TOSHIBA

GR Series Relay

Numerical Relay

GRC100

BREAKER FAILURE PROTECTION

FEATURES

- Numerical breaker failure protection
- Retrip function of original circuit breaker
- Back trip of adjacent circuit breakers
- Phase segregated protection
- Configurable binary outputs
- Automatic monitoring
- Metering and recording functions
- Menu-driven user interface
- Two serial ports for a local PC and a remote PC
- IRIG-B port for external clock

APPLICATION

GRC100 is a numerical breaker failure relay which issues a back trip command to adjacent circuit breakers in the event that the original circuit breaker fails.

If the fault current continues to flow for a pre-determined period of time after the issue of the original trip command, the GRC100 will issue a retrip command to the original circuit breaker. If fault current is still detected after the retrip then the relay will issue a trip command to adjacent circuit breakers.

GRC100 provides the following schemes,

- Retrip: Original circuit breaker instantaneous/time- delayed retrip with/without a overcurrent check.
- Back trip: Adjacent circuit breakers time-delayed trip when the original breaker fails to operate.

GRC100 can be applied for single busbar, double busbar and one-and-a-half breaker busbar systems.

GRC100 provides the following metering and recording functions.

- Metering
- Fault recording
- Event recording
- Disturbance recording

GRC100 provides the following user interfaces for relay settings or viewing of stored data.

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

The relay can be accessed from a local PC or a remote PC through communication ports.

A local PC can be connected to the relay via the RS232C port on the front fascia of the relay and a remote PC can be connected to the relay through the RS485 port at the rear of the relay.

FUNCTIONS

GRC100 incorporates three phase overcurrent elements and a zero sequence overcurrent element. The fast reset time of the overcurrent elements ensures high-speed protection.

Either phase overcurrent elements or phase overcurrent elements and a zero sequence overcurrent element can be used for current detection. The former enables per phase basis protection with individual timers and can operate correctly in the event of developing faults. The latter enables highly sensitive breaker failure detection for small fault currents.

■ Retrip

GRC100 provides a retrip of the original circuit breaker. A retrip command is given to the original circuit breaker before tripping adjacent circuit breakers. Instantaneous or delayed retrip command is issued unconditionally or under an overcurrent element operation. The use of retrip can be enabled or disabled.

■ Back trip

If the current continues to flow even after issuing a retrip command, GRC100 judges that the original circuit breaker failed. A trip command is then given to adjacent circuit breakers.

HARDWARE

Figure 1 shows the hardware block diagram of the relay.

The relay is a microprocessor design. The microprocessor performs software functions such as signal processing, protection algorithm, scheme logic, output relay control and management of the user interface.

Phase current analog inputs are provided. The internal auxiliary transformers are used to isolate, step down and condition the inputs from the CTs. Their output signals are then converted into digital data for further processing.

The front panel contains a 2x16 character, liquid crystal display (LCD) and 9 pushbutton keys to

provide local access to the relay menu. There are also 6 light emitting diodes (LED) for visual indication of the status of the relay.

The relay provides three communication ports, RS232C for connection of a local PC, RS485 for a remote PC and IRIG-B for an external clock.

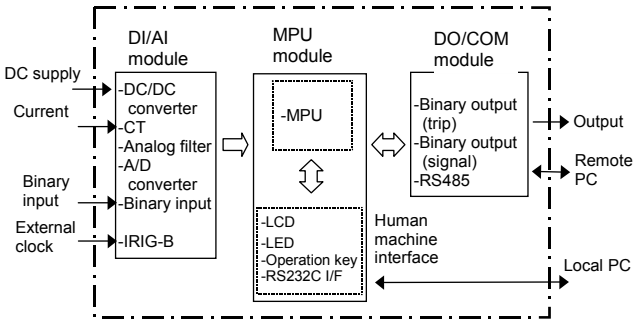


Figure 1. Hardware block diagram

The terminal blocks are located at the rear of the relay providing connections for all input and output circuits.

The relay is housed in the case as shown in Figure 4.

METERING AND RECORDING

■ Metering and Monitoring

Currents (phase, symmetrical components) are measured continuously and displayed on the LCD on the relay fascia, at the local PC, and the remote PC when connected, and can be indicated as primary or secondary values.

The user can monitor the following output and status on the LCD and at local/remote PCs.

