

TOSHIBA

Leading Innovation >>>

GR-200 Series
GRL 200

*Line Differential
Protection IED*



GR-200 series -

The GR-200 Series is Toshiba's next generation of protection and control IED's, designed for transmission/distribution networks and providing a platform for distributed and renewable energy systems and railway applications. Flexible adaptation is enabled using extensive hardware and modular software combinations facilitating an application oriented solution.

Meeting your needs -

Extensive hardware and modular software combinations provide the flexibility to meet your application and engineering requirements.

Future upgrade paths and minor modifications are readily achievable on demand.

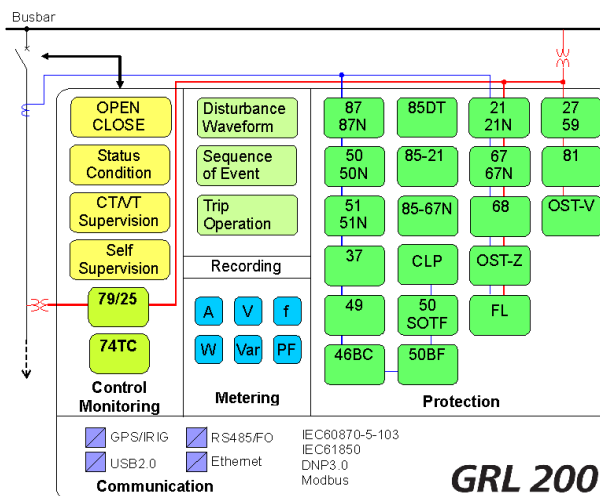
Powerful and wide application -

In addition to protection & control, GR-200 has been designed to meet the challenges and take advantage of developments in information & communications technology.

APPLICATION

GRL200 line differential protection is implemented on Toshiba's next generation GR-200 Series IED platform and has been designed to provide phase-segregated current differential protection using digital telecommunications, together with control applications. This powerful and user-friendly IED will provide you with the flexibility to meet your application and engineering requirements in addition to offering excellent performance, the high quality and operational peace of mind.

- Complete EHV/HV Transmission Line Protection package
 - Overhead lines or underground cables
 - Line differential protection for up to 3 terminals
 - Integrated Distance, Directional OC/EF and other voltage/current protections
 - Single or parallel lines
 - Lines with heavy load current
 - Short or long distance lines
 - Lines with weak or no in-feed
 - Single/three/multiphase tripping facilitating all auto-reclose schemes
- Communications
 - Line differential and teleprotection, direct optical fiber, ITU-T X.21, ITU-T G.703, IEEE Std. C37.94 and Ethernet packet-based communications
 - Within substation automation system or to a remote control centre, IEC 61850-8-1 [Station bus], Modbus® RTU protocol and IEC 60870-5-103



FEATURES

• Application

GRL200 can be applied in various EHV/HV network configurations.

- Overhead lines or underground cables
- Two to three-terminal lines
- Lines with weak or no-infeed
- Single or parallel lines
- Lines with heavy load current
- Short or long distance lines

• Functionality

- Eight settings groups
- Automatic supervision
- Metering and recording functions
- Time synchronization by external clock using IRIG-B or system network

• Communication

- System interface - RS485, Fiber optic, 100BASE-TX,-FX
- Multi protocol - Modbus® , IEC 60870-5-103 and IEC 61850

• Security

- Password protection

• Flexibility

- Various models and hardware options for flexible application depending on system requirement and controlled object
- Combined 1A / 5A current inputs
- Multi range DC power supply: 24 to 60V / 60 to 110 V / 110 to 250V
- Multi-language options
- Configurable binary inputs and outputs
- Programmable control, trip and alarm logic with PLC tool software

• Human Machine Interface

- Graphical LCD and 24 LEDs
- Configurable 7 function keys
- USB port for local PC connection
- Direct control buttons for open/close (O/I) and control authority (43R/L)
- Help key for supporting operation
- Monitoring terminals for testing

FUNCTIONS

• Protection

- Phase-segregated differential protection
- Zero-sequence current differential protection for high resistance earth faults
- Charging current compensation
- Distance protection with six independent zones
- Backup non-directional and directional earth fault command protection
- Non-directional and directional Overcurrent backup protection
- Non-directional and directional negative phase sequence overcurrent protection
- Undercurrent protection
- Thermal overload protection
- Broken conductor detection
- Circuit breaker failure protection
- Switch-on-to-fault (SOTF) protection
- Stub fault protection for one-and-a-half busbar system
- Phase to neutral and phase to phase

under/overvoltage protection

- Under/overfrequency protection
- Out-of-step protection
- Power swing blocking function
- Inrush Current Detector
- Cold load protection
- Direct transfer trip
- Fail-safe overcurrent scheme

• Control

- Single-shot (single / three / single + three phase / multi-phase) or multi-shot (three phase) autoreclose
- Synchronism voltage check
- Circuit breaker and isolator control
- Switchgear interlock check
- Programmable automatic sequence control
- Manual override

• Monitoring and Metering

- VT failure detection
- CT failure detection

- Relay address monitoring
- Status and condition monitoring of primary apparatus
- Switchgear operation monitoring
- Plausibility check
- Measurement of I, V, P, Q, PF, f, Wh and varh
- DC analog input [transducer input]
- DC analog output [transducer output]
- Current and voltage circuit supervision
- Trip circuit supervision
- Fault locator

• **HMI function**

- Selection of HMI: Standard LCD / large LCD / Separate large LCD
- Large LCD supports Single line diagram indication and touch-type operation or Multi-language option.
- 24 configurable tri-state LEDs selectable red/green/yellow
- 7 Programmable function keys for user

demand operation

• **Recording**

- Fault record
- Event record
- Disturbance record

• **Communication**

- IEC 60870-5-103 / IEC 61850
- Modbus® RTU / Modbus® TCP/IP

• **General functions**

- Eight settings groups
- Automatic supervision
- Metering and recording functions
- Time synchronization by external clock using IRIG-B or system network
- Password protection for settings and selection of local / remote control
- Checking internal circuit manually.
- Checking internal circuit using monitoring jacks.

APPLICATIONS

PROTECTION

■ Phase-segregated Current Differential Protection

GRL200 provides high-speed phase-segregated current differential protection for both phase-to-phase faults and phase-to-earth faults. The phase-segregated current differential protection exhibits high selectivity and sensitivity for all types of faults. It applies a percentage ratio differential characteristic as shown in Figure 1.

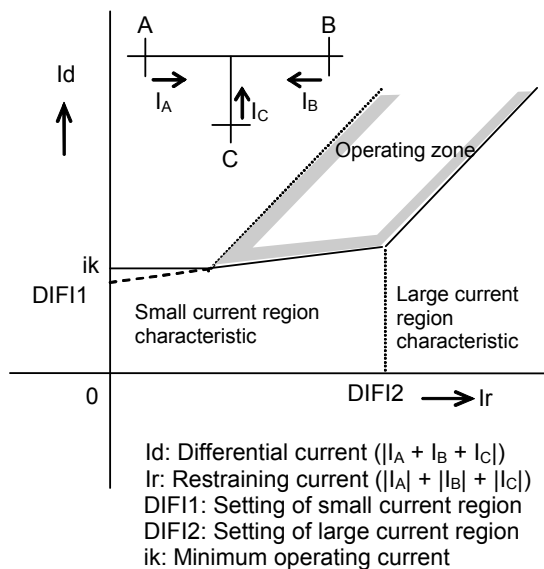


Figure 1 Percentage ratio differential element

The characteristic is composed of a small current region and a large current region. When the fault current is large, a large ratio is employed in the large current region of the characteristic, providing stability in the case of external faults accompanied by CT saturation.

Since a high level of sensitivity can be attained with the current differential relay, it can also detect high impedance faults provided that the load current is not too large.

■ Zero-sequence Current Differential Protection for High Impedance Earth Faults

Zero-sequence current differential protection can detect high impedance earth faults even with heavy load current. It applies the percentage ratio differential characteristic shown in Figure 2. As the restraining current is the scalar sum of the zero-sequence current at each terminal, the relay sensitivity is not affected by load current. When the zero-sequence current differential protection operates, it performs time-delayed three-phase tripping.

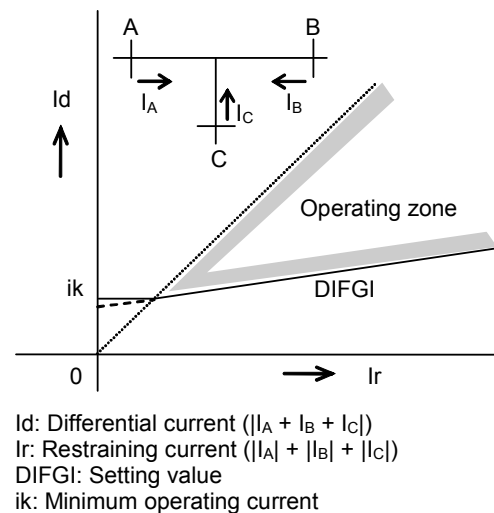


Figure 2 Zero-phase current differential element

■ Charging Current Compensation

When current differential protection is applied to underground cables or long-distance overhead lines, the charging current should be taken into account. It appears as an erroneous differential current in the no-fault condition and under external fault conditions. Charging current can be included within the relay setting, but the fault detection sensitivity for an internal fault is reduced as a consequence.

To suppress the effect of the charging current while at the same time maintaining its high fault detection sensitivity, GRL200 has a charging current compensation function which derives the charging current component from the phase current.

The amplitude of the charging current varies with that of the line voltage. If the value of charging current (DIFIC) at the rated line voltage is input, GRL200 calculates and compensates for the charging current at the measured line voltage.

Thus, instead of the phase current I_a , a compensated current $I = I_a - \text{DIFIC}$ is used for protection at all terminals.

■ Dual Communication

Dual communication mode can be applied to protection of two-terminal lines. Using dual communication mode, it is possible to maintain continuous operation of the current differential protection in the event of failure of one of the communication channels.

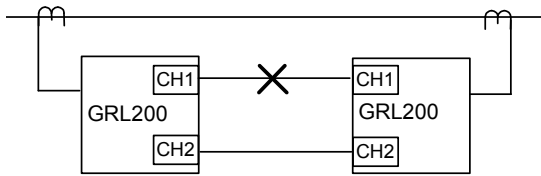


Figure 3 Dual Communication

■ Countermeasure for Through-Fault Current

As shown in Figure 4, for an external fault on a one-and-a-half busbar system, a large fault current I_A flows through CT1A and CT2A. If the saturation levels of CT1A and CT2A are different, an erroneous differential current may occur between I_{A1} and I_{A2} as a result of CT saturation.

This may cause terminal B to operate incorrectly if it is a weak infeed terminal and the restraining current is small.

To cope with the through-fault current, GRL200 can be set to output tripping commands under the condition that the differential protection operates at both terminals. As the remote current is sent by the result of DIF or each value of CT1 and CT2, GRL200 provide appropriate measurement on basis of CT's configuration.

