in the diagram.

A directional earth fault relay protecting a solidly earthed system is normally connected to measure V_R inverted. If GRD150 is applied to derive residual voltage from the phase voltages then the inversion of V_R is performed internally.

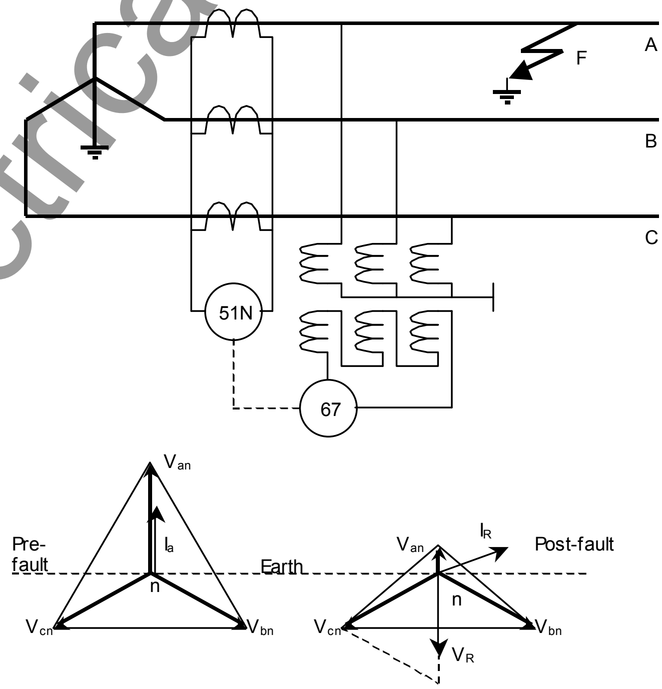

Figure B1 - Directional Earth Fault Protection for Solidly Earthed Systems

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The relay characteristic angle setting is applied to compensate for lag of the fault current. Generally accepted angle settings are -45° for solidly earthed distribution systems and -60° for transmission systems.

Due to system imbalances and measuring tolerances, small levels of residual voltage can be present during normal operating conditions. Therefore, GRD150 provides a voltage threshold which must be exceeded before the directional protection will operate. Although this threshold is user programmable, most applications will be satisfied by the default setting of 3V.

2. Unearthed (insulated) systems

An insulated system has no intentional connection to earth, although all systems are in fact earthed by natural capacitive coupling. Fault current is very low, being made up of capacitive charging currents, thus limiting damage to plant. However, high steady-state and transient overvoltages are produced, and selective isolation of faults is difficult.

An earth fault on an ungrounded system causes a voltage shift between the neutral point and earth, and the fault can be detected by measuring this shift. So called neutral voltage displacement protection is commonly applied but, unfortunately, the shift in voltage is essentially the same throughout the system and so this method cannot selectively isolate a faulted section.

The method of directional earth fault protection described previously for solidly earthed systems cannot be used in the case of insulated systems because of the absence of real fault current. However, an alternative method can be applied, using GRD150 directional sensitive earth fault protection. The relay must be connected using a core balance CT, to measure the flow of capacitive charging currents, which become unbalanced in the event of a fault.

A phase to earth fault effectively short circuits that phase's capacitance to earth for the whole system, thus creating an unbalance in the charging currents for all feeders connected to the system. The resulting fault current is made up of the sum of the combined residual charging currents for both the faulty and healthy feeders.

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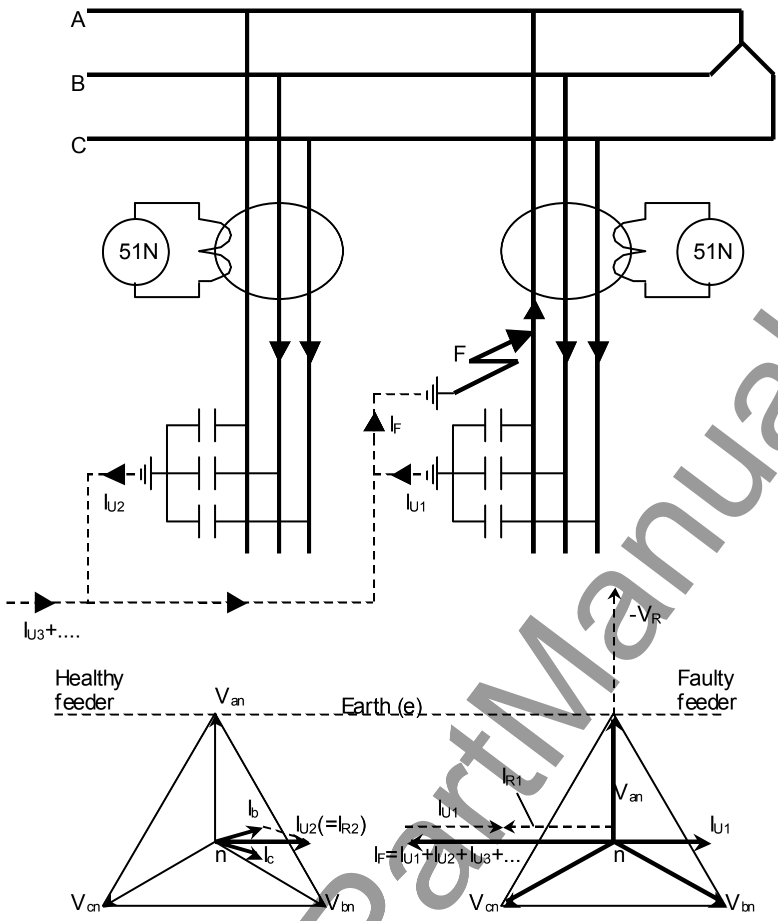

Figure B2 - Residual Current Flow in an Unearthed System

It can be shown that the residual current measured in the faulty feeder is 180° out of phase with that in the healthy feeder, as illustrated in Figure B2 This fact can be used to apply a GRD150 directional sensitive earth fault relay. The polarising voltage used for directional earth fault relays is normally $-V_R$ (the residual voltage inverted), and it can be seen that the residual current (I_{R1}) for the faulty feeder leads this voltage by 90°. For the healthy feeders the residual current lags the voltage by 90°. Therefore, the GRD150 sensitive earth fault protection should be applied with a characteristic angle of +90° so as to provide discriminatory protection.

The residual current in the faulted phase is equal to three times the per phase charging current, and the sensitive earth fault element should be set well below this value to ensure operation (30% of this value is typical).

3. Impedance earthing

In between the two extremes of solidly earthed and unearthed systems there are a variety of compromise solutions, which normally involve connecting the system neutrals to earth via a resistance or reactance.

3a. Resistance earthing

In the case of resistance earthed systems, GRD150 directional earth fault relays can normally be applied in a similar manner to that for solidly earthed systems, with the exceptions that current settings will be lower and the characteristic angle setting will probably be different. In the event of a fault, it is the resistance in the neutral which predominates in the source impedance, and so

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the residual current lags its polarising voltage by a much smaller angle. Characteristic angle settings of -15° or 0° are common.

3b. Reactance earthing

Reactance earthed systems are also common in many countries. A special case of this method is known as Petersen coil, or resonant, earthing. The inductance in the neutral is chosen to cancel the total capacitance of the system so that no current flows into an earth fault.

Directional sensitive earth fault protection can again be applied by detecting the unbalance in charging currents. It can be shown that the residual current distribution for healthy and faulty feeders is as illustrated in Figure B3.

In the case of the healthy feeder, the residual current lags the polarising voltage (-VR) by more than 90°, while for the faulty feeder, the angle is less than 90°. GRD150 directional sensitive earth fault protection can be applied, with a 0° characteristic angle. Note that the SEF boundary of directional operation should be set to ±90°. The residual current for the healthy feeder then falls in the restraint zone, while for the faulty feeder it lies in the operate zone, thus providing selective isolation of the fault.

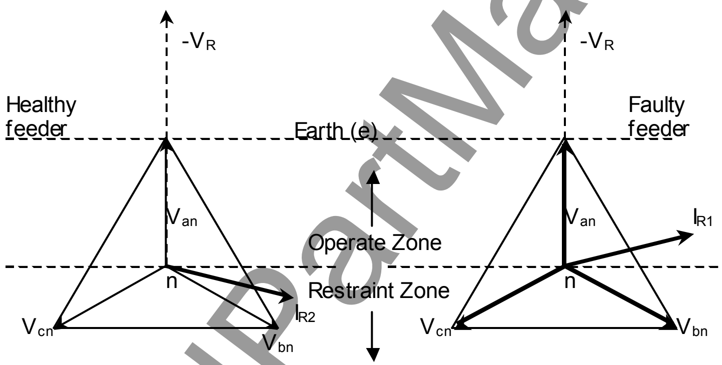

Figure B3 - Residual Current Flow in a Resonant Earthed System

3c. Reactance Earthing and Residual Power Control

GRD150 can provide an additional restraint on operation by the (optional) residual power control feature. The active component of residual power can be calculated as follows:

$$\Re(P_R) = I_R \times V_R \times \cos\phi$$

where ϕ is the phase angle between the residual current (I_R) and the polarising voltage ($-V_R$).

It is clear from Figure B3 that this value will be positive when measured at the faulty feeder and negative anywhere else. GRD150 directional sensitive earth fault protection can be applied with a power threshold such that operation is permitted when residual power exceeds the setting and is in the operate direction.

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Appendix C

Signal List

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Signal list (PLC input)

	No.	Record item / Common	Contents
	0	dummy 0	constant 0
	1	dummy 1	constant 1
	2		
	3		
Output Signal	4	OC1D-A	Relay element output signal
from	5	OC1D-B	ditto
Protection	6	OC1D-C	ditto
and	7		
Autoreclose	8	OC2D-A	ditto
↓	9	OC2D-B	ditto
	10	OC2D-C	ditto
	11		
	12	OC3D-A	ditto
	13	OC3D-B	ditto
	14	OC3D-C	ditto
	15		
	16	OC4D-A	ditto
	17	OC4D-B	ditto
	18	OC4D-C	ditto
	19		
	20	OC1I-A	ditto
	21	OC1I-B	ditto
	22	OC1I-C	ditto
	23		
	24	OC2I-A	ditto
	25	OC2I-B	ditto
	26	OC2I-C	ditto
	27		
	28	ICD-A	ditto
	29	ICD-B	ditto
	30	ICD-C	ditto
	31		
	32	ICLDO-A	ditto
	33	ICLDO-B	ditto
	34	ICLDO-C	ditto
	35		
	36	DOC1F-A	ditto
	37	DOC1F-B	ditto
	38	DOC1F-C	ditto
	39		
	40	DOC2F-A	ditto
	41	DOC2F-B	ditto
	42	DOC2F-C	ditto
	43		
	44	DOC3F-A	ditto
	45	DOC3F-B	ditto
	46	DOC3F-C	ditto
	47		
	48	DOC4F-A	ditto
	49	DOC4F-B	ditto
	50	DOC4F-C	ditto
	51		
	52	DOC1R-A	ditto
	53	DOC1R-B	ditto
	54	DOC1R-C	ditto
	55		
	56	DOC2R-A	ditto
	57	DOC2R-B	ditto
	58	DOC2R-C	ditto
	59		
	60	DOC3R-A	ditto
	61	DOC3R-B	ditto
	62	DOC3R-C	ditto
	63		
	64	DOC4R-A	ditto
	65	DOC4R-B	ditto
	66	DOC4R-C	ditto
	67		
	68	DOC1I-A	ditto
	69	DOC1I-B	ditto
	70	DOC1I-C	ditto
	71		
	72	DOC2I-A	ditto
	73	DOC2I-B	ditto
	74	DOC2I-C	ditto
	75		
	76	OCHS-A	ditto
	77	OCHS-B	ditto
	78	OCHS-C	ditto
	79		
	80	EFHS	ditto

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Signal list (PLC input)

No.	Record item Common	Contents
81	SEFHS	ditto
82		
83		
84	DEF1I	ditto
85	DEF2I	ditto
86		
87		
88	DSEF1I	ditto
89	DSEF2I	ditto
90		
91		
92	DNOC1I	ditto
93		
94		
95		
96		
97		
98		
99		
100	EF1D	ditto
101	EF2D	ditto
102	EF3D	ditto
103	EF4D	ditto
104	SEF1D	ditto
105	SEF2D	ditto
106	SEF3D	ditto
107	SEF4D	ditto
108	NOC1D	ditto
109	NOC2D	ditto
110		
111		
112	CBF-A	ditto
113	CBF-B	ditto
114	CBF-C	ditto
115		
116	EF1I	ditto
117	EF2I	ditto
118		
119		
120	SEF1I	ditto
121	SEF2I	ditto
122		
123		
124	NOC1I	ditto
125		
126		
127		
128		
129		
130	BCD	ditto
131		
132	DEF1F	ditto
133	DEF2F	ditto
134	DEF3F	ditto
135	DEF4F	ditto
136	DSEF1F	ditto
137	DSEF2F	ditto
138	DSEF3F	ditto
139	DSEF4F	ditto
140	DNOC1F	ditto
141	DNOC2F	ditto
142		
143		
144		
145		
146		
147	RPF	ditto
148	DEF1R	ditto
149	DEF2R	ditto
150	DEF3R	ditto
151	DEF4R	ditto
152	DSEF1R	ditto
153	DSEF2R	ditto
154	DSEF3R	ditto
155	DSEF4R	ditto
156	DNOC1R	ditto
157	DNOC2R	ditto
158		
159		
160		

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Signal list (PLC input)

No.	Record item Common	Contents
161		
162		
163	RPR	ditto
164	UC1-A	ditto
165	UC1-B	ditto
166	UC1-C	ditto
167		
168	UC2-A	ditto
169	UC2-B	ditto
170	UC2-C	ditto
171		
172	PHMAX-A	
173	PHMAX-B	
174	PHMAX-C	
175		
176	THM-T	ditto
177	THM-A	ditto
178		
179		
180	UC1-A_OCFLG	ditto
181	UC1-B_OCFLG	ditto
182	UC1-C_OCFLG	ditto
183		
184	UC2-A_OCFLG	ditto
185	UC2-B_OCFLG	ditto
186	UC2-C_OCFLG	ditto
187		
188	UC-A_UCFLG	ditto
189	UC-B_UCFLG	ditto
190	UC-C_UCFLG	ditto
191		
192		
193		
194		
195		
196	OV1D-1	ditto
197	OV1D-2	ditto
198	OV1D-3	ditto
199		
200	OV2D-1	ditto
201	OV2D-2	ditto
202	OV2D-3	ditto
203		
204	UV1D-1	ditto
205	UV1D-2	ditto
206	UV1D-3	ditto
207		
208	UV2D-1	ditto
209	UV2D-2	ditto
210	UV2D-3	ditto
211		
212	OV1I-1	ditto
213	OV1I-2	ditto
214	OV1I-3	ditto
215		
216		
217		
218		
219		
220	UV1I-1	ditto
221	UV1I-2	ditto
222	UV1I-3	ditto
223		
224	UVBLK-1	ditto
225	UVBLK-2	ditto
226	UVBLK-3	ditto
227		
228	ZOV1D	ditto
229	ZOV2D	ditto
230		
231		
232	NOV1D	ditto
233	NOV2D	ditto
234		
235		
236		
237		
238		
239		
240		

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Signal list (PLC input)

No.	Record item Common	Contents
241		
242		
243		
244	ZOV1I	ditto
245		
246		
247		
248	NOV1I	ditto
249		
250		
251		
252		
253		
254		
255		
256		
257		
258		
259		
260	OC-A_COORD	ditto
261	OC-B_COORD	ditto
262	OC-C_COORD	ditto
263	EF_COORD	ditto
264	SEF_COORD	ditto
265		
266		
267		
268		
269		
270		
271		
272		
273		
274		
275	PLUS_FLG	
276	SYN	ditto
277	UVIV	ditto
278	UVRV	ditto
279	OVIV	ditto
280	OVRV	ditto
281		
282		
283		
284	Delta_V	ditto
285	Delta_Deg	ditto
286	Delta_f	ditto
287		
288	UVCUT	
289		
290		
291		
292	UVVF-1	ditto
293	UVVF-2	ditto
294	UVVF-3	ditto
295	ZOVVF	ditto
296	OCDVF-A	ditto
297	OCDVF-B	ditto
298	OCDVF-C	ditto
299	EFVF	ditto
300	EFCF	ditto
301	ZOVCF	ditto
302		
303		
304		
305		
306		
307		
308	OCALM-A	ditto
309	OCALM-B	ditto
310	OCALM-C	ditto
311		
312		
313		
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315		
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320		

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Signal list (PLC input)

No.	Record item Common	Contents
321		
322		
323		
324	FRQ1	ditto
325	FRQ2	ditto
326	FRQ3	ditto
327	FRQ4	ditto
328	FRQ5	ditto
329	FRQ6	ditto
330		
331	FRQBLK	ditto
332	DFRQ1	ditto
333	DFRQ2	ditto
334	DFRQ3	ditto
335	DFRQ4	ditto
336	DFRQ5	ditto
337	DFRQ6	ditto
338		
339		
340		
341		
342		
343		
344		
345		
346		
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348		
349		
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351		
352		
353		
354		
355		
356	DR_OC-A	Relay element output signal for D.record initiation
357	DR_OC-B	ditto
358	DR_OC-C	ditto
359	DR_OC-OR	ditto
360		
361		
362		
363		
364	DR_EF	ditto
365	DR_SEF	ditto
366	DR_NOC	ditto
367		
368	DR_OV-1	ditto
369	DR_OV-2	ditto
370	DR_OV-3	ditto
371	DR_OV-OR	ditto
372	DR_UV-1	ditto
373	DR_UV-2	ditto
374	DR_UV-3	ditto
375	DR_UV-OR	ditto
376	DR_ZOV	ditto
377		
378	DR_NOV	ditto
379		
380		
381		
382		
383		
384		
385	OC1_TRIP	OC1 trip command
386	OC1-A_TRIP	ditto (Phase A)
387	OC1-B_TRIP	B
388	OC1-C_TRIP	C
389	OC2_TRIP	OC2 trip command
390	OC2-A_TRIP	ditto (Phase A)
391	OC2-B_TRIP	B
392	OC2-C_TRIP	C
393	OC3_TRIP	OC3 trip command
394	OC3-A_TRIP	ditto (Phase A)
395	OC3-B_TRIP	B
396	OC3-C_TRIP	C
397	OC4_ALARM	OC4 alarm command
398	OC4-A_ALARM	ditto (Phase A)
399	OC4-B_ALARM	B
400	OC4-C_ALARM	C

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Signal list (PLC input)

No.	Record item Common	Contents
401	DOC1 TRIP	DOC1 trip command
402	DOC1-A TRIP	ditto (Phase A)
403	DOC1-B TRIP	B
404	DOC1-C TRIP	C
405	DOC2 TRIP	DOC2 trip command
406	DOC2-A TRIP	ditto (Phase A)
407	DOC2-B TRIP	B
408	DOC2-C TRIP	C
409	DOC3 TRIP	DOC3 trip command
410	DOC3-A TRIP	ditto (Phase A)
411	DOC3-B TRIP	B
412	DOC3-C TRIP	C
413	DOC4 ALARM	DOC4 alarm command
414	DOC4-A ALARM	ditto (Phase A)
415	DOC4-B ALARM	B
416	DOC4-C ALARM	C
417	EF1 TRIP	EF1 trip command
418	EF2 TRIP	2
419	EF3 TRIP	3
420	EF4 ALARM	4 alarm command
421	DEF1 TRIP	DEF1 trip command
422	DEF2 TRIP	2
423	DEF3 TRIP	3
424	DEF4 ALARM	4 alarm command
425	SEF1 TRIP	SEF1 trip command
426	SEF1-S2 TRIP	SEF1 stage2 trip command
427	SEF2 TRIP	2 trip command
428	SEF3 TRIP	3
429	SEF4 ALARM	4 alarm command
430	DSEF1 TRIP	DSEF1 trip command
431	DSEF1-S2 TRIP	DSEF1 stage2 trip command
432	DSEF2 TRIP	2 trip command
433	DSEF3 TRIP	3
434	DSEF4 ALARM	4 alarm command
435	NOC1 TRIP	NOC1 trip command
436	NOC2 ALARM	2 alarm command
437	DNOC1 TRIP	DNOC1 trip command
438	DNOC2 ALARM	2 alarm command
439	UC1 TRIP	UC1 trip command
440	UC1-A TRIP	ditto (Phase A)
441	UC1-B TRIP	B
442	UC1-C TRIP	C
443	UC2 ALARM	UC2 alarm command
444	UC2-A ALARM	ditto (Phase A)
445	UC2-B ALARM	B
446	UC2-C ALARM	C
447	THM ALARM	Thermal Overload alarm command
448	THM TRIP	trip command
449	BCD TRIP	Bloken Conductor trip command
450	CBF RETRIP	CBF retrip command
451	CBF-A RETRIP	ditto (Phase A)
452	CBF-B RETRIP	B
453	CBF-C RETRIP	C
454	CBF TRIP	CBF back trip command
455	CBF-A TRIP	ditto (Phase A)
456	CBF-B TRIP	B
457	CBF-C TRIP	C
458	OV1 TRIP	OV1 trip command
459	OV1-1 TRIP	ditto (Phase A / AB)
460	OV1-2 TRIP	B / BC
461	OV1-3 TRIP	C / CA
462	OV2 ALARM	OV2 alarm command
463	OV2-1 ALARM	ditto (Phase A / AB)
464	OV2-2 ALARM	B / BC
465	OV2-3 ALARM	C / CA
466	UV1 TRIP	UV1 trip command
467	UV1-1 TRIP	ditto (Phase A / AB)
468	UV1-2 TRIP	B / BC
469	UV1-3 TRIP	C / CA
470	UV2 ALARM	UV2 alarm command
471	UV2-1 ALARM	ditto (Phase A / AB)
472	UV2-2 ALARM	B / BC
473	UV2-3 ALARM	C / CA
474	ZOV1 TRIP	ZOV1 trip command
475	ZOV2 ALARM	2 alarm command
476	NOV1 TRIP	NOV1 trip command
477	NOV2 ALARM	2 alarm command
478	FRQ TRIP	FRQ trip command
479	FRQ1 TRIP	FRQ1 trip command
480	FRQ2 TRIP	2

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Signal list (PLC input)

No.	Record item Common	Contents
481	FRQ3 TRIP	3
482	FRQ4 TRIP	4
483	FRQ5 TRIP	5
484	FRQ6 TRIP	6
485	GEN.TRIP	General trip command
486	GEN.TRIP-A	ditto (Phase A)
487	GEN.TRIP-B	B
488	GEN.TRIP-C	C
489	GEN.TRIP-AB	ditto (Phase AB)
490	GEN.TRIP-BC	BC
491	GEN.TRIP-CA	CA
492	GEN.ALARM	General alarm command
493	GEN.ALARM-A	ditto (Phase A)
494	GEN.ALARM-B	B
495	GEN.ALARM-C	C
496	GEN.ALARM-AB	ditto (Phase AB)
497	GEN.ALARM-BC	BC
498	GEN.ALARM-CA	CA
499	CLP STATE0	Cold Load Protection State
500	CLP STATE1	ditto
501	CLP STATE2	ditto
502	CLP STATE3	ditto
503	CB CLS COND	CB Closed
504	CB OPEN COND	CB Opend
505	CTF	CT failure detected
506	VTF1	VTF failure detected (Scheme 1)
507	VTF2	VTF failure detected (Scheme 2)
508	DFRQ1 TRIP	DFRQ1 trip command
509	DFRQ2 TRIP	2
510	DFRQ3 TRIP	3
511	DFRQ4 TRIP	4
512	DFRQ5 TRIP	5
513	DFRQ6 TRIP	6
514		
515		
516		
517		
518		
519		
520		
521		
522		
523		
524		
525		
526		
527		
528		
529	ARC READY	Auto-Reclosing ready condition
530	ARC IN-PROG	in-progress conditon
531	SHOT NUM1	Trip/Auto-Reclosing shot number1 condition
532	SHOT NUM2	2
533	SHOT NUM3	3
534	SHOT NUM4	4
535	SHOT NUM5	5
536	SHOT NUM6	6
537	ARC SHOT	Auto-Reclosing shot
538	ARC SHOT1	Auto-Reclosing shot of shot number1
539	ARC SHOT2	2
540	ARC SHOT3	3
541	ARC SHOT4	4
542	ARC SHOT5	5
543	ARC1 SHOT1	Auto-Reclosing shot of shot number1 in stage1
544	ARC1 SPAR	(Three Phase ARC)
545	ARC1 TPAR	(Single Phase ARC)
546	ARC1 CON	(Configurable ARC)
547	ARC1 SHOT2	Auto-Reclosing shot of shot number2 in stage1
548	ARC1 SHOT3	3
549	ARC1 SHOT4	4
550	ARC1 SHOT5	5
551	ARC2 SHOT1	Auto-Reclosing shot of shot number1 in stage2
552	ARC2 SPAR	(Three Phase ARC)
553	ARC2 TPAR	(Single Phase ARC)
554	ARC2 CON	(Configurable ARC)
555	ARC2 SHOT2	Auto-Reclosing shot of shot number2 in stage2
556	ARC2 SHOT3	3
557	ARC2 SHOT4	4
558	ARC2 SHOT5	5
559	ARC FT	Auto-Reclosing failed (Final trip)
560	ARC SUCCESS	Auto-Reclosing succeed

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Signal list (PLC input)

No.	Record item Common	Contents
561	ARC-S1 SUCCESS	Auto-Reclosing succeed in shot1 mode
562	ARC-S2 SUCCESS	2
563	ARC-S3 SUCCESS	3
564	ARC-S4 SUCCESS	4
565	ARC-S5 SUCCESS	5
566	ARC COORD	Auto-Reclosing Co-ordination judged
567	VCHK	Voltage conditon for Auto-Reclosing
568	VCHK SYN	ditto (Synchro.check)
569	VCHK LBDL	ditto (Live bus & Dead line)
570	VCHK DBLL	ditto (Dead bus & Live line)
571	VCHK DBDL	ditto (Dead bus & Dead line)
572	3P TP COMMAND	Three-phase trip command
573	ARC BRIDGE	ARC bridge
574	TP-APH	Trip A-phase
575	TP-BPH	Trip B-phase
576	TP-CPH	Trip C-phase
577	ARC-SW ON	Auto-Reclosing Scheme SW enable codition
578		
579	USW1 P0	User configurable scheme-SW (USW1=P0)
580	USW1 P1	(USW1=P1)
581	USW1 P2	(USW1=P2)
582	USW2 P0	(USW2=P0)
583	USW2 P1	(USW2=P1)
584	USW2 P2	(USW2=P2)
585	USW3 P0	(USW3=P0)
586	USW3 P1	(USW3=P1)
587	USW3 P2	(USW3=P2)
588	USW4 P0	(USW4=P0)
589	USW4 P1	(USW4=P1)
590	USW4 P2	(USW4=P2)
591	USW5 P0	(USW5=P0)
592	USW5 P1	(USW5=P1)
593	USW5 P2	(USW5=P2)
594	USW6 P0	(USW6=P0)
595	USW6 P1	(USW6=P1)
596	USW6 P2	(USW6=P2)
597	USW7 P0	(USW7=P0)
598	USW7 P1	(USW7=P1)
599	USW7 P2	(USW7=P2)
600	USW8 P0	(USW8=P0)
601	USW8 P1	(USW8=P1)
602	USW8 P2	(USW8=P2)
603		
604		
605		
606		
607		
608		
609	OC1-A OP	OC1-A relay element output with switch condition
610	OC1-B OP	B
611	OC1-C OP	C
612	OC2-A OP	OC2-A relay element output
613	OC2-B OP	B
614	OC2-C OP	C
615	OC3-A OP	OC3-A relay element output with switch condition
616	OC3-B OP	B
617	OC3-C OP	C
618	OC4-A OP	OC4-A relay element output with switch condition
619	OC4-B OP	B
620	OC4-C OP	C
621	DOC1-A OP	DOC1-A relay element output with switch condition
622	DOC1-B OP	B
623	DOC1-C OP	C
624	DOC2-A OP	DOC2-A relay element output with switch condition
625	DOC2-B OP	B
626	DOC2-C OP	C
627	DOC3-A OP	DOC3-A relay element output with switch condition
628	DOC3-B OP	B
629	DOC3-C OP	C
630	DOC4-A OP	DOC4-A relay element output with switch condition
631	DOC4-B OP	B
632	DOC4-C OP	C
633	EF1 OP	EF1 relay element output with switch condition
634	EF2 OP	2
635	EF3 OP	3
636	EF4 OP	4
637	DEF1 OP	DEFF1 relay element output with switch condition
638	DEF2 OP	2
639	DEF3 OP	3
640	DEF4 OP	4

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Signal list (PLC input)

No.	Record item Common	Contents
641	SEF1 OP	SEF1 relay element output with switch condition
642	SEF2 OP	2
643	SEF3 OP	3
644	SEF4 OP	4
645	DSEF1 OP	DSEFF1 relay element output with switch condition
646	DSEF2 OP	2
647	DSEF3 OP	3
648	DSEF4 OP	4
649	RPF OP	Residual Power element (Forward direction) output with switch condition.
650	RPR OP	Reverse direction
651	NOC1 OP	NOC1 relay element output with switch condition
652	NOC2 OP	2
653	DNOC1 OP	DNOCF1 relay element output with switch condition
654	DNOC2 OP	2
655	UC1-A OP	UC1-A relay element output with switch condition
656	UC1-B OP	B
657	UC1-C OP	C
658	UC2-A OP	UC2-A relay element output with switch condition
659	UC2-B OP	B
660	UC2-C OP	C
661	THM-A OP	Thermal for alarm relay element output with switch condition
662	THM-T OP	trip
663	BCD OP	Broken Conductor relay element output with switch condition
664	OV1-1 OP	OV1-1 relay element output with switch condition
665	OV1-2 OP	2
666	OV1-3 OP	3
667	OV2-1 OP	OV2-1 relay element output with switch condition
668	OV2-2 OP	2
669	OV2-3 OP	3
670	UV1-1 OP	UV1-1 relay element output with switch condition
671	UV1-2 OP	2
672	UV1-3 OP	3
673	UV2-1 OP	UV2-1 relay element output with switch condition
674	UV2-2 OP	2
675	UV2-3 OP	3
676	UVBLK	UV blocked element (Under voltage element) output with switch condition
677	ZOV1 OP	ZOV1 relay element output with switch condition
678	ZOV2 OP	2
679	NOV1 OP	NOV1 relay element output with switch condition
680	NOV2 OP	2
681	FRQ1 OP	FRQ1 relay element output with switch condition
682	FRQ2 OP	2
683	FRQ3 OP	3
684	FRQ4 OP	4
685	FRQ5 OP	5
686	FRQ6 OP	6
687	UC1-A OPC	UC1-A relay element with operating characteristic
688	UC1-B OPC	B
689	UC1-C OPC	C
690	UC2-A OPC	UC2-A relay element with operating characteristic
691	UC2-B OPC	B
692	UC2-C OPC	C
693		
694		
695	CB OPEN	CB open condition
696	CB CLOSE	CB close condition
697	DS1 OPEN	DS1 open condition
698	DS1 CLOSE	DS1 close condition
699	DS2 OPEN	DS2 open condition
700	DS2 CLOSE	DS2 close condition
701	DS3 OPEN	DS3 open condition
702	DS3 CLOSE	DS3 close condition
703	DS4 OPEN	DS4 open condition
704	DS4 CLOSE	DS4 close condition
705	DS5 OPEN	DS5 open condition
706	DS5 CLOSE	DS5 close condition
707	EDS1 OPEN	EDS1 open condition
708	EDS1 CLOSE	EDS1 close condition
709	EDS1 EARTH	EDS1 earth condition
710	EDS2 OPEN	EDS2 open condition
711	EDS2 CLOSE	EDS2 close condition
712	EDS2 EARTH	EDS2 earth condition
713	DFRQ1 OP	DFRQ1 relay element output with switch condition
714	DFRQ2 OP	2
715	DFRQ3 OP	3
716	DFRQ4 OP	4
717	DFRQ5 OP	5
718	DFRQ6 OP	6
719		
720		

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	Signal list (PLC input)		
	No.	Record item Common	Contents
	721	ARC_COM_ON	IEC103 communication command
	722		
	723	PROT_COM_ON	IEC103 communication command
	724	IND1_OPEN	IND1 open condition
	725	IND1_CLOSE	IND1 close condition
	726	IND2_OPEN	IND2 open condition
	727	IND2_CLOSE	IND2 close condition
	728	IND3_OPEN	IND3 open condition
	729	IND3_CLOSE	IND3 close condition
	730	IND4_OPEN	IND4 open condition
	731	IND4_CLOSE	IND4 close condition
	732	IND5_OPEN	IND5 open condition
	733	IND5_CLOSE	IND5 close condition
	734	IND6_OPEN	IND6 open condition
	735	IND6_CLOSE	IND6 close condition
	736	IND7_OPEN	IND7 open condition
	737	IND7_CLOSE	IND7 close condition
	738	IND8_OPEN	IND8 open condition
	739	IND8_CLOSE	IND8 close condition
	740	Vab_LOW_ALARM	Vab lower limit alarm
	741	Vab_LOW_WARNING	Vab lower limit warning
	742	Vab_UP_ALARM	Vab upper limit alarm
	743	Vab_UP_WARNING	Vab upper limit warning
	744	Vbc_LOW_ALARM	Vbc lower limit alarm
	745	Vbc_LOW_WARNING	Vbc lower limit warning
	746	Vbc_UP_ALARM	Vbc upper limit alarm
	747	Vbc_UP_WARNING	Vbc upper limit warning
	748	Vca_LOW_ALARM	Vca lower limit alarm
	749	Vca_LOW_WARNING	Vca lower limit warning
	750	Vca_UP_ALARM	Vca upper limit alarm
	751	Vca_UP_WARNING	Vca upper limit warning
	752	IND1_PLT_FAIL	IND1 pallet failed
	753	IND2_PLT_FAIL	IND2 pallet failed
	754	IND3_PLT_FAIL	IND3 pallet failed
	755	IND4_PLT_FAIL	IND4 pallet failed
	756	IND5_PLT_FAIL	IND5 pallet failed
	757	IND6_PLT_FAIL	IND6 pallet failed
	758	IND7_PLT_FAIL	IND7 pallet failed
	759	IND8_PLT_FAIL	IND8 pallet failed
	760	TTIME1_ALM	accumulate time1 alarm
	761	TTIME2_ALM	accumulate time2 alarm
	762	TTIME3_ALM	accumulate time3 alarm
	763	TTIME4_ALM	accumulate time4 alarm
	764	TTIME5_ALM	accumulate time5 alarm
	765	TTIME6_ALM	accumulate time6 alarm
	766	TTIME7_ALM	accumulate time7 alarm
	767	TTIME8_ALM	accumulate time8 alarm
Output Signal for Control ↓	768	CB_SELECTED	CB selected
	769	DS1_SELECTED	DS1 selected
	770	DS2_SELECTED	DS2 selected
	771	DS3_SELECTED	DS3 selected
	772	DS4_SELECTED	DS4 selected
	773	DS5_SELECTED	DS5 selected
	774	EDS1_SELECTED	EDS1 selected
	775	EDS2_SELECTED	EDS2 selected
	776	COS1_SELECTED	COS1 selected
	777	COS2_SELECTED	COS2 selected
	778	COS3_SELECTED	COS3 selected
	779	COS4_SELECTED	COS4 selected
	780	CB_FAILED	CB failed
	781	DS1_FAILED	DS1 failed
	782	DS2_FAILED	DS2 failed
	783	DS3_FAILED	DS3 failed
	784	DS4_FAILED	DS4 failed
	785	DS5_FAILED	DS5 failed
	786	EDS1_FAILED	EDS1 failed
	787	EDS2_FAILED	EDS2 failed
	788	COS1_FAILED	COS1 failed
	789	COS2_FAILED	COS2 failed
	790	COS3_FAILED	COS3 failed
	791	COS4_FAILED	COS4 failed
	792	CB_OPILK_ERR	Interlock failed(CB open)
	793	CB_CLILK_ERR	Interlock failed(CB close)
	794	DS1_OPILK_ERR	Interlock failed(DS1 open)
	795	DS1_CLILK_ERR	Interlock failed(DS1 close)
	796	DS2_OPILK_ERR	Interlock failed(DS2 open)
	797	DS2_CLILK_ERR	Interlock failed(DS2 close)
	798	DS3_OPILK_ERR	Interlock failed(DS3 open)
	799	DS3_CLILK_ERR	Interlock failed(DS3 close)
	800	DS4_OPILK_ERR	Interlock failed(DS4 open)

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Signal list (PLC input)

No.	Record item Common	Contents
801	DS4_CLILK_ERR	Interlock failed(DS4 close)
802	DS5_OPILK_ERR	Interlock failed(DS5 open)
803	DS5_CLILK_ERR	Interlock failed(DS5 close)
804	EDS1_OPILK_ERR	Interlock failed(EDS1 open)
805	EDS1_CLILK_ERR	Interlock failed(EDS1 close)
806	EDS1_ERILK_ERR	Interlock failed(EDS1 earth)
807	EDS1_FRILK_ERR	Interlock failed(EDS1 free)
808	EDS2_OPILK_ERR	Interlock failed(EDS2 open)
809	EDS2_CLILK_ERR	Interlock failed(EDS2 close)
810	EDS2_ERILK_ERR	Interlock failed(EDS2 earth)
811	EDS2_FRILK_ERR	Interlock failed(EDS2 free)
812	COS1_OFILK_ERR	Interlock failed(COS1 off)
813	COS1_ONILK_ERR	Interlock failed(COS1 on)
814	COS2_OFILK_ERR	Interlock failed(COS2 off)
815	COS2_ONILK_ERR	Interlock failed(COS2 on)
816	COS3_OFILK_ERR	Interlock failed(COS3 off)
817	COS3_ONILK_ERR	Interlock failed(COS3 on)
818	COS4_OFILK_ERR	Interlock failed(COS4 off)
819	COS4_ONILK_ERR	Interlock failed(COS4 on)
820	CB_OP_CNTL	CB open control
821	CB_CL_CNTL	CB close control
822	DS1_OP_CNTL	DS1 open control
823	DS1_CL_CNTL	DS1 close control
824	DS2_OP_CNTL	DS2 open control
825	DS2_CL_CNTL	DS2 close control
826	DS3_OP_CNTL	DS3 open control
827	DS3_CL_CNTL	DS3 close control
828	DS4_OP_CNTL	DS4 open control
829	DS4_CL_CNTL	DS4 close control
830	DS5_OP_CNTL	DS5 open control
831	DS5_CL_CNTL	DS5 close control
832	EDS1_OP_CNTL	EDS1 open control
833	EDS1_CL_CNTL	EDS1 close control
834	EDS1_EAR_CNTL	EDS1 earth control
835	EDS1_FR_CNTL	EDS1 free control
836	EDS2_OP_CNTL	EDS2 open control
837	EDS2_CL_CNTL	EDS2 close control
838	EDS2_EAR_CNTL	EDS2 earth control
839	EDS2_FR_CNTL	EDS2 free control
840	COS1_OFF_CNTL	COS1 off control
841	COS1_ON_CNTL	COS1 on control
842	COS2_OFF_CNTL	COS2 off control
843	COS2_ON_CNTL	COS2 on control
844	COS3_OFF_CNTL	COS3 off control
845	COS3_ON_CNTL	COS3 on control
846	COS4_OFF_CNTL	COS4 off control
847	COS4_ON_CNTL	COS4 on control
848	CB_NORESP	CB no-response
849	DS1_NORESP	DS1 no-response
850	DS2_NORESP	DS2 no-response
851	DS3_NORESP	DS3 no-response
852	DS4_NORESP	DS4 no-response
853	DS5_NORESP	DS5 no-response
854	EDS1_NORESP	EDS1 no-response
855	EDS2_NORESP	EDS2 no-response
856	CB_PLT_FAIL	CB pallet failed
857	DS1_PLT_FAIL	DS1 pallet failed
858	DS2_PLT_FAIL	DS2 pallet failed
859	DS3_PLT_FAIL	DS3 pallet failed
860	DS4_PLT_FAIL	DS4 pallet failed
861	DS5_PLT_FAIL	DS5 pallet failed
862	EDS1_PLT_FAIL	EDS1 pallet failed
863	EDS2_PLT_FAIL	EDS2 pallet failed
864	CB_OP_OUT	CB open pulse output
865	CB_CL_OUT	CB close pulse output
866	DS1_OP_OUT	DS1 open pulse output
867	DS1_CL_OUT	DS1 close pulse output
868	DS2_OP_OUT	DS2 open pulse output
869	DS2_CL_OUT	DS2 close pulse output
870	DS3_OP_OUT	DS3 open pulse output
871	DS3_CL_OUT	DS3 close pulse output
872	DS4_OP_OUT	DS4 open pulse output
873	DS4_CL_OUT	DS4 close pulse output
874	DS5_OP_OUT	DS5 open pulse output
875	DS5_CL_OUT	DS5 close pulse output
876	EDS1_OP_OUT	EDS1 open pulse output
877	EDS1_CL_OUT	EDS1 close pulse output
878	EDS1_EAR_OUT	EDS1 earth pulse output
879	EDS1_FR_OUT	EDS1 free pulse output
880	EDS2_OP_OUT	EDS2 open pulse output

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Signal list (PLC input)

No.	Record item Common	Contents
881	EDS2_CL_OUT	EDS2 close pulse output
882	EDS2_EAR_OUT	EDS2 earth pulse output
883	EDS2_FR_OUT	EDS2 free pulse output
884	COS1_ON_OUT	COS1 on pulse output
885	COS2_ON_OUT	COS2 on pulse output
886	COS3_ON_OUT	COS3 on pulse output
887	COS4_ON_OUT	COS4 on pulse output
888	CB_MV	CB movement
889	DS1_MV	DS1 movement
890	DS2_MV	DS2 movement
891	DS3_MV	DS3 movement
892	DS4_MV	DS4 movement
893	DS5_MV	DS5 movement
894	EDS1_MV	EDS1 movement
895	EDS2_MV	EDS2 movement
896	CB_UNDEF	CB pallet undefined
897	DS1_UNDEF	DS1 pallet undefined
898	DS2_UNDEF	DS2 pallet undefined
899	DS3_UNDEF	DS3 pallet undefined
900	DS4_UNDEF	DS4 pallet undefined
901	DS5_UNDEF	DS5 pallet undefined
902	EDS1_UNDEF	EDS1 pallet undefined
903	EDS2_UNDEF	EDS2 pallet undefined
904	IND1_UNDEF	IND1 pallet undefined
905	IND2_UNDEF	IND2 pallet undefined
906	IND3_UNDEF	IND3 pallet undefined
907	IND4_UNDEF	IND4 pallet undefined
908	IND5_UNDEF	IND5 pallet undefined
909	IND6_UNDEF	IND6 pallet undefined
910	IND7_UNDEF	IND7 pallet undefined
911	IND8_UNDEF	IND8 pallet undefined
912	CB_ENABLE	CB enabled
913	DS1_ENABLE	DS1 enabled
914	DS2_ENABLE	DS2 enabled
915	DS3_ENABLE	DS3 enabled
916	DS4_ENABLE	DS4 enabled
917	DS5_ENABLE	DS5 enabled
918	EDS1_ENABLE	EDS1 enabled
919	EDS2_ENABLE	EDS2 enabled
920	COS1_ENABLE	COS1 enabled
921	COS2_ENABLE	COS2 enabled
922	COS3_ENABLE	COS3 enabled
923	COS4_ENABLE	COS4 enabled
924	IND1_ENABLE	IND1 enabled
925	IND2_ENABLE	IND2 enabled
926	IND3_ENABLE	IND3 enabled
927	IND4_ENABLE	IND4 enabled
928	IND5_ENABLE	IND5 enabled
929	IND6_ENABLE	IND6 enabled
930	IND7_ENABLE	IND7 enabled
931	IND8_ENABLE	IND8 enabled
932	COS1_ON	COS1 ON/OFF status
933	COS2_ON	COS2 ON/OFF status
934	COS3_ON	COS3 ON/OFF status
935	COS4_ON	COS4 ON/OFF status
936	LR_REMOTE	L/R button (remote)
937	LR_LOCAL	L/R button (local)
938	KEY_REMOTE	KEY-SW(remote)
939	KEY_LOCAL	KEY-SW(local)
940	KEY_OOS	KEY-SW(out of service)
941	OPELOCK	operation lock
942	ILOCK_BYPS	interlock bypass
943	DCBLOCK	duble command blocking
944	SYNC_ESTB	syncronous check completed
945	SYNC_FAIL	syncronous check failed
946	SELCANSEL	select cansel
947	REMOTE	remote
948	LOCAL	local
949	C-RIGHT_UNDEF	control right undefined
950	OUTOFSERVICE	out of service
951	Ia_LOW_ALARM	Ia lower limit alarm
952	Ia_LOW_WARNING	Ia lower limit warning
953	Ia_UP_ALARM	Ia upper limit alarm
954	Ia_UP_WARNING	Ia upper limit warning
955	Ib_LOW_ALARM	Ib lower limit alarm
956	Ib_LOW_WARNING	Ib lower limit warning
957	Ib_UP_ALARM	Ib upper limit alarm
958	Ib_UP_WARNING	Ib upper limit warning
959	Ic_LOW_ALARM	Ic lower limit alarm
960	Ic_LOW_WARNING	Ic lower limit warning

