TOSHIBA

GR Series Relay

Numerical Relay

GRD130

NUMERICAL UNDER/OVERVOLTAGE PROTECTION

FEATURES

- Phase undervoltage protection with IDMTL or DTL.
- Phase overvoltage protection with IDMTL or DTL.
- Zero phase sequence overvoltage (neutral voltage displacement) protection with IDMTL/DTL.
- Negative phase sequence overvoltage protection with IDMTL or DTL.
- Programmable reset characteristics.
- Four settings groups.
- Configurable binary inputs and outputs.
- Circuit breaker condition monitoring.
- Trip circuit supervision.
- Automatic self-supervision.
- Menu-based HMI system.
- Configurable LED indication.
- Metering and recording functions.
- Communications for remote setting and data download is provided via the RSM (Relay Setting and Monitoring system.
- Front mounted RS232 serial port for local PC communications.
- Rear mounted RS485 or fibre optic serial port for remote PC communications.
- The IEC60870-5-103 protocol is provided for communication with substation control and automation systems.

APPLICATION

The GRD130 is a range of fully numeric voltage protection relays. GRD130 has two models which differ according to the number of voltage inputs fitted, see Table 1.

Table 1 - GRD130 Models

Model	Configuration
GRD130-210	2 pole
GRD130-410	4 pole

Both models include multiple, high accuracy, phase under/overvoltage protection with inverse time and definite time delay functions. Voltage inputs can be configured for phase to phase or phase to neutral operation. Zero sequence overvoltage (neutral voltage displacement) protection is available for detection of earth faults in high impedance earthed or isolated systems. For protection against operation on unbalanced supply voltages, negative phase sequence overvoltage protection is also available. The ZPS and NPS overvoltage protections are available depending on the model and on the configuration selected, see Table 2.

GRD130 provides continuous monitoring of internal circuits and of software. External circuits are also monitored, by trip circuit 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
- Disturbance recording (available via communications ports)

Table 2 - GRD130 Features

Model Number	GRD130 -		
	210		410
Configuration	$1V_{ph-ph}+V_0$ $1V_{ph-n}+V_0$	$2V_{ph-ph}$	$3V_{ph-n}$ $3V_{ph-n}+V_0$ $3V_{ph-ph}+V_0$ $2V_{ph-ph}+V_0$
Phase O/V (IDMTL) 59	✓	✓	✓
Phase O/V (DTL) 59	✓	✓	✓
Phase U/V (IDMTL) 27	✓	✓	✓
Phase U/V (DTL) 27	✓	✓	✓
ZPS O/V (IDMTL) 59N	✓	-	✓
ZPS O/V (DTL) 59N	✓	-	✓
NPS O/V (IDMTL) 47	-	✓	✓
NPS O/V (DTL) 47	-	✓	✓
Trip circuit supervision	✓	✓	✓
Self supervision	✓	✓	✓
CB State Monitoring	✓	✓	✓
Trip Counter Alarm	✓	✓	✓
Multiple settings groups	✓	✓	✓
Metering	✓	✓	✓
Fault records	✓	✓	✓
Event records	✓	✓	✓
Disturbance records	✓	✓	✓
Communication	✓	✓	✓

PROTECTION FUNCTIONS

Phase Overvoltage Protection

GRD130 overvoltage protection provides three independent overvoltage thresholds. The first and second thresholds may be set for inverse time or definite time operation. The third threshold can be programmed for definite time operation.

The first and second thresholds has a programmable reset feature, selectable for instantaneous or definite time operation. Each element gives outputs for alarm and trip, and each trip output can be inhibited by binary input.

Phase Undervoltage Protection

GRD130 undervoltage protection provides three independent undervoltage thresholds. The first and second thresholds may be set for inverse time or definite time operation. The third threshold can be programmed for definite time operation.

The first and second thresholds has a programmable reset feature, selectable for instantaneous or definite time operation. Each element gives outputs for alarm and trip, and each trip output can be inhibited by binary input.

An undervoltage blocking function prevents undervoltage tripping in the case of a dead line.

Zero Phase Sequence Overvoltage Protection (ZPS)

GRD130 provides ZPS protection with two independent overvoltage thresholds. The two thresholds may be set for inverse time or definite time operation. The two thresholds have a programmable reset feature, selectable for instantaneous or definite time operation.

In the case of GRD130-410, the zero sequence voltage, V_0 may either be calculated from the three measured phase voltages, or it may be measured directly in the form of the system residual voltage, typically using a five limb VT.

In the case of GRD130-210, the V_0 must be measured directly.

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

Each element gives outputs for alarm and trip, and each trip output can be inhibited by binary input.

Negative Phase Sequence Overvoltage Protection (NPS)

GRD130 provides NPS protection with two independent overvoltage thresholds. The two thresholds may be set for inverse time or definite time operation.

The two thresholds have a programmable reset feature, selectable for instantaneous or definite time operation. Each element gives outputs for alarm and trip, and each trip output can be inhibited by binary input.