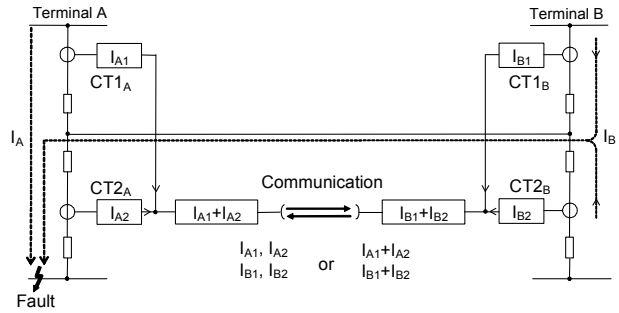


Figure 4 Through-fault current on one-and-a-half busbar system

■ Stub Protection

Stub protection operates for a fault in a stub zone on a breaker-and-a-half busbar system. With the auxiliary contact of the line disconnector open, only the local terminal current is used as the operating quantity by setting the remote terminal current data to zero.

■ Transfer Trip Function

GRL200 provides a transfer trip function which receives a trip signal from the remote terminal and outputs a trip command. Two transfer trip commands are provided. The sending signal is configured by PLC function. If the sending signal is assigned on a per phase basis by PLC, single-phase tripping is available.

■ Out-of-Step Protection

By transmitting the phase information of the local voltage to the remote terminal, the out-of-step protection can measure the phase difference between the terminals of a transmission line as illustrated in Figure 5. It detects an out-of-step condition when the difference in the phase angle exceeds 180° , and trips both terminals.

The out-of-step protection can detect an out-of-step condition even with a high rate of slip.

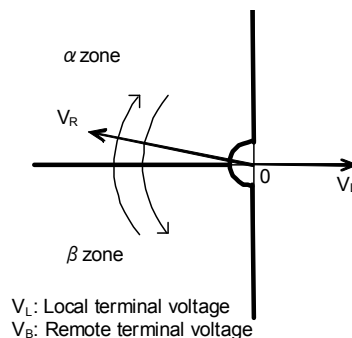


Figure 5 Out-of-step protection element

■ **Non-directional and Directional Overcurrent and Earth Fault Protection**

GRL200 provides non-directional and directional overcurrent protections with inverse time and definite time characteristics for both phase faults and earth faults.

Inverse time overcurrent protection consists of an IDMT (inverse definite minimum time) element. IDMT is available in conformity with the IEC 60255-151 standard which encompasses both the IEC and IEEE/ANSI standard characteristics. Alternatively, a user-configurable curve may be created.

The IDMT element has a programmable reset feature, selectable for instantaneous, definite time or dependent time operation. This feature can be used to protect against intermittent fault conditions, or to grade correctly with electromechanical overcurrent relays.

Definite time overcurrent protection is enabled by the instantaneous overcurrent element and pickup-delay timer.

Tripping by each element can be disabled by scheme switches, and overcurrent backup protection can be blocked by a binary input signal.

GRL200 can also provide non-directional and directional earth fault protection. Protection functionality is the same as for the phase fault elements.

The directional earth fault elements have a user selectable minimum voltage threshold.

GRL200 can provide directional earth fault command protection by using two-stage directional earth fault elements, of which one is for tripping and the other is for blocking or for current reversal detection.

■ **Non-Directional and Directional Sensitive Earth Fault Protection**

GRL200 provides non-directional and directional earth fault protection with more sensitive settings for use in applications where the fault current magnitude may be very low.

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

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

■ **Non-directional and Directional Negative Phase Sequence Overcurrent Protection**

Negative phase sequence overcurrent (OCN) protection can be used in applications where certain fault conditions may not be detected by the normal phase and earth overcurrent protections, for example, in the case of a relay applied on the delta side of a delta-star transformer, to detect an earth fault on the star side. Alternatively, OCN can be used to protect a three phase motor against the severe overheating which results from operating with an unbalanced supply.

The negative phase sequence overcurrent elements can be directionalised by polarising against the negative phase sequence voltage.

■ **Phase Undercurrent Protection**

Protection against loss of load is provided by the phase undercurrent protection. Two independent stages are provided, each with a programmable definite time delay.

■ **Breaker Failure Protection**

When an overcurrent element remains in operation longer than a pre-determined length of time following the output of a trip signal the associated circuit breaker is judged to have failed and adjacent circuit breakers can be tripped as a back-up measure.

Two independent timers are available, one of which can be used to control the RETRIP of the original circuit breaker(s). The second timer is used to control the back-tripping of adjacent circuit breakers.

For high-speed protection, an overcurrent element with high-speed reset time is used to prevent a spurious re-trip or back-trip following a successful trip or re-trip action.

■ **Broken Conductor Detection**

The unbalance condition caused by an open circuited conductor is detected by the broken conductor detection function. An unbalance threshold with programmable definite time delay is provided.

■ **Thermal Overload Protection**

The thermal overload feature provides protection for cables and other plant against the effects of prolonged operation under excess load conditions. A thermal replica algorithm is applied to create a model for the thermal characteristics of the protected plant. Tripping

times depend not only on the level of overload current, but also on the level of prior load current, the thermal replica providing 'memory' of previous conditions.

The thermal characteristics of the system are defined by entering settings for full load current and thermal time constant. GRL200 issues a trip according to the 'cold' and 'hot' curves specified in IEC 60255-8 as shown in Figure 6, to prevent the protected system from exceeding its thermal capacity. The cold curve tripping times are applicable when the system is first energised, while the hot curves are relevant when the system has already been carrying some prior load for a period of time. An alarm output is also available to give early warning of high load current, set as a percentage of thermal capacity.

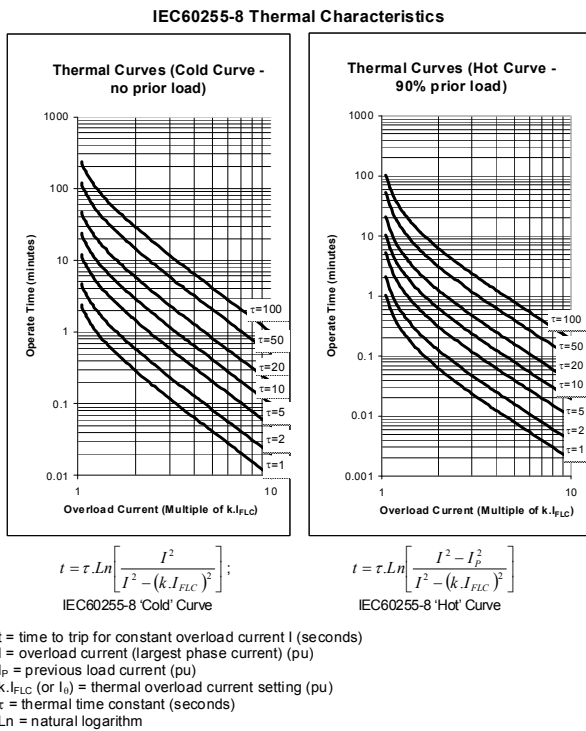


Figure 6 IEC60255-8 thermal characteristics

■ Overvoltage Protection

GRL200 provides overvoltage protections for both phase-to-phase voltage input and phase-to-neutral voltage input. All stages can be set for inverse time or definite time operation. In total, therefore, GRL200 provides four independent overvoltage thresholds.

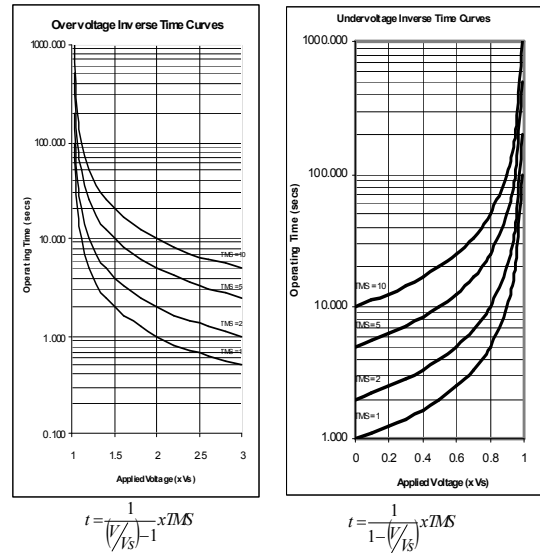


Figure 7 Inverse time characteristics

■ Zero Phase Sequence Overvoltage (Neutral Voltage Displacement) Protection

Neutral voltage displacement (NVD) protection is provided for detection of earth faults in high impedance earthed or isolated systems. NVD can be programmed with definite time delays, and one stage is also available with an inverse delay. The zero sequence voltage may be derived from the phase voltages, or directly measured. Suppression of superimposed 3rd harmonic components of the supply voltage is included.

■ Negative Phase Sequence Overvoltage Protection

For detection of unbalanced supply voltages, Negative Sequence (OVN) overvoltage thresholds are available, both of which can be programmed with definite time delays, and one is also available with an inverse delay.

■ Positive Phase Sequence Overvoltage Protection

To detect an overvoltage condition on a steady state, positive phase sequence overvoltage is provided. The overvoltage condition is observed for a light-loaded long transmission lines of which capacitance is large, and it is also recognized as so-called Ferranti-effect. Series reactors are normally installed for reducing the effect of capacitance, however, when the series reactor is not functioning, the network must be tripped for preventing further damages.

■ **Undervoltage Protection**

GRL200 provides two-stage undervoltage protection for phase-to-phase voltage input and two-stage undervoltage protection for phase-to-neutral voltage input. The undervoltage protection is provided with an undervoltage blocking function to prevent undervoltage tripping in the case of a dead line.

■ **Positive Phase Sequence Undervoltage Protection**

GRL200 provides positive phase sequence undervoltage protection element to detect steady-state and transient-state undervoltage conditions.

■ **Under/Overfrequency Protection**

GRL200 provides over/under frequency protection and frequency rate-of-change protection.

These protections provide independent frequency protection stages. The over/under frequency protection is programmable for either under- or over-frequency operation, and each has an associated DTL timer. The frequency rate-of-change protection calculates the gradient of frequency change (df/dt).

■ **Inrush Current Detector**

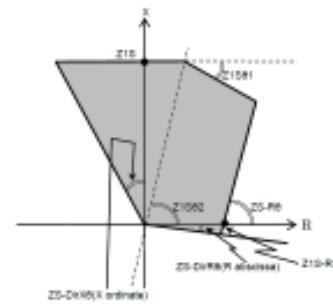
The inrush current detector is used to prevent an incorrect operation of overcurrent protections from a magnetising inrush current during transformer energisation. Inrush current detector (ICD) detects second harmonic inrush current during transformer energisation.

■ **Cold Load Protection**

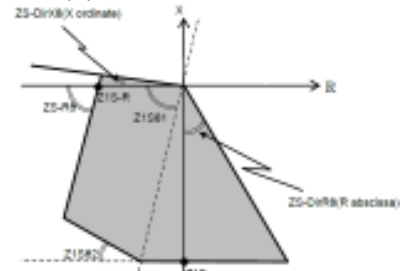
The cold load function modifies the overcurrent protection settings for a period after energising the system. This feature is used to prevent unwanted protection operation when closing on to the type of load which takes a high level of current for a period after energisation.

■ **Distance Protection**

GRL200 provides a distance protection scheme, so realizing a complete line protection capability within a single package. It provides four independent distance protection zones, the characteristics of which are shown in the Figure 8 and 9. Individual measurement zones are provided for phase-fault and earth-fault.



