INSTRUCTION MANUAL

AUTORECLOSING RELAY

GRR100 - ***B

TOSHIBA CORPORATION

(Ver. 0.8)

Safety Precautions

Before using this product, please read this chapter carefully.

This chapter describes the safety precautions recommended when using the GRR100. Before installing and using the equipment, this chapter must be thoroughly read and understood.

Explanation of symbols used

Signal words such as DANGER, WARNING, two kinds of CAUTION, and NOTE, 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.

⚠ 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.

⚠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.

- **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.

Contents

■ The data given in this manual are subject to change without notice. (Ver. 0.8)

1. Introduction

The GRR100 is a numerical autoreclosing relay suitable for single-shot or multi-shot autoreclosing schemes.

The GRR100 is a member of the G-series numerical single-function relays which are built on common hardware modules and equipped with the following functions:

- Human interfaces on relay front panel, and local and remote PCs
  2 × 16 character LCD and keypad
  RS232C and RS485 communication port
- Metering and recording of event, fault and disturbance
- IRIG-B time synchronisation
- Automatic supervision
- User configurable binary output

2. Application Notes

2.1 Application

The GRR100 provides a single- or multi-shot autoreclosing scheme and is applied for one-circuit breaker or two circuit breakers in the one-and-a-half breaker busbar configuration system:

- Multi-shots (selectable between 2 and 4) three phase reclosing scheme for one circuit breaker
- Selectable single phase and/or three phase reclosing scheme for the first shot
- Single-shot, single phase and/or three phase reclosing scheme for two circuit breakers
- Integrated synchronism check function for autoreclosing
- Autoreclosing counter

GRR100 provides the following metering and recording functions.

- Metering
- Fault record
- Event record
- Disturbance record

GRR100 provides the following human interfaces for relay setting or viewing of stored data.

- Relay front panel: LCD, LED display and operation keys
- Local PC
- Remote PC

The relay can be integrated with a local PC or a remote PC through a communication port.

A local PC can be connected via the RS232C port on the front panel of the relay. A remote PC can also be connected through the RS485 port on the rear panel of the relay.

IEC60870-5-103 protocol is provided for communication with substation control and automation systems.

The GRR100 has two model series, model 101 and model 201.

Relay Type:
- Type GRR100; Numerical autoreclosing relay
Relay Model:
- Model 101 • 1CB autoreclosing • Multi-shots(up to 4) three phase reclosing scheme • Single and/or three phase reclosing scheme for the first shot • Synchronism check function
- Model 201 • 2CB autoreclosing • Single-shot, single and/or three phase reclosing scheme • Synchronism check function

2.2 Autoreclosing Scheme

2.2.1 Autoreclosing Scheme

Most faults that occur on high voltage or extra-high voltage overhead lines are transient faults caused by lightning. If a transient fault occurs, the circuit breaker is tripped to isolate the fault, and then reclosed following a time delay to ensure that the gases caused by the fault arc have de-ionized. This makes it possible to recover power transmission.

The time between clearing the fault and reclosing the circuit breaker, that is, the dead time, should be made as short as possible to keep the power system stable. From the viewpoint of de-ionization of the fault arc, the fault arc is de-ionized more thoroughly as the period of this dead time is extended. The de-ionization commerces when the circuit breakers for all terminals of the line are tripped. Therefore, the dead time can be set at its minimum level if all terminals of the line are tripped at the same time.

Autoreclose is started by an external trip signal.

The GRR100 provides two autoreclose systems, single-shot autoreclose and multi-shot autoreclose.

Appendix A shows block diagram of the GRR100.

Single-shot autoreclose

Three types of single-shot autoreclose modes are provided: single-phase autoreclose, three-phase autoreclose, and single- and three-phase autoreclose. An optimal mode is selected by the autoreclose mode selection switch [ARC-M]. In any case, autoreclose is performed only once. If the fault state still continues after reclosing, three-phases final tripping is activated.

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.

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.

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

Single- and three-phase autoreclose:

In this autoreclose mode, the single-phase tripping and reclosing are performed if a single-phase fault occurs, while three-phase tripping and reclosing are performed if a multi-phase fault occurs.

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

Shingle-shot autoreclose can be applied to one-breaker reclosing and two-breaker reclosing in the one-and-a-half breaker busbar system.

Multi-shot autoreclose

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

Multi-shot autoreclose cannot be applied to two-breaker reclosing.

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

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

- Reclosing block signal is being received from external unit.
- Throughout the reclaim time

For evolving faults that occur during the dead time between single-phase tripping and reclosing, "S & T" functions as follows.

For evolving faults that occurred within the period of time set from the first fault, the reclosing mode enters the three-phase autoreclose mode. At this time, the total dead time becomes the dead time for three-phase autoreclose added to the dead time for single-phase autoreclose which has been used until the evolving fault occurs.

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 "S" is selected, three-phase final tripping is performed, and reclosing is not performed.

2.2.2 Scheme Logic

2.2.2.1 One-breaker Autoreclose

Figure 2.2.1 shows the simplified scheme logic for the single-shot autoreclose. Autoreclose for a further fault incident becomes ready when the circuit breaker is closed and ready for autoreclose (CB-RDY1=1), the [ARC-M] is set to "S", "T" or "S & T" and the on-delay timer TRDY1 is picked up. The TRDY1 is used to determine the reclaim time.

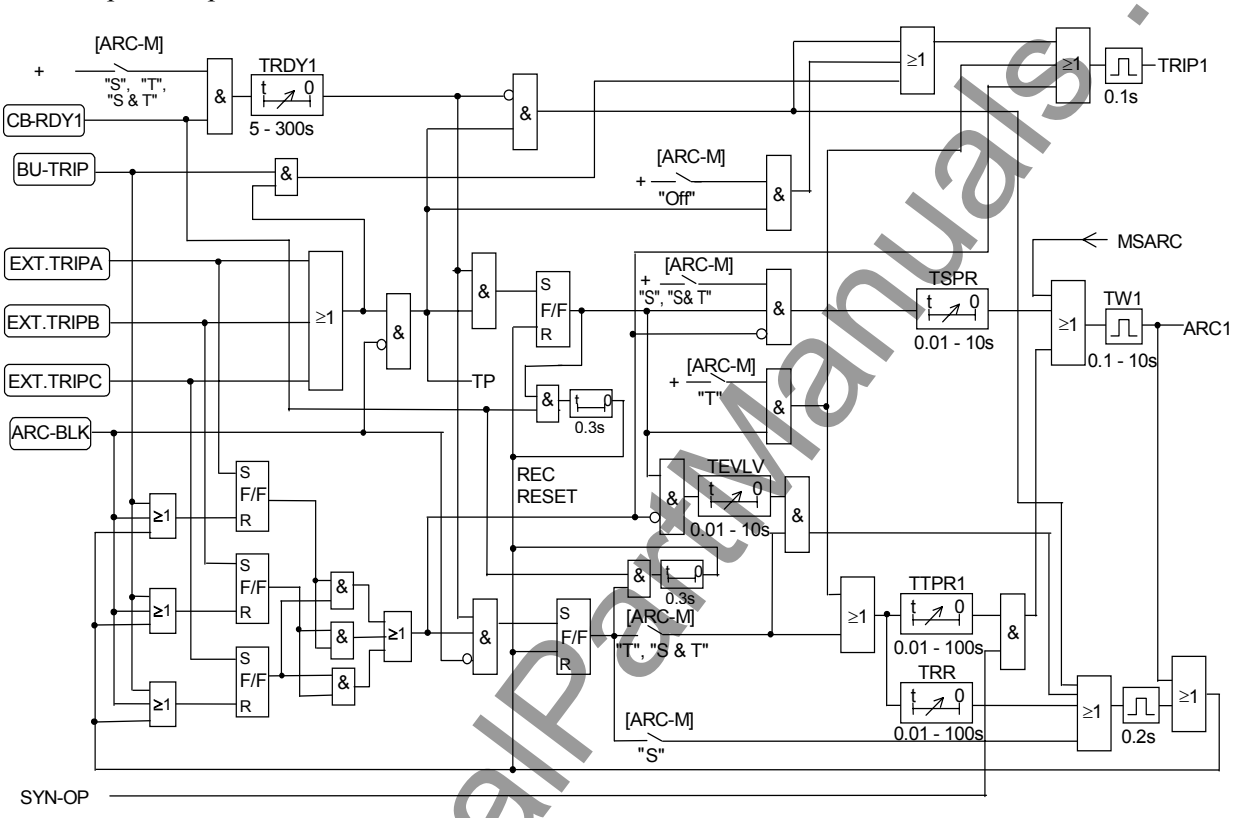


Figure 2.2.1 Autoreclose Scheme Logic

If the autoreclose is ready, the external tripping signal EXT.TRIPA, EXT.TRIPB, EXT.TRIPC for each phase of the breakers activates the autoreclose. These tripping signals are received from the line protection.

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

Autoreclose is not activated when an autoreclose prohibiting binary input signal is applied (ARC-BLK =1).

Autoreclose is not activated and all the phases are tripped (TRIP1=1) in the following conditions.

- The external tripping signal is applied when autoreclose is not ready.
- When the external tripping signal is issued from the backup protection (BU-TRIP=1).

If CB is fail, the autoreclose is activated as follows:

- When CB is fail to close, the autoreclose is not performed and the three-phase final tripping is performed.
- When CB is fail to open, the autoreclose is reset (REC RESET=1) in the AND condition

of autoreclose start signal and CB close status signal.

Autoreclose for a single-phase fault

If the switch [ARC-M] is set to "S" or "S & T", single-phase tripping is performed. The dead time counter TSPR for single-phase reclosing is started by any of the tripping signals EXT.TRIPA to EXT.TRIPC. After the dead time has elapsed, reclosing command ARC1 is initiated.

If the [ARC-M] is set to "T", three-phase tripping is performed and the dead time counter TTPR1 for three-phase reclosing is started. After the dead time has elapsed, a reclosing command ARC1 is initiated based on the operating conditions of the voltage and synchronism check elements output signal SYN-OP.

If the [ARC-M] is set to "Off", three-phase tripping is performed (TRIP1=1) and the autoreclose is not started.

Autoreclose for a multi-phase fault

Regardless of the reclosing mode, three-phase tripping is performed (TRIP1=1). If the [ARC-M] is set to "T" or "S & T", the dead time counter TTPR1 for three-phase reclosing is started. After the dead time has elapsed, reclosing command ARC1 is initiated based on the operating conditions of the voltage and synchronism check elements output signal SYN-OP.

If the [ARC-M] is set to "S" or "Off", autoreclose is not activated.

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

Autoreclose for an evolving fault

Figure 2.2.2 shows the sequence diagram of autoreclose for an evolving fault. If single-phase (1φ) tripping is performed, the evolving fault detection timer TEVLV is started at the same time when the TSPR is started. If no evolving faults occur, single-phase reclosing is performed when the TSPR is picked up.

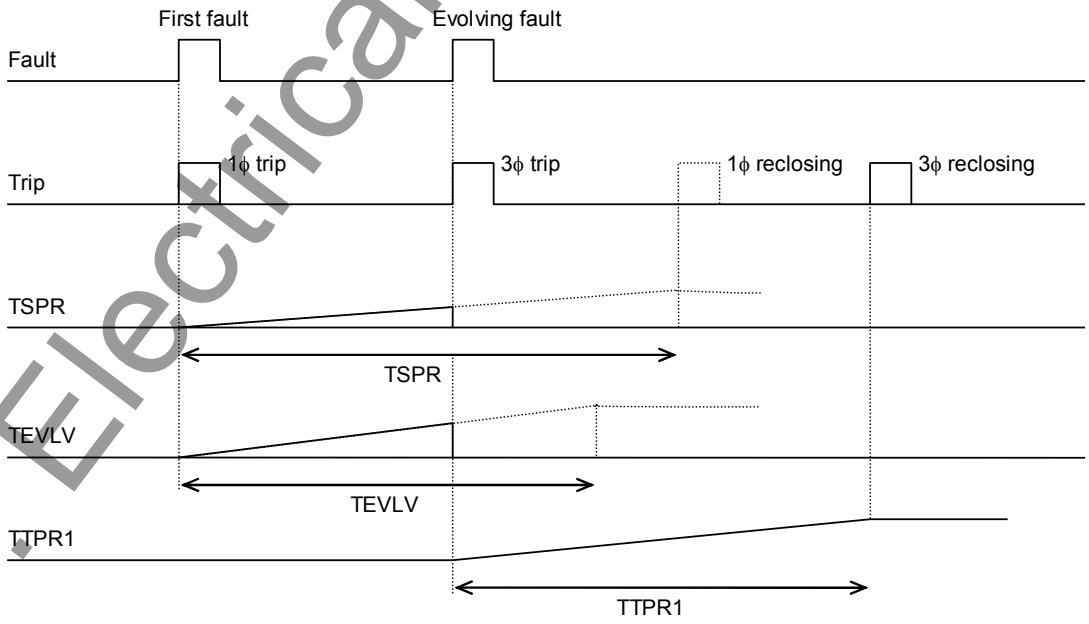


Figure 2.2.2 Autoreclose for Evolving Fault

As shown in the figure, if an evolving fault occurs before the TEVLV is picked up, three-phase

(3ϕ) tripping is performed. If this occurs, TSPR and TEVLV are reset, and TTPR1 is now started.

After TTPR1 is picked up, three-phase reclosing is performed based on the status of the voltage and synchronism check elements output signal SYN-OP. If an evolving fault occurs after the TEVLV has picked up, autoreclose is reset and reclosing is not performed.

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 3 and controls the energising process of the lines and busbars in the three-phase autoreclose mode.

Voltage Mode	1	2	3	4
Busbar voltage (V_B)	live	live	dead	dead
Line voltage (V_L)	live	dead	live	dead

The synchronism check is performed for voltage mode 1 while the voltage check is performed for voltage modes 2 and 3.

The mode 4 is used for manual closing.

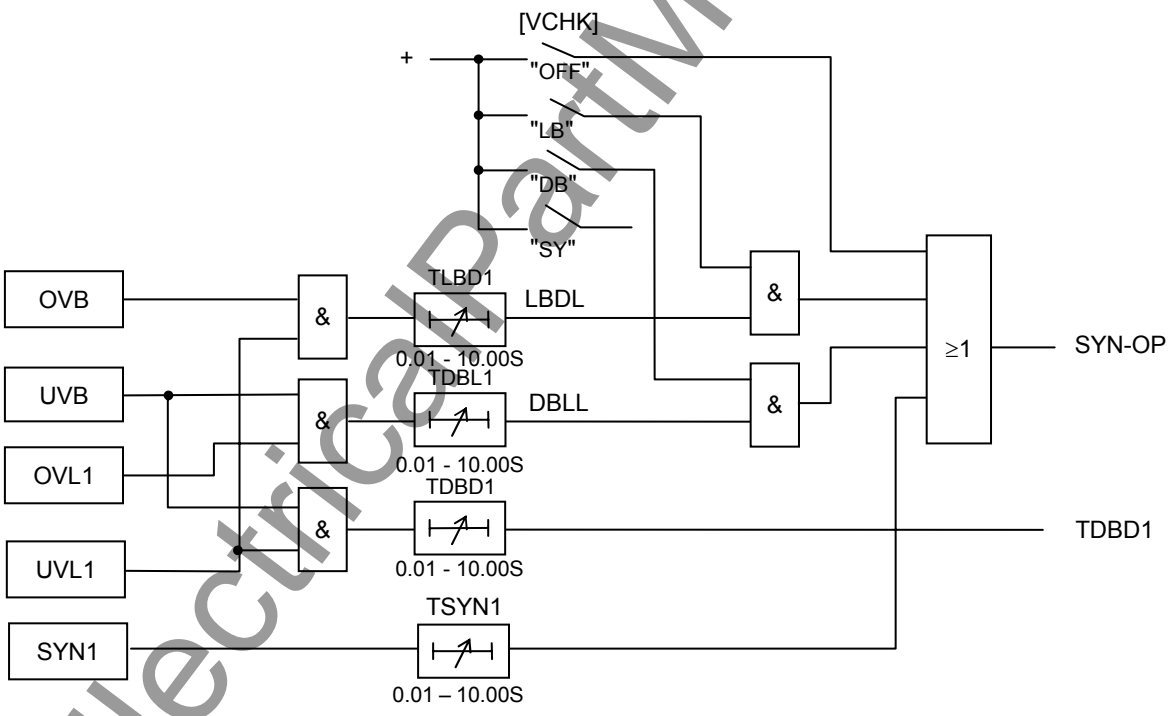


Figure 2.2.3 Energising Control Scheme

Figure 2.2.3 shows the energising control scheme. The voltage and synchronism check output signal SYN-OP is generated when the following conditions have been established;

- Synchronism check element SYN1 operates and on-delay timer TSYN1 is picked up.
- Busbar overvoltage detector OVB and line undervoltage detector UVL1 operate, and on-delay timer TLBD1 is picked up. (This detects live bus and dead line condition.)
- Busbar undervoltage detector UVB and line overvoltage detector OVL1 operate, and on-delay timer TDBL1 is picked up. (This detects dead bus and live line condition.)

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

Setting of [VCHK]	Energising control
LB	Reclosed under "live bus and dead line" condition or with synchronism check
DB	Reclosed under "dead bus and live line" condition or with synchronism check
SY	Reclosed with synchronism check only.
OFF	Reclosed without voltage and synchronism check.

When [VCHK] is set to "LB", the line is energised in the direction from the busbar to line under "live bus and dead line" condition. When [VCHK] is set to "DB", 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.

When [VCHK] is set to "SY", 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.

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.

Multi-shot autoreclose

In multi-shot autoreclose, low-speed autoreclose is executed up to three times after high-speed autoreclose fails. The first shot is high-speed autoreclose that functions in the same manner as described for single-shot autoreclose. Figure 2.2.4 shows the simplified scheme logic for the low-speed autoreclose of the second to fourth shot.

The multi-shot mode, two to four shots, is set with the scheme switch [ARC-SM].

In low-speed autoreclose, the dead time counter TS2 for the second shot is activated if high-speed autoreclose is performed (ARC1 = 1), but tripping occurs again (TP = 1). Second shot autoreclose is performed only when the voltage and synchronism check element operates (SYN-OP = 1) after a period of time set on the TS2 has elapsed. At this time, outputs of the step counter are: SP1 = 1, SP2 = 0, and SP3 = 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 (FT = 1).

If the voltage and synchronism check element does not operate within the period of time set on the timer TS2R which is started at the same time as TS2 is started, the multi-shot autoreclose is cancelled (FT = 1).

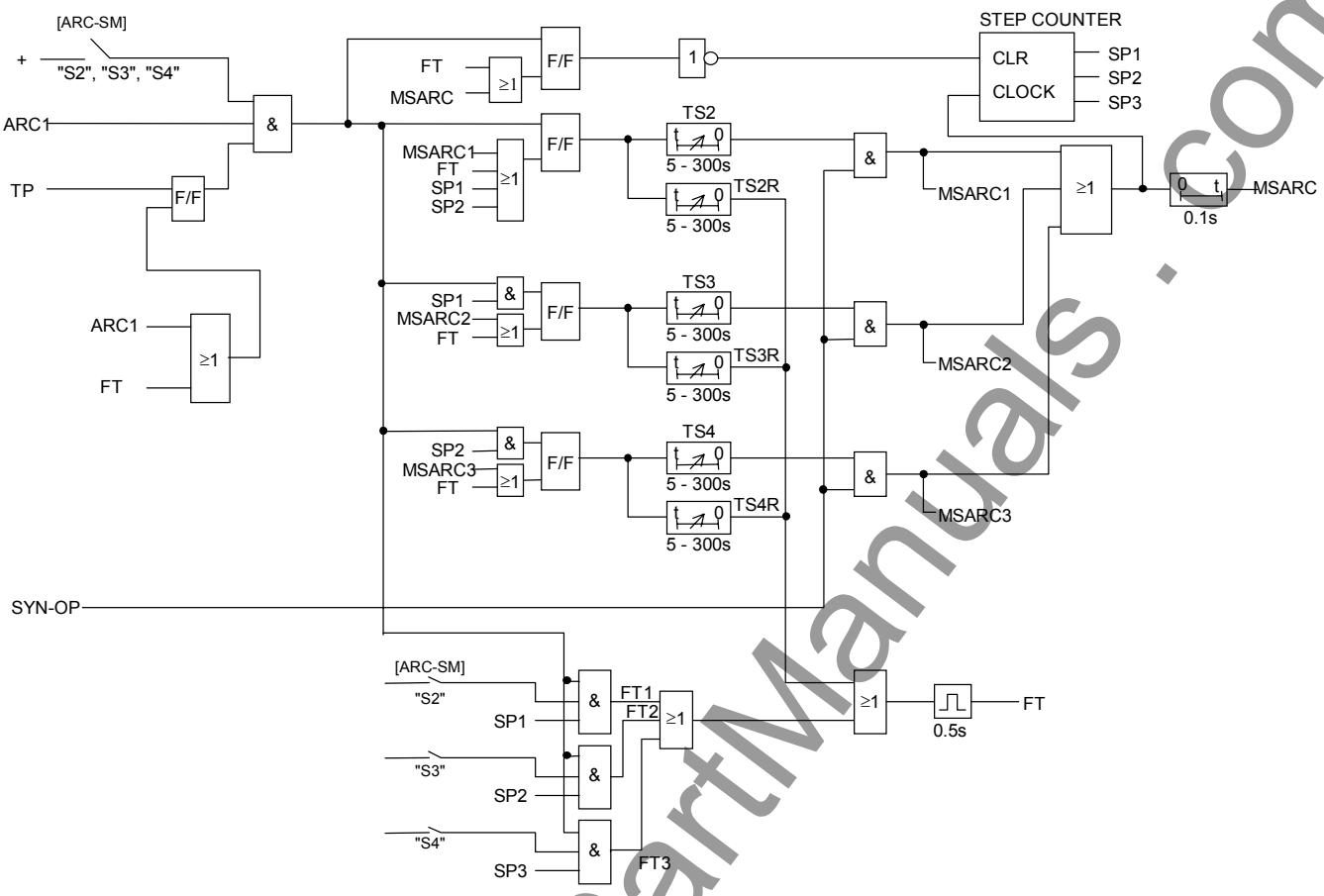


Figure 2.2.4 Scheme Logic of Multi-Shot Autoreclose

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 TS3 and TS3R 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 TS3 has elapsed. At this time, outputs of the step counter are: SP1 = 0, SP2 = 1, and SP3 = 0.

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

If the voltage and synchronism check element does not function within the period of time set on the TS3R, multi-shot autoreclose is cancelled.

When the four shot autoreclose is selected, low-speed 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.

2.2.2.2 Two-breaker Autoreclose

As shown in Figure 2.2.5, in the one-and-a-half breaker busbar arrangement, two circuit breakers, the busbar breaker and the centre breaker, must be reclosed. The GRR100 series model 201 is provided with the two-breaker autoreclose function.

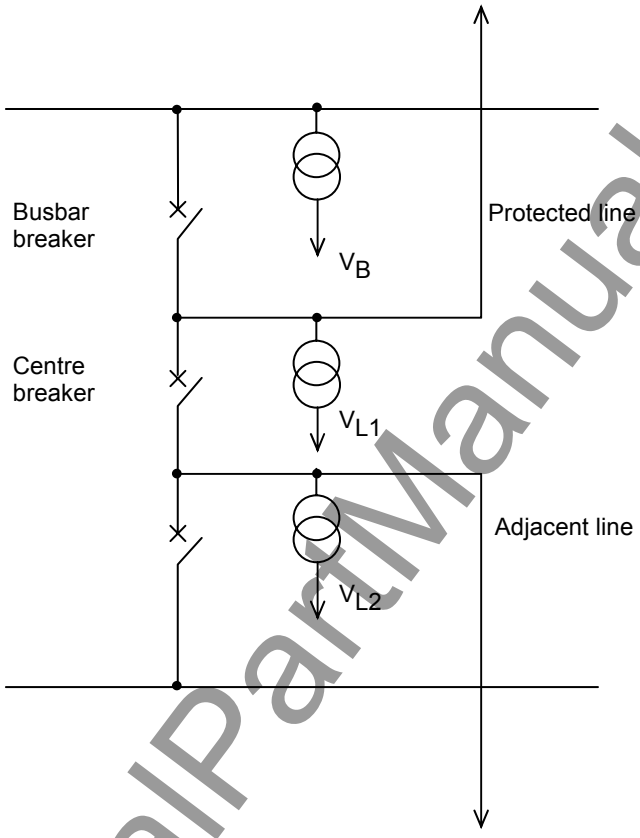


Figure 2.2.5 One-and-a-half Breaker Busbar Arrangement

The breaker(s) to be reclosed and the reclosing order can be set by the scheme switch [ARC-CB] as follows:

Setting of [ARC-CB]	Autoreclose mode
ONE	(Set when applied to a one-breaker system)
O1	Only the busbar breaker is reclosed and the centre breaker is subjected to final tripping.
O2	Only the centre breaker is reclosed and the busbar breaker is subjected to final tripping.
L1	Single-phase autoreclose: Both breakers are reclosed simultaneously.
	Three-phase autoreclose: The busbar breaker is reclosed first. If it successful, then the centre breaker is reclosed.
L2	Single-phase autoreclose: Both breakers are reclosed simultaneously.
	Three-phase autoreclose: The centre breaker is reclosed first. If it successful, then the busbar breaker is reclosed.

The autoreclose scheme logic for the two breakers are independent of each other and are almost the same. The autoreclose scheme logic of the breaker to be reclosed first (leader breaker) is the same as that shown in Figure 2.2.1. The scheme logic of the breaker to be reclosed later (follower breaker) is different from that shown in Figure 2.2.1 in that for the condition that a reclosing command is transmitted to the leader breaker the time is added to the initiation of the dead time counter of the three-phase autoreclose.

Therefore, the dead time of the follower breaker is equal to the sum of the dead time counter settings of the two breakers.

Since the dead timer counter setting of the single-phase autoreclose is common to both breakers, the single-phase autoreclose outputs a reclosing command to both breakers simultaneously.

Figure 2.2.6 shows the energising control scheme of the two breakers in the three-phase autoreclose. OVB and UVB are the overvoltage and undervoltage detectors of busbar voltage V_B in Figure 2.2.5. OVL1 and UVL1 are likewise the overvoltage and undervoltage detectors of line voltage V_{L1}.

OVL2 and UVL2 are likewise the overvoltage and undervoltage detectors of voltage V_{L2}. V_{L2} in the centre breaker corresponds to the busbar voltage V_B in the busbar breaker.

SYN1 and SYN2 are the synchronism check elements to check synchronisation between the two sides of the busbar breaker and centre breaker, respectively.

TPARL-SET is a scheme signal whose logical level becomes 1 when a three-phase autoreclose command is transmitted to the leader breaker. SYN-OP is a voltage and synchronism check output.

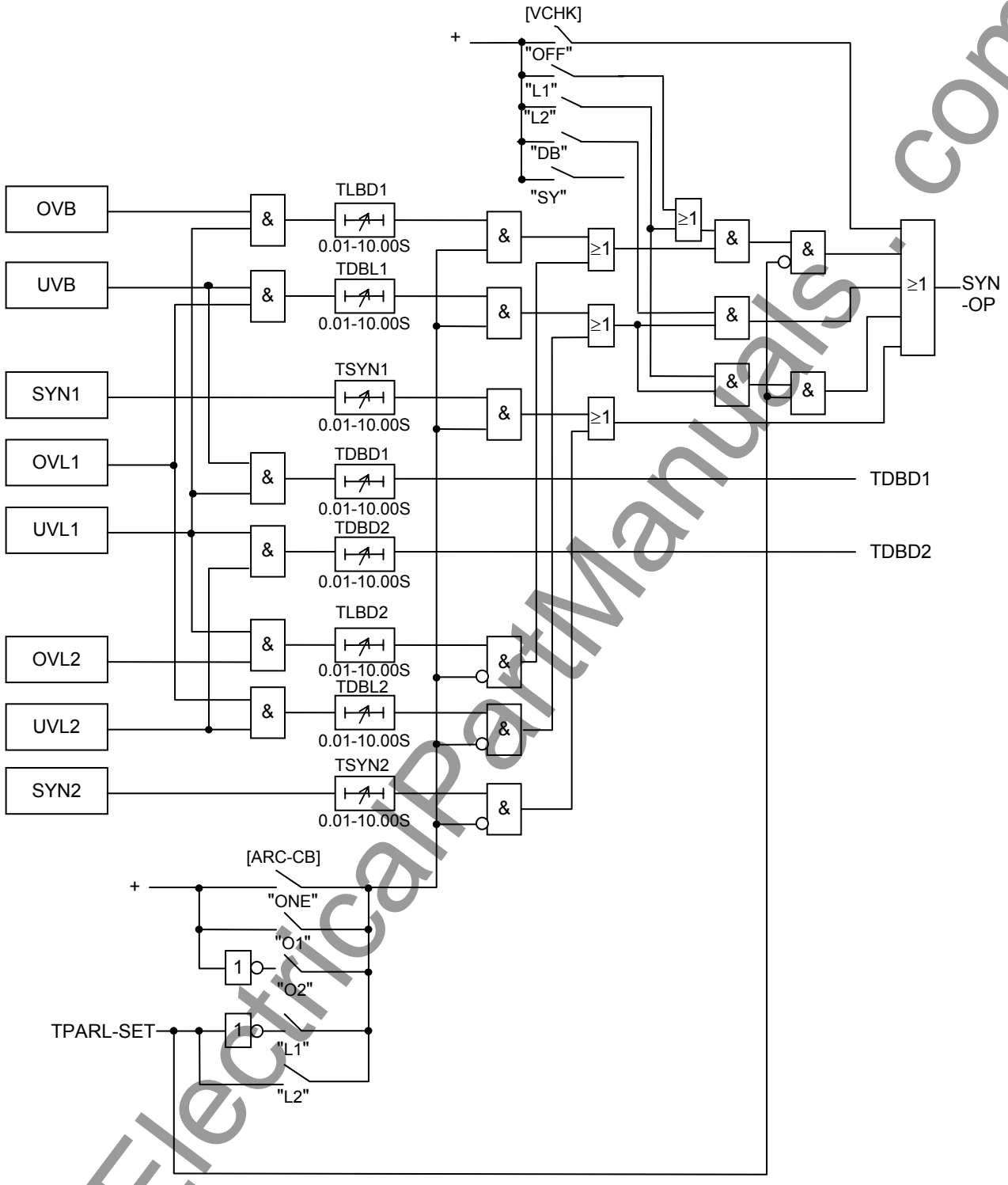


Figure 2.2.6 Energising Control Scheme for Two Breakers

The voltage and synchronism check is performed as shown below according to the [ARC-CB] settings:

Setting of [ARC-CB]	Voltage and synchronism check
ONE or O1	A voltage and synchronism check is performed using voltages V_B and V_{L1}.
O2	A voltage and synchronism check is performed using voltages V_{L1} and V_{L2}.
L1	Since the logical level of TPARL-SET is 0, a voltage and synchronism check is performed for the busbar breaker using voltages V_B and V_{L1}. Then logical level of TPARL-SET becomes 1 and a voltage and synchronism check is performed for the centre breaker using voltages V_{L1} and V_{L2} and a reclosing command is transmitted to the centre breaker.
L2	A voltage and synchronism check is performed for the centre breaker using voltages V_{L1} and V_{L2}. Then logical level of TPARL-SET becomes 1 and a voltage and synchronism check is performed for the busbar breaker using voltages V_B and V_{L1}.