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	Signal list (PLC input)		
	No.	Record item Common	Contents
	961	Ic_UP_ALARM	Ic upper limit alarm
	962	Ic_UP_WARNING	Ic upper limit warning
	963	Ie_LOW_ALARM	Ie lower limit alarm
	964	Ie_LOW_WARNING	Ie lower limit warning
	965	Ie_UP_ALARM	Ie upper limit alarm
	966	Ie_UP_WARNING	Ie upper limit warning
	967	Va_LOW_ALARM	Va lower limit alarm
	968	Va_LOW_WARNING	Va lower limit warning
	969	Va_UP_ALARM	Va upper limit alarm
	970	Va_UP_WARNING	Va upper limit warning
	971	Vb_LOW_ALARM	Vb lower limit alarm
	972	Vb_LOW_WARNING	Vb lower limit warning
	973	Vb_UP_ALARM	Vb upper limit alarm
	974	Vb_UP_WARNING	Vb upper limit warning
	975	Vc_LOW_ALARM	Vc lower limit alarm
	976	Vc_LOW_WARNING	Vc lower limit warning
	977	Vc_UP_ALARM	Vc upper limit alarm
	978	Vc_UP_WARNING	Vc upper limit warning
	979	Ve_LOW_ALARM	Ve lower limit alarm
	980	Ve_LOW_WARNING	Ve lower limit warning
	981	Ve_UP_ALARM	Ve upper limit alarm
	982	Ve_UP_WARNING	Ve upper limit warning
	983	Vs_LOW_ALARM	Vincomming lower limit alarm
	984	Vs_LOW_WARNING	Vincomming lower limit warning
	985	Vs_UP_ALARM	Vincomming upper limit alarm
	986	Vs_UP_WARNING	Vincomming upper limit warning
	987		
	988		
	989		
	990		
	991	P_LOW_ALARM	P lower limit alarm
	992	P_LOW_WARNING	P lower limit warning
	993	P_UP_ALARM	P upper limit alarm
	994	P_UP_WARNING	P upper limit warning
	995	Q_LOW_ALARM	Q lower limit alarm
	996	Q_LOW_WARNING	Q lower limit warning
	997	Q_UP_ALARM	Q upper limit alarm
	998	Q_UP_WARNING	Q upper limit warning
	999	f_LOW_ALARM	f lower limit alarm
	1000	f_LOW_WARNING	f lower limit warning
	1001	f_UP_ALARM	f upper limit alarm
	1002	f_UP_WARNING	f upper limit warning
	1003	CONSTANT_1	Constant 1 signal
	1004	CBCNT_ALM	CB count alarm
	1005	DS1CNT_ALM	DS1 count alarm
	1006	DS2CNT_ALM	DS2 count alarm
	1007	DS3CNT_ALM	DS3 count alarm
	1008	DS4CNT_ALM	DS4 count alarm
	1009	DS5CNT_ALM	DS5 count alarm
	1010	EDS1CLCNT_ALM	EDS1 close count alarm
	1011	EDS1EARCNT_ALM	EDS1 earth count alarm
	1012	EDS2CLCNT_ALM	EDS2 close count alarm
	1013	EDS2EARCNT_ALM	EDS2 earth count alarm
	1014	CNT1_ALM	count1 alarm
	1015	CNT2_ALM	count2 alarm
	1016	CNT3_ALM	count3 alarm
	1017	CNT4_ALM	count4 alarm
	1018	CNT5_ALM	count5 alarm
	1019	CNT6_ALM	count6 alarm
	1020	CNT7_ALM	count7 alarm
	1021	CNT8_ALM	count8 alarm
	1022	CNT_RIGHT_FAIL	control right failed
	1023		
Output Signal for Communication and HMI	1024	GROUP1_ACTIVE	group1 active
	1025	GROUP2_ACTIVE	group2 active
	1026	GROUP3_ACTIVE	group3 active
	1027	GROUP4_ACTIVE	group4 active
	1028	GROUP5_ACTIVE	group5 active
	1029	GROUP6_ACTIVE	group6 active
	1030	GROUP7_ACTIVE	group7 active
	1031	GROUP8_ACTIVE	group8 active
	1032		
	1033		
	1034	LOCAL_OP_ACT	local operation active
	1035	REMOTE_OP_ACT	remote operation active
	1036		
	1037		
	1038	GEN_PICKUP	General start/pick-up
	1039	IEC_TESTMODE	IEC61870-5-103 testmode
	1040	IEC_MDBLK	monitor direction blocked

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Signal list (PLC input)

No.	Record item Common	Contents
1041		
1042		
1043		
1044	FL_ERR	fault location start up error
1045	FL_OB_FWD	fault location out of bounds(forward)
1046	FL_OB_BACK	fault location out of bounds(backward)
1047	FL_NC	fault location not converged
1048	FL_COMPLETED	fault location completed
1049		
1050		
1051		
1052		
1053		
1054		
1055		
1056		
1057		
1058		
1059		
1060	CB_CMD_ACK	CB ACK
1061	DS1_CMD_ACK	DS1 ACK
1062	DS2_CMD_ACK	DS2 ACK
1063	DS3_CMD_ACK	DS3 ACK
1064	DS4_CMD_ACK	DS4 ACK
1065	DS5_CMD_ACK	DS5 ACK
1066	EDS1_CMD_ACK	EDS1 ACK
1067	EDS2_CMD_ACK	EDS2 ACK
1068	COS1_CMD_ACK	COS1 ACK
1069	COS2_CMD_ACK	COS2 ACK
1070	COS3_CMD_ACK	COS3 ACK
1071	COS4_CMD_ACK	COS4 ACK
1072	OPELK_CMD_ACK	OPELOCK ACK
1073	ILKBP_CMD_ACK	ILKBYPASS ACK
1074	CB_CMD_NACK	CB NACK
1075	DS1_CMD_NACK	DS1 NACK
1076	DS2_CMD_NACK	DS2 NACK
1077	DS3_CMD_NACK	DS3 NACK
1078	DS4_CMD_NACK	DS4 NACK
1079	DS5_CMD_NACK	DS5 NACK
1080	EDS1_CMD_NACK	EDS1 NACK
1081	EDS2_CMD_NACK	EDS2 NACK
1082	COS1_CMD_NACK	COS1 NACK
1083	COS2_CMD_NACK	COS2 NACK
1084	COS3_CMD_NACK	COS3 NACK
1085	COS4_CMD_NACK	COS4 NACK
1086	OPELK_CMD_NACK	OPELOCK NACK
1087	ILKBP_CMD_NACK	ILKBYPASS NACK
1088		
1089		
1090		
1091		
1092		
1093		
1094		
1095		
1096		
1097		
1098		
1099		
1100		
1101		
1102		
1103		
1104		
1105		
1106		
1107		
1108		
1109		
1110		
1111		
1112		
1113		
1114		
1115		
1116		
1117		
:		
:		
1250		

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Signal list (PLC input)

	No.	Record item Common	Contents
	1251		
	1252		
	1253		
	1254		
	1255		
	1256		
	1257		
	1258	IO3-BI1UF	Binary input signal of IO3-BI1 (unfiltered)
	1259	IO3-BI2UF	2 (unfiltered)
	1260	IO3-BI3UF	3 (unfiltered)
	1261	IO3-BI4UF	4 (unfiltered)
	1262	IO3-BI5UF	5 (unfiltered)
	1263	IO3-BI6UF	6 (unfiltered)
	1264	IO3-BI7UF	7 (unfiltered)
	1265	IO3-BI8UF	8 (unfiltered)
	1266	IO3-BI9UF	9 (unfiltered)
	1267	IO3-BI10UF	10 (unfiltered)
	1268	IO3-BI11UF	11 (unfiltered)
	1269	IO4-BI1UF	Binary input signal of IO4-BI1 (unfiltered)
	1270	IO4-BI2UF	2 (unfiltered)
	1271	IO4-BI3UF	3 (unfiltered)
	1272	IO4-BI4UF	4 (unfiltered)
	1273	IO4-BI5UF	5 (unfiltered)
	1274	IO4-BI6UF	6 (unfiltered)
	1275	IO4-BI7UF	7 (unfiltered)
	1276	IO4-BI8UF	8 (unfiltered)
	1277	IO4-BI9UF	9 (unfiltered)
	1278	IO4-BI10UF	10 (unfiltered)
	1279	IO4-BI11UF	11 (unfiltered)
Output Signal for Binary Input and Monitoring ↓	1280	IO1-BI1	Binary input signal of IO1-BI1 (filtered)
	1281	IO1-BI2	2 (filtered)
	1282	IO1-BI3	3 (filtered)
	1283	IO1-BI4	4 (filtered)
	1284	IO1-BI5	5 (filtered)
	1285	IO1-BI6	6 (filtered)
	1286	IO1-BI7	7 (filtered)
	1287	IO1-BI8	8 (filtered)
	1288	IO1-BI9	9 (filtered)
	1289	IO1-BI10	10 (filtered)
	1290	IO1-BI21	21(used for TCSV) (filtered)
	1291	IO1-BI22	22(ditto) (filtered)
	1292	IO2-BI1	Binary input signal of IO2-BI1 (filtered)
	1293	IO2-BI2	2 (filtered)
	1294	IO2-BI3	3 (filtered)
	1295	IO2-BI4	4 (filtered)
	1296	IO2-BI5	5 (filtered)
	1297	IO2-BI6	6 (filtered)
	1298	IO2-BI7	7 (filtered)
	1299	IO2-BI8	8 (filtered)
	1300	IO2-BI9	9 (filtered)
	1301	IO2-BI10	10 (filtered)
	1302	IO2-BI11	11 (filtered)
	1303	IO2-BI21	21(used for TCSV) (filtered)
	1304	IO2-BI22	22(ditto) (filtered)
	1305	IO3-BI1	Binary input signal of IO3-BI1 (filtered)
	1306	IO3-BI2	2 (filtered)
	1307	IO3-BI3	3 (filtered)
	1308	IO3-BI4	4 (filtered)
	1309	IO3-BI5	5 (filtered)
	1310	IO3-BI6	6 (filtered)
	1311	IO3-BI7	7 (filtered)
	1312	IO3-BI8	8 (filtered)
	1313	IO3-BI9	9 (filtered)
	1314	IO3-BI10	10 (filtered)
	1315	IO3-BI11	11 (filtered)
	1316	IO3-BI21	21(used for TCSV) (filtered)
	1317	IO3-BI22	22(ditto) (filtered)
	1318	IO4-BI1	Binary input signal of IO4-BI1 (filtered)
	1319	IO4-BI2	2 (filtered)
	1320	IO4-BI3	3 (filtered)
	1321	IO4-BI4	4 (filtered)
	1322	IO4-BI5	5 (filtered)
	1323	IO4-BI6	6 (filtered)
	1324	IO4-BI7	7 (filtered)
	1325	IO4-BI8	8 (filtered)
	1326	IO4-BI9	9 (filtered)
	1327	IO4-BI10	10 (filtered)
	1328	IO4-BI11	11 (filtered)
	1329	IO4-BI21	21(used for TCSV) (filtered)
	1330	IO4-BI22	22(ditto) (filtered)

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Signal list (PLC input)

No.	Record item Common	Contents
1331		
1332		
1333		
1334		
1335		
1336		
1337		
1338		
1339		
1340		
1341		
1342	VTF err	VT monitoring error1 or 2
1343	BO block	Binary output block signal
1344	A.M.F.OFF	Auotmatic monitoring function off
1345	RELAY FAIL	Relay failure & trip blocked alarm
1346	RELAY FAIL-A	Relay failure alarm (Trip not blocked)
1347		
1348	SUM err	The checksum value of written data checking error
1349		
1350	SRAM err	SRAM memory monitoring error
1351	BU-RAM err	BU-RAM memory monitoring error
1352	Data lost	BU-RAM data lost
1353	EEPROM err	EEPROM memory monitoring error
1354	A/D err	A/D accuracy checking error
1355		
1356	CT err	CT circuit current monitoring error
1357		
1358	DC err	DC supply monitoring error
1359	TC fail	Trip circuit 1-8 fail
1360	CTF err	CT monitoring error
1361	TP COUNT ALM	Trip count alarm
1362	VTF1 err	VT monitoring error1
1363	Sigma I^y ALM	ΣI^y count alarm
1364	V0 err	V0 circuit voltage monitoring error
1365	V2 err	V2 circuit voltage monitoring error
1366	PANEL err	LCD panel connecting err
1367	CB err	CB connecting error
1368	DIO AIO err	DIO1-8 AIO1-4 connecting error
1369	VTF2 err	VT monitoring error2
1370	ROM data err	The checksum value of written ROM data checking error
1371		
1372		
1373		
1374		
1375		
1376		
1377		
1378		
1379	DIO1 err	DIO1 connecting error
1380	DIO2 err	DIO2 connecting error
1381	DIO3 err	DIO3 connecting error
1382	DIO4 err	DIO4 connecting error
1383	DIO5 err	DIO5 connecting error
1384	DIO6 err	DIO6 connecting error
1385	DIO7 err	DIO7 connecting error
1386	DIO8 err	DIO8 connecting error
1387	AIO1 err	AIO1 connecting error
1388	AIO2 err	AIO2 connecting error
1389	AIO3 err	AIO3 connecting error
1390	AIO4 err	AIO4 connecting error
1391	TC1 fail	Trip circuit 1 fail
1392	TC2 fail	Trip circuit 2 fail
1393	TC3 fail	Trip circuit 3 fail
1394	TC4 fail	Trip circuit 4 fail
1395	TC5 fail	Trip circuit 5 fail
1396	TC6 fail	Trip circuit 6 fail
1397	TC7 fail	Trip circuit 7 fail
1398	TC8 fail	Trip circuit 8 fail
1399		
1400		
1401		
1402		
1403		
1404		
1405		
1406		
1407		
1408		
1409		
1410		

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Signal list (PLC input)

No.	Record item Common	Contents
1411		
1412	NORM_LED_ON	NORMAL LED ON
1413	ALM_LED_ON	ALARM LED ON
1414	TRIP_LED_ON	TRIP LED ON
1415	TEST_LED_ON	TEST LED ON
1416	LOCAL_LED_ON	LOCAL LED ON
1417	REMOTE_LED_ON	REMOTE LED ON
1418	TPALM_LED_RST	TRIP/ALARM LED RESET
1419	KEY-VIEW	MIMIC Panel VIEW key status (1:pressed)
1420	KEY-RESET	RESET
1421	KEY-LR	L/R
1422	KEY-SELECT	SELECT
1423	KEY-CLOSE	|
1424	KEY-OPEN	○
1425	KEY-ENTER	ENTER
1426	KEY-END	END
1427	KEY-CANCEL	CANCEL
1428	KEY-F1	F1
1429	KEY-F2	F2
1430	KEY-UP	↑
1431	KEY-DOWN	↓
1432	KEY-LEFT	←
1433	KEY-RIGHT	→
1434	KEY-LONG	Continuous pressing key
1435		
1436		
1437		
1438		
1439		
1440		
1441		
1442		
1443		
1444		
1445		
1446		
1447		
1448	DEV_time_CLR	Device time clear
1449	F.Record_DONE	
1450	F.Record_CLR	Fault record clear
1451	A.Record_CLR	Alarm record clear
1452	E.Record_CLR	Event record clear
1453	D.Record_CLR	Disturbance record clear
1454		
1455		
1456	D.REC_FULL	Disturbance record full
1457		Reserved for disturbance record status
1458		Reserved for disturbance record status
1459		Reserved for disturbance record status
1460	PC_DIST_TRIG	Trigger for disturbance recorder from PC
1461	PLC_data_CHG	PLC data change
1462	TR_ARC_CT_CHG	Trip,ARCs change
1463	Sigma_I^y_CHG	Sigma_I^y change
1464	Sys.set_change	System setting change
1465	Rly.set_change	Relay setting change
1466	Grp.set_change	Group setting change
1467	DEV_CT_CHG	Device counter change
1468	GEN_CT_CHG	General counter change
1469	Total_time_CHG	Total time change
1470	Wh_varh_CHG	Wh,varh change
1471	MIMIC_data_CHG	MIMIC data change
1472	IO1-BI1UF	Binary input signal of IO1-BI1 (unfiltered)
1473	IO1-BI2UF	2 (unfiltered)
1474	IO1-BI3UF	3 (unfiltered)
1475	IO1-BI4UF	4 (unfiltered)
1476	IO1-BI5UF	5 (unfiltered)
1477	IO1-BI6UF	6 (unfiltered)
1478	IO1-BI7UF	7 (unfiltered)
1479	IO1-BI8UF	8 (unfiltered)
1480	IO1-BI9UF	9 (unfiltered)
1481	IO1-BI10UF	10 (unfiltered)
1482	IO2-BI1UF	Binary input signal of IO2-BI1 (unfiltered)
1483	IO2-BI2UF	2 (unfiltered)
1484	IO2-BI3UF	3 (unfiltered)
1485	IO2-BI4UF	4 (unfiltered)
1486	IO2-BI5UF	5 (unfiltered)
1487	IO2-BI6UF	6 (unfiltered)
1488	IO2-BI7UF	7 (unfiltered)
1489	IO2-BI8UF	8 (unfiltered)
1490	IO2-BI9UF	9 (unfiltered)

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Signal list (PLC input)

No.	Record item Common	Contents
1491	IO2-BI10UF	10 (unfiltered)
1492	IO2-BI11UF	11 (unfiltered)
1493		
1494		
1495		
1496		
1497		
1498		
1499		
1500	IO1-TP1S	Binary output status of IO1-TP1
1501	IO1-TP2S	TP2
1502	IO1-BO1S	BO1
1503	IO1-BO2S	2
1504	IO1-BO3S	3
1505	IO1-BO4S	4
1506	IO1-BO5S	5
1507	IO1-FAILS	Binary output status of fail-BO
1508	IO2-TP1S	Binary output status of IO2-TP1
1509	IO2-TP2S	TP2
1510	IO2-BO1S	BO1
1511	IO2-BO2S	2
1512	IO2-BO3S	3
1513	IO2-BO4S	4
1514	IO2-BO5S	5
1515	IO2-BO6S	6
1516	IO3-TP1S	Binary output status of IO3-TP1
1517	IO3-TP2S	TP2
1518	IO3-BO1S	BO1
1519	IO3-BO2S	2
1520	IO3-BO3S	3
1521	IO3-BO4S	4
1522	IO3-BO5S	5
1523	IO3-BO6S	6
1524	IO4-TP1S	Binary output status of IO4-TP1
1525	IO4-TP2S	TP2
1526	IO4-BO1S	BO1
1527	IO4-BO2S	2
1528	IO4-BO3S	3
1529	IO4-BO4S	4
1530	IO4-BO5S	5
1531	IO4-BO6S	6
1532		
1533		
1534		
1535		

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Signal list (PLC output)

Input Signal to Protection

No.	Record item Common	Contents
1536	OC1 BLOCK	OC1 protection scheme block command
1537	OC2 BLOCK	2
1538	OC3 BLOCK	3
1539	OC4 BLOCK	4
1540	DOC1 BLOCK	DOC1 protection scheme block command
1541	DOC2 BLOCK	2
1542	DOC3 BLOCK	3
1543	DOC4 BLOCK	4
1544	EF1 BLOCK	EF1 protection scheme block command
1545	EF2 BLOCK	2
1546	EF3 BLOCK	3
1547	EF4 BLOCK	4
1548	DEF1 BLOCK	DEF1 protection scheme block command
1549	DEF2 BLOCK	2
1550	DEF3 BLOCK	3
1551	DEF4 BLOCK	4
1552	SEF1 BLOCK	SEF1 protection scheme block command
1553	SEF2 BLOCK	2
1554	SEF3 BLOCK	3
1555	SEF4 BLOCK	4
1556	DSEF1 BLOCK	DSEF1 protection scheme block command
1557	DSEF2 BLOCK	2
1558	DSEF3 BLOCK	3
1559	DSEF4 BLOCK	4
1560	NOC1 BLOCK	NOC1 protection scheme block command
1561	NOC2 BLOCK	2
1562		
1563		
1564	DNOC1 BLOCK	DNOC1 protection scheme block command
1565	DNOC2 BLOCK	2
1566		
1567		
1568	UC1 BLOCK	UC1 protection scheme block command
1569	UC2 BLOCK	2
1570	CBF BLOCK	CBF protection scheme block command
1571		
1572	THM BLOCK	Thermal Overload protection scheme block command
1573		
1574	BCD BLOCK	Bloken conductor protection scheme block command
1575		
1576		
1577		
1578		
1579		
1580		
1581		
1582		
1583		
1584	OV1 BLOCK	OV1 protection scheme block command
1585	OV2 BLOCK	2
1586		
1587		
1588	UV1 BLOCK	UV1 protection scheme block command
1589	UV2 BLOCK	2
1590		
1591		
1592	ZOV1 BLOCK	ZOV1 protection scheme block command
1593	ZOV2 BLOCK	2
1594		
1595		
1596	NOV1 BLOCK	NOV1 protection scheme block command
1597	NOV2 BLOCK	2
1598		
1599		
1600	FRQ1 BLOCK	Frequency protection 1 scheme block command
1601	FRQ2 BLOCK	2
1602	FRQ3 BLOCK	3
1603	FRQ4 BLOCK	4
1604	FRQ5 BLOCK	5
1605	FRQ6 BLOCK	6
1606		
1607		
1608	DFRQ1 BLOCK	Frequency rate-of-change protection 1 scheme block command
1609	DFRQ2 BLOCK	2
1610	DFRQ3 BLOCK	3
1611	DFRQ4 BLOCK	4
1612	DFRQ5 BLOCK	5
1613	DFRQ6 BLOCK	6
1614		
1615		

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Signal list (PLC output)

No.	Record item Common	Contents
1616	CTF_BLOCK	CTF scheme block command
1617	VTF_BLOCK	VTF scheme block command
1618		
1619		
1620	EXT_CTF	Extenal CTF command
1621	EXT_VTF	Extenal VTF command
1622		
1623		
1624		
1625		
1626		
1627		
1628		
1629		
1630		
1631		
1632	CB_READY	CB closed and ready for ARC command
1633	ARC_BLOCK	Auto-reclosing scheme block command
1634	ARC_NO_ACT	Auto-reclosing scheme not acted command
1635	MANUAL_CLOSE	CB manually close command
1636		
1637		
1638		
1639		
1640	EXT_TRIP-A	External trip command (Phase A)
1641	EXT_TRIP-B	B
1642	EXT_TRIP-C	C
1643	EXT_TRIP	External trip command
1644	CBF_INIT-A	CBF initiation command (Phase A)
1645	CBF_INIT-B	B
1646	CBF_INIT-C	C
1647	CBF_INIT	CBF initiation command
1648	ARC1_INIT	Auto-Reclosing initiation command in stage1
1649	ARC1-S1_COND	Auto-reclosing shot1 condition in stage1 (SPAR mode)
1650	ARC1-C_COND	Auto-reclosing shot1 condition in stage1 (Configurable ARC mode)
1651	ARC1-C_INIT	Auto-reclosing shot1 initiation comamnd in stage1 (Configurable ARC mode)
1652	ARC1-S2_COND	Auto-reclosing shot2 condition in stage1
1653	ARC1-S3_COND	3
1654	ARC1-S4_COND	4
1655	ARC1-S5_COND	5
1656		
1657		
1658		
1659		
1660		
1661		
1662		
1663		
1664	ARC2_INIT	Auto-Reclosing initiation command in stage2
1665	ARC2-S1_COND	Auto-reclosing shot1 condition in stage2 (SPAR mode)
1666	ARC2-C_COND	Auto-reclosing shot1 condition in stage2 (Configurable ARC mode)
1667	ARC2-C_INIT	Auto-reclosing shot1 initiation comamnd in stage2 (Configurable ARC mode)
1668	ARC2-S2_COND	Auto-reclosing shot2 condition in stage2
1669	ARC2-S3_COND	3
1670	ARC2-S4_COND	4
1671	ARC2-S5_COND	5
1672		
1673		
1674		
1675		
1676		
1677		
1678		
1679		
1680	FRQ_S1_TRIP	Frequency scheme trip command (Stage1)
1681	FRQ_S2_TRIP	Frequency scheme trip command (Stage2)
1682	FRQ_S3_TRIP	Frequency scheme trip command (Stage3)
1683	FRQ_S4_TRIP	Frequency scheme trip command (Stage4)
1684	FRQ_S5_TRIP	Frequency scheme trip command (Stage5)
1685	FRQ_S6_TRIP	Frequency scheme trip command (Stage6)
1686		
1687		
1688		
1689		
1690		

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Signal list (PLC output)

No.	Record item Common	Contents
1691		
1692		
1693		
1694		
1695		
1696	L_OC1D-A	Relay element output signal
1697	L_OC1D-B	ditto
1698	L_OC1D-C	ditto
1699		
1700	L_OC2D-A	ditto
1701	L_OC2D-B	ditto
1702	L_OC2D-C	ditto
1703		
1704	L_OC3D-A	ditto
1705	L_OC3D-B	ditto
1706	L_OC3D-C	ditto
1707		
1708	L_OC4D-A	ditto
1709	L_OC4D-B	ditto
1710	L_OC4D-C	ditto
1711		
1712	L_OC1I-A	ditto
1713	L_OC1I-B	ditto
1714	L_OC1I-C	ditto
1715		
1716	L_OC2I-A	ditto
1717	L_OC2I-B	ditto
1718	L_OC2I-C	ditto
1719		
1720	L_ICD-A	ditto
1721	L_ICD-B	ditto
1722	L_ICD-C	ditto
1723		
1724	L_ICLDO-A	ditto
1725	L_ICLDO-B	ditto
1726	L_ICLDO-C	ditto
1727		
1728	L_DOC1F-A	ditto
1729	L_DOC1F-B	ditto
1730	L_DOC1F-C	ditto
1731		
1732	L_DOC2F-A	ditto
1733	L_DOC2F-B	ditto
1734	L_DOC2F-C	ditto
1735		
1736	L_DOC3F-A	ditto
1737	L_DOC3F-B	ditto
1738	L_DOC3F-C	ditto
1739		
1740	L_DOC4F-A	ditto
1741	L_DOC4F-B	ditto
1742	L_DOC4F-C	ditto
1743		
1744	L_DOC1R-A	ditto
1745	L_DOC1R-B	ditto
1746	L_DOC1R-C	ditto
1747		
1748	L_DOC2R-A	ditto
1749	L_DOC2R-B	ditto
1750	L_DOC2R-C	ditto
1751		
1752	L_DOC3R-A	ditto
1753	L_DOC3R-B	ditto
1754	L_DOC3R-C	ditto
1755		
1756	L_DOC4R-A	ditto
1757	L_DOC4R-B	ditto
1758	L_DOC4R-C	ditto
1759		
1760	L_DOC1I-A	ditto
1761	L_DOC1I-B	ditto
1762	L_DOC1I-C	ditto
1763		
1764	L_DOC2I-A	ditto
1765	L_DOC2I-B	ditto
1766	L_DOC2I-C	ditto
1767		
1768	L_OCHS-A	ditto
1769	L_OCHS-B	ditto
1770	L_OCHS-C	ditto

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Signal list (PLC output)

No.	Record item Common	Contents
1771		
1772	L_EFHS	ditto
1773	L_SEFHS	ditto
1774		
1775		
1776	L_DEF1I	ditto
1777	L_DEF2I	ditto
1778		
1779		
1780	L_DSEF1I	ditto
1781	L_DSEF2I	ditto
1782		
1783		
1784	L_DNOC1I	ditto
1785		
1786		
1787		
1788		
1789		
1790		
1791		
1792	L_EF1D	ditto
1793	L_EF2D	ditto
1794	L_EF3D	ditto
1795	L_EF4D	ditto
1796	L_SEF1D	ditto
1797	L_SEF2D	ditto
1798	L_SEF3D	ditto
1799	L_SEF4D	ditto
1800	L_NOC1D	ditto
1801	L_NOC2D	ditto
1802		
1803		
1804	L_CBF-A	ditto
1805	L_CBF-B	ditto
1806	L_CBF-C	ditto
1807		
1808	L_EF1I	ditto
1809	L_EF2I	ditto
1810		
1811		
1812	L_SEF1I	ditto
1813	L_SEF2I	ditto
1814		
1815		
1816	L_NOC1I	ditto
1817		
1818		
1819		
1820		
1821		
1822	L_BCD	ditto
1823		
1824	L_DEF1F	ditto
1825	L_DEF2F	ditto
1826	L_DEF3F	ditto
1827	L_DEF4F	ditto
1828	L_DSEF1F	ditto
1829	L_DSEF2F	ditto
1830	L_DSEF3F	ditto
1831	L_DSEF4F	ditto
1832	L_DNOC1F	ditto
1833	L_DNOC2F	ditto
1834		
1835		
1836		
1837		
1838		
1839	L_RPF	ditto
1840	L_DEF1R	ditto
1841	L_DEF2R	ditto
1842	L_DEF3R	ditto
1843	L_DEF4R	ditto
1844	L_DSEF1R	ditto
1845	L_DSEF2R	ditto
1846	L_DSEF3R	ditto
1847	L_DSEF4R	ditto
1848	L_DNOC1R	ditto
1849	L_DNOC2R	ditto
1850		

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Signal list (PLC output)

No.	Record item Common	Contents
1851		
1852		
1853		
1854		
1855	L_RPR	ditto
1856	L_UC1-A	ditto
1857	L_UC1-B	ditto
1858	L_UC1-C	ditto
1859		
1860	L_UC2-A	ditto
1861	L_UC2-B	ditto
1862	L_UC2-C	ditto
1863		
1864	L_PHMAX-A	ditto
1865	L_PHMAX-B	ditto
1866	L_PHMAX-C	ditto
1867		
1868	L_THM-T	ditto
1869	L_THM-A	ditto
1870		
1871		
1872	L_UC1-A_OCFLG	ditto
1873	L_UC1-B_OCFLG	ditto
1874	L_UC1-C_OCFLG	ditto
1875		
1876	L_UC2-A_OCFLG	ditto
1877	L_UC2-B_OCFLG	ditto
1878	L_UC2-C_OCFLG	ditto
1879		
1880	L_UC-A_UCFLG	ditto
1881	L_UC-B_UCFLG	ditto
1882	L_UC-C_UCFLG	ditto
1883		
1884		
1885		
1886		
1887		
1888	L_OV1D-1	ditto
1889	L_OV1D-2	ditto
1890	L_OV1D-3	ditto
1891		
1892	L_OV2D-1	ditto
1893	L_OV2D-2	ditto
1894	L_OV2D-3	ditto
1895		
1896	L_UV1D-1	ditto
1897	L_UV1D-2	ditto
1898	L_UV1D-3	ditto
1899		
1900	L_UV2D-1	ditto
1901	L_UV2D-2	ditto
1902	L_UV2D-3	ditto
1903		
1904	L_OV1I-1	ditto
1905	L_OV1I-2	ditto
1906	L_OV1I-3	ditto
1907		
1908		
1909		
1910		
1911		
1912	L_UV1I-1	ditto
1913	L_UV1I-2	ditto
1914	L_UV1I-3	ditto
1915		
1916	L_UVBLK-1	ditto
1917	L_UVBLK-2	ditto
1918	L_UVBLK-3	ditto
1919		
1920	L_ZOV1D	ditto
1921	L_ZOV2D	ditto
1922		
1923		
1924	L_NOV1D	ditto
1925	L_NOV2D	ditto
1926		
1927		
1928		
1929		
1930		

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Signal list (PLC output)

No.	Record item Common	Contents
1931		
1932		
1933		
1934		
1935		
1936	L_ZOV1I	ditto
1937		
1938		
1939		
1940	L_NOV1I	ditto
1941		
1942		
1943		
1944		
1945		
1946		
1947		
1948		
1949		
1950		
1951		
1952	L_OC-A_COORD	ditto
1953	L_OC-B_COORD	ditto
1954	L_OC-C_COORD	ditto
1955	L_EF_COORD	ditto
1956	L_SEF_COORD	ditto
1957		
1958		
1959		
1960		
1961		
1962		
1963		
1964		
1965		
1966		
1967	L_PLUS_FLG	ditto
1968	L_SYN	ditto
1969	L_UVIV	ditto
1970	L_UVRV	ditto
1971	L_OVIV	ditto
1972	L_OVRV	ditto
1973		
1974		
1975		
1976	L_Delta_V	ditto
1977	L_Delta_Deg	ditto
1978	L_Delta_f	ditto
1979		
1980	L_UVCUT	ditto
1981		
1982		
1983		
1984	L_UVVF-1	ditto
1985	L_UVVF-2	ditto
1986	L_UVVF-3	ditto
1987	L_ZOVVF	ditto
1988	L_OCDVF-A	ditto
1989	L_OCDVF-B	ditto
1990	L_OCDVF-C	ditto
1991	L_EFVF	ditto
1992	L_EFCF	ditto
1993	L_ZOVCF	ditto
1994		
1995		
1996		
1997		
1998		
1999		
2000	L_OCALM-A	ditto
2001	L_OCALM-B	ditto
2002	L_OCALM-C	ditto
2003		
2004		
2005		
2006		
2007		
2008		
2009		
2010		

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Signal list (PLC output)

No.	Record item Common	Contents
2011		
2012		
2013		
2014		
2015		
2016	L_FRQ1	ditto
2017	L_FRQ2	ditto
2018	L_FRQ3	ditto
2019	L_FRQ4	ditto
2020	L_FRQ5	ditto
2021	L_FRQ6	ditto
2022		
2023	L_FRQBLK	ditto
2024		
2025		
2026		
2027		
2028		
2029		
2030		
2031		
2032		
2033		
2034		
2035		
2036		
2037		
2038		
2039		
2040		
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2042		
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2081		
2082		
2083		
2084		
2085		
2086		
2087		
:		
:		
2300		

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Signal list (PLC output)

	No.	Record item Common	Contents
	2301		
	2302		
	2303		
Input signal	2304	CB_N/O_CONT	CB normally open
to	2305	CB_N/C_CONT	CB normally close
control	2306	DS1_N/O_CONT	DS1 normally open
	2307	DS1_N/C_CONT	DS1 normally close
	2308	DS2_N/O_CONT	DS2 normally open
	2309	DS2_N/C_CONT	DS2 normally close
	2310	DS3_N/O_CONT	DS3 normally open
	2311	DS3_N/C_CONT	DS3 normally close
	2312	DS4_N/O_CONT	DS4 normally open
	2313	DS4_N/C_CONT	DS4 normally close
	2314	DS5_N/O_CONT	DS5 normally open
	2315	DS5_N/C_CONT	DS5 normally close
	2316	EDS1_N/O_CONT	EDS1 normally open
	2317	EDS1_N/C_CONT	EDS1 normally close
	2318	EDS1_N/E_CONT	EDS1 normally earth
	2319	EDS2_N/O_CONT	EDS2 normally open
	2320	EDS2_N/C_CONT	EDS2 normally close
	2321	EDS2_N/E_CONT	EDS2 normally earth
	2322	IND1_N/O_CONT	IND1 normally open
	2323	IND1_N/C_CONT	IND1 normally close
	2324	IND2_N/O_CONT	IND2 normally open
	2325	IND2_N/C_CONT	IND2 normally close
	2326	IND3_N/O_CONT	IND3 normally open
	2327	IND3_N/C_CONT	IND3 normally close
	2328	IND4_N/O_CONT	IND4 normally open
	2329	IND4_N/C_CONT	IND4 normally close
	2330	IND5_N/O_CONT	IND5 normally open
	2331	IND5_N/C_CONT	IND5 normally close
	2332	IND6_N/O_CONT	IND6 normally open
	2333	IND6_N/C_CONT	IND6 normally close
	2334	IND7_N/O_CONT	IND7 normally open
	2335	IND7_N/C_CONT	IND7 normally close
	2336	IND8_N/O_CONT	IND8 normally open
	2337	IND8_N/C_CONT	IND8 normally close
	2338	CB_SELCMD	CB selection command
	2339	CB_OPCMD	CB open command
	2340	CB_CLCMD	CB close command
	2341	DS1_SELCMD	DS1selection command
	2342	DS1_OPCMD	DS1 open command
	2343	DS1_CLCMD	DS1 close command
	2344	DS2_SELCMD	DS2 selection command
	2345	DS2_OPCMD	DS2 open command
	2346	DS2_CLCMD	DS2 close command
	2347	DS3_SELCMD	DS3 selection command
	2348	DS3_OPCMD	DS3 open command
	2349	DS3_CLCMD	DS3 close command
	2350	DS4_SELCMD	DS4 selection command
	2351	DS4_OPCMD	DS4 open command
	2352	DS4_CLCMD	DS4 close command
	2353	DS5_SELCMD	DS5 selection command
	2354	DS5_OPCMD	DS5 open command
	2355	DS5_CLCMD	DS5 close command
	2356	EDS1_SELCMD	EDS1 selection command
	2357	EDS1_OPCMD	EDS1 open command
	2358	EDS1_CLCMD	EDS1 close command
	2359	EDS1_EARCMD	EDS1 earth command
	2360	EDS1_FRCMD	EDS1 free command
	2361	EDS2_SELCMD	EDS2 selection command
	2362	EDS2_OPCMD	EDS2 open command
	2363	EDS2_CLCMD	EDS2 close command
	2364	EDS2_EARCMD	EDS2 earth command
	2365	EDS2_FRCMD	EDS2 free command
	2366	COS1_SELCMD	COS1 selection command
	2367	COS1_ONCMD	COS1 ON command
	2368	COS1_OFFCMD	COS1 OFF command
	2369	COS2_SELCMD	COS2 selection command
	2370	COS2_ONCMD	COS2 ON command
	2371	COS2_OFFCMD	COS2 OFF command
	2372	COS3_SELCMD	COS3 selection command
	2373	COS3_ONCMD	COS3 ON command
	2374	COS3_OFFCMD	COS3 OFF command
	2375	COS4_SELCMD	COS4 selection command
	2376	COS4_ONCMD	COS4 ON command
	2377	COS4_OFFCMD	COS4 OFF command
	2378	CB_OPILOCK	CB open interlock fail
	2379	CB_CLILOCK	CB close interlock fail
	2380	DS1_OPILOCK	DS1 open interlock fail

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No.	Record item Common	Contents
2381	DS1_CLILOCK	DS1 close interlock fail
2382	DS2_OPILOCK	DS2 open interlock fail
2383	DS2_CLILOCK	DS2 close interlock fail
2384	DS3_OPILOCK	DS3 open interlock fail
2385	DS3_CLILOCK	DS3 close interlock fail
2386	DS4_OPILOCK	DS4 open interlock fail
2387	DS4_CLILOCK	DS4 close interlock fail
2388	DS5_OPILOCK	DS5 open interlock fail
2389	DS5_CLILOCK	DS5 close interlock fail
2390	EDS1_OPILOCK	EDS1 open interlock fail
2391	EDS1_CLILOCK	EDS1 close interlock fail
2392	EDS1_EARILOCK	EDS1 earth interlock fail
2393	EDS1_FRILOCK	EDS1 free interlock fail
2394	EDS2_OPILOCK	EDS2 open interlock fail
2395	EDS2_CLILOCK	EDS2 close interlock fail
2396	EDS2_EARILOCK	EDS2 earth interlock fail
2397	EDS2_FRILOCK	EDS2 free interlock fail
2398	COS1_ONILOCK	COS1 on interlock fail
2399	COS1_OFFILOCK	COS1 off interlock fail
2400	COS2_ONILOCK	COS2 on interlock fail
2401	COS2_OFFILOCK	COS2 off interlock fail
2402	COS3_ONILOCK	COS3 on interlock fail
2403	COS3_OFFILOCK	COS3 off interlock fail
2404	COS4_ONILOCK	COS4 on interlock fail
2405	COS4_OFFILOCK	COS4 off interlock fail
2406	CNT1_SIG	Count1 signal
2407	CNT2_SIG	Count2 signal
2408	CNT3_SIG	Count3 signal
2409	CNT4_SIG	Count4 signal
2410	CNT5_SIG	Count5 signal
2411	CNT6_SIG	Count6 signal
2412	CNT7_SIG	Count7 signal
2413	CNT8_SIG	Count8 signal
2414		
2415	SYNC_ESTB_C	SYNC. Check establish
2416	DF_SYNC_CHK	DF Check establish
2417	TRIP_SIG	Trip signal
2418	ONTIME1_SIG	On time1 signal
2419	ONTIME2_SIG	On time2 signal
2420	ONTIME3_SIG	On time3 signal
2421	ONTIME4_SIG	On time4 signal
2422	ONTIME5_SIG	On time5 signal
2423	ONTIME6_SIG	On time6 signal
2424	ONTIME7_SIG	On time7 signal
2425	ONTIME8_SIG	On time8 signal
2426	CB_OP_COM	CB OPEN command received
2427	DS1_OP_COM	DS1 OPEN command received
2428	DS2_OP_COM	DS2 OPEN command received
2429	DS3_OP_COM	DS3 OPEN command received
2430	DS4_OP_COM	DS4 OPEN command received
2431	DS5_OP_COM	DS5 OPEN command received
2432	EDS1_CO_COM	EDS1 CLOSE to OPEN command received
2433	EDS2_CO_COM	EDS2 CLOSE to OPEN command received
2434	COS1_ON_COM	COS1 ON command received
2435	COS2_ON_COM	COS2 ON command received
2436	COS3_ON_COM	COS3 ON command received
2437	COS4_ON_COM	COS4 ON command received
2438	OPEBLK_COM	Operation Block command received
2439	ILOCKBYPS_COM	Interlock Bypass command received
2440	EDS1_EO_COM	EDS1 EARTH to OPEN command received
2441	EDS2_EO_COM	EDS2 EARTH to OPEN command received
2442	CB_CL_COM	CB CLOSE command received
2443	DS1_CL_COM	DS1 CLOSE command received
2444	DS2_CL_COM	DS2 CLOSE command received
2445	DS3_CL_COM	DS3 CLOSE command received
2446	DS4_CL_COM	DS4 CLOSE command received
2447	DS5_CL_COM	DS5 CLOSE command received
2448	EDS1_OC_COM	EDS1 OPEN to CLOSE command received
2449	EDS2_OC_COM	EDS2 OPEN to CLOSE command received
2450	COS1_OFF_COM	COS1 OFF command received
2451	COS2_OFF_COM	COS2 OFF command received
2452	COS3_OFF_COM	COS3 OFF command received
2453	COS4_OFF_COM	COS4 OFF command received
2454	OPENORM_COM	Operation block cancel command received
2455	IUNLOCK_COM	Interlock Bypass cancel command received
2456	EDS1_OE_COM	EDS1 OPEN to EARTH command received
2457	EDS2_OE_COM	EDS2 OPEN to EARTH command received
2458	RMT_C_RIGHT	Remote control command
2459	LOC_C_RIGHT	Local control command
2460		
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:		
2540		

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Signal list (PLC output)

	No.	Record item Common	Contents
	2541		
	2542		
	2543		
	2544		
	2545		
	2546		
	2547		
	2548		
	2549		
	2550		
	2551		
	2552		
	2553		
	2554		
	2555		
	2556		
	2557		
	2558		
	2559		
Others	2560	IO1-TP1	Binary output signal of IO1-TP1
	2561	IO1-TP2	TP2
	2562	IO1-BO1	BO1
	2563	IO1-BO2	2
	2564	IO1-BO3	3
	2565	IO1-BO4	4
	2566	IO1-BO5	5
	2567	IO1-FAIL	Binary output signal of fail-BO
	2568	IO2-TP1	Binary output signal of IO2-TP1
	2569	IO2-TP2	TP2
	2570	IO2-BO1	BO1
	2571	IO2-BO2	2
	2572	IO2-BO3	3
	2573	IO2-BO4	4
	2574	IO2-BO5	5
	2575	IO2-BO6	6
	2576	IO3-TP1	Binary output signal of IO3-TP1
	2577	IO3-TP2	TP2
	2578	IO3-BO1	BO1
	2579	IO3-BO2	2
	2580	IO3-BO3	3
	2581	IO3-BO4	4
	2582	IO3-BO5	5
	2583	IO3-BO6	6
	2584	IO4-TP1	Binary output signal of IO4-TP1
	2585	IO4-TP2	TP2
	2586	IO4-BO1	BO1
	2587	IO4-BO2	2
	2588	IO4-BO3	3
	2589	IO4-BO4	4
	2590	IO4-BO5	5
	2591	IO4-BO6	6
	2592		
	2593		
	2594		
	2595		
	2596		
	2597		
	2598		
	2599		
	2600		
	2601		
	2602		
	2603		
	2604		
	2605		
	2606		
	2607		
	2608		
	2609	LED_RST	LED reset command
	2610		
	2611	LED1	LED1 lit output
	2612	LED2	2
	2613	LED3	3
	2614	LED4	4
	2615	LED5	5
	2616	LED6	6
	2617	LED7	7
	2618	LED8	8
	2619		
	2620		

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Signal list (PLC output)

No.	Record item Common	Contents
2621		
2622		
2623		
2624	F.RECORD1	Fault record stored command 1
2625	F.RECORD2	2
2626	F.RECORD3	3
2627	F.RECORD4	4
2628		
2629		
2630		
2631		
2632	D.RECORD1	Disturbance record stored command 1
2633	D.RECORD2	2
2634	D.RECORD3	3
2635	D.RECORD4	4
2636	D.RECORD5	5
2637	D.RECORD6	6
2638	D.RECORD7	7
2639	D.RECORD8	8
2640	SET.GROUP1	Active setting group changed commamd (Change to group1)
2641	SET.GROUP2	2
2642	SET.GROUP3	3
2643	SET.GROUP4	4
2644	SET.GROUP5	5
2645	SET.GROUP6	6
2646	SET.GROUP7	7
2647	SET.GROUP8	8
2648	SYNC_CLOCK	Clock synchronized command
2649		
2650		
2651		
2652		
2653		
2654		
2655		
2656	TP_COUNT	Trip counter count up command
2657		
2658		
2659		
2660	SGM_IY	Sigma IY counter count up command
2661		
2662		
2663		
2664		
2665		
2666		
2667		
2668		
2669		
2670		
2671		
2672		
2673		
2674		
2675		
2676		
2677		
2678		
2679		
2680		
2681		
2682		
2683		
2684	ARC_COM_RECV	Auto-recloser inactivate command received
2685		
2686	PROT_COM_RECV	protection inactivate command received
2687		
2688	TPLED_RST_RCV	TRIP LED RESET command received
2689	ALMLED_RST_RCV	ALARM LED RESET command received
2690	TPALM_RST_RCV	TRIP/ALARM LED RESET command received
2691		
2692		
2693		
2694		
2695		
2696		
2697		
:		
:		
2800		

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Signal list (PLC output)

	No.	Record item Common	Contents
	2801		
	2802		
	2803		
	2804		
	2805		
	2806		
	2807		
	2808		
	2809		
	2810		
	2811		
	2812		
	2813		
	2814		
	2815		
Temporary	2816	TEMP001	
	2817	TEMP002	
	2818	TEMP003	
	2819	TEMP004	
	2820	TEMP005	
	2821	TEMP006	
	2822	TEMP007	
	2823	TEMP008	
	2824	TEMP009	
	2825	TEMP010	
	2826	TEMP011	
	2827	TEMP012	
	2828	TEMP013	
	2829	TEMP014	
	2830	TEMP015	
	2831	TEMP016	
	2832	TEMP017	
	2833	TEMP018	
	2834	TEMP019	
	2835	TEMP020	
	2836	TEMP021	
	2837	TEMP022	
	2838	TEMP023	
	2839	TEMP024	
	2840	TEMP025	
	2841	TEMP026	
	2842	TEMP027	
	2843	TEMP028	
	2844	TEMP029	
	2845	TEMP030	
	2846	TEMP031	
	2847	TEMP032	
	2848	TEMP033	
	2849	TEMP034	
	2850	TEMP035	
	2851	TEMP036	
	2852	TEMP037	
	2853	TEMP038	
	2854	TEMP039	
	2855	TEMP040	
	2856	TEMP041	
	2857	TEMP042	
	2858	TEMP043	
	2859	TEMP044	
	2860	TEMP045	
	2861	TEMP046	
	2862	TEMP047	
	2863	TEMP048	
	2864	TEMP049	
	2865	TEMP050	
	2866	TEMP051	
	2867	TEMP052	
	2868	TEMP053	
	2869	TEMP054	
	2870	TEMP055	
	2871	TEMP056	
	2872	TEMP057	
	2873	TEMP058	
	2874	TEMP059	
	2875	TEMP060	
	2876	TEMP061	
	2877	TEMP062	
	2878	TEMP063	
	2879	TEMP064	
	2880	TEMP065	

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Signal list (PLC output)

No.	Record item Common	Contents
2881	TEMP066	
2882	TEMP067	
2883	TEMP068	
2884	TEMP069	
2885	TEMP070	
2886	TEMP071	
2887	TEMP072	
2888	TEMP073	
2889	TEMP074	
2890	TEMP075	
2891	TEMP076	
2892	TEMP077	
2893	TEMP078	
2894	TEMP079	
2895	TEMP080	
2896	TEMP081	
2897	TEMP082	
2898	TEMP083	
2899	TEMP084	
2900	TEMP085	
2901	TEMP086	
2902	TEMP087	
2903	TEMP088	
2904	TEMP089	
2905	TEMP090	
2906	TEMP091	
2907	TEMP092	
2908	TEMP093	
2909	TEMP094	
2910	TEMP095	
2911	TEMP096	
2912	TEMP097	
2913	TEMP098	
2914	TEMP099	
2915	TEMP100	
2916	TEMP101	
2917	TEMP102	
2918	TEMP103	
2919	TEMP104	
2920	TEMP105	
2921	TEMP106	
2922	TEMP107	
2923	TEMP108	
2924	TEMP109	
2925	TEMP110	
2926	TEMP111	
2927	TEMP112	
2928	TEMP113	
2929	TEMP114	
2930	TEMP115	
2931	TEMP116	
2932	TEMP117	
2933	TEMP118	
2934	TEMP119	
2935	TEMP120	
2936	TEMP121	
2937	TEMP122	
2938	TEMP123	
2939	TEMP124	
2940	TEMP125	
2941	TEMP126	
2942	TEMP127	
2943	TEMP128	
2944	TEMP129	
2945	TEMP130	
2946	TEMP131	
2947	TEMP132	
2948	TEMP133	
2949	TEMP134	
2950	TEMP135	
2951	TEMP136	
2952	TEMP137	
2953	TEMP138	
2954	TEMP139	
2955	TEMP140	
2956	TEMP141	
2957	TEMP142	
2958	TEMP143	
2959	TEMP144	
2960	TEMP145	

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Signal list (PLC output)

No.	Record item Common	Contents
2961	TEMP146	
2962	TEMP147	
2963	TEMP148	
2964	TEMP149	
2965	TEMP150	
2966	TEMP151	
2967	TEMP152	
2968	TEMP153	
2969	TEMP154	
2970	TEMP155	
2971	TEMP156	
2972	TEMP157	
2973	TEMP158	
2974	TEMP159	
2975	TEMP160	
2976	TEMP161	
2977	TEMP162	
2978	TEMP163	
2979	TEMP164	
2980	TEMP165	
2981	TEMP166	
2982	TEMP167	
2983	TEMP168	
2984	TEMP169	
2985	TEMP170	
2986	TEMP171	
2987	TEMP172	
2988	TEMP173	
2989	TEMP174	
2990	TEMP175	
2991	TEMP176	
2992	TEMP177	
2993	TEMP178	
2994	TEMP179	
2995	TEMP180	
2996	TEMP181	
2997	TEMP182	
2998	TEMP183	
2999	TEMP184	
3000	TEMP185	
3001	TEMP186	
3002	TEMP187	
3003	TEMP188	
3004	TEMP189	
3005	TEMP190	
3006	TEMP191	
3007	TEMP192	
3008	TEMP193	
3009	TEMP194	
3010	TEMP195	
3011	TEMP196	
3012	TEMP197	
3013	TEMP198	
3014	TEMP199	
3015	TEMP200	
3016	TEMP201	
3017	TEMP202	
3018	TEMP203	
3019	TEMP204	
3020	TEMP205	
3021	TEMP206	
3022	TEMP207	
3023	TEMP208	
3024	TEMP209	
3025	TEMP210	
3026	TEMP211	
3027	TEMP212	
3028	TEMP213	
3029	TEMP214	
3030	TEMP215	
3031	TEMP216	
3032	TEMP217	
3033	TEMP218	
3034	TEMP219	
3035	TEMP220	
3036	TEMP221	
3037	TEMP222	
3038	TEMP223	
3039	TEMP224	
3040	TEMP225	

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Signal list (PLC output)

No.	Record item Common	Contents
3041	TEMP226	
3042	TEMP227	
3043	TEMP228	
3044	TEMP229	
3045	TEMP230	
3046	TEMP231	
3047	TEMP232	
3048	TEMP233	
3049	TEMP234	
3050	TEMP235	
3051	TEMP236	
3052	TEMP237	
3053	TEMP238	
3054	TEMP239	
3055	TEMP240	
3056	TEMP241	
3057	TEMP242	
3058	TEMP243	
3059	TEMP244	
3060	TEMP245	
3061	TEMP246	
3062	TEMP247	
3063	TEMP248	
3064	TEMP249	
3065	TEMP250	
3066	TEMP251	
3067	TEMP252	
3068	TEMP253	
3069	TEMP254	
3070	TEMP255	
3071	TEMP256	

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Appendix D

LCD Message for Fault Record

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Fault Record

Item	LCD message	Description	
Operating Phase	A	A ohase	
	B	B phase	
	C	C phase	
	AB	A-B phase	
	BC	B-C phase	
	CA	C-A phase	
Trip Mode	OC1	OC1trip	
	OC2	2	
	OC3	3	
	OC4	4	(For Alarm)
	DOC1	DOC1 trip	
	DOC2	2	
	DOC3	3	
	DOC4	4	(For Alarm)
	EF1	EF1 trip	
	EF2	2	
	EF3	3	
	EF4	4	(For Alarm)
	DEF1	DEF1 trip	
	DEF2	2	
	DEF3	3	
	DEF4	4	(For Alarm)
	SEF1	SEF1 trip	
	SEF1-2	SEF1 Stage2 trip	
	SEF2	SEF2 trip	
	SEF3	3	
	SEF4	4	(For Alarm)
	DSEF1	DSEF1 trip	
	DSEF1-2	DSEF1 Stage2 trip	
	DSEF2	DSEF2 trip	
	DSEF3	3	
	DSEF4	4	(For Alarm)
	NOC1	NOC1 NOC1 trip	
	NOC2	2	
	DNOC1	DNOC1 trip	
	DNOC2	2	
	UC1	UC1 trip	
	UC2	2	
	THM-A	Thermal Alarm	
	THM	Thermal trip	
	BCD	Broken Conductor trip	
	CBF-RE	CBF Retrip	
	CBF	CBF Back trip	
	OV1	OV1 trip	
	OV2	2	(For Alarm)
	UV1	UV1 trip	
	UV2	2	(For Alarm)
	ZOV1	ZOV1 trip	
	ZOV2	2	(For Alarm)
	NOV1	NOV1 trip	
	NOV2	2	(For Alarm)
	FRQ1	FRQ1 trip	
	FRQ2	2	
	FRQ3	3	
	FRQ4	4	
	FRQ5	5	
	FRQ6	6	
	EXTTP	Autoreclose initiation by Ext trip	
	ARC-FT	Final trip (ARC failed)	
Auto Reclosing Mode	ARC1-S1	Autoreclosing-Stage1 shot1 output	
	ARC1 S2	2	
	ARC1-S3	3	
	ARC1-S4	4	
	ARC1-S5	5	
	ARC2-S1	Autoreclosing-Stage2 shot1 output	
	ARC2-S2	2	
	ARC2-S3	3	

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Appendix E

Details of Relay Menu and LCD & Button Operation

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```
Main menu                 25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test
```

```
MIMIC                     25/Feb/2003 09:45
```

When pressing the L/R key to enter into "Local" control mode, the following password trap screen is displayed.