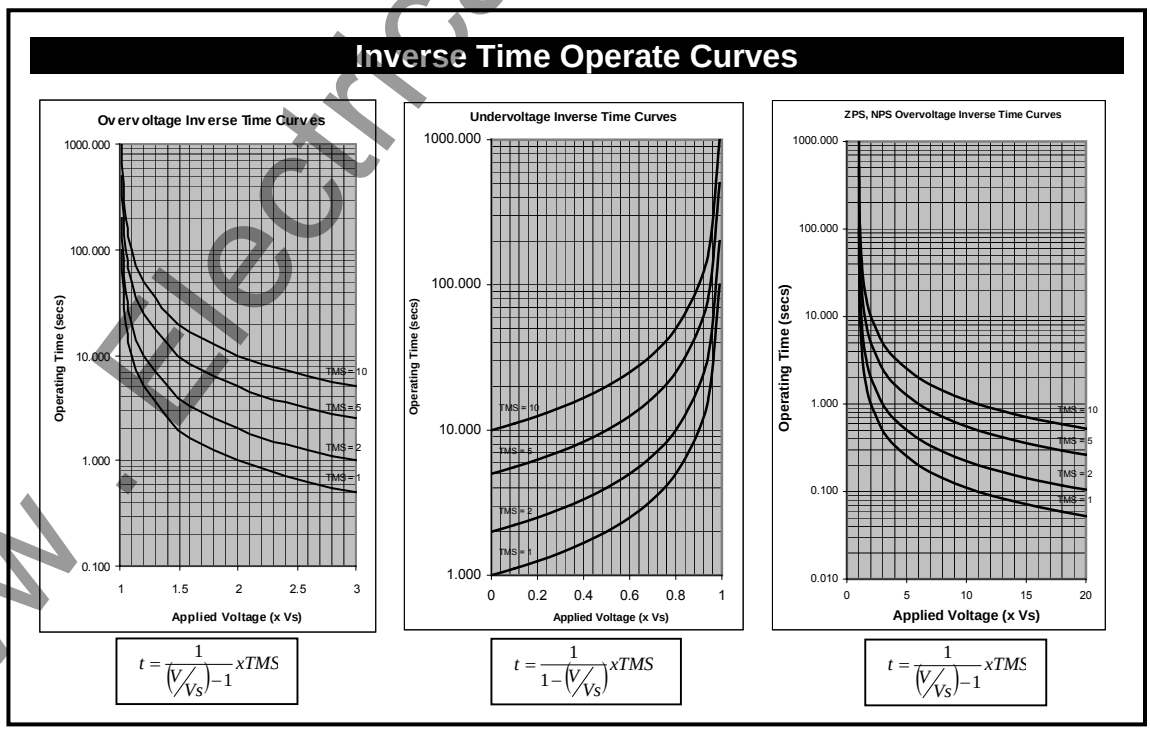


Figure 1 - IDMT curves for Overvoltage, Undervoltage and ZPS, NPS Overvoltage

MONITORING FUNCTIONS

Trip Circuit Supervision

The circuit breaker tripping control circuit can be monitored by a binary input. Figure 2 shows a typical scheme. When the trip circuit is complete, a small current flows through the binary input, the circuit breaker auxiliary contacts and the trip coil. This current flows for both the breaker open and closed conditions.

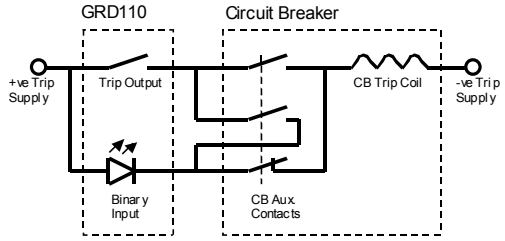


Figure 2 - Trip Circuit Supervision Scheme

If the trip supply is lost or if a connection becomes open circuit then the binary input resets and a Trip Circuit Fail alarm is given in the form of an output contact operation and LCD or LED indication.

Automatic Self-Supervision

Automatic monitoring of internal circuits and software is provided. In the event of a failure being detected, the ALARM LED on the relay fascia is illuminated, the 'RELAY FAILURE' binary output operates, and the date and time of the failure is recorded in the event record.

Circuit Breaker State Monitoring

If two binary inputs are programmed to the functions 'CB OPEN' and 'CB CLOSED' then the CB State Monitoring function becomes active. In normal circumstances these inputs are in opposite states. If both show the same state then a 'CB Defective' alarm is raised.

Trip Counter Alarm

The trip counter increments the number of tripping operations performed, and an alarm is issued when the count exceeds a user-defined setting. The trip count is triggered each time a trip is issued, and they can also be triggered by an external device via a binary input.

METERING AND RECORDING

Metering

The following data is continuously available on the relay fascia LCD and at a local or remote PC.

- Primary and secondary voltages for each input.
- Positive and negative phase sequence voltages.
- Power frequency.
- CB trip count.
- CB status.
- Relay element output status.
- Binary input and output status.

Event Record

Records are stored for the 480 most recent events, time-tagged to 1ms resolution. The event record is available on the relay fascia LCD and at a local or remote PC. Events are recorded as follows:

- Tripping operations.
- Alarms.
- Operation of protection elements.
- Change of state of binary inputs / outputs.
- Change of relay setting.
- Failure detected by automatic supervision.

Fault Record

A relay trip initiates fault recording. Records are stored for the 8 most recent faults, time-tagged to 1ms resolution. The fault record is available on the relay fascia LCD and at a local or remote PC. Fault records include the following data:

- Date and time of trip operation.
- Faulted phase.
- Protection element responsible for trip.
- Measured voltage data.

Disturbance Record

The relay can record 4 analog and 32 binary signals, initiated by relay tripping. The post-trigger recording time can be set, and the maximum number of records which can be stored is dependent on the recording time chosen.