The energising control for the two circuit breakers can be set by the scheme switch [VCHK] as follows:

Setting of [VCHK]	Energising control
L1	Leader breaker is reclosed under "live bus and dead line" condition or with synchronism check and follower breaker is reclosed with synchronism check only.
L2	Leader breaker is reclosed under "live bus and dead line" condition or with synchronism check and follower breaker is reclosed "dead bus and live line" condition or with synchronism check.
DB	Both breakers are reclosed under "dead bus and live line" condition or with synchronism check.
SY	Both breakers are reclosed with synchronism check only.
OFF	Both breakers are reclosed without voltage and synchronism check.

Note: Multi-shot autoreclose is not applicable to two breakers. The scheme switch [ARC-SM] must be set to "OFF".

2.3 Setting

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

Element	Range	Step	Default	Remarks
TSPR	0.01 - 10.00 s	0.01 s	0.80 s	Dead time for single - phase autoreclose
TTPR1	0.01 - 100.00 s	0.01 s	0.60 s	Dead time for three - phase autoreclose
TRR	0.01 - 100.00 s	0.01 s	2.00 s	Autoreclose reset time
TEVLV	0.01 - 10.00 s	0.01 s	0.30 s	Dead time reset for evolving fault
TRDY1	5 - 300 s	1 s	60 s	Reclaim time
SYN1				Synchronism check
SY1 θ	5 - 75°	1°	30°	
SY1UV	10 - 150 V	1 V	83 V	
SY1OV	10 - 150 V	1 V	51 V	
OVB	10 - 150 V	1 V	51 V	Live bus check
UVB	10 - 150 V	1 V	13 V	Dead bus check
OVL1	10 - 150 V	1 V	51 V	Live line check
UVL1	10 - 150 V	1 V	13 V	Dead line check
TSYN1	0.01 - 10.00 s	0.01 s	1.00 s	Synchronism check time
TLBD1	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time
TDBL1	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time
TDBD1	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time used for manual close
TW1	0.1 - 10.0 s	0.1 s	0.2 s	Reclosing signal output time
TS2	5.0 - 300.0 s	0.1 s	20.0 s	Second shot dead time
TS3	5.0 - 300.0 s	0.1 s	20.0 s	Third shot dead time
TS4	5.0 - 300.0 s	0.1 s	20.0 s	Fourth shot dead time
TS2R	5.0 - 300.0 s	0.1 s	30.0 s	Second shot reset time
TS3R	5.0 - 300.0 s	0.1 s	30.0 s	Third shot reset time
TS4R	5.0 - 300.0 s	0.1 s	30.0 s	Fourth shot reset time
[ARC - M]	OFF/S/T/S&T		S&T	Autoreclose mode
[ARC - SM]	OFF/S2/S3/S4		OFF	Multi - shot autoreclose mode
[VCHK]	OFF/LB/DB/SY		LB	Energising direction

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 TRR which is started at the same time as the dead time counter TTPR1 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 TTPR1 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 TSPR, 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.

For the two-breaker autoreclose, the following additional settings are required.

Element	Range	Step	Default	Remarks
For follower breaker				
TTPR2	0.1 - 10.0 s	0.1 s	0.1 s	Dead time for three-phase autoreclose
TRDY2	5 - 300 s	1 s	60 s	Reclaim time
For centre breaker				
SYN2				Synchronism check
SY2 θ	5 - 75°	1°	30°	
SY2UV	10 - 150 V	1 V	83 V	
SY2OV	10 - 150 V	1 V	51 V	
OVL2	10 - 150 V	1 V	51 V	Live line check
UVL2	10 - 150 V	1 V	13 V	Dead line check
TSYN2	0.01 - 10.00 s	0.01 s	1.00 s	Synchronism check time
TLBD2	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time
TDBL2	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time
TDBD2	0.01 - 10.00 s	0.01 s	0.05 s	Voltage check time used for manual close
TW2	0.1 - 10.0 s	0.1 s	0.2 s	Reclosing signal output time
[ARC-CB]	ONE/O1/O2/L1/L2		L1	Two breaker autoreclose mode
[VCHK]	OFF/L1/L2/DB/SY		L1	Energising direction

2.4 Autoreclose Output Signals

The autoreclose scheme logic outputs two reclosing signals ARC1 and ARC2 and two three-phase tripping signals TP-A1 to C1 and TP-A2 to C2. ARC1 and TP-A1 to C1 are reclosing and tripping signals of a single breaker autoreclose or reclosing and tripping signals of the busbar breaker in a two-breaker autoreclose.

ARC2 and TP-A2 to C2 are reclosing and tripping signals for the centre breaker of the two-breaker autoreclose scheme.

The assignment of these reclosing signals to the output relays can be configured, which is done using the setting menu. For more information on this, see Section 3.2.2 and 4.2.6.9. For the default setting, see Appendix D.

2.5 Characteristics of Measuring Elements

Voltage and Synchronism Check Elements OVL, UVL, OVB, UVB, 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 UVL and UVB, and overvoltage detectors OVL and OVB for the line voltage and busbar 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 2.5.1 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.

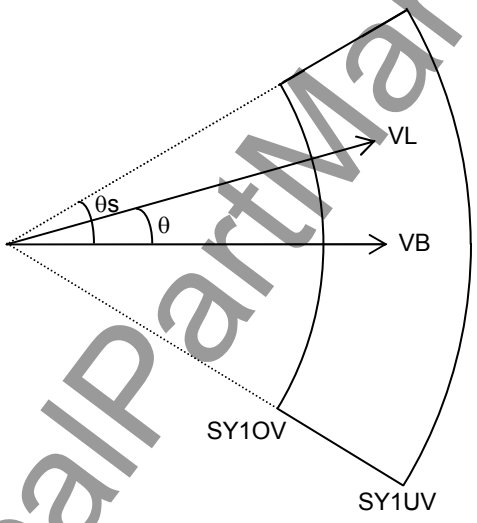


Figure 2.5.1 Synchronism Check Element

For the element SYN1, the voltage difference is checked by the following equations.

$$SY1OV \leq VB \leq SY1UV$$

$$SY1OV \leq VL \leq SY1UV$$

where,

VB = busbar voltage

VL = line voltage

SY1OV = lower voltage setting

SY1UV = upper voltage setting

The phase difference is checked by the following equations.

$$VB \cdot VL \cos \theta \geq 0$$

$$VB \cdot VL \sin (SY1\theta) \geq VB \cdot VL \sin\theta$$

where,

θ = phase difference between VB and VL

SY1θ = phase difference setting

Note: When the phase difference setting SY1θ and the synchronism check time setting are given, a detected maximum slip cycle is determined by the following equation:

$$f = \frac{SY1\theta s}{180° \times TSYN}$$

where,

f = slip cycle

SY1θ = phase difference setting (degree)

TSYN = setting of synchronism check timer TSYN1 or TSYN2(second)

3. Technical Description

3.1 Hardware Description

3.1.1 Outline of Hardware Modules

Case outlines of GRR100 is shown in Appendix F.

The hardware structure of GRR100 is shown in Figure 3.1.1.

The GRR100 relay unit consists of the following hardware modules. These modules are fixed and can not be taken off individually. The human machine interface module is provided with the front panel.

- Binary input and analogue input module (DI/AI)
- Main processing module (MPU)
- Binary output and communication module (DO/COM)
- Human machine interface module (HMI)

The hardware block diagram of GRR100 is shown in Figure 3.1.2.

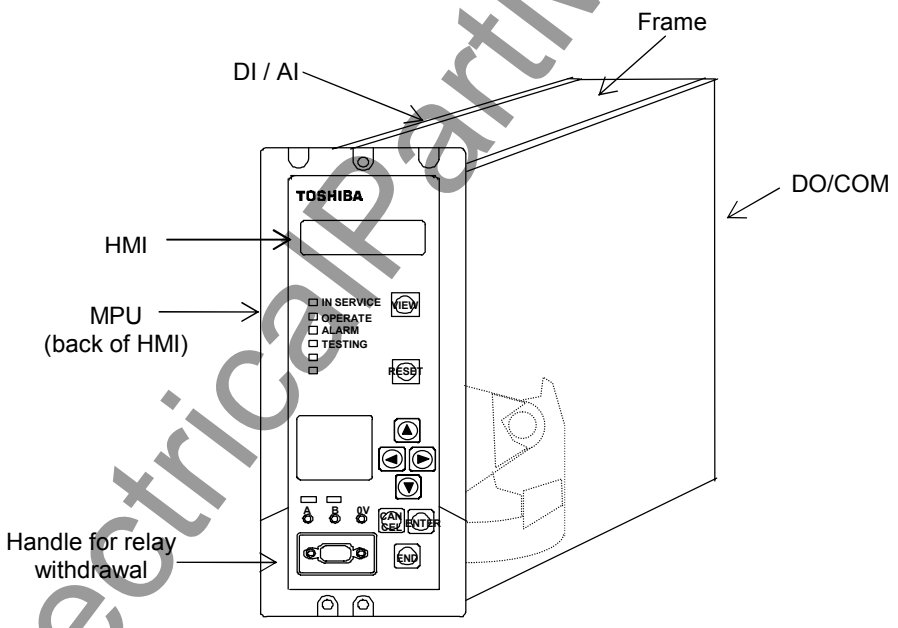


Figure 3.1.1 Hardware Structure without Case

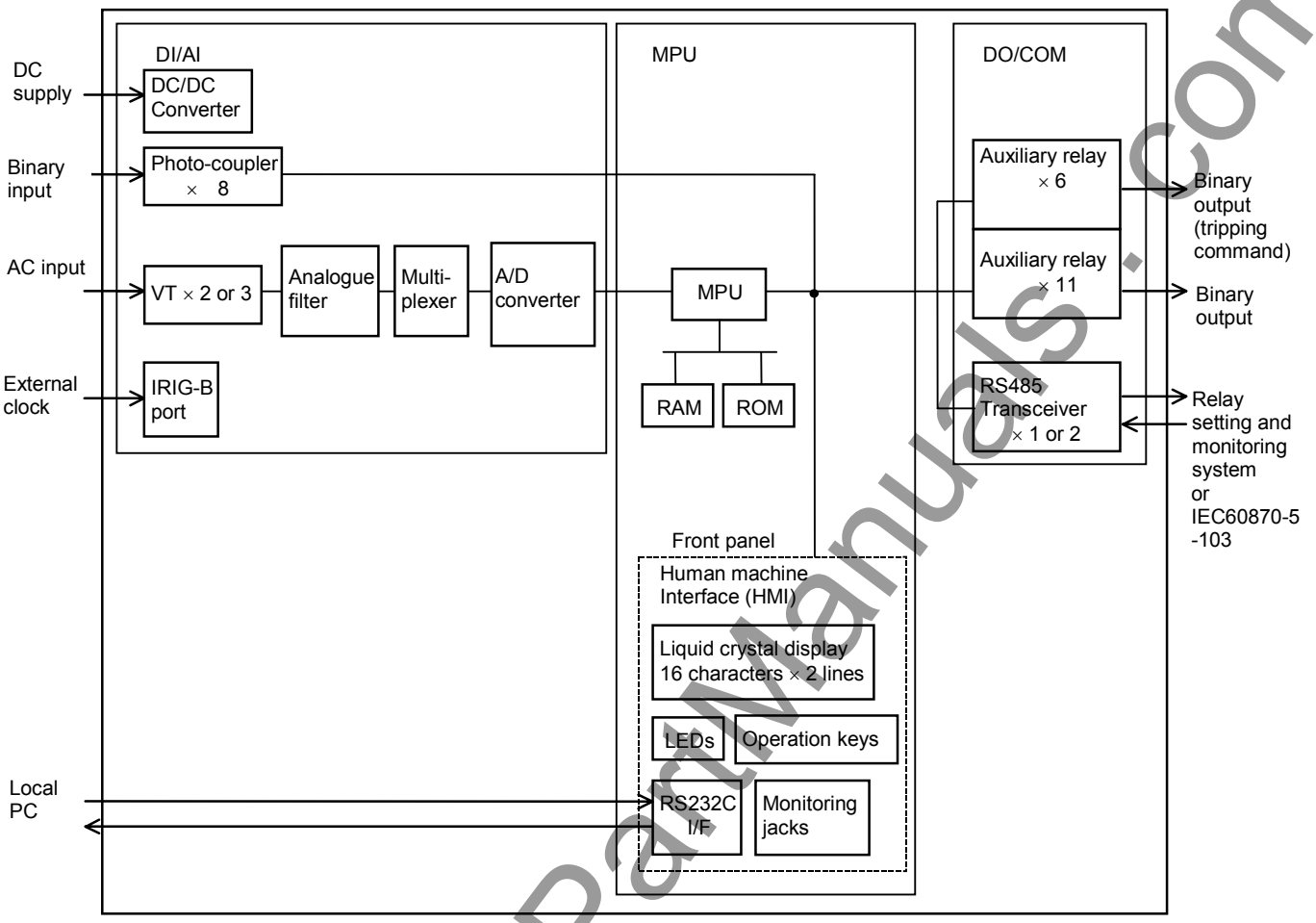


Figure 3.1.2 Hardware Block Diagram

DI/AI Module

The DI/AI module insulates between the internal and external circuits through an auxiliary transformer (VT) and transforms the magnitude of AC input signals to suit the electronic circuits. The AC input signals are busbar or line voltages.

There are 2 or 3 auxiliary VTs depending on the relay model. (For the correspondence between the relay model and number of AC input signals, see Table 3.2.1.)

This module incorporates a DC/DC converter, analogue filter, multiplexer, analogue to digital (A/D) converter and photo-coupler circuit for binary input signal.

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

The analogue filter performs low-pass filtering for the corresponding voltage signals.

The A/D converter has a resolution of 12 bits and samples input signals at sampling frequencies of 2400 Hz (at 50 Hz) and 2880 Hz (at 60 Hz).

This module is also provided with an IRIG-B port. This port collects the serial IRIG-B format data from the external clock for synchronisation of the relay calendar clock. The IRIG-B port is insulated from the external circuit by a photo-coupler. A BNC connector is used as the input connector.

MPU Module

The MPU module consists of main processing unit (MPU) and executes all kinds of processing such as autoreclosing, measurement, recording and display.

The MPU implements 60 MIPS and uses two RISC (Reduced Instruction Set Computer) type 32-bit microprocessors.

DO/COM Module

The DO/COM module incorporates 6 auxiliary relays (TP-A1 to TP-C2) dedicated to the circuit breaker tripping command, 11 auxiliary relays (BO1-BO10 and FAIL) for binary output signals including the circuit breaker reclosing and one or two RS485 transceivers. TP-A1 to TP-C2 have one normally open contact.

The auxiliary relay FAIL has one normally closed contact, and operates when a relay failure or abnormality in the DC circuit is detected. BO1 to BO10 each have one normally open contact.

The RS485 transceiver is used for the link with the relay setting and monitoring (RSM) system. The external signal is isolated from the relay internal circuitry.

Human Machine Interface (HMI) Module

The operator can access the GRR100 via the HMI module. As shown in Figure 3.1.3, the HMI module has a liquid crystal display (LCD), light emitting diodes (LED), view and reset keys, operation keys, monitoring jacks and an RS232C connector on the front panel.

The LCD consists of 16 columns by 2 rows with a back-light and displays recording, status and setting data.

There are a total of 6 LED indicators and their signal labels and LED colors are defined as follows:

Label	Color	Remarks
IN SERVICE	Green	Lit when relay is in service.
OPERATE	Red	Lit when autoreclose or trip command is issued.
ALARM	Red	Lit when failure is detected.
TESTING	Red	Lit when automatic monitoring function is off.
(LED1)	Red	User configurable
(LED2)	Red	User configurable

LED1 and LED2 are user-configurable. Each is driven via a logic gate which can be programmed for OR gate or AND gate operation. Further, each LED has a programmable reset characteristic, settable for instantaneous drop-off, or for latching operation. A configurable LED can be programmed to indicate the OR combination of a maximum of 4 elements. For the setting, see Section 4.2.6.10.

Once it has started operating, the OPERATE LED remains lit even after the command disappears. Pressing the RESET key resets it. Other LEDs operates only 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 back-light.

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

settings or change the settings.

The monitoring jacks and two pairs of LEDs, A and B, on top of the jacks can be used while the test mode is selected in the LCD window. Signals can be displayed on LED A or LED B by selecting the signal to be observed from the "Signal List" and setting it in the window and the signals can be transmitted to an oscilloscope via the monitoring jacks. (For the "Signal List" or "Variable Timer List", see Appendix B or C.)

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.

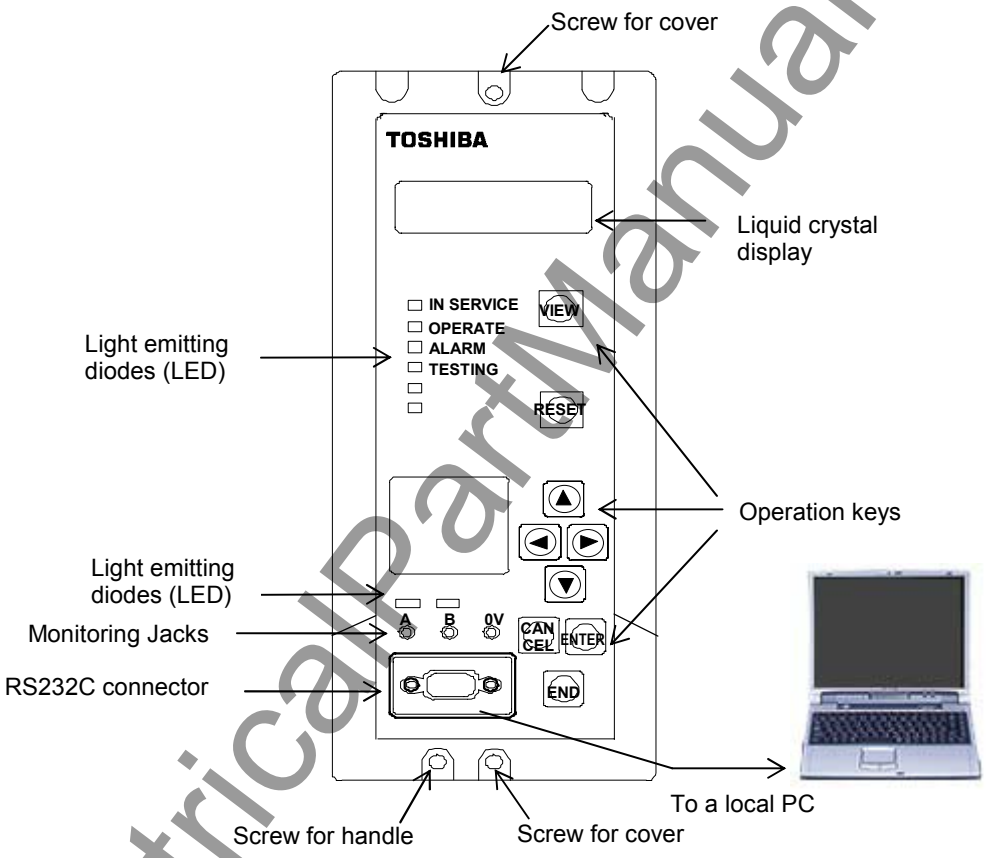


Figure 3.1.3 HMI Module (Front Panel)

3.2 Input and Output Signals

3.2.1 Input Signals

AC input signals

Table 3.2.1 shows the AC input signals necessary for each of the GRR100 models and their respective input terminal numbers.

Table 3.2.1 AC Input Signals

Terminal No. of TB1	GRR100-101	GRR100-201
A1-B1	Voltage of line	Voltage of line 1
A2-B2	Voltage of busbar	Voltage of busbar
A3-B3	—	Voltage of line 2

Binary input signals

Table 3.2.2 shows the binary input signals necessary for the GRR100, their driving contact conditions and functions enabled. See Appendix G for external connections

The binary input circuit of the GRR100 is provided with a logic level inversion function as shown in Figure 3.2.1. Each input circuit has a binary switch BISW which can be used to select either normal or inverted operation. This allows the inputs to be driven either by normally open or normally closed contacts. Where the driving contact meets the contact conditions indicated in Table 3.2.2 then the BISW can be set to “N” (normal). If not, then “I” (inverted) should be selected.

The default setting of the BISW is "N" (normal) for all input signals.

If a signal is not input, the function concerned is disabled.

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.

Table 3.2.2 Binary Input Signals

Signal Names (*1)	Driving Contact Condition / Function Enabled	BISW No.
External trip A(EXT.TRIPA)	Closed when external protection operated. / Initiate autoreclose externally.	1
External trip B(EXT.TRIPB)		2
External trip C(EXT.TRIPC)		3
Backup trip(BU-TRIP)	Closed when external backup protection operated. / Block autoreclose by backup trip.	4
Autoreclose block(ARC-BLK)	Closed to block autoreclose. / Block autoreclose externally.	5
CB1 autoreclose ready(CB-RDY1)	Closed when gas pressure of busbar CB is established for next reclosing. / Initiate reclaim time counting for busbar CB.	6
CB auxiliary contact(52A) or CB2 autoreclose ready(CB-RDY2)	Closed when CB closed. / Conduct multi-shot autoreclose. / Closed when gas pressure of center CB is established for next reclosing. / Initiate reclaim time counting for center CB	7
Indication reset	Closed to reset OPERATE LED indication. / Reset indication externally.	8

(*1) : Signal names in the bracket are those used in the scheme logic.

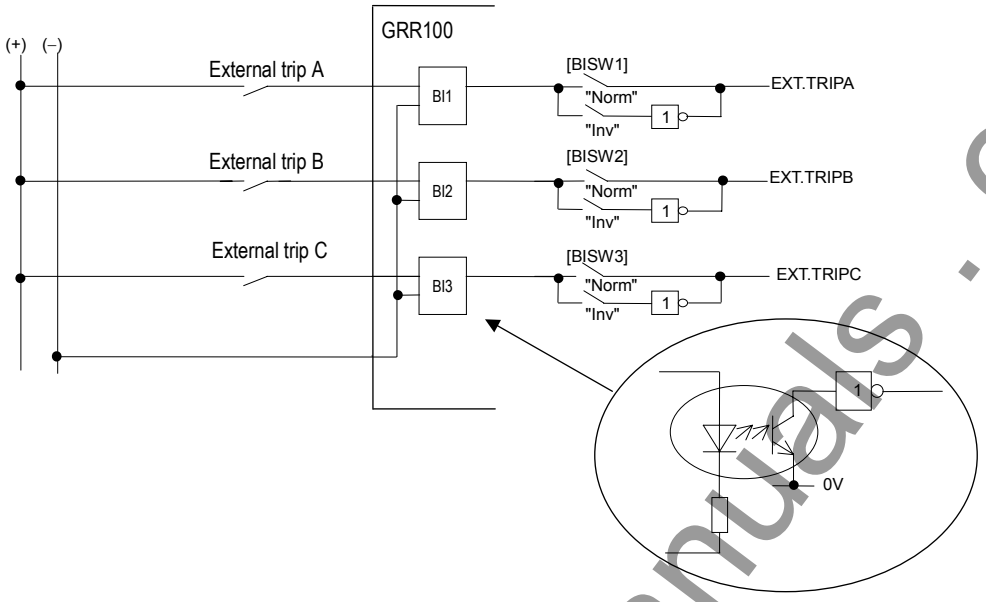


Figure 3.2.1 Logic Level Inversion

3.2.2 Binary Output Signals

The number of binary output signals and their output terminals are as shown in Appendix G. All outputs except the tripping command and relay failure signal can be configured.

The signals shown in the signal list in Appendix B can be assigned to the output relay BO1 to BO10 individually or in arbitrary combinations. Signals can be combined using either an AND circuit or OR circuit with 4 gates each as shown in Figure 3.2.2. The output circuit can be configured according to the setting menu. Appendix D shows the factory default settings.

Further, each BO has a programmable reset characteristic, settable for instantaneous drop-off, for delayed drop-off, or for latching operation by the scheme switch [RESET].

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

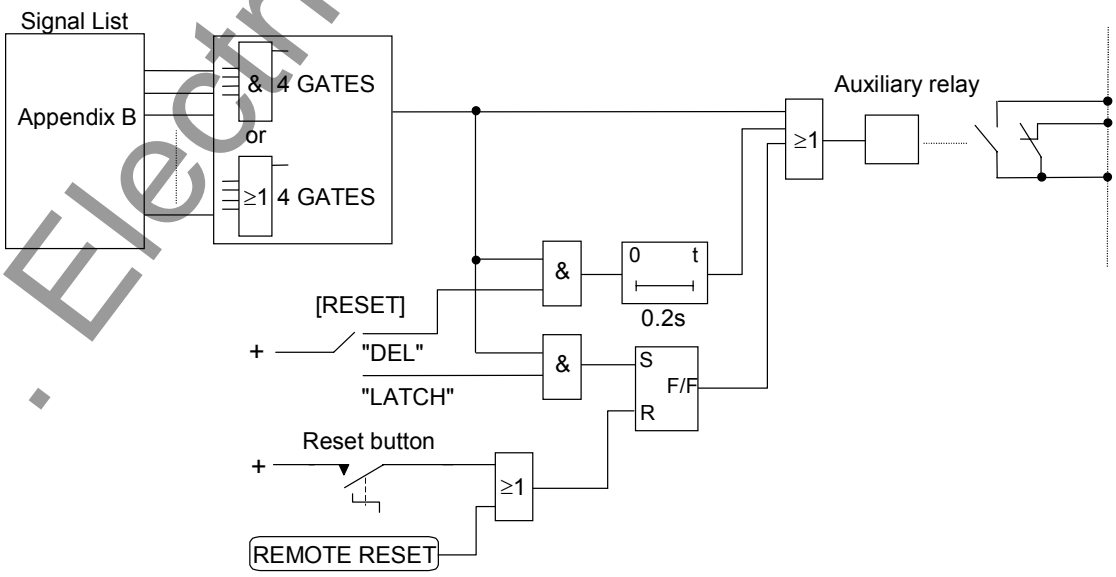


Figure 3.2.2 Configurable Output

3.3 Automatic Supervision

3.3.1 Basic Concept of Supervision

Though the protection system is in non-operating state under normal conditions, it is waiting 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. A numerical relay based on the microprocessor operations is suitable for implementing this automatic supervision function of the protection system. The GRR100 implements the automatic supervision function taking advantage of this feature based on the following concept:

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

Note: Automatic supervision function includes the automatic monitor function and automatic test function. For the terminology, refer to IEC IEV 60448.

3.3.2 Relay Monitoring and Testing

The relay is supervised with the following items.

A/D accuracy checking

An analogue reference voltage is input to a prescribed channel in the analogue-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.

Memory monitoring

The memories are monitored as follows depending on the type of memory, and checked that the 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 discrepancy between the setting values stored in duplicate.

Watchdog Timer

A hardware timer which is cleared periodically by the software is provided and is used to check that the software is running normally.

DC Supply Monitoring

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

3.3.3 Failure Alarms

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

The LCD messages are shown on the "Auto-supervision" screen which is displayed automatically when a failure is detected or displayed by pushing the [VIEW] key. The event record messages are shown on the "Event record" screen by opening the "Record" sub-menu.