- Relay element output
- Binary input/output

■ Event Record

The most recent 96 time-tagged events are stored with 1 ms resolution. Events recorded are as follows.

- Tripping
- Alarms
- Change of binary input signal
- Change of relay setting
- Relay failure

■ Fault Record

A relay trip initiates fault recording. Time-tagged fault data can be stored for the 8 most recent faults. Fault record items are as follows.

- Date and time
- Operating phase
- Pre-fault and post-fault current data

■ Disturbance Record

The relay can record 4 analog and 12 binary signals. The disturbance recorder is initiated by operation of the overcurrent element and/or relay tripping.

Pre-fault recording time is fixed at 300ms, and post-fault recording time is user selectable from 100ms to 3s. The maximum number of stored records depends on the post-fault recording time. In the case of a post-fault recording time of 500 ms, up to 20 disturbance records can be stored. The number of the recorded data is displayed on the LCD.

■ Calendar and Time

A calendar and time are provided for time-tagging of recorded data. Synchronisation with GPS (Global positioning system) is achieved via the IRIG-B port.

USER INTERFACE

■ Relay Front Panel

The relay front panel provides the following user interfaces. Setting the relay and viewing stored data are possible using the Liquid Crystal Display (LCD) and operation keys.

- 16 character, two line LCD with back light
- 6 Light Emitting Diodes (LEDs)
- Operation keys
- RS232C port
- Monitoring jacks

Figure 2 shows the relay front panel.

Figure 2. Relay front panel

The following items are displayed on the LCD.
- Setting
- Metering
- Event records
- Fault records
- The number of disturbance records
- Any failure message detected by the automatic monitoring

Password protection can be provided from the setting menu on the LCD to provide security for relay setting changes. After the password has been set, the password must be entered to access the setting menu from a local or remote PC as well as on the LCD.

Details of metering, fault records, and relay failures can be monitored by pressing the VIEW key. The VIEW key can be pressed without removing the relay front cover.

Arbitrary signals can be assigned to the two user configurable LEDs.

Two monitoring jacks are operable when the test mode is selected in the LCD window. An oscilloscope can be connected to the relay through these jacks. Selection of output signals to the monitoring jacks can be set from the menu.

■ Local PC

The user can communicate with the GRC100 from a local PC via the RS232C port on the relay fascia. The following data can be viewed or analysed on the local PC with RSM100 software.

- Setting
- Metering
- Event records
- Fault records
- Disturbance records

■ Relay Setting and Monitoring (RSM)

GRC100 can be connected to the RSM system via the RS485 interface at the rear of the relay. The user can operate the relay from a remote PC in the same way as from a local PC.

A maximum of 32 x 8 relays can be connected to the remote PC in multi-drop mode, via the protocol converter G1PR2. The G1PR2 can be provided with maximum 8 ports and each port supports maximum 32 relays addressing.

The RSM100 software is also used to communicate with the relay and to view or analyse disturbance records on the remote PC.

Data transmission rate between relays and the protocol converter is 64kbps.

Figure 3 shows the configuration of the RSM system.

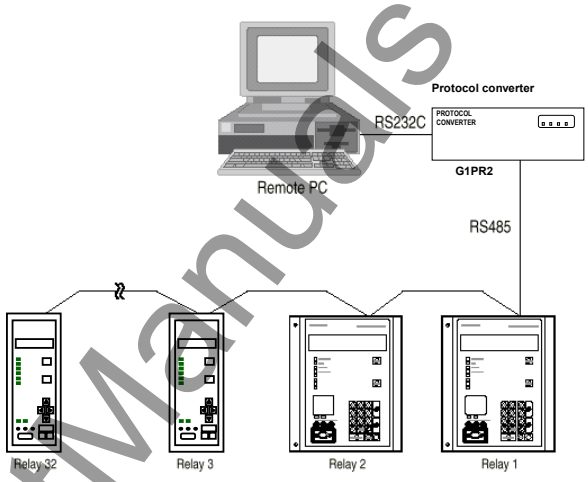


Figure 3. Relay setting and monitoring system

■ Relay Setting

The user can input or change settings using the operation keys on the relay fascia or via a local or remote PC with the RSM system.

Password protection is provided to change settings.

Four active setting groups are provided. This allows the user to set one group for normal operating conditions while other groups may be set to cover alternative operating conditions.