```
MIMIC                     25/Feb/2003 09:45



Password [      ]          <0123456789
```

```
MIMIC                     25/Feb/2003 09:45
```

MIMIC operation is enabled.

```
Record                    25/Feb/2003 09:45
Fault record
Alarm record
Event record
Disturbance record
Counters
Clear records
```

```
Record-Fault record       25/Feb/2003 09:45

#1 19/Oct/2002 09:32:50.091
#2 20/Sep/2002 10:33:55.091
```

```
Record-Fault record       25/Feb/2003 09:45
Fault#1 19/Oct/2002 09:32:50.091       1/4
Phase A               FL ***.*km (***)%
OC1
```

```
Record-Alarm record       25/Feb/2003 09:45
                                   ***/***
#1 10/Feb/2003 11:22:33.456
   **************             OFF
#2 10/Feb/2003 11:22:31.987
   **************             ON
```

```
Record-Event record       25/Feb/2003 09:45
                                   ***/***
#1 10/Feb/2003 11:22:33.456
   **************             OFF
#2 10/Feb/2003 11:22:31.987
   **************             ON
```

```
Record-Disturbance record 25/Feb/2003 09:45

#1 19/Oct/2002 09:32:50.091
#2 20/Sep/2002 10:33:55.091
```

```
Record-Counters           25/Feb/2003 09:45
                                       1/2
Trips   *****     ΣI^yA   ******E6
ARCs    *****     ΣI^yB   ******E6
                  ΣI^yC   ******E6
```

```
Record-Clear records      25/Feb/2003 09:45
Clear all records
Clear fault records
Clear alarm records
Clear event records
Clear disturbance records
Clear all counters
```

a-1

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a-1

```
Status                    25/Feb/2003 09:45
Metering
Relay element
Condition monitoring
Binary I/O
Information
```

```
Status-Metering           25/Feb/2003 09:45
Current
Demand
```

```
Status-Metering           25/Feb/2003 09:45
Current                                 1/2
Va   ***.**kV –***.*°   Ia  ******A –***.*°
Va   ***.**kV –***.*°   Ia  ******A –***.*°
Va   ***.**kV –***.*°   Ia  ******A –***.*°
```

```
Status-Metering           25/Feb/2003 09:45
Demand
Ia   max  ******A
Ib   max  ******A
Ic   max  ******A
```

```
Status-Relay element      25/Feb/2003 09:45
                                        1/2
A OC  [0000    ]       A DOC [0000    ]
B OC  [0000    ]       B DOC [0000    ]
C OC  [0000    ]       C DOC [0000    ]
```

```
Status-Cond. monitoring   25/Feb/2003 09:45
Operation time
Clear operation time
```

```
Status-Cond. monitoring    25/Feb/2003 09:45
Operation time                          1/2
CB   OPEN T     last **.***s   max **.***s
CB   CLOSE T    last **.***s   max **.***s
DS1  OPEN T     last **.***s   max **.***s
```

```
Status-Cond. monitoring    25/Feb/2003 09:45
Operation time
Clear operation time


Clear operation time? Y=ENTER/N=CANCEL
```

```
Status-Binary I/O         25/Feb/2003 09:45

Input IO1          [0000 0000 00  ]
Input IO2          [0000 0000 00  ]
```

```
Status-Information        25/Feb/2003 09:45
Relay version
 Relay type:    GRD150-101A-30-10
 Serial No.:    1234567890123456789012
 Main software: GS1FM1-01-A
 PLC data:      PLCDefault10 (12E05A78)
 IEC103 data:   *********** (000AE309)
```

a-1

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a-1

```
Settings menu            25/Feb/2003 09:45
Protection
Control
Record
Status
Time
Communication
Password
Panel
Others
```

▶: Password trap

```
Main menu                25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test

Password[   ]                 <0123456789
```

```
Settings-Protection      25/Feb/2003 09:45
Change active group
Change settings
Copy group
```

```
Settings-Protection      25/Feb/2003 09:45
Change active group
 Active group No. #    #
```

```
Settings-Protection      25/Feb/2003 09:45
Change settings (Active group=1)
  Common
  Group1
  Group2
```

```
Settings-Protection      25/Feb/2003 09:45
Common                                 1/2
APPL-CT   ***  ***
APPL-VT   ***  ***
APPL-VTS  ***  ***
```

```
Settings-Protection      25/Feb/2003 09:45
Group1
  Line name              NOC
  VT/CT ratio            DNOC
  FL                     UC/Thermal/BCD
  OC                     CBF
  DOC                    Cold Load/Inrush
  EF                     OV/UV
  DEF                    FRQ
  SEF                    CTF/VTF
  DSEF                   ARC
                         Sync CHK
                         PLC setting
```

```
Settings-Protection      25/Feb/2003 09:45
Group1-Line name
Line name  *********************
```

```
Settings-Protection      25/Feb/2003 09:45
Group1-VT/CT ratio
VT ratio   *****  *****
CT ratio   *****  *****
VTS ratio  *****  *****
```

```
Settings-Protection      25/Feb/2003 09:45
Group1-FL
X1   ***.**Ω  ***.**Ω   R1  ***.**Ω  ***.**Ω
X0   ***.**Ω  ***.**Ω   R0  ***.**Ω  ***.**Ω
kab   ***%     ***%     kab  ***%     ***%
```

```
Settings-Protection      25/Feb/2003 09:45
Group1-OC                              1/5
OC1EN      ***   ***    OC1     ##.#A   ##.#A
MOC1      ****  ****    TOC1D ###.##s ###.##s
MOC1C-IEC  ***   ***    TOC1P  #.###   #.###
```

```
Settings-Protection      25/Feb/2003 09:45
Group1-DOC                             1/5
DOCθ      -##°  -##°

DOC1EN     ***   ***    DOC1    ##.#A   ##.#A
```

a-1 b-1 c-1 D-1 E-1

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a-1 b-1 c-1 D-1 E-1

```
Settings-Protection        25/Feb/2003 09:45
Group1-EF                                1/5
EF1EN       ***   ***   EF1      ##.#A   ##.#A
MEF1       ****  ****   TEF1D ###.##s ###.##s
MEF1C-IEC   ***   ***   TEF1P  #.###    #.###
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-DEF                               1/5
DEFθ       -##°   -##°   DEFV    ###.#V  ###.#V

DEF1EN      ***    ***   DEF1   ##.##A  ##.##A
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-SEF                               1/5
SE1EN       ***   ***   SE1    #.###A   #.###A
MSE1       ****  ****   TSE1D ###.##s  ###.##s
MEF1C-IEC   ***   ***   TEF1P  #.###    #.###
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-DSEF                              1/5
DSEθ       -##°   -##°   DSEV   ###.#V  ###.#V
DSE1EN      ***    ***   DSE1   #.###A  #.###A
DSE1-DIR    ***    ***   TDSE1D ###.##s ###.##s
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-NOC
NC1EN       ***   ***    NC2EN       ***   ***
MNC1       ****  ****    NC2-2F      ***   ***
MNC1C-IEC   ***   ***    TNC2   ###.##s ###.##s
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-DNOC                              1/2
DNCθ       -##°   -##°   DNCV    ##.#V   ##.#V

DNC1EN      ***    ***   DNC1     #.#A    #.#A
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-UC/Thermal/BCD
UC1EN     ***   ***      BCDEN       ***   ***
UC1     ##.#A  ##.#A     BCD-2F      ***   ***
TUC1 ###.##s ###.##s     BCD       ##.#A  ##.#A
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-CBF
CBF     ##.#A  ##.#A

BTC       ***   ***
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-Cold load/Inrush                  1/2
CLEN      ***   ***      OC1     ##.#A   ##.#A
CLDOEN    ***   ***      OC2   ###.##A ###.##A
TCLE   #####s  #####s    OC3   ###.##A ###.##A
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-OV/UV                             1/2
OV1EN    ****  ****      OV1EN    ****  ****
OV1    ###.#V ###.#V     OV1    ###.#V ###.#V
TOV1D ###.##s ###.##s    TOV1D ###.##s ###.##s
```

a-1 b-1 c-1 D-1 E-1

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a-1 b-1 c-1 D-1 E-1

```
Settings-Protection        25/Feb/2003 09:45
Group1-FRQ
FRQ1EN      ***   ***   FRQ4EN      ***   ***
FRQ1  ##.##Hz ##.##Hz   FRQ4  ##.##Hz ##.##Hz
TFRQ1 ###.##s ###.##s   TFRQ4 ###.##s ###.##s
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-ARC                               1/4
ARCEN        ***   ***
ARCEN-S      ***   ***
ARCEN-C      ***   ***
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-Sync CHK
OVR     ###.#V  ###.#V
UVR     ###.#V  ###.#V
OVI     ###.#V  ###.#V
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-CTF/VTF
EFF     ##.##A  ##.##A
ZOVF    ###.#V  ###.#V
UVF     ###.#V  ###.#V
```

```
Settings-Protection        25/Feb/2003 09:45
Group1-PLC setting
UTM1    ***.**  ***.**s   USW1  ##   ##
UTM2    ***.**  ***.**s   USW2  ##   ##
UTM3    ***.**  ***.**s   USW3  ##   ##
```

```
Settings-Protection        25/Feb/2003 09:45
Group8
 Line name            NOC
 VT/CT ratio          DNOC
 FL                   UC/Thermal/BCD
 OC                   CBF
 DOC                  Cold Load/Inrush
 EF                   OV/UV
 DEF                  FRQ
 SEF                  CTF/VTF
 DSEF                 ARC
                      Sync CHK
                      PLC setting
```

```
Settings-Protection        25/Feb/2003 09:45
Copy group A to B (Active group=1)
  Group A   #
  Group B   #

    Execute
```

```
Settings-Control           25/Feb/2003 09:45
Switch
Pulse width
Alarm setting
```

```
Settings-Control           25/Feb/2003 09:45
Switch
OPLK    ******  ******
```

```
Settings-Control           25/Feb/2003 09:45
Pulse width
CBPM        ***   ***    DP3PM       ***   ***
CBOPP  ###.#s  ###.#s    DS3OPP ###.#s  ###.#s
CBCLP  ###.#s  ###.#s    DS3CLP ###.#s  ###.#s
```

```
Settings-Control           25/Feb/2003 09:45
Alarm setting                            1/2
CBPLT  ###.#s  ###.#s    CBRSPT ###.#s ###.#s

DS1PLT ###.#s  ###.#s   DS1RSPT ###.#s ###.#s
```

a-1 b-1

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a-1 b-1

```
Settings-Record            25/Feb/2003 09:45
Fault record
Disturbance record
Counter
```

```
Settings-Record            25/Feb/2003 09:45
Fault record
Fault locator    ***  ***
```

```
Settings-Record            25/Feb/2003 09:45
Disturbance record
AI sampling          ***   ***
Operation mode       ***   ***
Record time         ##.#s  ##.#s
```

```
Settings-Record            25/Feb/2003 09:45
Counter
Switch
Alarm setting
Change value
```

```
Settings-Record            25/Feb/2003 09:45
Counter-Switch                           1/2
CBCTS      *******   *******
DB1CTS     *******   *******
DB2CTS     *******   *******
```

```
Settings-Record            25/Feb/2003 09:45
Counter-Alarm setting                    1/4
Trip AEN    ***  ***  Trips ALM ##### #####
ΣI^y AEN    ***  ***  ΣI^y ALM #####E6 #####E6
Y VALUE    #.#  #.#
```

```
Settings-Record            25/Feb/2003 09:45
Counter-Change value                     1/2
Trips     ##### #####   ARCs     ##### #####
ΣI^yA   #####E6 #####E6
ΣI^yB   #####E6 #####E6
```

```
Settings-Status            25/Feb/2003 09:45
Metering switch
Alarm/Warning
Change value
```

```
Settings-Status            25/Feb/2003 09:45
Metering switch
Display value  *********  *********
Power            *******    *******
Current            ****       ****
Demand time        *****      *****
```

```
Settings-Status            25/Feb/2003 09:45
Alarm/Warning                            1/4
IHALMEN    ***  ***   IHALM ###.#kA ###.#kA
IHWAREN    ***  ***   IHWAR ###.#kA ###.#kA
ILALMEN    ***  ***   ILALM ###.#kA ###.#kA
```

```
Settings-Status            25/Feb/2003 09:45
Change value
Wh+     ######kWh    ######kWh
Wh-     ######kWh    ######kWh
varh+   ######kvarh  ######kvarh
varh-   ######kvarh  ######kvarh
```

a-1 b-1

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a-1 b-1

```
Settings-Time              25/Feb/2003 09:45

Time sync source    *******  *******
Sync adjustment     -####ms  -####ms
```

```
Settings-Communication     25/Feb/2003 09:45
Front port
Rear port
Protocol
```

```
Settings-Communication     25/Feb/2003 09:45
Front port
232C baut rate    ****  ****
```

```
Settings-Communication     25/Feb/2003 09:45
Rear port
CH1 Protocol    ******  ******
    Baud rate    ****    ****
    Stop bit     ****    ****
```

```
Settings-Communication     25/Feb/2003 09:45
Protocol
Modbus
RSM-X
IEC103
DNP3.0
```

```
Settings-Communication     25/Feb/2003 09:45
Protocol-Modbus
Address CH1   ###  ###
Address CH3   ###  ###
```

```
Settings-Communication     25/Feb/2003 09:45
Protocol-RSM-X
Address     ##  ##
```

```
Settings-Communication     25/Feb/2003 09:45
Protocol-IEC103
Address CH2   ###  ###
Address CH3   ###  ###
M.D.BLK   *******  ******
```

```
Settings-Communication     25/Feb/2003 09:45
Protocol-DNP3.0
Address CH2   #####  #####
Address CH3   #####  #####
```

```
Settings-Password          25/Feb/2003 09:45

Input new MIMIC password   :####
Input new Setting password :####
Input new Test password    :####

                              <0123456789
```

```
Settings-Panel             25/Feb/2003 09:45

LCD contrast [***********                  ]
BLOFFT       ##min  ##min
STARSTT      ##hrs ##hrs
```

```
Settings-Others            25/Feb/2003 09:45

Plant name     [**********************]
Description    [**********************]
```

a-1

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a-1

```
Test menu                    25/Feb/2003 09:45
Switch
Binary1 O/P
Logic circuit
```

```
Test-Switch             25/Feb/2003 09:45
Switch
A.M.F.     ***
UV test    ***
THM test   ***
SHOT NUM   ***
CLP test

Test mode  ******
Interlock  ******

IEC103 test   ***
```

```
Test-Binary O/P            25/Feb/2003 09:45
                                         1/2
IO1                         IO2
TRP1:TB3-19,20     ***   TRP1:TB5-19,20   ***
TRP2:TB4- 1, 2     ***   TRP2:TB6- 1, 2   ***
```

```
Test-Logic circuit         25/Feb/2003 09:45

TermA      ####
TermB      ####
```

▶ : Password trap

```
Main menu                    25/Feb/2003 09:45
MIMIC
Record
Status
Settings
Test