The alarms are retained until the failure is recovered.

The alarms can be disabled collectively by setting the scheme switch [AMF] 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 event recording of the failure may not function normally.

Table 3.3.1 Supervision Items and Alarms

Supervision Item	LCD Message	LED "IN SERVICE"	LED "ALARM"	External alarm	Event record Message
A/D accuracy check Memory monitoring	(1)	off	on	(3)	Relay fail
Watchdog Timer	----	off	on	(3)	----
DC supply monitoring	----	off	(2)	(3)	Relay fail

(1): Diverse messages are provided as expressed with "Err:---" in the table in Section 6.7.2.

(2): Whether the LED is lit or not depends on the degree of the voltage drop.

(3): The binary output relay "FAIL" operates.

3.3.4 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 checking
- Memory monitoring
- Watchdog Timer
- DC supply monitoring

3.4 Recording Function

The GRR100 is provided with the following recording functions:

Fault recording

Event recording

Disturbance recording

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 receiving an external tripping signal and the following items are recorded for one fault:

Date and time of fault occurrence

Start phase

Trip mode

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 of fault occurrence

This is the time at which an external tripping signal has been received.

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

Start phase

This is the phase to which a trip command is given.

Trip mode

When the GRR100 outputs three-phase tripping signal to busbar CB or centre CB, TP1 or TP2 is recorded.

Relevant events

Following events are recorded depending on the autoreclosing mode:

SPAR 1 : single-phase autoreclose of busbar CB

TPAR 1 : three-phase autoreclose of busbar CB

FT 1 : busbar CB final trip

Reset 1 : busbar CB autoreclose reset

SPAR 2 : single-phase autoreclose of centre CB

TPAR 2 : three-phase autoreclose of centre CB

FT 2 : centre CB final trip

Reset 2 : centre CB autoreclose reset

MSAR : multi-shot autoreclose
Reclosed 1 : first shot autoreclose
Reclosed 2 : second shot autoreclose
Reclosed 3 : third shot autoreclose
Reclosed 4 : fourth shot autoreclose
MSFT : final trip of multi-shot autoreclose

Power system quantities

The busbar voltage VB and line voltages VL1 (and VL2 only for model 201) in pre-faults and post-faults are recorded.

3.4.2 Event Recording

The events shown in Table 3.4.1 are recorded with a 1 ms resolution time-tag when the status changes. The user can select the recording items and their status change mode to initiate recording.

Up to 96 records can be stored. If an additional event occurs when 96 records have been stored, the oldest event record is deleted and the latest event record is then stored.

Table 3.4.1 Event Record Items

Event	LCD Indication	
External trip command (phase A) input or reset	Ext. trip A	On or Off
External trip command (phase B) input or reset	Ext. trip B	On or Off
External trip command (phase C) input or reset	Ext. trip C	On or Off
Busbar CB three-phase tripping command output or reset	Trip 1	On or Off
Centre CB three-phase tripping command output or reset (*)	Trip 2	On or Off
Busbar CB autoreclose command output or reset	CB1 ARC	On or Off
Centre CB autoreclose command output or reset (*)	CB2 ARC	On or Off
Busbar CB reclose ready or unready	CB1 ready	On or Off
Centre CB reclose ready or unready (*)	CB2 ready	On or Off
Backup trip command input or reset	BU trip	On or Off
Autoreclose blocking external command input or reset	ARC block	On or Off
Indication reset input or reset	Ind. reset	On or Off
Relay failed or restored	Relay fail	On or Off
System setting changed (**)	Sys. change	
Relay setting changed (**)	Rly. change	
Group setting changed (**)	Grp. change	

(*) : Only for Model 201
(**) : A change of setting is classified into three events. The event "System setting changed" corresponds to all the setting changes except setting changes in the sub-menu "Protection". (See section 4.2.6 for changing the settings). The event "Relay setting changed" corresponds to setting change of measuring elements and timers in the sub-menu "Protection". The event "Group setting changed" corresponds to other setting changes in the sub-menu "Protection".

Setting

Recording mode can be set for each event. One of the following four modes is selectable.

Modes	Setting
Not to record the event.	N
To record the event when the status changes to "operate".	O
To record the event when the status changes to "reset".	R
To record the event when the status changes both to "operate" and "reset".	B

For the setting, see the Section 4.2.6.5. The default setting is "B" (=both) for all events except those marked with (*). The events marked with (*) have a default setting of "O" (operate).

3.4.3 Disturbance Recording

Disturbance recording is started when an autoreclose command or a tripping command is initiated. The records include three analogue signals (V_B, V_{L1}, V_{L2}), 11 binary signals listed below and the dates and times at which recording started.

- Trip1
- Trip2
- CB1 ARC
- CB2 ARC
- Ext. trip A
- Ext. trip B
- Ext. trip C
- BU trip
- ARC block
- CB1 ready
- Cont1/Rdy2

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 instruction manual.

The pre-fault recording time is fixed at 0.3s and post-fault recording time can be set between 0.1 and 3.0s.

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

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

Table 3.4.2 Post Fault Recording Time and Number of Disturbance Records Stored

Recording time	0.1s	0.5s	1.0s	1.5s	2.0s	2.5s	3.0s
50Hz	49	25	15	11	8	7	6
60Hz	41	20	12	9	7	5	5

Setting

The disturbance recording is started by the autoreclose signals or the external tripping signals. The starting is enabled or disabled by the following scheme switches.

Element	Range	Step	Default	Remarks
[ARS]	ON/OFF		ON	Start by autoreclose signal
[TRIP]	ON/OFF		ON	Start by external tripping signal

3.5 Metering Function

The GRR100 performs continuous measurement of the busbar voltage VB and line voltageVL1 (and VL2 only for model 201). The measurement data is updated every second and displayed on the LCD of the relay front panel or on the local or remote PC.

Phase angles above are expressed taking the busbar voltage as a reference phase angle, where leading phase angles are expressed plus.

The voltages are displayed in values on the primary side or on the secondary side determined by the setting. To display accurate values, it is necessary to set the VT ratio as well. For the setting method, see “Setting the parameter” in 4.2.6.7.

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) or IEC60870-5-103 communication via 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 3.1.3, the front panel is provided with a liquid crystal display (LCD), light emitting diode (LED), operation keys, [VIEW] and [RESET] keys, monitoring jack and RS232C connector.

LCD

The LCD screen, provided with a 2-line, 16-character back-light, provides the user with information of the relay interior such as records, statuses and settings. The LCD screen is normally unlit, but pressing the [VIEW] key will display the digest 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 5 minutes or longer without operation, the back-light will go OFF.

LED

There are 6 LED displays. The signal labels and LED colors are defined as follows:

Label	Color	Remarks
IN SERVICE	Green	Lit when the relay is in service.
OPERATE	Red	Lit when trip or autoreclose command is issued.
ALARM	Red	Lit when a failure is detected.
TESTING	Red	Lit when test condition is set.
(LED1)	Red	
(LED2)	Red	

LED1 and LED2 are configurable. Refer to Section 3.1.1.

The OPERATE LED lights up once the relay issues the trip or autoreclose command and remains lit even after the command goes off. The OPERATE LED can be unlit by the [RESET] key. Other LEDs are lit as long as a signal is present and the [RESET] key is invalid while the signal is operating.

Operation keys

The operation keys are used to display records, status, and set values on the LCD, 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. Keys ◀ and ▶ are also used to enter numerical values.

② [CANCEL]: Used to cancel entries and return to the upper screen.

③ [END]: Used to end an 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 "Metering", "Latest fault" and "Auto-supervision".

Pressing [RESET] key turns off the display.

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 transmitted to an oscilloscope via a monitoring jack.

RS-232C connector

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

4.1.2 Communication Ports

The following three individual interfaces are 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 using this connector, setting operation and display functions can be performed on the personal computer.

RS485 port

The RS485 port is used for the RSM (Remote Setting and Monitoring system) via the protocol converter G1PR2 and IEC60870-5-103 communication via BCU/RTU (Bay Control Unit / Remote Terminal Unit) to connect between relays and to construct a network communication system. (See Figure 4.4.1 in Section 4.4.)

One or two (dual) RS485 ports (COM1 and COM2) are provided on the rear of the relay as shown in Figure 4.1.1 and Appendix G.

IRIG-B port

The IRIG-B port is mounted on the DI/AI module. This port collects serial IRIG-B format data from the external clock to synchronise the relay calendar clock. The IRIG-B port is isolated from the external circuit by using a photo-coupler. A BNC connector is used as the input connector.

This port is provided on the back of the relay and Figure 4.1.1 shows the location of this connector. The rated voltage level of the signal is from 2 to 8 V_{peak} (4 to 16 $V_{peak\text{-}to\text{-}peak}$).

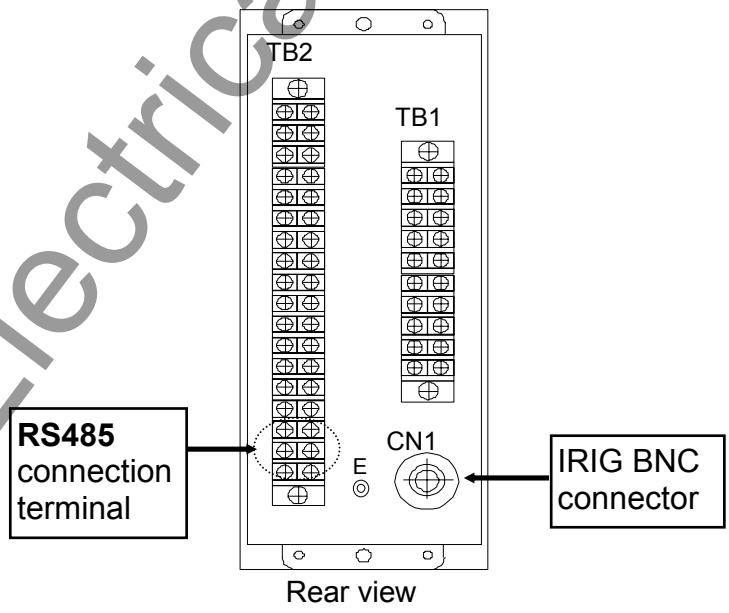


Figure 4.1.1 Locations of RS485 Port and IRIG Port

4.2 Operation of the User Interface

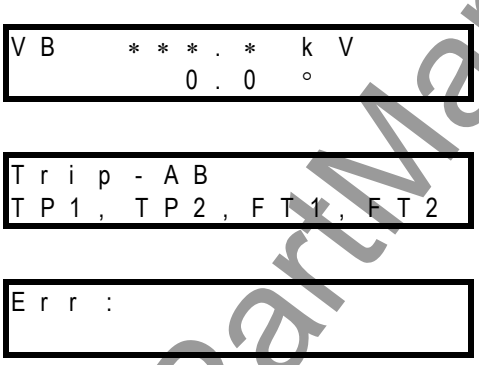
The user can access such functions as recording, measurement, relay setting and testing with the LCD display and operation keys.

4.2.1 LCD and LED Displays

Displays during normal operation

When the GRR100 is operating normally, the green "IN SERVICE" LED is lit and the LCD is off.

Press the [VIEW] key when the LCD is off to display the digest screens which are "Metering", "Latest fault" and "Auto-supervision" screens in turn. The last two screens are displayed only when there is some data. These are the digest screens and can be displayed without entering the menu screens.



To clear the latched indications (latched LEDs, LCD screen of Latest fault), press [RESET] key for 3 seconds or more.

For any display, the back-light is automatically turned off after five minutes.

Displays in tripping or autoreclosing

If a fault occurs and a tripping command is output when the LCD is off, the red "TRIP" LED and other configurable LED if signals assigned to trigger by tripping

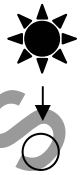
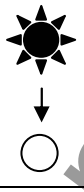
Press the [VIEW] key to scroll the LCD screen to read the rest of messages.

Press the [RESET] key to turn off the LEDs and LCD display.

Notes:

1) When configurable LEDs (LED1 and LED2) are assigned to latch signals by trigger of tripping, press the [RESET] key more than 3s until the LCD screens relight. Confirm turning off the configurable LEDs. Refer to Table 4.2.1 Step 1.
2) Then, press the [RESET] key again on the "Latest fault" screen in short period, confirm turning off the "TRIP" LED. Refer to Table 4.2.1 Step 2.
3) When only the "TRIP" LED is go off by pressing the [RESET] key in short period, press the [RESET] key again to reset remained LEDs in the manner 1) on the "Latest fault" screen or other digest screens. LED1 and LED2 will remain lit in case the assigned signals are still active state.

Table 4.2.1 Turning off latch LED operation

	Operation	LED lighting status	
		"TRIP" LED	Configurable LED (LED1, LED2)
Step 1	Press the [RESET] key more than 3s on the "Latest fault" screen	 continue to lit	 turn off
Step 2	Then, press the [RESET] key in short period on the "Latest fault" screen	 turn off	

When any of the menu screens is displayed, the [VIEW] and [RESET] keys do not function.

To return from menu screen to the digest "Latest fault" screen, do the following:

- Return to the top screen of the menu by repeatedly pressing the [END] key.
- Press the [END] key to turn off the LCD.
- Press the [VIEW] key to display the digest "Latest fault" screen.

Displays in automatic supervision operation

If the automatic supervision function detects a failure while the LCD is off, the "Auto-supervision" 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" and "Latest fault" screens.

Press the [RESET] key to turn off the LEDs and LCD display. However, if the failure continues, the "ALARM" LED remains lit.

After recovery from a failure, the "ALARM" LED and "Auto-supervision" display turn off automatically.

If a failure is detected while any of the screens is displayed, the current screen remains displayed and the "ALARM" LED lights.

Notes:

1) When configurable LEDs (LED1 and LED2) are assigned to latch signals by issuing an alarm, press the [RESET] key more than 3s until all LEDs reset except "IN SERVICE" LED.
2) When configurable LED is still lit by pressing [RESET] key in short period, press [RESET] key again to reset remained LED in the above manner.
3) LED1 and LED2 will remain lit in case the assigned signals are still active state.

While any of the menu screens is displayed, the [VIEW] and [RESET] keys do not function. To

return to the digest "Auto-supervision" screen, do the following:

- Return to the top screen of the menu by repeatedly pressing the END key.
- Press the END key to turn off the LCD.
- Press the VIEW key to display the digest screen.
- Press the RESET key to turn off the LCD.

4.2.2 Relay Menu

Figure 4.2.1 shows the menu hierarchy in the GRR100. The menu has five sub-menus, "Record", "Status", "Set.(view)", "Set.(change)", and "Test". For details of the menu hierarchy, see Appendix E.

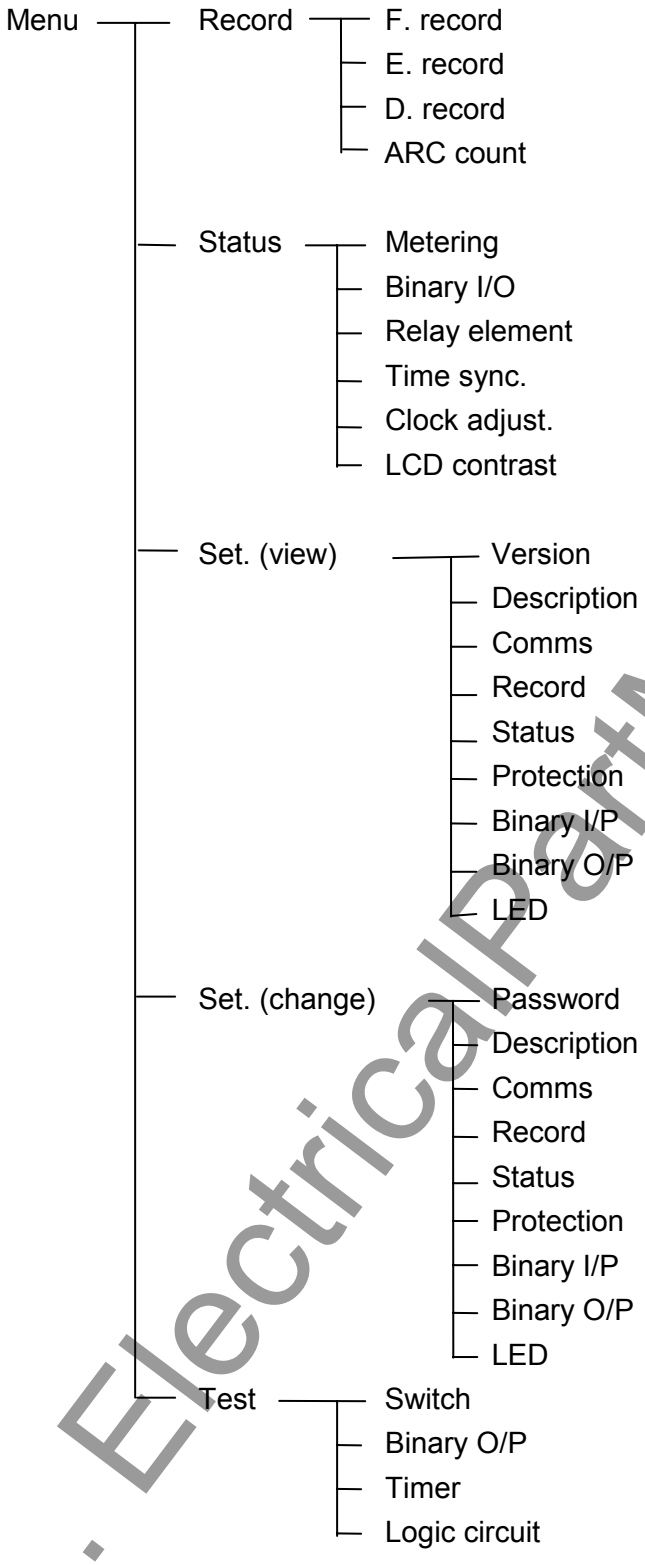


Figure 4.2.1 Relay Menu

Record

In the "Record" menu, the fault record, event record and disturbance record can be displayed or erased. Furthermore, the autoreclose function can be displayed in counter form or reset.

Status

The "Status" menu displays the power system quantities, binary input and output status, relay measuring element status, signal source for time synchronisation (IRIG-B, RSM or IEC60870-5-103) and adjusts the clock and LCD contrast.

Set. (view)

The "Set. (view)" menu displays the relay version, description, relay address and baud rate in RSM or IEC60870-5-103 communication, the current settings of record, status, protection, binary inputs, configurable binary outputs and the configurable LEDs.

Set. (change)

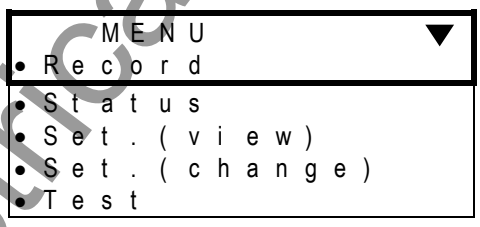
The "Set. (change)" menu is used to change the settings of password, description, relay address and baud rate in RSM or IEC60870-5-103 communication, record, status, protection, binary inputs, configurable binary outputs and configurable LEDs.

Since this is an important menu and is used to change settings related to relay tripping, it has password security protection.

Test

The "Test" menu is used to set testing switches, to forcibly operate binary output relays, to measure variable timer time and to observe the binary signals in the logic circuit.

When the LCD is off, press any key other than the [VIEW] and [RESET] keys to display the top "MENU" screen and then proceed to the relay menus.



To display the "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] and [RESET] 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. The top line shows the hierarchical layer. The last item is not displayed for all the screens. "/4" displayed on the far left means that the screen is in the fourth hierarchical layer, while "▼" or "▲" displayed on the far right shows that upper or lower lines are laid.

To move the cursor downward or upward for setting or for viewing other lines not displayed on the window, use the ▼ and ▲ keys.

```
/ 4  Scheme sw                ▼

Trip                  1   _
Off / On
ARC                   1   _
Off / On
```

To return to the higher screen or move from the right side screen to the left side screen in Appendix E, press the [END] 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 depth, first return to the higher screen and then move to the lower screen.

4.2.3 Displaying Records

The sub-menu of "Record" is used to display fault records, event records, disturbance records, and autoreclosing output count.

4.2.3.1 Displaying Fault Records

To display fault records, do the following:

- Open the top "MENU" screen by pressing any keys other than the [VIEW] and [RESET] keys.
- Select "Record" to display the "Record" sub-menu.

```
/ 1  Record                   ▼
• F. record
• E. record
• D. record
• ARC count
```

- Select "F. record" to display the "Fault record" screen.

```
/ 2  F. record                ▼
• Display
• Clear
```

- Select "Display" to display the dates and times of fault records stored in the relay from the top in new-to-old sequence.

```
/ 3  F. record                ▼

# 1  16/Oct/1997
     18:13:57.031
# 2  20/Sep/1997
     15:29:22.101
# 3  04/Jul/1997
     11:54:53.299
# 4  28/Feb/1997
     07:30:18.412
```

- Move the cursor to the fault record line to be displayed using the ▲ and ▼ keys and press

the [ENTER] key to display the details of the fault record.

```
/4  F.record  #1 ▼
16/Oct/1997
18:13:57.031

Trip-A
Prefault values
VB    ***.*  kV
         0.0  °
VL1   ***.*  kV
      ***.*  °
VL2   ***.*  kV
      ***.*  °
Fault values
VB    ***.*  kV
         0.0  °
VL1   ***.*  kV
      ***.*  °
VL2   ***.*  kV
      ***.*  °
16/Oct/1997
18:13:57.531
SPAR1, SPAR2
16/Oct/1997
18:13:58.031
TP1, TP2, FT1, FT2
```

Note: In case of model 101, VL2 is not displayed.

The lines which are not displayed in the window can be displayed by pressing the ▲ and ▼ keys.

To clear all fault records, do the following:

- Open the "Record" sub-menu.
- Select "F. record" to display the "Fault record" screen.
- Select "Clear" to display the following confirmation screen.

```
Clear records?
END=Y    CANCEL=N
```

- Press the [END] (= Y) key to clear all the fault records stored in non-volatile memory.

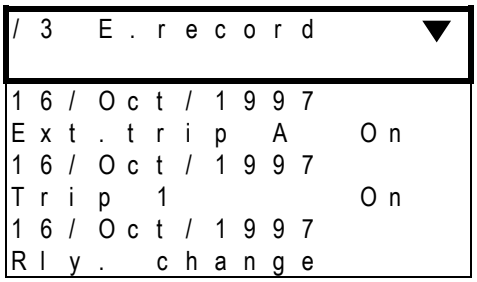
If all fault records have been cleared, the "Latest fault" screen of the digest screens is not displayed.

4.2.3.2 Displaying Event Records

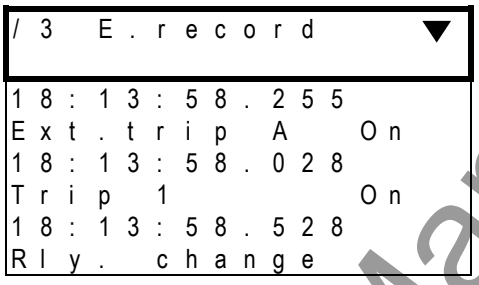
To display event records, do the following:

- Open the top "MENU" screen by pressing any keys other than the [VIEW] and [RESET] keys.
- Select "Record" to display the "Record" sub-menu.
- Select "E. record" to display the "Event record" screen.

- Select "Display" to display the events with date from the top in new-to-old sequence.



The time is displayed by pressing the ▶ key.



Press the ◀ key to return to the previous screen.

The lines which are not displayed in the window can be displayed by pressing the ▲and ▼ keys.

To clear all event records, do the following:

- Open the "Record" sub-menu.
- Select "E. record" to display the "Event record" screen.
- Select "Clear" to display the following confirmation screen.

- Press the END (= Y) key to clear all the event records stored in non-volatile memory.

4.2.3.3 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 "MENU" screen by pressing any keys other than the VIEW and RESET keys.
- Select "Record" to display the "Record" sub-menu.
- Select "D. record" to display the "Disturbance record" screen.
- Select "Display" to display the date and time of the disturbance records from the top in new-to-old sequence.

```
/ 3   D . r e c o r d                ▼

# 1   1 6 / O c t / 1 9 9 7
      1 8 : 1 3 : 5 7 . 4 0 1
# 2   2 0 / S e p / 1 9 9 7
      1 5 : 2 9 : 2 2 . 3 8 8
# 3   0 4 / J u l / 1 9 9 7
      1 1 : 5 4 : 5 3 . 4 4 4
# 4   2 8 / F e b / 1 9 9 7
      0 7 : 3 0 : 1 8 . 8 7 6
```

The lines which are not displayed in the window can be displayed by pressing the ▲ and ▼ keys.

To clear all disturbance records, do the following:

- Open the "Record" sub-menu.
- Select "D. record" to display the "Disturbance record" screen.
- Select "Clear" to display the following confirmation screen.

```
C l e a r   r e c o r d s ?
E N D = Y     C A N C E L = N
```

- Press the [END] (= Y) key to clear all the disturbance records stored in non-volatile memory.

4.2.3.4 Displaying Autoreclose Count

The autoreclose output counts can be displayed or can be reset to zero as follows.

- Open the top "MENU" screen by pressing any keys other than the [VIEW] and [RESET] keys.
- Select "Record" to display the "Record" sub-menu.
- Select "ARC count" to display the "Autoreclose count" screen.
- Select "Display" to display the autoreclose count.

```
C B 1   S P A R [ * * * * ]          ▼
C B 1   T P A R [ * * * * ]
C B 2   S P A R [ * * * * ]
C B 2   T P A R [ * * * * ]
```

In the case of two breaker autoreclose, CB1 and CB2 mean busbar breaker and centre breaker respectively. SPAR and TPAR mean single-phase and three-phase autoreclose respectively.

To reset the autoreclose count, do the following:

- Open the "Record" sub-menu.
- Select "ARC count" to display the "Autoreclose count" screen.
- Select "Reset" to reset the autoreclose count.

```
R e s e t   c o u n t                ▼
• C B 1
• C B 2
```

- Select CB1 or CB2 to display the following confirmation screen.

```
Clear  records?
END=Y    CANCEL=N
```

- Press the [END] (= Y) key to reset the count to zero and return to the previous screen.

4.2.4 Displaying the Status Information

From the sub-menu of "Status", the following status condition can be displayed on the LCD:

Metering data of the protected line, apparatus, etc.

Status of binary inputs and outputs

Status of measuring elements output

Status of time synchronisation source

This data is updated every second.

This sub-menu is also used to adjust the time of the internal clock.

4.2.4.1 Displaying Metering Data

To display metering data on the LCD, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.

```
/1 Status                ▼
• Metering
• Binary I/O
• Relay element
• Time sync.
• Clock adjust.
• LCD contrast
```

- Select "Metering" to display the "Metering" screen.

```
/2 Metering              ▼
VB    ***.*   kV
          0.0   °
VL1   ***.*   kV
      ***.*   °
VL2   ***.*   kV
      ***.*   °
f       **.*  Hz
```

Note: In case of model 101, VL2 is not displayed.

4.2.4.2 Displaying the Status of Binary Inputs and Outputs

To display the binary input and output status, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.
- Select "Binary I/O" to display the binary input and output status.

```
/2 Binary I/O            ▼
IP  [000  000  00]
OP1 [000  000     ]
OP2 [000  000  00]
OP3 [000          ]
```

The display format is shown below.

	[■	■	■	■	■	■	■	■]
IP(binary input)	BI1	BI2	BI3	BI4	BI5	BI6	BI7	BI8
OP1(binary output)	TP-A1	TP-B1	TP-C1	TP-A2	TP-B2	TP-C2	—	—
OP2 (binary output)	BO1	BO2	BO3	BO4	BO5	BO6	BO7	BO8
OP3 (binary output)	BO9	BO10	FAIL					

Line 1 shows the binary input status. BI1 to BI8 corresponds to each binary input signal. For the binary input signal, see Appendix G. The status is expressed with logical level "1" or "0" at the photo-coupler output circuit.

Lines 2 to 4 shows the binary output status. TP-A1 to TP-C2 of line 2 corresponds to the tripping command outputs. FAIL of line 4 corresponds to the relay failure output. Other outputs expressed with BO1 to BO10 are configurable. 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".

To display all the lines, press the ▲ and ▼ keys.

4.2.4.3 Displaying the Status of Measuring Elements

To display the status of measuring elements on the LCD, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.
- Select "Relay element" to display the status of the relay elements.

```
/2  Ry element
    [000 000 00]
```

The operation status of synchronism check elements is shown as below.

[■	■	■	■	■	■	■	■]
OVB	UVB	SYN1	OVL1	UVL1	SYN2	UVL2	OVL2

The status of each element is expressed with logical level "1" or "0". Status "1" means the element is in operation.

