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GR Series Relay

N u m e r i c a l R e l a y

GRD150

Feeder Manager



GRD150

FEATURES

Protection functions

- Non-directional and directional overcurrent and earth-fault protection and sensitive earth fault protection (option)
- Overvoltage and undervoltage protection
- Thermal overload protection
- Underfrequency or overfrequency protection
- Negative phase sequence overcurrent protection
- Undercurrent protection
- Circuit breaker failure protection
- Autoreclose function (option)

Control functions

- Indication of the status of switching devices, i.e. circuit breakers and disconnectors
- Open and close commands for switching devices
- Synchronism check function (option)
- MIMIC configuration display

Monitoring and Metering

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

Recording

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

User Interface

- Menu-based HMI system
- Graphical LCD display
- PLC function
- Configurable binary inputs and outputs
- Configurable LED indications
- Communication Interface: RS485, Fibre optic or Ethernet LAN (option)

APPLICATION

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

GRD150 includes multiple, high accuracy, overcurrent protection elements (for phase and/or earth fault) with

inverse time (IDMTL) and definite time delay (DTL) functions. All phase, earth and sensitive earth fault overcurrent elements can be independently subject to directional control. The directional elements provide user-settable characteristic angles.

Other protection functions are also available, including thermal protection to IEC60255-8, negative sequence overcurrent protection, under/overvoltage and under/over frequency protections.

GRD150 provides continuous monitoring of internal circuits and of software. External circuits are also monitored, by trip circuit supervision, CT and VT supervision, and CB condition monitoring features.

A user-friendly HMI is provided through a backlit LCD, programmable LEDs, keypad and menu-based operating system. PC access is also provided, either for local connection via a front-mounted RS232 port, or for remote connection via a rear-mounted RS485 or fibre optic port. The communication system allows the user to read and modify the relay settings, and to access data gathered by the relay's metering and recording functions.

Data available either via the relay HMI or communications ports includes the following functions.

- Metering
- Fault recording
- Event recording
- Alarm recording
- Disturbance recording (available via communications ports)



Figure 1 - Front View

Table 1 GRD150 models and Functions

Function	Models	GRD150-			
		10* series	20* series	30* series	40* series
Non-directional overcurrent OC (IDMTL, DTL, INST)		✓	✓	✓	✓
Non-directional earth fault EF (IDMTL, DTL, INST)		✓	✓	✓	✓
Non-directional sensitive earth fault SEF (IDMTL, DTL, INST)			✓		✓
Directional overcurrent DOC (IDMTL, DTL, INST)		✓	✓	✓	✓
Directional earth fault DEF (IDMTL, DTL, INST)		✓	✓	✓	✓
Directional sensitive earth fault DSEF (IDMTL, DTL, INST)			✓		✓
Undercurrent UC		✓	✓	✓	✓
Thermal over load THM		✓	✓	✓	✓
Non-directional negative phase overcurrent NOC (IDMTL, DTL, INST)		✓	✓	✓	✓
Directional negative phase overcurrent DNOC (IDMTL, DTL, INST)		✓	✓	✓	✓
Broken conductor detection BCD		✓	✓	✓	✓
Circuit breaker failure protection CBF		✓	✓	✓	✓
Cold load pick-up feature		✓	✓	✓	✓
Overvoltage OV (IDMTL, DTL, INST)		✓	✓	✓	✓
Undervoltage UV (IDMTL, DTL, INST)		✓	✓	✓	✓
Zero phase sequence overvoltage ZOV (IDMTL, DTL, INST)		✓	✓	✓	✓
Negative phase sequence overvoltage NOV (IDMTL, DTL, INST)		✓	✓	✓	✓
Under/over frequency FRQ		✓	✓	✓	✓
Autoreclose function				✓	✓
Fault locator		✓	✓	✓	✓
Indication of the status of switching devices		✓	✓	✓	✓
Open and close commands for switching devices		✓	✓	✓	✓
Synchronism check function				✓	✓
MIMIC configuration picture (*)		✓	✓	✓	✓
PLC function (*)		✓	✓	✓	✓
CT supervision		✓	✓	✓	✓
VT supervision		✓	✓	✓	✓
Trip circuit supervision		✓	✓	✓	✓
Self supervision		✓	✓	✓	✓
CB state monitoring		✓	✓	✓	✓
Trip counter alarm		✓	✓	✓	✓
ΣI_f alarm		✓	✓	✓	✓
CB operate time alarm		✓	✓	✓	✓
Multiple settings groups		✓	✓	✓	✓
Metering		✓	✓	✓	✓
Fault records		✓	✓	✓	✓
Alarm records		✓	✓	✓	✓
Event records		✓	✓	✓	✓
Disturbance records		✓	✓	✓	✓
Communication		✓	✓	✓	✓

IDMTL: inverse definite minimum time

DTL: definite time

INST: instantaneous

(*): PC tools (MIMIC editor and PLC editor) are option.

FUNCTIONS

Protection

- 4-stage non-directional and directional overcurrent and earth-fault protection and sensitive earth fault protection (option)
 - 1st and 2nd stage: Instantaneous, IDMTL or DTL
 - 3rd and 4th stage: Instantaneous or DTL
- 2-stage non-directional and directional negative phase sequence overcurrent protection
 - 1st stage: Instantaneous, IDMTL or DTL
 - 2nd stage: Instantaneous or DTL
- 2-stage overvoltage and undervoltage protection
 - 1st stage: Instantaneous, IDMTL or DTL
 - 2nd stage: Instantaneous or DTL
- 6-stage underfrequency or overfrequency protection
- Thermal overload protection
- Cold load protection function or Inrush current (2nd harmonic) detector provided for energising the system
- Undercurrent protection
- Broken conductor detection
- Circuit breaker failure protection
- Autoreclose function: 5-shots, 3-phase autoreclose (option)

Control

Two-stepped operation (select-control) is used for the control procedure of circuit breakers, disconnectors, earthing disconnector switches and transformers to ensure highly reliable operation.