Date and Time

GRD130 provides a date and time feature for tagging of records.

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.

- 16 character, 2-line LCD with backlight.
- 6 LEDs.
- Keypad.
- RS232C serial port for connection of local PC.

Local PC Connection

The user can communicate with the GRD130 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)

GRD130 can be connected to the RSM system via the rear mounted serial communications port, using either RS485 or fibre optic connections (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 x 8 relays can be connected to the remote PC in multi-drop mode, by connection via a protocol converter G1PR2, with a maximum data transmission rate of 64kbps. The G1PR2 can be provided with maximum 8 ports and each port supports maximum 32 relays addressing.

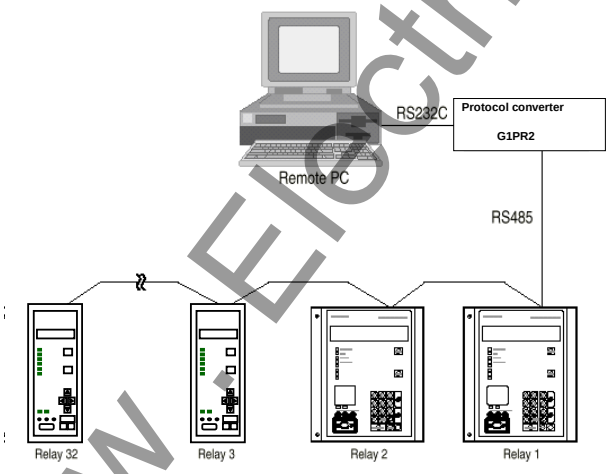


Figure 3 - Relay Setting and Monitoring System

Figure 3 and 4 show the configuration of the RSM system and typical displays from the RSM100 software.

IEC60870-5-103 Communications

GRD130 supports the IEC60870-5-103 communication protocol. This protocol is used for communication with a substation control and monitoring system and is used to transfer measurand data, status data and general commands between the relay and the control system.

Relay Setting

The user can modify relay settings either using the front panel keypad or using the RSM100 software from a local or remote PC. Password protection is available for added security.

Four settings groups are provided, allowing the user to set one group for normal conditions, while the other groups may be set to cover alternative operating conditions.

Using the RSM software, the user can create a settings file on a PC (without being connected to a relay), and store the file ready for download to a relay at a later date.

Binary Outputs

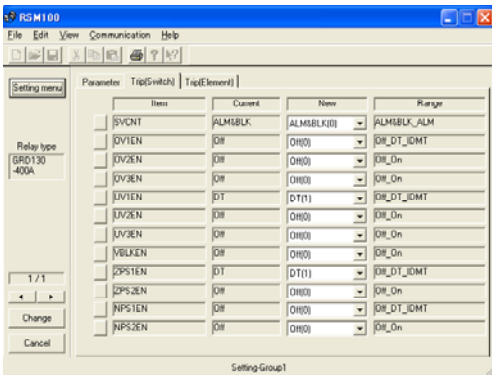
GRD130 provides eight binary output contacts for tripping and alarm, of which seven are user programmable. Each of the programmable binary outputs is driven via a logic gate which can be programmed for OR gate or AND gate operation. Further, each output has a programmable reset characteristic, settable for instantaneous drop-off, delayed drop-off, or for latching operation. If latching operation is selected then an operated relay must be reset by the user, either by pressing the RESET button, by energising a binary input which has been programmed for 'Remote Reset' operation, or by a communications command.

Binary Inputs

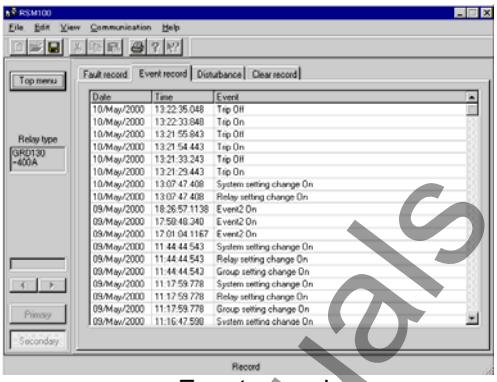
GRD130 provides eight programmable binary inputs. Each binary input is individually user-programmable for normal or inverted operation and for delayed pick-up and/or drop-off. Each input can also be used to switch relay operation to a different settings group.

General purpose alarm functions are also included. The user can define a text message for each alarm. Then when inputs associated with that alarm are raised, the defined text is displayed on the LCD.