Password[   ]                     <0123456789
```

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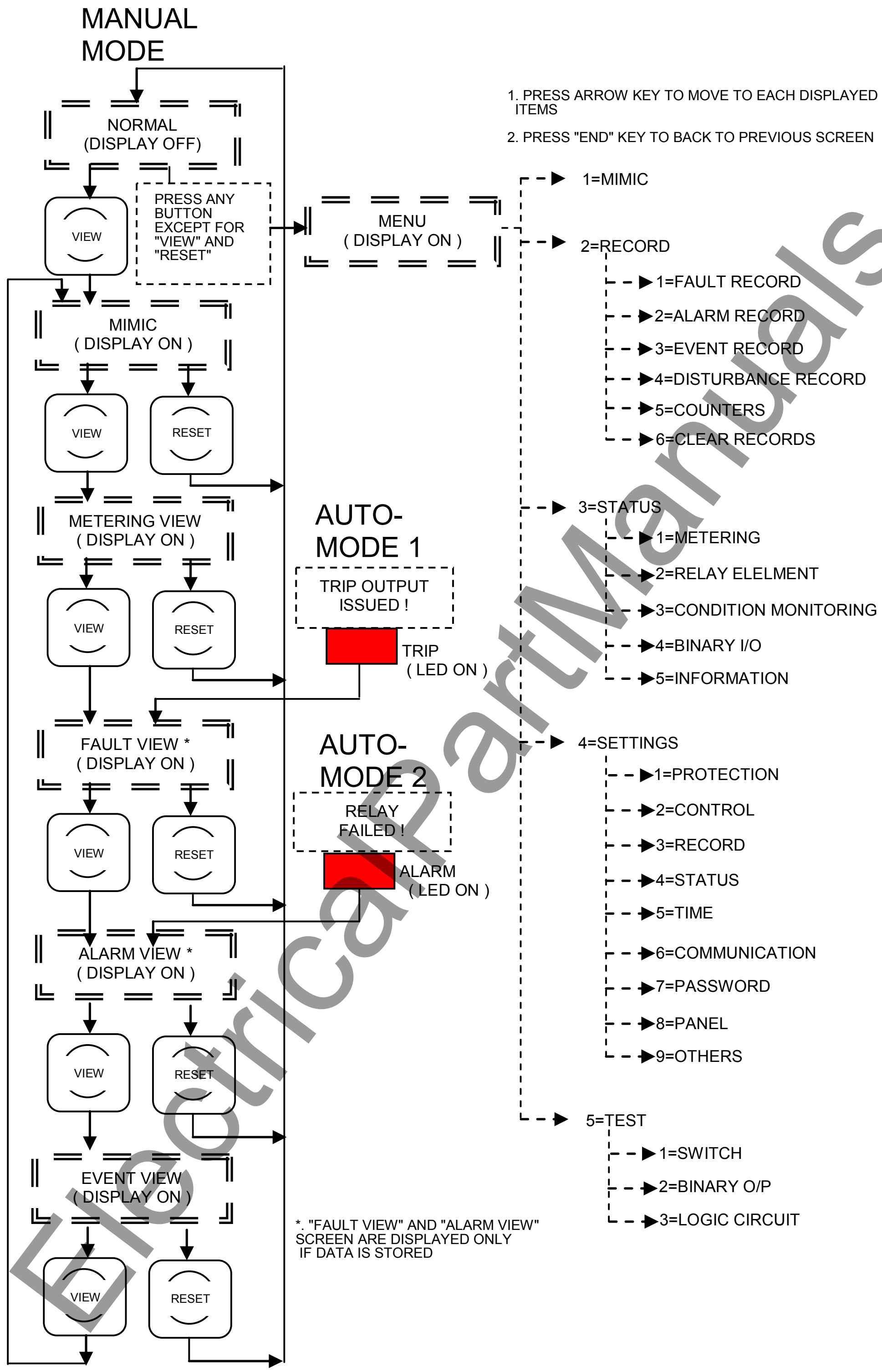
LCD AND BUTTON OPERATION INSTRUCTION



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Appendix F

Case Outline

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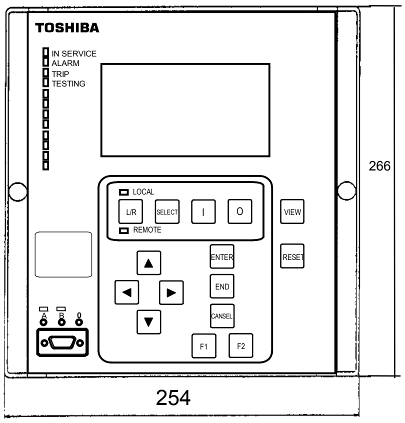
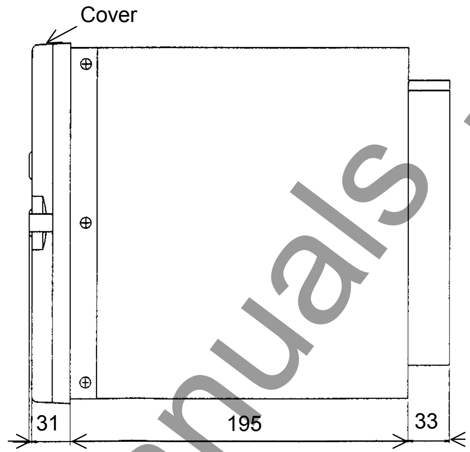
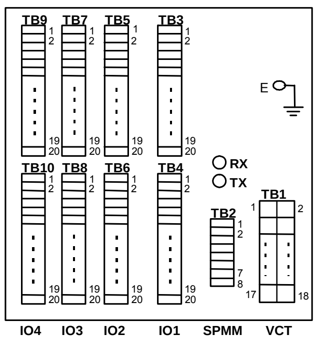


Front View

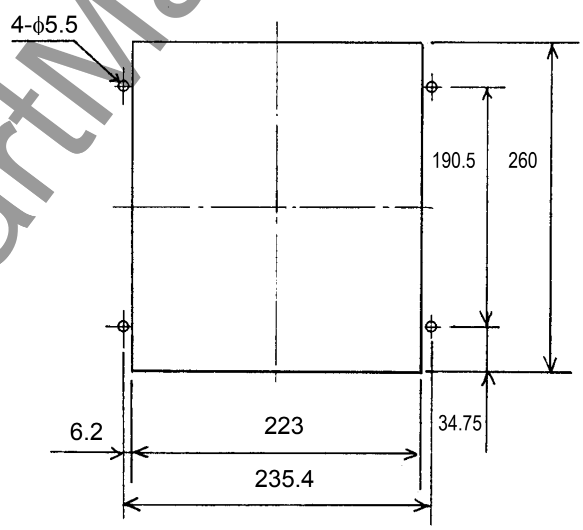


Side view



Model ∗∗1: IO1 only
Model ∗∗2: IO1, IO2
Model ∗∗3:IO1, IO2, IO3
Model ∗∗4: IO1, IO2, IO3, IO4

Rear View



Panel cut-out

Outline and Panel Cut-out Dimension

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Appendix G

Typical External Connection

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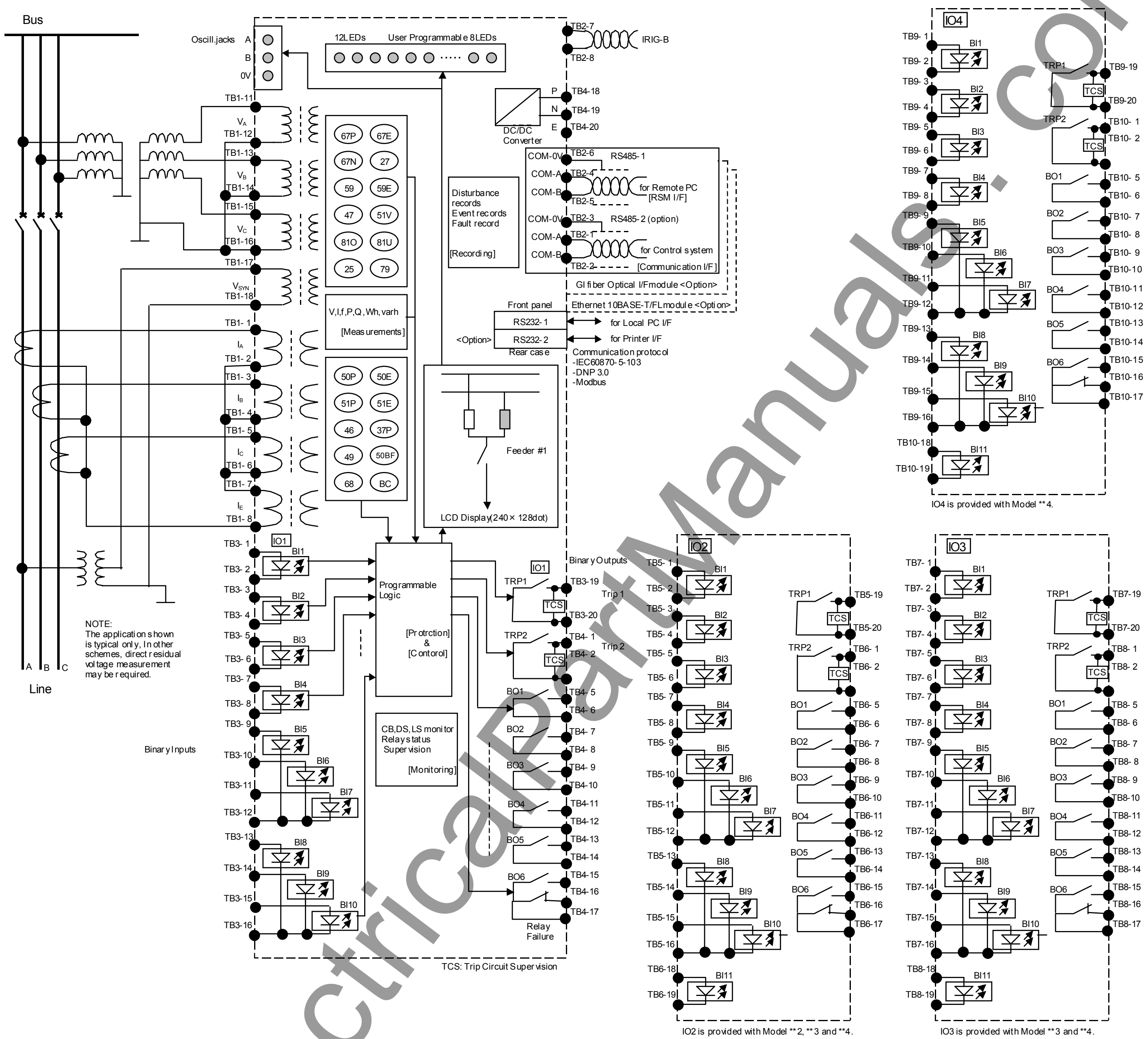

Typical External Connection

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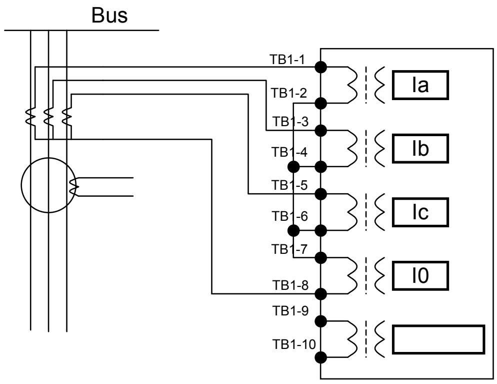
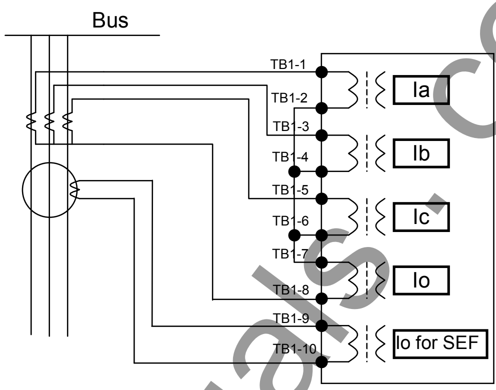
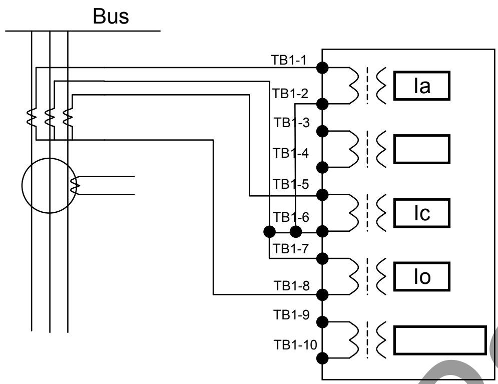
CT connection



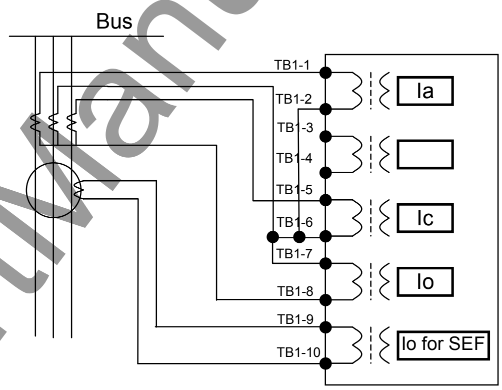
[APPL-CT] = 3P Setting for Model 1∗∗ or 3∗∗



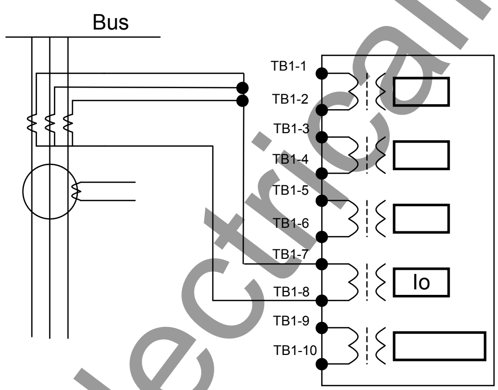
[APPL-CT] = 3P Setting for Model 2∗∗ or 4∗∗



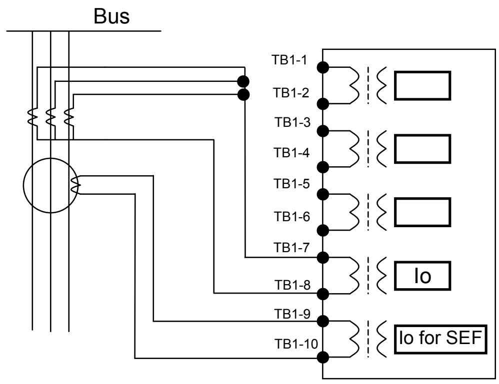
[APPL-CT] = 2P Setting for Model 1∗∗ or 3∗∗



[APPL-CT] = 2P Setting for Model 2∗∗ or 4∗∗



[APPL-CT] = 1P Setting for Model 1∗∗ or 3∗∗



[APPL-CT] = 1P Setting for Model 2∗∗ or 4∗∗

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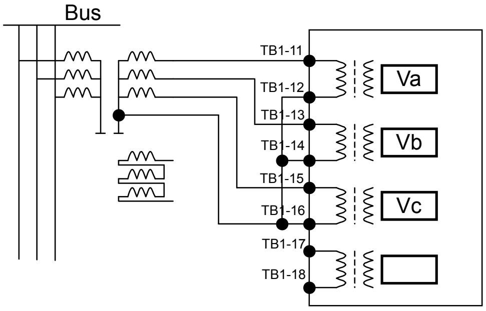
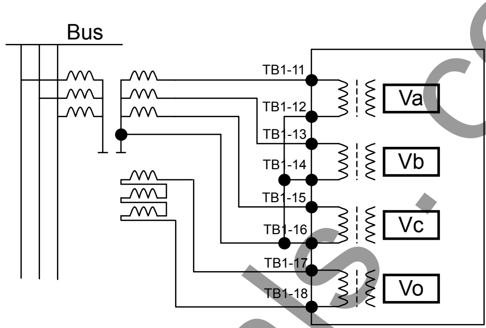
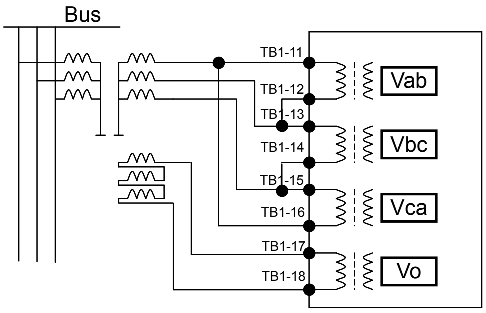
VT connection



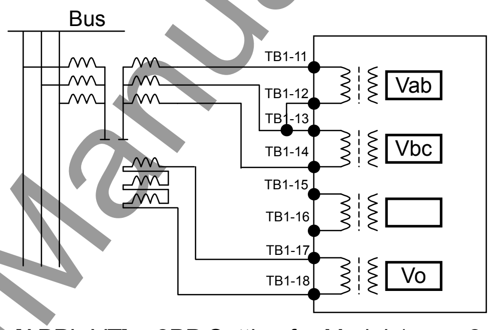
[APPL-VT] = 3PN Setting for Model 1∗∗ or 2∗∗



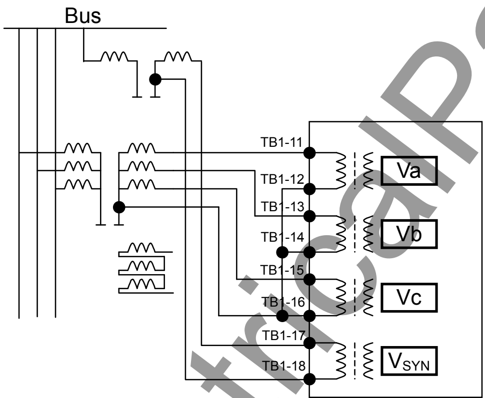
[APPL-VT] = 3PV Setting for Model 1∗∗ or 2∗∗



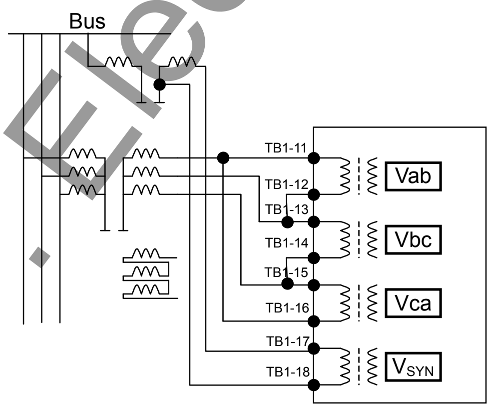
[APPL-VT] = 3PP Setting for Model 1∗∗ or 2∗∗



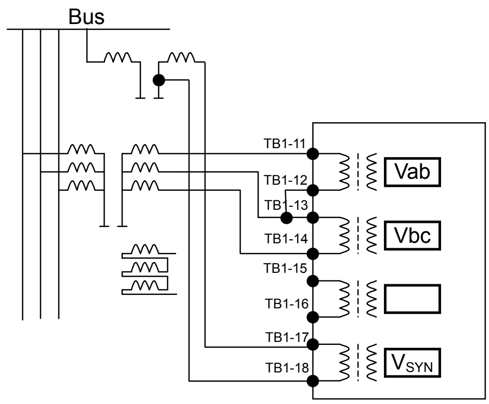
[APPL-VT] = 2PP Setting for Model 1∗∗ or 2∗∗



[APPL-VT] = 3PN Setting for Model 3∗∗ or 4∗∗



[APPL-VT] = 3PP Setting for Model 3∗∗ or 4∗∗



[APPL-VT] = 2PP Setting for Model 3∗∗ or 4∗∗

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Appendix H

Relay Setting Sheet

1. Relay Identification
2. Line parameters
3. Binary input and output setting
4. Programmable LED setting
5. Relay setting sheet

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1. Relay Identification Date:

Relay type
Frequency
DC supply voltage
Password
Active setting group

Serial Number
AC current

2. Line parameter

CT ratio OC: EF: SEF:
VT ratio

3. Binary input and output setting

Binary input

IO1
BI1
BI2
BI3
BI4
BI5
BI6
BI7
BI8
BI9
BI10

IO3
BI1
BI2
BI3
BI4
BI5
BI6
BI7
BI8
BI9
BI10
BI11

IO2
BI1
BI2
BI3
BI4
BI5
BI6
BI7
BI8
BI9
BI10
BI11

IO4
BI1
BI2
BI3
BI4
BI5
BI6
BI7
BI8
BI9
BI10
BI11

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Binary output

IO1		IO3	
TRP1		TRP1	
TRP2		TRP2	
BO1		BO1	
BO2		BO2	
BO3		BO3	
BO4		BO4	
BO5		BO5	
		BO6	

IO2		IO4	
TRP1		TRP1	
TRP2		TRP2	
BO1		BO1	
BO2		BO2	
BO3		BO3	
BO4		BO4	
BO5		BO5	
BO6		BO6	

4. Programmable LED setting

LED1	
LED2	
LED3	
LED4	
LED5	
LED6	
LED7	
LED8	

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5. Relay setting sheet

Setting for Protection

No.		Name	Range 5A rating	Range 1A rating	Units	Contents	Default Setting of Relay Series(5A rating / 1A rating) 1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	User Setting
1		APPL-CT	Off / 3P / 2P / 1P		--	Application setting of CT	3P				
2		APPL-VT	Off / 3PN / 3PV / 3PP / 2PP		--	Application setting of VT	3PV		--		
		APPL-VT	Off / 3PN / 3PP / 2PP				--		3PN		
3		APPL-VTS	A / B / C / AB / BC / CA		--	Application setting of VT for Syncro. Check.	--		A		
4		CTFEN	Off / On / OPT-On		--	CTF Enable	Off				
5		VTF1EN	Off / On / OPT-On		--	VTF1 Enable	Off				
6		VTF2EN	Off / On / OPT-On		--	VTF2 Enable	Off				
7		CTSVEN	Off / ALM&BLK / ALM		--	AC input imbalance Supervision Eable	ALM				
8		V0SVEN	Off / ALM&BLK / ALM		--	ditto	ALM				
9		V2SVEN	Off / ALM&BLK / ALM		--	ditto	ALM				
10		TCSVEN1	Off / On / OPT-On		--	Trip circuit supervision enable	Off				
11		TCSVEN2	Off / On / OPT-On		--	ditto	Off				
12		TCSVEN3	Off / On / OPT-On		--	ditto	Off				
13		TCSVEN4	Off / On / OPT-On		--	ditto	Off				
14		TCSVEN5	Off / On / OPT-On		--	ditto	Off				
15		TCSVEN6	Off / On / OPT-On		--	ditto	Off				
16		TCSVEN7	Off / On / OPT-On		--	ditto	Off				
17		TCSVEN8	Off / On / OPT-On		--	ditto	Off				
18		CBSVEN	Off / On		--	CB conditon supervision enable	Off				
19	OC	OC1EN	Off / On		--	OC1 Enable	Off				
20		MOC1	DT / IEC / IEEE / US / CON		--	OC1 Delay Type (if OC1EN=On)	DT				
21		MOC1C-IEC	NI / VI / EI / LTI		--	OC1 IEC Inverse Curve Type (if MOC1=IEC)	NI				
22		MOC1C-IEEE	MI / VI / EI		--	OC1 IEEE Inverse Curve Type (if MOC1=IEEE)	MI				
23		MOC1C-US	CO2 / CO8		--	OC1 US Inverse Curve Type (if MOC1=US)	CO2				
24		OC1R	DEF / DEP		--	OC1 Reset Characteristic (if MOCI=IEEE,orUS)	DEF				
25		OC1-2F	NA / BLK		--	2f Block Enable of OC1	NA				
26		OC1-TP1	Off / INST / SET		--	OC1 trip mode of 1st trip (if OC1EN=On)	--		SET		
27		OC1-TP2	Off / INST / SET		--	OC1 trip mode of 2nd trip (if OC1EN=On)	--		SET		
28		OC1-TP3	Off / INST / SET		--	OC1 trip mode of 3rd trip (if OC1EN=On)	--		SET		
29		OC1-TP4	Off / INST / SET		--	OC1 trip mode of 4th trip (if OC1EN=On)	--		SET		
30		OC1-TP5	Off / INST / SET		--	OC1 trip mode of 5th trip (if OC1EN=On)	--		SET		
31		OC1-TP6	Off / INST / SET		--	OC1 trip mode of 6th trip (if OC1EN=On)	--		SET		
32		OC2EN	Off / On		--	OC2 Enable	Off				
33		MOC2	DT / IEC / IEEE / US / CON		--	OC2 Delay Type (if OC2EN=On)	DT				
34		MOC2C-IEC	NI / VI / EI / LTI		--	OC2 IEC Inverse Curve Type (if MOC2=IEC)	NI				
35		MOC2C-IEEE	MI / VI / EI		--	OC2 IEEE Inverse Curve Type (if MOC2=IEEE)	MI				
36		MOC2C-US	CO2 / CO8		--	OC2 US Inverse Curve Type (if MOC2=US)	CO2				
37		OC2R	DEF / DEP		--	OC2 Reset Characteristic (if MOCI=IEEE,orUS)	DEF				
38		OC2-2F	NA / BLK		--	2f Block Enable of OC2	NA				
39		OC2-TP1	Off / INST / SET		--	OC2 trip mode of 1st trip (if OC2EN=On)	--		SET		
40		OC2-TP2	Off / INST / SET		--	OC2 trip mode of 2nd trip (if OC2EN=On)	--		SET		
41		OC2-TP3	Off / INST / SET		--	OC2 trip mode of 3rd trip (if OC2EN=On)	--		SET		
42		OC2-TP4	Off / INST / SET		--	OC2 trip mode of 4th trip (if OC2EN=On)	--		SET		
43		OC2-TP5	Off / INST / SET		--	OC2 trip mode of 5th trip (if OC2EN=On)	--		SET		
44		OC2-TP6	Off / INST / SET		--	OC2 trip mode of 6th trip (if OC2EN=On)	--		SET		
45		OC3EN	Off / On		--	OC3 Enable	Off				
46		OC3-2F	NA / BLK		--	2f Block Enable of OC3	NA				
47		OC3-TP1	Off / INST / SET		--	OC3 trip mode of 1st trip (if OC3EN=On)	--		SET		
48		OC3-TP2	Off / INST / SET		--	OC3 trip mode of 2nd trip (if OC3EN=On)	--		SET		
49		OC3-TP3	Off / INST / SET		--	OC3 trip mode of 3rd trip (if OC3EN=On)	--		SET		
50		OC3-TP4	Off / INST / SET		--	OC3 trip mode of 4th trip (if OC3EN=On)	--		SET		
51		OC3-TP5	Off / INST / SET		--	OC3 trip mode of 5th trip (if OC3EN=On)	--		SET		
52		OC3-TP6	Off / INST / SET		--	OC3 trip mode of 6th trip (if OC3EN=On)	--		SET		
53		OC4EN	Off / On		--	OC4 Enable	Off				
54		OC4-2F	NA / BLK		--	2f Block Enable of OC4	NA				
55		OC4-TP1	Off / INST / SET		--	OC4 trip mode of 1st trip (if OC4EN=On)	--		SET		
56		OC4-TP2	Off / INST / SET		--	OC4 trip mode of 2nd trip (if OC4EN=On)	--		SET		
57		OC4-TP3	Off / INST / SET		--	OC4 trip mode of 3rd trip (if OC4EN=On)	--		SET		
58		OC4-TP4	Off / INST / SET		--	OC4 trip mode of 4th trip (if OC4EN=On)	--		SET		
59		OC4-TP5	Off / INST / SET		--	OC4 trip mode of 5th trip (if OC4EN=On)	--		SET		
60		OC4-TP6	Off / INST / SET		--	OC4 trip mode of 6th trip (if OC4EN=On)	--		SET		
61	DOC	DOC1EN	Off / On		--	DOC1 Enable	On				
62		DOC1-DIR	FWD / REV		--	DOC1 Directional Characteristic (if DOC1EN=On)	FWD				
63		MDOC1	DT / IEC / IEEE / US / CON		--	DOC1 Delay Type (if DOC1EN=On)	DT				
64		MDOC1C-IEC	NI / VI / EI / LTI		--	DOC1 IEC Inverse Curve Type (if MDOC1=IEC)	NI				
65		MDOC1C-IEEE	MI / VI / EI		--	DOC1 IEEE Inverse Curve Type (if MDOC1=IEEE)	MI				
66		MDOC1C-US	CO2 / CO8		--	DOC1 US Inverse Curve Type (if MDOC1=US)	CO2				
67		DOC1R	DEF / DEP		--	DOC1 Reset Characteristic (if MOCI=IEEE,orUS)	DEF				
68		DOC1-2F	NA / BLK		--	2f Block Enable of DOC1	NA				
69		DOC1-TP1	Off / INST / SET		--	DOC1 trip mode of 1st trip (if DOC1EN=On)	--		SET		
70		DOC1-TP2	Off / INST / SET		--	DOC1 trip mode of 2nd trip (if DOC1EN=On)	--		SET		
71		DOC1-TP3	Off / INST / SET		--	DOC1 trip mode of 3rd trip (if DOC1EN=On)	--		SET		
72		DOC1-TP4	Off / INST / SET		--	DOC1 trip mode of 4th trip (if DOC1EN=On)	--		SET		
73		DOC1-TP5	Off / INST / SET		--	DOC1 trip mode of 5th trip (if DOC1EN=On)	--		SET		
74		DOC1-TP6	Off / INST / SET		--	DOC1 trip mode of 6th trip (if DOC1EN=On)	--		SET		
75		DOC2EN	Off / On		--	DOC2 Enable	Off				
76		DOC2-DIR	FWD / REV		--	DOC2 Directional Characteristic (if DOC2EN=On)	FWD				
77		MDOC2	DT / IEC / IEEE / US / CON		--	DOC2 Delay Type (if DOC2EN=On)	DT				
78		MDOC2C-IEC	NI / VI / EI / LTI		--	DOC2 IEC Inverse Curve Type (if MDOC2=IEC)	NI				
79		MDOC2C-IEEE	MI / VI / EI		--	DOC2 IEEE Inverse Curve Type (if MDOC2=IEEE)	MI				
80		MDOC2C-US	CO2 / CO8		--	DOC2 US Inverse Curve Type (if MDOC2=US)	CO2				
81		DOC2R	DEF / DEP		--	DOC2 Reset Characteristic (if MOCI=IEEE,orUS)	DEF				
82		DOC2-2F	NA / BLK		--	2f Block Enable of DOC2	NA				

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Setting for Protection

No.		Name	Range 5A rating	Range 1A rating	Units	Contents	Default Setting of Relay Series(5A rating / 1A rating) 1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	User Setting
83		DOC2-TP1	Off / INST / SET		--	DOC2 trip mode of 1st trip (if DOC2EN=On)	--		SET		
84		DOC2-TP2	Off / INST / SET		--	DOC2 trip mode of 2nd trip (if DOC2EN=On)	--		SET		
85		DOC2-TP3	Off / INST / SET		--	DOC2 trip mode of 3rd trip (if DOC2EN=On)	--		SET		
86		DOC2-TP4	Off / INST / SET		--	DOC2 trip mode of 4th trip (if DOC2EN=On)	--		SET		
87		DOC2-TP5	Off / INST / SET		--	DOC2 trip mode of 5th trip (if DOC2EN=On)	--		SET		
88		DOC2-TP6	Off / INST / SET		--	DOC2 trip mode of 6th trip (if DOC2EN=On)	--		SET		
89		DOC3EN	Off / On		--	DOC3 Enable	Off				
90		DOC3-DIR	FWD / REV		--	DOC3 Directional Characteristic (if DOC3EN=On)	FWD				
91		DOC3-2F	NA / BLK		--	2f Block Enable of DOC3	NA				
92		DOC3-TP1	Off / INST / SET		--	DOC3 trip mode of 1st trip (if DOC3EN=On)	--		SET		
93		DOC3-TP2	Off / INST / SET		--	DOC3 trip mode of 2nd trip (if DOC3EN=On)	--		SET		
94		DOC3-TP3	Off / INST / SET		--	DOC3 trip mode of 3rd trip (if DOC3EN=On)	--		SET		
95		DOC3-TP4	Off / INST / SET		--	DOC3 trip mode of 4th trip (if DOC3EN=On)	--		SET		
96		DOC3-TP5	Off / INST / SET		--	DOC3 trip mode of 5th trip (if DOC3EN=On)	--		SET		
97		DOC3-TP6	Off / INST / SET		--	DOC3 trip mode of 6th trip (if DOC3EN=On)	--		SET		
98		DOC4EN	Off / On		--	DOC4 Enable	Off				
99		DOC4-DIR	FWD / REV		--	DOC4 Directional Characteristic (if DOC4EN=On)	FWD				
100		DOC4-2F	NA / BLK		--	2f Block Enable of DOC4	NA				
101		DOC4-TP1	Off / INST / SET		--	DOC4 trip mode of 1st trip (if DOC4EN=On)	--		SET		
102		DOC4-TP2	Off / INST / SET		--	DOC4 trip mode of 2nd trip (if DOC4EN=On)	--		SET		
103		DOC4-TP3	Off / INST / SET		--	DOC4 trip mode of 3rd trip (if DOC4EN=On)	--		SET		
104		DOC4-TP4	Off / INST / SET		--	DOC4 trip mode of 4th trip (if DOC4EN=On)	--		SET		
105		DOC4-TP5	Off / INST / SET		--	DOC4 trip mode of 5th trip (if DOC4EN=On)	--		SET		
106		DOC4-TP6	Off / INST / SET		--	DOC4 trip mode of 6th trip (if DOC4EN=On)	--		SET		
107		DOCTP	3POR / 2OUTOF3		--	DOC trip mode (if DOC1 or 2 or 3 or 3EN=On)	3POR				
108	UC	UC1EN	Off / On		--	UC1 Enable	Off				
109		UC2EN	Off / On		--	UC2 Enable	Off				
110	EF	EF1EN	Off / On		--	EF1 Enable	Off				
111		MEF1	DT / IEC / IEEE / US / CON		--	EF1 Delay Type (if EF1EN=On)	DT				
112		MEF1C-IEC	NI / VI / EI / LTI		--	EF1 IEC Inverse Curve Type (if MEF1=IEC)	NI				
113		MEF1C-IEEE	MI / VI / EI		--	EF1 IEEE Inverse Curve Type (if MEF1=IEEE)	MI				
114		MEF1C-US	CO2 / CO8		--	EF1 US Inverse Curve Type (if MEF1=US)	CO2				
115		EF1R	DEF / DEP		--	EF1 Reset Characteristic (if MEFI=IEEE,orUS)	DEF				
116		EF1-2F	NA / BLK		--	2f Block Enable of EF1	NA				
117		EF1-TP1	Off / INST / SET		--	EF1 trip mode of 1st trip (if EF1EN=On)	--		SET		
118		EF1-TP2	Off / INST / SET		--	EF1 trip mode of 2nd trip (if EF1EN=On)	--		SET		
119		EF1-TP3	Off / INST / SET		--	EF1 trip mode of 3rd trip (if EF1EN=On)	--		SET		
120		EF1-TP4	Off / INST / SET		--	EF1 trip mode of 4th trip (if EF1EN=On)	--		SET		
121		EF1-TP5	Off / INST / SET		--	EF1 trip mode of 5th trip (if EF1EN=On)	--		SET		
122		EF1-TP6	Off / INST / SET		--	EF1 trip mode of 6th trip (if EF1EN=On)	--		SET		
123		EF2EN	Off / On		--	EF2 Enable	Off				
124		MEF2	DT / IEC / IEEE / US / CON		--	EF2 Delay Type (if EF2EN=On)	DT				
125		MEF2C-IEC	NI / VI / EI / LTI		--	EF2 IEC Inverse Curve Type (if MEF2=IEC)	NI				
126		MEF2C-IEEE	MI / VI / EI		--	EF2 IEEE Inverse Curve Type (if MEF2=IEEE)	MI				
127		MEF2C-US	CO2 / CO8		--	EF2 US Inverse Curve Type (if MEF2=US)	CO2				
128		EF2R	DEF / DEP		--	EF2 Reset Characteristic (if MEFI=IEEE,orUS)	DEF				
129		EF2-2F	NA / BLK		--	2f Block Enable of EF2	NA				
130		EF2-TP1	Off / INST / SET		--	EF2 trip mode of 1st trip (if EF2EN=On)	--		SET		
131		EF2-TP2	Off / INST / SET		--	EF2 trip mode of 2nd trip (if EF2EN=On)	--		SET		
132		EF2-TP3	Off / INST / SET		--	EF2 trip mode of 3rd trip (if EF2EN=On)	--		SET		
133		EF2-TP4	Off / INST / SET		--	EF2 trip mode of 4th trip (if EF2EN=On)	--		SET		
134		EF2-TP5	Off / INST / SET		--	EF2 trip mode of 5th trip (if EF2EN=On)	--		SET		
135		EF2-TP6	Off / INST / SET		--	EF2 trip mode of 6th trip (if EF2EN=On)	--		SET		
136		EF3EN	Off / On		--	EF3 Enable	Off				
137		EF3-2F	NA / BLK		--	2f Block Enable of EF3	NA				
138		EF3-TP1	Off / INST / SET		--	EF3 trip mode of 1st trip (if EF3EN=On)	--		SET		
139		EF3-TP2	Off / INST / SET		--	EF3 trip mode of 2nd trip (if EF3EN=On)	--		SET		
140		EF3-TP3	Off / INST / SET		--	EF3 trip mode of 3rd trip (if EF3EN=On)	--		SET		
141		EF3-TP4	Off / INST / SET		--	EF3 trip mode of 4th trip (if EF3EN=On)	--		SET		
142		EF3-TP5	Off / INST / SET		--	EF3 trip mode of 5th trip (if EF3EN=On)	--		SET		
143		EF3-TP6	Off / INST / SET		--	EF3 trip mode of 6th trip (if EF1EN=On)	--		SET		
144		EF4EN	Off / On		--	EF4 Enable	Off				
145		EF4-2F	NA / BLK		--	2f Block Enable of EF4	NA				
146		EF4-TP1	Off / INST / SET		--	EF4 trip mode of 1st trip (if EF4EN=On)	--		SET		
147		EF4-TP2	Off / INST / SET		--	EF4 trip mode of 2nd trip (if EF4EN=On)	--		SET		
148		EF4-TP3	Off / INST / SET		--	EF4 trip mode of 3rd trip (if EF4EN=On)	--		SET		
149		EF4-TP4	Off / INST / SET		--	EF4 trip mode of 4th trip (if EF4EN=On)	--		SET		
150		EF4-TP5	Off / INST / SET		--	EF4 trip mode of 5th trip (if EF4EN=On)	--		SET		
151		EF4-TP6	Off / INST / SET		--	EF4 trip mode of 6th trip (if EF1EN=On)	--		SET		
152	DEF	DEF1EN	Off / On		--	DEF1 Enable	On				
153		DEF1-DIR	FWD / REV		--	DEF1 Directional Characteristic (if DEF1EN=On)	FWD				
154		MDEF1	DT / IEC / IEEE / US / CON		--	DEF1 Delay Type (if DEF1EN=On)	DT				
155		MDEF1C-IEC	NI / VI / EI / LTI		--	DEF1 IEC Inverse Curve Type (if MDEF1=IEC)	NI				
156		MDEF1C-IEEE	MI / VI / EI		--	DEF1 IEEE Inverse Curve Type (if MDEF1=IEEE)	MI				
157		MDEF1C-US	CO2 / CO8		--	DEF1 US Inverse Curve Type (if MDEF1=US)	CO2				
158		DEF1R	DEF / DEP		--	DEF1 Reset Characteristic (if MDEFI=IEEE,orUS)	DDEF				
159		DEF1-2F	NA / BLK		--	2f Block Enable of DEF1	NA				
160		DEF1-TP1	Off / INST / SET		--	DEF1 trip mode of 1st trip (if DEF1EN=On)	--		SET		
161		DEF1-TP2	Off / INST / SET		--	DEF1 trip mode of 2nd trip (if DEF1EN=On)	--		SET		
162		DEF1-TP3	Off / INST / SET		--	DEF1 trip mode of 3rd trip (if DEF1EN=On)	--		SET		
163		DEF1-TP4	Off / INST / SET		--	DEF1 trip mode of 4th trip (if DEF1EN=On)	--		SET		
164		DEF1-TP5	Off / INST / SET		--	DEF1 trip mode of 5th trip (if DEF1EN=On)	--		SET		
165		DEF1-TP6	Off / INST / SET		--	DEF1 trip mode of 6th trip (if DEF1EN=On)	--		SET		

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No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
166		DEF2EN	Off / On		--	DEF2 Enable	Off				
167		DEF2-DIR	FWD / REV		--	DEF2 Directional Characteristic (if DEF2EN=On)	FWD				
168		MDEF2	DT / IEC / IEEE / US / CON		--	DEF2 Delay Type (if DEF2EN=On)	DT				
169		MDEF2C-IEC	NI / VI / EI / LTI		--	DEF2 IEC Inverse Curve Type (if MDEF2=IEC)	NI				
170		MDEF2C-IEEE	MI / VI / EI		--	DEF2 IEEE Inverse Curve Type (if MDEF2=IEEE)	MI				
171		MDEF2C-US	CO2 / CO8		--	DEF2 US Inverse Curve Type (if MDEF2=US)	CO2				
172		DEF2R	DEF / DEP		--	DEF2 Reset Characteristic (if MDEFI=IEEE,orUS)	DEF				
173		DEF2-2F	NA / BLK		--	2f Block Enable of DEF2	NA				
174		DEF2-TP1	Off / INST / SET		--	DEF2 trip mode of 1st trip (if DEF2EN=On)	--		SET		
175		DEF2-TP2	Off / INST / SET		--	DEF2 trip mode of 2nd trip (if DEF2EN=On)	--		SET		
176		DEF2-TP3	Off / INST / SET		--	DEF2 trip mode of 3rd trip (if DEF2EN=On)	--		SET		
177		DEF2-TP4	Off / INST / SET		--	DEF2 trip mode of 4th trip (if DEF2EN=On)	--		SET		
178		DEF2-TP5	Off / INST / SET		--	DEF2 trip mode of 5th trip (if DEF2EN=On)	--		SET		
179		DEF2-TP6	Off / INST / SET		--	DEF2 trip mode of 6th trip (if DEF2EN=On)	--		SET		
180		DEF3EN	Off / On		--	DEF3 Enable	Off				
181		DEF3-DIR	FWD / REV		--	DEF3 Directional Characteristic (if DEF3EN=On)	FWD				
182		DEF3-2F	NA / BLK		--	2f Block Enable of DEF3	NA				
183		DEF3-TP1	Off / INST / SET		--	DEF3 trip mode of 1st trip (if DEF3EN=On)	--		SET		
184		DEF3-TP2	Off / INST / SET		--	DEF3 trip mode of 2nd trip (if DEF3EN=On)	--		SET		
185		DEF3-TP3	Off / INST / SET		--	DEF3 trip mode of 3rd trip (if DEF3EN=On)	--		SET		
186		DEF3-TP4	Off / INST / SET		--	DEF3 trip mode of 4th trip (if DEF3EN=On)	--		SET		
187		DEF3-TP5	Off / INST / SET		--	DEF3 trip mode of 5th trip (if DEF3EN=On)	--		SET		
188		DEF3-TP6	Off / INST / SET		--	DEF3 trip mode of 6th trip (if DEF1EN=On)	--		SET		
189		DEF4EN	Off / On		--	DEF4 Enable	Off				
190		DEF4-DIR	FWD / REV		--	DEF4 Directional Characteristic (if DEF4EN=On)	FWD				
191		DEF4-2F	NA / BLK		--	2f Block Enable of DEF4	NA				
192		DEF4-TP1	Off / INST / SET		--	DEF4 trip mode of 1st trip (if DEF4EN=On)	--		SET		
193		DEF4-TP2	Off / INST / SET		--	DEF4 trip mode of 2nd trip (if DEF4EN=On)	--		SET		
194		DEF4-TP3	Off / INST / SET		--	DEF4 trip mode of 3rd trip (if DEF4EN=On)	--		SET		
195		DEF4-TP4	Off / INST / SET		--	DEF4 trip mode of 4th trip (if DEF4EN=On)	--		SET		
196		DEF4-TP5	Off / INST / SET		--	DEF4 trip mode of 5th trip (if DEF4EN=On)	--		SET		
197		DEF4-TP6	Off / INST / SET		--	DEF4 trip mode of 6th trip (if DEF1EN=On)	--		SET		
198	SEF	SE1EN	Off / On		--	SEF1 Enable	--	Off	--	Off	
199		MSE1	DT / IEC / IEEE / US / CON		--	SEF1 Delay Type (if SE1EN=On)	--	DT	--	DT	
200		MSE1C-IEC	NI / VI / EI / LTI		--	SEF1 IEC Inverse Curve Type (if MSE1=IEC)	--	NI	--	NI	
201		MSE1C-IEEE	MI / VI / EI		--	SEF1 IEEE Inverse Curve Type (if MSE1=IEEE)	--	MI	--	MI	
202		MSE1C-US	CO2 / CO8		--	SEF1 US Inverse Curve Type (if MSE1=US)	--	CO2	--	CO2	
203		SE1R	DEF / DEP		--	SEF1 Reset Characteristic (if MSEI=IEEE,orUS)	--	DEF	--	DEF	
204		SE1S2	Off / On		--	SEF1 Stage 2 Timer Enable (if SE1EN=0m)	--	Off	--	Off	
205		SE1-2F	NA / BLK		--	2f Block Enable of SEF1	--	NA	--	NA	
206		SE1-TP1	Off / INST / SET		--	SEF1 trip mode of 1st trip (if SE1EN=On)	--			SET	
207		SE1-TP2	Off / INST / SET		--	SEF1 trip mode of 2nd trip (if SE1EN=On)	--			SET	
208		SE1-TP3	Off / INST / SET		--	SEF1 trip mode of 3rd trip (if SE1EN=On)	--			SET	
209		SE1-TP4	Off / INST / SET		--	SEF1 trip mode of 4th trip (if SE1EN=On)	--			SET	
210		SE1-TP5	Off / INST / SET		--	SEF1 trip mode of 5th trip (if SE1EN=On)	--			SET	
211		SE1-TP6	Off / INST / SET		--	SEF1 trip mode of 6th trip (if SE1EN=On)	--			SET	
212		SE2EN	Off / On		--	SEF2 Enable	--	Off	--	Off	
213		MSE2	DT / IEC / IEEE / US / CON		--	SEF2 Delay Type (if SE2EN=On)	--	DT	--	DT	
214		MSE2C-IEC	NI / VI / EI / LTI		--	SEF2 IEC Inverse Curve Type (if MSE2=IEC)	--	NI	--	NI	
215		MSE2C-IEEE	MI / VI / EI		--	SEF2 IEEE Inverse Curve Type (if MSE2=IEEE)	--	MI	--	MI	
216		MSE2C-US	CO2 / CO8		--	SEF2 US Inverse Curve Type (if MSE2=US)	--	CO2	--	CO2	
217		SE2R	DEF / DEP		--	SEF2 Reset Characteristic (if MSEI=IEEE,orUS)	--	DEF	--	DEF	
218		SE2-2F	NA / BLK		--	2f Block Enable of SEF2	--	NA	--	NA	
219		SE2-TP1	Off / INST / SET		--	SEF2 trip mode of 1st trip (if SE2EN=On)	--			SET	
220		SE2-TP2	Off / INST / SET		--	SEF2 trip mode of 2nd trip (if SE2EN=On)	--			SET	
221		SE2-TP3	Off / INST / SET		--	SEF2 trip mode of 3rd trip (if SE2EN=On)	--			SET	
222		SE2-TP4	Off / INST / SET		--	SEF2 trip mode of 4th trip (if SE2EN=On)	--			SET	
223		SE2-TP5	Off / INST / SET		--	SEF2 trip mode of 5th trip (if SE2EN=On)	--			SET	
224		SE2-TP6	Off / INST / SET		--	SEF2 trip mode of 6th trip (if SE2EN=On)	--			SET	
225		SE3EN	Off / On		--	SEF3 Enable	--	Off	--	Off	
226		SE3-2F	NA / BLK		--	2f Block Enable of SEF3	--	NA	--	NA	
227		SE3-TP1	Off / INST / SET		--	SEF3 trip mode of 1st trip (if SE3EN=On)	--			SET	
228		SE3-TP2	Off / INST / SET		--	SEF3 trip mode of 2nd trip (if SE3EN=On)	--			SET	
229		SE3-TP3	Off / INST / SET		--	SEF3 trip mode of 3rd trip (if SE3EN=On)	--			SET	
230		SE3-TP4	Off / INST / SET		--	SEF3 trip mode of 4th trip (if SE3EN=On)	--			SET	
231		SE3-TP5	Off / INST / SET		--	SEF3 trip mode of 5th trip (if SE3EN=On)	--			SET	
232		SE3-TP6	Off / INST / SET		--	SEF3 trip mode of 6th trip (if SE3EN=On)	--			SET	
233		SE4EN	Off / On		--	SEF4 Enable	--	Off	--	Off	
234		SE4-2F	NA / BLK		--	2f Block Enable of SEF4	--	NA	--	NA	
235		SE4-TP1	Off / INST / SET		--	SEF4 trip mode of 1st trip (if SE4EN=On)	--			SET	
236		SE4-TP2	Off / INST / SET		--	SEF4 trip mode of 2nd trip (if SE4EN=On)	--			SET	
237		SE4-TP3	Off / INST / SET		--	SEF4 trip mode of 3rd trip (if SE4EN=On)	--			SET	
238		SE4-TP4	Off / INST / SET		--	SEF4 trip mode of 4th trip (if SE4EN=On)	--			SET	
239		SE4-TP5	Off / INST / SET		--	SEF4 trip mode of 5th trip (if SE4EN=On)	--			SET	
240		SE4-TP6	Off / INST / SET		--	SEF4 trip mode of 6th trip (if SE4EN=On)	--			SET	
241	DSEF	DSE1EN	Off / On		--	DSEF1 Enable	--	On	--	On	
242		DSE1-DIR	FWD / REV		--	DSEF1 Directional Characteristic (if DSE1EN=On)	--	FWD	--	FWD	
243		MDSE1	DT / IEC / IEEE / US / CON		--	DSEF1 Delay Type (if DSE1EN=On)	--	DT	--	DT	
244		MDSE1C-IEC	NI / VI / EI / LTI		--	DSEF1 IEC Inverse Curve Type (if MDSE1=IEC)	--	NI	--	NI	
245		MDSE1C-IEEE	MI / VI / EI		--	DSEF1 IEEE Inverse Curve Type (if MDSE1=IEEE)	--	MI	--	MI	
246		MDSE1C-US	CO2 / CO8		--	DSEF1 US Inverse Curve Type (if MDSE1=US)	--	CO2	--	CO2	
247		DSE1R	DEF / DEP		--	DSEF1 Reset Characteristic (if MDSEI=IEEE,orUS)	--	DEF	--	DEF	
248		DSE1S2	Off / On		--	DSEF1 Stage 2 Timer Enable (if DSE1EN=0m)	--	Off	--	Off	
249		DSE1-2F	NA / BLK		--	2f Block Enable of DSEF1	--	NA	--	NA	

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			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
250		DSE1-TP1	Off / INST / SET		--	DSEF1 trip mode of 1st trip (if DSE1EN=On)	--			SET	
251		DSE1-TP2	Off / INST / SET		--	DSEF1 trip mode of 2nd trip (if DSE1EN=On)	--			SET	
252		DSE1-TP3	Off / INST / SET		--	DSEF1 trip mode of 3rd trip (if DSE1EN=On)	--			SET	
253		DSE1-TP4	Off / INST / SET		--	DSEF1 trip mode of 4th trip (if DSE1EN=On)	--			SET	
254		DSE1-TP5	Off / INST / SET		--	DSEF1 trip mode of 5th trip (if DSE1EN=On)	--			SET	
255		DSE1-TP6	Off / INST / SET		--	DSEF1 trip mode of 6th trip (if DSE1EN=On)	--			SET	
256		DSE2EN	Off / On		--	DSEF2 Enable	--	Off	--	Off	
257		DSE2-DIR	FWD / REV		--	DSEF2 Directional Characteristic (if DSE2EN=On)	--	FWD	--	FWD	
258		MDSE2	DT / IEC / IEEE / US / CON		--	DSEF2 Delay Type (if DSE2EN=On)	--	DT	--	DT	
259		MDSE2C-IEC	NI / VI / EI / LTI		--	DSEF2 IEC Inverse Curve Type (if MDSE2=IEC)	--	NI	--	NI	
260		MDSE2C-IEEE	MI / VI / EI		--	DSEF2 IEEE Inverse Curve Type (if MDSE2=IEEE)	--	MI	--	MI	
261		MDSE2C-US	CO2 / CO8		--	DSEF2 US Inverse Curve Type (if MDSE2=US)	--	CO2	--	CO2	
262		DSE2R	DEF / DEP		--	DSEF2 Reset Characteristic (if MDSEI=IEEE,orUS)	--	DEF	--	DEF	
263		DSE2-2F	NA / BLK		--	2f Block Enable of DSEF2	--	NA	--	NA	
264		DSE2-TP1	Off / INST / SET		--	DSEF2 trip mode of 1st trip (if DSE2EN=On)	--			SET	
265		DSE2-TP2	Off / INST / SET		--	DSEF2 trip mode of 2nd trip (if DSE2EN=On)	--			SET	
266		DSE2-TP3	Off / INST / SET		--	DSEF2 trip mode of 3rd trip (if DSE2EN=On)	--			SET	
267		DSE2-TP4	Off / INST / SET		--	DSEF2 trip mode of 4th trip (if DSE2EN=On)	--			SET	
268		DSE2-TP5	Off / INST / SET		--	DSEF2 trip mode of 5th trip (if DSE2EN=On)	--			SET	
269		DSE2-TP6	Off / INST / SET		--	DSEF2 trip mode of 6th trip (if DSE2EN=On)	--			SET	
270		DSE3EN	Off / On		--	DSEF3 Enable	--	Off	--	Off	
271		DSE3-2F	NA / BLK		--	2f Block Enable of DSEF3	--	NA	--	NA	
272		DSE3-DIR	FWD / REV		--	DSEF3 Directional Characteristic (if DSE3EN=On)	--	FWD	--	FWD	
273		DSE3-TP1	Off / INST / SET		--	DSEF3 trip mode of 1st trip (if DSE3EN=On)	--			SET	
274		DSE3-TP2	Off / INST / SET		--	DSEF3 trip mode of 2nd trip (if DSE3EN=On)	--			SET	
275		DSE3-TP3	Off / INST / SET		--	DSEF3 trip mode of 3rd trip (if DSE3EN=On)	--			SET	
276		DSE3-TP4	Off / INST / SET		--	DSEF3 trip mode of 4th trip (if DSE3EN=On)	--			SET	
277		DSE3-TP5	Off / INST / SET		--	DSEF3 trip mode of 5th trip (if DSE3EN=On)	--			SET	
278		DSE3-TP6	Off / INST / SET		--	DSEF3 trip mode of 6th trip (if DSE3EN=On)	--			SET	
279		DSE4EN	Off / On		--	DSEF4 Enable	--	Off	--	Off	
280		DSE4-2F	NA / BLK		--	2f Block Enable of DSEF4	--	NA	--	NA	
281		DSE4-DIR	FWD / REV		--	DSEF4 Directional Characteristic (if DSE4EN=On)	--	FWD	--	FWD	
282		DSE4-TP1	Off / INST / SET		--	DSEF4 trip mode of 1st trip (if DSE4EN=On)	--			SET	
283		DSE4-TP2	Off / INST / SET		--	DSEF4 trip mode of 2nd trip (if DSE4EN=On)	--			SET	
284		DSE4-TP3	Off / INST / SET		--	DSEF4 trip mode of 3rd trip (if DSE4EN=On)	--			SET	
285		DSE4-TP4	Off / INST / SET		--	DSEF4 trip mode of 4th trip (if DSE4EN=On)	--			SET	
286		DSE4-TP5	Off / INST / SET		--	DSEF4 trip mode of 5th trip (if DSE4EN=On)	--			SET	
287		DSE4-TP6	Off / INST / SET		--	DSEF4 trip mode of 6th trip (if DSE4EN=On)	--			SET	
288		RPEN	Off / On		--	Residual Power block Enable	--	Off	--	Off	
289	NOC	NC1EN	Off / On		--	NOC1 Enable	Off				
290		MNC1	DT / IEC / IEEE / US / CON		--	NOC1 Delay Type (if NC1EN=On)	DT				
291		MNC1C-IEC	NI / VI / EI / LTI		--	NOC1 IEC Inverse Curve Type (if MNC1=IEC)	NI				
292		MNC1C-IEEE	MI / VI / EI		--	NOC1 IEEE Inverse Curve Type (if MNC1=IEEE)	MI				
293		MNC1C-US	CO2 / CO8		--	NOC1 US Inverse Curve Type (if MNC1=US)	CO2				
294		NC1R	DEF / DEP		--	NOC1 Reset Characteristic (if MNCI=IEEE,orUS)	DEF				
295		NC1-2F	NA / BLK		--	2f Block Enable of NOC1	NA				
296		NC2EN	Off / On		--	NOC2 Enable	Off				
297		NC2-2F	NA / BLK		--	2f Block Enable of NOC2	NA				
298	DNOC	DNC1EN	Off / On		--	DNOC1 Enable	Off				
299		DNC1-DIR	FWD / REV		--	DNOC1 Directional Characteristic (if DNC1EN=On)	FWD				
300		MDNC1	DT / IEC / IEEE / US / CON		--	DNOC1 Delay Type (if DNOC1EN=On)	DT				
301		MDNC1C-IEC	NI / VI / EI / LTI		--	DNOC1 IEC InverNC Curve Type (if MDNC1=IEC)	NI				
302		MDNC1C-IEEE	MI / VI / EI		--	DNOC1 IEEE InverNC Curve Type (if MDNC1=IEEE)	MI				
303		MDNC1C-US	CO2 / CO8		--	DNOC1 US InverNC Curve Type (if MDNC1=US)	CO2				
304		DNC1R	DEF / DEP		--	DNOC1 ReNCt Characteristic (if MDNCI=IEEE,orUS)	DEF				
305		DNC1-2F	NA / BLK		--	2f Block Enable of DNOC1	NA				
306		DNC2EN	Off / On		--	DNOC2 Enable	Off				
307		DNC2-DIR	FWD / REV		--	DNOC2 Directional Characteristic (if DNC2EN=On)	FWD				
308		DNC2-2F	NA / BLK		--	2f Block Enable of DNOC2	NA				
309	Thermal	THMEN	Off / On		--	Thermal OL Enable	Off				
310		THMAEN	Off / On		--	Thermal Alarm Enable	Off				
311	BCD	BCDEN	Off / On		--	Broken Conductor Enable	Off				
312		BCD-2F	NA / BLK		--	2f Block Enable of BCD	NA				
313	CBF	BTC	Off / On		--	Back-trip control	Off				
314		RTC	Off / DIR / OC		--	Re-trip control	Off				
315	Cold Load	CLEN	Off / On		--	Cold Load Protection Enable	Off				
316	Load	CLDOEN	Off / On		--	Cold Load drop-off Enable	Off				
317	OV	OV1EN	Off / DT / IDMT		--	OV1 Enable	Off				
318		OV2EN	Off / On		--	OV2 Enable	Off				
319	UV	UV1EN	Off / DT / IDMT		--	UV1 Enable	DT				
320		UV2EN	Off / On		--	UV2 Enable	Off				
321		VBLKEN	Off / On		--	UV Block Enable	Off				
322	ZOV	ZOV1EN	Off / DT / IDMT		--	ZOV1 Enable	DT				
323		ZOV2EN	Off / On		--	ZOV2 Enable	Off				
324	NOV	NOV1EN	Off / DT / IDMT		--	NOV1 Enable	Off				
325		NOV2EN	Off / On		--	NOV2 Enable	Off				
326	FRQ	FRQ1EN	Off / OF / UF		--	FRQ1 Enable	Off				
327		FRQ2EN	Off / OF / UF		--	FRQ2 Enable	Off				
328		FRQ3EN	Off / OF / UF		--	FRQ3 Enable	Off				
329		FRQ4EN	Off / OF / UF		--	FRQ4 Enable	Off				
330		FRQ5EN	Off / OF / UF		--	FRQ5 Enable	Off				
331		FRQ6EN	Off / OF / UF		--	FRQ6 Enable	Off				

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Setting for Protection

No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
332	DFRQ	DFRQ1EN	Off / R / D		--	DFRQ1 Enable	Off				
333		DFRQ2EN	Off / R / D		--	DFRQ2 Enable	Off				
334		DFRQ3EN	Off / R / D		--	DFRQ3 Enable	Off				
335		DFRQ4EN	Off / R / D		--	DFRQ4 Enable	Off				
336		DFRQ5EN	Off / R / D		--	DFRQ5 Enable	Off				
337		DFRQ6EN	Off / R / D		--	DFRQ6 Enable	Off				
338	ARC	ARCEN	Off / On		--	Autoreclosing Enable.	--		On		
339		ARCEN-S	Off / On		--	Single-Phase Autoreclosing mode Enable.	--		Off		
340		ARCEN-C	Off / On		--	Configurable Autoreclosing mode Enable.	--		Off		
341		ARC-NUM	S1 / S2 / S3 / S4 / S5		--	Reclosing shot max. number	--		S1		
342		OC1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by OC1 enable	--		A1		
343		OC2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by OC2 enable	--		NA		
344		OC3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by OC3 enable	--		NA		
345		OC4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by OC4 enable	--		NA		
346		DOC1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DOC1 enable	--		NA		
347		DOC2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DOC2 enable	--		NA		
348		DOC3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DOC3 enable	--		NA		
349		DOC4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DOC4 enable	--		NA		
350		EF1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by EF1 enable	--		NA		
351		EF2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by EF2 enable	--		NA		
352		EF3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by EF3 enable	--		NA		
353		EF4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by EF4 enable	--		NA		
354		DEF1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DEF1 enable	--		NA		
355		DEF2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DEF2 enable	--		NA		
356		DEF3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DEF3 enable	--		NA		
357		DEF4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DEF4 enable	--		NA		
358		SE1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by SEF1 enable	--			NA	
359		SE2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by SEF2 enable	--			NA	
360		SE3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by SEF3 enable	--			NA	
361		SE4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by SEF4 enable	--			NA	
362		DSE1-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DSEF1 enable	--			NA	
363		DSE2-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DSEF2 enable	--			NA	
364		DSE3-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DSEF3 enable	--			NA	
365		DSE4-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by DSEF4 enable	--			NA	
366		EXT-INIT	NA / A1 / A2 / BLK		--	Autoreclosing initiation by External Trip Command enable	--		NA		
367		VCHK	Non / LRDI / DRLI / DRDI / SYN		--	Voltage condition	--		Non		
368		COORD-OC	Off / On		--	OC relay for Co-ordination Enable	--		Off		
369		COORD-EF	Off / On		--	EF relay for Co-ordination Enable	--		Off		
370		COORD-SE	Off / On		--	SEF relay for Co-ordination Enable	--			Off	
371	CTF	EFF	0.05 - 25.00	0.01 - 5.00	A	EF Threshold setting for CTF/VTF scheme.	1.00 / 0.20				
372	VTF	ZOVF	5.0 - 130.0		V	ZOV Threshold setting for CTF/VTF scheme.	20.0				
373		UVF	5.0 - 130.0		V	UV(Ph-G) Threshold setting for CTF scheme.	51.0				
374		OCDF	0.5(Fixed)	0.1(Fixed)	A	OCD Threshold setting for CTF scheme.	--				
375	OC	OC1	0.2 - 25.0	0.04 - 5.00	A	OC1 Threshold setting (if OC1EN=On)	5.0 / 1.00				
376		TOC1D	0.00 - 300.00		s	OC1 Definite time setting (if MOC1=DT)	1.00				
377		TOC1P	0.010 - 1.500		--	OC1 Time multiplier setting (if MOC1=IEC,IEEE,US)	1.000				
378		TOC1RD	0.0 - 300.0		s	OC1 Definite time reset delay (if OC1R =DEF)	0.0				
379		TOC1RP	0.010 - 1.500		--	OC1 Dependent time reset time multiplier (if OC1R=DEP)	1.000				
380		OC2	0.5 - 250.0	0.10 - 50.00	A	OC2 Threshold setting (if OC2EN=On)	25.0 / 5.00				
381		TOC2D	0.00 - 300.00		s	OC2 Definite time setting (if MOC2=DT)	1.00				
382		TOC2P	0.010 - 1.500		--	OC2 Time multiplier setting (if MOC2=IEC,IEEE,US)	1.000				
383		TOC2RD	0.0 - 300.0		s	OC2 Definite time reset delay (if OC2R =DEF)	0.0				
384		TOC2RP	0.010 - 1.500		--	OC2 Dependent time reset time multiplier (if OC2R=DEP)	1.000				
385		OC3	0.5 - 250.0	0.10 - 50.00	A	OC3 Threshold setting (if OC3EN=On)	50.0 / 10.00				
386		TOC3	0.00 - 300.00		s	OC3 Definite time setting (if OC3EN=On)	1.00				
387		OC4	0.5 - 250.0	0.10 - 50.00	A	OC4 Threshold setting (if OC4EN=On)	100.0 / 20.00				
388		TOC4	0.00 - 300.00		s	OC4 Definite time setting (if OC4EN=On)	1.00				
389	DOC	DOCθ	-95 - 95		Degree	DOC Characteristic Angle (if DOC1 or 2 or 3 or 4EN=On)	-45				
390		DOC1	0.2 - 25.0	0.04 - 5.00	A	DOC1 Threshold setting (if DOC1EN=On)	5.0 / 1.00				
391		TDOC1D	0.00 - 300.00		s	DOC1 Definite time setting (if MDOC1=DT)	1.00				
392		TDOC1P	0.010 - 1.500		--	DOC1 Time multiplier setting (if MDOC1=IEC,IEEE,US)	1.000				
393		TDOC1RD	0.0 - 300.0		s	DOC1 Definite time reset delay (if DOC1R =DEF)	0.0				
394		TDOC1RP	0.010 - 1.500		--	DOC1 Dependent time reset time multiplier (if DOC1R=DEP)	1.000				
395		DOC2	0.5 - 250.0	0.10 - 50.00	A	DOC2 Threshold setting (if DOC2EN=On)	25.0 / 5.00				
396		TDOC2D	0.00 - 300.00		s	DOC2 Definite time setting (if MDOC2=DT)	1.00				
397		TDOC2P	0.010 - 1.500		--	DOC2 Time multiplier setting (if MDOC2=IEC,IEEE,US)	1.000				
398		TDOC2RD	0.0 - 300.0		s	DOC2 Definite time reset delay (if DOC2R =DEF)	0.0				
399		TDOC2RP	0.010 - 1.500		--	DOC2 Dependent time reset time multiplier (if DOC2R=DEP)	1.000				
400		DOC3	0.5 - 250.0	0.10 - 50.00	A	DOC3 Threshold setting (if DOC3EN=On)	50.0 / 10.00				
401		TDOC3	0.00 - 300.00		s	DOC3 Definite time setting (if DOC3EN=On)	1.00				
402		DOC4	0.5 - 250.0	0.10 - 50.00	A	DOC4 Threshold setting (if DOC4EN=On)	100.0 / 20.00				
403		TDOC4	0.00 - 300.00		s	DOC4 Definite time setting (if DOC4EN=On)	1.00				
404	UC	UC1	0.5 - 10.0	0.10 - 2.00	A	UC1 Threshold setting (if UC1EN=On)	1.0 / 0.20				
405		TUC1	0.00 - 300.00		s	UC1 Definite time setting (if UC1EN=On)	1.00				
406		UC2	0.5 - 10.0	0.10 - 2.00	A	UC2 Threshold setting (if UC2EN=On)	2.0 / 0.40				
407		TUC2	0.00 - 300.00		s	UC2 Definite time setting (if UC2EN=On)	1.00				
408	EF	EF1	0.05 - 25.00	0.01 - 5.00	A	EF1 Threshold setting (if EF1EN=On)	1.50 / 0.30				
409		TEF1D	0.00 - 300.00		s	EF1 Definite time setting (if MEF1=DT)	1.00				
410		TEF1P	0.010 - 1.500		--	EF1 Time multiplier setting (if MEF1=IEC,IEEE,US)	1.000				
411		TEF1RD	0.0 - 300.0		s	EF1 Definite time reset delay (if EF1R =DEF)	0.0				
412		TEF1RP	0.010 - 1.500		--	EF1 Dependent time reset time multiplier (if EF1R=DEP)	1.000				

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Setting for Protection

No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
413		EF2	0.2 - 250.0	0.04 - 50.00	A	EF2 Threshold setting (if EF2EN=On)	15.0 / 3.00				
414		TEF2D	0.00 - 300.00		s	EF2 Definite time setting (if MEF2=DT)	1.00				
415		TEF2P	0.010 - 1.500		--	EF2 Time multiplier setting (if MEF2=IEC,IEEE,US)	1.000				
416		TEF2RD	0.0 - 300.0		s	EF2 Definite time reset delay (if EF2R =DEF)	0.0				
417		TEF2RP	0.010 - 1.500		--	EF2 Dependent time reset time multiplier (if EF2R=DEP)	1.000				