(a) Forward zone



(c) Non directional zone

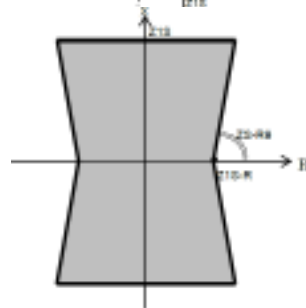
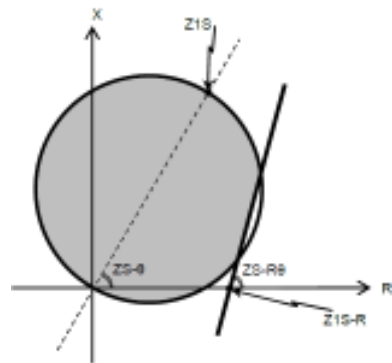
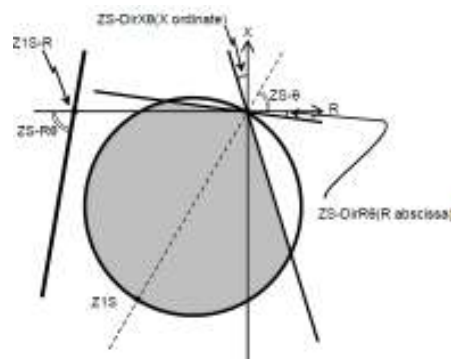


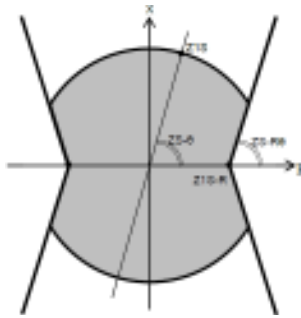
Figure 8 Quadrilateral Characteristics



(a) Forward zone



(b) Reverse zone



(c) Non directional zone

Figure 9 Mho-based Characteristics

■ OC/UV and EF Guard Schemes

GRL200 provides OC, OCD, UV, UVS, UVD and EFD elements as additional fault detection criteria to prevent unwanted operation in the unlikely event that a communication failure should go undetected. OC is a phase overcurrent element, OCD is a phase current change detection element, UV is a phase undervoltage element, UVS is phase to phase undervoltage element, UVD is phase voltage change detection element and EFD is a zero-sequence current change detection element.

Control

■ Autoreclose

Most faults on HV and EHV overhead transmission lines are transient faults, which are removed following line de-energization. After a short time, the hot gases disperse and the air de-ionizes. After clearing the fault and de-ionizing the fault arc, reclosing can be performed. GRL200 provides two autoreclose schemes, single-shot autoreclose and multi-shot autoreclose.

GRL200's autoreclose function can be initiated by any of the following high-speed protections.

- Protection using telecommunication
- Distance zone is set to zone 1 extension

■ Single-shot autoreclose

Single-shot reclosing can provide any of three autoreclose modes; single-phase autoreclose, three-phase autoreclose, single-and three-phase autoreclose and multi-phase autoreclose.

In the single-phase autoreclose mode, only a faulted phase is tripped, and then reclosed if a single-phase earth fault occurs.

In the three-phase autoreclose mode, all three phases are tripped, and then reclosed regardless of the fault mode, whether a single-phase fault or a multi-phase fault has occurred.

In the single- and three-phase autoreclose mode, the single-phase is reclosed if a single-phase is tripped and the three phases are reclosed if three phases are tripped.

Multi-phase autoreclose mode can be applied to double-circuit lines. In this mode, only the faulted phases are tripped and reclosed when the terminals of double-circuit lines are interconnected during the dead time through at least two or three different phases.

■ Multi-shot autoreclose

In a multi-shot autoreclose, two- to five-shot reclosing can be selected. The first shot is selected from any of the five autoreclose modes available in the single-shot autoreclose scheme.

If reclosing by the first shot fails, three-phase tripping and reclosing is applied for the second to fifth shots.

■ Synchronism Check

For the correct operation of three-phase autoreclose, voltage and synchronism check are necessary. The characteristics of the synchronism check element are shown in Figure 10.

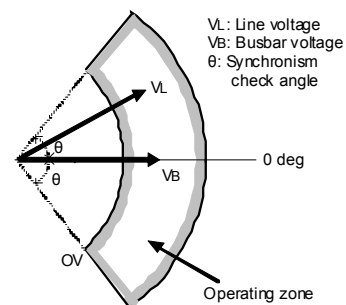


Figure 10 Synchronism check element

A detected slip cycle is determined by the following equation:

$$f = \frac{\theta}{180^\circ \times \text{XTSYN}}$$

where,

f: slip cycle

θ: synchronism check angle setting

TSYN: synchronism check timer setting

■ One-and-a-half Breaker Scheme

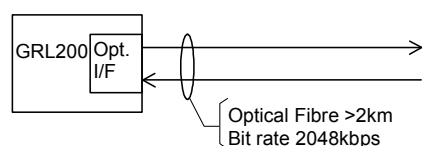
GRL200 performs two-breaker autoreclose in a one-and-a-half breaker scheme.

Only single-shot autoreclose is available in a one-and-a-half breaker scheme. Single-phase autoreclose, three-phase autoreclose or single and three-phase autoreclose can be applied to the two circuit breakers.

■ Interfaces with Telecommunication Systems

Current data sampled at the local terminal is transmitted to the remote terminal(s) via the telecommunication system.

GRL200 can be provided with the following interface(s) and linked to a dedicated optical fibre communication circuit or multiplexed communication circuit (multiplexer) shown in Figure 11.



a) Optical interface

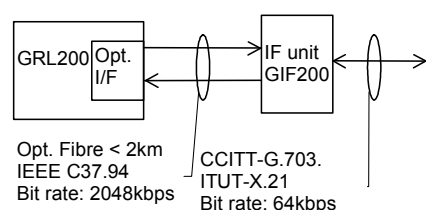


Figure 11 Telecommunication system

HMI FUNCTION

■ Front Panel

GRL200 provides the following front panel options.

- Standard LCD
- Large LCD (optional separate LCD type is also available)

The standard LCD panel incorporates the user interfaces listed below. Setting the relay and viewing stored data are possible using the Liquid Crystal Display (LCD) and operation keys.

- 21 character, 8 line LCD with back light
- Support of English language

The large LCD panel incorporates a touch type screen for control and navigation purposes.

■ Switchgear Control

GRL200 provides functions for local control of switchgear from the HMI. Two-stepped operation (select-control) is applied for the control of circuit breakers, isolator switches and earthing switches.

Also, switchgear control commands from the station level can be performed through GRL200 within the application of a substation automation control system.

■ Interlock check

The interlocking function blocks the operation of primary switching devices, for instance when an isolator switch is under load, in order to prevent equipment damage and/or accidental human injury.

Each switchgear control function has interlocking modules included for different switchyard arrangements, where each function handles interlocking for one bay. The interlocking function is distributed to each IED and is not dependent on any central function.

- 40 character, 40 line LCD with back light
- Support of multi language (20 character and 26 line LCD for multi-language)

The local human machine interface includes an LCD which can display the single line diagram for the bay.

The local human machine interface is simple and easy to understand with the following facilities and indications.

- Status indication LEDs (IN SERVICE, ERROR and 24 configurable LEDs)
- 7 Function keys for control, monitoring, setting group change and screen jump functions of which operation is configurable by the user
- Test terminals which can monitor three different

signals from the front panel without connection to the rear terminals.

- USB port



Figure 12 - HMI Panel

■ Local PC connection

The user can communicate with GRL200 from a local PC via the USB port on the front panel. Using GR-200 series engineering tool software (called GR-TIEMS), the user can view, change settings and monitor real-time measurements.

MONITORING

■ Metering

The following power system data is measured continuously and can be displayed on the LCD on the relay fascia, and on a local or remotely connected PC.

- Measured analog voltages, currents, frequency, active- and reactive-power

The accuracy of analog measurement is $\pm 0.5\%$ for I, V, P, Q at rated input and $\pm 0.03\text{Hz}$ for frequency measurement.

■ Status Monitoring

The open or closed status of each switchgear device and failure information concerning power apparatus and control equipment can be monitored by GRL200.

Both normally open and normally closed contacts are used to monitor switchgear status. If an unusual status is detected, a switchgear abnormality alarm is generated.

RECORDING

■ Event Record

Continuous event-logging is useful for monitoring of the system from an overview perspective and is a complement to specific disturbance recorder functions. Up to 1,024 time-tagged events are stored with 1ms resolution.

■ Fault records

Information about the pre-fault and fault values for currents and voltages are recorded and displayed for trip event confirmation. The most recent 8 time-tagged faults with 1ms resolution are stored. Fault record items are as follows.

- Date and time
- Faulted phase
- Tripping phase
- Operating mode
- Pre-fault and post-fault current and voltage data (phase, phase to phase, symmetrical components)
- Autoreclose operation

- Fault location

Fault location is initiated by relay tripping signals. It can also be started on receipt of a start signal from external relays.

Fault location is indicated in km, mile and % for the whole length of the protected line. The fault location is highly accurate for parallel lines due to the implementation of zero-sequence mutual impedance compensation.

The result of the fault location is stored as fault record data.

■ Disturbance records

The Disturbance Recorder function supplies fast, complete and reliable information for disturbances in the power system. It facilitates understanding of system behavior and performance of related primary and secondary equipment during and after a disturbance.

The Disturbance Recorder acquires sampled data

from all selected analogue input and binary signals.
The data can be stored in COMTRADE format.

COMMUNICATION

■ Station bus

Ethernet port(s) for the substation communication standards IEC 61850 and Modbus® TPC are provided for the station bus.

■ Serial communication

Serial ports for communicating with legacy equipment or protection relays over IEC 60870-5-103 or Modbus® RTU protocol are provided. The GRL200 can function as a protocol converter to connect to SAS.

GENERAL FUNCTION

■ Self supervision

Automatic self-supervision of internal circuits and software is provided. In the event of a failure being detected, the ALARM LED on the front panel is illuminated, the 'UNIT FAILURE' binary output operates, and the date and time of the failure is recorded in the event record.

■ Time synchronization

Current time can be provided with time synchronization via the station bus by SNTP (Simple Network Time Protocol) with the IEC 61850 protocol. IRIG-B port is also available as an option.

■ Setting groups

8 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.

■ Password protection

Password protection is available for the execution of setting changes, executing control, clearing records and switching between local/remote control.

■ Simulation and test

GRL200 provides simulation and test functions to check control functions without modification to wiring provided by a dummy circuit breaker (virtual equipment), and the capability to test communication signals by forced signal status change.

The simulation and test can work in the Test mode only.

TOOLS & ACCESSORY

The PC interface GR-TIEMS allows users to access GRL200 and other Toshiba GR-200 series IEDs from a local personal computer (PC) to view on-line or stored data, to change settings, to edit the LCD screen, to configure sequential logics and for other purposes.

disturbance records can be displayed, edited, measured and analyzed in detail. An advanced version of the engineering tool can provide additional and powerful analysis tools and setting calculation support functions.

■ REMOTE SETTING AND MONITORING

The engineering tool supports functions to change settings and to view and analyze fault and disturbance records stored in GRL200. Waveform data in the



Figure 13 PC Display of GR-TIEMS

■ PROGRAMMABLE LOGIC EDITOR

The programmable logic capability allows the user to configure flexible logic for customized application and operation. Configurable binary inputs, binary outputs and LEDs are also programmed by the programmable logic editor. This complies with IEC61131-3 standard.