■ Configurable Binary Output Contacts

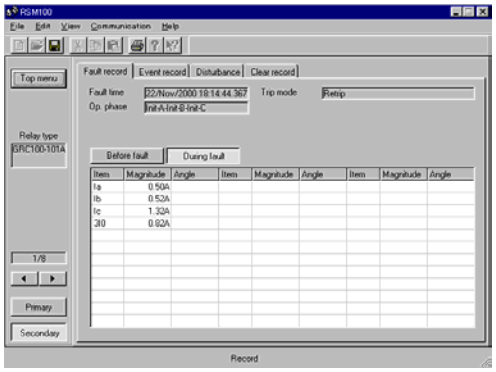
GRC100 is provided with 4 user configurable normally open output contacts for alarm and indication.

■ Binary Inputs

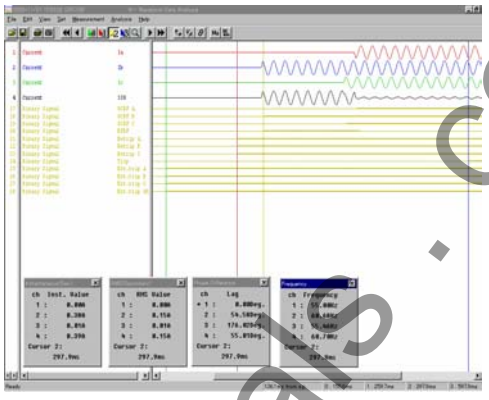
GRC100 is provided with 5 binary inputs for initiation of the GRC100 from external devices and indication reset.

The binary input circuit is provided with a logic level inversion function.

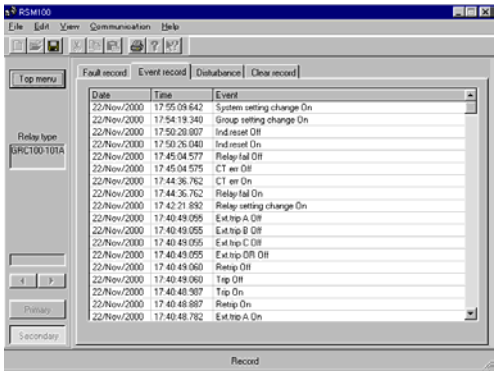
PC DISPLAY



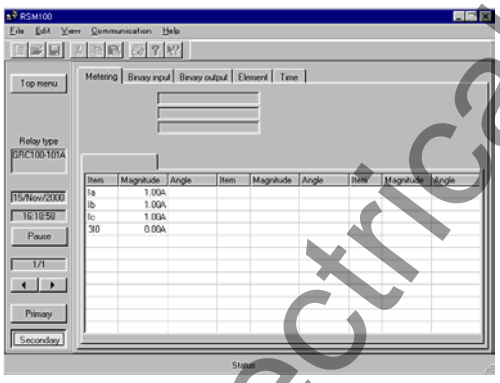
Fault record



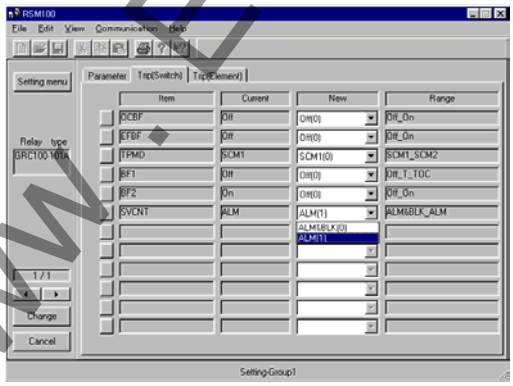
Wave form data analysis



Event record



Metering



Setting

AUTOMATIC MONITORING

■ Automatic Monitoring Function

The automatic monitoring function will detect failures, should they occur, that might cause unwanted operation. The items monitored include the following:

- Analog-to-digital converter
- Watchdog timer
- DC power supply circuits
- CPU

■ Alarms

In the unlikely event that a relay failure should occur, it will be detected by the automatic monitoring function and the LED ALARM on the relay fascia will be illuminated. A binary “RELAY FAILURE” output operates simultaneously and the date/time of any such failure will be stored in the event record.