- Control of circuit breakers, disconnectors and earthing disconnector switches
- Interlock check
- Synchronism check for circuit breaker closing (option)
- MIMIC configuration picture displayed on LCD
- Double command blocking
- Switchgear operation counter
- Control blocking

Password protection is provided to operate above functions.

Monitoring and Metering

- Status monitoring of switchgear devices and failure monitoring of power apparatus, control equipment, protection relays and ancillary equipment
- Metering: current, voltage, frequency, active power, reactive power and max. demand values
An energy calculation (Watt-hour, var-hour) is also available.
- Limit value checking of metering
- Opening and closing time monitoring

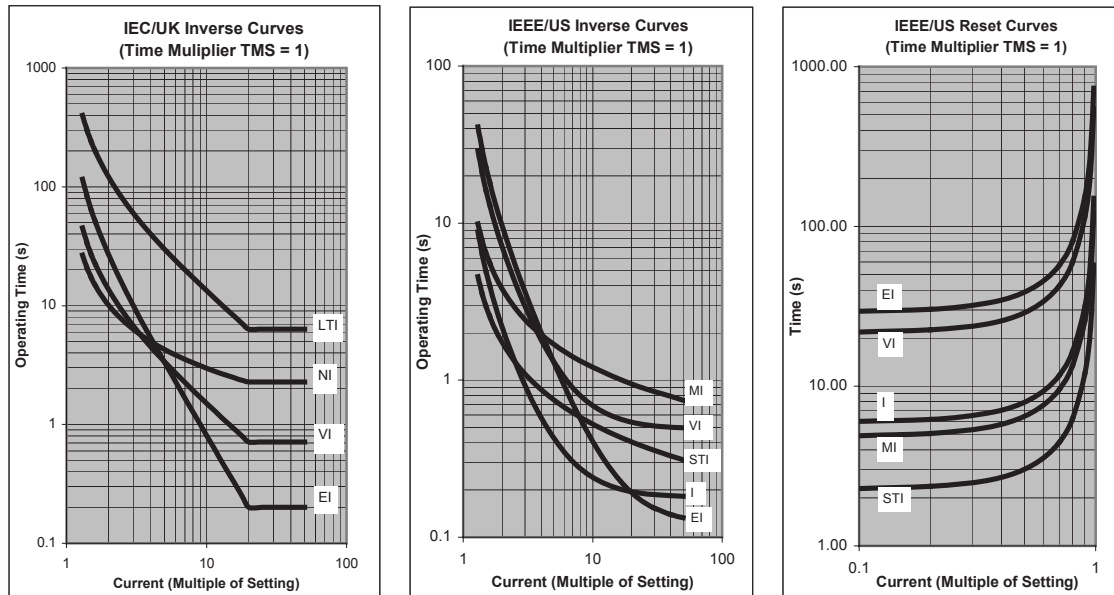
These data are available on the HMI and at a local or remote PC.

Recording

- Event records: The most recent 480 time-tagged events with 1ms resolution are stored.
- Alarm records: The most recent 32 time-tagged alarms with 1ms resolution are stored.
- Fault records: The most recent 8 time-tagged faults with 1ms resolution are stored.
- Disturbance records: GRD150 can record 9 analog and 32 binary signals, initiated by relay tripping. Pre-trigger and post-trigger recording times can be set, and the maximum number of records which can be stored is dependent on the recording times chosen.

These records are available on the HMI and at a local or remote PC.

Inverse Time Operate and Reset Curves



$$t = TMS \times \left\{ \left[\frac{k}{\left(\frac{I}{I_s} \right)^\alpha - 1} \right] + c \right\}$$

Inverse time operate function

$$t = RTMS \times \left[\frac{t_r}{1 - \left(\frac{I}{I_s} \right)^2} \right]$$

Dependent time reset function

Constants for dependent time curves

Curve Description	k	α	C	t_r
IEC Normal Inverse (NI)	0.14	0.02	0	-
IEC Very Inverse (VI)	13.5	1	0	-
IEC Extremely Inverse (EI)	80	2	0	-
UK Long Time Inverse (LTI)	120	1	0	-
IEEE Moderately Inverse (MI)	0.0515	0.02	0.114	4.85
IEEE Very Inverse (VI)	19.61	2	0.491	21.6
IEEE Extremely Inverse (EI)	28.2	2	0.1217	29.1
US CO8 Inverse (I)	5.95	2	0.18	5.95
US CO2 Short Time Inverse (STI)	0.02394	0.02	0.01694	2.261

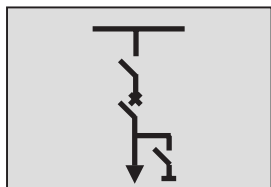
Figure 2 - Operate and Reset Characteristics of IDMTL

USER INTERFACE

Relay Front Panel

A user friendly interface is provided on the relay front panel. A menu-based system provides for easy programming of relay functions and access to real-time and stored data. The front panel includes the following features.

- Graphical LCD display with backlight.
- 12 LEDs including 8 user programmable LEDs.
- Keypad.
- RS232C serial port for connection of local PC.



Local PC Connection

The user can communicate with the GRD150 from a local PC via the RS232C port on the front panel. Using RSM100 software, the user can view and modify settings, monitor real-time metering and analyse recorded data.