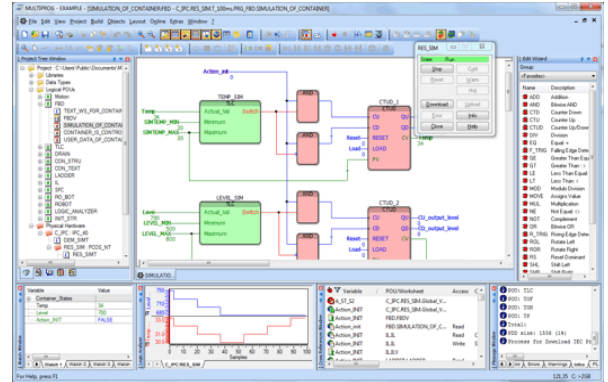


Figure 15 PC display of PLC editor

■ LCD CONFIGURATION

The user can configure and customize the MIMIC data displayed on the LCD of GRL200 using GR-TIEMS software.

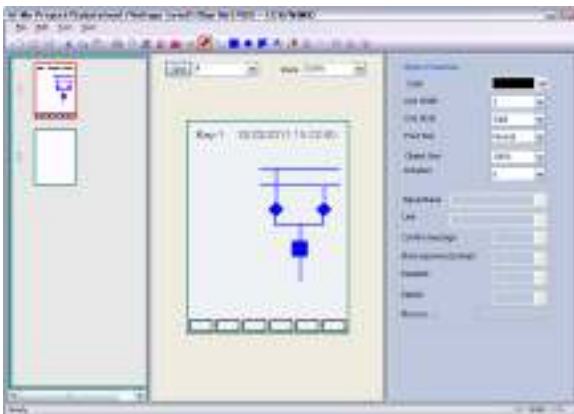


Figure 14 PC Display of MIMIC configuration

TECHNICAL DATA

HARDWARE	
Analog Inputs	
Rated current I_n	1A / 5A (selectable by user)
Rated voltage V_n	100V to 120V
Rated Frequency	50Hz / 60Hz (selectable by user)
Overload Rating	
Current inputs	4 times rated current continuous 5 times rated current for 3 mins 6 times rated current for 2 mins 30 times rated current for 10 sec 100 times rated current for 1 second 250 times rated current for one power cycle (20 or 16.6ms)
Voltage inputs	2 times rated voltage continuous 2.5 times rated voltage for 1 second
Burden	
Phase current inputs	$\leq 0.1VA$ at $I_n = 1A$, $\leq 0.2VA$ at $I_n = 5A$
Earth current inputs	$\leq 0.3VA$ at $I_n = 1A$, $\leq 0.4VA$ at $I_n = 5A$
Sensitive earth fault inputs	$\leq 0.3VA$ at $I_n = 1A$, $\leq 0.4VA$ at $I_n = 5A$
Voltage inputs	$\leq 0.1VA$ at V_n
Power Supply	
Rated auxiliary voltage	24/48/60Vdc (Operative range: 19.2 – 72Vdc), 48/110Vdc (Operative range: 38.4 – 132Vdc), 110/250Vdc or 100/220Vac (Operative range: 88 – 300Vdc or 80 – 230Vac)
Superimposed AC ripple on DC supply	$\leq 15\%$
Supply interruption	$\leq 20ms$ at 110Vdc
Restart time	$< 5ms$
Power consumption	$\leq 15W$ (quiescent) $\leq 25W$ (maximum)
Binary Inputs	
Input circuit DC voltage	24/48/60Vdc (Operating range: 19.2 – 72Vdc), 48/110Vdc (Operating range: 38.4 – 132Vdc), 110/125/220/250Vdc (Operating range: 88 – 300Vdc) Note: Variable threshold settings are available for BI2 and BIO4 from 14V to 154V in various steps.
Capacitive discharge immunity	10 μ F charged to maximum supply voltage and discharged into the input terminals, according to ENA TS 48-4 with an external resistor
Maximum permitted voltage	72Vdc for 24/48/60Vdc rating, 300Vdc for 110/250Vdc rating
Power consumption	$\leq 0.5W$ per input at 220Vdc
Binary Outputs	
Fast operating contacts	
Make and carry	5A continuously 30A, 290Vdc for 0.2s (L/R=5ms)
Break	0.15A, 290Vdc (L/R=40ms)
Operating time	2 ms
Semi-fast operating contacts	
Make and carry	8A continuously 10A, 110Vdc for 0.5s (L/R=5ms)
Break	0.13A, 110Vdc (L/R=40ms)

Operating time	4 ms
Auxiliary contacts Make and carry	8A continuously 10A, 110Vdc for 0.5s (L/R=5ms)
Break Operating time	0.13A, 110Vdc (L/R=40ms) 9 ms
Hybrid contacts (10 A breaking) Make and carry	8A continuously 10A, 220Vdc for 0.5s (L/R=5ms)
Break Operating time	10A, 220Vdc (L/R=20ms) 10A, 110Vdc (L/R=40ms) 1 ms
Durability	≥ 10,000 operations (loaded contact) ≥ 100,000 operations (unloaded contact)
Measuring input capability	
Full scale Standard current input Sensitive current input Voltage input Sampling rate Frequency response	≥ 60A (1A rating) or 300A (5A rating) ≥ 3A (1A rating) or 15 A (5A rating) ≥ 200V 48 samples / cycle < 5% deviation over range 16.7Hz to 600Hz
Mechanical Design	
Installation Weight Case color	Flush mounting Approx. 12kg (1/2 size), 15kg (3/4 size), 25kg (1/1 size) 2.5Y7.5/1 (approximation to Munsell value)
LED	
Number Color	26 (Fixed for "In service" and "ERROR") Red / Yellow / Green (configurable) except In service (green) and Error (red)
Function keys	
Number	7
Local Interface	
USB Maximum cable length	Type B 2m (max.)
System Interface (rear port)	
100BASE-TX Physical medium 100BASE-FX Physical medium Protocol	Fast Ethernet Twisted pair cable, RJ-45 connector Fast Ethernet 50/125 or 62.5/125µm fibre, SC connector IEC61850 or DNP3 or Modbus® RTU
Serial communication (rear port)	
RS485 Fiber optical	Protocol IEC 60870-5-103 or DNP3 or Modbus® RTU Protocol IEC 60870-5-103
Integral Communication Interface (Protection Signalling)	
Optical interface (2 km class) Type of fibre Connector type Wave length Optical transmitter Optical receiver	Graded-index multi-mode 50/125µm or 62.5/125µm ST type 820nm LED, more than -19dBm(50/125µm), -16dBm(62.5/125µm) PIN diode, less than -24dBm

Optical interface (30 km class)	
Type of fibre	Single mode 10/125µm
Connector type	Duplex LC
Wave length	1310nm
Optical transmitter	Laser, more than -13dBm
Optical receiver	PIN diode, less than -30dBm
Optical interface (80 km class)	
Type of fibre	DSF 8/125µm
Connector type	Duplex LC
Wave length	1550nm
Optical transmitter	Laser, more than -5dBm
Optical receiver	PIN diode, less than -34dBm
Terminal Block	
CT/VT input	M3.5 Ring terminal
Binary input, Binary output	FRONT-MSTB 2.5/20-STF 5.08by PHOENIX CONTACT® (for compression type terminal) M3.5 ring terminal (for ring lug type terminal)

FUNCTIONIONAL DATA

Phase-segregated Current Differential Protection	
DIF11 (Small current region)	0.10 to 2.00A in 0.01A steps (1A rating) 0.50 to 10.00A in 0.01A steps (5A rating)
DIF12 (Large current region)	0.6 to 60.0A in 0.1A steps (1A rating) 3.0 to 300.0A in 0.1A steps (5A rating)
DIFL-Slop1 (Small current region)	10 to 50 %
DIFL-Slop2 (Large current region)	50 to 100 %
Time setting for DIF	0.00 to 100.00s in 0.01s steps
Reference voltage	100 to 120V in 1V step
Operating time	Less than 1 cycle at 300% of DIF11
Resetting time	Less than 110 ms (for tripping output) Less than 40 ms (for signal output)
Zero-sequence Current Differential Protection for high-resistance earth	
DIFGI	0.05 to 1.00A in 0.01A steps (1A rating) 0.25 to 5.00A in 0.01A steps (5A rating)
DIFG-Slop	10 to 50 %
Timer	0.00 to 300.00s in 0.01s steps
Operating time	less than 45ms
Resetting time	less than 100ms
Charging Current Compensation	
DIFL-IcC	0.00 to 1.00A in 0.01A steps (1A rating) 0.00 to 5.00A in 0.01A steps (5A rating)
Differential Current Supervision	
DIFSV	0.05 to 2.00A in 0.01A steps (1A rating) 0.25 to 10.00A in 0.01A steps (5A rating)
Timer	0 to 300s in 1s steps
DIF Guard characteristic	
Overcurrent threshold	0.02 to 50.00A in 0.01A steps (1A rating) 0.10 to 250.00A in 0.01A steps (5A rating)
Rate of Overcurrent change threshold	0.05 to 0.20A in 0.01A steps (1A rating) 0.25 to 1.00A in 0.01A steps (5A rating)
Phase sequence Undervoltage threshold	5.0 to 130.0V in 0.1V steps
Phase to Phase Undervoltage threshold	5.0 to 130.0V in 0.1V steps
Rate of voltage change threshold	1 to 20V in 1steps
DIFG Guard characteristic	
Rate of Earth fault change threshold	0.02 to 50.00A in 0.01A steps (1A rating) 0.10 to 250.00A in 0.01A steps (5A rating)
Out-of-step protection (voltage phase comparison)	
Out-of-step trip	OFF / TRIP / BO(separated from other trip signals)
Optical interface (80 km class)	
Type of fibre	DSF 8/125 μ m
Connector type	Duplex LC
Wave length	1550nm
Optical transmitter	Laser, more than -5dBm
Optical receiver	PIN diode, less than -34dBm
Phase Fault Distance Measuring Element	
Z*-Mho.Reach, Z*-X.Reach and Z*-R.Reach (Z1S, Z2S, Z3S, Z4S, Z5S, ZCSF and ZCSB)	0.10 to 500.00 Ω in 0.01 Ω steps (1A rating) 0.01 to 100.00 Ω in 0.01 Ω steps (5A rating)
Characteristic angle	30° to 90° in 1° steps
Z*-Mho.Angle and Z*-R.Angle (Z1S, Z2S, Z3S, Z4S, Z5S, ZCSF and ZCSB)	
Z*- DirX.Angle and Z*-DirR.Angle (Z1S, Z2S,	0° to 60° in 1° steps