4.2.4.4 Displaying the Status of the Time Synchronisation Source

The internal clock of the GRR100 can be synchronised with external clocks such as the IRIG-B time standard signal clock, RSM (relay setting and monitoring system) clock or IEC60870-5-103. To display on the LCD whether these clocks are active (=Act.) or inactive (=Inact.) and which clock the relay is synchronised with, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.
- Select "Time sync." to display the status of time synchronisation sources.

```
/2  Time sync.   ▼
*IRIG:  Act.
 RSM:   Inact.
 IEC:   Inact.
```

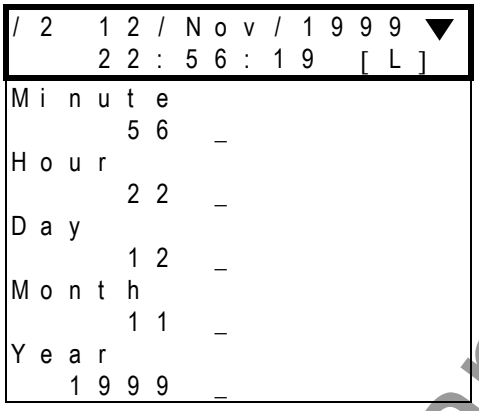
The asterisk on the far left shows that the internal clock is synchronised with the marked source clock. If the marked source clock is inactive, the internal clock runs locally.

For details of the setting time synchronisation, see Section 4.2.6.6.

4.2.4.5 Clock Adjustment

To adjust the clock when the internal clock is running locally, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.
- Select "Clock adjust." to display the setting screen.



Line 1 shows the current date, time and time synchronisation source with which the internal clock is synchronised. The time can be adjusted only when [L] is indicated on the top line, showing that the clock is running locally. When [IRIG], [RSM] or [IEC] is indicated, the adjustment is invalid.

- Enter a numerical value for each item and press the ENTER key. For details to enter a numerical value, see 4.2.6.1.
- Press the END key to adjust the internal clock to the set hours without fractions and return to the previous screen.

If a date which does not exist in the calendar is set and END key is pressed, "**** Error ****" is displayed on the top line and the adjustment is discarded. Adjust again.

4.2.4.6 LCD Contrast

To adjust the contrast of LCD screen, do the following:

- Select "Status" on the top "MENU" screen to display the "Status" screen.
- Select "LCD contrast" to display the setting screen.

- Press the ◀ or ▶ key to adjust the contrast. The screen becomes dark by pressing the ◀ key and light by pressing the ▶ key.

4.2.5 Viewing the Settings

The sub-menu "Set. (view)" is used to view the settings made using the sub-menu "Set. (change)".

The following items are displayed:

Relay version

Description

Relay address and baud rate in the RSM (relay setting and monitoring system) or IEC60870-5-103 communication

Recording setting

Status setting

Protection setting

Binary input setting

Binary output setting

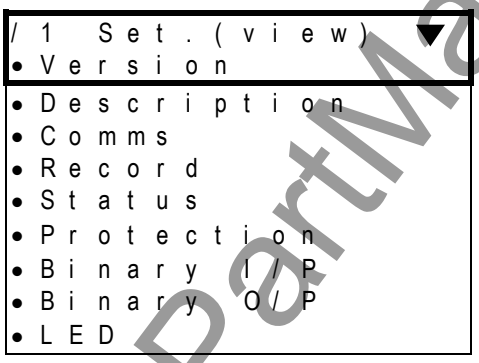
LED setting

Enter an item on the LCD to display each item as described in the previous sections.

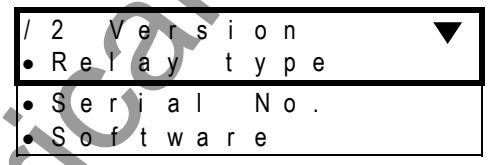
4.2.5.1 Relay Version

To view the relay version, do the following.

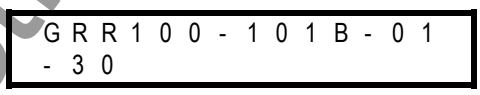
- Select the "Set.(view)" on the main menu.



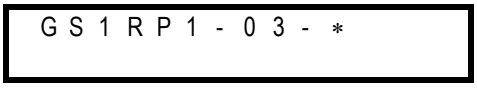
- Select the "Version" to display the relay version screen.



- Select "Relay type" to display the relay type form and model number



- Select "Serial number" to display the relay manufacturing number.
- Select "Software" to display the relay software type form.



4.2.5.2 Settings

The "Description", "Comms", "Record", "Status", "Protection", "Binary I/P", "Binary O/P" and "LED" screens display the current settings input using the "Set. (change)" sub-menu.

4.2.6 Changing the Settings

The "Set. (change)" sub-menu is used to make or change settings for the following items:

Password

Description

Relay address and baud rate in the RSM or IEC60870-5-103 communication

Recording

Status

Protection

Binary input

Binary output

LED

All of the above settings except the password can be seen using the "Set. (view)" sub-menu.

4.2.6.1 Setting Method

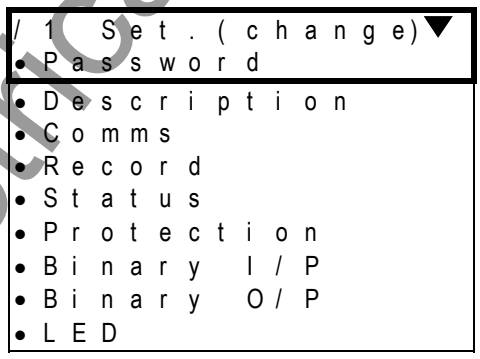
There are three setting methods as follows:

- To enter a selected item
- To enter a text string
- To enter numerical values

To enter a selected item

If a screen as shown below is displayed, perform setting as follows.

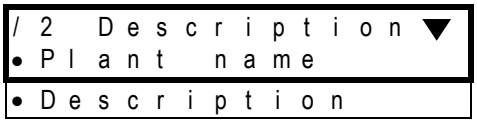
The cursor can be moved to upper or lower lines within the screen by pressing the ▲ and ▼ keys. If setting (change) is not required, skip the line with the ▲ and ▼ keys.



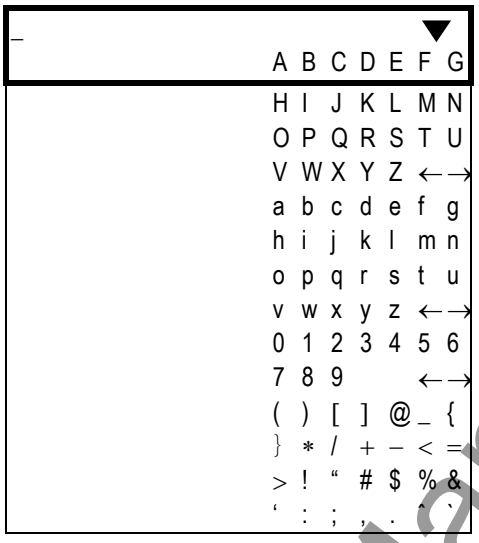
- Move the cursor to a setting item.
- Press the [ENTER] key.

To enter a text string

Texts strings are entered under "Plant name" or "Description" screen.



To select a character, use keys ▼, ▲, ◀ and ▶ to move blinking cursor down, left, up and right. "→" and "←" on each of lines 4, 8 and 10 indicate a space and backspace, respectively. A maximum of 22 characters can be entered.



- Set the cursor position in the bracket by selecting "→" or "←" and pressing the ENTER key.
- Move the blinking cursor to a selecting character.
- Press the ENTER key to enter the blinking character at the cursor position in the brackets.
- Press the END key to confirm the entry and return to the upper screen.

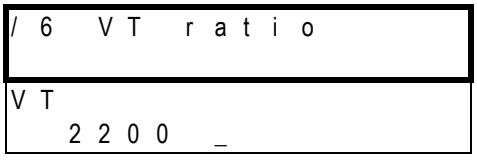
To correct the entered character, do either of the followings:

- Discard the character by selecting "←" and pressing the ENTER key and enter the new character.
- Discard the whole entry by pressing the CANCEL key and restart the entry from the first.

To enter numerical values

When the screen shown below is displayed, perform setting 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.



- 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 setting on the screen, press the [END] key to return to the upper screen.

To correct the entered numerical value, do the followings.

- If it is before pressing the [ENTER] key, press the [CANCEL] key and enter the new numerical value.
- 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 of the entries 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 setting

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 screen shown below is displayed. The confirmation screen is displayed just before returning to the "Set. (change)" sub-menu.

```
Change settings?
ENTER=Y  CANCEL=N
```

- When the screen is displayed, press the [ENTER] key to start operation using the new settings, or press the [CANCEL] key to correct or cancel the entries. In the latter case, the screen turns back to the setting screen to enable re-entries. Press the [CANCEL] key to cancel entries made so far and to turn to the "Set. (change)" sub-menu.

4.2.6.2 Password

For the sake of security of setting changes, password protection can be set as follows:

- Select "Set. (change)" on the main "MENU" screen to display the "Set. (change)" screen.
- Select "Password" to display the "Password" screen.
- Enter a 4-digit number within the brackets after "Input" and press the [ENTER] key.

```
Input          [ _      ]
1 2 3 4 5 6 7 8 9 0 ←
```

- For confirmation, enter the same 4-digit number in the brackets after "Retype".

```
Retype         [ _      ]
1 2 3 4 5 6 7 8 9 0 ←
```

- Press the [END] key to display the confirmation screen. If the retyped number is different from that first entered, the following message is displayed on the bottom of the "Password" screen before returning to the upper screen.

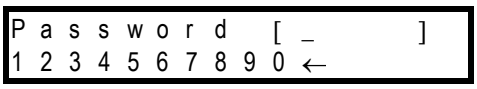
  "Unmatch passwd"

  Reentry is then requested.

Password trap

After the password has been set, the password must be entered in order to enter the setting change screens.

If "Set. (change)" is entered on the top "MENU" screen, the password trap screen "Password" is displayed. If the password is not entered correctly, it is not possible to move to the "Set. (change)" sub-menu screens.



Canceling or changing the password

To cancel the password protection, enter "0000" in the two brackets on the "Password" screen. The "Set. (change)" screen is then displayed without having to enter a 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 CANCEL and RESET together for one second on the top "MENU" screen. The screen goes off, and the password protection of the GRR100 is canceled. Set the password again.

4.2.6.3 Description

To enter the plant name and other data, do the following. This data is attached to records.

- Select "Set. (change)" on the main "MENU" screen to display the "Set. (change)" screen.
- Select "Description" to display the "Description" screen.

- To enter the plant name, select "Plant name" on the "Description" screen.

To enter special items, select "Description" on the "Description" screen.

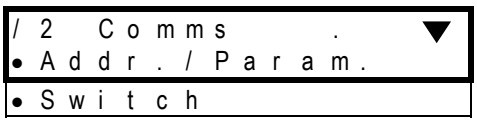
- Enter the text string.

4.2.6.4 Communication

If the relay is linked with RSM (relay setting and monitoring system) or IEC60870-5-103 communication, the relay address must be set. Do this as follows:

Note: The settings related to IEC60870-5-103 communication are available for the relay with dual RS485 port.

- Select "Set. (change)" on the main "MENU" screen to display the "Set. (change)" screen.
- Select "Comms" to display the "Comms" screen.

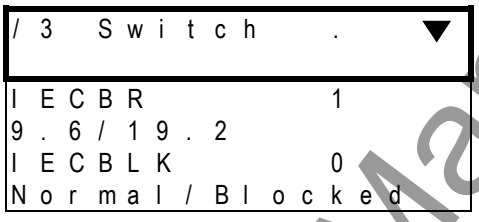


- Select "Addr./Param." on the "Comms" screen to enter the relay address number.

- Enter the relay address number on "HDLC" line for RSM or "IEC" line for IEC60870-5-103 and press the [ENTER] key.

CAUTION Do not overlap the relay address number.

- Select "Switch" on the "Comms" screen to select the protocol and transmission speed (baud rate), etc., of the RSM and IEC60870-5-103.



- Select the number and press the [ENTER] key.

<IECBR>

This line is to select the baud rate when the IEC60870-5-103 system is applied.

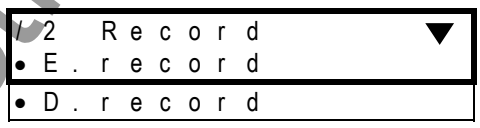
<IECBLK>

Select 1 (=Blocked) to block the monitor direction in the IEC60870-5-103 communication.

4.2.6.5 Setting the Recording

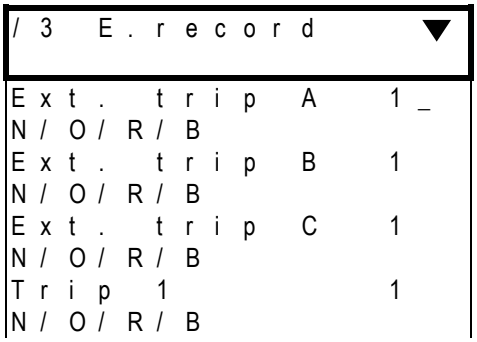
To set the recording function as described in Section 4.2.3, do the following:

- Select "Set. (change)" on the main "MENU" screen to display the "Set. (change)" screen.
- Select "Record" to display the "Record " screen.



Setting the event recording

- Select "E. record" to display the "E.record" screen.



```
Trip 2              1
N/O/R/B
CB1 ARC             1
N/O/R/B
CB2 ARC             1
N/O/R/B
CB1 ready           1
N/O/R/B
CB2 ready           1
N/O/R/B
BU trip             1
N/O/R/B
ARC block           1
N/O/R/B
Ind. reset          1
N/O/R/B
Relay fail          1
N/O/R/B
Sys. change         1
N/O
Rly. change         1
N/O
Grp. change         1
N/O
```

Note: In case of model 101, "Trip 2", "CB2 ARC" and "CB2 ready" are not displayed.

- Enter 0 or 1 or 2 or 3 and press the ENTER key. Repeat this for all events.

  Enter 0 (= N) not to record the event.

  Enter 1 (= O) to record the event when the status changes to "operate".

  Enter 2 (= R) to record the event when the status changes to "reset".

  Enter 3 (= B) to record the event when the status changes both to "operate" and "reset".

Setting the disturbance recording

- Select "D. record" to display the "D. record" screen.

```
/3 D.record          ▼
• Time/starter
• Scheme sw
```

- Select "Time/starter" to display the "Time/starter" screen.

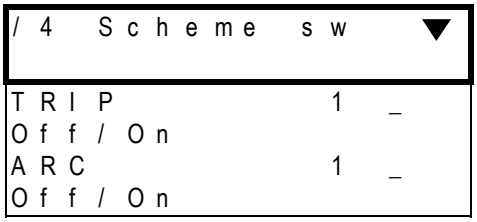
```
/4 Time/starter      ▼

Time                 s
   2.0 _
```

- Enter the recording time setting.

To use or not to use the trip command or the autoreclose command for a starter, do the following:

- Select "Scheme sw" on the "Disturbance record" screen to display the "Scheme switch" screen.

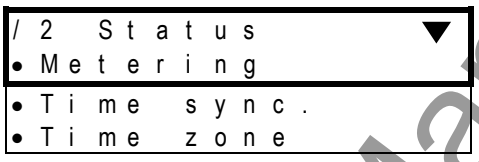


- Enter 1 to use as a starter.
- If not to use as a starter, enter 0.

4.2.6.6 Status

To set the status display described in Section 4.2.4, do the following:

Select "Status" on the "Set. (change)" sub-menu to display the "Status" screen.



Setting the metering

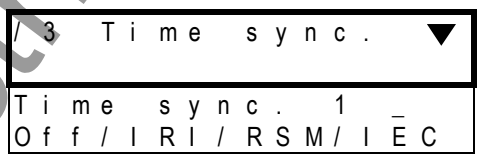
- Select "Metering" to display the "Metering" screen.

- Enter 0 (=Prim.) or 1 (=Second.) to display the primary or secondary value respectively.

Setting the time synchronisation

The calendar clock can run locally or be synchronised with the external IRIG-B time standard signal, RSM clock, or by an IEC60870-5-103. This is selected by setting as follows.

- Select "Time sync." to display the "Time sync." screen.



- Enter 0 or 1 or 2 or 3 and press the [ENTER] key.

  Enter 0 (=Off) not to be synchronised with any external signals.

  Enter 1 (=IRIG) to be synchronised with the external IRIG-B time standard signal.

  Enter 2 (=RSM) to be synchronised with the RSM clock.

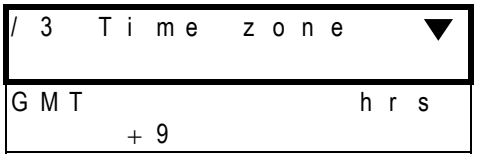
  Enter 3 (=IEC) to be synchronised with IEC60870-5-103.

Note: When to select IRIG-B, RSM or IEC, check that they are active on the "Status" screen in "Status" sub-menu. If it is set to an inactive IRIG-B, RSM or IEC, the calendar clock runs locally.

Setting the time zone

When the calendar clock is synchronised with the IRIG-B time standard, it is possible to transform GMT to the local time.

- Select "Time zone" to display the "Time zone" screen.

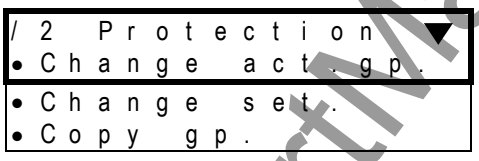


- Enter the difference between GMT and local time and press the ENTER key.

4.2.6.7 Protection

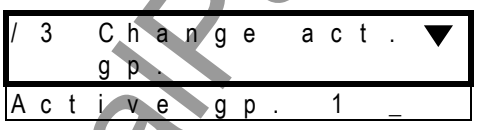
The GRR100 can have 4 setting groups for protection in order to accommodate changes in the operation of the power system, one setting group is assigned active. To set the protection, do the following:

- Select "Protection" on the "Set. (change)" screen to display the "Protection" screen.



Changing the active group

- Select "Change act. gp." to display the "Change act. gp." screen.



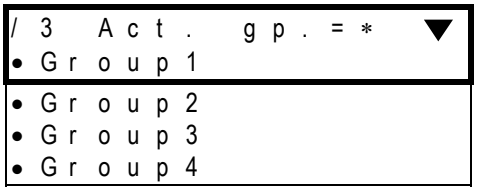
- Enter the group number and press the ENTER key.

Changing the settings

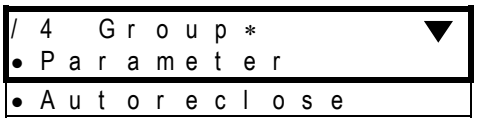
Almost all the setting items have default values that are set when the product was shipped. For the default values, see Appendix D and H.

To change the settings, do the following:

- Select "Change set." to display the "Act. gp. = ∗" screen.



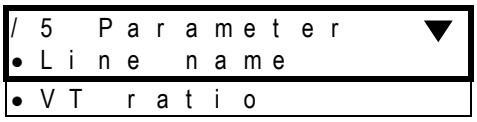
- Select the group number to change the settings and display the "Group *" screen.



Setting the parameter

Enter the line name as follows:

- Select "Parameter" on the "Group ∗" screen to display the "Parameter" screen.

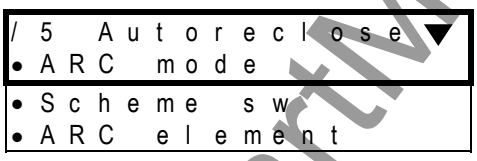


- Select "Line name" to display the "Line name" screen.
- Enter the line name as a text string and press the END key.
- Select "VT ratio" to display the "VT ratio" screen.
- Enter the VT ratio and press the ENTER key.

Setting the autoreclose function

To set the autoreclose(ARC) mode, scheme switches and ARC elements, do the following. ARC elements are measuring element and timers.

- Select "Autoreclose" on the "Group ∗" screen to display the "Autoreclose" screen.



- Select "ARC mode" on the "Autoreclose" screen to display the "Autoreclose mode" screen.

- Enter 0 or 1 or 2 or 3 and press the ENTER key.

  Enter 0 (= Off) not to perform the autoreclose.

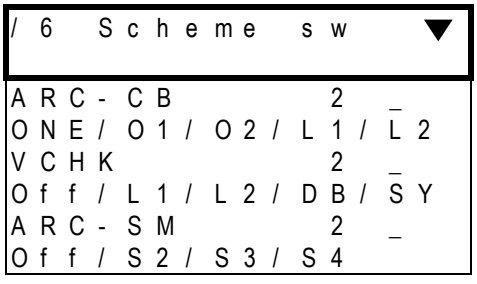
  Enter 1 (= S) to perform the single-phase autoreclose.

  Enter 2 (= T) to perform the three-phase autoreclose.

  Enter 3 (= S&T) to perform the single- and three-phase autoreclose.

Setting the scheme switch

- Select "Scheme sw" to display the "Scheme sw" screen. The following is the case of model 201.



<ARC-CB>

- Enter 0 or 1 or 2 or 3 or 4 and press the [ENTER] key.

  Enter 0 (= ONE) to perform the reclose in case of one-breaker system.

  Enter 1 (= O1) to perform only busbar breaker reclose.

  Enter 2 (= O2) to perform only centre breaker reclose.

  Enter 3 (= L1) to perform single-phase autoreclose and three-phase autoreclose (the busbar breaker is a leader breaker and reclosed first in case of the three-phase autoreclose).

  Enter 4 (= L2) to perform single-phase autoreclose and three-phase autoreclose(the centre breaker is a leader breaker and reclosed first in case of the three-phase autoreclose).

<VCHK>

- Enter 0 or 1 or 2 or 3 or 4 and press the [ENTER] key.

  Enter 0 (= Off) to perform the reclose without voltage and synchronism check.

  Enter 1 (= L1) to perform the reclose of leader breaker under "live bus and dead line" condition or with synchronism check and the reclose of follower breaker with voltage and synchronism check.

  Enter 2 (= L2) to perform the reclose of leader breaker under "live bus and dead line" condition or with synchronism check and the reclose of follower breaker under "dead bus and live line" condition or with voltage and synchronism check.

  Enter 3 (= DB) to perform the reclose of both breakers under "dead bus and live line" condition or with synchronism check.

  Enter 4 (= SY) to perform the reclose of both breakers with synchronism check..

<ARC-SM>

- Enter 0 or 1 or 2 or 3 and press the [ENTER] key.

  Enter 0 (= Off) not to perform the multi-shot autoreclosing.

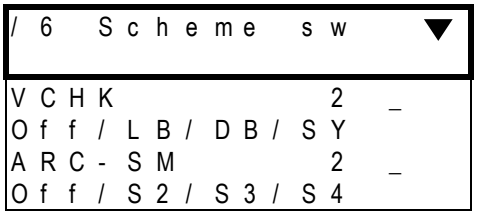
  Enter 1 (= S2) to perform the two-shot autoreclosing..

  Enter 2 (= S3) to perform the three-shot autoreclosing.

  Enter 3 (= S4) to perform the four-shot autoreclosing.

- Press the [END] key to return to the "Autoreclose" screen.

In the case of model 101, the following screen is displayed. The settings can be performed same as above.



Setting the ARC element

- Select "ARC element" to display the "ARC element" screen.

```
/ 6  ARC element ▼
• ARC timer
• Synchrocheck
```

<ARC timer>

- Select "ARC timer" to set the autoreclose timers.

```
/ 7  ARC timer ▼

TEVLV                    s
   1.00  _
TRDY1                    s
      60  _
TSPR                     s
   0.80  _
TTPR1                    s
   0.60  _
TRR                      s
   2.00  _
TW1                      s
     0.3  _
TS2                      s
   20.0  _
TS2R                     s
   30.0  _
TS3                      s
   20.0  _
TS3R                     s
   30.0  _
TS4                      s
   20.0  _
TS4R                     s
   30.0  _
```

Note: This screen shows a sample of Model 100 series.

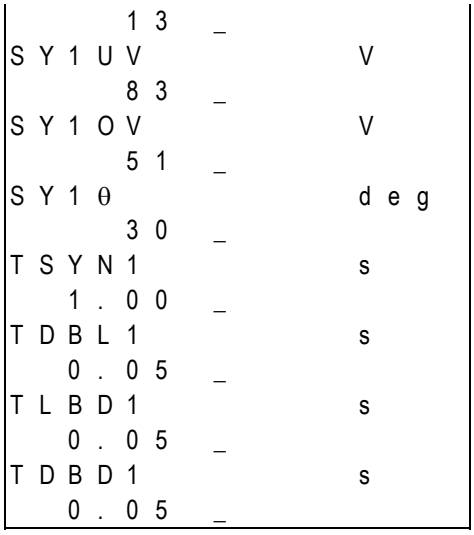
- Enter the numerical value and press the [ENTER] key.

<Synchrocheck>

- Select "Synchrocheck" to setting the synchronism check elemrnt.

```
/ 7  Synchrocheck ▼

OVB                      V
      51  _
UVB                      V
      13  _
OVL1                     V
      51  _
UVL1                     V
```



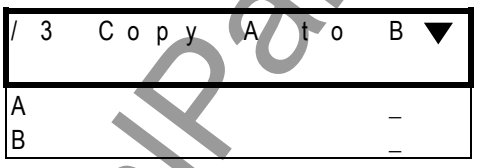
Note: This screen shows a sample of Model 100 series.

- Enter the numerical value and press the [ENTER] key.
- After setting, press the [END] key to return to the "ARC element" screen.

Setting group copy

To copy the settings of one group and overwrite them to another group, do the following:

- Select "Copy gp." on the "Protection" screen to display the "Copy A to B" screen.

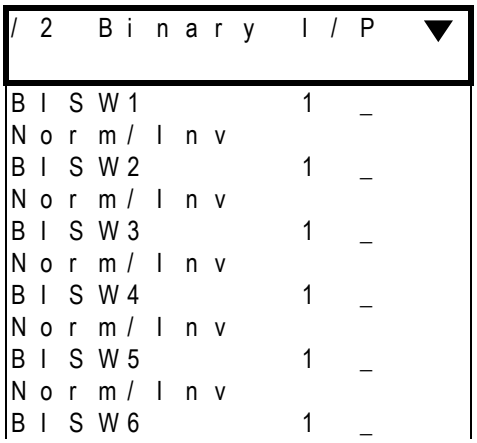


- Enter the group number to be copied in line A and press the [ENTER] key.
- Enter the group number to be overwritten by the copy in line B and press the [ENTER] key.

4.2.6.8 Binary Input

The logic level of binary input signals can be inverted by setting before entering the scheme logic. Inversion is used when the input contact cannot meet the requisite described in Table 3.2.2.

- Select "Binary I/P" on the "Set. (change)" sub-menu to display the "Binary I/P" screen.



```
Norm/Inv
BISW7          1   _
Norm/Inv
BISW8          1   _
Norm/Inv
```

- Enter 0 (= Norm) or 1 (= Inv) and press the [ENTER] key.

4.2.6.9 Binary Output

All the binary outputs of the GRR100 except the tripping command, and relay failure signal are user-configurable. It is possible to assign one signal or up to four ANDing or ORing signals to one output relay. Available signals are listed in Appendix B.

It is also possible to attach Instantaneous or delayed or latched reset timing to these signals.

Appendix D shows the factory default settings.

To configure the binary output signals, do the following:

Selection of output relay

- Select "Binary O/P" on the "Set. (change)" screen to display the "Binary O/P" screen.

```
/2 Binary O/P ▼
• BO1
• BO2
• BO3
• BO4
• BO5
• BO6
• BO7
• BO8
• BO9
• BO10
```

Note: The setting is required for all the binary outputs. If any of the binary outputs are not used, enter 0 to logic gates #1 to #4 in assigning signals.

- Select the output relay number (BO number) and press the [ENTER] key to display the "Set. (BO**)" screen.

```
/3 Set. (BO**) ▼
• Logic/Reset
• Functions
```

Setting the logic gate type and reset type

- Select "Logic/Reset" to display the "Logic/Reset" screen.

```
/4 Logic/Reset ▼

Logic          0   _
OR/AND
Reset          0
Inst/Del/Latch
```

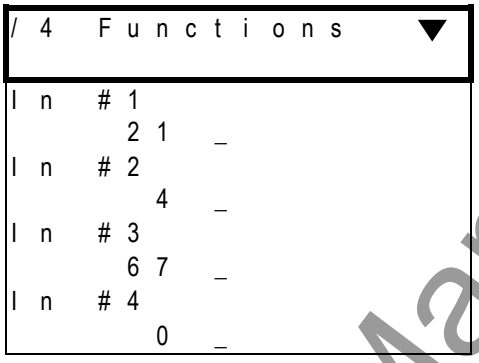
- Enter 0 (= OR) or 1 (= AND) to use an OR gate or AND gate and press the [ENTER] key.

- Enter 0 (= Instantaneous) or 1 (= Delayed) or 2 (=Latched) to select the reset timing and press the [ENTER] key.
- Press the [END] key to return to the "Set. (BO**)" screen.

Note: To release the latch state, push the [RESET] key for more than 3 seconds.

Assigning signals

- Select "Functions" on the "Set. (BO**)" screen to display the "Functions" screen.



- Assign signals to gates (In #1 to #4) by entering the number corresponding to each signal referring to Appendix B. Do not assign the signal numbers 120 to 129 (signal names: "BO1 OP" to "BO10 OP").

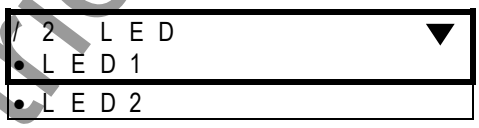
Note: If signals are not assigned to all the gates #1 to #4, enter 0 for the unassigned gate(s).

Repeat this process for the outputs to be configured.