Relay Setting and Monitoring (RSM) and Remote Control System

GRD150 can be connected to the RSM system via the rear mounted serial communications port, using RS485 or other connections such as fibre optic, Ethernet LAN, etc., (specified at time of order). Using RSM100 software, the user can view and modify settings, monitor real-time metering and analyse recorded data.

A maximum of 32 relays can be connected to the remote PC in multi-drop mode, by connection via a protocol converter, with data transmission rate of 64kbps using RSM-X protocol. Modbus®(RTU) protocol can be also available.

The figures below show the configuration of the RSM system and typical displays from the RSM100 software.

Using an additional port (option), GRD150 can be connected to a Substation Control System. In this case, GRD150 supports IEC60870-5-103 or DNP3.0 transmission protocols.

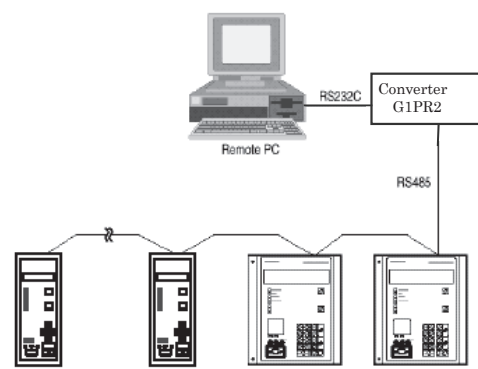


Figure 3 - Relay Setting and Monitoring System

Mimic Editor (MMEdit)

The user can configure and customize the MIMIC data displayed on the LCD of GRD150 using MMEdit software. The MIMIC data produced by the MMEdit software can be uploaded to GRD150 via the PC communication port (RS232C).

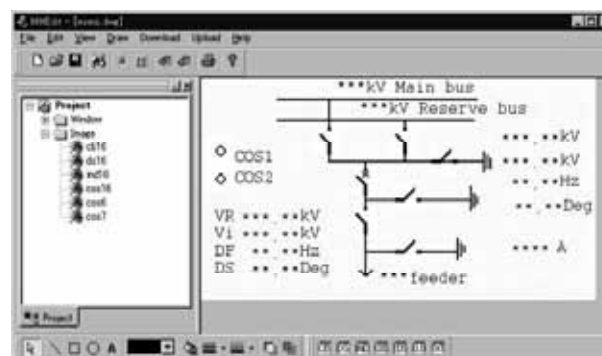


Figure 4 - PC Display of MMEdit

PLC Editor (PLCEdit)

The user can customize logic functions on GRD150 such as trip and interlock sequence, etc., using PLCEdit software. The PLC data produced by the PLCEdit software can be uploaded to GRD150 via PC communication port (RS232C).

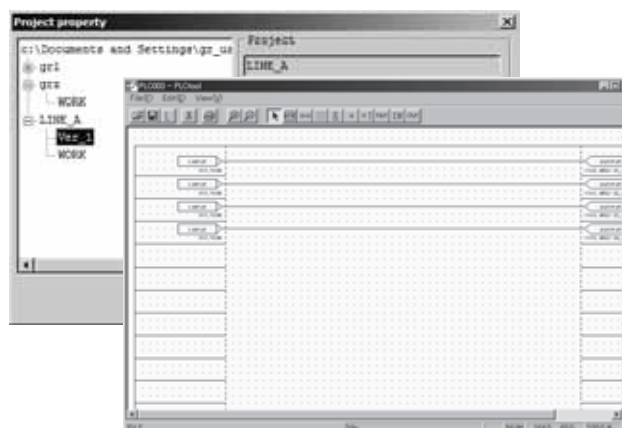
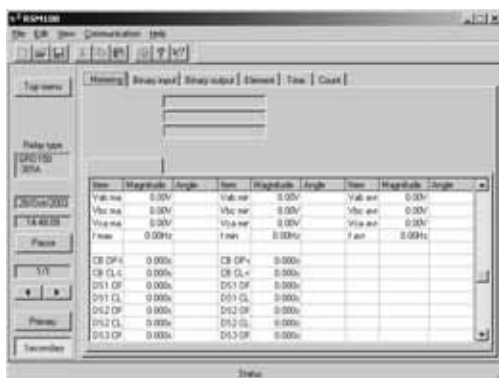
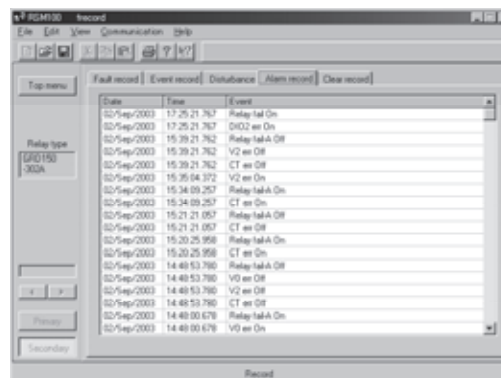


Figure 5 - PC Display of PLCEdit

PC DISPLAY



Status (Metering)



Record (Alarm record)



Setting



Record (disturbance record: data analysis)

Status: display measurement values of power system quantities and status of relay element, etc.

Setting: change settings of protection relay and control function, etc.

Record: display fault record, event record, alarm record and disturbance record.