Z3S, Z4S, Z5S, ZCSF and ZCSB) ZSF-X.GrAngle1 and ZSB-X.GrAngle1 ZSF-X.GrAngle2 and ZSB-X.GrAngle2	0° to 45° in 1° steps 45° to 90° in 1° steps
Timer Setting	
Time setting of Z1S, Z2S, Z3S, Z4S, Z5S and ZCSF	0.00 to 100.00s in 0.01steps
Overcurrent Element for Guard	
Overcurrent elements Z*_OCFS for supervision distance measuring elements (Z1S, Z2S, Z3S, Z4S, Z5S, Z1G, Z2G, Z3G, Z4G and Z5G)	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 25.00A in 0.01A steps (5A rating)
Command Protection Distance Scheme	
Time for current reverse block Coordination time for BOP scheme Delayed drop-off timer	0.00 to 10.00s in 0.01s steps 0 to 50ms in 1ms steps 0.00 to 1.00s in 0.01s steps
Command Protection Earth Fault Scheme	
Time for delay trip Time for current reverse block Coordination time for BOP scheme delayed drop-off timer	0.00 - 0.30s in 0.01s steps 0.00 to 10.00s in 0.01s steps 0 to 50ms in 1ms steps 0.00 to 1.00s in 0.01s steps
Power Swing Block	
Detection zone (PSBGS) Detection timer (TPSBS)	2.50 to 75.00Ω in 0.01Ω steps (1A rating) 0.50 to 15.00Ω in 0.01Ω steps (5A rating)
Load Encroachment	
Minimum load resistance (LESR, LESL) Maximum load angle (LESR-Angle, LESL-Angle)	0.10 to 500.00Ω in 0.01Ω steps (1A rating) 0.01 to 100.00Ω in 0.01Ω steps (5A rating) 5° to 75° in 1° steps
Charging Current Compensation	
Charging current compensation for distance relay Rated voltage for charging current compensation	0.00 to 1.00A in 0.01A steps (1A rating) 0.00 to 5.00A in 0.01A steps (5A rating) 100 to 120V in 1V steps
Minimum Operating Current	
Current Earth fault current	0.08A fixed (1A relay) 0.4A fixed (5A relay) 0.10 to 1.00A in 0.01A steps(1A rating) 0.50 to 5.00A in 0.01A steps (5A rating)
Switch-on-to-fault Protection	
Overcurrent threshold	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 15.00A in 0.01A steps (5A rating)
Stub Protection	
Overcurrent threshold	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 15.00A in 0.01A steps (5A rating)
Out-of-step Protection (Out of step tripping (voltage phase comparison))	
Out-of-step trip	OFF / TRIP / BO(separated from other trip signals)
Out-of-step Protection (impedance locus)	
Resistive reach (at Right side) Resistive reach (at Left side) Resistive reach (at Forward) Resistive reach (at Backward)	15.00 to 150.00Ω in 0.01Ω steps (1A rating) 3.000 to 30.000Ω in 0.01Ω steps (5A rating) 5.00 to 50.00Ω in 0.01Ω steps (1A rating) 1.000 to 10.000Ω in 0.01Ω steps (5A rating) 5.00 to 250.00Ω in 0.01Ω steps (1A rating) 1.000 to 50.000Ω in 0.001Ω steps (5A rating) 1.0 to 50.00Ω in 0.01Ω steps (1A rating)

Detection time	0.200 to 10.000 Ω in 0.001 Ω steps(5A rating) 0.01 to 1.00s in 0.01s steps
Breaker Failure (BF) Protection	
Overcurrent element	0.1 to 2.0A in 0.1A steps (1A rating) 0.5 to 10.0A in 0.1A steps (5A rating)
BF timer for retry-trip of failed breaker	50 to 500ms in 1ms steps
BF timer for related breaker trip	50 to 500ms in 1ms steps
Non-directional and Directional Overcurrent Protection	
1 st , 2 nd , 3 rd , 4 th Definite time overcurrent threshold	0.02 to 50.00A in 0.01A steps (1A rating) 0.10 to 250.00A in 0.01A steps (5A rating)
1 st , 2 nd , 3 rd , 4 th Inverse time overcurrent threshold	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 25.00A in 0.01A steps (5A rating)
Direction characteristic	Non Directional / Forward / Backward
Characteristic angle	0 – 180 deg in 1 deg steps
Delay type	DT / IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 to 300.00s in 0.01s steps
Reset Time Multiplier Setting RTMS	0.010 to 50.000 in 0.001 steps
Non-directional and Directional Earth Fault Protection	
1 st , 2 nd , 3 rd , 4 th Definite time earth fault threshold	0.02 to 50.00A in 0.01A steps (1A rating) 0.10 to 250.00A in 0.01A steps (5A rating)
1 st , 2 nd , 3 rd , 4 th Inverse time earth fault threshold	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 25.00A in 0.01A steps (5A rating)
Direction characteristic	Non Directional / Forward / Backward
Characteristic angle	0 to 180° in 1° steps (310 lags for –3V0)
Polarising voltage (3V0)	0.5 to 100.0V in 0.1V steps
Delay type	DT / IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 to 300.00s in 0.01s steps
Reset Time Multiplier Setting RTMS	0.010 to 50.000 in 0.001 steps
Non-directional and Directional Negative Sequence Phase Overcurrent (NOC) Protection	
1 st , 2 nd , 3 rd , 4 th Definite time NOC threshold	0.02 to 50.00A in 0.01A steps (1A rating) 0.10 to 250.00A in 0.01A steps (5A rating)
1 st , 2 nd , 3 rd , 4 th Inverse time NOC threshold	0.02 to 5.00A in 0.01A steps (1A rating) 0.10 to 25.00A in 0.01A steps (5A rating)
Direction characteristic	Non Directional / Forward / Backward
Characteristic angle	0 to 180° in 1° steps (310 lags for –3V0)
Polarising voltage	0.5 to 25.0V in 0.1V steps
Delay type	DT / IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 to 300.00s in 0.01s steps

Reset Time Multiplier Setting RTMS	0.010 to 50.000 in 0.001 steps
Phase Undercurrent Protection	
Undercurrent 1st, 2nd threshold:	0.10 – 2.00A in 0.01A steps (1A rating) 0.5 – 10.0A in 0.1A steps (5A rating)
DTL delay	0.00 to 300.00s in 0.01s steps
Inrush Current Detection	
Second harmonic detection	10 to 50% in 1% steps
Inrush current thresholds	0.10 to 5.00A in 0.01A steps (1A rating) 0.5 to 25.0A in 0.1A steps (5A rating)
Thermal overload Protection	
Thermal setting (THM = k.IFLC)	0.40 – 2.00A in 0.01A steps (1A rating) 2.0 – 10.0A in 0.1A steps (5A rating)
Time constant (τ)	0.5 – 500.0mins in 0.1min steps
Thermal alarm	OFF, 50% to 100% in 1% steps
Pre-load current setting	0.00 – 1.00A in 0.01A steps (1A rating) 0.0 – 5.0A in 0.1A steps (5A rating)
Broken Conductor Detection	
Broken conductor threshold	0.10 to 1.00 in 0.01 steps
DTL delay	0.00 to 300.00s in 0.01s steps
Phase Overvoltage Protection	
1 st , 2 nd overvoltage threshold	1.0 to 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps
Phase to Phase Overvoltage Protection	
1 st , 2 nd overvoltage threshold	1.0 to 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps
Neutral Voltage Displacement Protection (NVD)	
1 st , 2 nd OVN thresholds:	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps
Positive sequence phase overvoltage protection (POV)	
1 st , 2 nd POV thresholds:	1.0 – 220.0V in 0.1V steps
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
Negative sequence phase overvoltage protection (NOV)	
1 st , 2 nd NOV thresholds:	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	10 to 100% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps


Phase Undervoltage Protection	
1 st , 2 nd undervoltage threshold	5.0 to 130.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	100 to 120% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps
Undervoltage block threshold	5.0 to 20.0V in 0.1V steps
Undervoltage block delay	0.00 to 300.00s in 0.01s steps
Phase to Phase Undervoltage Protection	
1 st , 2 nd undervoltage threshold	5.0 to 130.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-out/pick-up ratio	100 to 120% in 1% steps
DTL delay	0.00 to 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 to 100.000 in 0.001 steps
Reset delay	0.0 to 300.0s in 0.1s steps
Undervoltage block threshold	5.0 to 20.0V in 0.1V steps
Undervoltage block delay	0.00 to 300.00s in 0.01s steps
Under/Over Frequency Protection	
1 st - 4 th under/overfrequency threshold	($F_{nom} - 10.00\text{Hz}$) – ($F_{nom} + 10.00\text{Hz}$) in 0.01Hz steps F_{nom} : nominal frequency
DTL delay:	0.00 – 300.00s in 0.01s steps
Frequency UV Block	40.0 – 100.0V in 0.1V steps
Autoreclosing	
Number of shots	1 to 5 shots
Dead time for single-phase autoreclose	0.01 to 300.00s in 0.01s steps
Dead time for three-phase autoreclose	0.01 to 300.00s in 0.01s steps
Multi-shot dead line time	0.01 to 300.00s in 0.01s steps
Reclaim time	0.0 to 600.0s in 0.1s steps
Pulse width of reclosing signal output	0.01 to 10.00s in 0.01s steps
Autoreclose reset time	0.01 to 310.00s in 0.01s steps
Reset time for developing fault	0.01 to 300.00s in 0.01s steps
Follower breaker autoreclose delay time	0.01 to 300.00s in 0.01s steps
Voltage and Synchronism Check	
Synchronism check angle	0° to 75° in 1° 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 100.00s in 0.01s steps
Voltage check time	0.01 to 100.00s in 0.01s steps
Voltage Transformer Failure Supervision	
Undervoltage element (phase-to-phase)	50 to 100V in 1V steps
Undervoltage element (phase-to-earth)	10 to 60V in 1V steps
Current change detection element	0.1A fixed (1A rating) 0.5A fixed (5A rating)
Residual voltage element	20V fixed
Residual current element	Common use with earth fault detection element
Fault Locator	
Line reactance and resistance setting	0.0 to 999.9Ω in 0.1Ω steps (1A rating) 0.00 to 199.99Ω in 0.01Ω steps (5A rating)

Line length	0.0 to 399.9km in 0.1km steps
Correction factor of impedance between lines	80 to 120% in 1% steps
Correction factor of impedance between in each phase	80 to 120% in 1% steps
Accuracy	±2.5km (up to 100km) ±2.5% (up to 399.9km)
Minimum measuring cycles	2.5 cycles
Metering Function	
Current	Accuracy ± 0.5% (at rating)
Voltage	Accuracy ± 0.5% (at rating)
Power (P, Q)	Accuracy ± 0.5% (at rating)
Energy (Wh, varh)	Accuracy ± 1.0% (at rating)
Frequency	Accuracy ± 0.03Hz
GPS Time Synchronisation	
Protocol	SNTP

ENVIRONMENTAL PERFORMANCE

Atmospheric Environment		
Temperature	IEC 60068-2-1/2 IEC 60068-2-14	Operating range: -10°C to +55°C. Storage / Transit: -25°C to +70°C. Cyclic temperature test as per IEC 60068-2-14
Humidity	IEC 60068-2-30 IEC 60068-2-78	56 days at 40°C and 93% relative humidity. Cyclic temperature with humidity test as per IEC 60068-2-30
Enclosure Protection	IEC 60529	IP52 - Dust and Dripping Water Proof IP20 for rear panel
Mechanical Environment		
Vibration	IEC 60255-21-1	Response - Class 1 Endurance - Class 1
Shock and Bump	IEC 60255-21-2	Shock Response Class 1 Shock Withstand Class 1 Bump Class 1
Seismic	IEC 60255-21-3	Class 1
Electrical Environment		
Dielectric Withstand	IEC 60255-5	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	IEC 60255-5 IEEE C37.90	Three positive and three negative impulses of 5kV(peak), 1.2/50µs, 0.5J between all terminals and between all terminals and earth.
Voltage Dips, Interruptions, Variations and Ripple on DC supply	IEC 60255-11, IEC 61000-4-29, IEC 61000-4-17 IEC 60255-26 Ed 3	1. Voltage dips: 0 % residual voltage for 20 ms 40 % residual voltage for 200 ms 70 % residual voltage for 500 ms 2. Voltage interruptions: 0 % residual voltage for 5 s 3. Ripple: 15 % of rated d.c. value, 100 / 120 Hz 4. Gradual shut-down / start-up: 60 s shut-down ramp, 5 min power off, 60s start-up ramp 5. Reversal of d.c. power supply polarity: 1 min
Capacitive Discharge	ENA TS 48-4	10µF charged to maximum supply voltage and discharged into the input terminals with an external resistance