418		EF3	0.2 - 250.0	0.04 - 50.00	A	EF3 Threshold setting (if EF3EN=On)	25.0 / 5.00				
419		TEF3	0.00 - 300.00		s	EF3 Definite time setting (if EF3EN=On)	1.00				
420		EF4	0.2 - 250.0	0.04 - 50.00	A	EF4 Threshold setting (if EF4EN=On)	50.0 / 10.00				
421		TEF4	0.00 - 300.00		s	EF4 Definite time setting (if EF4EN=On)	1.00				
422	DEF	DEFθ	-95 - 95		Degree	DEF Characteristic Angle (if DEF1 or 2 or 3 or 4EN=On)	-45				
423		DEFV	0.5 - 100.0		V	DEF ZPS voltage level (if DEF1 or 2 or 3 or 4EN=On)	3.0				
424		DEF1	0.05 - 25.00	0.01 - 5.00	A	DEF1 Threshold setting (if DEF1EN=On)	1.50 / 0.30				
425		TDEF1D	0.00 - 300.00		s	DEF1 Definite time setting (if MDEF1=DT)	1.00				
426		TDEF1P	0.010 - 1.500		--	DEF1 Time multiplier setting (if MDEF1=IEC,IEEE,US)	1.000				
427		TDEF1RD	0.0 - 300.0		s	DEF1 Definite time reset delay (if DEF1R =DDEF)	0.0				
428		TDEF1RP	0.010 - 1.500		--	DEF1 Dependent time reset time multiplier (if DEF1R=DEP)	1.000				
429		DEF2	0.2 - 250.0	0.04 - 50.00	A	DEF2 Threshold setting (if DEF2EN=On)	15.0 / 3.00				
430		TDEF2D	0.00 - 300.00		s	DEF2 Definite time setting (if MDEF2=DT)	1.00				
431		TDEF2P	0.010 - 1.500		--	DEF2 Time multiplier setting (if MDEF2=IEC,IEEE,US)	1.000				
432		TDEF2RD	0.0 - 300.0		s	DEF2 Definite time reset delay (if DEF2R =DDEF)	0.0				
433		TDEF2RP	0.010 - 1.500		--	DEF2 Dependent time reset time multiplier (if DEF2R=DEP)	1.000				
434		DEF3	0.2 - 250.0	0.04 - 50.00	A	DEF3 Threshold setting (if DEF3EN=On)	25.0 / 5.00				
435		TDEF3	0.00 - 300.00		s	DEF3 Definite time setting (if DEF3EN=On)	1.00				
436		DEF4	0.2 - 250.0	0.04 - 50.00	A	DEF4 Threshold setting (if DEF4EN=On)	50.0 / 10.00				
437		TDEF4	0.00 - 300.00		s	DEF4 Definite time setting (if DEF4EN=On)	1.00				
438	SEF	SE1	0.025 - 0.125	0.005 - 0.025	A	SE1 Threshold setting (if SE1EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
439		TSE1D	0.00 - 300.00		s	SEF1 Definite time setting (if MSE1=DT)	--	1.00	--	1.00	
440		TSE1P	0.010 - 1.500		--	SEF1 Time multiplier setting (if MSE1=IEC,IEEE,US)	--	1.000	--	1.000	
441		TSE1RD	0.0 - 300.0		s	SEF1 Definite time reset delay (if SE1R =DEF)	--	0.0	--	0.0	
442		TSE1RP	0.010 - 1.500		--	SEF1 Dependent time reset time multiplier (if SE1R=DEP)	--	1.000	--	1.000	
443		TSE1S2	0.00 - 300.00		s	SEF1 Stage 2 definite timer settings (if SE1EN=0n and SE1S2=On)	--	1.00	--	1.00	
444		SE2	0.025 - 0.125	0.005 - 0.025	A	SEF2 Threshold setting (if SE2EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
445		TSE2D	0.00 - 300.00		s	SEF2 Definite time setting (if MSE2=DT)	--	1.00	--	1.00	
446		TSE2P	0.010 - 1.500		--	SEF2 Time multiplier setting (if MSE2=IEC,IEEE,US)	--	1.000	--	1.000	
447		TSE2RD	0.0 - 300.0		s	SEF2 Definite time reset delay (if SE2R =DEF)	--	0.0	--	0.0	
448		TSE2RP	0.010 - 1.500		--	SEF2 Dependent time reset time multiplier (if SE2R=DEP)	--	1.000	--	1.000	
449		SE3	0.025 - 0.125	0.005 - 0.025	A	SEF3 Threshold setting (if SE3EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
450		TSE3	0.00 - 300.00		s	SEF3 Definite time setting (if SE3EN=On)	--	0.00	--	0.00	
451		SE4	0.025 - 0.125	0.005 - 0.025	A	SEF4 Threshold setting (if SE4EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
452		TSE4	0.00 - 300.00		s	SEF4 Definite time setting (if SE4EN=On)	--	0.00	--	0.00	
453	DSEF	DSEθ	-95 - 95		Degree	DSEF Characteristic Angle (if DEF1 or 2 or 3 or 4EN=On)	--	0	--	0	
454		DSEV	0.5 - 100.0		V	DSEF ZPS voltage level (if DEF1 or 2 or 3 or 4EN=On)	--	3.0	--	3.0	
455		DSE1	0.025 - 0.125	0.005 - 0.025	A	DSEF1 Threshold setting (if DSE1EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
456		TDSE1D	0.00 - 300.00		s	DSEF1 Definite time setting (if MDSE1=DT)	--	1.00	--	1.00	
457		TDSE1P	0.010 - 1.500		--	DSEF1 Time multiplier setting (if MDSE1=IEC,IEEE,US)	--	1.000	--	1.000	
458		TDSE1RD	0.0 - 300.0		s	DSEF1 Definite time reset delay (if DSE1R =DEF)	--	0.0	--	0.0	
459		TDSE1RP	0.010 - 1.500		--	DSEF1 Dependent time reset time multiplier (if DSE1R=DEP)	--	1.000	--	1.000	
460		TDSE1S2	0.00 - 300.00		s	DSEF1 Stage 2 definite timer settings (if DSE1EN=0n and DSE1S2=On)	--	1.00	--	1.00	
461		DSE2	0.025 - 0.125	0.005 - 0.025	A	DSEF2 Threshold setting (if DSE2EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
462		TDSE2D	0.00 - 300.00		s	DSEF2 Definite time setting (if MDSE2=DT)	--	1.00	--	1.00	
463		TDSE2P	0.010 - 1.500		--	DSEF2 Time multiplier setting (if MDSE2=IEC,IEEE,US)	--	1.000	--	1.000	
464		TDSE2RD	0.0 - 300.0		s	DSEF2 Definite time reset delay (if DSE2R =DEF)	--	0.0	--	0.0	
465		TDSE2RP	0.010 - 1.500		--	DSEF2 Dependent time reset time multiplier (if DSE2R=DEP)	--	1.000	--	1.000	
466		DSE3	0.025 - 0.125	0.005 - 0.025	A	DSEF3 Threshold setting (if DSE3EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
467		TDSE3	0.00 - 300.00		s	DSEF3 Definite time setting (if DSE3EN=On)	--	1.00	--	1.00	
468		DSE4	0.025 - 0.125	0.005 - 0.025	A	DSEF4 Threshold setting (if DSE4EN=On)	--	0.050 / 0.010	--	0.050 / 0.010	
469		TDSE4	0.00 - 300.00		s	DSEF4 Definite time setting (if DSE4EN=On)	--	1.00	--	1.00	
470		RP	0.00 - 100.00	0.00 - 20.00	W	Residual Power Threshold.	--	0.00 / 0.00	--	0.00 / 0.00	
471	NOC	NC1	0.5 - 5.0	0.10 - 2.00	A	NOC1 Threshold setting (if NC1EN=On)	2.0 / 0.40				
472		TNC1D	0.00 - 300.00		s	NOC1 Definite time setting (if MNC1=DT)	1.00				
473		TNC1P	0.010 - 1.500		--	NOC1 Time multiplier setting (if MNC1=IEC,IEEE,US)	1.000				
474		TNC1RD	0.0 - 300.0		s	NOC1 Definite time reset delay (if NC1R =DNOC)	0.0				
475		TNC1RP	0.010 - 1.500		--	NOC1 Dependent time reset time multiplier (if NC1R=DEP)	1.000				
476		NC2	0.5 - 5.0	0.10 - 2.00	A	NOC2 Threshold setting (if NC2EN=On)	1.0 / 0.20				
477		TNC2	0.00 - 300.00		s	NOC2 Definite time setting (if NC2EN=On)	1.00				
478	DNOC	DNCθ	-95 - 95		Degree	DNOC Characteristic Angle (if DNC1 or 2 or 3 or 4EN=On)	-45				
479		DNCV	0.5 - 25.0		V	DNOC NPS voltage level (if DNC1 or 2 or 3 or 4EN=On)	3.0				
480		DNC1	0.5 - 5.0	0.10 - 2.00	A	DNOC1 Threshold setting (if DNC1EN=On)	2.0 / 0.40				
481		TDNC1D	0.00 - 300.00		s	DNOC1 Definite time setting (if MDNC1=DT)	1.00				
482		TDNC1P	0.010 - 1.500		--	DNOC1 Time multiplier setting (if MDNC1=IEC,IEEE,US)	1.000				
483		TDNC1RD	0.0 - 300.0		s	DNOC1 Definite time reset delay (if DNC1R =DDNOC)	0.0				
484		TDNC1RP	0.010 - 1.500		--	DNOC1 Dependent time reset time multiplier (if DNC1R=DEP)	1.000				
485		DNC2	0.5 - 5.0	0.10 - 2.00	A	DNOC2 Threshold setting (if DNC2EN=On)	1.0 / 0.20				
486		TDNC2	0.00 - 300.00		s	DNOC2 Definite time setting (if DNC2EN=On)	1.00				
487	Thermal	THM	2.0 - 10.0	0.40 - 2.00	A	Thermal overload setting (if OLTEN=On)	5.00 / 1.00				
488		THMIP	0.0 - 5.0	0.00 - 1.00	A	Pre Current value (if OLTEN=On)	0.0 / 0.00				
489		TTHM	0.5 - 100.0		min	Thermal Time Constant (if OLTEN=On)	10.0				
490		THMA	50 - 99		%	Thermal alarm setting (if OLTEN =On & ALTEN=On)	80				
491	BCD	BCD	0.10 - 1.00		--	Broken Conductor Threshold setting (if BCDEN=On)	0.20				
492		TBCD	0.00 - 300.00		s	Broken Conductor Definite time setting (if BCDEN=On)	1.00				

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Setting for Protection											
No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
493	CBF	CBF	0.5 - 10.0	0.10 - 2.00	A	CBF Threshold setting (if CBFEN=On)	2.50 / 0.50				
494		TBTC	0.00 - 300.00		s	Back trip Definite time setting	0.50				
495		TRTC	0.00 - 300.00		s	Re-trip Definite time setting	0.40				
496	Inrush	ICD-2f	10 - 50		%		15				
497		ICDOC	0.5 - 25.0	0.10 - 2.00	A		0.5 / 0.10				
498	Cold	OC1	0.2 - 25.0	0.04 - 5.00	A	OC1 Threshold setting in CLP mode.	10.0 / 2.00				
499	Load	OC2	0.5 - 250.0	0.10 - 50.00	A	OC2 Threshold setting in CLP mode.	50.0 / 10.00				
500		OC3	0.5 - 250.0	0.10 - 50.00	A	OC3 Threshold setting in CLP mode.	100.0 / 20.00				
501		OC4	0.5 - 250.0	0.10 - 50.00	A	OC4 Threshold setting in CLP mode.	200.00 / 40.00				
502		DOC1	0.2 - 25.0	0.04 - 5.00	A	DOC1 Threshold setting in CLP mode.	10.0 / 2.00				
503		DOC2	0.5 - 250.0	0.10 - 50.00	A	DOC2 Threshold setting in CLP mode.	50.0 / 10.00				
504		DOC3	0.5 - 250.0	0.10 - 50.00	A	DOC3 Threshold setting in CLP mode.	100.0 / 20.00				
505		DOC4	0.5 - 250.0	0.10 - 50.00	A	DOC4 Threshold setting in CLP mode.	200.00 / 40.00				
506		EF1	0.05 - 25.00	0.01 - 5.00	A	EF1 Threshold setting in CLP mode.	10.0 / 2.00				
507		EF2	0.2 - 250.0	0.04 - 50.00	A	EF2 Threshold setting in CLP mode.	50.0 / 10.00				
508		EF3	0.2 - 250.0	0.04 - 50.00	A	EF3 Threshold setting in CLP mode.	100.0 / 20.00				
509		EF4	0.2 - 250.0	0.04 - 50.00	A	EF4 Threshold setting in CLP mode.	200.00 / 40.00				
510		DEF1	0.05 - 25.00	0.01 - 5.00	A	DEF1 Threshold setting in CLP mode.	10.0 / 2.00				
511		DEF2	0.2 - 250.0	0.04 - 50.00	A	DEF2 Threshold setting in CLP mode.	50.0 / 10.00				
512		DEF3	0.2 - 250.0	0.04 - 50.00	A	DEF3 Threshold setting in CLP mode.	100.0 / 20.00				
513		DEF4	0.2 - 250.0	0.04 - 50.00	A	DEF4 Threshold setting in CLP mode.	200.00 / 40.00				
514		SE1	0.025 - 0.125	0.005 - 0.025	A	SEF1 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
515		SE2	0.025 - 0.125	0.005 - 0.025	A	SEF2 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
516		SE3	0.025 - 0.125	0.005 - 0.025	A	SEF3 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
517		SE4	0.025 - 0.125	0.005 - 0.025	A	SEF4 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
518		DSE1	0.025 - 0.125	0.005 - 0.025	A	DSEF1 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
519		DSE2	0.025 - 0.125	0.005 - 0.025	A	DSEF2 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
520		DSE3	0.025 - 0.125	0.005 - 0.025	A	DSEF3 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
521		DSE4	0.025 - 0.125	0.005 - 0.025	A	DSEF4 Threshold setting in CLP mode.	--	0.100 / 0.020	--	0.100 / 0.020	
522		NC1	0.5 - 5.0	0.10 - 2.00	A	NOC1 Threshold setting in CLP mode.	4.0 / 0.80				
523		NC2	0.5 - 5.0	0.10 - 2.00	A	NOC2 Threshold setting in CLP mode.	2.0 / 0.40				
524		DNC1	0.5 - 5.0	0.10 - 2.00	A	DNOC1 Threshold setting in CLP mode.	4.0 / 0.80				
525		DNC2	0.5 - 5.0	0.10 - 2.00	A	DNOC2 Threshold setting in CLP mode.	2.0 / 0.40				
526		BCD	0.10 - 1.00		--	Broken Conductor Threshold setting in CLP mode	0.40				
527		TCLE	0 - 10000		s	Cold load enable timer (if CLEN=On)	100				
528		TCLR	0 - 10000		s	Cold load reset timer (if CLEN=On)	100				
529		ICLDO	0.5 - 10.0	0.10 - 2.00	A	Cold load drop-out threshold setting (if CLDOEN=On)	2.5 / 0.50				
530		TCLDO	0.00 - 100.00		s	Cold load drop-out timer (if CLDOEN=1)	0.00				
531	OV	OV1	10.0 - 200.0		V	OV1 Threshold setting.	120.0				
532		TOV1D	0.00 - 300.00		s	OV1 Definite time setting. Display if [OV1EN] = 1.	1.00				
533		TOV1P	0.05 - 100.00		--	OV1 Time multiplier setting. Display if [OV1EN] = 2.	1.00				
534		TOV1R	0.0 - 300.0		s	OV1 Definite time reset delay.	0.0				
535		OV1DPR	10 - 98		%	OV1 DO/PU ratio	95				
536		OV2	10.0 - 200.0		V	OV2 Threshold setting.	140.0				
537		TOV2	0.00 - 300.00		s	OV2 Definite time setting.	1.00				
538		OV2DPR	10 - 98		%	OV2 DO/PU ratio	95				
539	UV	UV1	5.0 - 130.0		V	UV1 Threshold setting.	60.0				
540		TUV1D	0.00 - 300.00		s	UV1 Definite time setting. Display if [UV1EN] = 1.	1.00				
541		TUV1P	0.05 - 100.00		--	UV1 Time multiplier setting. Display if [UV1EN] = 2.	1.00				
542		TUV1R	0.0 - 300.0		s	UV1 Definite time reset delay.	0.0				
543		UV2	5.0 - 130.0		V	UV2 Threshold setting.	40.0				
544		TUV2	0.00 - 300.00		s	UV2 Definite time setting.	1.00				
545		VBLK	5.0 - 20.0		V	UV Blocking threshold	10.0				
546	ZOV	ZOV1	5.0 - 130.0		V	ZOV1 Threshold setting.	20.0				
547		TZOV1D	0.00 - 300.00		s	ZOV1 Definite time setting. Display if [ZOV1EN] = 1.	1.00				
548		TZOV1P	0.05 - 100.00		--	ZOV1 Time multiplier setting. Display if [ZOV1EN] = 2.	1.00				
549		TZOV1R	0.0 - 300.0		s	ZOV1 Definite time reset delay.	0.0				
550		ZOV2	5.0 - 130.0		V	ZOV2 Threshold setting.	40.0				
551		TZOV2	0.00 - 300.00		s	ZOV2 Definite time setting.	1.00				
552	NOV	NOV1	5.0 - 130.0		V	NOV1 Threshold setting.	20.0				
553		TNOV1D	0.00 - 300.00		s	NOV1 Definite time setting. Display if [MNOV1] = 0.	1.00				
554		TNOV1P	0.05 - 100.00		--	NOV1 Time multiplier setting. Display if [MNOV1] = 1.	1.00				
555		TNOV1R	0.0 - 300.0		s	NOV1 Definite time reset delay.	0.0				
556		NOV2	5.0 - 130.0		V	NOV2 Threshold setting.	40.0				
557		TNOV2	0.00 - 300.00		s	NOV2 Definite time setting.	1.00				
558	FRQ	FRQ1	25.00 - 75.00		Hz	FRQ1 Threshold setting.	49.00				
559		TFRQ1	0.00 - 300.00		s	FRQ1 Definite time setting.	1.00				
560		FRQ2	25.00 - 75.00		Hz	FRQ2 Threshold setting.	49.00				
561		TFRQ2	0.00 - 300.00		s	FRQ2 Definite time setting.	1.00				
562		FRQ3	25.00 - 75.00		Hz	FRQ3 Threshold setting.	49.00				
563		TFRQ3	0.00 - 300.00		s	FRQ3 Definite time setting.	1.00				
564		FRQ4	25.00 - 75.00		Hz	FRQ4 Threshold setting.	49.00				
565		TFRQ4	0.00 - 300.00		s	FRQ4 Definite time setting.	1.00				
566		FRQ5	25.00 - 75.00		Hz	FRQ5 Threshold setting.	49.00				
567		TFRQ5	0.00 - 300.00		s	FRQ5 Definite time setting.	1.00				
568		FRQ6	25.00 - 75.00		Hz	FRQ6 Threshold setting.	49.00				
569		TFRQ6	0.00 - 300.00		s	FRQ6 Definite time setting.	1.00				
570		FVBLK	40.0 - 100.0		V	UV Blocking threshold	40.0				
571	DFRQ	DFRQ1	0.1 - 15.0		Hz/s	DFRQ1 Threshold setting	0.5				
572		DFRQ2	0.1 - 15.0		Hz/s	DFRQ2 Threshold setting	0.5				
573		DFRQ3	0.1 - 15.0		Hz/s	DFRQ3 Threshold setting	0.5				
574		DFRQ4	0.1 - 15.0		Hz/s	DFRQ4 Threshold setting	0.5				
575		DFRQ5	0.1 - 15.0		Hz/s	DFRQ5 Threshold setting	0.5				
576		DFRQ6	0.1 - 15.0		Hz/s	DFRQ6 Threshold setting	0.5				

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Setting for Protection

No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
577	ARC	TRDY	0.0 - 600.0		s	Reclaim timer	--		60.0		
578		T1S1	0.01 - 300.00		s	1st shot Dead timer of Stage1	--		10.00		
579		T1S1S	0.01 - 300.00		s	1st shot Dead timer of Stage1 (Single Phase ARC)	--		10.00		
580		T1S1C	0.01 - 300.00		s	1st shot Dead timer of Stage1 (Configurable ARC)	--		10.00		
581		T1S1R	0.01 - 310.00		s	1st shot Reset timer of Stage1	--		20.00		
582		T1S2	0.01 - 300.00		s	2nd shot Dead timer of Stage1	--		10.00		
583		T1S2R	0.01 - 310.00		s	2nd shot Reset timer of Stage1	--		20.00		
584		T1S3	0.01 - 300.00		s	3rd shot Dead timer of Stage1	--		10.00		
585		T1S3R	0.01 - 310.00		s	3rd shot Reset timer of Stage1	--		20.00		
586		T1S4	0.01 - 300.00		s	4th shot Dead timer of Stage1	--		10.00		
587		T1S4R	0.01 - 310.00		s	4th shot Reset timer of Stage1	--		20.00		
588		T1S5	0.01 - 300.00		s	5th shot Dead timer of Stage1	--		10.00		
589		T1S5R	0.01 - 310.00		s	5th shot Reset timer of Stage1	--		20.00		
590		T2S1	0.01 - 300.00		s	1st shot Dead timer of Stage2	--		10.00		
591		T2S1S	0.01 - 300.00		s	1st shot Dead timer of Stage2 (Single Phase ARC)	--		10.00		
592		T2S1C	0.01 - 300.00		s	1st shot Dead timer of Stage2 (Configurable ARC)	--		10.00		
593		T2S1R	0.01 - 310.00		s	1st shot Reset timer of Stage2	--		20.00		
594		T2S2	0.01 - 300.00		s	2nd shot Dead timer of Stage2	--		10.00		
595		T2S2R	0.01 - 310.00		s	2nd shot Reset timer of Stage2	--		20.00		
596		T2S3	0.01 - 300.00		s	3rd shot Dead timer of Stage2	--		10.00		
597		T2S3R	0.01 - 310.00		s	3rd shot Reset timer of Stage2	--		20.00		
598		T2S4	0.01 - 300.00		s	4th shot Dead timer of Stage2	--		10.00		
599		T2S4R	0.01 - 310.00		s	4th shot Reset timer of Stage2	--		20.00		
600		T2S5	0.01 - 300.00		s	5th shot Dead timer of Stage2	--		10.00		
601		T2S5R	0.01 - 310.00		s	5th shot Reset timer of Stage2	--		20.00		
602		TW	0.01 - 10.00		s	Out put pulse timer	--		2.00		
603		TSUC	0.1 - 600.0		s	Autoreclosing succeed Judgement time	--		3.0		
604		TRCOV	0.1 - 600.0		s	Autoreclosing Recovery time after Final Trip	--		10.0		
605		TARCP	0.1 - 600.0		s	Autoreclosing Pause Time after manualy close	--		10.0		
606		TEVLV	0.01 - 300.00		s	FT Judgment time in Evolving fault mode.	--		0.30		
607		TRSET	0.01 - 300.00		s	ARC reset time in CB closing mode.	--		3.00		
608		OC	0.2 - 250.0	0.04 - 50.00	A	For Co-ordination	--		5.0 / 1.00		
609		EF	0.2 - 250.0	0.04 - 50.00	A	ditto	--		1.50 / 0.30		
610		SEF	0.025 - 0.125	0.005 - 0.025	A	ditto	--			0.050 / 0.010	
611	VCHK	OVR	5.0 - 150.0		V	OV element Checking for Running Voltage.	50.8				
612		UVR	5.0 - 150.0		V	UV element Checking for Running Voltage.	12.7				
613		OVI	5.0 - 150.0		V	OV element Checking for Incoming Voltage.	50.8				
614		UVI	5.0 - 150.0		V	UV element Checking for Incoming Voltage.	12.7				
615		SYNOV	5.0 - 150.0		V	Synchro.Check element	50.8				
616		SYNUV	5.0 - 150.0		V	ditto	82.6				
617		SYNθ	5 - 75		Degree	ditto	30				
618		SYNDf	0.02 - 0.50		Hz	ditto	0.50				
619		TLRDI	0.00 - 100.00		s	Voltage(Live Run. Voltage & Dead Incom. Voltage) check timer.	0.05				
620		TDRLI	0.00 - 100.00		s	Voltage(Dead Run. Voltage & Live Incom. Voltage) check timer.	0.05				
621		TDRDI	0.00 - 100.00		s	Voltage(Dead Run. Voltage & Dead Incom. Voltage) check timer.	0.05				
622		TSYN	0.00 - 100.00		s	Voltage(Synchronism) check timer.	1.00				
623	OC	OC1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of OC1.	0.000				
624		OC1-α	0.00 - 5.00		--	ditto	0.00				
625		OC1-C	0.000 - 5.000		--	ditto	0.000				
626		OC1-kr	0.000 - 30.000		--	ditto	0.000				
627		OC1-β	0.00 - 5.00		--	ditto	0.00				
628		OC2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of OC2.	0.000				
629		OC2-α	0.00 - 5.00		--	ditto	0.00				
630		OC2-C	0.000 - 5.000		--	ditto	0.000				
631		OC2-kr	0.000 - 30.000		--	ditto	0.000				
632		OC2-β	0.00 - 5.00		--	ditto	0.00				
633	DOC	DOC1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DOC1.	0.000				
634		DOC1-α	0.00 - 5.00		--	ditto	0.00				
635		DOC1-C	0.000 - 5.000		--	ditto	0.000				
636		DOC1-kr	0.000 - 30.000		--	ditto	0.000				
637		DOC1-β	0.00 - 5.00		--	ditto	0.00				
638		DOC2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DOC2.	0.000				
639		DOC2-α	0.00 - 5.00		--	ditto	0.00				
640		DOC2-C	0.000 - 5.000		--	ditto	0.000				
641		DOC2-kr	0.000 - 30.000		--	ditto	0.000				
642		DOC2-β	0.00 - 5.00		--	ditto	0.00				
643	EF	EF1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of EF1.	0.000				
644		EF1-α	0.00 - 5.00		--	ditto	0.00				
645		EF1-C	0.000 - 5.000		--	ditto	0.000				
646		EF1-kr	0.000 - 30.000		--	ditto	0.000				
647		EF1-β	0.00 - 5.00		--	ditto	0.00				
648		EF2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of EF2.	0.000				
649		EF2-α	0.00 - 5.00		--	ditto	0.00				
650		EF2-C	0.000 - 5.000		--	ditto	0.000				
651		EF2-kr	0.000 - 30.000		--	ditto	0.000				
652		EF2-β	0.00 - 5.00		--	ditto	0.00				

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Setting for Protection

No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
653	DEF	DEF1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DEF1.	0.000				
654		DEF1-α	0.00 - 5.00		--	ditto	0.00				
655		DEF1-C	0.000 - 5.000		--	ditto	0.000				
656		DEF1-kr	0.000 - 30.000		--	ditto	0.000				
657		DEF1-β	0.00 - 5.00		--	ditto	0.00				
658		DEF2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DEF2.	0.000				
659		DEF2-α	0.00 - 5.00		--	ditto	0.00				
660		DEF2-C	0.000 - 5.000		--	ditto	0.000				
661		DEF2-kr	0.000 - 30.000		--	ditto	0.000				
662		DEF2-β	0.00 - 5.00		--	ditto	0.00				
663	SEF	SE1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of SEF1.	--	0.000	--	0.000	
664		SE1-α	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
665		SE1-C	0.000 - 5.000		--	ditto	--	0.000	--	0.000	
666		SE1-kr	0.000 - 30.000		--	ditto	--	0.000	--	0.000	
667		SE1-β	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
668		SE2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of SEF2.	--	0.000	--	0.000	
669		SE2-α	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
670		SE2-C	0.000 - 5.000		--	ditto	--	0.000	--	0.000	
671		SE2-kr	0.000 - 30.000		--	ditto	--	0.000	--	0.000	
672		SE2-β	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
673	DSEF	DSE1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DSEF1.	--	0.000	--	0.000	
674		DSE1-α	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
675		DSE1-C	0.000 - 5.000		--	ditto	--	0.000	--	0.000	
676		DSE1-kr	0.000 - 30.000		--	ditto	--	0.000	--	0.000	
677		DSE1-β	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
678		DSE2-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DSEF2.	--	0.000	--	0.000	
679		DSE2-α	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
680		DSE2-C	0.000 - 5.000		--	ditto	--	0.000	--	0.000	
681		DSE2-kr	0.000 - 30.000		--	ditto	--	0.000	--	0.000	
682		DSE2-β	0.00 - 5.00		--	ditto	--	0.00	--	0.00	
683	NOC	NC1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of NOC1.	0.000				
684		NC1-α	0.00 - 5.00		--	ditto	0.00				
685		NC1-C	0.000 - 5.000		--	ditto	0.000				
686		NC1-kr	0.000 - 30.000		--	ditto	0.000				
687		NC1-β	0.00 - 5.00		--	ditto	0.00				
688	DNOC	DNC1-k	0.000 - 30.000		--	Configurable IDMT Curve settig of DNOC1.	0.000				
689		DNC1-α	0.00 - 5.00		--	ditto	0.00				
690		DNC1-C	0.000 - 5.000		--	ditto	0.000				
691		DNC1-kr	0.000 - 30.000		--	ditto	0.000				
692		DNC1-β	0.00 - 5.00		--	ditto	0.00				
693	Fault	X1	0.00 - 199.99	0.0 - 999.9	OHM	Fault locator setting	2.00 / 10.0				
694	locator	X0	0.00 - 199.99	0.0 - 999.9	OHM	ditto	6.80 / 34.0				
695		R1	0.00 - 199.99	0.0 - 999.9	OHM	ditto	0.20 / 1.0				
696		R0	0.00 - 199.99	0.0 - 999.9	OHM	ditto	0.70 / 3.5				
697		Kab	80 - 120		%	ditto	100				
698		Kbc	80 - 120		%	ditto	100				
699		Kca	80 - 120		%	ditto	100				
700		Ka	80 - 120		%	ditto	100				
701		Kb	80 - 120		%	ditto	100				
702		Kc	80 - 120		%	ditto	100				
703		LINE	0.0 - 399.9		km	ditto	50.0				
704	Param-	VT ratio	1 - 8000		--	VT ratio	100				
705	eters	CT ratio	1 - 10000		--	CT ratio	400				
706		VTS ratio	1 - 8000		--	VT ratio for syn	--		100		
707		EFCT ratio	1 - 10000		--	CT ratio for Ie	400				
708		SEFCT ratio	1 - 10000		--	CT ratio for Ise	--	400	--	400	
709	System	Line name	Specified by user		--	Line name	no-name				
710	AG/ Common	Active group	1 - 8		--	Active group	1				
711	PLC	USW1	P0 / P1 / P2		--	User switch for PLC	P0				
712	setting	USW2	P0 / P1 / P2		--	ditto	P0				
713		USW3	P0 / P1 / P2		--	ditto	P0				
714		USW4	P0 / P1 / P2		--	ditto	P0				
715		USW5	P0 / P1 / P2		--	ditto	P0				
716		USW6	P0 / P1 / P2		--	ditto	P0				
717		USW7	P0 / P1 / P2		--	ditto	P0				
718		USW8	P0 / P1 / P2		--	ditto	P0				
719	PLC	UTM1	0.00 - 300.00		s	User timer for PLC	0.00				
720	setting	UTM2	0.00 - 300.00		s	ditto	0.00				
721		UTM3	0.00 - 300.00		s	ditto	0.00				
722		UTM4	0.00 - 300.00		s	ditto	0.00				
723		UTM5	0.00 - 300.00		s	ditto	0.00				
724		UTM6	0.00 - 300.00		s	ditto	0.00				
725		UTM7	0.00 - 300.00		s	ditto	0.00				
726		UTM8	0.00 - 300.00		s	ditto	0.00				

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No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
1	Passwd	Setting Password	-		--	Password for Setting menu	0000				
2		Test password	–		--	Password for Test menu	0000				
3		MIMIC password	-		--	Password for MIMIC control mode	0000				
4	Notes	Plant name	-		--	Plant name	no-name				
5		Description	-		--	Description	no-data				
6	Records	TripAEN	Off / On		--	Trip Alarm Enable	Off				
7		Trips ALM	0 - 30000		--	Trip Alarm	10000				
8		ΣI^y AEN	Off / On		--	ΣI^y Alarm Enable	Off				
9		ΣI^y ALM	1 - 30000		E6	ΣI^y Alarm	10000				
10		Y value	1.0 - 2.0		--	Y value	2.0				
11		Bi-trigger events	0 - 128		--	Number of bi-trigger (on/off) events	100				
12		Fault locator	Off / On		--	Fault Locator Enable	Off				
13		AI sampling	24 / 48		--	AI sampling frequency	24				
14		Record time	0.1 - 60.0		s	Record time	1.0				
15		Pre-trig POS	0 - 100		%	Pre-trigger position	50				
16		Operation mode	OW / SAT		--	Record operation mode	OW				
17		OPT1	Off / On		--	Option1 for disturbance record trigger Enable	On				
18		OPT2	Off / On		--	Option2 for disturbance record trigger Enable	On				
19		OPT3	Off / On		--	Option3 for disturbance record trigger Enable	On				
20		OPT4	Off / On		--	Option4 for disturbance record trigger Enable	On				
21		OPT5	Off / On		--	Option5 for disturbance record trigger Enable	On				
22		OPT6	Off / On		--	Option6 for disturbance record trigger Enable	On				
23		OPT7	Off / On		--	Option7 for disturbance record trigger Enable	On				
24		OPT8	Off / On		--	Option8 for disturbance record trigger Enable	On				
25		OC	0.5 - 250.0	0.10 - 50.00	A	OC	10.0 / 2.00				
26		EF	0.5 - 125.0	0.10 - 25.00	A	EF	3.0 / 0.60				
27		SEF	0.025 - 0.125	0.005 - 0.025	A	SEF	--	1.00 / 0.200	--	1.00 / 0.200	
28		NOC	0.5 - 10.0	0.10 - 2.00	A	NOC	2.0 / 0.40				
29		OV	10.0 - 200.0		V	OV	120.0				
30		UV	1.0 - 130.0		V	UV	60.0				
31		ZOV	1.0 - 130.0		V	ZOV	20.0				
32		NOV	1.0 - 130.0		V	NOV	20.0				
33		SIG1	0 - 3071		--	Disturbance record binary signal #1	Refer to the Disturbance record default setting				
34		SIG2	0 - 3071		--	Disturbance record binary signal #2	ditto				
35		SIG3	0 - 3071		--	Disturbance record binary signal #3	ditto				
36		SIG4	0 - 3071		--	Disturbance record binary signal #4	ditto				
37		SIG5	0 - 3071		--	Disturbance record binary signal #5	ditto				
38		SIG6	0 - 3071		--	Disturbance record binary signal #6	ditto				
39		SIG7	0 - 3071		--	Disturbance record binary signal #7	ditto				
40		SIG8	0 - 3071		--	Disturbance record binary signal #8	ditto				
41		SIG9	0 - 3071		--	Disturbance record binary signal #9	ditto				
42		SIG10	0 - 3071		--	Disturbance record binary signal #10	ditto				
43		SIG11	0 - 3071		--	Disturbance record binary signal #11	ditto				
44		SIG12	0 - 3071		--	Disturbance record binary signal #12	ditto				
45		SIG13	0 - 3071		--	Disturbance record binary signal #13	ditto				
46		SIG14	0 - 3071		--	Disturbance record binary signal #14	ditto				
47		SIG15	0 - 3071		--	Disturbance record binary signal #15	ditto				
48		SIG16	0 - 3071		--	Disturbance record binary signal #16	ditto				
49		SIG17	0 - 3071		--	Disturbance record binary signal #17	ditto				
50		SIG18	0 - 3071		--	Disturbance record binary signal #18	ditto				
51		SIG19	0 - 3071		--	Disturbance record binary signal #19	ditto				
52		SIG20	0 - 3071		--	Disturbance record binary signal #20	ditto				
53		SIG21	0 - 3071		--	Disturbance record binary signal #21	ditto				
54		SIG22	0 - 3071		--	Disturbance record binary signal #22	ditto				
55		SIG23	0 - 3071		--	Disturbance record binary signal #23	ditto				
56		SIG24	0 - 3071		--	Disturbance record binary signal #24	ditto				
57		SIG25	0 - 3071		--	Disturbance record binary signal #25	ditto				
58		SIG26	0 - 3071		--	Disturbance record binary signal #26	ditto				
59		SIG27	0 - 3071		--	Disturbance record binary signal #27	ditto				
60		SIG28	0 - 3071		--	Disturbance record binary signal #28	ditto				
61		SIG29	0 - 3071		--	Disturbance record binary signal #29	ditto				
62		SIG30	0 - 3071		--	Disturbance record binary signal #30	ditto				
63		SIG31	0 - 3071		--	Disturbance record binary signal #31	ditto				
64		SIG32	0 - 3071		--	Disturbance record binary signal #32	ditto				
65		EVENT1	0 - 3071		--	Event record signal #1	Refer to the Event record default setting				
66		EVENT2	0 - 3071		--	Event record signal #2	ditto				
67		EVENT3	0 - 3071		--	Event record signal #3	ditto				
68		EVENT4	0 - 3071		--	Event record signal #4	ditto				
69		EVENT5	0 - 3071		--	Event record signal #5	ditto				
70		EVENT6	0 - 3071		--	Event record signal #6	ditto				
71		EVENT7	0 - 3071		--	Event record signal #7	ditto				
72		EVENT8	0 - 3071		--	Event record signal #8	ditto				
73		EVENT9	0 - 3071		--	Event record signal #9	ditto				
74		EVENT10	0 - 3071		--	Event record signal #10	ditto				
75		EVENT11	0 - 3071		--	Event record signal #11	ditto				
76		EVENT12	0 - 3071		--	Event record signal #12	ditto				
77		EVENT13	0 - 3071		--	Event record signal #13	ditto				
78		EVENT14	0 - 3071		--	Event record signal #14	ditto				
79		EVENT15	0 - 3071		--	Event record signal #15	ditto				
80		EVENT16	0 - 3071		--	Event record signal #16	ditto				

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No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
81		EVENT17	0 - 3071		--	Event record signal #17	ditto				
82		EVENT18	0 - 3071		--	Event record signal #18	ditto				
83		EVENT19	0 - 3071		--	Event record signal #19	ditto				
84		EVENT20	0 - 3071		--	Event record signal #20	ditto				
85		EVENT21	0 - 3071		--	Event record signal #21	ditto				
86		EVENT22	0 - 3071		--	Event record signal #22	ditto				
87		EVENT23	0 - 3071		--	Event record signal #23	ditto				
88		EVENT24	0 - 3071		--	Event record signal #24	ditto				
89		EVENT25	0 - 3071		--	Event record signal #25	ditto				
90		EVENT26	0 - 3071		--	Event record signal #26	ditto				
91		EVENT27	0 - 3071		--	Event record signal #27	ditto				
92		EVENT28	0 - 3071		--	Event record signal #28	ditto				
93		EVENT29	0 - 3071		--	Event record signal #29	ditto				
94		EVENT30	0 - 3071		--	Event record signal #30	ditto				
95		EVENT31	0 - 3071		--	Event record signal #31	ditto				
96		EVENT32	0 - 3071		--	Event record signal #32	ditto				
97		EVENT33	0 - 3071		--	Event record signal #33	ditto				
98		EVENT34	0 - 3071		--	Event record signal #34	ditto				
99		EVENT35	0 - 3071		--	Event record signal #35	ditto				
100		EVENT36	0 - 3071		--	Event record signal #36	ditto				
101		EVENT37	0 - 3071		--	Event record signal #37	ditto				
102		EVENT38	0 - 3071		--	Event record signal #38	ditto				
103		EVENT39	0 - 3071		--	Event record signal #39	ditto				
104		EVENT40	0 - 3071		--	Event record signal #40	ditto				
105		EVENT41	0 - 3071		--	Event record signal #41	ditto				
106		EVENT42	0 - 3071		--	Event record signal #42	ditto				
107		EVENT43	0 - 3071		--	Event record signal #43	ditto				
108		EVENT44	0 - 3071		--	Event record signal #44	ditto				
109		EVENT45	0 - 3071		--	Event record signal #45	ditto				
110		EVENT46	0 - 3071		--	Event record signal #46	ditto				
111		EVENT47	0 - 3071		--	Event record signal #47	ditto				
112		EVENT48	0 - 3071		--	Event record signal #48	ditto				
113		EVENT49	0 - 3071		--	Event record signal #49	ditto				
114		EVENT50	0 - 3071		--	Event record signal #50	ditto				
115		EVENT51	0 - 3071		--	Event record signal #51	ditto				
116		EVENT52	0 - 3071		--	Event record signal #52	ditto				
117		EVENT53	0 - 3071		--	Event record signal #53	ditto				
118		EVENT54	0 - 3071		--	Event record signal #54	ditto				
119		EVENT55	0 - 3071		--	Event record signal #55	ditto				
120		EVENT56	0 - 3071		--	Event record signal #56	ditto				
121		EVENT57	0 - 3071		--	Event record signal #57	ditto				
122		EVENT58	0 - 3071		--	Event record signal #58	ditto				
123		EVENT59	0 - 3071		--	Event record signal #59	ditto				
124		EVENT60	0 - 3071		--	Event record signal #60	ditto				
125		EVENT61	0 - 3071		--	Event record signal #61	ditto				
126		EVENT62	0 - 3071		--	Event record signal #62	ditto				
127		EVENT63	0 - 3071		--	Event record signal #63	ditto				
128		EVENT64	0 - 3071		--	Event record signal #64	ditto				
129		EVENT65	0 - 3071		--	Event record signal #65	ditto				
130		EVENT66	0 - 3071		--	Event record signal #66	ditto				
131		EVENT67	0 - 3071		--	Event record signal #67	ditto				
132		EVENT68	0 - 3071		--	Event record signal #68	ditto				
133		EVENT69	0 - 3071		--	Event record signal #69	ditto				
134		EVENT70	0 - 3071		--	Event record signal #70	ditto				
135		EVENT71	0 - 3071		--	Event record signal #71	ditto				
136		EVENT72	0 - 3071		--	Event record signal #72	ditto				
137		EVENT73	0 - 3071		--	Event record signal #73	ditto				
138		EVENT74	0 - 3071		--	Event record signal #74	ditto				
139		EVENT75	0 - 3071		--	Event record signal #75	ditto				
140		EVENT76	0 - 3071		--	Event record signal #76	ditto				
141		EVENT77	0 - 3071		--	Event record signal #77	ditto				
142		EVENT78	0 - 3071		--	Event record signal #78	ditto				
143		EVENT79	0 - 3071		--	Event record signal #79	ditto				
144		EVENT80	0 - 3071		--	Event record signal #80	ditto				
145		EVENT81	0 - 3071		--	Event record signal #81	ditto				
146		EVENT82	0 - 3071		--	Event record signal #82	ditto				
147		EVENT83	0 - 3071		--	Event record signal #83	ditto				
148		EVENT84	0 - 3071		--	Event record signal #84	ditto				
149		EVENT85	0 - 3071		--	Event record signal #85	ditto				
150		EVENT86	0 - 3071		--	Event record signal #86	ditto				
151		EVENT87	0 - 3071		--	Event record signal #87	ditto				
152		EVENT88	0 - 3071		--	Event record signal #88	ditto				
153		EVENT89	0 - 3071		--	Event record signal #89	ditto				
154		EVENT90	0 - 3071		--	Event record signal #90	ditto				
155		EVENT91	0 - 3071		--	Event record signal #91	ditto				
156		EVENT92	0 - 3071		--	Event record signal #92	ditto				
157		EVENT93	0 - 3071		--	Event record signal #93	ditto				
158		EVENT94	0 - 3071		--	Event record signal #94	ditto				
159		EVENT95	0 - 3071		--	Event record signal #95	ditto				
160		EVENT96	0 - 3071		--	Event record signal #96	ditto				

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No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
161		EVENT97	0 - 3071		--	Event record signal #97	ditto				
162		EVENT98	0 - 3071		--	Event record signal #98	ditto				
163		EVENT99	0 - 3071		--	Event record signal #99	ditto				
164		EVENT100	0 - 3071		--	Event record signal #100	ditto				
165		EVENT101	0 - 3071		--	Event record signal #101	ditto				
166		EVENT102	0 - 3071		--	Event record signal #102	ditto				
167		EVENT103	0 - 3071		--	Event record signal #103	ditto				
168		EVENT104	0 - 3071		--	Event record signal #104	ditto				
169		EVENT105	0 - 3071		--	Event record signal #105	ditto				
170		EVENT106	0 - 3071		--	Event record signal #106	ditto				
171		EVENT107	0 - 3071		--	Event record signal #107	ditto				
172		EVENT108	0 - 3071		--	Event record signal #108	ditto				
173		EVENT109	0 - 3071		--	Event record signal #109	ditto				
174		EVENT110	0 - 3071		--	Event record signal #110	ditto				
175		EVENT111	0 - 3071		--	Event record signal #111	ditto				
176		EVENT112	0 - 3071		--	Event record signal #112	ditto				
177		EVENT113	0 - 3071		--	Event record signal #113	ditto				
178		EVENT114	0 - 3071		--	Event record signal #114	ditto				
179		EVENT115	0 - 3071		--	Event record signal #115	ditto				
180		EVENT116	0 - 3071		--	Event record signal #116	ditto				
181		EVENT117	0 - 3071		--	Event record signal #117	ditto				
182		EVENT118	0 - 3071		--	Event record signal #118	ditto				
183		EVENT119	0 - 3071		--	Event record signal #119	ditto				
184		EVENT120	0 - 3071		--	Event record signal #120	ditto				
185		EVENT121	0 - 3071		--	Event record signal #121	ditto				
186		EVENT122	0 - 3071		--	Event record signal #122	ditto				
187		EVENT123	0 - 3071		--	Event record signal #123	ditto				
188		EVENT124	0 - 3071		--	Event record signal #124	ditto				
189		EVENT125	0 - 3071		--	Event record signal #125	ditto				
190		EVENT126	0 - 3071		--	Event record signal #126	ditto				
191		EVENT127	0 - 3071		--	Event record signal #127	ditto				
192		EVENT128	0 - 3071		--	Event record signal #128	ditto				
193	Com	RSM-X addr	1 - 32		--	RSM-X address	1				
194		R-CH1 protocol	Modbus / RSM-X		--	Rear port CH1 protocol	RSM-X				
195		R-CH2 protocol	IEC103 / DNP3.0		--	Rear port CH2 protocol	IEC103				
196		R-CH3 protocol	PRN / Modbus / IEC103 / DNP3.0		--	Rear port CH3 protocol	PRN				
197		R-CH1 Baud rate	9.6 / 19.2		--	Rear port CH1 Baud rate	9.6				
198		R-CH2 Baud rate	9.6 / 19.2		--	Rear port CH2 Baud rate	9.6				
199		R-CH3 Baud rate	4.8 / 9.6 / 19.2		--	Rear port CH3 Baud rate	9.6				
200		R-CH1 Stop bit	1bit / 2bit		--	Rear port CH1 Stop bit	1bit				
201		R-CH2 Stop bit	1bit / 2bit		--	Rear port CH2 Stop bit	1bit				
202		R-CH3 Stop bit	1bit / 2bit		--	Rear port CH3 Stop bit	1bit				
203		R-CH1 parity	Non / Odd / Even		--	Rear port CH1 parity	Non				
204		R-CH2 parity	Non / Odd / Even		--	Rear port CH2 parity	Non				
205		R-CH3 parity	Non / Odd / Even		--	Rear port CH3 parity	Non				
206		R-EthCH1 protocol	NA / DNP3.0		--	Rear port Ether CH1 protocol	NA				
207		R-EthCH2 protocol	NA / DNP3.0		--	Rear port Ether CH2 protocol	NA				
208		R-EthCH1 IP(low)	-		--	Rear port Ether CH1 IP address (Low)					
209		R-EthCH1 IP(high)	-		--	Rear port Ether CH1 IP address (High)					
210		R-EthCH1 sm(low)	-		--	Rear port Ether CH1 Subnet mask (Low)					
211		R-EthCH1 sm(high)	-		--	Rear port Ether CH1 Subnet mask (High)					