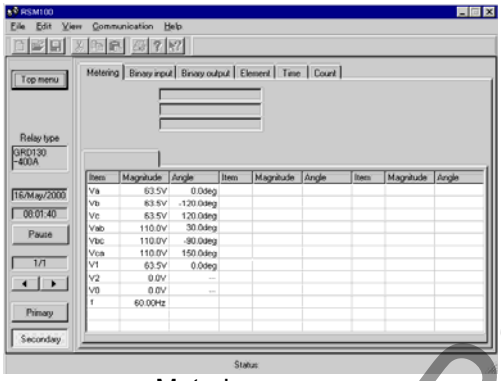
PC DISPLAY



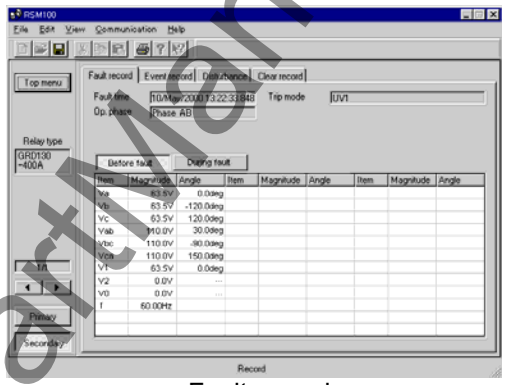
Setting



Event record



Metering



Fault record

Figure 4 - Relay Setting and Monitoring System - PC Displays

TECHNICAL DATA

Ratings	
AC voltage V_n:	110V
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:	maximum 12%
DC supply interruption:	maximum 50ms at 110V
Binary input circuit DC voltage:	110/125Vdc (Operative range: 88 - 150Vdc) 220/250Vdc (Operative range: 176 - 300Vdc) 48/54/60Vdc (Operative range: 38.4 - 72Vdc)
Overload Ratings	
AC voltage inputs:	2 times rated voltage continuous
Burden	
AC phase voltage inputs:	≤ 0.1VA (at rated voltage)
DC power supply:	≤ 10W (quiescent), ≤ 15W (maximum)
Binary input circuit:	≤ 0.5W per input at 110Vdc
Overvoltage Protection	
1st, 2nd, 3rd Overvoltage thresholds:	OFF, 10.0 – 200.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 - 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 - 300.00s in 0.01s steps
DO/PU ratio	10 - 98% in 1% steps
Reset Delay (1st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Undervoltage Protection	
1st, 2nd, 3rd Undervoltage thresholds:	OFF, 5.0 – 130.0V in 0.1V syeps
Delay type (1st 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 (1st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Zero Sequence Overvoltage (ZPS) Protection	
1st, 2nd ZPS Overvoltage thresholds:	OFF, 1.0 – 160.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 - 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 - 300.00s in 0.01s steps
Reset Delay (1st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Negative Sequence Overvoltage (NPS) Protection	
1st, 2nd NPS Overvoltage thresholds:	OFF, 1.0 – 160.0V in 0.1V steps
Delay type (1st threshold only):	DTL, IDMTL
IDMTL Time Multiplier Setting TMS:	0.05 - 100.00 in 0.01 steps
DTL delay:	Inst, 0.01 - 300.00s in 0.01s steps
Reset Delay (1st threshold only):	Instantaneous, 0.1 – 300.0s in 0.1s steps
Accuracy	
IDMTL Overvoltage Pick-up:	105% of setting ± 5%
All Other Overvoltage Pick-ups:	100% of setting ± 5%
Overvoltage PU/DO ratio:	≥95% (settable for phase overvoltage)
IDMTL Undervoltage Pick-up:	95% of setting ± 5%
All Other Undervoltage Pick-ups:	100% of setting ± 5%
Undervoltage PU/DO ratio:	≤105%
Inverse Time Delays:	± 5% or 30ms
Definite Time Delays:	± 1% or 10ms

Front 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
Rear Communication port - remote PC (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 system 9.6, 19.2kbps for IEC60870-5-103
Rear Communication port - remote PC (Fibre Optic for IEC60870-5-103: option)	
Connection:	Multidrop (max. 32 relays)
Cable type:	50/125 or 62.5/125μm fibre
Cable length:	1000m (max.)
Connector:	ST
Transmission rate:	9.6, 19.2kbps for IEC60870-5-103
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
Binary Outputs	
Number	8
Ratings:	Make and carry: 4A continuously Make and carry: 20A, 290Vdc for 0.5s (L/R≥5ms) Break: 0.1A, 290Vdc (L/R=40ms)
Durability:	Loaded contact: 10000 operations Unloaded contact: 100000 operations
Mechanical design	
Weight	4.5kg
Case color	Munsell No. 10YR8/0.5
Installation	Flush mounting

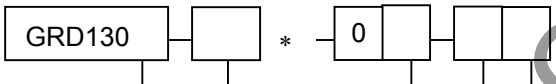
ENVIRONMENTAL PERFORMANCE

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	IP50 – Dust Proof
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

Test	Standards	Details
Electrical 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 / EN61000-4-12	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 / EN61000-4-2	6kV contact discharge, 8kV air discharge.
Radiated RF Electromagnetic Disturbance	IEC60255-22-3 Class 3, IEC61000-4-3 / EN61000-4-3	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 / EN61000-4-4	4kV, 2.5kHz, 5/50ns applied to all inputs.
Surge Immunity	IEC60255-22-5, IEC61000-4-5 / EN61000-4-5	1.2/50μs surge in common/differential modes: HV ports: 4kV/2kV (peak) PSU and I/O ports: 2kV/1kV (peak) RS485 port: 1kV/0.5kV (peak)
Conducted RF Electromagnetic Disturbance	IEC60255-22-6 Class 3, IEC61000-4-6 / EN61000-4-6	10Vrms applied over frequency range 150kHz to 100MHz. Additional spot tests at 27 and 68MHz.
Power Frequency Disturbance	IEC60255-22-7, IEC61000-4-16 / EN61000-4-16	300V 50Hz for 10s applied to ports in common mode. 150V 50Hz for 10s applied to ports in differential mode. Not applicable to AC inputs.
Conducted and Radiated Emissions	IEC60255-25, EN55022 Class A, IEC61000-6-4 / EN61000-6-4	Conducted emissions: 0.15 to 0.50MHz: <79dB (peak) or <66dB (mean) 0.50 to 30MHz: <73dB (peak) or <60dB (mean) Radiated emissions (at 30m): 30 to 230MHz: <30dB 230 to 1000MHz: <37dB
European Commission Directives		
CE	89/336/EEC	Compliance with the European Commission Electromagnetic Compatibility Directive is demonstrated according to EN 61000-6-2 and EN 61000-6-4.
	73/23/EEC	Compliance with the European Commission Low Voltage Directive is demonstrated according to EN 50178 and EN 60255-5.