Electromagnetic Environment		
High Frequency Disturbance / Damped Oscillatory Wave	IEC 60255-22-1 Class 3, IEC 61000-4-18 IEC 60255-26 Ed 3	1 MHz burst in common / differential modes Auxiliary supply and I/O ports: 2.5 kV / 1 kV Communications ports: 1 kV / 0 kV
Electrostatic Discharge	IEC 60255-22-2 Class 4, IEC 61000-4-2 IEEE C37.90.3-2001 IEC 60255-26 Ed 3	Contact: 2, 4, 6, 8kV Air: 2, 4, 8, 15kV
Radiated RF Electromagnetic Disturbance	IEC 60255-22-3, IEC 61000-4-3 Level 3 IEC 60255-26 Ed 3	Sweep test ranges: 80 MHz to 1 GHz and 1.4 GHz to 2.7 GHz. Spot tests at 80, 160, 380, 450, 900, 1850 and 2150 MHz. Field strength: 10 V/m
Radiated RF Electromagnetic Disturbance	IEEE C37.90.2-1995	Field strength 35V/m for frequency sweep of 25MHz to 1GHz.
Fast Transient Disturbance	IEC 60255-22-4 IEC 61000-4-4 IEC 60255-26 Ed 3	5 kHz, 5/50ns disturbance Auxiliary supply and input / output ports: 4 kV Communications ports: 2 kV
Surge Immunity	IEC 60255-22-5 IEC 61000-4-5 IEC 60255-26 Ed 3	1.2/50µms surge in common/differential modes: Auxiliary supply and input / output ports: 4, 2, 1, 0.5 kV / 1, 0.5 kV Communications ports: up to 1, 0.5 kV / 0 kV
Surge Withstand	IEEE C37.90.1-2002	3kV, 1MHz damped oscillatory wave 4kV, 5/50ns fast transient
Conducted RF Electromagnetic Disturbance	IEC 60255-22-6 IEC 61000-4-6 IEC 60255-26 Ed 3	Sweep test range: 150 kHz to 80MHz Spot tests at 27 and 68 MHz. Voltage level: 10 V r.m.s
Power Frequency Disturbance	IEC 60255-22-7 IEC 61000-4-16 IEC 60255-26 Ed 3	50/60 Hz disturbance for 10 s in common / differential modes Binary input ports: 300 V / 150 V
Power Frequency Magnetic Field	IEC 61000-4-8 Class 4 IEC 60255-26 Ed 3	Field applied at 50/60Hz with strengths of: 30A/m continuously, 300A/m for 1 second.
Conducted and Radiated Emissions	IEC 60255-25 EN 55022 Class A, EN 61000-6-4 IEC 60255-26 Ed 3	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 230 MHz: < 40 dB(uV/m) 230 to 1000 MHz: < 47 dB(uV/m) Measured at a distance of 10 m

Performance and Functional Standards		
Category	Standards	
General		
Common requirements	IEC 60255-1	
Data Exchange	IEC 60255-24 / IEEE C37.111 (COMTRADE) IEEE C37-239 (COMFEDE)	
Product Safety	IEC 60255-27	
Functional		
Synchronizing	IEC 60255-125	
Under/Over Voltage Protection	IEC 60255-127	
Under/Over Power Protection	IEC 60255-132	
Thermal Protection	IEC 60255-149	
Over/Under Current Protection	IEC 60255-151	
Directional Current Protection	IEC 60255-167	
Reclosing	IEC 60255-179	
Frequency Protection	IEC 60255-181	
Teleprotection	IEC 60255-185	
European Commission Directives		
	2004/108/EC	Compliance with the European Commission Electromagnetic Compatibility Directive is demonstrated according to generic EMC standards EN 61000-6-2 and EN 61000-6-4, and product standard IEC 60255-26.
	2006/95/EC	Compliance with the European Commission Low Voltage Directive for electrical safety is demonstrated according EN 60255-27.

ORDERING INFORMATION

[Hardware selection]

	7	8	9	A	B	C	D	E	F	G	H	J	K	L
Configurations	G	R	L	2	0	0	-	-	-	-	-	-	-	0
Application of power system														
Function for single breaker scheme (CTx5,VT4)				1										
Function for one and a half breaker scheme(CTx9, VTx5)				2										
System Frequency														
50Hz												1		
60Hz												2		
AC Rating for Phase Currents														
1A													1	
5A													2	
DC Rating														
110-250 Vdc or 100-220Vac				1										
48-110 Vdc				2										
24- 48 Vdc				3										
Outline														
Standard LCD, 1/2 x 19" rack for flush mounting					2									
Standard LCD, 3/4 x 19" rack for flush mounting					3									
Standard LCD, 1/1 x 19" rack for flush/rack mounting					4									
Large LCD, 1/2 x 19" rack for flush mounting					6									
Large LCD, 3/4 x 19" rack for flush mounting					7									
Large LCD, 1/1 x 19" rack for flush/rack mounting					8									
Separate Large LCD, 1/2 rack for flush mounting					B									
Separate Large LCD, 3/4 rack for flush mounting					C									
Separate Large LCD, 1/1 rack for flush/rack mounting					D									
Standard LCD, 1/2 x 19" rack for rack mounting					F									
Standard LCD, 3/4 x 19" rack for rack mounting					G									
Large LCD, 1/2 x 19" rack for rack mounting					J									
Large LCD, 3/4 x 19" rack for rack mounting					K									
Standard LCD, 1/2 x 19" rack for vertical flush mounting					M									
Standard LCD, 3/4 x 19" rack for vertical flush mounting					N									
Standard LCD, 1/1 x 19" rack for vertical flush mounting					P									
Large LCD, 1/2 x 19" rack for vertical flush mounting					R									
Large LCD, 3/4 x 19" rack for vertical flush mounting					S									
Large LCD, 1/1 x 19" rack for vertical flush mounting					T									
BI/BO Module														
Refer to Number of BI/BO Table														
BI/BO Terminal Type														
Compression plug type terminal												0		
Ring lug type terminal												1		
Communication for Protection (1)														
1CH							1							
2CH							2							

	7	8	9	A	B	C	D	E	F	G	H	J	K	L
Configurations	G	R	L	2	0	0	-	-	-	-	-	-	-	0

Communication for Protection (2)

Refer to communication Table

Number of Serial and/or Ethernet Communication and/or Time Synch Port(s)

1 port	1
1 port + GPS	2
1 port + IRIG-B	3
2 ports	4
2 ports + GPS	5
2 ports + IRIG-B	6
3 ports (Note : Selectable when Communication for Protection is 1 or 2 CH.)	7
3 ports + GPS (Note : Selectable when Communication for Protection is 1 CH.)	8
3 ports + IRIG-B (Note : Selectable when Communication for Protection is 1 CH.)	9
1 port + connection terminal for external I/O unit (GIO200)	B
1 port + GPS + connection terminal for external I/O unit (GIO200)	C
1 port + IRIG-B + connection terminal for external I/O unit (GIO200)	D
2 ports + connection terminal for external I/O unit (GIO200)	E
2 ports + GPS + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 1 CH.)	F
2 ports + IRIG-B + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 1 CH.)	G
3 ports + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 1 CH.)	H

Selection of Serial and/or Ethernet Communication Port(s)

100Base-TX x 1 port (When position E = 1 - 3 and B - D)	3
100Base-FX x 1 port (When position E = 1 - 3 and B - D)	4
100Base-TX x 2 ports (When position E = 4 - 6 and E - G)	5
100Base-FX x 2 ports (When position E = 4 - 6 and E - G)	6
RS485 x 1 port + 100Base-TX x 1 port (When position E = 4 - 6 and E - G)	A
RS485 x 1 port + 100Base-TX x 2 ports (When position E = 7 - 9 and H)	B
RS485 x 1 port + 100Base-FX x 1 port (When position E = 4 - 6 and E - G)	C
RS485 x 1 port + 100Base-FX x 2 ports (When position E = 7 - 9 and H)	D
Fiber optic (for serial) + 100Base-TX x 1 port (When position E = 4 - 6 and E - G)	E
Fiber optic (for serial) + 100Base-TX x 2 ports (When position E = 7 - 9 and H)	F
Fiber optic (for serial) + 100Base-FX x 1 port (When position E = 4 - 6 and E - G)	G
Fiber optic (for serial) + 100Base-FX x 2 ports (When position E = 7 - 9 and H)	H

Function Block (linked with software selection)

See function table of software selection

Please contact with our sales staffs when you require user configurable models that are not indicated in the ordering sheet above.

[Software selection]

							7	S	G	T		E	F	U		9	V	
Configurations	G	R	L	2	0	0	-	0			-				-			
Application of power system																		
Assignment on position "7"																		
Function Block																		
Refer to Function Table																		
Communication for Remote / Time Synch. (1)																		
Assignment on position "E"																		
Communication for Remote / Time Synch. (2)																		
Assignment on position "F"																		
Protocol																		
Standard (IEC 60870-5-103, Modbus,DNP)																	0	
Standard + IEC 61850																		1
IEC 61850																		2
Outline																		
Assignment on position "9"																		
Language																		
English																		E

Note: Software selection codes "1" to "7", "E", "F" and "9" are common with hardware selection codes.

Number of BI/BO

BI/BO 1 x I/O module

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
7	-	-	-	-	6	4	-	-	11	1xBIO1
12	-	-	-	-	3	2	-	-	12	1xBIO2
8	-	-	-	6	-	2	-	-	13	1xBIO3
-	6	-	-	-	-	2	6	-	14	1xBIO4
18	-	-	-	-	-	-	-	-	15	1xBI1
-	12	-	-	-	-	-	-	-	16	1xBI2
-	-	32	-	-	-	-	-	-	17	1xBI3
Other Configuration									ZZ	To be specified at ordering

BI/BO 2 x I/O module

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
-	-	32	-	-	6	12	-	-	21	1xBI3+1xBO1
7	-	32	-	-	6	4	-	-	22	1xBI3+1xBIO1
12	-	32	-	-	3	2	-	-	23	1xBI3+1xBIO2
18	-	-	-	-	6	12	-	-	24	1xBI1+1xBO1
25	-	-	-	-	6	4	-	-	25	1xBI1+1xBIO1
30	-	-	-	-	3	2	-	-	26	1xBI1+1xBIO2
8	-	-	-	6	6	14	-	-	27	1xBO1+1xBIO3
15	-	-	-	6	6	6	-	-	28	1xBIO1+1xBIO3
7	-	-	-	-	12	16	-	-	29	1xBO1+1xBIO1
16				12		4			2A	2xBIO3
Other Configuration									ZZ	To be specified at ordering