212		R-EthCH1 gw(low)	-		--	Rear port Ether CH1 default gateway (Low)					
213		R-EthCH1 gw(high)	-		--	Rear port Ether CH1 default gateway (High)					
214		R-EthCH2 IP(low)	-		--	Rear port Ether CH2 IP address (Low)					
215		R-EthCH2 IP(high)	-		--	Rear port Ether CH2 IP address (High)					
216		R-EthCH2 sm(low)	-		--	Rear port Ether CH2 Subnet mask (Low)					
217		R-EthCH2 sm(high)	-		--	Rear port Ether CH2 Subnet mask (High)					
218		R-EthCH2 gw(low)	-		--	Rear port Ether CH2 default gateway (Low)					
219		R-EthCH2 gw(high)	-		--	Rear port Ether CH2 default gateway (High)					
220		F-baud rate	9.6 / 19.2 / 38.4 / 57.6		--	Front port baud rate	9.6				
221		Mod-addr CH1	1 - 247		--	Modbus address CH1	1				
222		Mod-addr CH3	1 - 247		--	Modbus address CH3	1				
223		IEC-addr CH1	0 - 254		--	IEC103 address CH1	1				
224		IEC-addr CH3	0 - 254		--	IEC103 address CH3	1				
225		IEC-M.D.BLK	Normal / Blocked		--	IEC103 M.D.BLK	Normal				
226		DNP-addr CH2	0 - 30000		--	DNP3.0 address CH2	0				
227		DNP-addr CH3	0 - 30000		--	DNP3.0 address CH3	0				
228	Status	Display value	Primary / Secondary		--	metering	Primary				
229		Time sync	Local / IRIG / GPS / BI / Com.CH1 / Com.CH2 / Com.CH3		--	time sync source	Local				
230		GMT	-12 - 12		hrs		0				
231		Sync adjustment	-9999 - 9999		ms	Time sync compensation	0				
232		BLOFFT	1 - 60		min	Panel backlight off time	3				
233		STARSTT	0 - 24		hrs	Panel state reset time	24				
234		Power	Send / Receive		--		Send				
235		Current	Lag / Lead		--		Lead				
236	Control	CBPM	Fix / Var		--	CB pulse mode	Fix				
237		DS1PM	Fix / Var		--	DS1 pulse mode	Fix				
238		DS2PM	Fix / Var		--	DS2 pulse mode	Fix				
239		DS3PM	Fix / Var		--	DS3 pulse mode	Fix				
240		DS4PM	Fix / Var		--	DS4 pulse mode	Fix				

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Setting for Control, Record, Status, Time, Communication, Password, Panel, Others

No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User Setting
			5A rating	1A rating			1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	
241		DS5PM	Fix / Var		--	DS5 pulse mode	Fix				
242		EDS1PM	Fix / Var		--	EDS1 pulse mode	Fix				
243		EDS2PM	Fix / Var		--	EDS2 pulse mode	Fix				
244		CBOPP	0.1 - 100.0		s	CB open pulse width	5.0				
245		CBCLP	0.1 - 100.0		s	CB close pulse width	5.0				
246		DS1OPP	0.1 - 100.0		s	DS1 open pulse width	5.0				
247		DS1CLP	0.1 - 100.0		s	DS1 close pulse width	5.0				
248		DS2OPP	0.1 - 100.0		s	DS2 open pulse width	5.0				
249		DS2CLP	0.1 - 100.0		s	DS2 close pulse width	5.0				
250		DS3OPP	0.1 - 100.0		s	DS3 open pulse width	5.0				
251		DS3CLP	0.1 - 100.0		s	DS3 close pulse width	5.0				
252		DS4OPP	0.1 - 100.0		s	DS4 open pulse width	5.0				
253		DS4CLP	0.1 - 100.0		s	DS4 close pulse width	5.0				
254		DS5OPP	0.1 - 100.0		s	DS5 open pulse width	5.0				
255		DS5CLP	0.1 - 100.0		s	DS5 close pulse width	5.0				
256		EDS1OPP	0.1 - 100.0		s	EDS1 open pulse width	5.0				
257		EDS1CLP	0.1 - 100.0		s	EDS1 close pulse width	5.0				
258		EDS1EAP	0.1 - 100.0		s	EDS1 earth pulse width	5.0				
259		EDS1FRP	0.1 - 100.0		s	EDS1 free pulse width	5.0				
260		EDS2OPP	0.1 - 100.0		s	EDS2 open pulse width	5.0				
261		EDS2CLP	0.1 - 100.0		s	EDS2 close pulse width	5.0				
262		EDS2EAP	0.1 - 100.0		s	EDS2 earth pulse width	5.0				
263		EDS2FRP	0.1 - 100.0		s	EDS2 free pulse width	5.0				
264		COS1PM	Latch / Pulse		--	COS1 pulse mode	Latch				
265		COS2PM	Latch / Pulse		--	COS2 pulse mode	Latch				
266		COS3PM	Latch / Pulse		--	COS3 pulse mode	Latch				
267		COS4PM	Latch / Pulse		--	COS4 pulse mode	Latch				
268		CBRSPT	0.1 - 100.0		s	CB response check timer	20.0				
269		DS1RSPT	0.1 - 100.0		s	DS1 response check timer	20.0				
270		DS2RSPT	0.1 - 100.0		s	DS2 response check timer	20.0				
271		DS3RSPT	0.1 - 100.0		s	DS3 response check timer	20.0				
272		DS4RSPT	0.1 - 100.0		s	DS4 response check timer	20.0				
273		DS5RSPT	0.1 - 100.0		s	DS5 response check timer	20.0				
274		EDS1RSPT	0.1 - 100.0		s	EDS1 response check timer	20.0				
275		EDS2RSPT	0.1 - 100.0		s	EDS2 response check timer	20.0				
276		CBPLT	0.1 - 100.0		s	CB palette check timer	20.0				
277		DS1PLT	0.1 - 100.0		s	DS1 palette check timer	20.0				
278		DS2PLT	0.1 - 100.0		s	DS2 palette check timer	20.0				
279		DS3PLT	0.1 - 100.0		s	DS3 palette check timer	20.0				
280		DS4PLT	0.1 - 100.0		s	DS4 palette check timer	20.0				
281		DS5PLT	0.1 - 100.0		s	DS5 palette check timer	20.0				
282		EDS1PLT	0.1 - 100.0		s	EDS1 palette check timer	20.0				
283		EDS2PLT	0.1 - 100.0		s	EDS2 palette check timer	20.0				
284		IND1PLT	0.1 - 100.0		s	IND1 palette check timer	20.0				
285		IND2PLT	0.1 - 100.0		s	IND2 palette check timer	20.0				
286		IND3PLT	0.1 - 100.0		s	IND3 palette check timer	20.0				
287		IND4PLT	0.1 - 100.0		s	IND4 palette check timer	20.0				
288		IND5PLT	0.1 - 100.0		s	IND5 palette check timer	20.0				
289		IND6PLT	0.1 - 100.0		s	IND6 palette check timer	20.0				
290		IND7PLT	0.1 - 100.0		s	IND7 palette check timer	20.0				
291		IND8PLT	0.1 - 100.0		s	IND8 palette check timer	20.0				
292		OPLOCK	Unlock / Lock		--	Operation lock	Unlock				
293		IHALMEN	Off / On		--	I high alarm enable	Off				
294		IHWAREN	Off / On		--	I high warning enable	Off				
295		ILALMEN	Off / On		--	I low alarm enable	Off				
296		ILWAREN	Off / On		--	I low warning enable	Off				
297		VHALMEN	Off / On		--	V high alarm enable	Off				
298		VHWAREN	Off / On		--	V high warning enable	Off				
299		VLALMEN	Off / On		--	V low alarm enable	Off				
300		VLWAREN	Off / On		--	V low warning enable	Off				
301		PHALMEN	Off / On		--	P high alarm enable	Off				
302		PHWAREN	Off / On		--	P high warning enable	Off				
303		PLALMEN	Off / On		--	P low alarm enable	Off				
304		PLWAREN	Off / On		--	P low warning enable	Off				
305		QHALMEN	Off / On		--	Q high alarm enable	Off				
306		QHWAREN	Off / On		--	Q high warning enable	Off				
307		QLALMEN	Off / On		--	Q low alarm enable	Off				
308		QLWAREN	Off / On		--	Q low warning enable	Off				
309		fHALMEN	Off / On		--	f high alarm enable	Off				
310		fHWAREN	Off / On		--	f high warning enable	Off				
311		fLALMEN	Off / On		--	f low alarm enable	Off				
312		fLWAREN	Off / On		--	f low warning enable	Off				
313		IeHALMEN	Off / On		--	Ie high alarm enable	Off				
314		IeHWAREN	Off / On		--	Ie high warning enable	Off				
315		IeLALMEN	Off / On		--	Ie low alarm enable	Off				
316		IeLWAREN	Off / On		--	Ie low warning enable	Off				
317		VeHALMEN	Off / On		--	Ve high alarm enable	Off				
318		VeHWAREN	Off / On		--	Ve high warning enable	Off				
319		VeLALMEN	Off / On		--	Ve low alarm enable	Off				
320		VeLWAREN	Off / On		--	Ve low warning enable	Off				

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Setting for Control, Record, Status, Time, Communication, Password, Panel, Others

No.	Name	Range (5A rating / 1A rating)	Units	Contents	Default Setting of Relay Series(5A rating / 1A rating): 1** Standard Model / 2** With SEF / 3** With ARC / 4** With SEF and ARC	User Setting
321	IHALM	0.0 - 999.9	kA	I high alarm	0.0	
322	IHWAR	0.0 - 999.9	kA	I high warning	0.0	
323	ILALM	0.0 - 999.9	kA	I low alarm	0.0	
324	ILWAR	0.0 - 999.9	kA	I low warning	0.0	
325	IHYST	0.00 - 0.10	kA	I hysteresis	0.00	
326	VHALM	0.0 - 999.9	kV	V high alarm	0.0	
327	VHWAR	0.0 - 999.9	kV	V high warning	0.0	
328	VLALM	0.0 - 999.9	kV	V low alarm	0.0	
329	VLWAR	0.0 - 999.9	kV	V low warning	0.0	
330	VHYST	0.0 - 20.0	kV	V hysteresis	0.0	
331	PHALM	-999.9 - 999.9	MW	P high alarm	0.0	
332	PHWAR	-999.9 - 999.9	MW	P high warning	0.0	
333	PLALM	-999.9 - 999.9	MW	P low alarm	0.0	
334	PLWAR	-999.9 - 999.9	MW	P low warning	0.0	
335	PHYST	0.0 - 20.0	MW	P hysteresis	0.0	
336	QHALM	-999.9 - 999.9	Mv	Q high alarm	0.0	
337	QHWAR	-999.9 - 999.9	Mv	Q high warning	0.0	
338	QLALM	-999.9 - 999.9	Mv	Q low alarm	0.0	
339	QLWAR	-999.9 - 999.9	Mv	Q low warning	0.0	
340	QHYST	0.0 - 20.0	Mv	Q hysteresis	0.0	
341	fHALM	25.0 - 75.0	Hz	f high alarm	25.0	
342	fHWAR	25.0 - 75.0	Hz	f high warning	25.0	
343	fLALM	25.0 - 75.0	Hz	f low alarm	25.0	
344	fLWAR	25.0 - 75.0	Hz	f low warning	25.0	
345	fHYST	0.00 - 0.10	Hz	f hysteresis	0.00	
346	IeHALM	0.00 - 99.99	kA	Ie high alarm	0.00	
347	IeHWAR	0.00 - 99.99	kA	Ie high warning	0.00	
348	IeLALM	0.00 - 99.99	kA	Ie low alarm	0.00	
349	IeLWAR	0.00 - 99.99	kA	Ie low warning	0.00	
350	IeHYST	0 - 100	A	Ie hysteresis	0	
351	VeHALM	0.0 - 999.9	kV	Ve high alarm	0.0	
352	VeHWAR	0.0 - 999.9	kV	Ve high warning	0.0	
353	VeLALM	0.0 - 999.9	kV	Ve low alarm	0.0	
354	VeLWAR	0.0 - 999.9	kV	Ve low warning	0.0	
355	VeHYST	0.0 - 20.0	kV	Ve hysteresis	0.0	
356	Demand time	1min/5min/10min/15min/30min/60min	--	Demand time	10min	
357	CBCTS	NA/C-On/C-Off/C-OnOff/Cycle	--	CB count status	NA	
358	DS1CTS	NA/C-On/C-Off/C-OnOff/Cycle	--	DS1 count status	NA	
359	DS2CTS	NA/C-On/C-Off/C-OnOff/Cycle	--	DS2 count status	NA	
360	DS3CTS	NA/C-On/C-Off/C-OnOff/Cycle	--	DS3 count status	NA	
361	DS4CTS	NA/C-On/C-Off/C-OnOff/Cycle	--	DS4 count status	NA	
362	DS5CTS	NA/C-On/C-Off/C-OnOff/Cycle	--	DS5 count status	NA	
363	EDS1CLOSECTS	NA/C-On/C-Off/C-OnOff/Cycle	--	EDS1 close count status	NA	
364	EDS1EARTHCTS	NA/C-On/C-Off/C-OnOff/Cycle	--	EDS1 earth count status	NA	
365	EDS2CLOSECTS	NA/C-On/C-Off/C-OnOff/Cycle	--	EDS2 close count status	NA	
366	EDS2EARTHCTS	NA/C-On/C-Off/C-OnOff/Cycle	--	EDS2 earth count status	NA	
367	CT1S	NA / On / Off / OnOff	--	Counter1 status	NA	
368	CT2S	NA / On / Off / OnOff	--	Counter2 status	NA	
369	CT3S	NA / On / Off / OnOff	--	Counter3 status	NA	
370	CT4S	NA / On / Off / OnOff	--	Counter4 status	NA	
371	CT5S	NA / On / Off / OnOff	--	Counter5 status	NA	
372	CT6S	NA / On / Off / OnOff	--	Counter6 status	NA	
373	CT7S	NA / On / Off / OnOff	--	Counter7 status	NA	
374	CT8S	NA / On / Off / OnOff	--	Counter8 status	NA	
375	CBCTAEN	Off / On	--	CB count alarm enable	Off	
376	CBCTALM	0 - 30000	--	CB count alarm	0	
377	DS1CTAEN	Off / On	--	DS1 count alarm enable	Off	
378	DS1CTALM	0 - 30000	--	DS1 count alarm	0	
379	DS2CTAEN	Off / On	--	DS2 count alarm enable	Off	
380	DS2CTALM	0 - 30000	--	DS2 count alarm	0	
381	DS3CTAEN	Off / On	--	DS3 count alarm enable	Off	
382	DS3CTALM	0 - 30000	--	DS3 count alarm	0	
383	DS4CTAEN	Off / On	--	DS4 count alarm enable	Off	
384	DS4CTALM	0 - 30000	--	DS4 count alarm	0	
385	DS5CTAEN	Off / On	--	DS5 count alarm enable	Off	
386	DS5CTALM	0 - 30000	--	DS5 count alarm	0	
387	EDS1CLOSECTAEN	Off / On	--	EDS1 close count alarm enable	Off	
388	EDS1CLOSECTALM	0 - 30000	--	EDS1 close count alarm	0	
389	EDS1EARTHCTAEN	Off / On	--	EDS1 earth count alarm enable	Off	
390	EDS1EARTHCTALM	0 - 30000	--	EDS1 earth count alarm	0	
391	EDS2CLOSECTAEN	Off / On	--	EDS2 close count alarm enable	Off	
392	EDS2CLOSECTALM	0 - 30000	--	EDS2 close count alarm	0	
393	EDS2EARTHCTAEN	Off / On	--	EDS2 earth count alarm enable	Off	
394	EDS2EARTHCTALM	0 - 30000	--	EDS2 earth count alarm	0	
395	CT1AEN	Off / On	--	Counter1 alarm enable	Off	
396	CT1ALM	0 - 30000	--	Counter1 alarm	0	
397	CT2AEN	Off / On	--	Counter2 alarm enable	Off	
398	CT2ALM	0 - 30000	--	Counter2 alarm	0	
399	CT3AEN	Off / On	--	Counter3 alarm enable	Off	
400	CT3ALM	0 - 30000	--	Counter3 alarm	0	

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Setting for Control, Record, Status, Time, Communication, Password, Panel, Others

No.		Name	Range 5A rating	Range 1A rating	Units	Contents	Default Setting of Relay Series(5A rating / 1A rating) 1** Standard Model	2** With SEF	3** With ARC	4** With SEF and ARC	User Setting
401		CT4AEN	Off / On		--	Counter4 alarm enable	Off				
402		CT4ALM	0 - 30000		--	Counter4 alarm	0				
403		CT5AEN	Off / On		--	Counter5 alarm enable	Off				
404		CT5ALM	0 - 30000		--	Counter5 alarm	0				
405		CT6AEN	Off / On		--	Counter6 alarm enable	Off				
406		CT6ALM	0 - 30000		--	Counter6 alarm	0				
407		CT7AEN	Off / On		--	Counter7 alarm enable	Off				
408		CT7ALM	0 - 30000		--	Counter7 alarm	0				
409		CT8AEN	Off / On		--	Counter8 alarm enable	Off				
410		CT8ALM	0 - 30000		--	Counter8 alarm	0				
411		CBCTTAEN	Off / On		--	CB close total time alarm enable	Off				
412		CBCTT ALM	0 - 30000		day	CB close total time alarm	0				
413		CBCTT ALM	0 - 1440		min	CB close total time alarm	0				
414		CBCTT ALM	0 - 60		s	CB close total time alarm	0				
415		TT1AEN	Off / On		--	total time1 alarm enable	Off				
416		TT1 ALM	0 - 30000		day	total time1 alarm	0				
417		TT1 ALM	0 - 1440		min	total time1 alarm	0				
418		TT1 ALM	0 - 60		s	total time1 alarm	0				
419		TT2AEN	Off / On		--	total time2 alarm enable	Off				
420		TT2 ALM	0 - 30000		day	total time2 alarm	0				
421		TT2 ALM	0 - 1440		min	total time2 alarm	0				
422		TT2 ALM	0 - 60		s	total time2 alarm	0				
423		TT3AEN	Off / On		--	total time3 alarm enable	Off				
424		TT3 ALM	0 - 30000		day	total time3 alarm	0				
425		TT3 ALM	0 - 1440		min	total time3 alarm	0				
426		TT3 ALM	0 - 60		s	total time3 alarm	0				
427		TT4AEN	Off / On		--	total time4 alarm enable	Off				
428		TT4 ALM	0 - 30000		day	total time4 alarm	0				
429		TT4 ALM	0 - 1440		min	total time4 alarm	0				
430		TT4 ALM	0 - 60		s	total time4 alarm	0				
431		TT5AEN	Off / On		--	total time5 alarm enable	Off				
432		TT5 ALM	0 - 30000		day	total time5 alarm	0				
433		TT5 ALM	0 - 1440		min	total time5 alarm	0				
434		TT5 ALM	0 - 60		s	total time5 alarm	0				
435		TT6AEN	Off / On		--	total time6 alarm enable	Off				
436		TT6 ALM	0 - 30000		day	total time6 alarm	0				
437		TT6 ALM	0 - 1440		min	total time6 alarm	0				
438		TT6 ALM	0 - 60		min	total time6 alarm	0				
439		TT7AEN	Off / On		--	total time7 alarm enable	Off				
440		TT7 ALM	0 - 30000		day	total time7 alarm	0				
441		TT7 ALM	0 - 1440		min	total time7 alarm	0				
442		TT7 ALM	0 - 60		s	total time7 alarm	0				
443	Notes	Signal name1	-		--	Signal name for disturbanse BI signal	Refer to the Disturbance record default setting				
444		Signal name2	-		--	ditto	ditto				
445		Signal name3	-		--	ditto	ditto				
446		Signal name4	-		--	ditto	ditto				
447		Signal name5	-		--	ditto	ditto				
448		Signal name6	-		--	ditto	ditto				
449		Signal name7	-		--	ditto	ditto				
450		Signal name8	-		--	ditto	ditto				
451		Signal name9	-		--	ditto	ditto				
452		Signal name10	-		--	ditto	ditto				
453		Signal name11	-		--	ditto	ditto				
454		Signal name12	-		--	ditto	ditto				
455		Signal name13	-		--	ditto	ditto				
456		Signal name14	-		--	ditto	ditto				
457		Signal name15	-		--	ditto	ditto				
458		Signal name16	-		--	ditto	ditto				
459		Signal name17	-		--	ditto	ditto				
460		Signal name18	-		--	ditto	ditto				
461		Signal name19	-		--	ditto	ditto				
462		Signal name20	-		--	ditto	ditto				
463		Signal name21	-		--	ditto	ditto				
464		Signal name22	-		--	ditto	ditto				
465		Signal name23	-		--	ditto	ditto				
466		Signal name24	-		--	ditto	ditto				
467		Signal name25	-		--	ditto	ditto				
468		Signal name26	-		--	ditto	ditto				
469		Signal name27	-		--	ditto	ditto				
470		Signal name28	-		--	ditto	ditto				
471		Signal name29	-		--	ditto	ditto				
472		Signal name30	-		--	ditto	ditto				
473		Signal name31	-		--	ditto	ditto				
474		Signal name32	-		--	ditto	ditto				
475		Event name1	-		--	Event name for event record	Refer to the Event record default setting				
476		Event name2 - 127	-		--	ditto	ditto				
477		Event name128	-		--	ditto	ditto				
478		Contrast	10 - 90		--	Panel LCD contrast	--				

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No.		Name	Range		Units	Contents	Default Setting of Relay Series(5A rating / 1A rating)				User
							1**	2**	3**	4**	Setting
			5A rating	1A rating			Standard Model	With SEF	With ARC	With SEF and ARC	
479	Records	Trips	0 - 99999		--	Trips (lowerword)	0				
480		Trips	0 - 99999		--	Trips (upper wor)	0				
481		ARCs	0 - 99999		--	ARCs (lower word)	--		0		
482		ARCs	0 - 99999		--	ARCs (upper word)	--		0		
483		$\Sigma I^{y}A$	0 - 99999		E6	$\Sigma I^{y}A$ (lower word)	0				
484		$\Sigma I^{y}A$	0 - 99999		E6	$\Sigma I^{y}A$ (upper word)	0				
485		$\Sigma I^{y}B$	0 - 99999		E6	$\Sigma I^{y}B$ (lower word)	0				
486		$\Sigma I^{y}B$	0 - 99999		E6	$\Sigma I^{y}B$ (upper word)	0				
487		$\Sigma I^{y}C$	0 - 99999		E6	$\Sigma I^{y}C$ (lower word)	0				
488		$\Sigma I^{y}C$	0 - 99999		E6	$\Sigma I^{y}C$ (upper word)	0				
489	Status	Wh+	0 - 999999		kWh	Wh+ (lower word)	0				
490		Wh+	0 - 999999		kWh	Wh+ (upper word)	0				
491		Wh-	0 - 999999		kWh	Wh- (lower word)	0				
492		Wh-	0 - 999999		kWh	Wh- (upper word)	0				
493		varh+	0 - 999999		kvarh	varh+ (lower word)	0				
494		varh+	0 - 999999		kvarh	varh+ (upper word)	0				
495		varh-	0 - 999999		kvarh	varh- (lower word)	0				
496		varh-	0 - 999999		kvarh	varh- (upper word)	0				
497	Control	CBCT	0 - 29999		--	CB operation counter (lower word)	0				
498		CBCT	0 - 29999		--	CB operation counter (upper word)	0				
499		DS1CT	0 - 29999		--	DS1 operation counter (lower word)	0				
500		DS1CT	0 - 29999		--	DS1 operation counter (upper word)	0				
501		DS2CT	0 - 29999		--	DS2 operation counter (lower word)	0				
502		DS2CT	0 - 29999		--	DS2 operation counter (upper word)	0				
503		DS3CT	0 - 29999		--	DS3 operation counter (lower word)	0				
504		DS3CT	0 - 29999		--	DS3 operation counter (upper word)	0				
505		DS4CT	0 - 29999		--	DS4 operation counter (lower word)	0				
506		DS4CT	0 - 29999		--	DS4 operation counter (upper word)	0				
507		DS5CT	0 - 29999		--	DS5 operation counter (lower word)	0				
508		DS5CT	0 - 29999		--	DS5 operation counter (upper word)	0				
509		EDS1CLOSECT	0 - 29999		--	EDS1 close counter (lower word)	0				
510		EDS1CLOSECT	0 - 29999		--	EDS1 close counter (Upper word)	0				
511		EDS1EARTHCT	0 - 29999		--	EDS1 Earth counter (lower word)	0				
512		EDS1EARTHCT	0 - 29999		--	EDS1 Earth counter (upper word)	0				
513		EDS2CLOSECT	0 - 29999		--	EDS2 close counter (lower word)	0				
514		EDS2CLOSECT	0 - 29999		--	EDS2 close counter (upper word)	0				
515		EDS2EARTHCT	0 - 29999		--	EDS2 Earth counter (lower word)	0				
516		EDS2EARTHCT	0 - 29999		--	EDS2 Earth counter (upper word)	0				
517		CT1	0 - 29999		--	Counter1 (lower word)	0				
518		CT1	0 - 29999		--	Counter1 (upper word)	0				
519		CT2	0 - 29999		--	Counter2 (lower word)	0				
520		CT2	0 - 29999		--	Counter2 (upper word)	0				
521		CT3	0 - 29999		--	Counter3 (lower word)	0				
522		CT3	0 - 29999		--	Counter3 (upper word)	0				
523		CT4	0 - 29999		--	Counter4 (lower word)	0				
524		CT4	0 - 29999		--	Counter4 (upper word)	0				
525		CT5	0 - 29999		--	Counter5 (lower word)	0				
526		CT5	0 - 29999		--	Counter5 (upper word)	0				
527		CT6	0 - 29999		--	Counter6 (lower word)	0				
528		CT6	0 - 29999		--	Counter6 (upper word)	0				
529		CT7	0 - 29999		--	Counter7 (lower word)	0				
530		CT7	0 - 29999		--	Counter7 (upper word)	0				
531		CT8	0 - 29999		--	Counter8 (lower word)	0				
532		CT8	0 - 29999		--	Counter8 (upper word)	0				
533		CBCTT	0 - 29999		day	CB close total timer	0				
534		CBCTT	0 - 1439		min	CB close total timer	0				
535		CBCTT	0 - 59		s	CB close total timer	0				
536		TT1	0 - 29999		day	Total timer1	0				
537		TT1	0 - 1439		min	Total timer1	0				
538		TT1	0 - 59		s	Total timer1	0				
539		TT2	0 - 29999		day	Total timer2	0				
540		TT2	0 - 1439		min	Total timer2	0				
541		TT2	0 - 59		s	Total timer2	0				
542		TT3	0 - 29999		day	Total timer3	0				
543		TT3	0 - 1439		min	Total timer3	0				
544		TT3	0 - 59		s	Total timer3	0				
545		TT4	0 - 29999		day	Total timer4	0				
546		TT4	0 - 1439		min	Total timer4	0				
547		TT4	0 - 59		s	Total timer4	0				
548		TT5	0 - 29999		day	Total timer5	0				
549		TT5	0 - 1439		min	Total timer5	0				
550		TT5	0 - 59		s	Total timer5	0				
551		TT6	0 - 29999		day	Total timer6	0				
552		TT6	0 - 1439		min	Total timer6	0				
553		TT6	0 - 59		s	Total timer6	0				
554		TT7	0 - 29999		day	Total timer7	0				
555		TT7	0 - 1439		min	Total timer7	0				
556		TT7	0 - 59		s	Total timer7	0				

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PLC Default Setting (User cycle is 500ms.)

Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				None
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
1536	OC1_BLOCK					–											
1537	OC2_BLOCK					–											
1538	OC3_BLOCK					–											
1539	OC4_BLOCK					–											
1540	DOC1_BLOCK					–											
1541	DOC2_BLOCK					–											
1542	DOC3_BLOCK					–											
1543	DOC4_BLOCK					–											
1544	EF1_BLOCK					–											
1545	EF2_BLOCK					–											
1546	EF3_BLOCK					–											
1547	EF4_BLOCK					–											
1548	DEF1_BLOCK					–											
1549	DEF2_BLOCK					–											
1550	DEF3_BLOCK					–											
1551	DEF4_BLOCK					–											
1552	SEF1_BLOCK					–											
1553	SEF2_BLOCK					–											
1554	SEF3_BLOCK					–											
1555	SEF4_BLOCK					–											
1556	DSEF1_BLOCK					–											
1557	DSEF2_BLOCK					–											
1558	DSEF3_BLOCK					–											
1559	DSEF4_BLOCK					–											
1560	NOC1_BLOCK					–											
1561	NOC2_BLOCK					–											
1562																	
1563																	
1564	DNOC1_BLOCK					–											
1565	DNOC2_BLOCK					–											
1566																	
1567																	
1568	UC1_BLOCK					–											
1569	UC2_BLOCK					–											
1570	CBF_BLOCK					–											
1571																	
1572	THM_BLOCK					–											
1573																	
1574	BCD_BLOCK					–											
1575																	
1576																	
1577																	
1578																	
1579																	
1580																	
1581																	
1582																	
1583																	
1584	OV1_BLOCK					–											
1585	OV2_BLOCK					–											
1586																	
1587																	
1588	UV1_BLOCK					–											
1589	UV2_BLOCK					–											
1590																	
1591																	
1592	ZOV1_BLOCK					–											
1593	ZOV2_BLOCK					–											
1594																	
1595																	
1596	NOV1_BLOCK					–											
1597	NOV2_BLOCK					–											
1598																	
1599																	
1600	FRQ1_BLOCK					–											
1601	FRQ2_BLOCK					–											
1602	FRQ3_BLOCK					–											
1603	FRQ4_BLOCK					–											
1604	FRQ5_BLOCK					–											
1605	FRQ6_BLOCK					–											
1606																	
1607																	
1608	DFRQ1_BLOCK					–											
1609	DFRQ2_BLOCK					–											
1610	DFRQ3_BLOCK					–											
1611	DFRQ4_BLOCK					–											
1612	DFRQ5_BLOCK					–											
1613	DFRQ6_BLOCK					–											
1614																	
1615																	

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Output		Timing				Logic expression	Timer / Flip Flop							
№	Name	Cycle			Turn	100 / 200 / 300 / 400	Flip Flop			Timer				None
		30	90	User			Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
1616	CTF_BLOCK					–								
1617	VTF_BLOCK					–								
1618														
1619														
1620	EXT_CTF					–								
1621	EXT_VTF					–								
1622														
1623														
1624														
1625														
1626														
1627														
1628														
1629														
1630														
1631														
1632	CB_READY	X				[1282]IO1-BI3								X
1633	ARC_BLOCK	X				[1283]IO1-BI4								X
1634	ARC_NO_ACT					–								
1635	MANUAL_CLOSE					–								
1636														
1637														
1638														
1639														
1640	EXT_TRIP-A					–								
1641	EXT_TRIP-B					–								
1642	EXT_TRIP-C					–								
1643	EXT_TRIP					–								
1644	CBF_INT-A					–								
1645	CBF_INT-B					–								
1646	CBF_INT-C					–								
1647	CBF_INT	X				[485]GEN TRIP								X
1648	ARC1_INT					–								
1649	ARC1-S1_COND	X				[567]VCHK								X
1650	ARC1-C_COND					–								
1651	ARC1-C_INT					–								
1652	ARC1-S2_COND	X				[567]VCHK								X
1653	ARC1-S3_COND	X				[567]VCHK								X
1654	ARC1-S4_COND	X				[567]VCHK								X
1655	ARC1-S5_COND	X				[567]VCHK								X
1656														
1657														
1658														
1659														
1660														
1661														
1662														
1663														
1664	ARC2_INT					–								
1665	ARC2-S1_COND	X				[567]VCHK								X
1666	ARC2-C_COND					–								
1667	ARC2-C_INT					–								
1668	ARC2-S2_COND	X				[567]VCHK								X
1669	ARC2-S3_COND	X				[567]VCHK								X
1670	ARC2-S4_COND	X				[567]VCHK								X
1671	ARC2-S5_COND	X				[567]VCHK								X
1672														
1673														
1674														
1675														
1676														
1677														
1678														
1679														
1680	FRQ_S1_TRIP					[479]FRQ1_TRIP+[508]DFRQ1_TRIP								
1681	FRQ_S2_TRIP					[480]FRQ2_TRIP+[509]DFRQ2_TRIP								
1682	FRQ_S3_TRIP					[481]FRQ3_TRIP+[510]DFRQ3_TRIP								
1683	FRQ_S4_TRIP					[482]FRQ4_TRIP+[511]DFRQ4_TRIP								
1684	FRQ_S5_TRIP					[483]FRQ5_TRIP+[512]DFRQ5_TRIP								
1685	FRQ_S5_TRIP					[484]FRQ6_TRIP+[513]DFRQ6_TRIP								
1686														
1687														
1688														
1689														
1690														
1691														
1692														
1693														
1694														
1695														

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Output №	Output Name	Timing Cycle 30	Timing Cycle 90	Timing Cycle User	Timing Turn	Logic expression (100 / 200 / 300 / 400)	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
1696	L_OC1D-A					–								
1697	L_OC1D-B					–								
1698	L_OC1D-C					–								
1699														
1700	L_OC2D-A					–								
1701	L_OC2D-B					–								
1702	L_OC2D-C					–								
1703														
1704	L_OC3D-A					–								
1705	L_OC3D-B					–								
1706	L_OC3D-C					–								
1707														
1708	L_OC4D-A					–								
1709	L_OC4D-B					–								
1710	L_OC4D-C					–								
1711														
1712	L_OC1I-A					–								
1713	L_OC1I-B					–								
1714	L_OC1I-C					–								
1715														
1716	L_OC2I-A					–								
1717	L_OC2I-B					–								
1718	L_OC2I-C					–								
1719														
1720	L_ICD-A					–								
1721	L_ICD-B					–								
1722	L_ICD-C					–								
1723														
1724	L_ICLDO-A					–								
1725	L_ICLDO-B					–								
1726	L_ICLDO-C					–								
1727														
1728	L_DOC1F-A					–								
1729	L_DOC1F-B					–								
1730	L_DOC1F-C					–								
1731														
1732	L_DOC2F-A					–								
1733	L_DOC2F-B					–								
1734	L_DOC2F-C					–								
1735														
1736	L_DOC3F-A					–								
1737	L_DOC3F-B					–								
1738	L_DOC3F-C					–								
1739														
1740	L_DOC4F-A					–								
1741	L_DOC4F-B					–								
1742	L_DOC4F-C					–								
1743														
1744	L_DOC1R-A					–								
1745	L_DOC1R-B					–								
1746	L_DOC1R-C					–								
1747														
1748	L_DOC2R-A					–								
1749	L_DOC2R-B					–								
1750	L_DOC2R-C					–								
1751														
1752	L_DOC3R-A					–								
1753	L_DOC3R-B					–								
1754	L_DOC3R-C					–								
1755														
1756	L_DOC4R-A					–								
1757	L_DOC4R-B					–								
1758	L_DOC4R-C					–								
1759														
1760	L_DOC1I-A					–								
1761	L_DOC1I-B					–								
1762	L_DOC1I-C					–								
1763														
1764	L_DOC2I-A					–								
1765	L_DOC2I-B					–								
1766	L_DOC2I-C					–								
1767														
1768	L_OCHS-A					–								
1769	L_OCHS-B					–								
1770	L_OCHS-C					–								
1771														
1772	L_EFHS					–								
1773	L_SEFHS					–								
1774							–								
1775														

Output №	Output Name	Timing Cycle 30	Timing Cycle 90	Timing Cycle User	Timing Turn	Logic expression (100 / 200 / 300 / 400)	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
1776	L_DEF1I					–								
1777	L_DEF2I					–								
1778						–								
1779														
1780	L_DSEF1I					–								
1781	L_DSEF2I					–								
1782														
1783														
1784	L_DNOC1I					–								
1785														
1786														
1787														
1788														
1789														
1790														
1791														
1792	L_EF1D					–								
1793	L_EF2D					–								
1794	L_EF3D					–								
1795	L_EF4D					–								
1796	L_SEF1D					–								
1797	L_SEF2D					–								
1798	L_SEF3D					–								
1799	L_SEF4D					–								
1800	L_NOC1D					–								
1801	L_NOC2D					–								
1802														
1803														
1804	L_CBF-A					–								
1805	L_CBF-B					–								
1806	L_CBF-C					–								
1807														
1808	L_EF1I					–								
1809	L_EF2I					–								
1810														
1811														
1812	L_SEF1I					–								
1813	L_SEF2I					–								
1814														
1815														
1816	L_NOC1I					–								
1817														
1818														
1819														
1820														
1821														
1822	L_BCD					–								
1823														
1824	L_DEF1F					–								
1825	L_DEF2F					–								
1826	L_DEF3F					–								
1827	L_DEF4F					–								
1828	L_DSEF1F					–								
1829	L_DSEF2F					–								
1830	L_DSEF3F					–								
1831	L_DSEF4F					–								
1832	L_DNOC1F					–								
1833	L_DNOC2F					–								
1834														
1835														
1836														
1837														
1838														
1839	L_RFF					–								
1840	L_DEF1R					–								
1841	L_DEF2R					–								
1842	L_DEF3R					–								
1843	L_DEF4R					–								
1844	L_DSEF1R					–								
1845	L_DSEF2R					–								
1846	L_DSEF3R					–								
1847	L_DSEF4R					–								
1848	L_DNOC1R					–								
1849	L_DNOC2R					–								
1850														
1851														
1852														
1853														
1854														
1855	L_RFR					–								

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Output		Timing				Logic expression				Timer / Flip Flop							
№	Name	Cycle 30	Cycle 90	Cycle User	Turn	100	200	300	400	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
1856	L_UC1-A					–											
1857	L_UC1-B					–											
1858	L_UC1-C					–											
1859																	
1860	L_UC2-A					–											
1861	L_UC2-B					–											
1862	L_UC2-C					–											
1863																	
1864	L_PHMAX-A					–											
1865	L_PHMAX-B					–											
1866	L_PHMAX-C					–											
1867																	
1868	L_THM-T					–											
1869	L_THM-A					–											
1870																	
1871																	
1872	L_UC1-A_OCFLG					–											
1873	L_UC1-B_OCFLG					–											
1874	L_UC1-C_OCFLG					–											
1875																	
1876	L_UC2-A_OCFLG					–											
1877	L_UC2-B_OCFLG					–											
1878	L_UC2-C_OCFLG					–											
1879																	
1880	L_UC-A_UCFLG					–											
1881	L_UC-B_UCFLG					–											
1882	L_UC-C_UCFLG					–											
1883																	
1884																	
1885																	
1886																	
1887																	
1888	L_OV1D-1					–											
1889	L_OV1D-2					–											
1890	L_OV1D-3					–											
1891																	
1892	L_OV2D-1					–											
1893	L_OV2D-2					–											
1894	L_OV2D-3					–											
1895																	
1896	L_UV1D-1					–											
1897	L_UV1D-2					–											
1898	L_UV1D-3					–											
1899																	
1900	L_UV2D-1					–											
1901	L_UV2D-2					–											
1902	L_UV2D-3					–											
1903																	
1904	L_OV1I-1					–											
1905	L_OV1I-2					–											
1906	L_OV1I-3					–											
1907																	
1908																	
1909																	
1910																	
1911																	
1912	L_UV1I-1					–											
1913	L_UV1I-2					–											
1914	L_UV1I-3					–											
1915																	
1916	L_UVBLK-1					–											
1917	L_UVBLK-2					–											
1918	L_UVBLK-3					–											
1919																	
1920	L_ZOV1D					–											
1921	L_ZOV2D					–											
1922																	
1923																	
1924	L_NOV1D					–											
1925	L_NOV2D					–											
1926																	
1927																	
1928																	
1929																	
1930																	
1931																	
1932																	
1933																	
1934																	
1935																	

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Output			Timing			Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
1936	L_ZOV1I					–											
1937																	
1938																	
1939																	
1940	L_NOV1I					–											
1941																	
1942																	
1943																	
1944																	
1945																	
1946																	
1947																	
1948																	
1949																	
1950																	
1951																	
1952	L_OC-A_COORD					–											
1953	L_OC-B_COORD					–											
1954	L_OC-C_COORD					–											
1955	L_EF_COORD					–											
1956	L_SEF_COORD					–											
1957																	
1958																	
1959																	
1960																	
1961																	
1962																	
1963																	
1964																	
1965																	
1966																	
1967	L_FLUS_FLG					–											
1968	L_SYN					–											
1969	L_UVV					–											
1970	L_UVRV					–											
1971	L_OVV					–											
1972	L_OVRV					–											
1973																	
1974																	
1975																	
1976	L_Delta_V					–											
1977	L_Delta_Deg					–											
1978	L_Delta_f					–											
1979																	
1980	L_UVOUT					–											
1981																	
1982																	
1983																	
1984	L_UVVF-1					–											
1985	L_UVVF-2					–											
1986	L_UVVF-3					–											
1987	L_ZOVVF					–											
1988	L_OCDVF-A					–											
1989	L_OCDVF-B					–											
1990	L_OCDVF-C					–											
1991	L_EFVF					–											
1992	L_EFCF					–											
1993	L_ZOVCF					–											
1994																	
1995																	
1996																	
1997																	
1998																	
1999																	
2000	L_OCALM-A					–											
2001	L_OCALM-B					–											
2002	L_OCALM-C					–											
2003																	
2004																	
2005																	
2006																	
2007																	
2008																	
2009																	
2010																	
2011																	
2012																	
2013																	
2014																	
2015																	

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Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
2016	L_FRQ1						–										
2017	L_FRQ2						–										
2018	L_FRQ3						–										
2019	L_FRQ4						–										
2020	L_FRQ5						–										
2021	L_FRQ6						–										
2022																	
2023	L_FRQBLK						–										
2024																	
2025																	
2026																	
2027																	
2028																	
2029																	
2030																	
2031																	
2032																	
2033																	
2034																	
2035																	
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2095																	

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Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
2096																	
2097																	
2098																	
2099																	
2100																	
2101																	
2102																	
2103																	
2104																	
2105																	
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2108																	
2109																	
2110																	
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2139																	
2140																	
2141																	
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2154																	
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2157																	
2158																	
2159																	
2160																	
2161																	
2162																	
2163																	
2164																	
2165																	
2166																	
2167																	
2168																	
2169																	
2170																	
2171																	
2172																	
2173																	
2174																	
2175																	

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Output		Timing				Logic expression				Timer / Flip Flop							
№	Name	Cycle			Turn	100	200	300	400	Flip Flop			Timer				None
		30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
2176																	
2177																	
2178																	
2179																	
2180																	
2181																	
2182																	
2183																	
2184																	
2185																	
2186																	
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2208																	
2209																	
2210																	
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2216																	