Figure 6 - Relay Setting and Monitoring System - PC Displays

TECHNICAL DATA

Ratings	
AC current In	1A or 5A
AC voltage Vn:	100V to 120V
Frequency:	50Hz or 60Hz
DC auxiliary supply:	110/125Vdc (Operative range: 88 – 150Vdc), 220/250Vdc (Operative range: 176 – 300Vdc), 48/54/60Vdc, (Operative range: 38.4 – 72Vdc)
Superimposed AC ripple on DC supply:	≤ 12%
DC supply interruption:	≤ 50ms at 110V
Binary input circuit DC voltage:	110/125Vdc, 220/250Vdc, 48/54/60Vdc
Overload Ratings	
AC current inputs:	3 times rated current continuous 100 times rated current for 1 second
AC voltage inputs:	2 times rated voltage continuous
Burden	
AC phase current inputs:	≤ 0.1VA (1A rating) ≤ 0.3VA (5A rating)
AC earth current inputs:	≤ 0.3VA (1A rating) ≤ 0.4VA (5A rating)
AC sensitive earth inputs:	≤ 0.3VA (1A rating) ≤ 0.4VA (5A rating)
AC voltage inputs:	≤ 0.1VA (at rated voltage)
DC power supply:	≤ 15W (quiescent) ≤ 20W (maximum)
Binary input circuit:	≤ 0.5W per input at 110Vdc
Protection Functions	
Current Transformer Requirements	
Phase Inputs	Typically 5P20 with rated burden according to load, (refer to manual for detailed instructions).
Standard Earth Inputs:	Core balance CT or residual connection of phase CTs.
Sensitive Earth Inputs:	Core balance CT.
Non-directional Phase Overcurrent Protection	
OC 1 st Overcurrent threshold:	OFF, 0.04 – 5.00A in 0.01A steps (1A rating) OFF, 0.2 – 25.0A in 0.1A steps (5A rating)
OC 2 nd Overcurrent threshold:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
OC 3 rd , 4 th Overcurrent thresholds:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps

Non-directional Earth Fault Protection	
EF 1 st Overcurrent threshold:	OFF, 0.01 – 5.00A in 0.01A steps (1A rating) OFF, 0.05 – 25.00A in 0.01A steps (5A rating)
EF 2 nd Overcurrent threshold:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
EF 3 rd , 4 th thresholds:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Non-directional Sensitive Earth Fault Protection (Option)	
SEF 1 st , 2 nd Overcurrent threshold:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
Delay Type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
SEF 3 rd , 4 th thresholds:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Non-directional Negative Phase Sequence Overcurrent Protection	
NOC 1 st overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
Delay type (1 st threshold only):	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps

Directional Phase Overcurrent Protection	
DOC 1 st Overcurrent threshold:	OFF, 0.04 – 5.00A in 0.01A steps (1A rating) OFF, 0.2 – 25.0A in 0.1A steps (5A rating)
DOC 2 nd Overcurrent threshold:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DOC 3 rd , 4 th Overcurrent thresholds:	OFF, 0.10 – 50.00A in 0.01A steps (1A rating) OFF, 0.5 – 250.0A in 0.1A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
DOC Characteristic Angle:	–95° to +95° in 1° steps
Directional Earth Fault Protection	
DEF 1 st Overcurrent threshold:	OFF, 0.01 – 5.00A in 0.01A steps (1A rating) OFF, 0.05 – 25.00A in 0.01A steps (5A rating)
DEF 2 nd Overcurrent threshold:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
Delay type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time.
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DEF 3 rd , 4 th thresholds:	OFF, 0.04 – 50.00A in 0.01A steps (1A rating) OFF, 0.2 – 250.0A in 0.1A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
DEF Characteristic angle:	–95° to +95° in 1° steps
DEF Voltage threshold:	0.5 – 100.0V in 0.1V steps
Directional Sensitive Earth Fault Protection (Option)	
DSEF 1 st , 2 nd Overcurrent threshold:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
Delay Type:	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DSEF 3 rd , 4 th thresholds:	OFF, 0.005 – 0.025A in 0.001A steps (1A rating) OFF, 0.025 – 0.125A in 0.001A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
DSEF Characteristic angle:	–95° to +95° in 1° steps
DSEF Boundary of operation:	±87.5°
DSEF Voltage threshold:	0.5 – 100.0V in 0.1V steps
Residual power threshold:	OFF, 0.00 – 20.00W in 0.05W (1A rating) OFF, 0.00 – 100.00W in 0.25W (5A rating)

Directional Negative Phase Sequence Overcurrent Protection	
DNOC 1 st overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
Delay type (1 st threshold only):	DTL, IEC NI, IEC VI, IEC EI, UK LTI, IEEE MI, IEEE VI, IEEE EI, US CO8 I, US CO2 STI, User SI
IDMTL Time Multiplier Setting TMS:	0.010 – 1.500 in 0.001steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Type:	Definite Time or Dependent Time
Reset Definite Delay:	Instantaneous, 0.1 – 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS:	0.010 – 1.500 in 0.001 steps
DNOC 2 nd overcurrent threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
DNOC Characteristic angle:	–95° to +95° in 1° steps
DNOC Dir. Voltage threshold	0.5 – 25.0V in 0.1V steps
Overvoltage Protection	
1 st , 2 nd Overvoltage thresholds:	OFF, 10.0 – 200.0V in 0.1V steps
Delay type (1 st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
DO/PU ratio	10 – 98% in 1% steps
Reset Delay (1 st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Undervoltage Protection	
1 st , 2 nd Undervoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1 st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Delay (1 st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Zero Sequence Overvoltage Protection	
ZOV 1 st , 2 nd Overvoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1 st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Delay (1 st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Negative Sequence Overvoltage Protection	
NOV 1 st , 2 nd Overvoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V steps
Delay type (1 st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 – 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Reset Delay (1 st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Under/Over Frequency Protection	
1 st - 6 th under/overfrequency threshold:	25.00 – 75.00Hz in 0.01Hz steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
Undervoltage block:	40.0 – 100.0V in 0.1V steps
Thermal Overload Protection	
$I_0 = k \cdot I_{FLC}$ (Thermal setting):	OFF, 0.40 – 2.00A in 0.01A steps (1A rating) OFF, 2.0 – 10.0A in 0.1A steps (5A rating)
Pre-load current setting:	0.00 – 1.00A in 0.01A steps (1A rating) 0.0 – 5.0A in 0.1A steps (5A rating)
Time constant (τ):	0.5 - 100.0 mins in 0.1min steps
Thermal alarm:	OFF, 50% to 99% in 1% steps