BI/BO 3 x I/O module

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
15	-	-	-	6	12	18	-	-	31	1xBO1+1xBIO1+1xBIO3
20	-	-	-	6	9	16	-	-	32	1xBO1+1xBIO2+1xBIO3
23	-	-	-	12	6	8	-	-	33	1xBIO1+2xBIO3
26	-	-	-	6	6	14	-	-	34	1xBI1+1xBO1+1xBIO3
8	-	32	-	6	6	14	-	-	35	1xBI3+1xBO1+1xBIO3
24	-	-	-	18	-	6	-	-	36	3xBIO3
25	-	-	-	-	12	16	-	-	37	1xBI1+1xBO1+1xBIO1
36	-	-	-	-	6	12	-	-	39	2xBI1+1xBO1
-	24	-	-	-	6	12	-	-	3A	2xBI2+1xBO1
18	6	-	-	-	6	14	6	-	3B	1xBI1+1xBO1+1xBIO4
7	-	32	-	-	6	4	16	-	3C	1xBI3+1xBIO1+1xBO2
7	-	32	-	-	12	16	-	-	3D	1xBI3+1xBO1+1xBIO1
-	-	32	-	-	6	12	16	-	3E	1xBI3+1xBO1+1xBO2
16	-	-	-	12	6	16	-	-	3G	1xBO1+2xBIO3
-	6	32	-	-	6	14	6	-	3H	1xBI3+1xBO1+1xBIO4
26	-	-	-	6	6	14	-	-	3J	1xBO1+1xBIO3+1xBI1
-	-	62	-	-	6	12	-	-	3K	2xBI3+1xBO1
Other Configuration									ZZ	To be specified at ordering

BI/BO 4 x I/O modules (Set code position "9" to "3", "4", "7", "8", "C", "D", "G", "K", "N", "P", "S" or "T")

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
26	-	-	-	6	12	26	-	-	41	1xBI1+2xBO1+1xBIO3
32	-	-	-	24	-	8	-	-	42	4xBIO3
8	-	32	-	6	12	26	-	-	43	1xBI3+2xBO1+1xBIO3
-	-	64	-	-	12	24	-	-	44	2xBI3+2xBO1
54	-	-	-	-	6	12	-	-	46	3xBI1+1xBO1
20	-	32	-	6	9	16	-	-	47	1xBI3+1xBO1+1xBIO2+1xBIO3
26	-	-	-	6	12	26	-	-	48	1xBO1+1xBI1+1xBO1+1xBIO3
20	-	-	-	6	15	28	-	-	49	2xBO1+1xBIO2+1xBIO3
Other Configuration									ZZ	To be specified at ordering

BI/BO 5 x I/O modules (Set code position "9" to "3", "4", "7", "8", "C", "D", "G", "K", "N", "P", "S" or "T")

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
33	-	-	-	6	6	6	32	-	51	1xBI1+1xBIO1+1xBIO3+2xBO2
44	-	-	-	6	12	26	-	-	52	2xBI1+2xBO1+1xBIO3
25	-	96	-	-	6	4	-	-	53	1xBI1+3xBI3+1xBIO1
8	-	96	-	6	6	14	-	-	54	3xBI3+1xBO1+1xBIO3
62	-	-	-	6	6	14	-	-	56	3xBI1+1xBO1+1xBIO3
54	6	-	-	-	6	14	6	-	57	3xBI1+1xBO1+1xBIO4
20	-	32	-	6	9	16	-	-	5A	1xBI3+1xDCAI2+1xBO1+1xBIO2+1xBIO3
-	-	96	-	-	12	24	-	-	5B	3xBI3+2xBO1
Other Configuration									ZZ	To be specified at ordering

BI/BO 6 x I/O modules (Set code position "9" to "3", "4", "7", "8", "C", "D", "G", "K", "N", "P", "S" or "T")

Number of BI/BO									Ordering No. (Position "A" to "B")	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
51	-	-	-	6	18	30	-	-	61	2xBI1+2xBO1+1xBIO1+1xBIO3
8	-	96	-	6	12	26	-	-	62	3xBI3+2xBO1+1xBIO3
-	-	128	-	-	12	24	-	-	63	4xBI3+2xBO1
8	-	128	-	6	6	14	-	-	64	4xBI3+1xBO1+1xBIO3
52	-	-	-	12	-	4	32	-	69	2xBI1+2xBIO3+2xBO2
52	-	-	-	12	12	28	-	-	6A	2xBI1+2xBO1+2xBIO3
36	-	-	-	-	24	48	-	-	6B	2xBI1+4xBO1
36	-	64	-	-	12	24	-	-	6C	2xBI1+2xBI3+2xBO1
Other Configuration									ZZ	To be specified at ordering

BI/BO 7 x I/O modules (Set code position “9” to “4”, “8”, “D”, “P” or “T”)

Number of BI/BO									Ordering No. (Position “A” to “B”)	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
80	-	-	-	6	12	26	-	-	71	4xBI1+2xBO1+1xBIO3
72	6	-	-	-	12	26	6	-	72	4xBI1+2xBO1+1xBIO4
8	-	96	-	6	18	38	-	-	73	3xBI3+3xBO1+1xBIO3
-	6	96	-	-	18	38	6	-	74	3xBI3+3xBO1+1xBIO4
-	60	-	-	-	6	12	16	-	78	5xBI2+1xBO1+1xBO2
-	-	160	-	-	12	24	-	-	79	5xBI3+2xBO1
54	-	64	-	-	12	24	-	-	7B	3xBI1 + 2xBI3 + 2xBO1
-	-	128	-	-	18	36	-	-	7D	4xBI3+3xBO1
Other Configuration									ZZ	To be specified at ordering

BI/BO 8 x I/O modules (Set code position “9” to “4”, “8”, “D”, “P” or “T”)

Number of BI/BO									Ordering No. (Position “A” to “B”)	Configuration
Independent BI	Independent BI (variable)	Common BI	DC-AI	Fast-BO	Semi-fast BO	BO	Heavy duty BO	DC-AO		
-	-	160	-	-	18	36	-	-	83	5xBI3+3xBO1
-	60	-	-	-	6	12	32	-	87	5xBI2+1xBO1+2xBO2
8	-	128	-	6	18	38	-	-	88	4xBI3+3xBO1+1xBIO3
-	-	256	-	-	-	-	-	-	8C	8xBI3
Other Configuration									ZZ	To be specified at ordering

Please contact with our sales staffs when you require “other configuration (Ordering number: ZZ)” that is not indicated in the ordering code above.

Communication

1CH Communication for Protection (Position "C" is set to "1")

Communication Type	Ordering No. (Position "D")
Protection signal GI 2km Class (C37.94)	1
Protection signal SM 30km Class	2
Protection signal DSF 80km Class	3

2CH Communication for Protection (Position "C" is set to "2")

Communication Type	Ordering No. (Position "D")
Protection signal GI 2km Class (C37.94) x2ch	1
Protection signal SM 30km Class x2ch	2
Protection signal DSF 80km Class x2ch	3
Protection signal GI 2km Class (C37.94) x1ch Protection signal SM 30km Class x1ch	4
Protection signal GI 2km Class (C37.94) x1ch Protection signal DSF 80km Class x1ch	5
Protection signal SM 30km Class x1ch Protection signal DSF 80km Class x1ch	6

FUNCTION TABLE

Function Block	Protection function		Ordering No. (Position "G & T")					
			10	11	13	15	22	24
DIFL	87	Phase-segregated current differential protection						
	50 FS	Fail safe OC						
	27 FS	Fail safe UV						
	CCC	Charging current compensation	•	•	•	•	•	•
	CTF	CT failure detection by Id						
	87R	Remote differential trip						
	THC	Through-fault current countermeasure						
	50STUB	Stub protection	NA	NA	NA	NA	NA	NA
DIFG	87N	Zero phase current differential protection						
	50N/51N FS	Fail safe EF	•	•	•	•	•	•
	CCC	Charging current compensation						
	87R	Remote differential trip						
	THC	Through-fault current countermeasure						
	50STUB	Stub protection	NA	NA	NA	NA	NA	NA
DTT	DTT	Direct transfer trip function(*1)		•	•	•	•	•
DISTANCE_ZS (4zone)	21	Distance protection(for phase fault) with 4zone						
	68	Power swing block			•	•		•
	50SOTF	Switch on to fault protection						
DISTANCE_ZG (4zone)	21N	Distance protection(for earth fault) with 4zone						
	68	Power swing block			•	•		•
	50SOTF	Switch on to fault protection						
CARRIER-DEF	85-67N	Directional earth fault carrier command protection			•	•		•
CARRIER_DISTANCE	85-21	Distance carrier command protection			•	•		•
SOTF-OC	50SOTF	Switch on to fault protection		•	•	•	•	•
OC	50/67	Non-directional / directional definite time over-current protection	•	•	•	•	•	•
	51/67	Non-directional / directional inverse time over-current protection						
EF	50N/67N	Non-directional / directional definite time earth fault over-current protection	•	•	•	•	•	•
	51N/67N	Non-directional / directional inverse time earth fault over-current protection						
OCN	46/67	Non-Directional / directional Negative sequence phase over-current protection		•	•	•	•	•
UC	37	Phase under-current protection						
THR	49	Thermal overload protection		•	•	•	•	•
BCD	46BC	Broken conductor protection		•	•	•	•	•
CBF	50BF	Circuit breaker failure protection		•	•	•	•	•
OV	59	Phase over-voltage protection		•	•	•	•	•
OVS	59	Phase-phase over-voltage protection		•	•	•	•	•
OVG	59N	Neutral Voltage Displacement protection						
OVP	59P	Positive sequence phase over-voltage protection						
OVN	59N	Negative sequence phase over-voltage protection						
		Function for single breaker scheme (Position "7" is set to "1")	Basic	Standard for single breaker scheme	Standard for single breaker scheme, with Distance	Standard for single breaker scheme, with Distance	Standard for single breaker scheme, with Control	Standard for single breaker scheme, with Distance

Function Block	Protection function		Ordering No. (Position "G & T")					
			10	11	13	15	22	24
UV	27	Phase under-voltage protection		•	•	•	•	•
UVS	27	Phase-phase under-voltage protection		•	•	•	•	•
UVP	27P	Positive sequence phase under-voltage protection						•
FRQ	81	Frequency protection		•	•	•	•	•
OSTZ	56Z	Out of step tripping by distance						•
OSTV	56V	Out of step tripping by voltage(*1)		•	•	•	•	•
ICD	ICD	Inrush current detection function				•		
CLP	CLP	Cold load protection function						
FS	FS	Fail-safe function		•	•	•	•	•
VTF	VTF	VTF detection function	•	•	•	•	•	•
CTF	CTF	CTF detection function	•	•	•	•	•	•
FL-Z	21FL	Fault locator		•	•	•	•	•
FL-A	FL	Fault locator						
ARC	79	Autoreclosing function		•	•	•	•	•
SYNC	25	Voltage check for autoreclosing		•	•	•	•	•
Ctrl		Switching control Interlock function					•	•
PQM		Power Quality Management						
LS	81LS	Load shedding						
			Function for single breaker scheme (Position "7" is set to "1")					
			Basic					
			Standard for single breaker scheme					
			Standard for single breaker scheme, with Distance					
			Standard for single breaker scheme, with Distance					
			Standard for single breaker scheme, with Control					
			Standard for single breaker scheme, with Control, with Distance					