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2235																	
2236																	
2237																	
2238																	
2239																	
2240																	
2241																	
2242																	
2243																	
2244																	
2245																	
2246																	
2247																	
2248																	
2249																	
2250																	
2251																	
2252																	
2253																	
2254																	
2255																	

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Output №	Output Name	Timing Cycle 30	Timing Cycle 90	Timing Cycle User	Timing Turn	Logic expression (100 / 200 / 300 / 400)	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
2256														
2257														
2258														
2259														
2260														
2261														
2262														
2263														
2264														
2265														
2266														
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2291														
2292														
2293														
2294														
2295														
2296														
2297														
2298														
2299														
2300														
2301														
2302														
2303														
2304	CB_N/O_CONT	X				[1280]IO1-BI1								X
2305	CB_N/C_CONT	X				[1281]IO1-BI2								X
2306	DS1_N/O_CONT					–								
2307	DS1_N/C_CONT					–								
2308	DS2_N/O_CONT					–								
2309	DS2_N/C_CONT					–								
2310	DS3_N/O_CONT					–								
2311	DS3_N/C_CONT					–								
2312	DS4_N/O_CONT					–								
2313	DS4_N/C_CONT					–								
2314	DS5_N/O_CONT					–								
2315	DS5_N/C_CONT					–								
2316	EDS1_N/O_CONT					–								
2317	EDS1_N/C_CONT					–								
2318	EDS1_N/E_CONT					–								
2319	EDS2_N/O_CONT					–								
2320	EDS2_N/C_CONT					–								
2321	EDS2_N/E_CONT					–								
2322	IND1_N/O_CONT					–								
2323	IND1_N/C_CONT					–								
2324	IND2_N/O_CONT					–								
2325	IND2_N/C_CONT					–								
2326	IND3_N/O_CONT					–								
2327	IND3_N/C_CONT					–								
2328	IND4_N/O_CONT					–								
2329	IND4_N/C_CONT					–								
2330	IND5_N/O_CONT					–								
2331	IND5_N/C_CONT					–								
2332	IND6_N/O_CONT					–								
2333	IND6_N/C_CONT					–								
2334	IND7_N/O_CONT					–								
2335	IND7_N/C_CONT					–								

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Output		Timing				Logic expression	Timer / Flip Flop							
		Cycle			Turn	100 / 200 / 300 / 400	Flip Flop			Timer				
№	Name	30	90	User			Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
2336	IND8_NO_CONT					–								
2337	IND8_NC_CONT					–								
2338	CB_SELCMD					–								
2339	CB_OPCMD					–								
2340	CB_CLCMD					–								
2341	DS1_SELCMD					–								
2342	DS1_OPCMD					–								
2343	DS1_CLCMD					–								
2344	DS2_SELCMD					–								
2345	DS2_OPCMD					–								
2346	DS2_CLCMD					–								
2347	DS3_SELCMD					–								
2348	DS3_OPCMD					–								
2349	DS3_CLCMD					–								
2350	DS4_SELCMD					–								
2351	DS4_OPCMD					–								
2352	DS4_CLCMD					–								
2353	DS5_SELCMD					–								
2354	DS5_OPCMD					–								
2355	DS5_CLCMD					–								
2356	EDS1_SELCMD					–								
2357	EDS1_OPCMD					–								
2358	EDS1_CLCMD					–								
2359	EDS1_EARCMD					–								
2360	EDS1_FRCMD					–								
2361	EDS2_SELCMD					–								
2362	EDS2_OPCMD					–								
2363	EDS2_CLCMD					–								
2364	EDS2_EARCMD					–								
2365	EDS2_FRCMD					–								
2366	COS1_SELCMD					–								
2367	COS1_ONCMD					–								
2368	COS1_OFFCMD					–								
2369	COS2_SELCMD					–								
2370	COS2_ONCMD					–								
2371	COS2_OFFCMD					–								
2372	COS3_SELCMD					–								
2373	COS3_ONCMD					–								
2374	COS3_OFFCMD					–								
2375	COS4_SELCMD					–								
2376	COS4_ONCMD					–								
2377	COS4_OFFCMD					–								
2378	CB_OPILOCK					–								
2379	CB_CLILOCK					–								
2380	DS1_OPILOCK					–								
2381	DS1_CLILOCK					–								
2382	DS2_OPILOCK					–								
2383	DS2_CLILOCK					–								
2384	DS3_OPILOCK					–								
2385	DS3_CLILOCK					–								
2386	DS4_OPILOCK					–								
2387	DS4_CLILOCK					–								
2388	DS5_OPILOCK					–								
2389	DS5_CLILOCK					–								
2390	EDS1_OPILOCK					–								
2391	EDS1_CLILOCK					–								
2392	EDS1_EARILOCK					–								
2393	EDS1_FRILOCK					–								
2394	EDS2_OPILOCK					–								
2395	EDS2_CLILOCK					–								
2396	EDS2_EARILOCK					–								
2397	EDS2_FRILOCK					–								
2398	COS1_ONILOCK					–								
2399	COS1_OFFILOCK					–								
2400	COS2_ONILOCK					–								
2401	COS2_OFFILOCK					–								
2402	COS3_ONILOCK					–								
2403	COS3_OFFILOCK					–								
2404	COS4_ONILOCK					–								
2405	COS4_OFFILOCK					–								
2406	CNT1_SIG					–								
2407	CNT2_SIG					–								
2408	CNT3_SIG					–								
2409	CNT4_SIG					–								
2410	CNT5_SIG					–								
2411	CNT6_SIG					–								
2412	CNT7_SIG					–								
2413	CNT8_SIG					–								
2414														
2415	SYNC_ESTB					–								

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Output		Timing				Logic expression	Timer / Flip Flop							
№	Name	Cycle 30	Cycle 90	Cycle User	Turn	100 / 200 / 300 / 400	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
2416	DF_SYNC_CHK					–								
2417	TRIP_SIG					–								
2418	ONTIME1_SIG		X		0	[1280]IO1-BI1								X
2419	ONTIME2_SIG					–								
2420	ONTIME3_SIG					–								
2421	ONTIME4_SIG					–								
2422	ONTIME5_SIG					–								
2423	ONTIME6_SIG					–								
2424	ONTIME7_SIG					–								
2425	ONTIME8_SIG					–								
2426	CB_OP_COM					–								
2427	DS1_OP_COM					–								
2428	DS2_OP_COM					–								
2429	DS3_OP_COM					–								
2430	DS4_OP_COM					–								
2431	DS5_OP_COM					–								
2432	EDS1_CO_COM					–								
2433	EDS2_CO_COM					–								
2434	COS1_ON_COM					–								
2435	COS2_ON_COM					–								
2436	COS3_ON_COM					–								
2437	COS4_ON_COM					–								
2438	OPEBLK_COM					–								
2439	ILOCKBYPS_COM					–								
2440	EDS1_EO_COM					–								
2441	EDS2_EO_COM					–								
2442	CB_CL_COM					–								
2443	DS1_CL_COM					–								
2444	DS2_CL_COM					–								
2445	DS3_CL_COM					–								
2446	DS4_CL_COM					–								
2447	DS5_CL_COM					–								
2448	EDS1_OC_COM					–								
2449	EDS2_OC_COM					–								
2450	COS1_OFF_COM					–								
2451	COS2_OFF_COM					–								
2452	COS3_OFF_COM					–								
2453	COS4_OFF_COM					–								
2454	OPENORM_COM					–								
2455	IUNLOCK_COM					–								
2456	EDS1_OE_COM					–								
2457	EDS2_OE_COM					–								
2458	RMT_C_RIGHT	X				[936]LR_REMOTE								X
2459	LOC_C_RIGHT	X				[937]LR_LOCAL								X
2460														
2461														
2462														
2463														
2464														
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Output		Timing				Logic expression				Timer / Flip Flop								
№	Name	Cycle			Turn	100	200	300	400	Flip Flop			Timer					None
		30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value		
2496																		
2497																		
2498																		
2499																		
2500																		
2501																		
2502																		
2503																		
2504																		
2505																		
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2554																		
2555																		
2556																		
2557																		
2558																		
2559																		
2560	IO1-TP1	X				([485]GEN TRIP + [864]CB_OP_OUT)												X
2561	IO1-TP2	X				([485]GEN TRIP + [864]CB_OP_OUT)												X
2562	IO1-BO1		X		0	[401]DOC1_TRIP							X			100	ms	
2563	IO1-BO2		X		1	[421]DEF1_TRIP							X			100	ms	
2564	IO1-BO3		X		2	[466]UV1_TRIP							X			100	ms	
2565	IO1-BO4		X		0	[474]ZOV1_TRIP							X			100	ms	
2566	IO1-BO5		X		1	–	[425]SEF1_TRIP	–	[425]SEF1_TRIP				X			100	ms	
2567	IO1-FAIL	X				[1345]RELAY_FAIL												X
2568	IO2-TP1					–												
2569	IO2-TP2					–												
2570	IO2-BO1	X				[865]CB_CL_OUT		([537]ARC_SHOT + [865]CB_CL_OUT)										X
2571	IO2-BO2					–												
2572	IO2-BO3					–												
2573	IO2-BO4					–												
2574	IO2-BO5		X		1	–		[560]ARC_SUCCESS					X			100	ms	
2575	IO2-BO6		X		2	–		[559]ARC_FT					X			100	ms	

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Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
2576	IO3-TP1					–											
2577	IO3-TP2					–											
2578	IO3-BO1					–											
2579	IO3-BO2					–											
2580	IO3-BO3					–											
2581	IO3-BO4					–											
2582	IO3-BO5					–											
2583	IO3-BO6					–											
2584	IO4-TP1					–											
2585	IO4-TP2					–											
2586	IO4-BO1					–											
2587	IO4-BO2					–											
2588	IO4-BO3					–											
2589	IO4-BO4					–											
2590	IO4-BO5					–											
2591	IO4-BO6					–											
2592																	
2593																	
2594																	
2595																	
2596																	
2597																	
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2602																	
2603																	
2604																	
2605																	
2606																	
2607																	
2608																	
2609	LED_RST	X				[1289]IO1-BI10											X
2610																	
2611	LED1					–											
2612	LED2					–											
2613	LED3					–											
2614	LED4					–											
2615	LED5					–											
2616	LED6					–											
2617	LED7					–											
2618	LED8					–											
2619																	
2620																	
2621																	
2622																	
2623																	
2624	F.RECORD1					–											
2625	F.RECORD2					–											
2626	F.RECORD3					–											
2627	F.RECORD4					–											
2628																	
2629																	
2630																	
2631																	
2632	D.RECORD1	X				[485]GEN.TRIP											X
2633	D.RECORD2	X				[359]DR_OC-OR											X
2634	D.RECORD3	X				[364]DR_EF											X
2635	D.RECORD4	X				[375]DR_UV-OR											X
2636	D.RECORD5	X				[376]DR_ZOV											X
2637	D.RECORD6					–											
2638	D.RECORD7					–											
2639	D.RECORD8					–											
2640	SET.GROUP1					–											
2641	SET.GROUP2					–											
2642	SET.GROUP3					–											
2643	SET.GROUP4					–											
2644	SET.GROUP5					–											
2645	SET.GROUP6					–											
2646	SET.GROUP7					–											
2647	SET.GROUP8					–											
2648	SYNC_CLOCK					–											
2649																	
2650																	
2651																	
2652																	
2653																	
2654																	
2655																	

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Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	None
2656	TP_COUNT	X				[485]GEN TRIP											X
2657																	
2658																	
2659																	
2660	SGM_IY	X				[485]GEN TRIP											X
2661																	
2662																	
2663																	
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2667																	
2668																	
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2678																	
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2680																	
2681																	
2682																	
2683																	
2684	ARC_COM_RECV					–											
2685																	
2686	PROT_COM_RECV					–											
2687																	
2688	TPLED_RST_RCV					–											
2689	ALMLED_RST_RCV					–											
2690	TPALM_RST_RCV					–											
2691																	
2692																	
2693																	
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Output		Timing				Logic expression				Timer / Flip Flop							
№	Name	Cycle			Turn	100	200	300	400	Flip Flop			Timer				None
		30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
2736																	
2737																	
2738																	
2739																	
2740																	
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Output		Timing				Logic expression				Timer / Flip Flop							
№	Name	Cycle			Turn	100	200	300	400	Flip Flop			Timer				None
		30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
2816	TEMP001					–											
2817	TEMP002					–											
2818	TEMP003					–											
2819	TEMP004					–											
2820	TEMP005					–											
2821	TEMP006					–											
2822	TEMP007					–											
2823	TEMP008					–											
2824	TEMP009					–											
2825	TEMP010					–											
2826	TEMP011					–											
2827	TEMP012					–											
2828	TEMP013					–											
2829	TEMP014					–											
2830	TEMP015					–											
2831	TEMP016					–											
2832	TEMP017					–											
2833	TEMP018					–											
2834	TEMP019					–											
2835	TEMP020					–											
2836	TEMP021					–											
2837	TEMP022					–											
2838	TEMP023					–											
2839	TEMP024					–											
2840	TEMP025					–											
2841	TEMP026					–											
2842	TEMP027					–											
2843	TEMP028					–											
2844	TEMP029					–											
2845	TEMP030					–											
2846	TEMP031					–											
2847	TEMP032					–											
2848	TEMP033					–											
2849	TEMP034					–											
2850	TEMP035					–											
2851	TEMP036					–											
2852	TEMP037					–											
2853	TEMP038					–											
2854	TEMP039					–											
2855	TEMP040					–											
2856	TEMP041					–											
2857	TEMP042					–											
2858	TEMP043					–											
2859	TEMP044					–											
2860	TEMP045					–											
2861	TEMP046					–											
2862	TEMP047					–											
2863	TEMP048					–											
2864	TEMP049					–											
2865	TEMP050					–											
2866	TEMP051					–											
2867	TEMP052					–											
2868	TEMP053					–											
2869	TEMP054					–											
2870	TEMP055					–											
2871	TEMP056					–											
2872	TEMP057					–											
2873	TEMP058					–											
2874	TEMP059					–											
2875	TEMP060					–											
2876	TEMP061					–											
2877	TEMP062					–											
2878	TEMP063					–											
2879	TEMP064					–											
2880	TEMP065					–											
2881	TEMP066					–											
2882	TEMP067					–											
2883	TEMP068					–											
2884	TEMP069					–											
2885	TEMP070					–											
2886	TEMP071					–											
2887	TEMP072					–											
2888	TEMP073					–											
2889	TEMP074					–											
2890	TEMP075					–											
2891	TEMP076					–											
2892	TEMP077					–											
2893	TEMP078					–											
2894	TEMP079					–											
2895	TEMP080					–											

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Output		Timing				Logic expression	Timer / Flip Flop							
№	Name	Cycle 30	Cycle 90	Cycle User	Turn	100 200 300 400	Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer Off Delay	Timer On Delay	Timer One Shot	Time Value	None
2896	TEMP081					–								
2897	TEMP082					–								
2898	TEMP083					–								
2899	TEMP084					–								
2900	TEMP085					–								
2901	TEMP086					–								
2902	TEMP087					–								
2903	TEMP088					–								
2904	TEMP089					–								
2905	TEMP090					–								
2906	TEMP091					–								
2907	TEMP092					–								
2908	TEMP093					–								
2909	TEMP094					–								
2910	TEMP095					–								
2911	TEMP096					–								
2912	TEMP097					–								
2913	TEMP098					–								
2914	TEMP099					–								
2915	TEMP100					–								
2916	TEMP101					–								
2917	TEMP102					–								
2918	TEMP103					–								
2919	TEMP104					–								
2920	TEMP105					–								
2921	TEMP106					–								
2922	TEMP107					–								
2923	TEMP108					–								
2924	TEMP109					–								
2925	TEMP110					–								
2926	TEMP111					–								
2927	TEMP112					–								
2928	TEMP113					–								
2929	TEMP114					–								
2930	TEMP115					–								
2931	TEMP116					–								
2932	TEMP117					–								
2933	TEMP118					–								
2934	TEMP119					–								
2935	TEMP120					–								
2936	TEMP121					–								
2937	TEMP122					–								
2938	TEMP123					–								
2939	TEMP124					–								
2940	TEMP125					–								
2941	TEMP126					–								
2942	TEMP127					–								
2943	TEMP128					–								
2944	TEMP129					–								
2945	TEMP130					–								
2946	TEMP131					–								
2947	TEMP132					–								
2948	TEMP133					–								
2949	TEMP134					–								
2950	TEMP135					–								
2951	TEMP136					–								
2952	TEMP137					–								
2953	TEMP138					–								
2954	TEMP139					–								
2955	TEMP140					–								
2956	TEMP141					–								
2957	TEMP142					–								
2958	TEMP143					–								
2959	TEMP144					–								
2960	TEMP145					–								
2961	TEMP146					–								
2962	TEMP147					–								
2963	TEMP148					–								
2964	TEMP149					–								
2965	TEMP150					–								
2966	TEMP151					–								
2967	TEMP152					–								
2968	TEMP153					–								
2969	TEMP154					–								
2970	TEMP155					–								
2971	TEMP156					–								
2972	TEMP157					–								
2973	TEMP158					–								
2974	TEMP159					–								
2975	TEMP160					–								

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№ (Output)	Name (Output)	Timing: Cycle 30	Timing: Cycle 90	Timing: Cycle User	Timing: Turn	Logic expression (100 / 200 / 300 / 400)	Timer / Flip Flop: Flip Flop Norm	Flip Flop Back Up	Signal to reset	Timer: Off Delay	Timer: On Delay	Timer: One Shot	Time Value	None
2976	TEMP161					–								
2977	TEMP162					–								
2978	TEMP163					–								
2979	TEMP164					–								
2980	TEMP165					–								
2981	TEMP166					–								
2982	TEMP167					–								
2983	TEMP168					–								
2984	TEMP169					–								
2985	TEMP170					–								
2986	TEMP171					–								
2987	TEMP172					–								
2988	TEMP173					–								
2989	TEMP174					–								
2990	TEMP175					–								
2991	TEMP176					–								
2992	TEMP177					–								
2993	TEMP178					–								
2994	TEMP179					–								
2995	TEMP180					–								
2996	TEMP181					–								
2997	TEMP182					–								
2998	TEMP183					–								
2999	TEMP184					–								
3000	TEMP185					–								
3001	TEMP186					–								
3002	TEMP187					–								
3003	TEMP188					–								
3004	TEMP189					–								
3005	TEMP190					–								
3006	TEMP191					–								
3007	TEMP192					–								
3008	TEMP193					–								
3009	TEMP194					–								
3010	TEMP195					–								
3011	TEMP196					–								
3012	TEMP197					–								
3013	TEMP198					–								
3014	TEMP199					–								
3015	TEMP200					–								
3016	TEMP201					–								
3017	TEMP202					–								
3018	TEMP203					–								
3019	TEMP204					–								
3020	TEMP205					–								
3021	TEMP206					–								
3022	TEMP207					–								
3023	TEMP208					–								
3024	TEMP209					–								
3025	TEMP210					–								
3026	TEMP211					–								
3027	TEMP212					–								
3028	TEMP213					–								
3029	TEMP214					–								
3030	TEMP215					–								
3031	TEMP216					–								
3032	TEMP217					–								
3033	TEMP218					–								
3034	TEMP219					–								
3035	TEMP220					–								
3036	TEMP221					–								
3037	TEMP222					–								
3038	TEMP223					–								
3039	TEMP224					–								
3040	TEMP225					–								
3041	TEMP226					–								
3042	TEMP227					–								
3043	TEMP228					–								
3044	TEMP229					–								
3045	TEMP230					–								
3046	TEMP231					–								
3047	TEMP232					–								
3048	TEMP233					–								
3049	TEMP234					–								
3050	TEMP235					–								
3051	TEMP236					–								
3052	TEMP237					–								
3053	TEMP238					–								
3054	TEMP239					–								
3055	TEMP240					–								

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Output		Timing				Logic expression				Timer / Flip Flop							
		Cycle			Turn	100	200	300	400	Flip Flop			Timer				None
№	Name	30	90	User						Norm	Back Up	Signal to reset	Off Delay	On Delay	One Shot	Time Value	
3056	TEMP241					–											
3057	TEMP242					–											
3058	TEMP243					–											
3059	TEMP244					–											
3060	TEMP245					–											
3061	TEMP246					–											
3062	TEMP247					–											
3063	TEMP248					–											
3064	TEMP249					–											
3065	TEMP250					–											
3066	TEMP251					–											
3067	TEMP252					–											
3068	TEMP253					–											
3069	TEMP254					–											
3070	TEMP255					–											
3071	TEMP256					–											

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Disturbance record default setting

Name	Range	Model 1**		Model 2**		Model 3**		Model 4**	
		NO.	Signal name	NO.	Signal name	NO.	Signal name	NO.	Signal name
SIG1	0 - 3071	621	DOC1-A OP	621	DOC1-A OP	621	DOC1-A OP	621	DOC1-A OP
SIG2	0 - 3071	622	DOC1-B OP	622	DOC1-B OP	622	DOC1-B OP	622	DOC1-B OP
SIG3	0 - 3071	623	DOC1-C OP	623	DOC1-C OP	623	DOC1-C OP	623	DOC1-C OP
SIG4	0 - 3071	401	DOC1 TRIP	401	DOC1 TRIP	401	DOC1 TRIP	401	DOC1 TRIP
SIG5	0 - 3071	637	DEF1 OP	637	DEF1 OP	637	DEF1 OP	637	DEF1 OP
SIG6	0 - 3071	421	DEF1 TRIP	421	DEF1 TRIP	421	DEF1 TRIP	421	DEF1 TRIP
SIG7	0 - 3071	670	UV1-1 OP	670	UV1-1 OP	670	UV1-1 OP	670	UV1-1 OP
SIG8	0 - 3071	671	UV1-2 OP	671	UV1-2 OP	671	UV1-2 OP	671	UV1-2 OP
SIG9	0 - 3071	672	UV1-3 OP	672	UV1-3 OP	672	UV1-3 OP	672	UV1-3 OP
SIG10	0 - 3071	466	UV1 TRIP	466	UV1 TRIP	466	UV1 TRIP	466	UV1 TRIP
SIG11	0 - 3071	677	ZOV1 OP	677	ZOV1 OP	677	ZOV1 OP	677	ZOV1 OP
SIG12	0 - 3071	474	ZOV1 TRIP	474	ZOV1 TRIP	474	ZOV1 TRIP	474	ZOV1 TRIP
SIG13	0 - 3071	0	NA	645	DSEF1 OP	0	NA	645	DSEF1 OP
SIG14	0 - 3071	0	NA	430	DSEF1 TRIP	0	NA	430	DSEF1 TRIP
SIG15	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG16	0 - 3071	485	GEN. TRIP	485	GEN. TRIP	485	GEN. TRIP	485	GEN. TRIP
SIG17	0 - 3071	0	NA	0	NA	529	ARC READY	529	ARC READY
SIG18	0 - 3071	0	NA	0	NA	1633	ARC BLOCK	1633	ARC BLOCK
SIG19	0 - 3071	0	NA	0	NA	537	ARC SHOT	537	ARC SHOT
SIG20	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG21	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG22	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG23	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG24	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG25	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG26	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG27	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG28	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG29	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG30	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG31	0 - 3071	0	NA	0	NA	0	NA	0	NA
SIG32	0 - 3071	0	NA	0	NA	0	NA	0	NA

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Event record default setting

Event No	Range	Model 1**		Model 2**		Model 3**		Model 4**	
		NO.	Event name	NO.	Event name	NO.	Event name	NO.	Event name
1	0 - 3071	485	GEN.TRIP	485	GEN.TRIP	485	GEN.TRIP	485	GEN.TRIP
2	0 - 3071	621	DOC1-A_OP	621	DOC1-A_OP	621	DOC1-A_OP	621	DOC1-A_OP
3	0 - 3071	622	DOC1-B_OP	622	DOC1-B_OP	622	DOC1-B_OP	622	DOC1-B_OP
4	0 - 3071	623	DOC1-C_OP	623	DOC1-C_OP	623	DOC1-C_OP	623	DOC1-C_OP
5	0 - 3071	402	DOC1-A_TRIP	402	DOC1-A_TRIP	402	DOC1-A_TRIP	402	DOC1-A_TRIP
6	0 - 3071	403	DOC1-B_TRIP	403	DOC1-B_TRIP	403	DOC1-B_TRIP	403	DOC1-B_TRIP
7	0 - 3071	404	DOC1-C_TRIP	404	DOC1-C_TRIP	404	DOC1-C_TRIP	404	DOC1-C_TRIP
8	0 - 3071	637	DEF1_OP	637	DEF1_OP	637	DEF1_OP	637	DEF1_OP
9	0 - 3071	421	DEF1_TRIP	421	DEF1_TRIP	421	DEF1_TRIP	421	DEF1_TRIP
10	0 - 3071	670	UV1-1_OP	670	UV1-1_OP	670	UV1-1_OP	670	UV1-1_OP
11	0 - 3071	671	UV1-2_OP	671	UV1-2_OP	671	UV1-2_OP	671	UV1-2_OP
12	0 - 3071	672	UV1-3_OP	672	UV1-3_OP	672	UV1-3_OP	672	UV1-3_OP
13	0 - 3071	467	UV1-1_TRIP	467	UV1-1_TRIP	467	UV1-1_TRIP	467	UV1-1_TRIP
14	0 - 3071	468	UV1-2_TRIP	468	UV1-2_TRIP	468	UV1-2_TRIP	468	UV1-2_TRIP
15	0 - 3071	469	UV1-3_TRIP	469	UV1-3_TRIP	469	UV1-3_TRIP	469	UV1-3_TRIP
16	0 - 3071	677	ZOV1_OP	677	ZOV1_OP	677	ZOV1_OP	677	ZOV1_OP
17	0 - 3071	474	ZOV1_TRIP	474	ZOV1_TRIP	474	ZOV1_TRIP	474	ZOV1_TRIP
18	0 - 3071	0		645	DSEF1_OP	0		645	DSEF1_OP
19	0 - 3071	0		430	DSEF1_TRIP	0		430	DSEF1_TRIP
20	0 - 3071	0		0		529	ARC_READY	529	ARC_READY
21	0 - 3071	0		0		1633	ARC_BLOCK	1633	ARC_BLOCK
22	0 - 3071	0		0		537	ARC_SHOT	537	ARC_SHOT
23	0 - 3071	0		0		0		0	
24	0 - 3071	0		0		0		0	
25	0 - 3071	0		0		0		0	
26	0 - 3071	0		0		0		0	
27	0 - 3071	0		0		0		0	
28	0 - 3071	0		0		0		0	
29	0 - 3071	0		0		0		0	
30	0 - 3071	0		0		0		0	
31	0 - 3071	0		0		0		0	
32	0 - 3071	0		0		0		0	
33	0 - 3071	947	REMOTE	947	REMOTE	947	REMOTE	947	REMOTE
34	0 - 3071	948	LOCAL	948	LOCAL	948	LOCAL	948	LOCAL
35	0 - 3071	941	OPELOCK	941	OPELOCK	941	OPELOCK	941	OPELOCK
36	0 - 3071	942	ILOCK_BYPS	942	ILOCK_BYPS	942	ILOCK_BYPS	942	ILOCK_BYPS
37	0 - 3071	943	DCBLOCK	943	DCBLOCK	943	DCBLOCK	943	DCBLOCK
38	0 - 3071	0		0		944	SYNC_ESTB	944	SYNC_ESTB
39	0 - 3071	0		0		945	SYNC_FAIL	945	SYNC_FAIL
40	0 - 3071	0		0		0		0	
41	0 - 3071	2304	CB_N/O_CONT	2304	CB_N/O_CONT	2304	CB_N/O_CONT	2304	CB_N/O_CONT
42	0 - 3071	2305	CB_N/C_CONT	2305	CB_N/C_CONT	2305	CB_N/C_CONT	2305	CB_N/C_CONT
43	0 - 3071	0		0		0		0	
44	0 - 3071	0		0		0		0	
45	0 - 3071	0		0		0		0	
46	0 - 3071	0		0		0		0	
47	0 - 3071	0		0		0		0	
48	0 - 3071	0		0		0		0	
49	0 - 3071	0		0		0		0	
50	0 - 3071	0		0		0		0	
51	0 - 3071	0		0		0		0	
52	0 - 3071	0		0		0		0	
53	0 - 3071	0		0		0		0	
54	0 - 3071	0		0		0		0	
55	0 - 3071	0		0		0		0	
56	0 - 3071	0		0		0		0	
57	0 - 3071	0		0		0		0	
58	0 - 3071	0		0		0		0	
59	0 - 3071	0		0		0		0	
60	0 - 3071	0		0		0		0	
61	0 - 3071	0		0		0		0	
62	0 - 3071	0		0		0		0	
63	0 - 3071	0		0		0		0	
64	0 - 3071	0		0		0		0	

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Event record default setting									
Event No	Range	Model 1**		Model 2**		Model 3**		Model 4**	
		NO.	Event name	NO.	Event name	NO.	Event name	NO.	Event name
65	0 - 3071	0		0		0		0	
66	0 - 3071	0		0		0		0	
67	0 - 3071	0		0		0		0	
68	0 - 3071	0		0		0		0	
69	0 - 3071	0		0		0		0	
70	0 - 3071	0		0		0		0	
71	0 - 3071	0		0		0		0	
72	0 - 3071	0		0		0		0	
73	0 - 3071	0		0		0		0	
74	0 - 3071	0		0		0		0	
75	0 - 3071	0		0		0		0	
76	0 - 3071	0		0		0		0	
77	0 - 3071	0		0		0		0	
78	0 - 3071	0		0		0		0	
79	0 - 3071	0		0		0		0	
80	0 - 3071	0		0		0		0	
81	0 - 3071	0		0		0		0	
82	0 - 3071	0		0		0		0	
83	0 - 3071	0		0		0		0	
84	0 - 3071	0		0		0		0	
85	0 - 3071	0		0		0		0	
86	0 - 3071	0		0		0		0	
87	0 - 3071	0		0		0		0	
88	0 - 3071	0		0		0		0	
89	0 - 3071	0		0		0		0	
90	0 - 3071	0		0		0		0	
91	0 - 3071	0		0		0		0	
92	0 - 3071	0		0		0		0	
93	0 - 3071	0		0		0		0	
94	0 - 3071	0		0		0		0	
95	0 - 3071	0		0		0		0	
96	0 - 3071	0		0		0		0	
97	0 - 3071	1345	Relay_fail	1345	Relay_fail	1345	Relay_fail	1345	Relay_fail
98	0 - 3071	1346	Relay_fail-A	1346	Relay_fail-A	1346	Relay_fail-A	1346	Relay_fail-A
99	0 - 3071	0		0		0		0	
100	0 - 3071	0		0		0		0	
101	0 - 3071	2640	SET.GROUP1	2640	SET.GROUP1	2640	SET.GROUP1	2640	SET.GROUP1
102	0 - 3071	2641	SET.GROUP2	2641	SET.GROUP2	2641	SET.GROUP2	2641	SET.GROUP2
103	0 - 3071	2642	SET.GROUP3	2642	SET.GROUP3	2642	SET.GROUP3	2642	SET.GROUP3
104	0 - 3071	2643	SET.GROUP4	2643	SET.GROUP4	2643	SET.GROUP4	2643	SET.GROUP4
105	0 - 3071	2644	SET.GROUP5	2644	SET.GROUP5	2644	SET.GROUP5	2644	SET.GROUP5
106	0 - 3071	2645	SET.GROUP6	2645	SET.GROUP6	2645	SET.GROUP6	2645	SET.GROUP6
107	0 - 3071	2646	SET.GROUP7	2646	SET.GROUP7	2646	SET.GROUP7	2646	SET.GROUP7
108	0 - 3071	2647	SET.GROUP8	2647	SET.GROUP8	2647	SET.GROUP8	2647	SET.GROUP8
109	0 - 3071	1464	Sys.set_change	1464	Sys.set_change	1464	Sys.set_change	1464	Sys.set_change
110	0 - 3071	1465	Rly.set_change	1465	Rly.set_change	1465	Rly.set_change	1465	Rly.set_change
111	0 - 3071	1466	Grp.set_change	1466	Grp.set_change	1466	Grp.set_change	1466	Grp.set_change
112	0 - 3071	1642	TR_ARC_CT_CHG	1642	TR_ARC_CT_CHG	1642	TR_ARC_CT_CHG	1642	TR_ARC_CT_CHG
113	0 - 3071	1643	Sigma_I^y_CHG	1643	Sigma_I^y_CHG	1643	Sigma_I^y_CHG	1643	Sigma_I^y_CHG
114	0 - 3071	1467	DEV_CT_CHG	1467	DEV_CT_CHG	1467	DEV_CT_CHG	1467	DEV_CT_CHG
115	0 - 3071	1468	GEN_CT_CHG	1468	GEN_CT_CHG	1468	GEN_CT_CHG	1468	GEN_CT_CHG
116	0 - 3071	1469	Total_time_CHG	1469	Total_time_CHG	1469	Total_time_CHG	1469	Total_time_CHG
117	0 - 3071								
118	0 - 3071	1448	DEV_time_CLR	1448	DEV_time_CLR	1448	DEV_time_CLR	1448	DEV_time_CLR
119	0 - 3071	1461	PLC_data_CHG	1461	PLC_data_CHG	1461	PLC_data_CHG	1461	PLC_data_CHG
120	0 - 3071	1471	MIMIC_data_CHG	1471	MIMIC_data_CHG	1471	MIMIC_data_CHG	1471	MIMIC_data_CHG
121	0 - 3071	2609	LED_RST	2609	LED_RST	2609	LED_RST	2609	LED_RST
122	0 - 3071	1450	F.Record_CLR	1450	F.Record_CLR	1450	F.Record_CLR	1450	F.Record_CLR
123	0 - 3071	1451	A.Record_CLR	1451	A.Record_CLR	1451	A.Record_CLR	1451	A.Record_CLR
124	0 - 3071	1452	E.Record_CLR	1452	E.Record_CLR	1452	E.Record_CLR	1452	E.Record_CLR
125	0 - 3071	1453	D.Record_CLR	1453	D.Record_CLR	1453	D.Record_CLR	1453	D.Record_CLR
126	0 - 3071	0		0		0		0	
127	0 - 3071	0		0		0		0	
128	0 - 3071	0		0		0		0	

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Appendix I

Commissioning Test Sheet (sample)

1. Relay identification
2. Preliminary check
3. Hardware check
   3.1 User interface check
   3.2 Binary input/binary output circuit check
   3.3 AC input circuit
4. Function test
   4.1 Overcurrent elements test
   4.2 BCD element check
   4.3 Cold load function check
   4.4 Overvoltage and undervoltage element check
   4.5 Directional element check
   4.6 Frequency element test
   4.7 Synchronism check test
5. Protection scheme test
6. Metering and recording check
7. Conjunctive test

1. Relay identification

Type ______________________ Serial number ______________________

Model ______________________ System frequency ______________________

Station ______________________ Date ______________________

Circuit ______________________ Engineer ______________________

Protection scheme ______________________ Witness ______________________

Active settings group number __________

2. Preliminary check

Ratings	☐
CT shorting contacts	☐
DC power supply	☐
Power up	☐
Wiring	☐
Relay inoperative alarm contact	☐
Calendar and clock	☐

3. Hardware check

3.1 User interface check ☐

3.2 Binary input/binary output circuit check

Binary input circuit	☐
Binary output circuit	☐

3.3 AC input circuit ☐

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4. Function test

4.1 Overcurrent elements test

Element	Current setting	Measured current
OC1-A		
OC2-A		
OC3-A		
OC4-A		
EF1		
EF2		
EF3		
EF4		
SEF1		
SEF2		

Element	Current setting	Measured current
SEF3		
SEF4		
UC1-A		
UC2-A		
THM-A		
THM-T		
NOC1		
NOC2		
BCD		
CBF-A		

Operating time test (IDMT)

Element	Curve setting	Multiplier setting	Measured time
OC1-A			
EF1			
SEF1			
NOC1			

4.2 BCD element check

4.3 Cold load function check

4.4 Overvoltage and undervoltage elements check

Element	Voltage setting	Measured voltage
OV1-1		
OV2-1		
UV1-1		
UV2-1		

Element	Voltage setting	Measured voltage
ZOV1		
ZOV2		
NOV1		
NOV2		

Operating time test (IDMT)

Element	Curve setting	Multiplier setting	Measured time
OV1-1			
UV1-1			
ZOV1			
NOV1			

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4.5 Directional element check

Element	Setting	Measured current
DOC1		
DEF1		
DSEF1		
DNOC1		

4.6 Frequency element test

Element	Setting	Measured frequency
FRQ1		
FRQ2		
FRQ3		

Element	Setting	Measured frequency
FRQ4		
FRQ5		
FRQ6		

4.7 Synchronism check test

(1) Voltage check element

Element	Setting	Measured voltage
OVR		
UVR		
OVI		
UVI		

(2) Synchronism check element

① Voltage check

Element	Setting	Measured voltage
SYNOV		
SYNUV		

② Phase angle check

Element	Setting	Measured angle
SYNθ		

5. Protection scheme test

6. Metering and recording check

7. Conjunctive test

Scheme	Results
On load check Tripping circuit	

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Appendix J

Return Repair Form

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RETURN / REPAIR FORM

Please fill in this form and return it to Toshiba Corporation with the GRD150 to be repaired.

TOSHIBA CORPORATION FUCHU COMPLEX

1,Toshiba-cho, Fuchu-shi, Tokyo, Japan

For: Power Systems Protection & Control Department

Quality Assurance Group

Type: GRD150 Model: ________

(Example: Type: GRD150 Model: 101A-10-10)

Product No.: ______________________________

Serial No.: ______________________________

Date: ______________________________

1. Reason for returning the relay
   - ☐ mal-function
   - ☐ does not operate
   - ☐ increased error
   - ☐ investigation
   - ☐ others

   ____

   ____

   ____

   ____

2. Fault records, event records or disturbance records stored in the relay and relay settings are very helpful information to investigate the incident.

   Please provide relevant information regarding the incident on floppy disk, or fill in the attached fault record sheet and relay setting sheet.

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Fault Record

Date/Month/Year Time / / / : : .

(Example: 04/ Jul./ 2003 15:09:58.442)

Faulty phase:

Prefault values

Va:	V	I_a:	A
Vb:	V	I_b:	A
Vc:	V	I_c:	A
Ve:	V	I_e:	A
Vs:	V	I_{se}:	A
Vab:	V	I1:	A
Vbc:	V	I2:	A
Vca:	V	I0:	A
V1:	V		
V2:	V		
V0:	V		
f:	Hz		

Fault values

Va:	V	I_a:	A
Vb:	V	I_b:	A
Vc:	V	I_c:	A
Ve:	V	I_e:	A
Vs:	V	I_{se}:	A
Vab:	V	I1:	A
Vbc:	V	I2:	A
Vca:	V	I0:	A
V1:	V	THM:	%
V2:	V		
V0:	V		
f:	Hz		

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3. What was the message on the LCD display at the time of the incident?

4. Describe the details of the incident:

5. Date incident occurred

Day/Month/Year: / / /

(Example: 10/July/2003)

6. Give any comments about the GRD150, including the documents:

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Customer

Name: ______________________________

Company Name: ______________________________

Address: ______________________________

____

____

Telephone No.: ______________________________

Facsimile No.: ______________________________

Signature: ______________________________

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Appendix K

Technical Data

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TECHNICAL DATA

Ratings	
AC current In	1A or 5A
AC voltage Vn:	100V, 110V, 115V, 120V
Frequency:	50Hz or 60Hz
DC auxiliary supply:	110/125Vdc (Operative range: 88 – 150Vdc), 220/250Vdc (Operative range: 176 – 300Vdc), 48/54/60Vdc (Operative range: 38.4 – 72Vdc) 24/30Vdc (Operative range: 19.2 – 36Vdc)
Superimposed AC ripple on DC supply:	≤ 12%
DC supply interruption:	≤ 50ms at 110V
Binary input circuit DC voltage:	110/125Vdc, 220/250Vdc, 48/54/60Vdc 24/30Vdc
Overload Ratings	
AC current inputs:	3 times rated current continuous 100 times rated current for 1 second
AC voltage inputs:	2 times rated voltage continuous
Burden	
AC phase current inputs:	≤ 0.1VA (1A rating) or ≤ 0.3VA (5A rating)
AC earth current inputs:	≤ 0.3VA (1A rating) or ≤ 0.4VA (5A rating)
AC sensitive earth inputs:	≤ 0.3VA (1A rating) or ≤ 0.4VA (5A rating)
AC voltage inputs:	≤ 0.1VA (at rated voltage)
DC power supply:	≤ 15W (quiescent) or ≤ 20W (maximum)
Binary input circuit:	≤ 0.5W per input at 110Vdc
Protection Functions	
Current Transformer Requirements	
Phase Inputs	Typically 5P20 with rated burden according to load, (refer to manual for detailed instructions).
Standard Earth Inputs:	Core balance CT or residual connection of phase CTs.
Sensitive Earth Inputs:	Core balance CT.
Directional Phase Overcurrent Protection	
DOC 1st Overcurrent threshold:	OFF, 0.04 – 5.00A in 0.01A steps (1A rating) OFF, 0.2 – 25.0A in 0.1A steps (5A rating)
DOC 2nd Overcurrent threshold:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DOC 3rd, 4th Overcurrent thresholds:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
DOC Characteristic Angle:	−95° to +95° in 1° steps

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Directional Earth Fault Protection	
DEF 1st Overcurrent threshold:	OFF, 0.01 – 5.00A in 0.01A steps (1A rating) OFF, 0.05 – 25.00A in 0.01A steps (5A rating)
DEF 2nd Overcurrent threshold:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DEF 3rd, 4th thresholds:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
DEF Characteristic angle:	−95° to +95° in 1° steps
DEF Voltage threshold:	0.5 – 100.0V in 0.1V steps
Directional Sensitive Earth Fault Protection (Option)	
DSEF 1st, 2nd Overcurrent threshold:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
Delay Type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DSEF 3rd, 4th thresholds:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
DSEF Characteristic angle:	−95° to +95° in 1° steps
DSEF Boundary of operation:	±87.5°
DSEF Voltage threshold:	0.5 – 100.0V in 0.1V steps