Phase Undercurrent Protection	
Undercurrent 1 st , 2 nd threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
DTL Delay:	Inst, 0.01 – 300.00s in 0.01s steps
Broken Conductor Protection	
Broken conductor threshold (I_2/I_1):	OFF, 0.10 – 1.00 in 0.01 steps
DTL delay:	Inst, 0.01 – 300.00s in 0.01s steps
CBF Protection	
CBF threshold:	OFF, 0.10 – 2.00A in 0.01A steps (1A rating) OFF, 0.5 – 10.0A in 0.1A steps (5A rating)
CBF back trip DTL:	Inst, 0.01 – 300.00s in 0.01s steps
CBF Retrip DTL:	Inst, 0.01 – 300.00s in 0.01s steps
Accuracy	
IDMTL Overcurrent Pick-up:	Setting value $\pm 5\%$
All Other Overcurrent Pick-ups:	Setting value $\pm 5\%$
Overcurrent PU/DO ratio:	$\geq 95\%$
Undercurrent Pick-up:	Setting value $\pm 5\%$
Undercurrent PU/DO ratio:	$\leq 105\%$
IDMTL Overvoltage Pick-up:	Setting value $\pm 2\%$
All Other Overvoltage Pick-ups:	Setting value $\pm 2\%$
Inverse Time Delays:	$\pm 5\%$ or 30ms (1.5 to 30 times setting)
Definite Time Delays:	$\pm 1\%$ (for more than 1s setting) or 10ms
Transient Overreach for instant. elements:	$< -5\%$ for X/R = 100.
Synchronism Check Function (option)	
Synchronism check angle:	5 – 75° in 1° steps
Frequency difference check:	0.02 – 0.50Hz in 0.01Hz steps
Voltage difference check:	5.0 – 150.0V in 0.1V steps
Voltage dead check:	5.0 – 150.0V in 0.1V steps
Voltage live check:	5.0 – 150.0V in 0.1V steps
Auto-Reclose (option)	
ARC Reclaim Time	0.0 – 600.0s in 0.1s steps
Close Pulse Width	0.01 – 10.00s in 0.01s steps
Lock-out Recovery Time	OFF, 0.1 – 600.0s in 0.1s steps
Sequences	1 – 5 Shots to Lock-out, each trip programmable for Inst or Delayed operation.
Dead Times (programmable for each shot)	0.01 – 300.00s in 0.01s steps
Metering Function	
Current	IL1, IL2, IL3, 3Io. Accuracy $\pm 0.5\%$ (at rated frequency)
Voltage	V12, V23, V31, 3Vo. Accuracy $\pm 0.5\%$ (at rated frequency)
Power	P, Q, cos ϕ , Wh, varh. Accuracy $\pm 1\%$ (at rated frequency)
Frequency	Accuracy $\pm 0.05\text{Hz}$
Control and Monitoring Function	
Control devices Circuit breaker $\times 1$, Disconnecter $\times 5$, Earthing disconnector switch $\times 2$	Control input Interlock setting Interlock bypass setting Operate time counter Breaker travel time Double command blocking Control blocking

Disturbance record	
Analogue input	Max. 9
Binary input	Max. 32
Number of recordings	6 at recording length 3s
Trigger	Rising or falling edge of binary input
Data format	OC, EF, SEF, NOC, OV, UV, NOV, ZOV COMTRADE format
Communication port - local PC (RS232)	
Connection:	Point to point
Cable type:	Multi-core (straight)
Cable length:	15m (max.)
Connector:	RS232C 9-way D-type female
Communication port (RS485)	
Connection:	Multidrop (max. 32 relays)
Cable type:	Twisted pair
Cable length:	1200m (max.)
Connector:	Screw terminals
Isolation:	1kVac for 1 min.
Transmission rate:	64kpbs for RSM-X protocol. 9.6, 19.2kpbs for others
Communication port (Fibre Optic): Option	
Connection:	Multidrop (max. number depending on protocol) or Star by using Opt. Hub
Cable type:	50/125µm or 62.5/125µm fibre
Cable length:	1000m (max.)
Connector:	ST
Transmission rate:	9.6, 19.2kpbs
IRIG-B	
Connection:	Screw terminals
Binary Inputs	
Operating voltage	Typical 74Vdc(min.70Vdc) for 110V/125Vdc rating Typical 138Vdc(min.125Vdc) for 220V/250Vdc rating Typical 31Vdc(min.28Vdc) for 48V/54V/60Vdc rating Typical 15Vdc(min.14Vdc) for 24Vdc rating
Binary Outputs	
Number	8 - 32
Ratings for tripping auxiliary relay	Make and carry: 4A continuously Make and carry: 20A, 290Vdc for 0.5s (L/R≥5ms) Break: 0.1A, 290Vdc (L/R=40ms)
Mechanical design	
Weight	8.9 kg (Standard model)
Case color	Munsell No. 10YR8/0.5
Installation	Flush mounting
Connection terminals	
TB1:	M3.5 Ring terminal
TB2 – TB10:	Phoenix Contact, UK MSTB Direct cable connection: AWG24 to AWG12 recommended, stripping length is 10mm. Cable ferrule: AI 2,5-10BU from Phoenix Contact is recommended for AWG14 (cross-section 2mm ²). AI 1,5-10BK from Phoenix Contact is recommended for AWG14 (cross-section 1.25mm ²).