4.2.6.10 LEDs

Two LEDs of the GRR100 are user-configurable. A configurable LED can be programmed to indicate the OR/AND combination of a maximum of 4 elements. One of the signals listed in Appendix B can be assigned to each LED as follows:

- Select "LED" on the "Set. (change)" screen to display the "LED" screen.

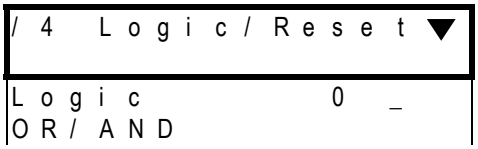


Note: The setting is required for all the LEDs. If any of the LEDs are not used, enter 0 to logic gates #1 to #4 in assigning signals.

- Select the LED number and press the [ENTER] key to display the "LED*" screen.

Setting the logic gate type and reset type

- Select "Logic/Reset" to display the "Logic/Reset" screen.



```
Reset              0
Inst/Latch
```

- Enter 0 (= OR) or 1 (= AND) to use an OR gate or AND gate and press the ENTER key.
- Enter 0 (= Instantaneous) or 1(=Latched) to select the reset timing and press the ENTER key.
- Press the END key to return to the "LED∗" screen.

Note: To release the latch state, push the [RESET] key for more than 3 seconds.

Assigning signals

- Select "Functions" on the "LED∗" screen to display the "Functions" screen.

```
/ 5  Functions          ▼

In  # 1
      2 1  _
In  # 2
      1 1
In  # 3
      2 4
In  # 4
        0
```

- Assign signals to gates (In #1 to #4) by entering the number corresponding to each signal referring to Appendix B.

Note: If signals are not assigned to all the gates #1 to #4, enter 0 for the unassigned gate(s).

- Press the END key to return to the "LED∗" screen.

Repeat this process for all the LEDs to be configured.

4.2.7 Testing

The sub-menu "Test" provides such functions as disabling automatic monitoring, forced operation of binary outputs, measurement of variable timer and logic signal observation.

4.2.7.1 Scheme Switch

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 A.M.F. is useful for blocking the output of unnecessary alarms during testing.

- Select "Test" on the top "MENU" screen to display the "Test" screen.

```
/ 1  Test               ▼
• Switch
• Binary  O/P
• Timer
• Logic  circuit
```

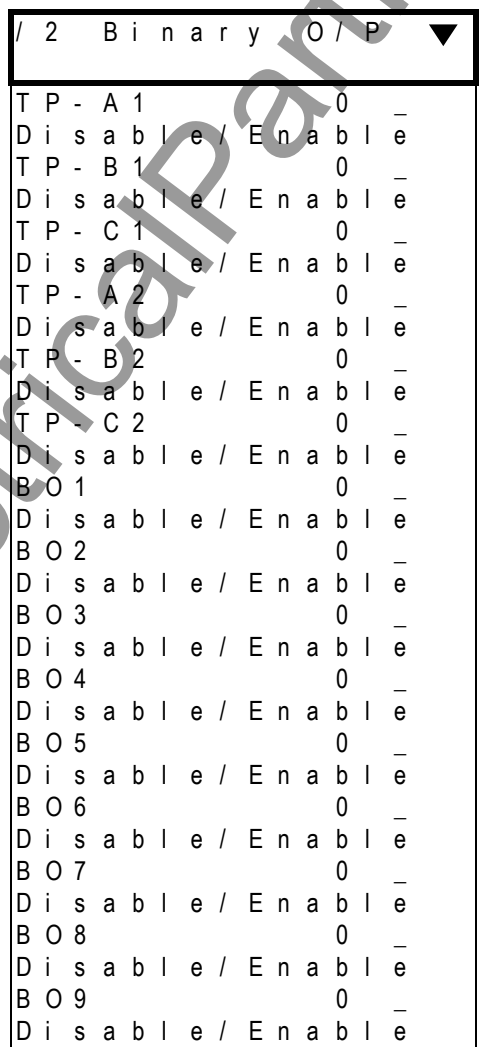
- Select "Switch" to display the "Switch" screen.

- Enter 0 or 1 to disable the A.M.F. or not and press the ENTER key for each switch.
- Enter 1(=On) for IECTST to transmit 'test mode' to the control system by IEC60870-5-103 communication when testing the local relay, and press the ENTER key.
- Press the END key to return to the "Test" screen.

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. Then the LCD displays the name of the output relay.



```
BO10              0  _
Disable/Enable
FAIL              0  _
Disable/Enable
```

- Enter 1 (=Enable) and press the [ENTER] key to operate the output relays forcibly.
- After completing the entries, press the [END] key. Then the LCD displays the screen shown below.

```
Operate?
ENTER=Y  CANCEL=N
```

- Keep pressing the [ENTER] 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 "Binary O/P" screen.

4.2.7.3 Timer

The pick-up time of the variable timer used in the scheme logic can be measured with monitoring jacks A and B. Monitoring jacks A and B are used to observe the input signal and output signal to the timer, respectively.

- Select "Timer" on the "Test" screen to display the "Timer" screen.

```
/ 2  Timer                ▼

Timer
        1  _
```

- Enter the number corresponding to the timer to be observed and press the [ENTER] key. The timers and related numbers are listed in Appendix C.
- Press the [END] key to display the following screen.

```
Operate?
ENTER=Y  CANCEL=N
```

- Press the [ENTER] key to operate the timer. The "TESTING" LED turns on, and the timer is initiated and the following display appears. The input and output signals of the timer can be observed at monitoring jacks A and B respectively. The LEDs above monitoring jacks A or B are also lit if the input or output signal exists.

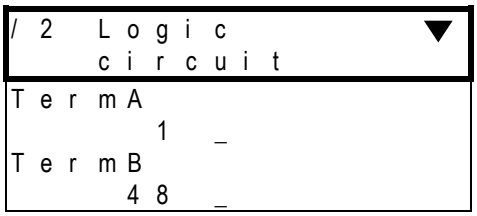
```
Reset?
END=Y       CANCEL=N
```

- Press the [END] key to reset the input signal to the timer. The "TESTING" LED turns off.
- Press the [CANCEL] key to test the other timers. Repeat the above testing.

4.2.7.4 Logic Circuit

It is possible to observe the binary signal level on the signals listed in Appendix B with monitoring jacks A and B.

- Select "Logic circuit" on the "Test" screen to display the "Logic circuit" screen.



- Enter a signal number to be observed at monitoring jack A and press the ENTER key.
- Enter the other signal number 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.

4.3 Personal Computer Interface

The relay can be operated from a personal computer using an RS232C port on the front panel. On the personal computer, the following analysis and display of the fault voltages are available in addition to the items available on the LCD screen.

- Display of voltage waveform: Oscillograph, vector display
- Harmonic analysis: On arbitrary time span
- Frequency analysis: On arbitrary time span

For the details, see the separate instruction manual "PC INTERFACE RSM100".

4.4 Relay Setting and Monitoring System

The Relay Setting and Monitoring (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 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.

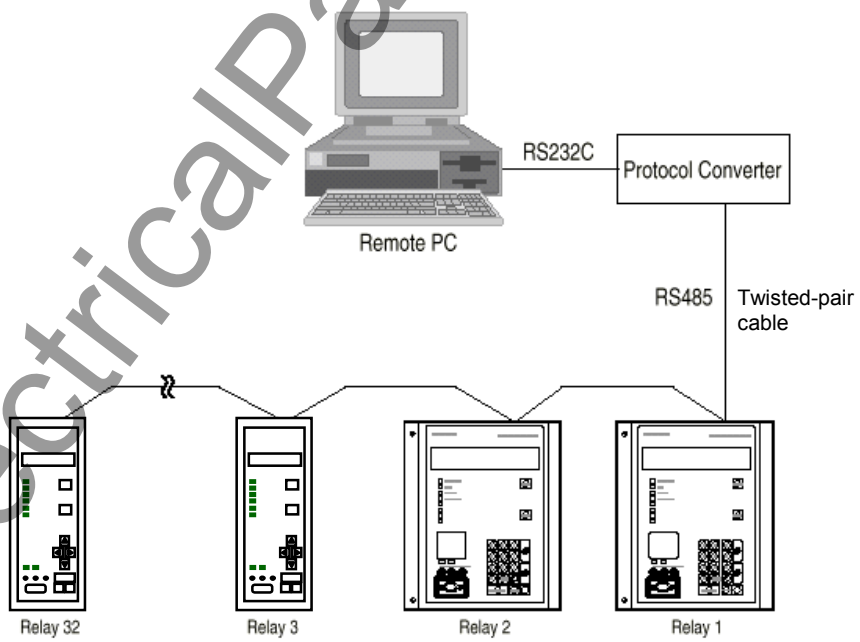


Figure 4.4.1 Relay Setting and Monitoring System

4.5 IEC 60870-5-103 Interface

The GRR100 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, status data and general command from the relay to the control system.

- Measurand data: voltage, frequency
- 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. For the default setting of IEC60870-5-103, see Appendix M.

The protocol can be used through the RS485 port on the relay rear panel and can be also used through the optional fibre optical interface.

The relay supports two baud-rates 9.6kbps and 19.2kbps.

The data transfer from the relay can be blocked by the setting.

For the settings, see the Section 4.2.6.4.

4.6 Clock Function

The clock function (Calendar clock) is used for time-tagging for the following purposes:

- Event records
- Disturbance records
- Fault records

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.

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.

Check that the following accessories are attached.

- 3 pins for the monitoring jack, packed in a plastic bag.

Always store the relays in a clean, dry environment.

5.2 Relay Mounting

A flush mounting relay is delivered. Appendix F shows the case outlines.

For details of relay withdrawal and insertion, see Section 6.7.3.

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, which 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 relay unit unnecessarily.

The relay unit incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw the relay unit, the precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

⚠CAUTION

- Before removing the relay unit, ensure that you are at the same electrostatic potential as the equipment by touching the case.
- Use the handle to draw out the relay unit. Avoid touching the electronic components, printed circuit board or connectors.
- Do not pass the relay unit to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.

- Place the relay unit on an anti-static surface, or on a conducting surface which is at the same potential as yourself.
- Do not place the relay unit 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 aforementioned IEC 60747.

5.5 External Connections

External connections for each relay model are shown in Appendix G.

6. Commissioning and Maintenance

6.1 Outline of Commissioning Tests

The GRR100 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 functions 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 tripping and reclosing circuits are tested after the relay is connected with the primary equipment and other external equipment.

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 VT circuit is not short-circuited.
- If dc power has not been supplied to the relay for two days or more, then it is recommended that all fault records, event records and disturbance records be cleared soon after restoring the power. This is because the back-up RAM may have discharged and may contain uncertain data.
- Be careful that the relay is not damaged due to an 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.

6.3 Preparations

Test equipment

The following test equipment is required for the commissioning tests.

2 Single-phase voltage source
1 DC power supply
1 DC voltmeter
2 AC voltmeter
1 Phase angle meter
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 D	Binary Output Default Setting List
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 voltage 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".

6.4 Hardware Tests

The tests can be performed without external wiring, but a DC power supply and AC voltage source is required.

6.4.1 User Interfaces

This test ensures that the LCD, LEDs and keys function correctly.

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 "Err: " screen when the DC voltage is applied.

- Press the [RESET] key for 1 second and check that black dots appear on the whole screen.

LED display

- Apply the rated DC voltage and check that the "IN SERVICE" LED is lit in green.
- Press the [RESET] key for 1 second and check that the remaining five LEDs are lit in red.

VIEW and RESET key

- Press the [VIEW] key when the LCD is off and check that the "Metering" screen is displayed on the LCD.
- Press the [RESET] key and check that the LCD turns off.

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.

6.4.2 Binary Input Circuit

The testing circuit is shown in Figure 6.4.1.

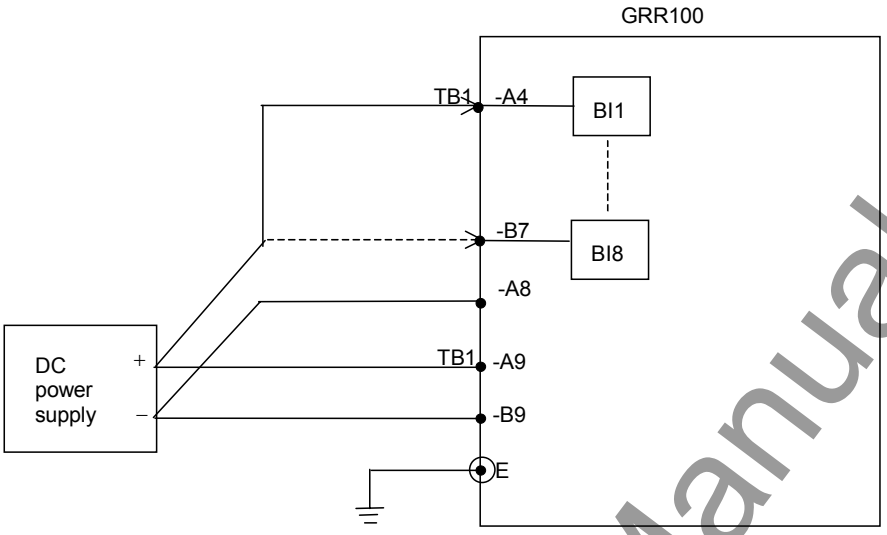


Figure 6.4.1 Testing Binary Input Circuit

- Display the "Binary I/O" screen from the "Status" sub-menu.

```
/ 2  B i n a r y  I / O  ▼
I P  [ 0 0 0   0 0 0   0 0 ]
O P 1 [ 0 0 0   0 0 0       ]
O P 2 [ 0 0 0   0 0 0   0 0 ]
O P 3 [ 0 0 0               ]
```

- Apply rated DC voltage to terminal A4, B4, ..., B7 of terminal block TB1.

  Check that the status display corresponding to the input signal changes from 0 to 1. (For 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 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.

- Select "Binary O/P" on the "Test" screen to display the "Binary O/P" screen. The LCD will display the name of the output relay.

```
/ 2  B i n a r y  O / P  ▼

T P - A 1              0  _
D i s a b l e / E n a b l e
T P - B 1              0  _
D i s a b l e / E n a b l e
T P - C 1              0  _
```

- Enter 1 (=Enable) and press the [ENTER] key.
- After completing the entries, press the [END] key. The LCD will display the screen shown below. If 1 is entered for all the output relays, the forcible operation can be performed collectively.

```
Operate?
ENTER=Y  CANCEL=N
```

- Keep pressing the [ENTER] key to operate the output relays forcibly.
- Check that the output contacts operate at the terminal.
- Stop pressing the [ENTER] key to reset the operation.

6.4.4 AC Input Circuits

This test can be performed by applying the checking voltages 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 single-phase voltage source is required.

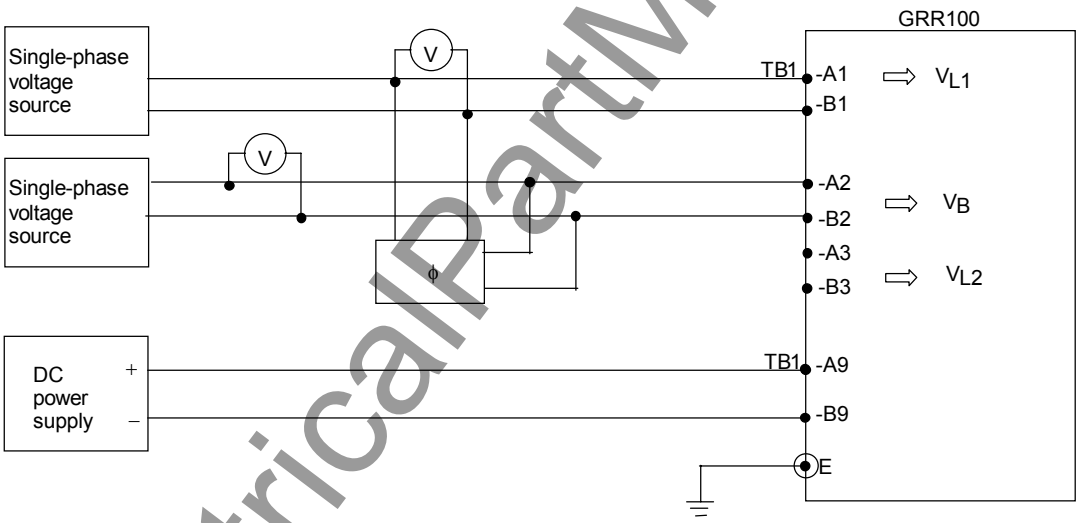


Figure 6.4.2 Testing AC Input Circuit

- Check the metering data on the "Metering" screen.

  "Set. (view)" sub-menu → "Status" screen → "Metering" screen

  If the setting is 0 (= Primary), change the setting to 1 (= Secondary) in the "Set. (change)" sub-menu.

  "Set. (change)" sub-menu → "Status" screen → "Metering" screen

  Remember to reset it to the initial setting after the test is finished.
- Open the "Metering" screen in the "Status" sub-menu.

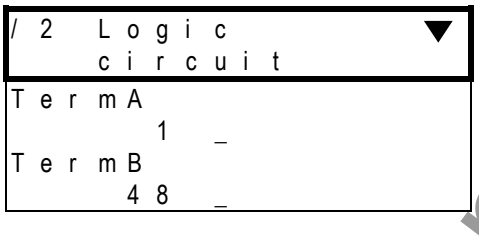
  "Status" sub-menu → "Metering" screen
- Apply AC voltages and check that the displayed values are within ±5% of the input values.

6.5 Function Test

6.5.1 Measuring Element

Measuring 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.



When a signal number is entered for the Term A line, the signal is observed at monitoring jack A and when entered for the Term B line, it is observed at monitoring jack B.

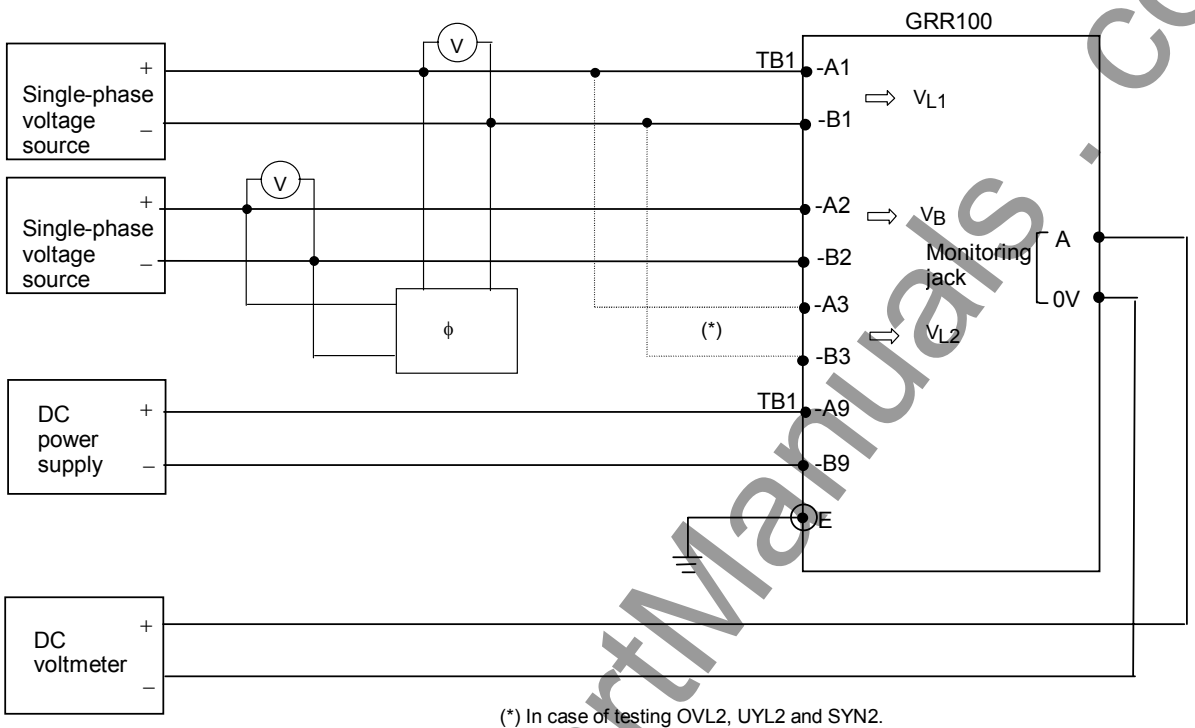
Note: The voltage level at the monitoring jacks is +5V for logic level "1" and less than 0.1V for logic level "0".

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.
- Do not leave the A or B terminal shorted to 0V terminal for a long time.

6.5.1.1 Voltage and Synchronism Check Elements

The testing circuit is shown in Figure 6.5.1.



(*) In case of testing OVL2, UYL2 and SYN2.

Figure 6.5.1 Operating Voltage Value Test Circuit

When testing OVL2, UVL2 and SYN2 of Model 201, the single-phase voltage must be applied to terminal A3 and B3.

Voltage and synchronism check elements and their output signal number are listed below. OVL2, UVL2 and SYN2 are used for two-breaker autoreclose and provided in Model 201.

Measuring element	Signal number
OVB	11
UVB	12
OVL1	14
UVL1	15
OVL2	16
UVL2	17
SYN1	13
SYN2	18

Voltage check element OVB, UVB, OVL1, UVL1, OVL2, and UVL2

- Select "Logic circuit" on the "Test" sub-menu screen to display the "Logic circuit" screen.
- Enter a signal number for the Term A line to observe at monitoring jack A and press the ENTER key.
- Apply a rated voltage as shown in Figure 6.5.1.

OVB and UVB :

- Addjust the magnitude of the voltage applied to terminal A2 and B2 and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

OVL1 and UVL1 :

- Adjust the magnitude of the voltage applied to terminal A1 and B1 and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

OVL2 and UVL2 :

- Adjust the magnitude of the voltage applied to terminal A3 and B3 and measure the value at which the element operates. Check that the measured value is within ± 5% of the setting.

Synchronism check element SYN1

- Select "Logic circuit" on the "Test" sub-menu screen to display the "Logic circuit" screen.
- Enter a signal number 13 for the TermA line to observe at monitoring jack A and press the [ENTER] key.
- Apply rated voltages VB and VL1 as shown Figure 6.5.1.

Voltage check:

- Set the voltage to any value over the SY1OV setting. (The default setting of SY1OV is 51 V.)

  Whilst keeping V_{L1} in-phase with V_B, increase the single-phase voltage V_{L1} from zero volt. Measure the voltage at which the element operates. Check that the measured voltage is within ± 5% of the SY1UV setting.
- Further increase V_{L1} and measure the voltage at that the element resets. Check that the measured voltage is within ±5% of the SY1OV setting.

Phase angle check:

- Set V_B and V_{L1} to any value between the SY1OV and SY1UV settings keeping V_B in-phase with V_{L1}. Then the SYN1 element operates.
- Shift the angle of V_{L1} from that of V_B, and measure the angle at which the element resets.
- Check that the measured angle is within ±5% of the SY1 θ setting. (The default setting of SY1 θ is 30°.)
- Change V_B and V_{L1}, and repeat the above.

Synchronism check element SYN2

- Apply a rated voltage VL2 instead of VB as shown with broken lines in Figure 6.5.1. Substituting VL2 for VB, the test can take the same step as testing SYN1.

6.5.2 Timer

The pick-up delay time of the variable timer can be measured by connecting the monitoring jacks A and B to a time counter as shown in Figure 6.5.2. Jacks A and B are used to observe the input signal and output signal of the timer, respectively.

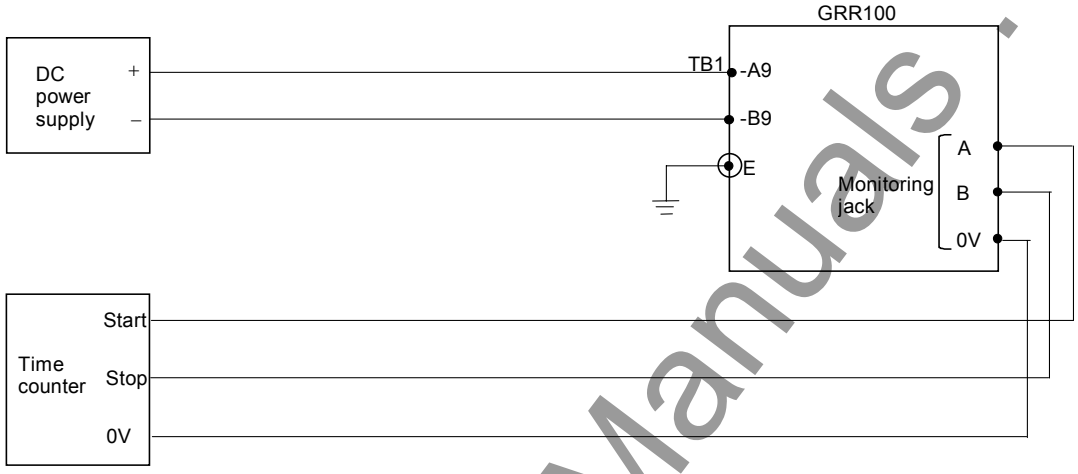
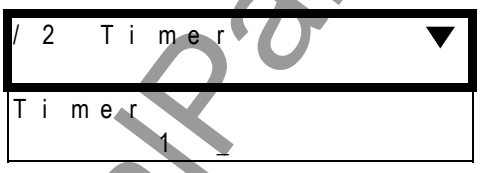
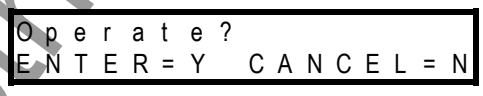


Figure 6.5.2 Testing Variable Timer

- Select the "Timer" on the "Test" screen to display the "Timer" screen.



- Enter the number corresponding to the timer to be observed and press the [ENTER] key. The timers and assigned numbers are listed in Appendix C.
- Press the [END] key to display the following screen.



- Press the [ENTER] key to operate the time. The "TESTIMG" LED turns on, and the timer is initiated and the following display appears. Check that the measured time is within ±10ms of the setting time.
- Press the [END] key to reset the input signal to the timer. The "TESTIMG" LED turns off.
- Press the [CANCEL] key to test the other timers. Repeat the above testing.

6.5.3 Autoreclosing Scheme

The autoreclosing scheme test requires the dynamic test of the protection equipment combining the GRR100 with a line protection relay. In this test, a dynamic test set is required to simulate power system pre-fault, fault and post-fault conditions.

Reclosing is observed with the user configurable reclosing command output relays assigned to signals ARC1 and ARC2. For the default setting, see Appendix D.

Tripping is observed with the tripping command output relays TP-A1 to -C2.

6.5.4 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 "F. records" screen and check that the descriptions are correct for the applied fault.

Recording events are listed in Table 3.4.1. The top 3 events and 8th to 12th events are external events and others are internal events. Event recording on the external event can be checked by changing the status of binary input 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 "E. records" screen is correct.

Note: The choice of whether to record or not can be set for each event. Change the status of the binary input signal after confirming that the related event is set to record. (The default setting enables all the events to be recorded.)

Some of the internal events can be checked in the autoreclosing scheme tests.

Disturbance recording can be checked while testing the autoreclosing schemes. The LCD display only shows the date and time when a disturbance is recorded. Open the "D. records" 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.

6.6 Conjunctive Tests

6.6.1 Tripping Circuit and Reclosing Circuit Test

The tripping and reclosing circuits including the circuit breaker is checked by forcibly operating the output relay and monitoring the circuit breaker to confirm that it is tripped or reclosed. 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.

TP-A1 to TP-C2 are output relays with one normally open contact.

- Enter 1 for TP-A1 and press the [ENTER] key.
- Press the [END] key. Then the LCD displays the screen shown below.

```
Operate?
ENTER=Y  CANCEL=N
```

- Keep pressing the [ENTER] key to operate the output relay TP-A1 and check that the A-phase breaker is tripped.
- Stop pressing the [ENTER] key to reset the operation.
- Repeat the above for TP-B1 to TP-C2.

Reclosing circuit

- Set the breaker to be open.
- Select "Binary O/P" on the "Test" sub-menu screen to display the "Binary O/P" screen.

In Model 101, BO3 is set to the reclosing output relay. In Model 201, BO1 and BO2 are set to the reclosing output relays for busbar breaker and centre breaker, respectively.

6.7 Maintenance

6.7.1 Regular Testing

The relay is almost completely self-supervised. The circuits that cannot be supervised are binary input and output circuits and human interfaces.

Therefore, regular testing is minimized 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 event record.

Failures detected by supervision are traced by checking the "Err: " screen on the LCD. Table 6.7.1 shows LCD messages and failure locations. The location includes peripheral circuits.

Table 6.7.1 LCD Message and Failure Location

Message	Failure location
Err: Sum	Flash memory
Err: MEM	ROM or RAM
Err: RAM	RAM
Err: BRAM	Backup RAM
Err: ROM	EEPROM
Err: A/D	A/D converter
Err: SP	Sampling signal circuit
Err: DI	Binary input circuit
Err: DO	Binary output drive circuit
Err: LCD	LCD circuit
Err: CH	Analogue input channel circuit

If no message is shown on the LCD, it means that the failure location is either in the DC power supply circuit or in the microprocessors. If the "ALARM" LED is off, the failure is in the DC power supply circuit. If the LED is lit, the failure is in the microprocessors. Replace the relay unit in both cases after checking if the correct DC voltage is applied to the relay.