TECHNICAL DATA

Ratings	
AC current	1A or 5A
Frequency	50Hz or 60Hz
DC power supply	110Vdc/125Vdc (Operative range: 88 to 150Vdc) 220Vdc/250Vdc (Operative range: 176 to 300Vdc) 48Vdc/54Vdc/60Vdc (Operative range: 38.4 to 72Vdc)
AC ripple on DC supply IEC 60255-11	maximum 12%
DC supply interruption IEC 60255-11 Permissive duration of DC supply voltage	maximum 50ms at 110Vdc
interruption to maintain normal operation	less than 10s
Restart time	110Vdc/125Vdc (Operative range: 88 to 150Vdc) 220Vdc/250Vdc (Operative range: 176 to 300Vdc)
Binary input circuit DC voltage	48Vdc/54Vdc/60Vdc (Operative range: 38.4 to 72Vdc)
Overload rating	
AC current input	4 times rated continuous 100 times rated for 1 seconds
Burden	
AC current circuit	0.2VA per phase (at rated 5A) 0.1VA per phase (at rated 1A)
DC power supply	less than 10W (quiescent) less than 15W(operation)
Binary input circuit	0.5W/input at 110Vdc
Breaker failure protection	
Phase overcurrent element	0.1 to 2.0A in 0.1A steps (1A relay) 0.5 to 10.0A in 0.1A steps (5A relay)
Zero sequence overcurrent element	0.1 to 2.0A in 0.1A steps (1A relay) 0.5 to 10.0A in 0.1A steps (5A relay)
Timer for retrip	0 to 500ms in 1ms steps
Timer for adjacent breaker trip	50 to 500ms in 1ms steps
Operating time and resetting time of overcurrent element	
Operating time	Less than 20ms at 50Hz Less than 17ms at 60Hz
Resetting time	Less than 15ms at 50Hz Less than 13ms at 60Hz
Accuracy	
Overcurrent element	±5%
Communication port	
Front communication port (local PC)	
Connection	Point to point
Cable type	Multi-core (straight)
Cable length	15m (max.)
Connector	RS232C 9-pin D-subminiature connector 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 1min.
IRIG-B port	
Connection	BNC connector
Cable type	50 ohm coaxial cable

Binary inputs	
Operating voltage	Typical 74Vdc(min. 70Vdc) for 110V/125Vdc rating Typical 138Vdc(min. 125Vdc) for 220V/250Vdc rating Typical 31Vdc(min. 26Vdc) for 48V/54V/60Vdc rating
Contact ratings	
Trip contacts	
Make and carry	5A continuously, 30A, 290Vdc for 0.5s (L/R=10ms)
Break	0.15A, 290Vdc (L/R=40ms)
Auxiliary contacts	
Make and carry	4A continuously, 10A, 220Vdc for 0.5s (L/R≧5ms)
Break	0.1A, 220Vdc (L/R=40ms)
Durability	
Make and carry	10,000 operations minimum
Break	100,000 operations minimum
Mechanical design	
Weight	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	IP51
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
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: 2kV/1kV PSU: 2kV/1kV RS485: 1kV

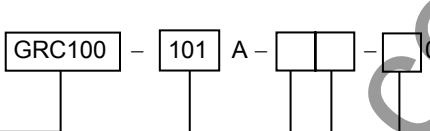
Test	Standards	Details
Conducted RF Electromagnetic Disturbance	IEC60255-22-6 Class 3, IEC61000-4-6 / EN61000-4-6	10Vrms applied over frequency range 150kHz to 100MHz. Additional spot tests at 27 and 68MHz.
Power Frequency Disturbance	IEC60255-22-7, IEC61000-4-16 / EN61000-4-16	300V 50Hz for 10s applied 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.

PROTOCOL 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	RS232C 9-pin D-subminiature connector female	
Cable type	Multi-core (straight)	
RS485 interface		
Connector	Screw terminals (Phoenix Contact, FRONT type)	
Cable type	Twisted pair cable	
Optical interface		
Operative Range:	less than 1.2km with 62.5/125μm GI fibre (3dB/km)	
Wavelength:	820nm	
Connector type:	ST	
Fibre type:	62.5/125μm glass fibre	
IRIG-B		
Connector	Screw terminals (Phoenix Contact, FRONT-MSTB type)	
Mechanical design		
Enclosure Protection	IEC60529, IP20	
Weight	5 kg	
Installation	Flush mounting	
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.