ENVIRONMENTAL PERFORMANCE

Test	Standards	Details
Atmospheric Environment		
Temperature	IEC60068-2-1/2	Operating range: –10°C to +55°C. Storage / Transit: –25°C to +70°C.
Humidity	IEC60068-2-3	56 days at 40°C and 93% relative humidity.
Enclosure Protection	IEC60529	Front: IP51 or IP52 with cover Rear: IP20
Mechanical Environment		
Vibration	IEC60255-21-1	Response - Class 1 Endurance - Class 1
Shock and Bump	IEC60255-21-2	Shock Response Class 1 Shock Withstand Class 1 Bump Class 1
Seismic	IEC60255-21-3	Class 1
High Voltage Environment		
Dielectric Withstand	IEC60255-5	2kVrms for 1 minute between all terminals and earth. 2kVrms for 1 minute between independent circuits. 1kVrms for 1 minute across normally open contacts.
High Voltage Impulse	IEC60255-5	Three positive and three negative impulses of 5kV(peak), 1.2/50µs, 0.5J between all terminals and between all terminals and earth.
Electromagnetic Environment		
High Frequency Disturbance / Damped Oscillatory Wave	IEC60255-22-1 Class 3, IEC61000-4-12	1MHz 2.5kV applied to all ports in common mode. 1MHz 1.0kV applied to all ports in differential mode.
Electrostatic Discharge	IEC60255-22-2 Class 3, IEC61000-4-2	6kV contact discharge. 8kV air discharge.
Radiated RF Electromagnetic Disturbance	IEC60255-22-3 Class 3 ^(*) , IEC61000-4-3 Note (*): Class 4 with cover	Field strength 10V/m for frequency sweeps of 80MHz to 1GHz and 1.7GHz to 2.2GHz. Additional spot tests at 80, 160, 450, 900 and 1890MHz.
Fast Transient Disturbance	IEC60255-22-4, IEC61000-4-4	4kV, 2.5kHz, 5/50ns applied to all inputs.
Conducted RF Electromagnetic Disturbance	IEC60255-22-6, IEC61000-4-6	10Vrms applied over frequency range 150kHz to 100MHz. Additional spot tests at 27 and 68MHz.
Conducted Disturbance over freq. Range 15Hz to 150kHz	IEC61000-4-16 Class 3	Varying voltages applied in common mode as follows: 15Hz to 150Hz: 10V → 1Vrms (20dB/decade) 150Hz to 1.5kHz: 1Vrms 1.5kHz to 15kHz: 1 → 10Vrms (20dB/decade) 15kHz to 150kHz: 10Vrms
Power Frequency Disturbance	IEC60255-22-7	300V 50Hz for 10s applied to ports in common mode. 100V 50Hz for 10s applied to ports in differential mode. Not applicable to AC inputs.

Test	Standards	Details
Surge Immunity	IEC60255-22-5	1.2/50 μ s surge in common/differential modes: Auxiliary power supply: 2kV/1kV (peak) Input/Output: 2kV/1kV (peak) RS485 port: 1kV (peak)
Conducted and Radiated Emissions	IEC60255-25 EN55022 Class A	Conducted emissions: 0.15 to 0.50MHz: <79dB (peak) or <66dB (mean) 0.50 to 30MHz: <73dB (peak) or <60dB (mean) Radiated emissions: 30 to 230MHz: <30dB 230 to 1000MHz: <37dB
Power Frequency Magnetic Field	IEC61000-4-8 Class 4	Field applied at 50Hz with strengths of: 30A/m continuously, 300A/m for 1 second.

PRPTOCOL CONVERTER G1PR2 (OPTION)

Ratings		
Power supply:	110Vdc/100Vac Operative range: 88 - 150Vdc of 110Vdc rated voltage 80 - 120Vac of 100Vac rated voltage 220Vdc/200Vac Operative range: 170 - 300Vdc of 220Vdc rated voltage 200 - 240Vac of 200Vac rated voltage 48Vdc Operative range: 38.4 - 72Vdc	
Burden:	less than 20W	
Communication port		
RS232C interface Connector type Cable type RS485 interface Connector Cable type Optical interface Operative Range: Wavelength: Connector type: Fibre type: IRIG-B Connector	RS232C 9-pin D-subminiature connector female Multi-core (straight) Screw terminals (Phoenix Contact, FRONT type) Twisted pair cable less than 1.2km with 62.5/125µm GI fibre (3dB/km) 850nm ST 62.5/125µm glass fibre Screw terminals (Phoenix Contact, FRONT-MSTB type)	
Mechanical design		
Enclosure Protection Weight Installation	IEC60529, IP20 (excluding terminal parts) 5 kg Flush mounting	
Atmospheric Environment		
Temperature Humidity	IEC60068-2-1/2 IEC60068-2-3	Operating range: -10°C to +55°C. Storage / Transit: -25°C to +70°C. 56 days at 40°C and 93% relative humidity.