If a failure is detected by automatic supervision or regular testing, replace the failed relay unit.

Note: When a failure or an abnormality is detected during the regular test, confirm the following first:

- Test circuit connections are correct.
- Relay unit is securely inserted in position.
- Correct DC power voltage with correct polarity is applied and connected to the correct terminals.
- Correct AC inputs are applied and connected to the correct terminals.
- Test procedures comply with those stated in the manual.

6.7.3 Replacing a 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 No. and relay version (software type form) as the removed relay.

The Model No. is indicated on the front of the relay. For the relay version, see Section 4.2.5.1.

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 approximately 30 seconds for the voltage to discharge.

- Disconnect the trip outputs.
- Disconnect all AC voltage inputs.
- Unscrew the relay front cover.
- Unscrew the binding screw on the handle.
- To remove the relay unit from its case, pull up the handle and pull the handle towards you. (See Figure 6.7.1.)
- Insert the (spare) relay unit in the reverse procedure.

CAUTION To avoid risk of damage:

- Keep the handle up when inserting the relay unit into the case.
- Do not catch the handle when carrying the relay unit.

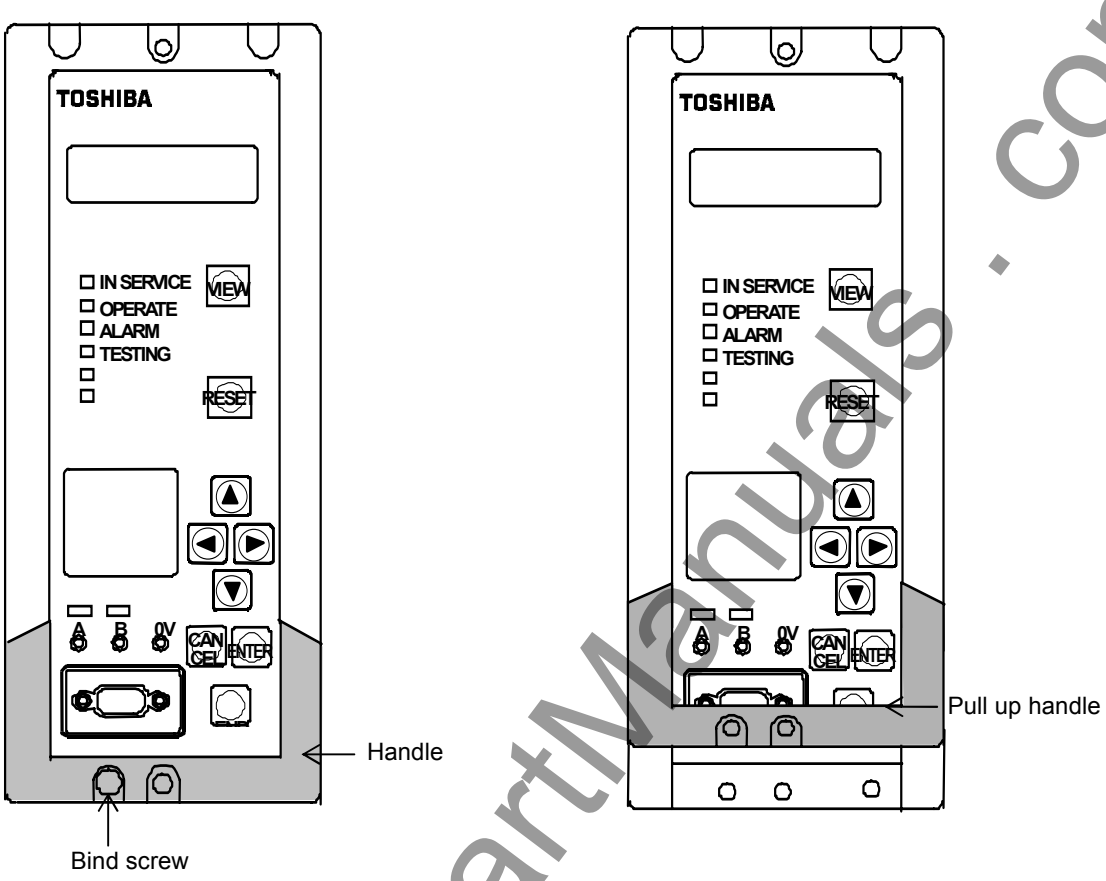


Figure 6.7.1 Handle of Relay Unit

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 service.

- Switch on the DC power supply and confirm that the "IN SERVICE" green LED is lit and the "ALARM" red LED is not lit.
- Supply the AC inputs and reconnect the trip outputs.

6.7.5 Storage

The spare relay should be stored in a dry and clean room. Based on IEC Standard 60255-0 the storage temperature should be –25°C to +70°C, but a temperature of 0°C to +40°C is recommended for long-term storage.

7. Putting the 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 external connections are correct.
- Check the settings of all measuring elements, timers, scheme switches, recordings and clock are correct.

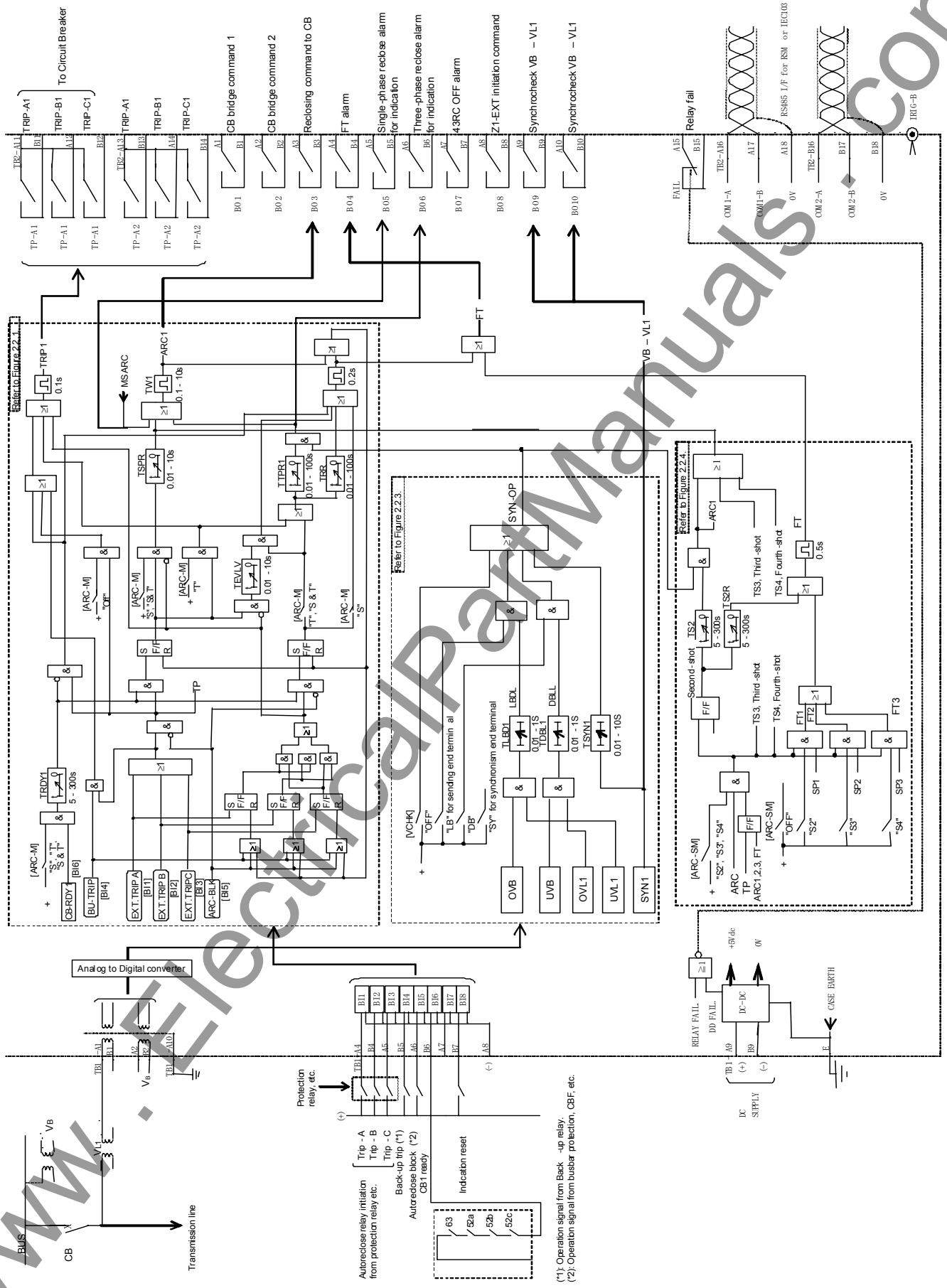
  In particular, when settings are changed temporarily for testing, be sure to restore them.
- Clear any unnecessary records on faults, events and disturbances which are recorded during the tests.

  CAUTION:

  If dc power has not been supplied to the relay for two days or more, then it is recommended that all fault records, event records and disturbance records be cleared soon after restoring the power. This is because the back-up RAM may have discharged and may contain uncertain data.
- Reset the counter figures of autoreclose, if necessary. For resetting the count, see Section 4.2.3.4.
- Press the [VIEW] key and check that no failure message is displayed on the "Auto-supervision" screen.
- Check that the green "IN SERVICE" LED is lit and no other LEDs are lit on the front panel.

Appendix A

Block Diagram



Block Diagram for Model 101

Appendix B

Signal List

No.	SIGNAL NAME	CONTENTS	No.	SIGNAL NAME	CONTENTS	No.	SIGNAL NAME	CONTENTS
0	Zero Level	"0" (Zero logic)						
1	EXT-TRIPA	BI (EXT. TRIP COMMAND A ph.)	71	TPAR2	FLW TPAR O/P	141	LOCAL OP ACT.	LOCAL OPERATION ACTIVE
2	EXT-TRIPB	BI (EXT. TRIP COMMAND B ph.)	72	ARC1	REC OUTPUT FOR BUS CB	142	REMOTE OP ACT.	REMOTE OPERATION ACTIVE
3	EXT-TRIPC	BI (EXT. TRIP COMMAND C ph.)	73	ARC2	REC OUTPUT FOR CENTER CB	143	NORMAL LED ON	IN SERVICE LED ON
4	BU-TRIP	BI (BACKUP TRIP COMMAND)	74	94TT1	LEAD REMAINING PHASE TRIP	144	ALARM LED ON	ALARM LED ON
5	REC-BLK	BI (RECLOSE BLOCK COMMAND)	75	94TT2	FLW REMAINING PHASE TRIP	145	TRIP LED ON	TRIP LED ON
6	CB-RDY1	BI (CB1 READY CONDITION)	76	86YR1	LEAD FINAL TRIP SIGNAL	146	TEST LED ON	TEST LED ON
7	52AND	BI (CB1 AUX. CONTACT)	77	86YR2	FLW FINAL TRIP SIGNAL	147		
8	CB-RDY2	BI (CB2 READY CONDITION)	78	TEVLV	EVOLVING FAULT WAITING TIME	148		
9	IND. RESET	BI (INDICATION RESET)	79	RESET1	LEAD ARC RESET BY CB CLOSED	149	LED RESET	TRIP LED RESET
10			80	RESET2	FLW ARC RESET BY CB CLOSED	150		
11	OVB	OV RELAY (BUS VT)	81	TRIP-H	TRIP SIGNAL HOLD	151		
12	UVB	UV RELAY (BUS VT)	82	FAULT RECORD INIT	TRIG OF FAULT RECORD	152		
13	SYN1	SYNCHRO.CHECK RELAY(VB-VL1)	83	IND. DAT TRIG	ditto	153	ARC COM ON	ARC COMMAND ON
14	OVL1	OV RELAY (LINE1 VT)	84	FT1T	FAULT RECORD DATA	154		
15	UVL1	UV RELAY (LINE1 VT)	85	FT2T	ditto	155		
16	OVL2	OV RELAY (LINE2 VT)	86	A. MF OFF	SV BLOCK	156	PRG. LED1 ON	PROGRAMMABLE LED1 ON
17	UVL2	UV RELAY (LINE2 VT)	87	TRIP-AT	FAULT RECORD DATA	157	PRG. LED2 ON	PROGRAMMABLE LED2 ON
18	SYN2	SYNCHRO.CHECK RELAY(VB-VL2)	88	TRIP-BT	ditto	158		
19			89	TRIP-CT	ditto	159		
20			90			160		
21	TRIP1	TRIP O/P FOR CB1	91	TP-2PH	MULTI PHASE TRIP COMMAND	161		
22	TRIP2	TRIP O/P FOR CB2	92	TDBD1	LEAD DEAD BUS & DEAD LINE	162	GEN PICK-UP	GENERAL START/PICK-UP
23	Z1-EXT. INIT	Z1-EXT INITIATION	93	TDBD2	FLW DEAD BUS & DEAD LINE	163		
24	TRDY1	LEAD REC READY TIMER	94			164	DI ERR	DI CONTACT ERROR
25	TSPR1	LEAD SPAR DEAD LINE TIMER	95	ARC OR	ARC1 OR ARC2	165		
26	TTPR1	LEAD TPAR DEAD LINE TIMER	96			166	FAULT RECORD DONE	FAULT RECORD DONE
27	ARC.L	LEAD RECLOSE O/P PULSE	97			167		
28	TPARL-SET	LEAD TPAR O/P CONFIRMED	98			168		
29	TRR1	LEAD RESET TIMER	99			169		
30	TRDY2	FLW REC READY TIMER	100			170		
31	TSPR2	FLW SPAR DEAD LINE TIMER	101	RELAY FAIL	RELAY FAIL	171		
32	TTPR2	FLW TPAR DEAD LINE TIMER	102	RELAY BLOCK	RELAY BLOCK	172		
33	ARC.F	FLW RECLOSE O/P PULSE	103	TESTING	TEST SWITCH ACTIVATED	173		
34	TPAR.F	FLW TPAR O/P CONFIRMED	104			174		
35	TRR2	FLW RESET TIMER	105			175		
36	TS2	MULTI.SHOT-2 DEAD TIMER	106			176		
37	TS3	MULTI.SHOT-3 DEAD TIMER	107			177		
38	TS4	MULTI.SHOT-4 DEAD TIMER	108			178		
39	TS2R	MULTI.SHOT-2 RESET TIMER	109			179		
40	TS3R	MULTI.SHOT-3 RESET TIMER	110			180		
41	TS4R	MULTI.SHOT-4 RESET TIMER	111			181		
42	MULTI.ARC	MULTI. SHOT REC. OUTPUT	112			182		
43	MAR-0K0	1 SHOT REC. SUCCESS	113			183		
44	MAR"0K1	2 SHOT REC. SUCCESS	114			184		
45	MAR-0K2	3 SHOT REC. SUCCESS	115			185	ARC COM RECV	ARC COMMAND RECEIVE
46	MAR-0K3	4 SHOT REC. SUCCESS	116			186		
47	MAR-FT	MULTI. REC. FINAL TRIP	117			187		
48	LB.DL-1	LEAD LIVE BUS & DEAD LINE	118			188	TPLED RST RCV	TRIP LED RESET RECEIVE
49	LB.LL-1	LEAD DEAD BUS & LIVE LINE	119			189		
50	LB.LL.SYN-1	LEAD LIVE BUS & LIVE LINE +SYN.	120	BO1 OP	BINARY OUTPUT 1	190		
51	LB.DL-2	FLW LIVE BUS & DEAD LINE	121	BO2 OP	BINARY OUTPUT 2	191	PRGLED/DO RST RCV	PROGRAMMABLE LED/DO RESET
52	LB.LL-2	FLW DEAD BUS & LIVE LINE	122	BO3 OP	BINARY OUTPUT 3	192		
53	LB.LL.SYN-2	FLW LIVE BUS & LIVE LINE +SYN.	123	BO4 OP	BINARY OUTPUT 4	193	SET. GROUP1	ACTIVE GRP CHANGED COMMAND
54	SYN-OP	SYN. CONDITION FOR TPAR	124	BO5 OP	BINARY OUTPUT 5	194	SET. GROUP2	ditto
55	SYN-SEL	SYN. ELEMENT SERLECT SIGNAL	125	BO6 OP	BINARY OUTPUT 6	195	SET. GROUP3	ditto
56	TDBL1	VOLTAGE CHECK TIMER	126	BO7 OP	BINARY OUTPUT 7	196	SET. GROUP4	ditto
57	TLBD1	ditto	127	BO8 OP	BINARY OUTPUT 8	197		
58	TSYN1	LEAD SYN CHECK TIMER	128	BO9 OP	BINARY OUTPUT 9	199		
59	TDBL2	VOLTAGE CHECK TIMER	129	BO10 OP	BINARY OUTPUT 10	200		
60	TLBD2	Ditto	130					
61	TSYN2	FLW SYN CHECK TIMER	131	IECBLK	MONITORING DIRECTION BLOCK			
62	REC.READY1	LEAD REC. READY SIGNAL	132	IECTST	IEC103 TEST			
63	REC.READY2	FLW REC. READY SIGNAL	133	GROUP1 ACTIVE	GROUP1 ACTIVE			
64	BRIDGE1	LEAD BRIDGE CONDITION	134	GROUP2 ACTIVE	GROUP2 ACTIVE			
65	BRIDGE2	FLW BRIDGE CONDITION	135	GROUP3 ACTIVE	GROUP3 ACTIVE			
66	IN-PROG1	LEAD REC. IN PROGRESS	136	GROUP4 ACTIVE	GROUP4 ACTIVE			
67	IN-PROG2	FLW REC. IN PROGRESS	137					
68	SPAR1	LEAD SPAR O/P	138					
69	SPAR2	FLW SPAR O/P	139					
70	TPAR1	LEAD TPAR O/P	140					

Appendix C

Variable Timer List

Variable Timer List

Timer	Timer No.	Contents
TEVLV	1	EVOLVING FAULT WAITING TIMER
TRDY1	2	LEAD RECLAIM TIMER
TSPR1	3	LEAD SPAR DEAD LINE TIMER
TTPR1	4	LEAD TPAR DEAD LINE TIMER
TW1	5	RECLOSING O/P FOR BUS CB
TRR1	6	LEAD RESET TIMER
TRDY2	7	FLW RECLAIM TIMER
TSPR2	8	FLW SPAR DEAD LINE TIMER
TTPR2	9	FLW TPAR DEAD LINE TIMER
TW2	10	RECLOSING O/P FOR CENTRE CB
TRR2	11	FLW RESET TIMER
TS2	12	MULTI. SHOT DEAD TIMER
TS3	13	ditto
TS4	14	ditto
TS2R	15	MULTI. SHOT RESET TIMER
TS3R	16	ditto
TS4R	17	ditto
TLBD1	18	VOLTAGE CHECK TIMER
TDBL1	19	VOLTAGE CHECK TIMER
TSYN1	20	LEAD SYN CHECK TIMER
TLBD2	21	VOLTAGE CHECK TIMER
TDBL2	22	VOLTAGE CHECK TIMER
TSYN2	23	FLW SYN CHECK TIMER
TDBD1	24	VOLTAGE CHECK TIMER
TDBD2	25	VOLTAGE CHECK TIMER

Appendix D

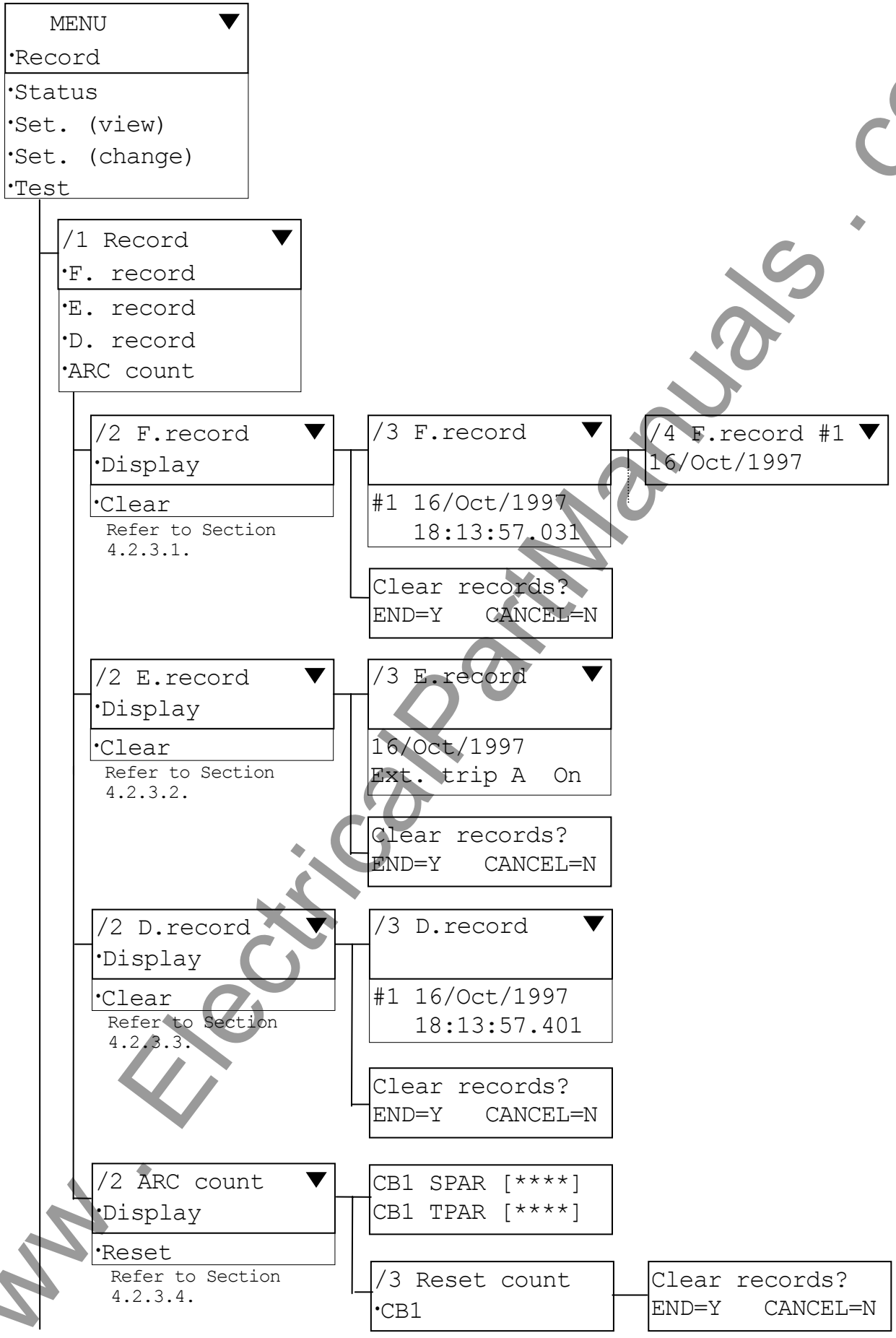
Binary Output Default Setting List

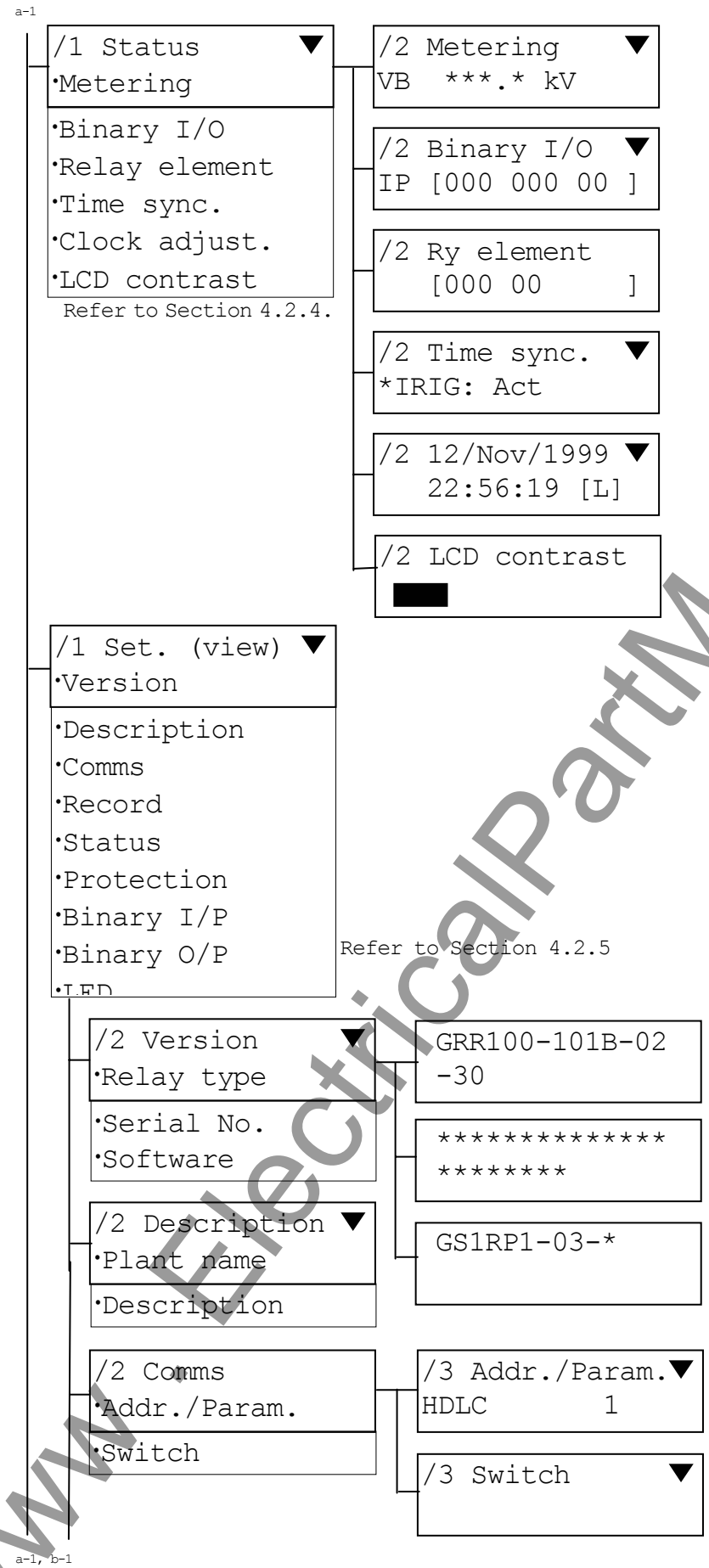
Binary Output Default Setting List

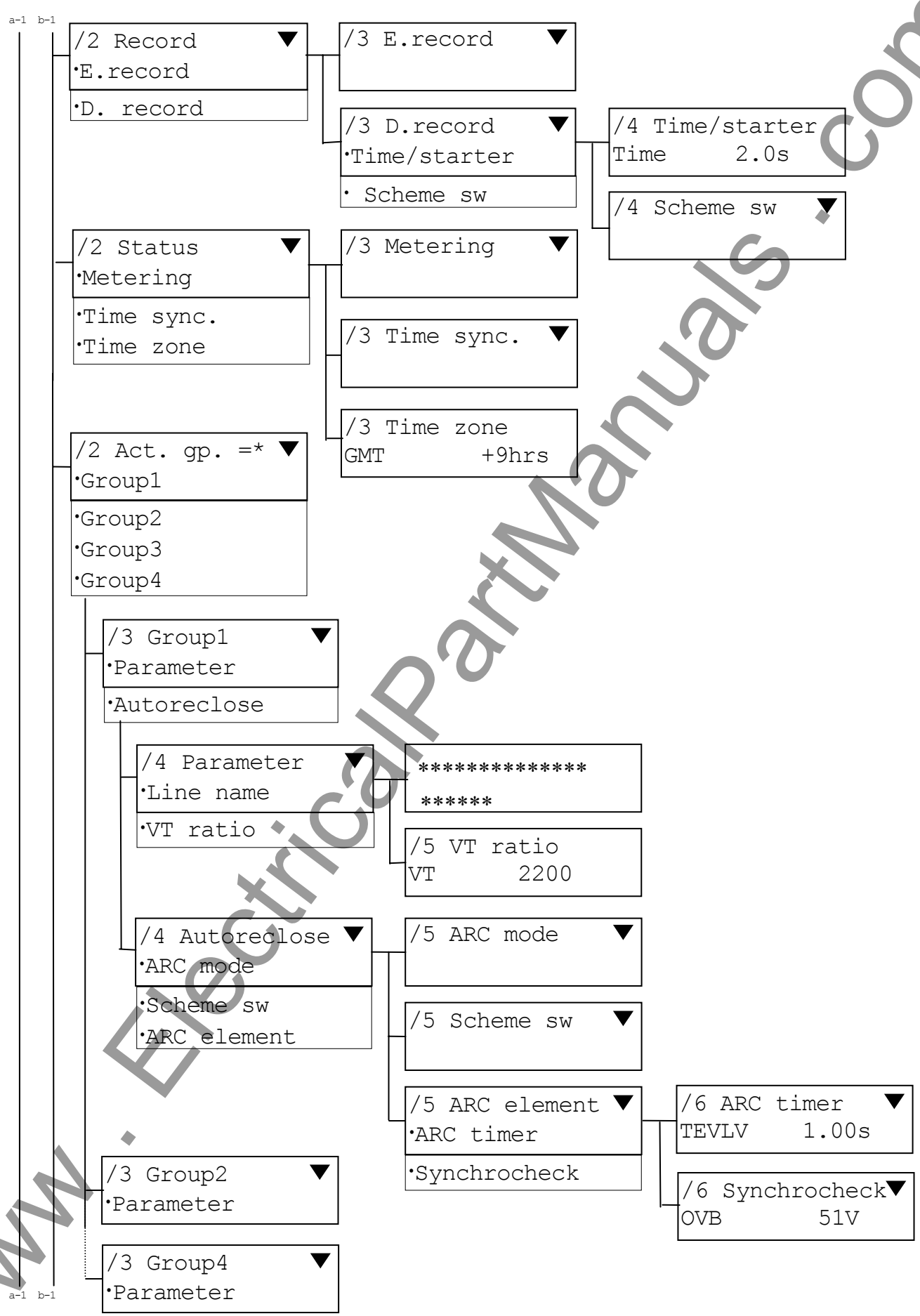
Model	BO No.	Signal Name	Contents	Setting					
				Signal No.(See Appendix B)				LOGIC (OR:0, AND:1)	Reset (Inst:0, Del:1, Latch:2)
				In #1	In #2	In #3	In #4		
101									
	BO1	BRIDGE1	CB bridge command 1	64	0	0	0	0	1
	BO2	BRIDGE1	CB bridge command 1	64	0	0	0	0	1
	BO3	ARC1	Reclosing command	72	0	0	0	0	0
	BO4	86YR1	FT alarm	76	0	0	0	0	1
	BO5	SPAR1	SPAR alarm	68	0	0	0	0	1
	BO6	TPAR1	TPAR alarm	70	0	0	0	0	1
	BO7	REC-BLK	43RC off alarm	5	0	0	0	0	1
	BO8	Z1-EXT.INT	Z1-EXT initiation command	23	0	0	0	0	1
	BO9	SYN1	SYNCHROCHECK VB-VL1	13	0	0	0	0	1
	BO10	SYN1	ditto	13	0	0	0	0	1
201									
	BO1	ARC1	CB1 REC command	72	0	0	0	0	0
	BO2	ARC2	CB2 REC command	73	0	0	0	0	0
	BO3	BRIDGE1	CB bridge command 1	64	0	0	0	0	1
	BO4	BRIDGE2	CB bridge command 2	65	0	0	0	0	1
	BO5	86YR1	CB1 FT alarm	76	0	0	0	0	1
	BO6	86YR2	CB2 FT alarm	77	0	0	0	0	1
	BO7	REC-BLK	43RC off alarm	5	0	0	0	0	1
	BO8	Z1-EXT.INT	Z1-EXT initiation command	23	0	0	0	0	1
	BO9	SYN1	SYNCHROCHECK VB-VL1	13	0	0	0	0	1
	BO10	SYN2	SYNCHROCHECK VB-VL2	18	0	0	0	0	1