ORDERING

Under/Overvoltage Relay



Type:	
Under/Overvoltage Relay	GRD130
Model:	
Two pole	210
Four pole	410
Frequency:	
50Hz	1
60Hz	2
DC auxiliary supply rating:	
110V/125V	1
220V/250V	2
48V/54V/60V	3
Rear communication port:	
RS485	1
Fibre optic	2
Dual RS485	3
RS485 + Fibre optic	9

TYPICAL APPLICATIONS / CONNECTIONS

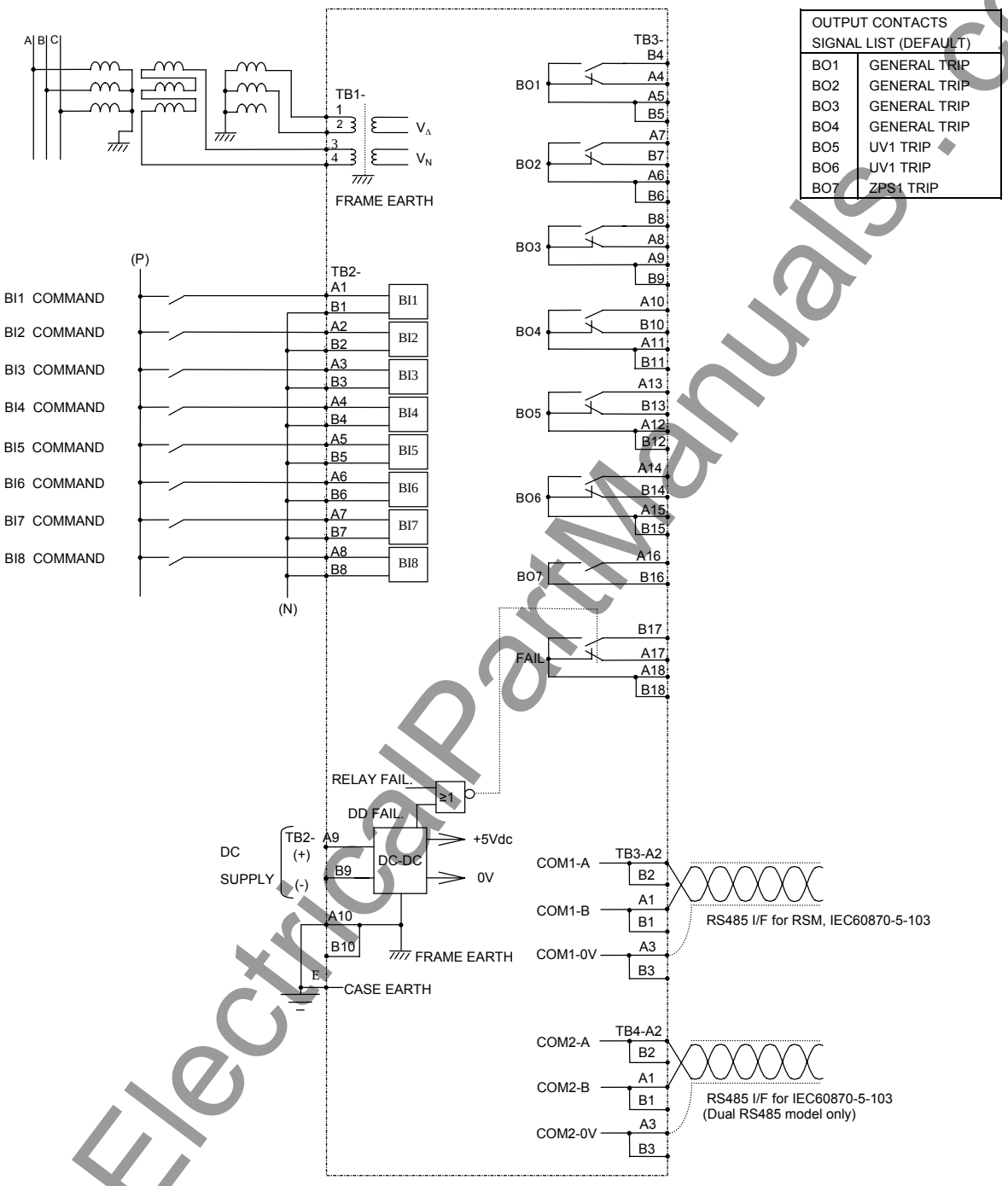
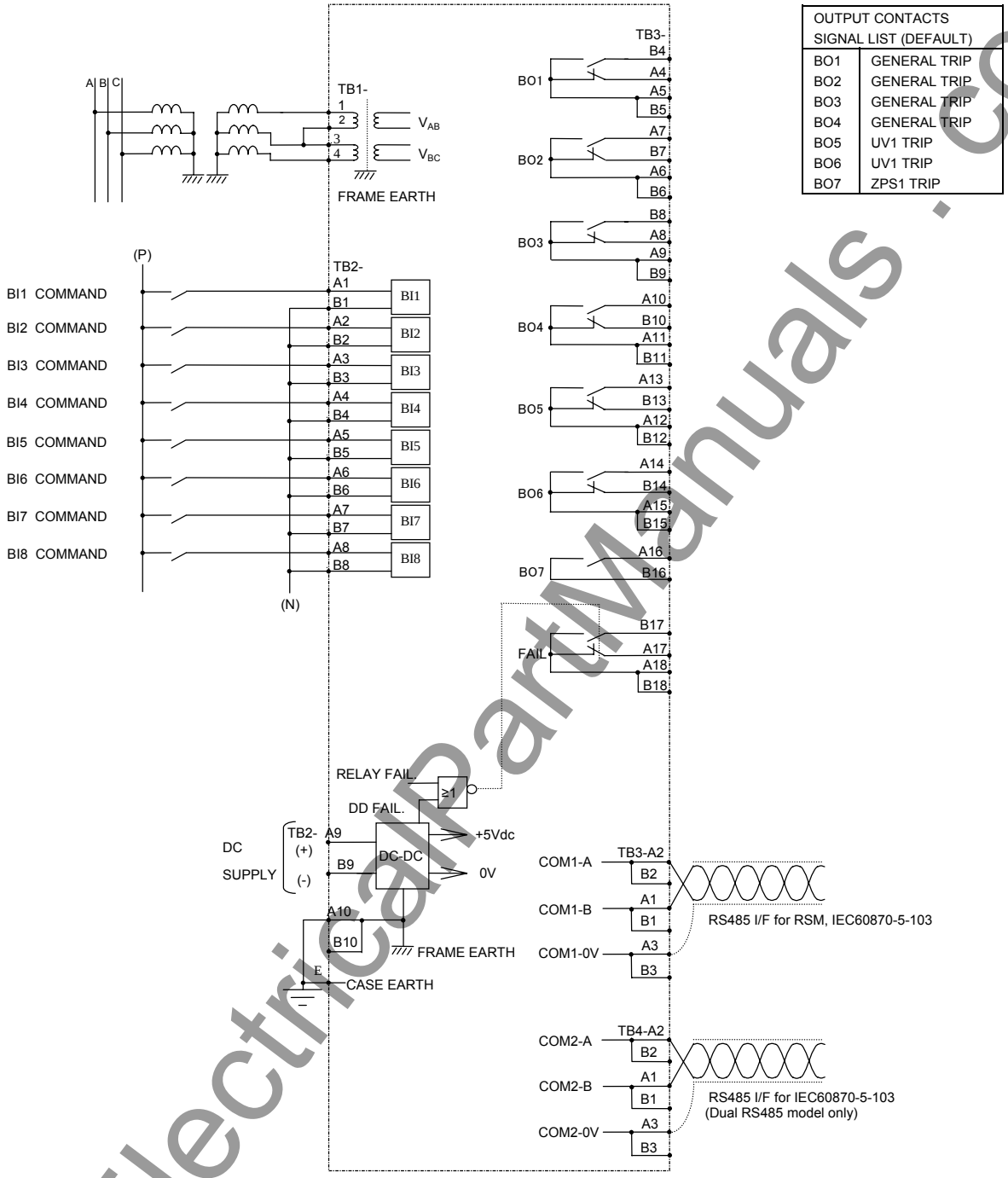