ORDERING INFORMATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
G	R	D	1	5	0	–						0		
Configurations Basic Standard model with integral Sensitive Earth Fault function (SEF) with integral Synchronism check, Auto Reclose function with integral SEF & Synchronism check, Auto Reclose function MIMIC panel fixed on the front BI/BO Module BI ≤ 10, BO ≤ 8 BI ≤ 21, BO ≤ 16 BI ≤ 32, BO ≤ 24 BI ≤ 43, BO ≤ 32 Model version/ Language A,B,C... VT, CT, Frequency rating 100 – 120Vac, 1A, 50Hz, 110/125Vdc 100 – 120Vac, 1A, 60Hz, 110/125Vdc 100 – 120Vac, 5A, 50Hz, 110/125Vdc 100 – 120Vac, 5A, 60Hz, 110/125Vdc 100 – 120Vac, 1A, 50Hz, 220/250Vdc 100 – 120Vac, 1A, 60Hz, 220/250Vdc 100 – 120Vac, 5A, 50Hz, 220/250Vdc 100 – 120Vac, 5A, 60Hz, 220/250Vdc 100 – 120Vac, 1A, 50Hz, 48/54/60Vdc 100 – 120Vac, 1A, 60Hz, 48/54/60Vdc 100 – 120Vac, 5A, 50Hz, 48/54/60Vdc 100 – 120Vac, 5A, 60Hz, 48/54/60Vdc 100 – 120Vac, 1A, 50Hz, 24Vdc 100 – 120Vac, 1A, 60Hz, 24Vdc 100 – 120Vac, 5A, 50Hz, 24Vdc 100 – 120Vac, 5A, 60Hz, 24Vdc Hardware options Communication RS485 Fibre optic. dual RS485 dual Fibre optic. RS485 + fibre optic RS485 + 10BASE-FL RS485 + 100BASE-FX RS485 + 10BASE-T Fibre opt. + 10BASE-FL Fibre opt. + 100BASE-FX RS485 + dual 10BASE-FL RS485 + dual 100BASE-FX RS485 + dual 10BASE-T Fibre opt. + dual 10BASE-FL Fibre opt. + dual 100BASE-FX Miscellaneous None							1 2 3 4	0	1 2 3 4	A	1 2 3 4 5 6 7 8 A B C D E F G H		1 2 3 4 9 A B C D E F G H J K	0

ORDERING INFORMATION (cont'd)

PC TOOLS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R	S	M	1	0	0	–	0		–	0	0	–	0	0
Tool software														
RSM100 software (Standard)								1						
RSM100 + PLCEdit software								2						
RSM100 + MMEdit software								3						
RSM100 + PLCEdit + MMEdit software								4						

Protocol Converter (Option)

Type:		G1PR2 – [] A – [] – []
Protocol converter	G1PR2	
Model:		
1 port, Electrical signal (RS485)	101	
4 ports, Electrical signal (RS485)	104	
8 ports, Electrical signal (RS485)	108	
8 ports, Electrical signal (RS485): Max. 8, Optical signal: Max. 1	118	
8 ports, Electrical signal (RS485): Max. 8, Optical signal: Max. 4	148	
8 ports, Electrical signal (RS485): Max. 4, Optical signal: Max. 8	184	
1 port, Electrical signal (RS485) or Optical signal	111	
1 port, Optical signal	110	
4 ports, Optical signal	140	
8 ports, Optical signal	180	
AC power supply rating:		
AC 100/DC 110V	10	
AC 200/DC 220V	50	
DC 48V	A0	
External time synchronisation:		
None.	00	
Provided. (IRIG-B)	10	