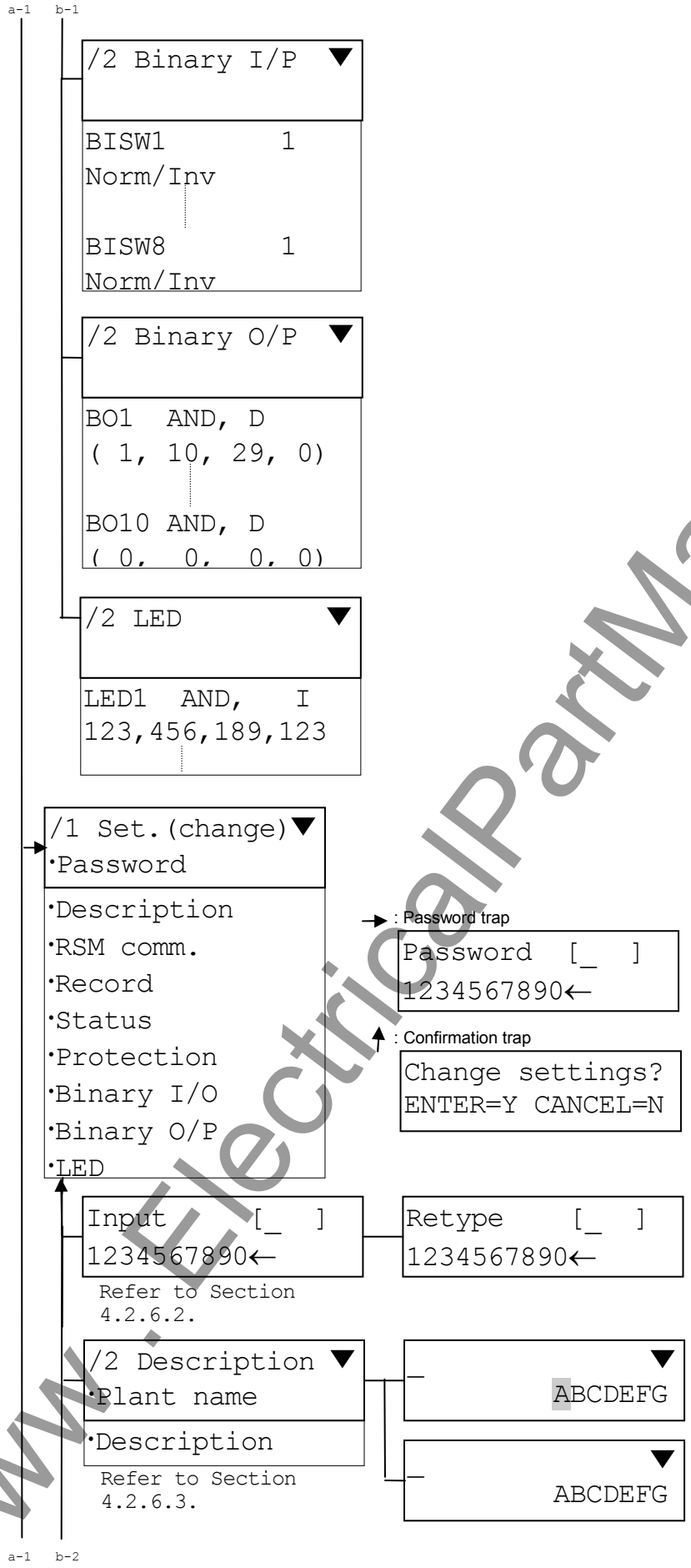
Appendix E

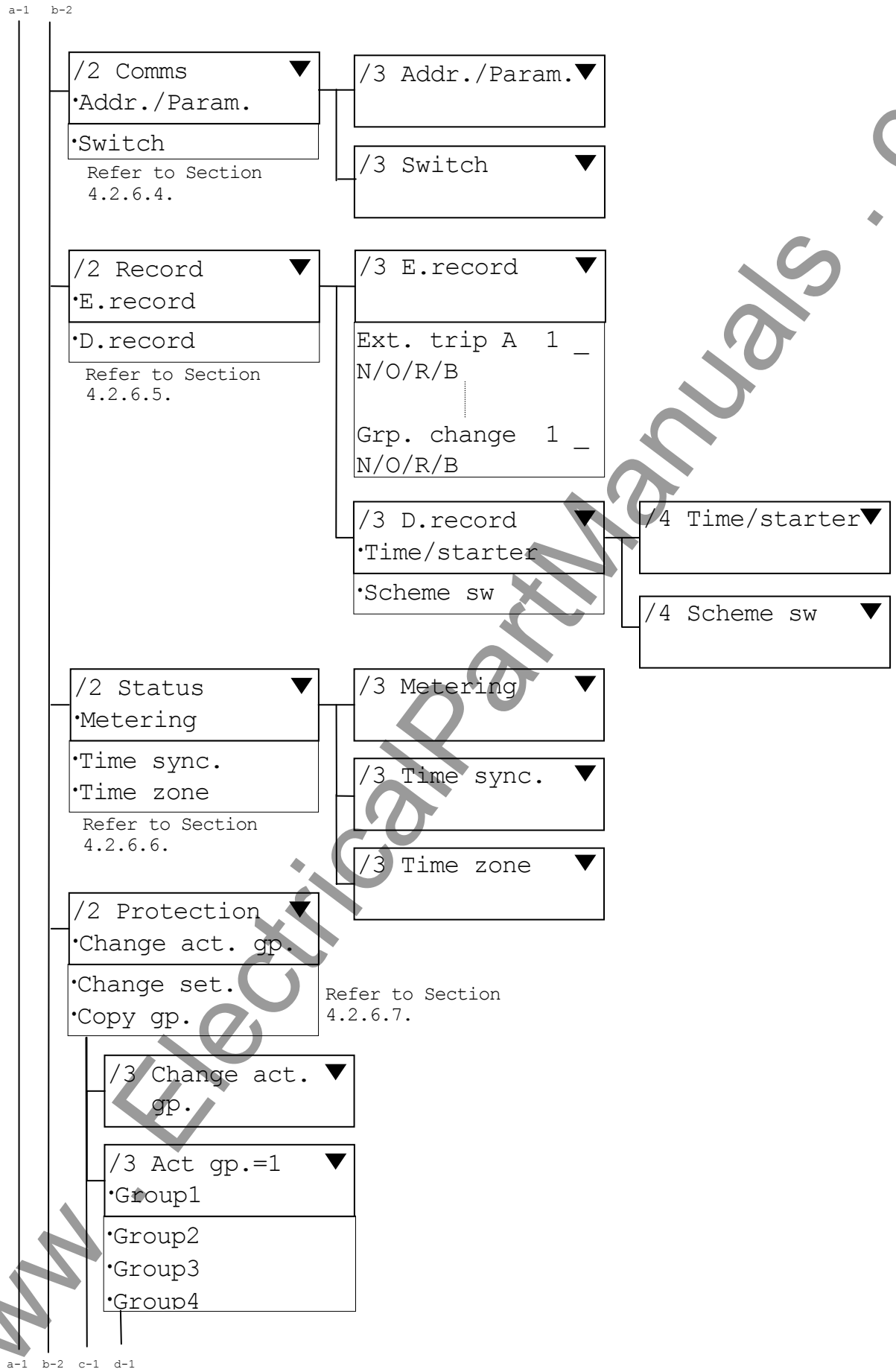
Details of Relay Menu and LCD & Button Operation

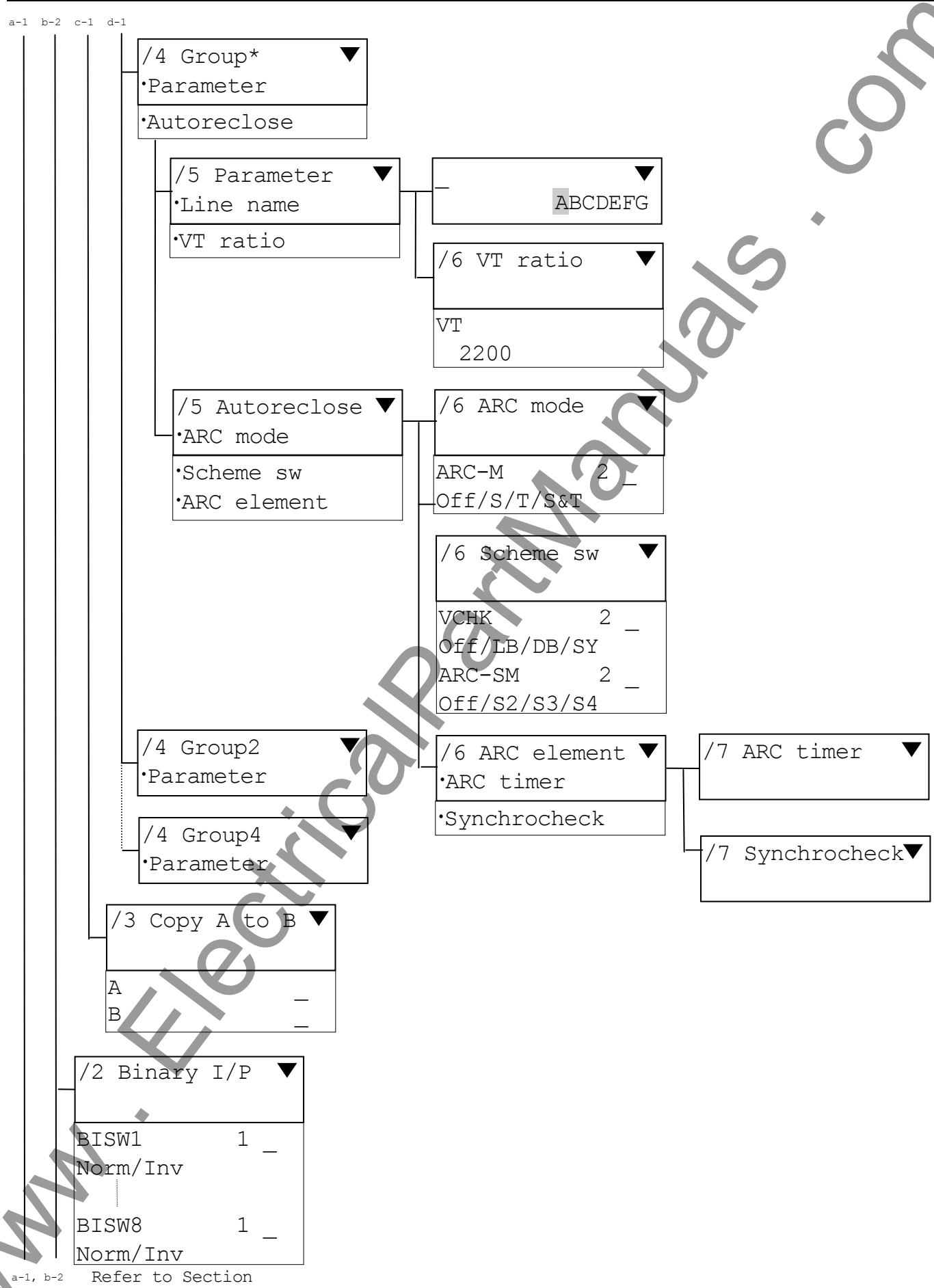


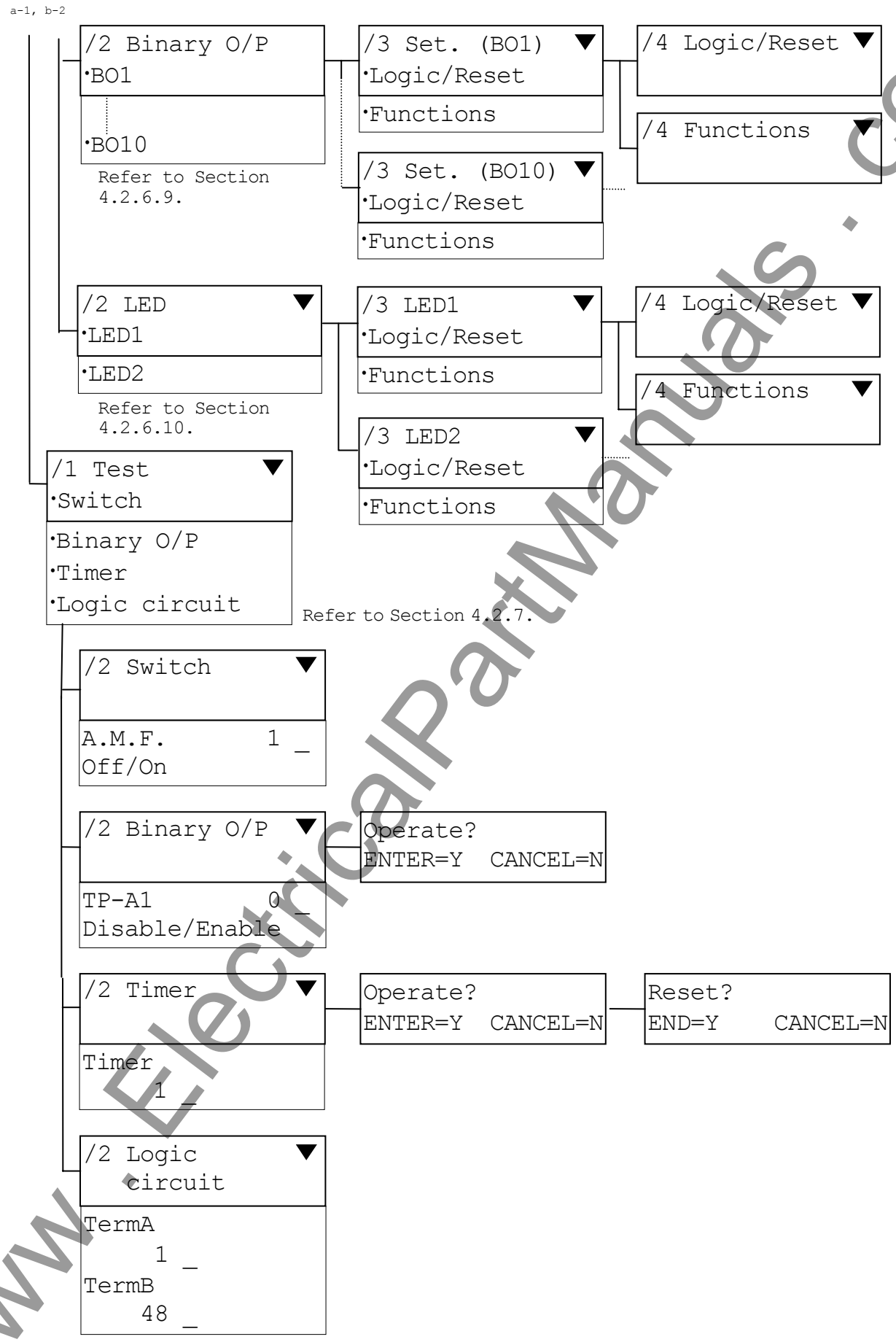




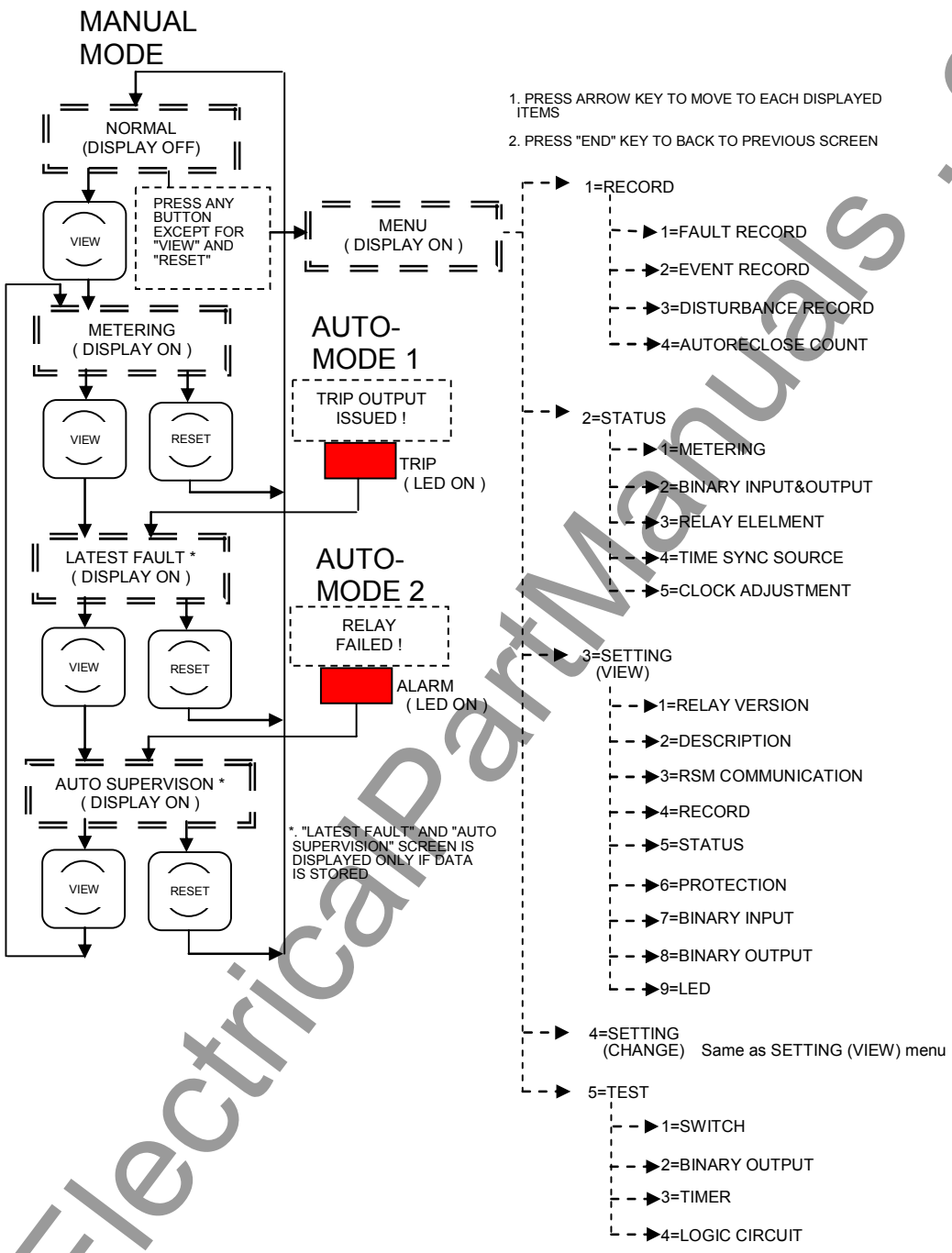








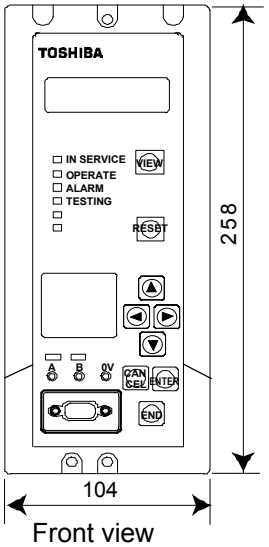
LCD AND BUTTON OPERATION INSTRUCTION



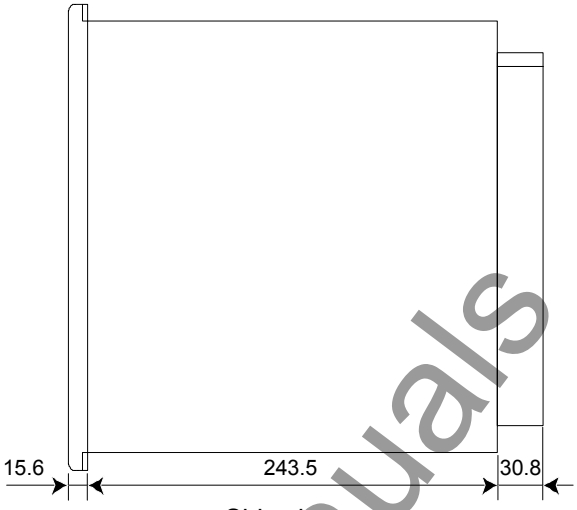
Appendix F

Case Outline

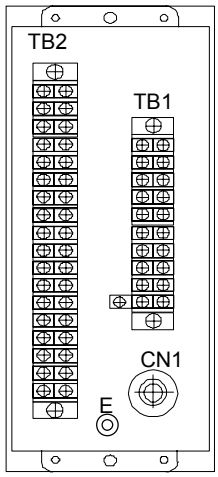
- Case Type: Flush Mount Type



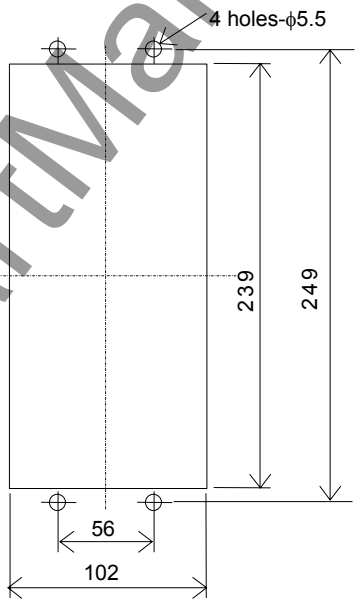
Front view



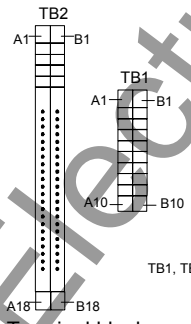
Side view



Rear view



Panel cut-out



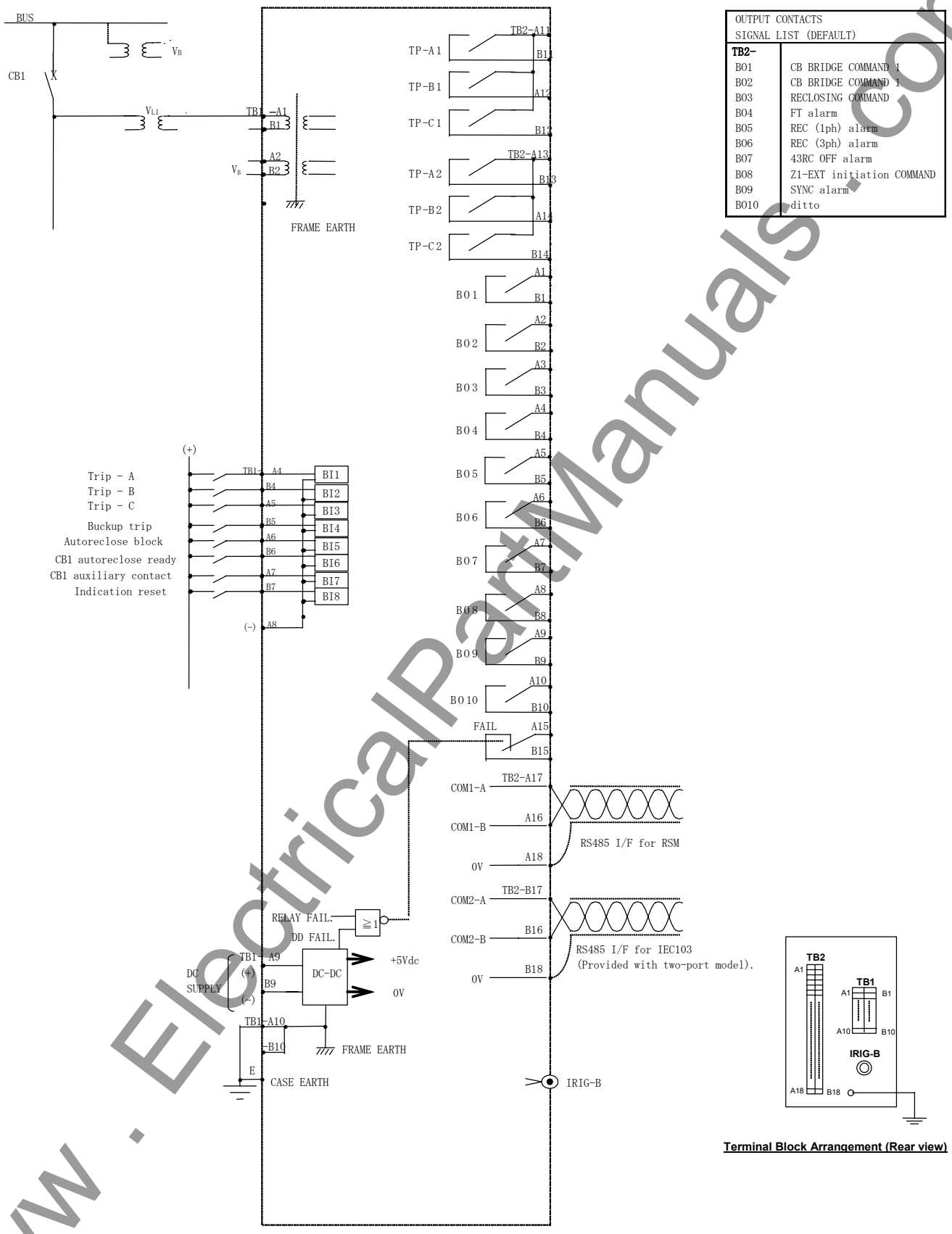
TB1, TB2: M3.5 Ring terminal

Terminal block

Case Outline of GRR100 : Flush Mount Type

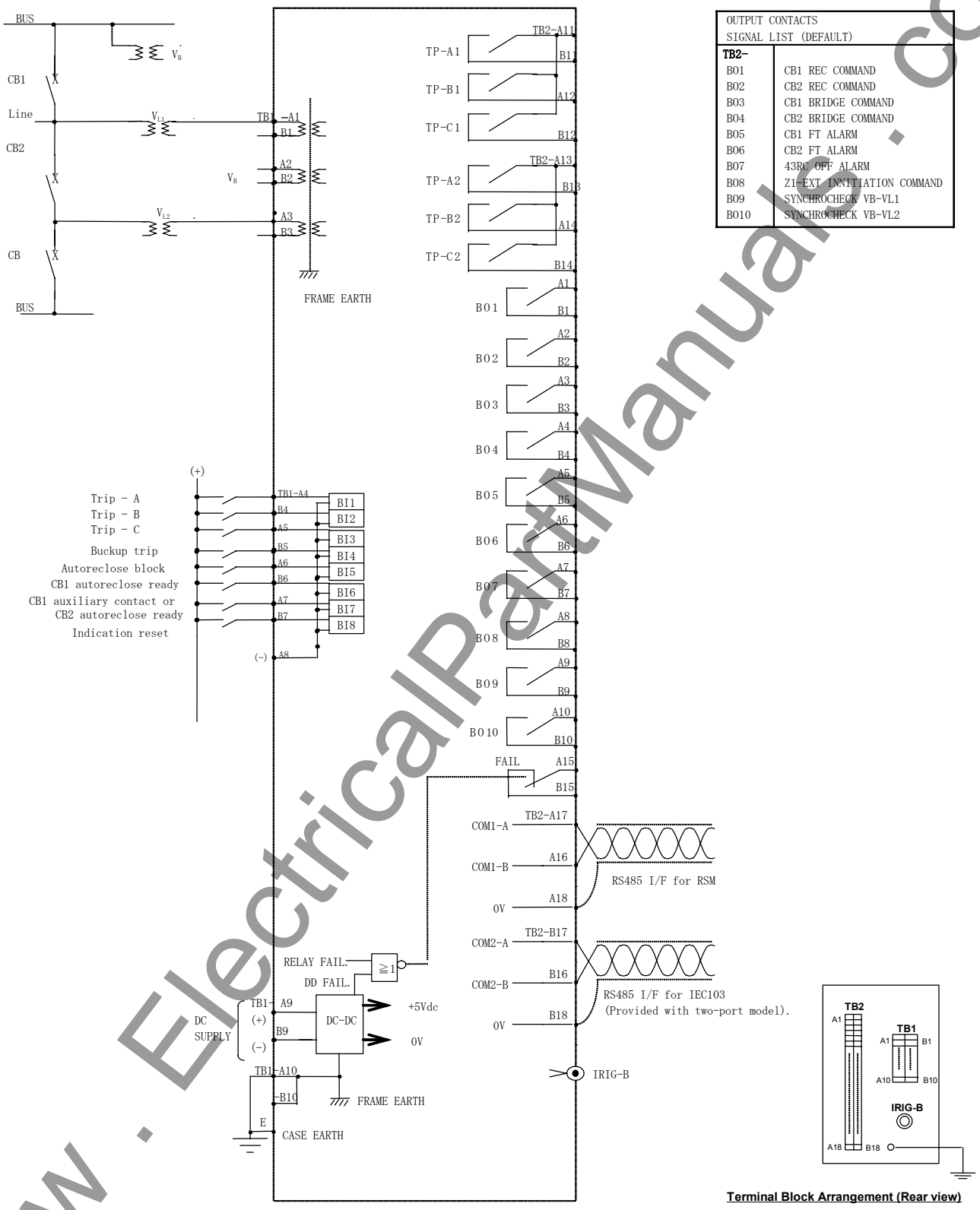
Appendix G

External Connection



Terminal Block Arrangement (Rear view)