Figure 5 - GRD130-210 Typical Application Diagram for Single Phase-to-Phase Voltage and Direct Neutral Connection



OUTPUT CONTACTS SIGNAL LIST (DEFAULT)	
BO1	GENERAL TRIP
BO2	GENERAL TRIP
BO3	GENERAL TRIP
BO4	GENERAL TRIP
BO5	UV1 TRIP
BO6	UV1 TRIP
BO7	ZPS1 TRIP

Figure 6 - GRD130-210 Typical Application Diagram for Two Phase-to-Phase Voltage Connection

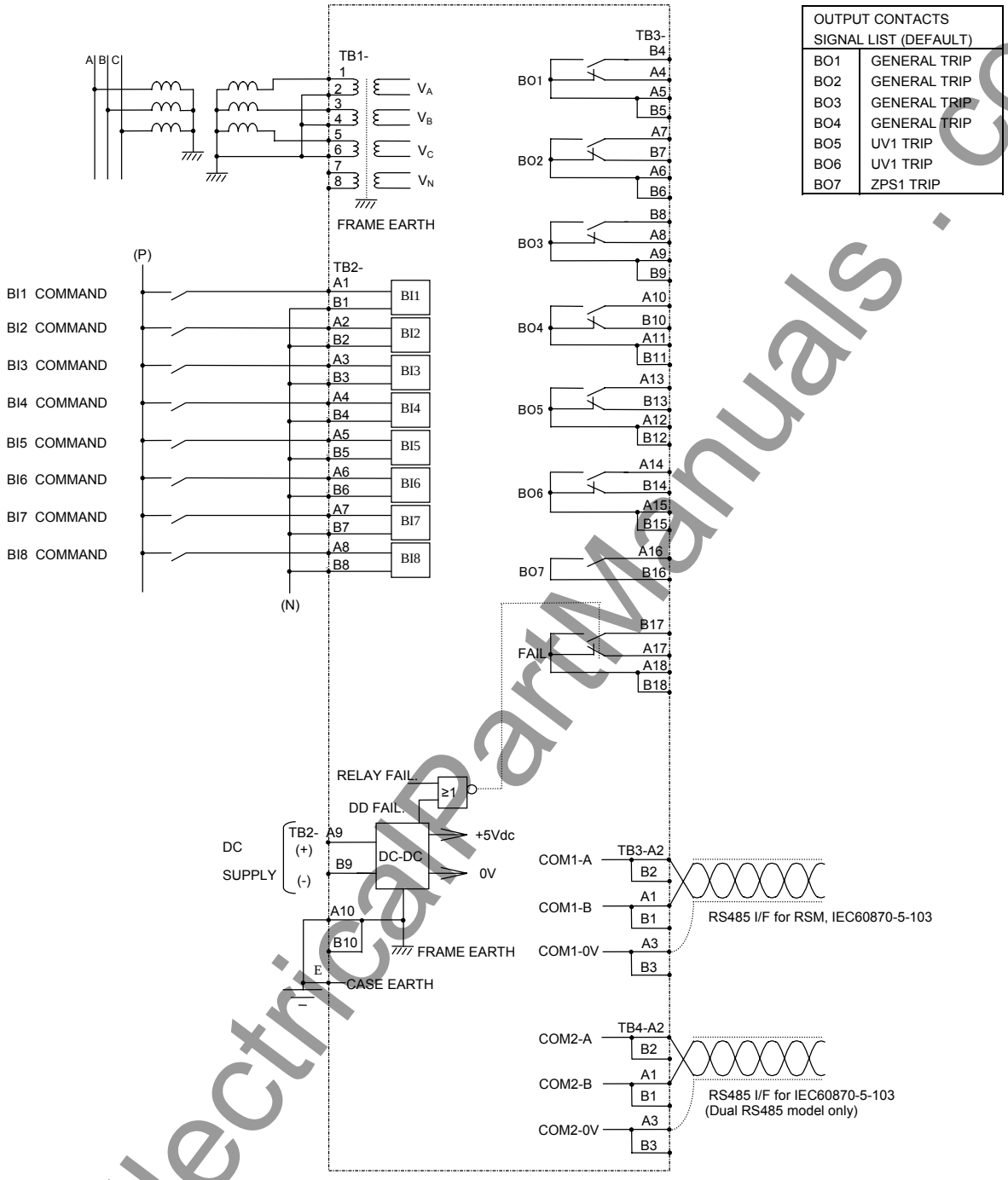


Figure 7 - GRD130-410 Typical Application Diagram for Three Phase to Neutral Voltage Connection (Derived Zero Sequence Quantity)