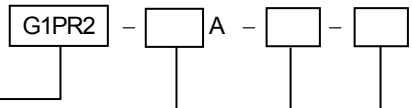
ORDERING

1. Breaker Failure Protection Relay



Relay Type:	
Breaker failure protection relay	GRC100
Model:	101
CT rating	
1A	1
5A	2
Frequency:	
50Hz	1
60Hz	2
DC power supply rating:	
110V/125V	1
220V/250V	2
48V/54V/60V	3

2. Protocol Converter (Option)



Type:	
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

RELAY OUTLINE

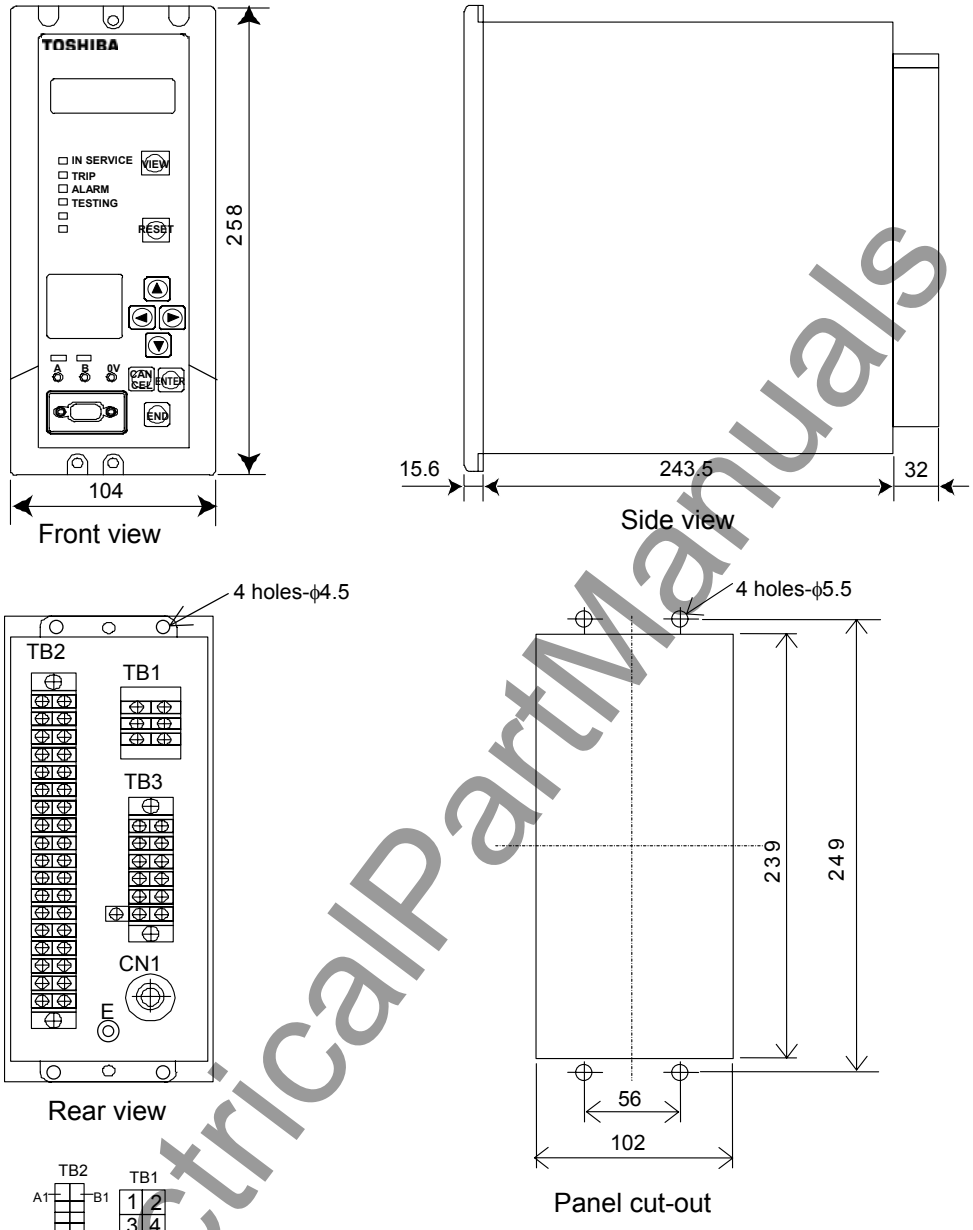