Residual power threshold:	OFF, 0.00 – 20.00W in 0.05W (1A rating) OFF, 0.00 – 100.00W in 0.25W (5A rating)
Directional Negative Phase Sequence Overcurrent Protection	
DNOC 1st overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
Delay type (1st threshold only):	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DNOC 2nd overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
DNOC Characteristic angle:	−95° to +95° in 1° steps
DNOC Dir. Voltage threshold	0.5 – 25.0V in 0.1V steps

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Non-directional Phase Overcurrent Protection	
OC 1st Overcurrent threshold:	OFF, 0.04 – 5.00A in 0.01A steps (1A rating) OFF, 0.2 – 25.0A in 0.1A steps (5A rating)
OC 2nd Overcurrent threshold:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
OC 3rd, 4th Overcurrent thresholds:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
Non-directional Earth Fault Protection	
EF 1st Overcurrent threshold:	OFF, 0.01 – 5.00A in 0.01A steps (1A rating) OFF, 0.05 – 25.00A in 0.01A steps (5A rating)
EF 2nd Overcurrent threshold:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
EF 3rd, 4th thresholds:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps
Non-directional Sensitive Earth Fault Protection (Option)	
SEF 1st, 2nd Overcurrent threshold:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
Delay Type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
SEF 3rd, 4th thresholds:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
DTL delay:	0.00 – 300.00s in 0.01s steps

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Non-directional Negative Phase Sequence Overcurrent Protection	
NOC 1st overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
Delay type (1st threshold only):	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	0.0 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Overvoltage Protection	
1st, 2nd Overvoltage thresholds:	OFF, 10.0 – 200.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
DO/PU ratio	10 – 98% in 1% steps
Reset Delay (1st threshold only):	0.0 – 300.0s in 0.1s steps
Undervoltage Protection	
1st, 2nd Undervoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Delay (1st threshold only):	0.0 – 300.0s in 0.1s steps
Zero Sequence Overvoltage Protection	
ZOV 1st, 2nd Overvoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Delay (1st threshold only):	0.0 – 300.0s in 0.1s steps
Negative Sequence Overvoltage Protection	
NOV 1st, 2nd Overvoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Reset Delay (1st threshold only):	0.0 – 300.0s in 0.1s steps
Frequency Protection	
1st - 6th under/overfrequency threshold:	25.00 – 75.00Hz in 0.01Hz steps
DTL delay:	0.00 – 300.00s in 0.01s steps
Undervoltage block:	40.0 – 100.0V in 0.1V steps
1st - 6th frequency rate-of-change threshold:	0.1 – 15.0Hz/s in 0.1Hz/s steps
Thermal Overload Protection	
$I_\theta = k.I_{FLC}$ (Thermal setting):	OFF, 0.40 – 2.00A in 0.01A steps (1A rating) OFF, 2.0 – 10.0A in 0.1A steps (5A rating)
Pre-load current setting:	0.00 – 1.00A in 0.01A steps (1A rating) 0.0 – 5.0A in 0.1A steps (5A rating)
Time constant (τ):	0.5 - 100.0 mins in 0.1min steps
Thermal alarm:	OFF, 50% to 99% in 1% steps

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Phase Undercurrent Protection	
Undercurrent 1st, 2nd threshold: DTL Delay:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating) 0.00 – 300.00s in 0.01s steps
Broken Conductor Protection	
Broken conductor threshold (I_2/I_1): DTL delay:	OFF, 0.10 – 1.00 in 0.01 steps 0.00 – 300.00s in 0.01s steps
Inrush Current Detector	
Second harmonic ratio setting (I2f / I1f): Overcurrent thresholds:	10 - 50% in 1% steps 0.10 - 2.00A in 0.01A steps (1A rating) 0.5 - 25.0A in 0.1A steps (5A rating)
CBF Protection	
CBF threshold: CBF back trip DTL: CBF Retrip DTL:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating) 0.00 – 300.00s in 0.01s steps 0.00 – 300.00s in 0.01s steps
Accuracy	
IDMTL Overcurrent Pick-up: All Other Overcurrent Pick-ups: Overcurrent PU/DO ratio: Undercurrent Pick-up: Undercurrent PU/DO ratio: IDMTL Overvoltage Pick-up: All Other Overvoltage Pick-ups: Inverse Time Delays: Definite Time Delays: Transient Overreach for instant. elements:	Setting value ± 5% Setting value ± 5% ≥95% Setting value ± 5% ≤105% Setting value ± 2% Setting value ± 2% ± 5% or 30ms (1.5 to 30 times setting) ± 1% (for more than 1s setting) or 10ms < −5% for X/R = 100.
Synchronism Check Function (option)	
Synchronism check angle: Frequency difference check: Voltage difference check: Voltage dead check: Voltage live check:	5 – 75° in 1° steps 0.02 – 0.50Hz in 0.01Hz steps 5.0 – 150.0V in 0.1V steps 5.0 – 150.0V in 0.1V steps 5.0 – 150.0V in 0.1V steps
Auto-Reclose (option)	
ARC Reclaim Time Close Pulse Width Lock-out Recovery Time Sequences Dead Times (programmable for each shot)	0.0 – 600.0s in 0.1s steps 0.01 – 10.00s in 0.01s steps OFF, 0.1 – 600.0s in 0.1s steps 1 – 5 Shots to Lock-out, each trip programmable for Inst or Delayed operation. 0.01 – 300.00s in 0.01s steps
Metering Function	
Current Voltage Power Frequency	IL1, IL2, IL3, 3Io. Accuracy ± 0.5% (at rated frequency) V12, V23, V31, 3Vo. Accuracy ± 0.5% (at rated frequency) P, Q, cosϕ, Wh, varh. Accuracy ± 1% (at rated frequency) Accuracy ± 0.05Hz

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Control and Monitoring Function	
Control devices Circuit breaker × 1, Disconnector × 5, Earthing disconnector switch × 2	Control input Interlock setting Interlock bypass setting Operate time counter, Breaker travel time, Double command blocking, Control blocking
Disturbance record	
Analogue input	Max. 9
Binary input	Max. 32
Number of recordings	6 at recording length 3s
Trigger	Rising or falling edge of binary input OC, EF, SEF, NOC, OV, UV, NOV, ZOV
Data format	COMTRADE format
Communication port - local PC (RS232)	
Connection:	Point to point
Cable type:	Multi-core (straight)
Cable length:	15m (max.)
Connector:	RS232C 9-way D-type female
Communication port (RS485)	
Connection:	Multidrop (max. 32 relays)
Cable type:	Twisted pair cable with shield
Cable length:	1200m (max.)
Connector:	Screw terminals
Isolation:	1kVac for 1 min.
Transmission rate:	64kpbs for RSM-X protocol. 9.6, 19.2kbps for others
Communication port (Fibre Optic): Option	
Connection:	Multidrop (max. number depending on protocol) or Star by using Opt. Hub
Cable type:	Graded-index multi-mode 50/125μm or 62.5/125μm fibre
Cable length:	1000m (max.)
Connector:	ST connector
Transmission rate:	9.6, 19.2kbps
Time synchronization port	
Connection: Time code: IRIG-B (AM modulated, TTL)	Screw terminals
Binary Inputs	
Operating voltage	Typical 74Vdc(min.70Vdc) for 110V/125Vdc rating Typical 138Vdc(min.125Vdc) for 220V/250Vdc rating Typical 31Vdc(min.28Vdc) for 48V/54V/60Vdc rating Typical 15Vdc(min.14Vdc) for 24V/30Vdc rating
Binary Outputs	
Number	8 - 32
Ratings for tripping relay	Make and carry: 4A continuously 10A, 220Vdc for 0.5s (L/R≥5ms) Break: 0.1A, 220Vdc (L/R=40ms)
Rating for auxiliary relay	Make and carry: 4A continuously 10A, 220Vdc for 0.2s (Resistive load)) Break: 0.1A, 220Vdc (L/R=40ms)

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Mechanical design	
Weight	8.9 kg (Standard model)
Case color	2.5Y7.5/1(approximation to Munsell value)
Installation	Flush mounting
Connection terminals	
TB1:	M3.5 Ring terminal
TB2 – TB10:	Phoenix Contact, UK MSTB Direct cable connection: AWG24 to AWG12 recommended, stripping length is 10mm. Cable ferrule: AI 2,5-10BU from Phoenix Contact is recommended for AWG14 (cross-section 2mm^2). AI 1,5-10BK from Phoenix Contact is recommended for AWG16 (cross-section 1.25mm^2).

ENVIRONMENTAL PERFORMANCE

Test	Standards	Details
Atmospheric Environment		
Temperature	IEC60068-2-1/2	Operating range: −10°C to +55°C. Storage / Transit: −25°C to +70°C.
Humidity	IEC60068-2-3	56 days at 40°C and 93% relative humidity.
Enclosure Protection	IEC60529	Front: IP51 or IP52 with cover Rear: IP20
Mechanical Environment		
Vibration	IEC60255-21-1	Response - Class 1 Endurance - Class 1
Shock and Bump	IEC60255-21-2	Shock Response Class 1 Shock Withstand Class 1 Bump Class 1
Seismic	IEC60255-21-3	Class 1
High Voltage Environment		
Dielectric Withstand	IEC60255-5	2kVrms for 1 minute between all terminals and earth. 2kVrms for 1 minute between independent circuits. 1kVrms for 1 minute across normally open contacts.
High Voltage Impulse	IEC60255-5	Three positive and three negative impulses of 5kV(peak), 1.2/50μs, 0.5J between all terminals and between all terminals and earth.
Electromagnetic Environment		
High Frequency Disturbance / Damped Oscillatory Wave	IEC60255-22-1 Class 3, IEC61000-4-12	1MHz 2.5kV applied to all ports in common mode. 1MHz 1.0kV applied to all ports in differential mode.
Electrostatic Discharge	IEC60255-22-2 Class 3, IEC61000-4-2	6kV contact discharge. 8kV air discharge.
Radiated RF Electromagnetic Disturbance	IEC60255-22-3 Class 3(∗), IEC61000-4-3 Note (∗): Class 4 with cover	Field strength 10V/m for frequency sweeps of 80MHz to 1GHz and 1.7GHz to 2.2GHz. Additional spot tests at 80, 160, 450, 900 and 1890MHz.
Fast Transient Disturbance	IEC60255-22-4, IEC61000-4-4	4kV, 2.5kHz, 5/50ns applied to all inputs.

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Test	Standards	Details
Conducted RF Electromagnetic Disturbance	IEC60255-22-6, IEC61000-4-6	10Vrms applied over frequency range 150kHz to 100MHz. Additional spot tests at 27 and 68MHz.
Conducted Disturbance over freq. Range 15Hz to 150kHz	IEC61000-4-16 Class 3	Varying voltages applied in common mode as follows: 15Hz to 150Hz: 10V → 1Vrms (20dB/decade) 150Hz to 1.5kHz: 1Vrms 1.5kHz to 15kHz: 1 → 10Vrms (20dB/decade) 15kHz to 150kHz: 10Vrms
Power Frequency Disturbance	IEC60255-22-7	300V 50Hz for 10s applied to ports in common mode. 100V 50Hz for 10s applied to ports in differential mode. Not applicable to AC inputs.
Surge Immunity	IEC60255-22-5	1.2/50μs surge in common/differential modes: Auxiliary power supply: 2kV/1kV (peak) Input/Output: 2kV/1kV (peak) RS485 port: 1kV (peak)
Conducted and Radiated Emissions	IEC60255-25 EN55022 Class A	Conducted emissions: 0.15 to 0.50MHz: <79dB (peak) or <66dB (mean) 0.50 to 30MHz: <73dB (peak) or <60dB (mean) Radiated emissions: 30 to 230MHz: <30dB 230 to 1000MHz: <37dB
Power Frequency Magnetic Field	IEC61000-4-8 Class 4	Field applied at 50Hz with strengths of: 30A/m continuously, 300A/m for 1 second.

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Appendix L

Symbols Used in Scheme Logic

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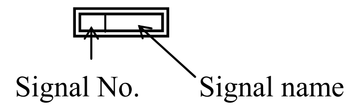
Symbols used in the scheme logic and their meanings are as follows:

Signal names

Marked with [box] : Measuring element output signal

Marked with [signal number symbol] : Signal number

Marked with [double box] : Signal number and name of binary input by PLC function

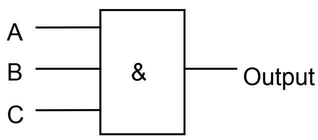


Marked with [ ] : Scheme switch

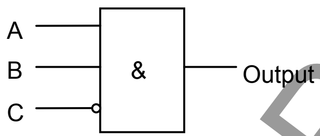
Marked with " " : Scheme switch position

Unmarked : Internal scheme logic signal

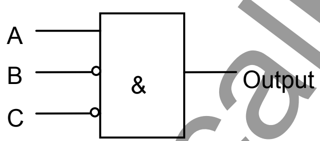
AND gates



A	B	C	Output
1	1	1	1
Other cases			0

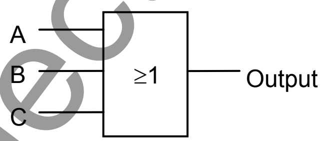


A	B	C	Output
1	1	0	1
Other cases			0

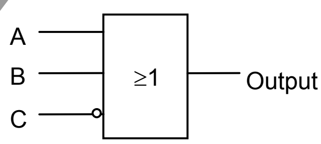


A	B	C	Output
1	0	0	1
Other cases			0

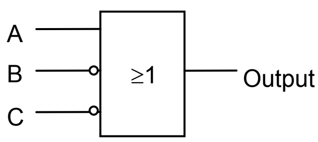
OR gates



A	B	C	Output
0	0	0	0
Other cases			1



A	B	C	Output
0	0	1	0
Other cases			1



A	B	C	Output
0	1	1	0
Other cases			1

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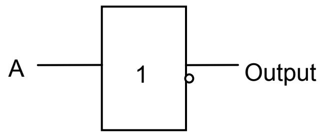
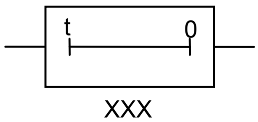
Signal inversion



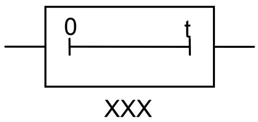
A	Output
0	1
1	0

Timer



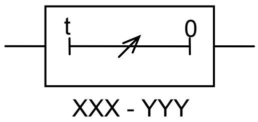
Delayed pick-up timer with fixed setting

XXX: Set time



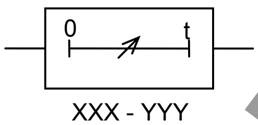
Delayed drop-off timer with fixed setting

XXX: Set time



Delayed pick-up timer with variable setting

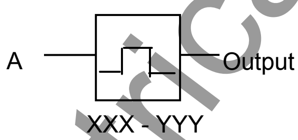
XXX - YYY: Setting range

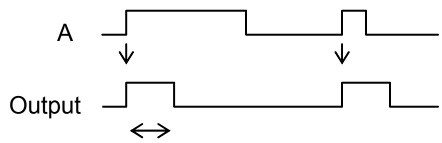


Delayed drop-off timer with variable setting

XXX - YYY: Setting range

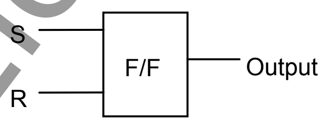
One-shot timer





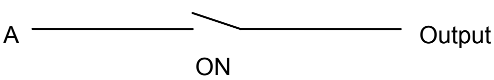
XXX - YYY: Setting range

Flip-flop



S	R	Output
0	0	No change
1	0	1
0	1	0
1	1	0

Scheme switch



A	Switch	Output
1	ON	1
Other cases		0

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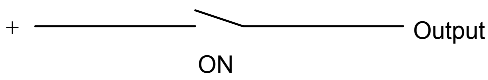

Switch	Output
ON	1
OFF	0

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Appendix M

IEC60870-5-103: Interoperability

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IEC60870-5-103 Configurator

IEC103 configurator software is included in a same CD as RSM100, and can be installed easily as follows:

Installation of IEC103 Configurator

Insert the CD-ROM (RSM100) into a CDROM drive to install this software on a PC.

Double click the "Setup.exe" of the folder "¥IEC103Conf" under the root directory, and operate it according to the message.

When installation has been completed, the IEC103 Configurator will be registered in the start menu.

Starting IEC103 Configurator

Click [Start]→[Programs]→[IEC103 Configurator]→[IECConf] to the IEC103 Configurator software.

Note: The instruction manual of IEC103 Configurator can be viewed by clicking [Help]→[Manual] on IEC103 Configurator.

IEC60870-5-103: Interoperability

1. Physical Layer

1.1 Electrical interface: EIA RS-485

Number of loads, 32 for one protection equipment

1.2 Optical interface

Glass fibre (option)

ST type connector (option)

1.3 Transmission speed

User setting: 9600 or 19200 bit/s

2. Application Layer

COMMON ADDRESS of ASDU

One COMMON ADDRESS OF ASDU (identical with station address)

3. List of Information

The following items can be customized with the original software tool "IEC103 configurator". (For details, refer to "IEC103 configurator" manual No.6F2S0812.)

- Items for "Time-tagged message": Type ID(1/2), INF, FUN, Transmission condition(Signal number), COT
- Items for "Time-tagged measurands": INF, FUN, Transmission condition(Signal number), COT, Type of measurand quantities
- Items for "General command": INF, FUN, Control condition(Signal number)
- Items for "Measurands": Type ID(3/9), INF, FUN, Number of measurand, Type of measurand quantities

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- Common setting
  - Transmission cycle of Measurand frame
  - FUN of System function
  - Test mode, etc.

Note: To be effective the setting data written via the RS232C, turn off the DC supply of the relay and turn on again.

3.1 IEC60870-5-103 Interface

3.1.1 Spontaneous events

The events created by the relay will be sent using Function type (FUN) / Information numbers (INF) to the IEC60870-5-103 master station.

3.1.2 General interrogation

The GI request can be used to read the status of the relay, the Function types and Information numbers that will be returned during the GI cycle are shown in the table below.

For details, refer to the standard IEC60870-5-103 section 7.4.3.

3.1.3 Cyclic measurements

The relay will produce measured values using Type ID=3 or 9 on a cyclical basis, this can be read from the relay using a Class 2 poll. The rate at which the relay produces new measured values can be customized.

3.1.4 Commands

The supported commands can be customized. The relay will respond to non-supported commands with a cause of transmission (COT) of negative acknowledgement of a command.

For details, refer to the standard IEC60870-5-103 section 7.4.4.

3.1.5 Test mode

In test mode, both spontaneous messages and polled measured values, intended for processing in the control system, are designated by means of the CAUSE OF TRANSMISSION ‘test mode’. This means that CAUSE OF TRANSMISSION = 7 ‘test mode’ is used for messages normally transmitted with COT=1 (spontaneous) or COT=2 (cyclic).

For details, refer to the standard IEC60870-5-103 section 7.4.5.

3.1.6 Blocking of monitor direction

If the blocking of the monitor direction is activated in the protection equipment, all indications and measurands are no longer transmitted.

For details, refer to the standard IEC60870-5-103 section 7.4.6.

3.2 List of Information

The followings are the default settings.

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List of Information

INF	Description	Contents	GI	Type ID	COT	FUN	DPI Signal No.	DPI OFF	DPI ON
			IEC103 Configurator Default setting						
Standard Information numbers in monitor direction									
System Function									
0	End of General Interrogation	Transmission completion of GI items.	--	8	10	255	--	--	--
0	Time Synchronization	Time Synchronization ACK.	--	6	8	255	--	--	--
2	Reset FCB	Reset FCB(toggle bit) ACK	--	5	3	216	--	--	--
3	Reset CU	Reset CU ACK	--	5	4	216	--	--	--
4	Start/Restart	Relay start/restart	--	5	5	216	--	--	--
5	Pow er On	Relay pow er on.	Not supported				--	--	--
Status Indications									
16	Auto-recloser active	If it is possible to use auto-recloser, this item is set active, if impossible, inactive.	GI	1	1, 7, 9, 11, 12	216	721	1	2
17	Teleprotection active	If protection using telecommunication is available, this item is set to active. If not, set to inactive.	Not supported						
18	Protection active	If the protection is available, this item is set to active. If not, set to inactive.	GI	1	1, 7, 9, 12	216	723	1	2
19	LED reset	Reset of latched LEDs	--	1	1, 7, 11, 12	216	1418	--	2
20	Monitor direction blocked	Block the 103 transmission from a relay to control system. IECBLK: "Blocked" settimg.	GI	1	9, 11	216	1040	1	2
21	Test mode	Transmission of testmode situation froma relay to control system. IECTST "ON" setting.	GI	1	9, 11	216	1039	1	2
22	Local parameter Setting	When a setting change has done at the local, the event is sent to control system.	Not supported						
23	Characteristic1	Setting group 1 active	GI	1	1, 7, 9, 11, 12	216	1024	1	2
24	Characteristic2	Setting group 2 active	GI	1	1, 7, 9, 11, 12	216	1025	1	2
25	Characteristic3	Setting group 3 active	GI	1	1, 7, 9, 11, 12	216	1026	1	2
26	Characteristic4	Setting group 4 active	GI	1	1, 7, 9, 11, 12	216	1027	1	2
27	Auxiliary input1	Binary input 1	No set						
28	Auxiliary input2	Binary input 2	No set						
29	Auxiliary input3	Binary input 3	No set						
30	Auxiliary input4	Binary input 4	No set						
Supervision Indications									
32	Measurand supervision I	Zero sequence current supervision	GI	1	1, 7, 9	216	1356	1	2
33	Measurand supervision V	Zero sequence voltage supervision	GI	1	1, 7, 9	216	1364	1	2
35	Phase sequence supervision	Negative sequence voltage supevision	GI	1	1, 7, 9	216	1365	1	2
36	Trip circuit supervision	Output circuit supervision	GI	1	1, 7, 9	216	1359	1	2
37	I>>backup operation		Not supported						
38	VT fuse failure	VT failure	GI	1	1, 7, 9	216	1342	1	2
39	Teleprotection disturbed	CF(Communication system Fail) supervision	Not supported						
46	Group w arning	Only alarming	GI	1	1, 7, 9	216	1346	1	2
47	Group alarm	Trip blocking and alarming	GI	1	1, 7, 9	216	1343	1	2
Earth Fault Indications									
48	Earth Fault L1	A phase earth fault	No set						
49	Earth Fault L2	B phase earth fault	No set						
50	Earth Fault L3	C phase earth fault	No set						
51	Earth Fault Fw d	Earth fault forw ard	No set						
52	Earth Fault Rev	Earth fault reverse	No set						

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INF	Description	Contents	IEC103 Configurator Default setting						
			GI	Type ID	COT	FUN	DPI		
							Signal NO.	OFF	ON
Fault Indications									
64	Start/pick-up L1	A phase, A-B phase or C-A phase element pick-up	No set						
65	Start/pick-up L2	B phase, A-B phase or B-C phase element pick-up	No set						
66	Start/pick-up L3	C phase, B-C phase or C-A phase element pick-up	No set						
67	Start/pick-up N	Earth fault element pick-up	No set						
68	General trip	Any trip	--	2	1, 7	216	485	--	2
69	Trip L1	A phase, A-B phase or C-A phase trip	No set						
70	Trip L2	B phase, A-B phase or B-C phase trip	No set						
71	Trip L3	C phase, B-C phase or C-A phase trip	No set						
72	Trip I>>(back-up)	Back up trip	No set						
73	Fault location X In ohms	Fault location	No set						
74	Fault forward/line	Forward fault	No set						
75	Fault reverse/Busbar	Reverse fault	No set						
76	Teleprotection Signal transmitted	Carrier signal sending	Not supported						
77	Teleprotection Signal received	Carrier signal receiving	Not supported						
78	Zone1	Zone 1 trip	Not supported						
79	Zone2	Zone 2 trip	Not supported						
80	Zone3	Zone 3 trip	Not supported						
81	Zone4	Zone 4 trip	Not supported						
82	Zone5	Zone 5 trip	Not supported						
83	Zone6	Zone 6 trip	Not supported						
84	General Start/Pick-up	Any elements pick-up	GI	2	1, 7, 9	216	1038	1	2
85	Breaker Failure	CBF trip or CBF retrip	No set						
86	Trip measuring system L1		Not supported						
87	Trip measuring system L2		Not supported						
88	Trip measuring system L3		Not supported						
89	Trip measuring system E		Not supported						
90	Trip I>	Inverse time OC trip	No set						
91	Trip I>>	Definite time OC trip	No set						
92	Trip IN>	Inverse time earth fault OC trip	No set						
93	Trip IN>>	Definite time earth fault OC trip	No set						
Autoreclose indications									
128	CB 'ON' by Autoreclose	CB close command output	No set						
129	CB 'ON' by long-time Autoreclose		Not supported						
130	Autoreclose Blocked	Autoreclose block	No set						

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INF	Description	Contents	IEC103 configurator Default setting				
			GI	Type ID	COT	FUN	Max. No.
Measurands							
144	Measurand I	<meaurand I>	No				0
145	Measurand I,V	<meaurand I>	No				0
146	Measurand I,V,P,Q	<meaurand I>	No				0
147	Measurand IN,VEN	<meaurand I>	No				0
148	Measurand IL1,2,3, VL1,2,3, P,Q,f	Ia, Ib, Ic, Va, Vb, Vc, P, Q, f measurand <meaurand II>	--	9	2, 7	216	9
Generic Function							
240	Read Headings		Not supported				
241	Read attributes of all entries of a group		Not supported				
243	Read directory of entry		Not supported				
244	Real attribute of entry		Not supported				
245	End of GGI		Not supported				
249	Write entry with confirm		Not supported				
250	Write entry with execute		Not supported				
251	Write entry aborted		Not supported				

Details of MEA settings in IEC103 configurator

INF	MEA	Tbl	Offset	Data type	Limit		Coeff
					Lower	Upper	
148	Ia	1	0	long	0	4096	0.85333
	Ib	1	4	long	0	4096	0.85333
	Ic	1	8	long	0	4096	0.85333
	Va	1	32	long	0	4096	3.22519
	Vb	1	36	long	0	4096	3.22519
	Vc	1	40	long	0	4096	3.22519
	P	1	172	long	-4096	4096	0.000806
	Q	1	176	long	-4096	4096	0.000806
	f	1	160	long	0	4096	0.68266

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INF	Description	Contents	IEC103 Configurator Default setting			
			Control direction	Type ID	COT	FUN
Selection of standard information numbers in control direction						
System functions						
0	Initiation of general interrogation		--	7	9	255
0	Time synchronization		--	6	8	255
General commands						
16	Auto-recloser on/off		ON/OFF	20	20	216
17	Teleprotection on/off		Not supported			
18	Protection on/off	(*1)	ON/OFF	20	20	216
19	LED reset	Reset indication of latched LEDs.	ON	20	20	216
23	Activate characteristic 1	Setting Group 1	ON	20	20	216
24	Activate characteristic 2	Setting Group 2	ON	20	20	216
25	Activate characteristic 3	Setting Group 3	ON	20	20	216
26	Activate characteristic 4	Setting Group 4	ON	20	20	216
Generic functions						
240	Read headings of all defined groups		Not supported			
241	Read values or attributes of all entries of one group		Not supported			
243	Read directory of a single entry		Not supported			
244	Read values or attributes of a single entry		Not supported			
245	General Interrogation of generic data		Not supported			
248	Write entry		Not supported			
249	Write entry with confirmation		Not supported			
250	Write entry with execution		Not supported			

(∗1) Note: While the relay receives the "Protection off" command, "IN SERVICE LED" is off.

Details of Command settings in IEC103 configurator

INF	DCO			
	Sig off	Sig on	Rev	Valid time
16	2684	2684		0
18	2686	2686	✓	0
19	0	2690		200
23	0	2640		1000
24	0	2641		1000
25	0	2642		1000
26	0	2643		1000

✓: signal reverse

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	Description	Contents	GRD150 supported	Comment
Basic application functions				
	Test mode		Yes	
	Blocking of monitor direction		Yes	
	Disturbance data		No	
	Generic services		No	
	Private data		Yes	
Miscellaneous				
	Measurand		Max. MVAL = rated value times	
	Current L1	Ia	Configurable	
	Current L2	Ib	Configurable	
	Current L3	Ic	Configurable	
	Voltage L1-E	Va	Configurable	
	Voltage L2-E	Vb	Configurable	
	Voltage L3-E	Vc	Configurable	
	Active power P	P	Configurable	
	Reactive power Q	Q	Configurable	
	Frequency f	f	Configurable	
	Voltage L1 - L2	Vab	No set	

Details of Common settings in IEC103 configurator

- Setting file's remark: GRD150_0.00
- Remote operation valid time [ms]: 2000
- Local operation valid time [ms]: 2000
- Measurand period [s]: 2
- Function type of System functions: 216
- Signal No. of Test mode: 1039
- Signal No. for Real time and Fault number: 1038

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[Legend]

GI: General Interrogation (refer to IEC60870-5-103 section 7.4.3)

Type ID: Type Identification (refer to IEC60870-5-103 section 7.2.1)

1 : time-tagged message
2 : time-tagged message with relative time
3 : measurands I
4 : time-tagged measurands with relative time
5 : identification
6 : time synchronization
8 : general interrogation termination
9 : measurands II
10: generic data
11: generic identification
20: general command
23: list of recorded disturbances
26: ready for transmission for disturbance data
27: ready for transmission of a channel
28: ready for transmission of tags
29: transmission of tags
30: transmission of disturbance values
31: end of transmission

COT: Cause of Transmission (refer to IEC60870-5-103 section 7.2.3)

1: spontaneous
2: cyclic
3: reset frame count bit (FCB)
4: reset communication unit (CU)
5: start / restart
6: power on
7: test mode
8: time synchronization
9: general interrogation
10: termination of general interrogation
11: local operation
12: remote operation
20: positive acknowledgement of command
21: negative acknowledgement of command
31: transmission of disturbance data
40: positive acknowledgement of generic write command
41: negative acknowledgement of generic write command
42: valid data response to generic read command
43: invalid data response to generic read command
44: generic write confirmation

FUN: Function type (refer to IEC60870-5-103 section 7.2.5.1)

DPI: Double-point Information (refer to IEC60870-5-103 section 7.2.6.5)

DCO: Double Command (refer to IEC60870-5-103 section 7.2.6.4)

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IEC103 setting data is recommended to be saved as follows:

(1) Naming for IEC103setting data

The file extension of IEC103 setting data is “.csv”. The version name is recommended to be provided with a revision number in order to be changed in future as follows:

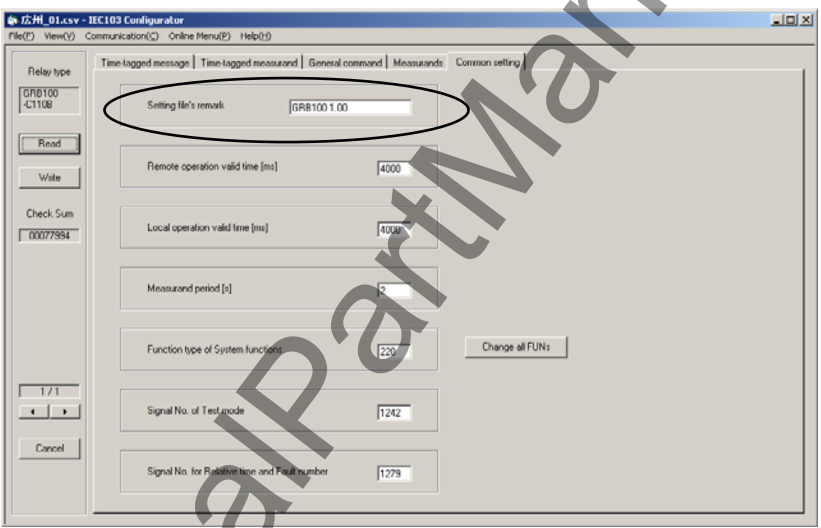
First draft: ******_01.csv

Second draft: ******_02.csv

Third draft: ******_03.csv

Revision number

The name “******” is recommended to be able to discriminate the relay type such as GRZ100 or GRL100, etc. The setting files remark field of IEC103 is able to enter up to 12 one-byte characters. It is utilized for control of IEC103 setting data.



(2) Saving theIEC103 setting data

The IEC103 setting data is recommended to be saved in external media such as FD (floppy disk) or CD-R, not to remain in the folder.

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Troubleshooting

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Phenomena</th><th rowspan="2">Supposed causes</th><th colspan="2">Check / Confirmation</th></tr>
<tr><th>Object</th><th>Procedure</th></tr>
<tr><td rowspan="10">1</td><td rowspan="10">Communication trouble（IEC103 communication is not available.）</td><td>Address setting is incorrect.</td><td>BCU
RY</td><td>Match address setting between BCU and relay.
Avoid duplication of address with other relay.</td></tr>
<tr><td>Transmission baud rate setting is incorrect.</td><td>BCU
RY</td><td>Match transmission baud rate setting between BCU and relay.</td></tr>
<tr><td>Start bit, stop bit and parity settings of data that BCU transmits to relay is incorrect.</td><td>BCU</td><td>Go over the following settings by BCU. Relay setting is fixed as following settings.
- Start bit: 1bit
- Stop bit: 1bit
- Parity setting: even</td></tr>
<tr><td>The PRTCL1 setting is incorrect. (The model with PRTCL1 setting.)</td><td>RY</td><td>Change the PRTCL1 setting. Relation between PRTCL1 setting and available transmission protocol is referred to the following table.<table><tr><td>RS485 port at the back of the relay</td><td>PRTCL1 =HDLC</td><td>PRTCL1 =IEC</td></tr><tr><td>COM1 (CH1)</td><td>HDLC</td><td>IEC</td></tr><tr><td>COM2 (CH2)</td><td>IEC</td><td>–</td></tr></table></td></tr>
<tr><td>RS485 or optical cable interconnection is incorrect.</td><td>Cable</td><td>- Check the connection port.(CH1/CH2)
- Check the interconnection of RS485 A/B/COM
- Check the send and received interconnection of optical cable.</td></tr>
<tr><td>The setting of converter is incorrect. (RS485/optic conversion is executed with the transmission channel, etc.)</td><td>Converter</td><td>In the event of using G1IF2, change the DIPSW setting in reference to INSTRUCTION MANUAL (6F2S0794).</td></tr>
<tr><td>The relationship between logical “0/1” of the signal and Sig.on/off is incorrect. (In the event of using optical cable)</td><td>BCU</td><td>Check the following;
Logical0 : Sig.on
Logical1:Sig.off</td></tr>
<tr><td>Terminal resistor is not offered. (Especially when RS485 cable is long.)</td><td>cable</td><td>Impose terminal resistor (150[ohms]) to both ends of RS 485 cable.</td></tr>
<tr><td>Relay cannot receive the requirement frame from BCU.
(The timing coordination of sending and receiving switch control is irregular in half-duplex communication.)</td><td>BCU</td><td>Check to secure the margin more than 15ms between receiving the reply frame from the relay and transmitting the next requirement frame on BCU.</td></tr>
<tr><td>The requirement frame from BCU and the reply frame from relay contend.
(The sending and receiving timing coordination is irregular in half-duplex communication.)</td><td>BCU</td><td>Check to set the time-out of reply frame from the relay.
Time-out setting: more than 100ms (acceptable value of response time 50ms plus margin)</td></tr>
</table>

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No.	Phenomena	Supposed causes	Check / Confirmation	
			Object	Procedure
2	HMI does not display IEC103 event on the SAS side.	The relevant event sending condition is not valid.	RY	Change the event sending condition (signal number) of IEC103 configurator if there is a setting error. When the setting is correct, check the signal condition by programmable LED, etc.
		The relevant event Information Number (INF) and/or Function Type (FUN) may be different between the relay and SAS.	RY SAS	Match the relevant event Information Number (INF) or Function Type (FUN) between the relay and SAS.
		The relay is not initialised after writing IEC103 configurator setting.	RY	Check the sum value of IEC103 setting data from the LCD screen. When differing from the sum value on IEC103 configurator, initialise the relay.
		It changes to the block mode.	RY	Change the IECBR settling to Normal.
3	Time can be synchronised with IEC103 communication.	BCU does not transmit the frame of time synchronisation.	BCU	Transmit the frame of time synchronisation.
		The settling of time synchronisation source is set to other than IEC.	RY	Change the settling of time synchronisation source to IEC.

(Note) BCU: Bay control unit, RY: Relay

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Appendix N

Inverse Time Characteristics

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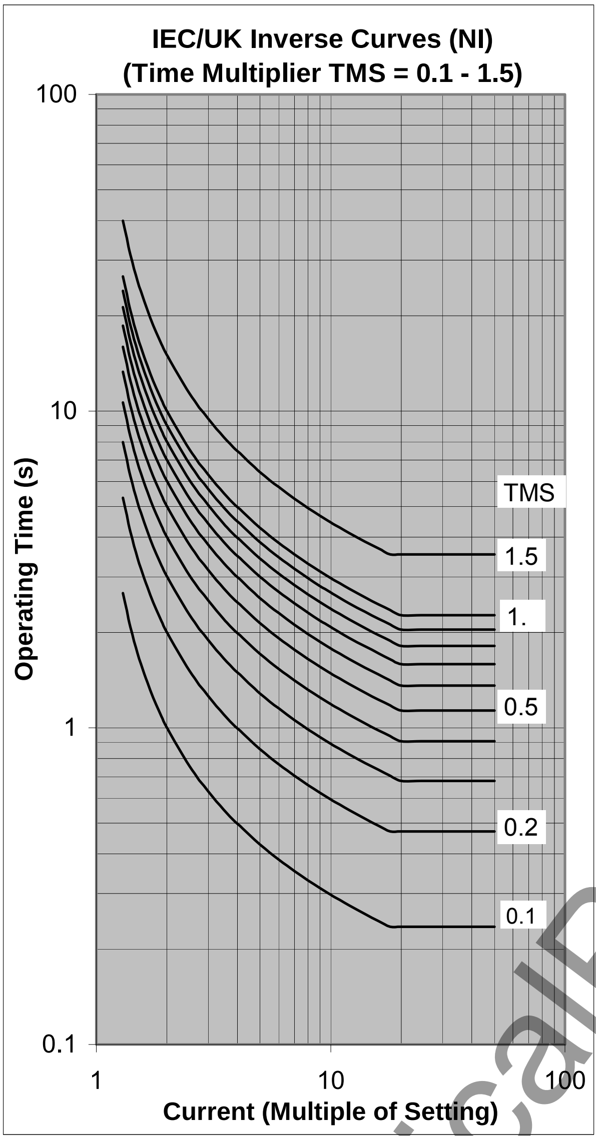
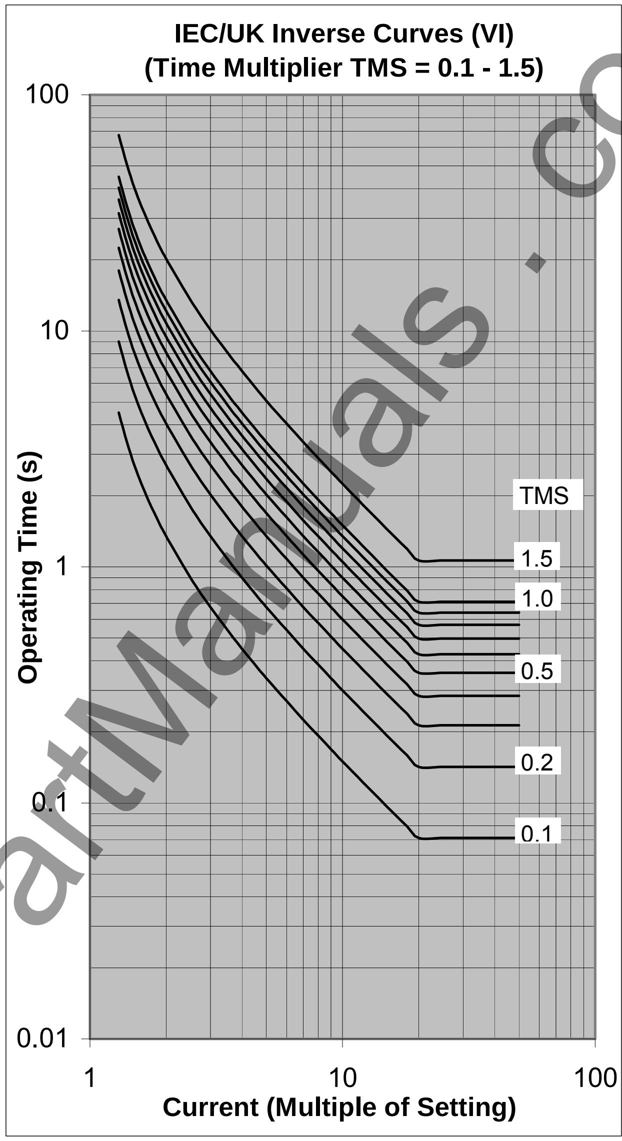


Normal Inverse



Very Inverse

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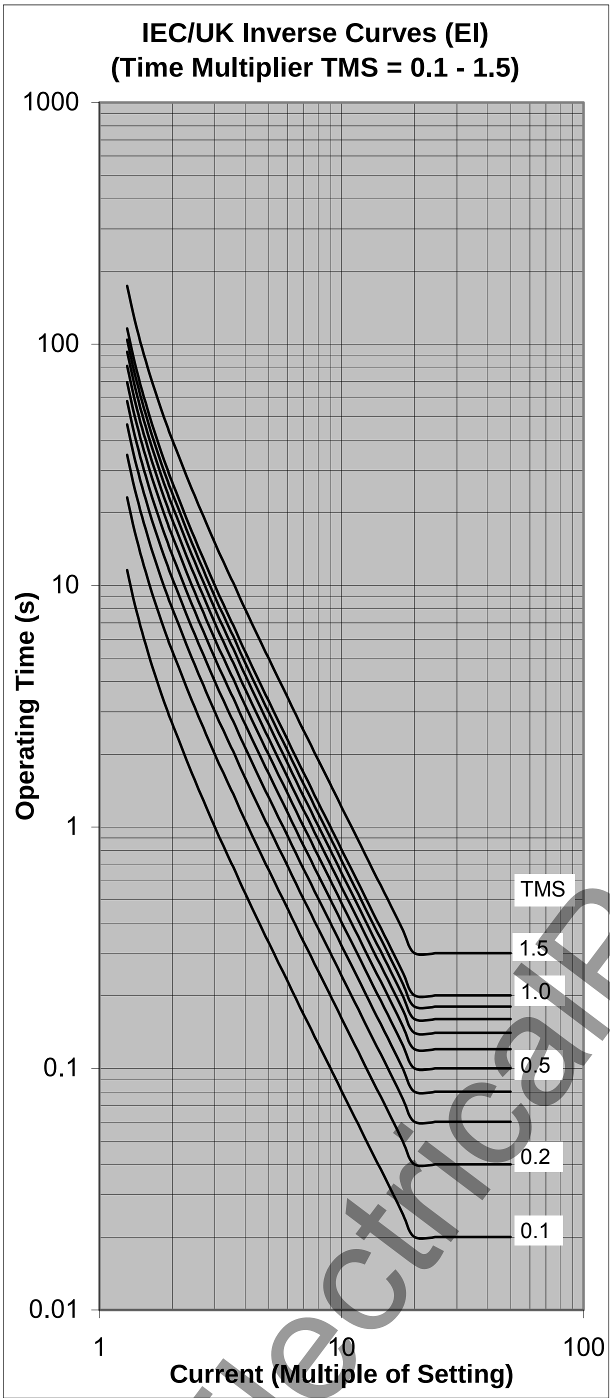
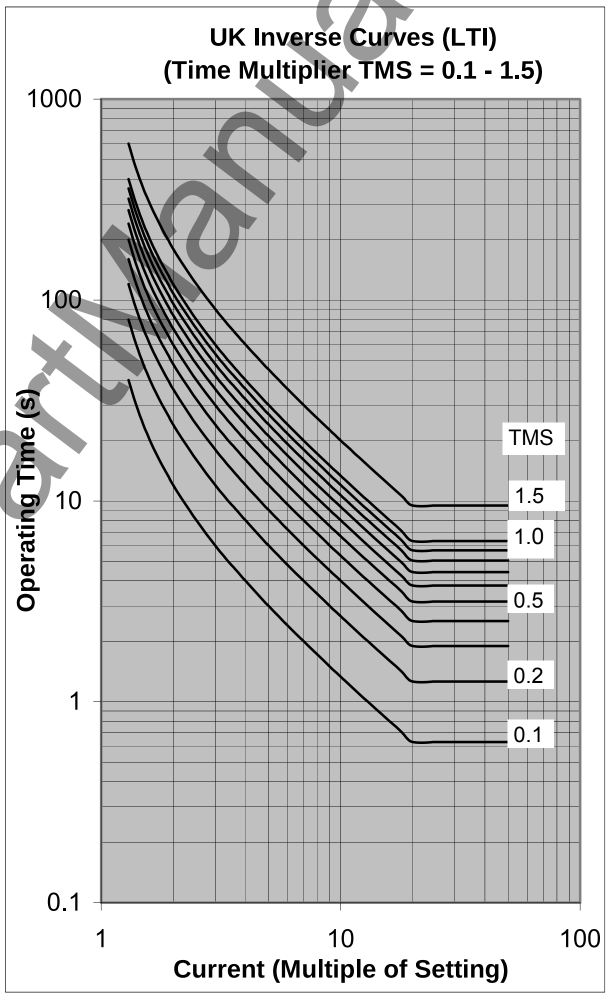


Extremely Inverse



Long Time Inverse

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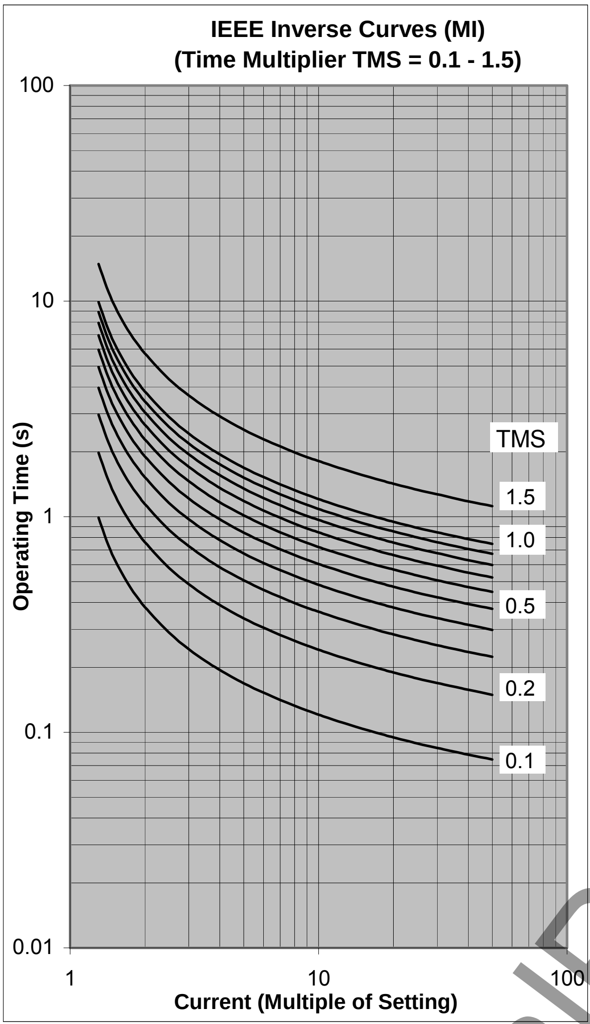
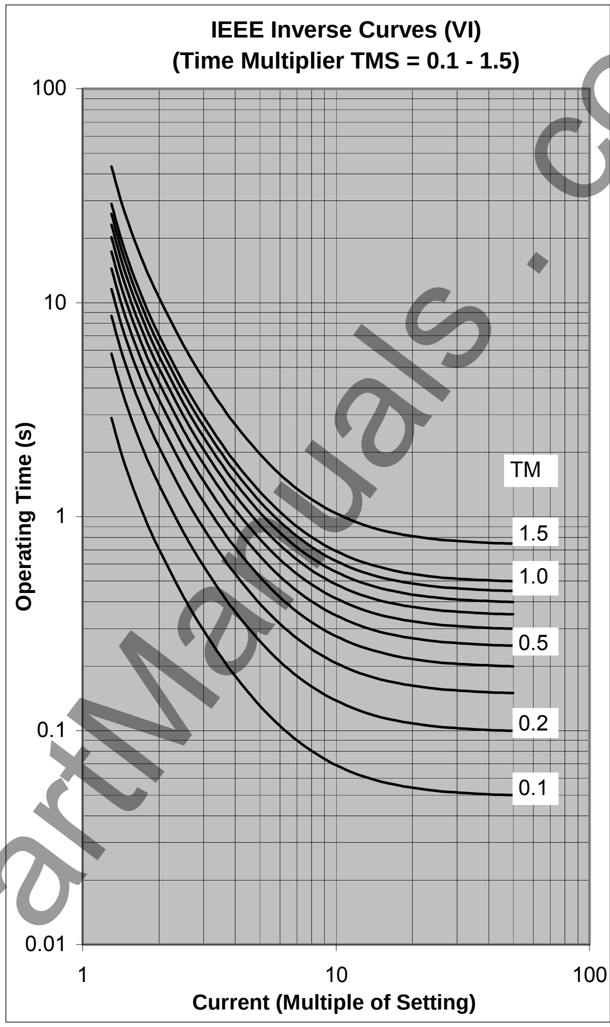


Moderately Inverse



Very Inverse

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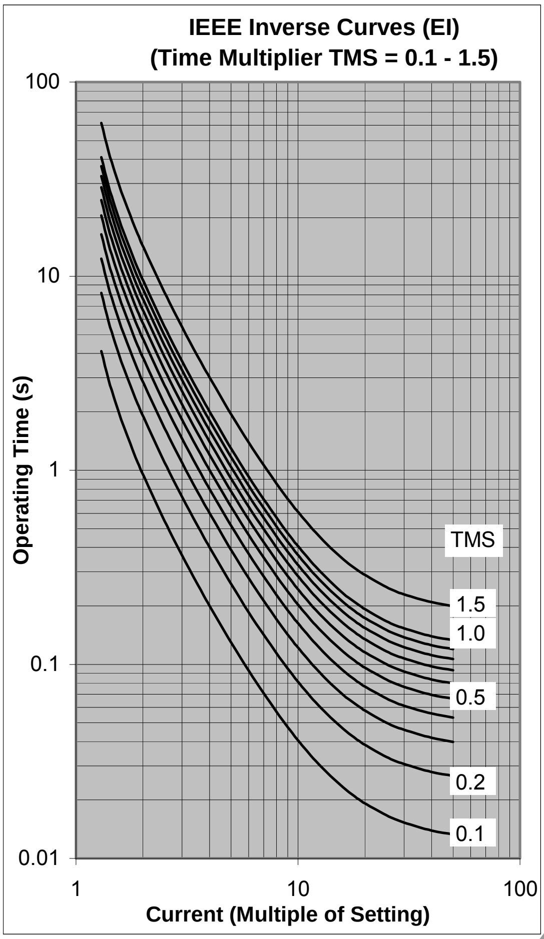

Extremely Inverse

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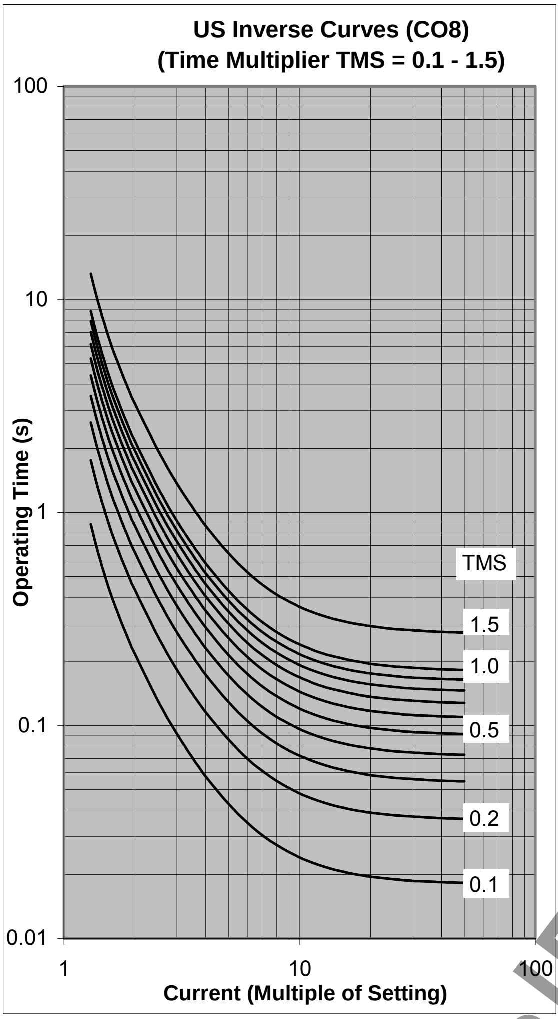
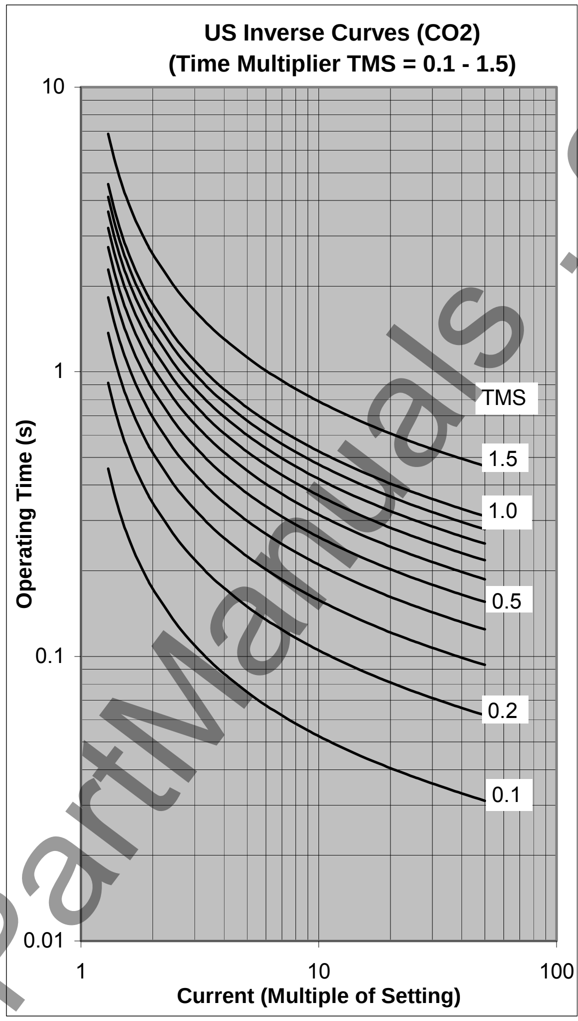


CO8 Inverse



CO2 Short Time Inverse

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Appendix O

Ordering

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ORDERING

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
G	**R**	**D**	**1**	**5**	**0**	**–**						**0**		

	7	8	9	10	11	12	13	14	15
Configurations									
Basic Standard model		1							
with integral Sensitive Earth Fault function (SEF)		2							
with integral Synchronism check, Auto Reclose function		3							
with integral SEF & Synchronism check, Auto Reclose function		4							
MIMIC panel									
fixed on the front			0						
BI/BO Module									
BI ≤ 10, BO ≤ 8				1					
BI ≤ 21, BO ≤ 16				2					
BI ≤ 32, BO ≤ 24				3					
BI ≤ 43, BO ≤ 32				4					
Model version/ Language									
A,B,C…					A				
VT, CT, Frequency rating									
100 – 120Vac, 1A, 50Hz, 110/125Vdc						1			
100 – 120Vac, 1A, 60Hz, 110/125Vdc						2			
100 – 120Vac, 5A, 50Hz, 110/125Vdc						3			
100 – 120Vac, 5A, 60Hz, 110/125Vdc						4			
100 – 120Vac, 1A, 50Hz, 220/250Vdc						5			
100 – 120Vac, 1A, 60Hz, 220/250Vdc						6			
100 – 120Vac, 5A, 50Hz, 220/250Vdc						7			
100 – 120Vac, 5A, 60Hz, 220/250Vdc						8			
100 – 120Vac, 1A, 50Hz, 48/54/60Vdc						A			
100 – 120Vac, 1A, 60Hz, 48/54/60Vdc						B			
100 – 120Vac, 5A, 50Hz, 48/54/60Vdc						C			
100 – 120Vac, 5A, 60Hz, 48/54/60Vdc						D			
100 – 120Vac, 1A, 50Hz, 24V/30Vdc						E			
100 – 120Vac, 1A, 60Hz, 24V/30Vdc						F			
100 – 120Vac, 5A, 50Hz, 24V/30Vdc						G			
100 – 120Vac, 5A, 60Hz, 24V/30Vdc						H			
Hardware options									
Communication RS485								1	
Fibre optic.								2	
dual RS485								3	
dual Fibre optic.								4	
RS485 + fibre optic								9	
Miscellaneous									
None									0

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Version-up Records

Version No.	Date	Revised Section	Contents
0.0	Jul. 21, 2005		First issue.
0.1	Aug. 23, 2005	1 2.1.4 2.3 2.4 2.7 3.2.2 4.2.1, 4.2.4 to 4.2.6 Appendices	Modified the description and Table 1.1.1. (Added DFRQ element.) Added the description of 'Note'. Modified the description. (Added DFRQ element.) Modified the description. (Added DFRQ element.) Modified the PLC sample screens. Modified the description. Modified the description and sample screens. (Added DFRQ element.) Modified Appendix B, H, I, K and M.
0.2	Sep. 22, 2005	2.1.4 4.2.6.2 4.2.7.1 Appendices	Modified the setting range of THM. Modified the setting range of THM. Modified the description of <THMRST>. Modified the setting range of THM in Appendix H and K.
0.3	Oct. 13, 2006	2.5.2 2.5.3 2.6.1 2.7 4.1.2 4.2.6.2 Appendices	Modified the description in 'Voltage and synchronism check. Modified the setting range table. (APPL-VTS) Modified Table 2.6.2 Modified Figure 2.7.2. Modified the description and Figure 4.1.3. Added 'EFCT ratio' and 'SEFCT ratio', and modified the description of 'Power setting. Modified Appendix C, F and H, and added Appendix O.
0.4	Apr. 24, 2007	4.2.1, 4.4 6.7.2 Appendices	Modified the description. Modified the description and Table 6.7.1. Modified Appendix E and M
0.5	Dec. 27, 2007	2.1.5 2.6.4 3.5.1 4.2.6.4 Appendices	Modified the description. Modified the unit. Added 'Note'. Modified samples of LCD screen. Modified Appendix H.
0.6	Apr. 24, 2008	Safety Precaution 2.1.4 Appendices	Added the description. Modified the description of "Setting". Modified Appendix K and O.

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