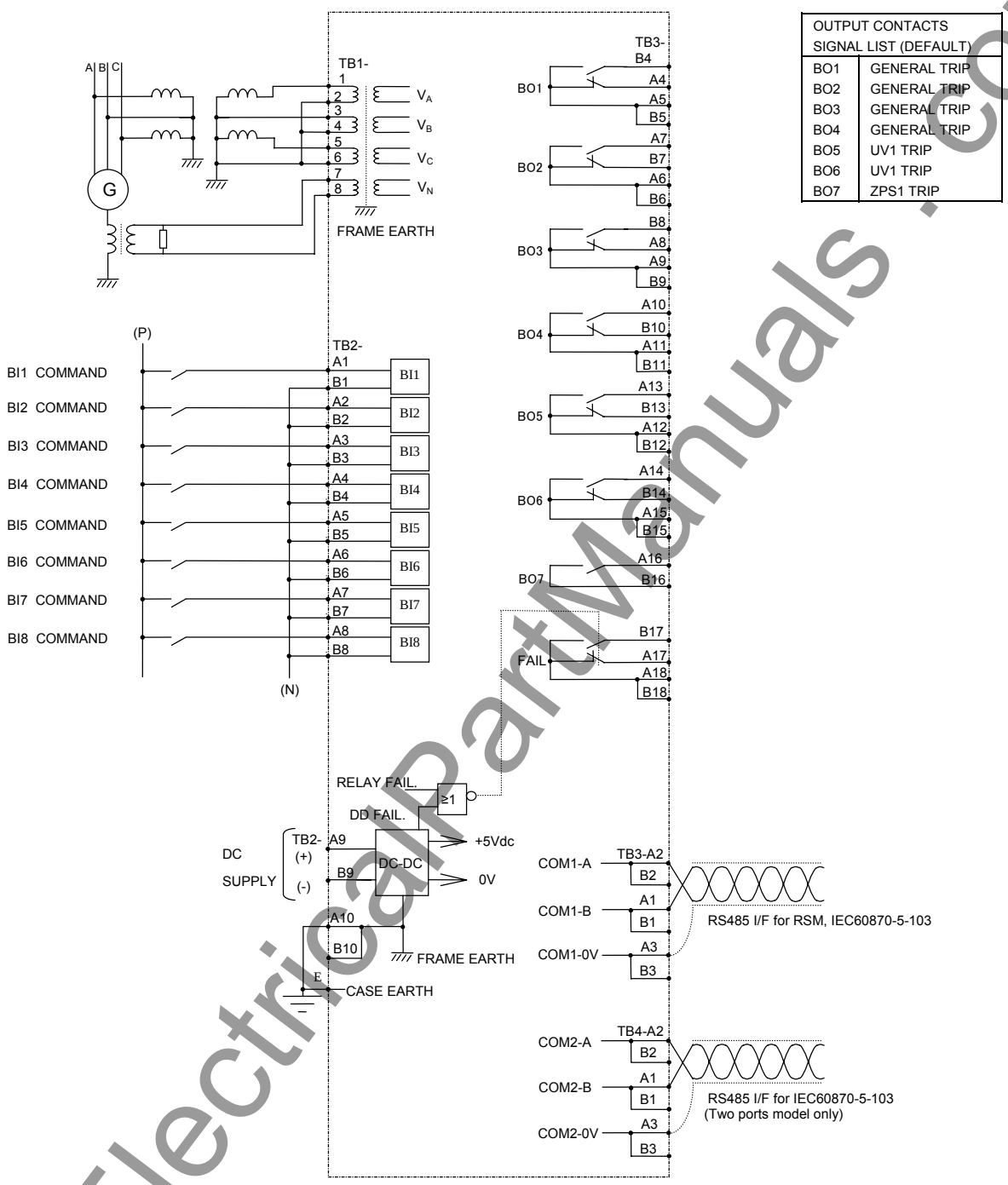


Figure 8 - GRD130-410 Typical Application Diagram for Two Phase VT Connection with Residual Voltage Measured by Earthing Transformer

RELAY OUTLINE

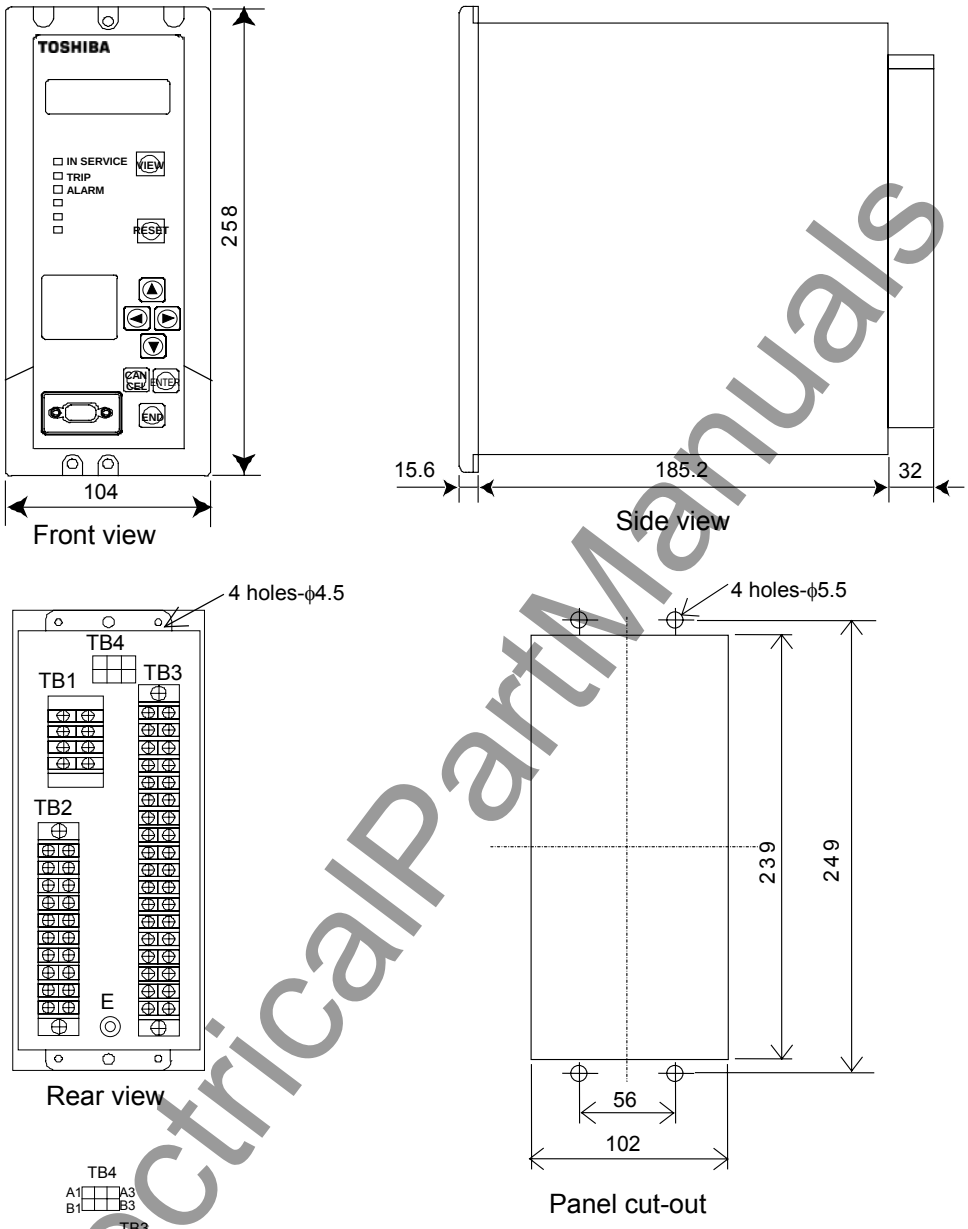


Figure 9 - GRD130 Outline Diagram

Numerical Relay

GRD130

NUMERICAL UNDER/OVERVOLTAGE PROTECTION

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