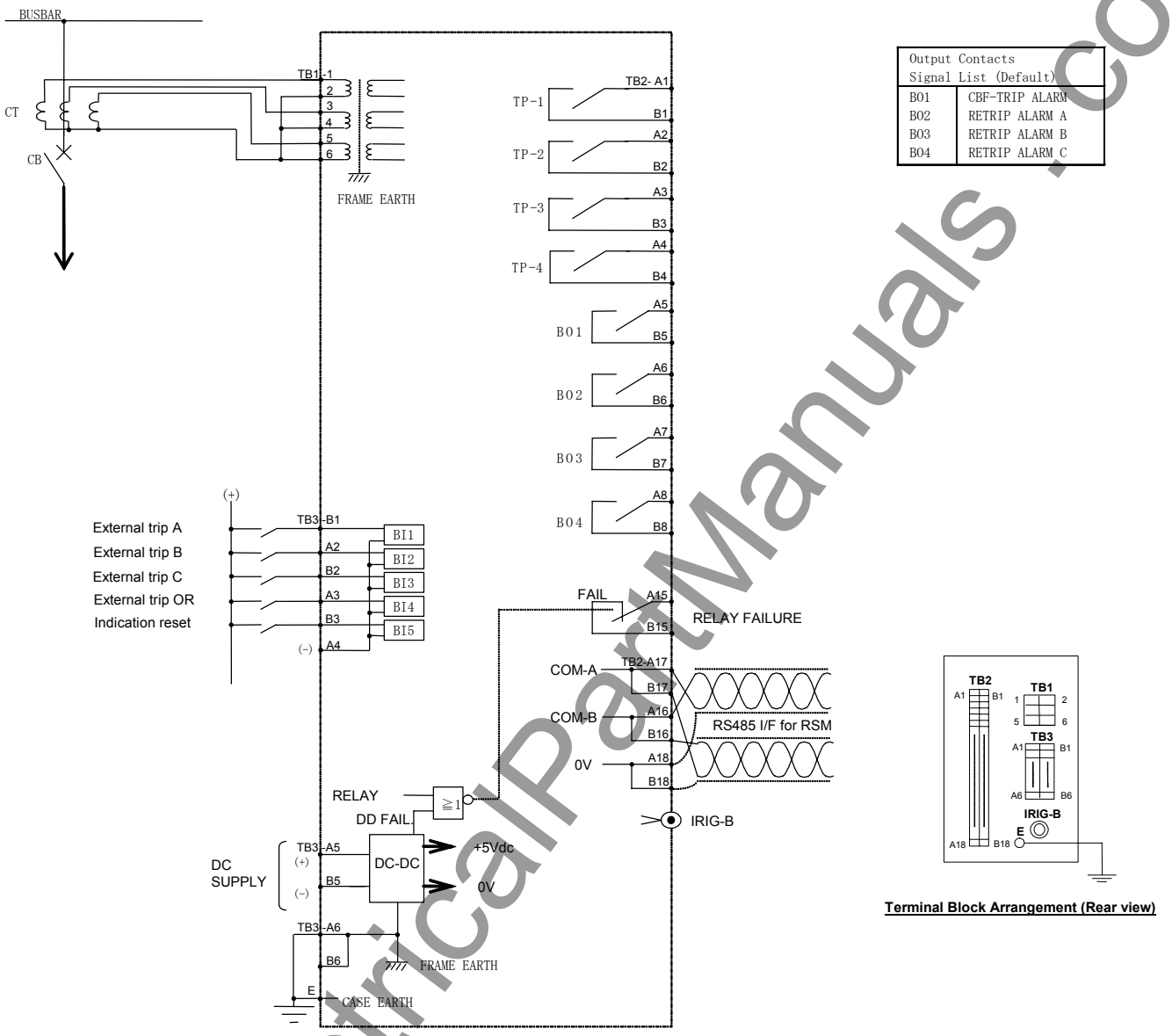


Figure 4. Outline of GRC100

EXTERNAL CONNECTION DIAGRAM



Output Contacts Signal List (Default)	
BO1	CBF-TRIP ALARM
BO2	RETRIP ALARM A
BO3	RETRIP ALARM B
BO4	RETRIP ALARM C

Terminal Block Arrangement (Rear view)

Figure 5. Typical External connection

Numerical Relay

GRL100

BREAKER FAILURE PROTECTION

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