TYPICAL APPLICATIONS / CONNECTIONS

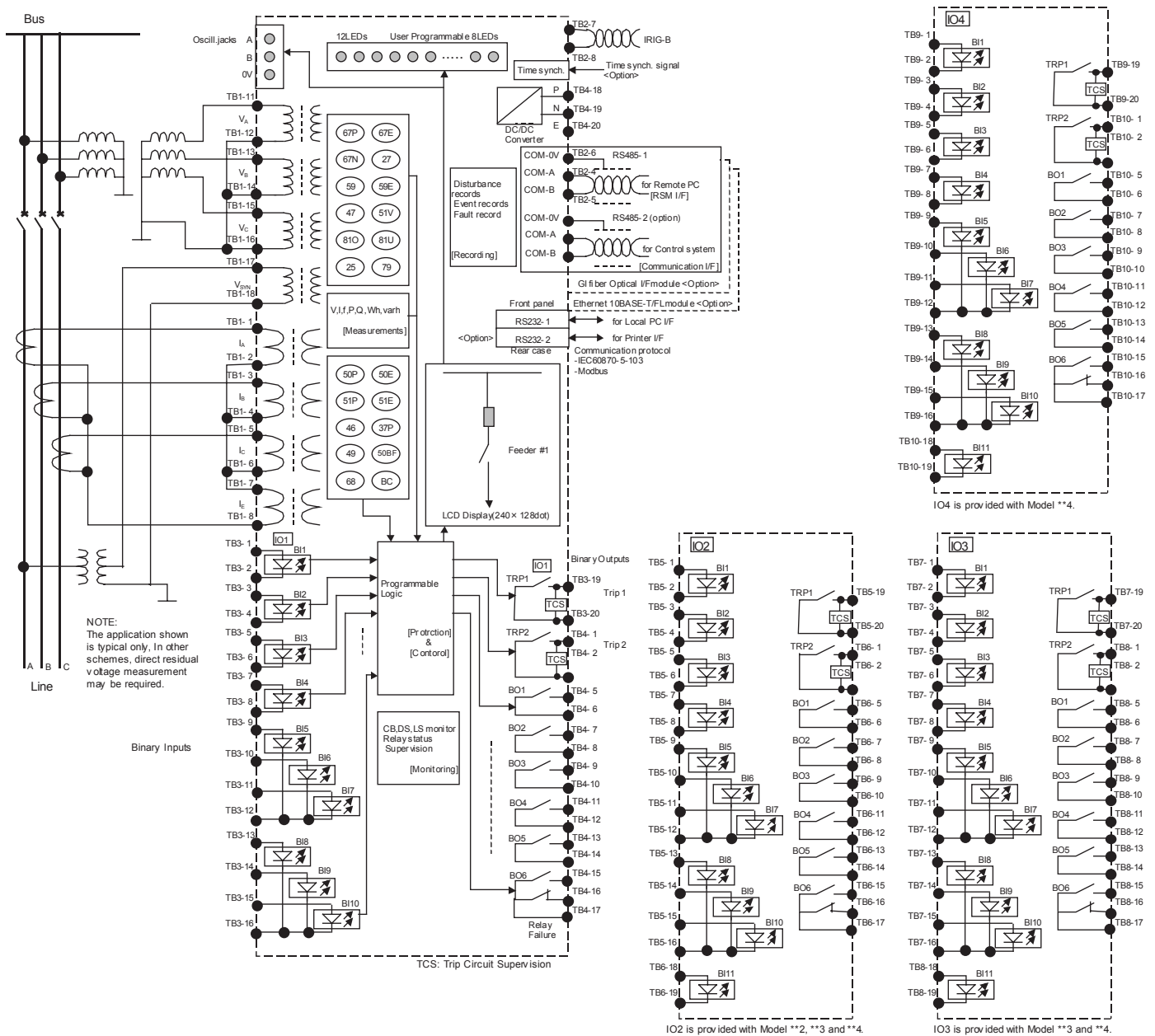


Figure 7 - GRD150 Typical Application Diagram

OUTLINE

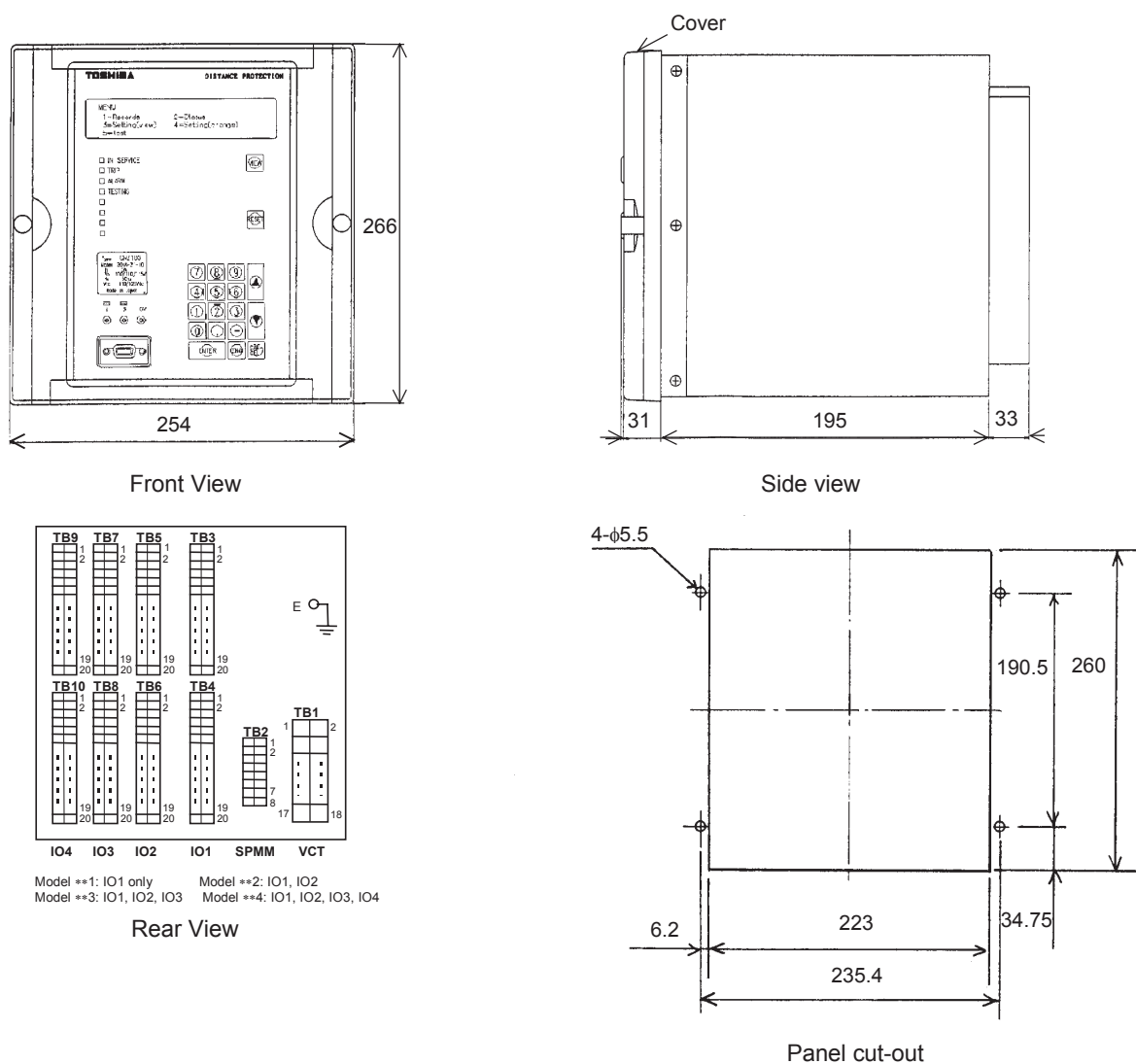


Figure 8 - Outline and Panel Cut-out Dimension

Numerical Relay CRD150

Feeder Manager

TOSHIBA

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The data given in this catalog are subject to change without notice.

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