Typical External Connection of Model 101



OUTPUT CONTACTS
SIGNAL LIST (DEFAULT)

TB2-	
B01	CB1 REC COMMAND
B02	CB2 REC COMMAND
B03	CB1 BRIDGE COMMAND
B04	CB2 BRIDGE COMMAND
B05	CB1 FT ALARM
B06	CB2 FT ALARM
B07	43RC OFF ALARM
B08	Z1-EXT INNITIATION COMMAND
B09	SYNCHROCHECK VB-VL1
B010	SYNCHROCHECK VB-VL2

Terminal Block Arrangement (Rear view)

Typical External Connection of Model 201

Appendix H

Relay Setting Sheet

1. Relay identification
2. Line parameters
3. Contacts setting
4. Relay setting sheet

1. Relay identification Date:

Relay type _____ Serial Number _____

Frequency _____ AC voltage _____

DC supply voltage _____

Password _____

Active setting group

2. Line parameters

VT ratio _____

3. Contacts setting

(1)

BO1 _____

BO2 _____

BO3 _____

BO4 _____

BO5 _____

BO6 _____

BO7 _____

BO8 _____

BO9 _____

BO10 _____

4. Relay setting sheet

№	Name		Range	Units	Contents	Default Setting of Relay series		Setting
						101	201	
1	Act.gp.		1 - 4	—	Active setting group	1		
2	Line name		Specified by user	—	Line name	Specified by user		
3	VT		1 - 20000	—	VT ratio	2000		
4	ARC-M		Off(0) / S(1) / T(2) / S&T(3)	—	Autoreclose mode	S&T(3)		
5	ARC-CB		ONE(0) / 01(1) / 02(2) / L1(3) / L2(4)	—	ARC mode for 1,5CB system	--	L1(1)	
6	VCHK	101	Off(0) / LB(1) / DB(2) / SY(3)	—	TPAR condition	LB(1)	--	
		201	Off(0) / L1(1) / L2(2) / DB(3) / SY(4)			--	LB1(1)	
7	ARC-SM		Off(0) / S2(1) / S3(2) / S4(3)	—	Multi. shot ARC mode	Off(0)		
8	TEVLV		0.01 - 10.00	s	Dead timer reset timing	0.30		
9	TRDY1		5 - 300	s	Reclaim timer	60		
10	TSPR		0.01 - 10.00	s	SPAR dead line timer	0.80		
11	TTPR1		0.01 - 100.00	s	TPAR dead line timer	0.60		
12	TRR		0.01 - 100.00	s	ARC reset timer	2.00		
13	TW1		0.1 - 10.0	s	ARC reset timer	0.2		
14	TRDY2		5 - 300	s	Reclaim timer	--	60	
15	TTPR2		0.1 - 10.0	s	ARC timing for follower CB	--	0.1	
16	TW2		0.1 - 10.0	s	ARC reset timer	--	0.2	
17	TS2		5.0 - 300.0	s	Multi. shot dead timer	20.0		
18	TS2R		5.0 - 300.0	s	Multi. shot reset timer	30.0		
19	TS3		5.0 - 300.0	s	Multi. shot dead timer	20.0		
20	TS3R		5.0 - 300.0	s	Multi. shot reset timer	30.0		
21	TS4		5.0 - 300.0	s	Multi. shot dead timer	20.0		
22	TS4R		5.0 - 300.0	s	Multi. shot reset timer	30.0		
23	OVB		10 - 150	V	OV element	51		
24	UVB		10 - 150	V	UV element	13		
25	OVL1		10 - 150	V	OV element	51		
26	UVL1		10 - 150	V	UV element	13		
27	SY1UV		10 - 150	V	Synchro. check (UV)	83		
28	SY1OV		10 - 150	V	Synchro. check (OV)	51		
29	SY1θ		5 - 75	deg	Synchro. check (ph. diff.)	30		
30	TSYN1		0.01 - 10.00	s	Synchronism check timer	1.00		
31	TDBL1		0.01 - 10.00	s	Voltage check timer	0.05		
32	TLBD1		0.01 - 10.00	s	Voltage check timer	0.05		
33	TDBD1		0.01 - 10.00	s	Voltage check timer	0.05		
34	OVL2		10 - 150	V	OV element	--	51	
35	UVL2		10 - 150	V	UV element	--	13	
36	SY2UV		10 - 150	V	Synchro. check (UV)	--	83	
37	SY2OV		10 - 150	V	Synchro. check (OV)	--	51	
38	SY2θ		5 - 75	deg	Synchro. check (ph. diff.)	--	30	
39	TSYN2		0.01 - 10.00	s	Synchronism check timer	--	1.00	
40	TDBL2		0.01 - 10.00	s	Voltage check timer	--	0.05	
41	TLBD2		0.01 - 10.00	s	Voltage check timer	--	0.05	
42	TDBD2		0.01 - 10.00	s	Voltage check timer	--	0.05	
43	BISW1		Norm(0) / Inv(1)	—	Binary input	Norm(0)		
44	BISW2		Norm(0) / Inv(1)	—	ditto	Norm(0)		
45	BISW3		Norm(0) / Inv(1)	—	ditto	Norm(0)		
46	BISW4		Norm(0) / Inv(1)	—	ditto	Norm(0)		
47	BISW5		Norm(0) / Inv(1)	—	ditto	Norm(0)		
48	BISW6		Norm(0) / Inv(1)	—	ditto	Norm(0)		
49	BISW7		Norm(0) / Inv(1)	—	ditto	Norm(0)		
50	BISW8		Norm(0) / Inv(1)	—	ditto	Norm(0)		
51	LED1	Logic	OR(0)/AND(1)	—	LED1 Logic Gate Type	OR(0)		
52		Reset	Inst(0)/ Latch(1)	—	LED1 Reset operation	Inst(0)		
53		In #1	0 - 200	—	LED Functions	0		
54		In #2	0 - 200	—	ditto	0		
55		In #3	0 - 200	—	ditto	0		
56		In #4	0 - 200	—	ditto	0		
57	LED2	Logic	OR(0) / AND(1)	—	LED2 Logic Gate Type	OR(0)		
58		Reset	Inst(0) / Latch(1)	—	LED2 Reset operation	Inst(0)		
59		In #1	0 - 200	—	LED Functions	0		
60		In #2	0 - 200	—	ditto	0		
61		In #3	0 - 200	—	ditto	0		
62		In #4	0 - 200	—	ditto	0		

№	Name	Range	Units	Contents	Default Setting of Relay series		Setting
					101	201	
63	Plant name	Specified by user	—	Plant name	Specified by user		
64	Description	ditto	—	Memorandum for user	Specified by user		
65	HDLC	1 - 32	—	Relay ID No. for RSM	1		
66	IEC	0 - 254	—	Relay ID No. for IEC	2		
67	IECBR	9.6(0) / 19.2(1)	—	Switch for communications	19.2(1)		
68	IECBLK	Normal(0) / Blocked(1)	—	Switch for communications	Normal(0)		
69	Ext.trip A	N(0) / O(1) / R(2) / B(3)	—	Event record trigger	B(3)		
70	Ext.trip B	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
71	Ext.trip C	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
72	Trip1	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
73	Trip2	N(0) / O(1) / R(2) / B(3)	—	ditto	--	B(3)	
74	CB1 ARC	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
75	CB2 ARC	N(0) / O(1) / R(2) / B(3)	—	ditto	--	B(3)	
76	CB1 ready	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
77	CB2 ready	N(0) / O(1) / R(2) / B(3)	—	ditto	--	B(3)	
78	BU trip	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
79	ARC block	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
80	Ind.reset	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
81	Relay fail	N(0) / O(1) / R(2) / B(3)	—	ditto	B(3)		
82	Sys.change	N(0) / O(1)	—	ditto	O(1)		
83	Rly.change	N(0) / O(1)	—	ditto	O(1)		
84	Grp.change	N(0) / O(1)	—	ditto	O(1)		
85	Time	0.1 - 3.0	s	Disturbance record	1.0		
86	TRIP	Off(0) / On(1)	—	Disturbance record trigger use or not	On(1)		
87	ARC	Off(0) / On(1)	—	ditto	On(1)		
88	Display	Prim.(0) / Second.(1)	—	Metering	Prim.(0)		
89	Time sync	Off(0) / IRI(1) / RSM(2) / IEC(3)	—	Time synchronization	Off(0)		
90	GMT	-12 - +12	hrs	Time zone	0		
91	A.M.F	Off(0) / On(1)	—	Automatic monitoring function	On(1)		
92	IECTST	Off(0) / On(1)	—	IEC103 test	Off(0)		

Appendix I

Commissioning Test Sheet (sample)

1. Relay identification
2. Preliminary check
3. Hardware test
   - 3.1 User interface check
   - 3.2 Binary input / binary output circuit check
   - 3.3 AC input circuit check
4. Function test
   - 4.1 Voltage and synchronism check elements test
5. Autoreclosing 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 test

3.1 User interface check ☐

3.2 Binary input / binary output circuit check

Binary input circuit	☐
Binary output circuit	☐

3.3 AC input circuit check ☐

4. Function test

4.1 Voltage and synchronism check elements test

(1) Voltage check element

Element	Setting	Measured voltage
OVB		
UVB		
OVL1		
UVL1		
OVL2		
UVL2		

(2) Synchronism check element

① Voltage check

Element	Setting	Measured voltage
SYN1 (SY1UV)		
SYN1 (SY1OV)		
SYN2 (SY2UV)		
SYN2 (SY2OV)		

② Phase angle check

Element	Setting	Measured angle
SYN1 (SY1θ)		
SYN2 (SY2θ)		

5. Autoreclosing scheme test

6. Metering and recording check

7. Conjunctive test

Scheme	Results
Tripping circuit	
Reclosing circuit	

Appendix J

Return Repair Form

RETURN / REPAIR FORM

Please fill in this form and return it to Toshiba Corporation with the GRR100 to be repaired.

TOSHIBA CORPORATION Fuchu Complex
1, Toshiba-cho, Fuchu-shi, Tokyo, Japan
For: Power Systems Protection & Control Department
Quality Assurance Section

Type: GRR100 Model: _____
(Example: Type: GRR100 Model: 101B-10-30)

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.

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/1998)

6. Give any comments about the GRR100, including the documents:

Customer

Name: _____

Company Name: _____

Address: _____

_____

_____

Telephone No.: _____

Facsimile No.: _____

Signature: _____

Appendix K

Technical Data

TECHNICAL DATA

Ratings

AC voltage:	100V, 110V, 115V, 120V
Frequency:	50Hz or 60Hz
DC power supply:	110Vdc/125Vdc 220Vdc/250Vdc 48Vdc (Normal range: -20% and +20% of rated voltage)
AC ripple on DC supply, IEC60255-11:	Maximum 12%
DC supply interruption, IEC60255-11	
Permissive duration of DC supply voltage interruption to maintain normal operation:	less than 50ms at 110Vdc
Restart time:	less than 10s

Binary input signal

Operating voltage:	Typical 74Vdc, minimum 70Vdc at 110Vdc/125Vdc rating Typical 138Vdc, minimum 125Vdc at 220Vdc/250Vdc rating

Overload rating

AC voltage input:	1.2 times rated continuous

Burden

AC voltage circuit:	0.1VA per phase (at rated voltage)
DC power supply:	less than 10W (quiescent) less than 15W (operation)
Binary input circuit:	0.5W/input at 110Vdc

Autoreclosing setting

Number of shots:	1 to 4
Timer settings	
Dead time for single-phase autoreclose:	0.01 to 10.00s in 0.01s steps
Dead time for three-phase autoreclose:	0.01 to 100.00s in 0.01s steps
Multi-shot dead line time:	5.0 to 300.0s in 0.1s steps
Multi-shot dead reset time:	5.0 to 300.0s in 0.1s steps
Reclaim time:	5 to 300s in 1s steps
Pulse width of reclosing signal output:	0.1 to 10.0s in 0.1s steps
Autoreclose reset time:	0.01 to 100.00s in 0.01s steps
Reset time for developing fault:	0.01 to 10.00s in 0.01s steps

One-and-a-half breaker scheme

Follower breaker autoreclose delay time: 0.1 to 10.0s in 0.1s steps

Voltage and synchronism check element

Synchronism check angle: 5 to 75 degrees in 1-degree steps
UV element: 10 to 150V in 1V steps
OV element: 10 to 150V in 1V steps
Busbar or line dead check: 10 to 150V in 1V steps
Busbar or line live check: 10 to 150V in 1V steps
Synchronism check time: 0.01 to 10.00s in 0.01 steps
Voltage check time: 0.01 to 10.00s in 0.01 steps
Operating time of synchronism check element: less than 50ms
Operating time of UV and OV element: less than 40ms

Communication port

Front communication port (local PC)

Connection: Point to point
Cable type: Multi-core (straight)
Cable length: 15m (max.)
Connector: RS232C 9-way D-type female

Rear communication port (remote PC)

Signal level: RS485
Transmission data rate for RSM system: 64kbps
Connection: Multidrop mode (max. 32 relays)
Connector: Screw terminals
Cable and length: Twisted-pair cable, max. 1200m
Isolation: 2kVac for 1 min.

Contact ratings

Make and carry: 4A continuously
10A, 220Vdc for 0.2s (L/R ≥ 5ms)
Break: 0.1A, 220Vdc (L/R=40ms)

Mechanical design

Weight: 5kg
Case color: Munsell No. 10YR8/0.5
Installation: Flush mounting

ENVIRONMENTAL PERFORMANCE CLAIMS

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	IEC60068-2-78	4 days at 40°C and 93% relative humidity.
Enclosure Protection	IEC60529	IP51 (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	IEC60255-22-1 Class 3	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 IEC60255-22-2 Class 4	6kV contact discharge. 15kV air discharge.
Radiated RF Electromagnetic Disturbance	IEC60255-22-3	Field strength 10V/m for frequency sweeps of 80MHz to 1GHz. Additional spot tests at 80, 160, 450, 900 and 1890MHz.
Fast Transient Disturbance	IEC60255-22-4 Class 4	4kV, 2.5kHz, 5/50ns applied to all inputs.

Appendix L

Symbols Used in Scheme Logic

Symbols used in the scheme logic and their meanings are as follows:

Signal names

Marked with ▭ : Measuring element output signal

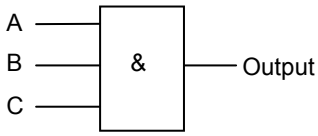
Marked with ⬭ : Binary signal input from or output to the external equipment

Marked with [ ] : Scheme switch

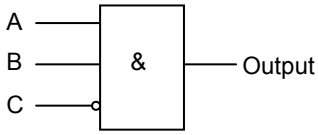
Marked with " " : Scheme switch position

Unmarked : Internal scheme logic signal

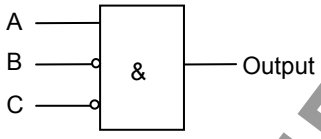
AND gates



A	B	C	Output
1	1	1	1
Other cases			0

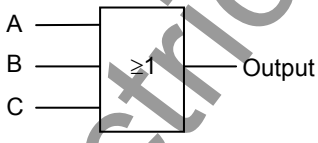


A	B	C	Output
1	1	0	1
Other cases			0

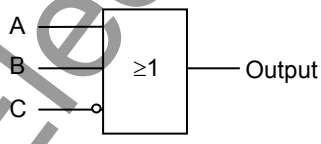


A	B	C	Output
1	0	0	1
Other cases			0

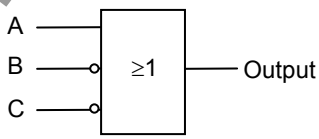
OR gates



A	B	C	Output
0	0	0	0
Other cases			1

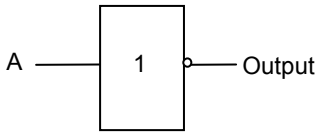


A	B	C	Output
0	0	1	0
Other cases			1



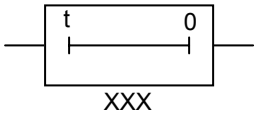
A	B	C	Output
0	1	1	0
Other cases			1

Signal inversion



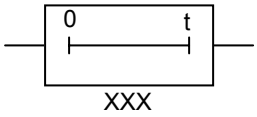
A	Output
0	1
1	0

Timer



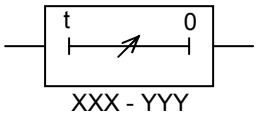
Delayed pick-up timer with fixed setting

XXX: Set time



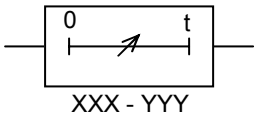
Delayed drop-off timer with fixed setting

XXX: Set time



Delayed pick-up timer with variable setting

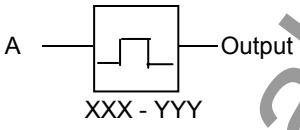
XXX - YYY: Setting range

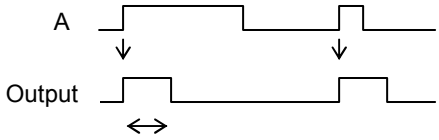


Delayed drop-off timer with variable setting

XXX - YYY: Setting range

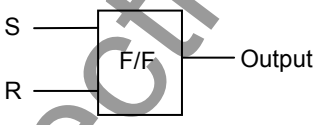
One-shot timer





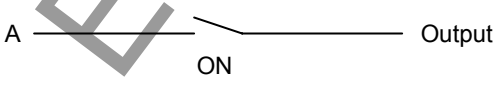
XXX - YYY: Setting range

Flip-flop

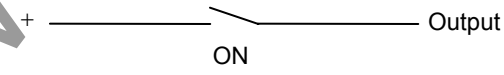


S	R	Output
0	0	No change
1	0	1
0	1	0
1	1	0

Scheme switch



A	Switch	Output
1	ON	1
Other cases		0



Switch	Output
ON	1
OFF	0

Appendix M

IEC60870-5-103: Interoperability and Troubleshooting

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.6F2S0839.)

- 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

- 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.

List of Information

INF	Description	Contents	IEC103 Configurator Default setting						
			GI	Type ID	COT	FUN	DPI		
							Signal No.	OFF	ON
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	218	--	--	--
3	Reset CU	Reset CU ACK	--	5	4	218	--	--	--
4	Start/Restart	Relay start/restart	--	5	5	218	--	--	--
5	Power On	Relay power 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, 9, 11, 12	218	153	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.	Not supported						
19	LED reset	Reset of latched LEDs	--	1	1, 7, 11, 12, 20, 21	218	149	--	2
20	Monitor direction blocked	Block the 103 transmission from a relay to control system. IECBLK: "Blocked" settimg.	GI	1	9, 11	218	131	1	2
21	Test mode	Transmission of testmode situation froma relay to control system. IECTST "ON" setting.	GI	1	9, 11	218	132	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, 20, 21	176	133	1	2
24	Characteristic2	Setting group 2 active	GI	1	1, 7, 9, 11, 12, 20, 21	176	134	1	2
25	Characteristic3	Setting group 3 active	GI	1	1, 7, 9, 11, 12, 20, 21	176	135	1	2
26	Characteristic4	Setting group 4 active	GI	1	1, 7, 9, 11, 12, 20, 21	176	136	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	Not supported						
33	Measurand supervision V	Zero sequence voltage supervision	Not supported						
35	Phase sequence supervision	Negative sequence voltage supevision	Not supported						
36	Trip circuit supervision	Output circuit supervision	Not supported						
37	I>>backup operation		Not supported						
38	VT fuse failure	VT failure	Not supported						
39	Teleprotection disturbed	CF(Communication system Fail) supervision	Not supported						
46	Group warning	Only alarming	Not supported						
47	Group alarm	Trip blocking and alarming	GI	1	1, 7, 9	176	102	1	2
Earth Fault Indications									
48	Earth Fault L1	A phase earth fault	No						
49	Earth Fault L2	B phase earth fault	No						
50	Earth Fault L3	C phase earth fault	No						
51	Earth Fault Fwd	Earth fault forward	Not supported						
52	Earth Fault Rev	Earth fault reverse	Not supported						

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						
65	Start/pick-up L2	B phase, A-B phase or B-C phase element pick-up	No						
66	Start/pick-up L3	C phase, B-C phase or C-A phase element pick-up	No						
67	Start/pick-up N	Earth fault element pick-up	No						
68	General trip	Any trip	No						
69	Trip L1	A phase, A-B phase or C-A phase trip	No						
70	Trip L2	B phase, A-B phase or B-C phase trip	No						
71	Trip L3	C phase, B-C phase or C-A phase trip	No						
72	Trip I>>(back-up)	Back up trip	Not supported						
73	Fault location X In ohms	Fault location	Not supported						
74	Fault forward/line	Forward fault	Not supported						
75	Fault reverse/Busbar	Reverse fault	Not supported						
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	No set						
85	Breaker Failure	CBF trip or CBF retrip	Not supported						
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	Not supported						
91	Trip I>>	Definite time OC trip	Not supported						
92	Trip IN>	Inverse time earth fault OC trip	Not supported						
93	Trip IN>>	Definite time earth fault OC trip	Not supported						
Autoreclose indications									
128	CB 'ON' by Autoreclose	CB close command output	--	1	1, 7	218	95	1	2
129	CB 'ON' by long-time Autoreclose		Not supported						
130	Autoreclose Blocked	Autoreclose block	GI	1	1, 7, 9	218	153	2	1

INF	Description	Contents	IEC103 configurator Default setting				
			GI	Type ID	COT	FUN	Max. No.
Measurands							
144	Measurand I	<meaurand I>	Not supported				0
145	Measurand I,V	<meaurand I>	Not supported				0
146	Measurand I,V,P,Q	<meaurand I>	Not supported				0
147	Measurand IN,VEN	<meaurand I>	Not supported				0
148	Measurand IL1,2,3, VL1,2,3, P,Q,f	VB, Vline1, VLine2 measurand <meaurand II>	--	9	2, 7	218	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	(empty)						
	(empty)						
	(empty)						
	VB	1	0	short	0	4096	2.15013
	VLine1	1	2	short	0	4096	2.15013
	VLine2	1	4	short	0	4096	2.15013
	(empty)						
	(empty)						
	f	1	10	short	0	4096	0.68266

INF	Description	Contents	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	218
17	Teleprotection on/off		Not supported			
18	Protection on/off		Not supported			
19	LED reset	Reset indication of latched LEDs.	ON	20	20	218
23	Activate characteristic 1	Setting Group 1	ON	20	20	218
24	Activate characteristic 2	Setting Group 2	ON	20	20	218
25	Activate characteristic 3	Setting Group 3	ON	20	20	218
26	Activate characteristic 4	Setting Group 4	ON	20	20	218
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	185	185	✓	0
19	0	188		200
23	0	193		1000
24	0	194		1000
25	0	195		1000
26	0	196		1000

✓: signal reverse

	Description	Contents	GRR100 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	No	
	Current L2	Ib	No	
	Current L3	Ic	No	
	Voltage L1-E	VB	Configurable	
	Voltage L2-E	VLine1	Configurable	
	Voltage L3-E	VLine2	Configurable	
	Active power P	P	No	
	Reactive power Q	Q	No	
	Frequency f	f	Configurable	
	Voltage L1 - L2	Vab	No set	

Details of Common settings in IEC103 configurator

- Setting file's remark: GRR100_1.00
- Remote operation valid time [ms]: 4000
- Local operation valid time [ms]: 4000
- Measurand period [s]: 2
- Function type of System functions: 218
- Signal No. of Test mode: 132
- Signal No. for Real time and Fault number: 162

[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)

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:

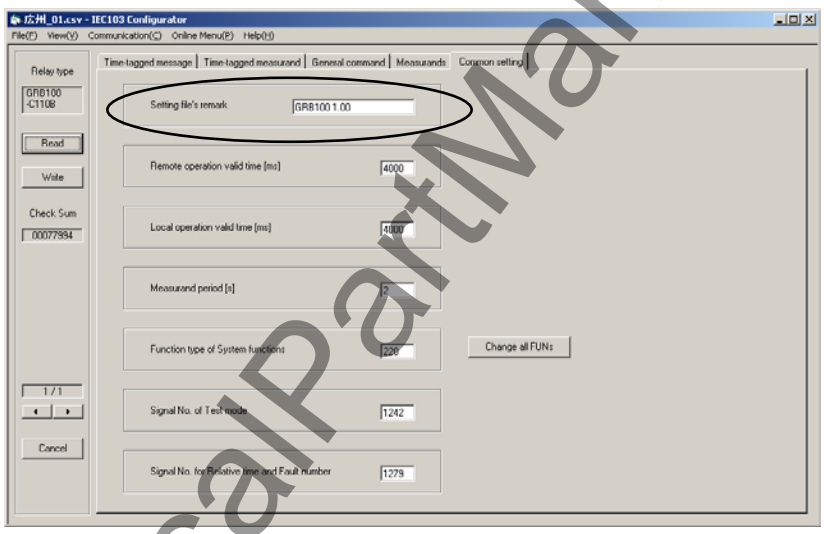
First draft: ******_01.csv

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.

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="11">1</td><td rowspan="11">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>

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

Appendix N

Ordering

Ordering

GRR100 – [ ] B – [ ] 0 – [ ] 0 – [ ]

Type:	
Autoreclosing Relay	GRR100
Model:	
- Model 100: Applied for 1 circuit breaker configuration at 1 CB busbar configuration system	101
- Model 200: Applied for 2 circuit breaker configuration at 1 1/2 CB busbar configuration system	201
Ratings:	
50Hz, 110V/125Vdc	1
60Hz, 110V/125Vdc	2
50Hz, 220V/250Vdc	5
60Hz, 220V/250Vdc	6
50Hz, 48V/54V/60Vdc	A
60Hz, 48V/54V/60Vdc	B
Communications:	
Dual RS485	3
LED label:	
Standard	None
Option: User configurable LED label	J

Version-up Records

Version No.	Date	Revised Section	Contents
0.0	Dec. 24, 2003	--	First issue
0.1	Apr. 28, 2004	Appendices	Modified the Appendix M and added the Appendix N.
0.2	May 20, 2004	Appendix B	Added No.166 and changed the name of No.131.
0.3	Aug. 24, 2004	3.2.1 4.5 6.7.2 Appendices	Modified the description of Binary input signals. Modified the description. Modified the description of Note. Modified the Appendix K and M.
0.4	Feb. 25, 2005	Appendix M	Modified the Appendix M.
0.5	Jan. 31, 2006	Appendices	Modified the Appendix J, K and N.
0.6	Apr. 20, 2006	3.2.1 4.1.2 Appendices	Modified the description. Modified the description. Modified Appendix G, K and N.
0.7	Aug. 02, 2007	4.2.1 4.4 Appendices	Modified the description. Modified the description. Modified Appendix E and M.
0.8	Aug. 07, 2007	Appendices	Modified Appendix N.

TOSHIBA CORPORATION