Function Block	Protection function		Ordering No. (Position "G & T")				
			19	2A	2B	2C	
DIFL	87	Phase-segregated current differential protection					
	50 FS	Fail safe OC					
	27 FS	Fail safe UV					
	CCC	Charging current compensation	•	•	•	•	
	CTF	CT failure detection by Id					
	87R	Remote differential trip					
	THC	Through-fault current countermeasure					
	50STUB	Stub protection					
DIFG	87N	Zero phase current differential protection					
	50N/51N FS	Fail safe EF					
	CCC	Charging current compensation	•	•	•	•	
	87R	Remote differential trip					
	THC	Through-fault current countermeasure					
	50STUB	Stub protection					
DTT	DTT	Direct transfer trip function(*1)	•	•	•	•	
DISTANCE_ZS (4zone)	21	Distance protection(for phase fault) with 4zone					
	68	Power swing block			•	•	
	50SOTF	Switch on to fault protection					
DISTANCE_ZG (4zone)	21N	Distance protection(for earth fault) with 4zone					
	68	Power swing block			•	•	
	50SOTF	Switch on to fault protection					
CARRIER-DEF	85-67N	Directional earth fault carrier command protection			•	•	
CARRIER_DISTANCE	85-21	Distance carrier command protection			•	•	
SOTF-OC	50SOTF	Switch on to fault protection	•	•	•	•	
OC	50/67	Non-directional / directional definite time over-current protection	•	•	•	•	
	51/67	Non-directional / directional inverse time over-current protection					
EF	50N/67N	Non-directional / directional definite time earth fault over-current protection	•	•	•	•	
	51N/67N	Non-directional / directional inverse time earth fault over-current protection					
OCN	46/67	Non-Directional / directional Negative sequence phase over-current protection	•	•	•	•	
UC	37	Phase under-current protection					
THR	49	Thermal overload protection	•	•	•	•	
BCD	46BC	Broken conductor protection	•	•	•	•	
CBF	50BF	Circuit breaker failure protection	•	•	•	•	
OV	59	Phase over-voltage protection	•	•	•	•	
OVS	59	Phase-phase over-voltage protection	•	•	•	•	
OVG	59N	Neutral Voltage Displacement protection					
OVP	59P	Positive sequence phase over-voltage protection					
OVN	59N	Negative sequence phase over-voltage protection					
			Function for one and half breaker scheme (Position "7" is set to "2")	Standard for one and half breaker scheme	Standard for one and half breaker scheme, with Control	Standard for one and half breaker scheme, with Distance	Standard for one and half breaker scheme, with Control, with Distance

Function Block	Protection function		Ordering No. (Position "G & T")				
			19	2A	2B	2C	
UV	27	Phase under-voltage protection	•	•	•	•	
UVS	27	Phase-phase under-voltage protection	•	•	•	•	
UVP	27P	Positive sequence phase under-voltage protection				•	
FRQ	81	Frequency protection	•	•	•	•	
OSTZ	56Z	Out of step tripping by distance				•	
OSTV	56V	Out of step tripping by voltage(*1)	•	•	•	•	
ICD	ICD	Inrush current detection function					
CLP	CLP	Cold load protection function					
FS	FS	Fail-safe function	•	•	•	•	
VTF	VTF	VTF detection function	•	•	•	•	
CTF	CTF	CTF detection function	•	•	•	•	
FL-Z	21FL	Fault locator	•	•	•	•	
FL-A	FL	Fault locator					
ARC	79	Autoreclosing function	•	•	•	•	
SYNC	25	Voltage check for autoreclosing	•	•	•	•	
Ctrl		Switching control Interlock function		•		•	
PQM		Power Quality Management					
LS	81LS	Load shedding					
			Function for one and half breaker scheme (Position "7" is set to "2")	Standard for one and half breaker scheme	Standard for one and half breaker scheme, with Control	Standard for one and half breaker scheme, with Distance	Standard for one and half breaker scheme, with Control, with Distance

DIMENSION AND PANEL CUT-OUT (1/2 size)

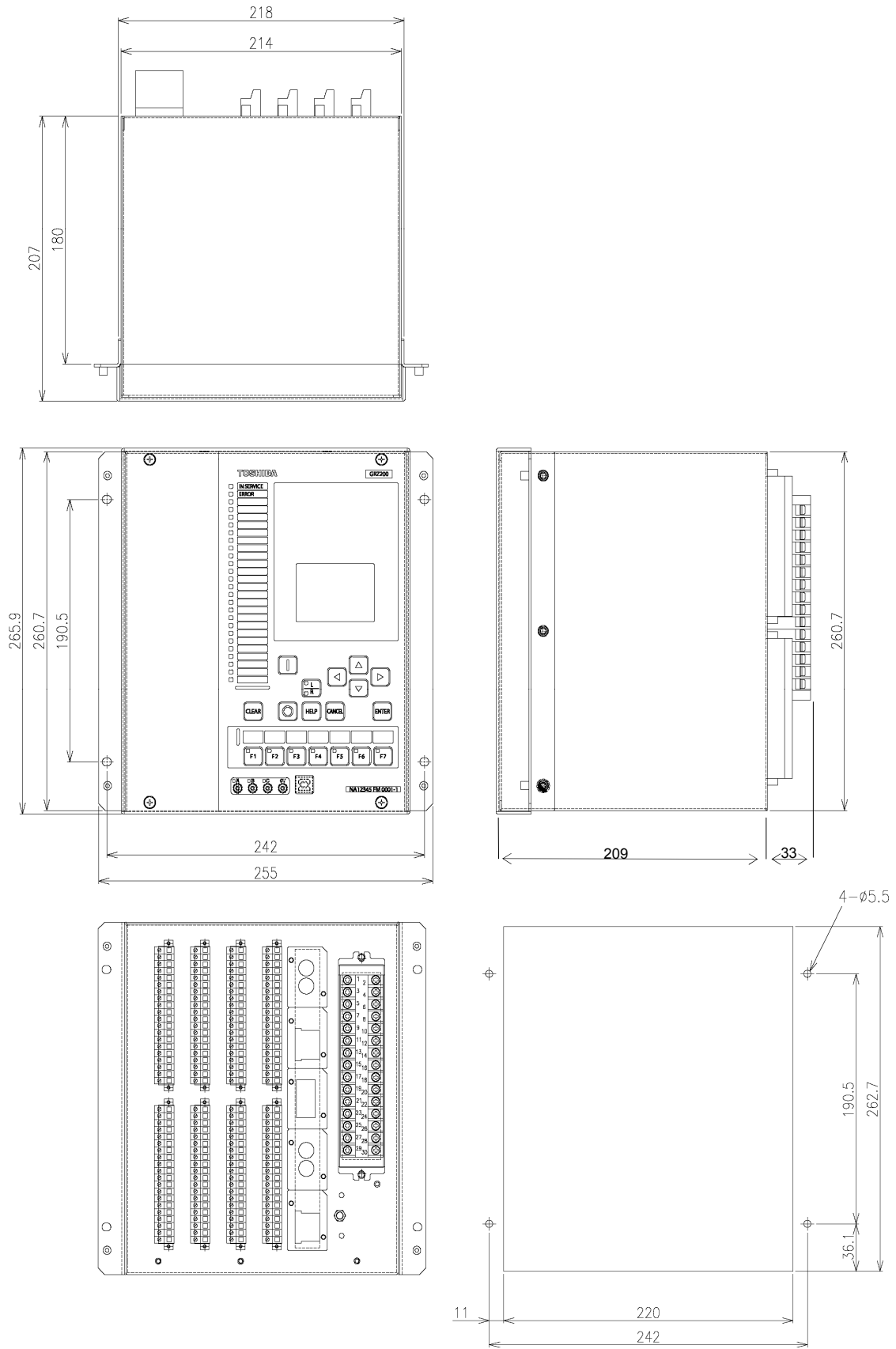


Figure 16 – Dimension and Panel Cut-out – 1/2 x 19” case size

DIMENSION AND PANEL CUT-OUT (3/4 size)

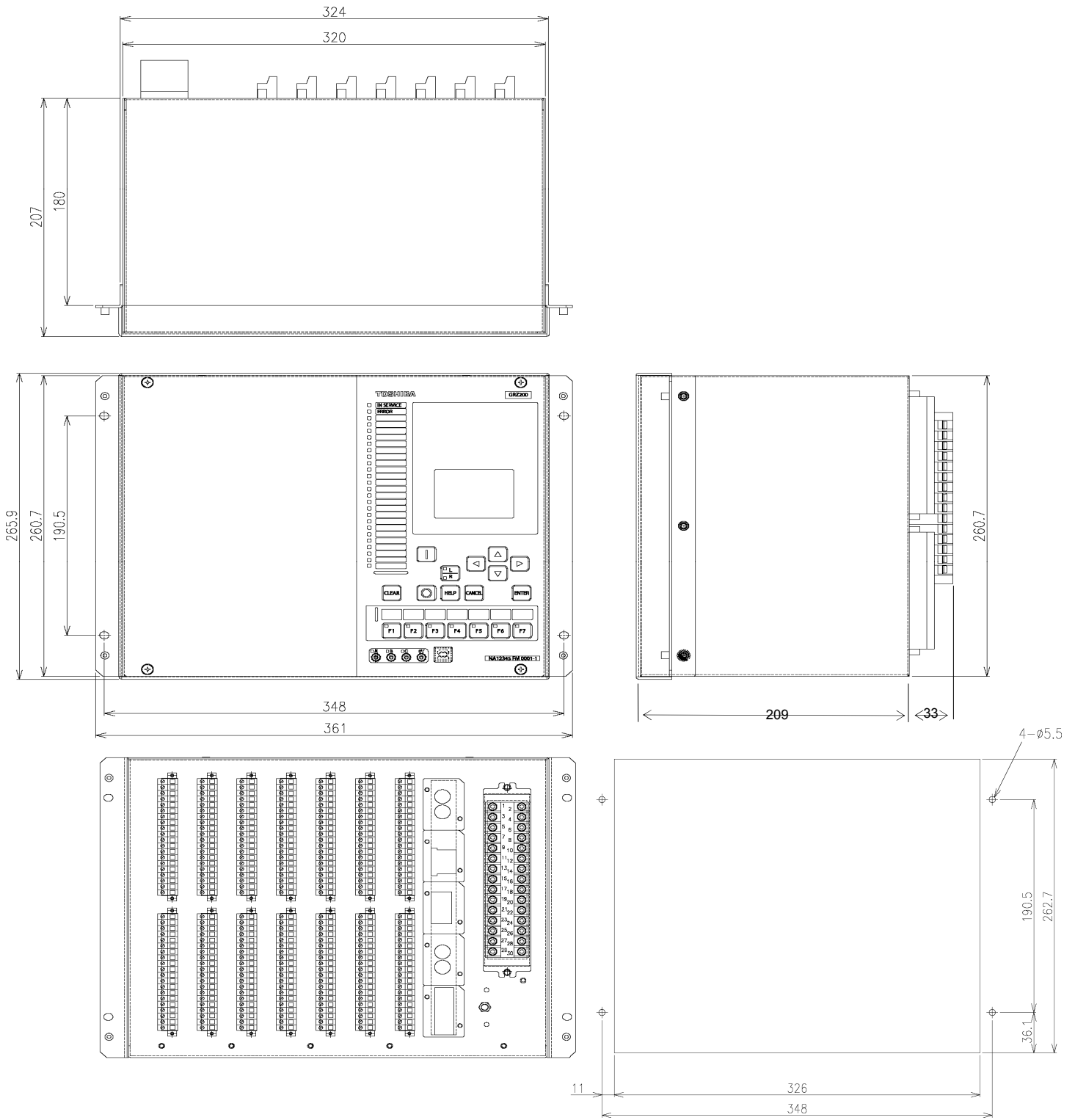


Figure 17 – Dimension and Panel Cut-out – 3/4 x 19” case size

DIMENSION AND PANEL CUT-OUT (1/1 size)

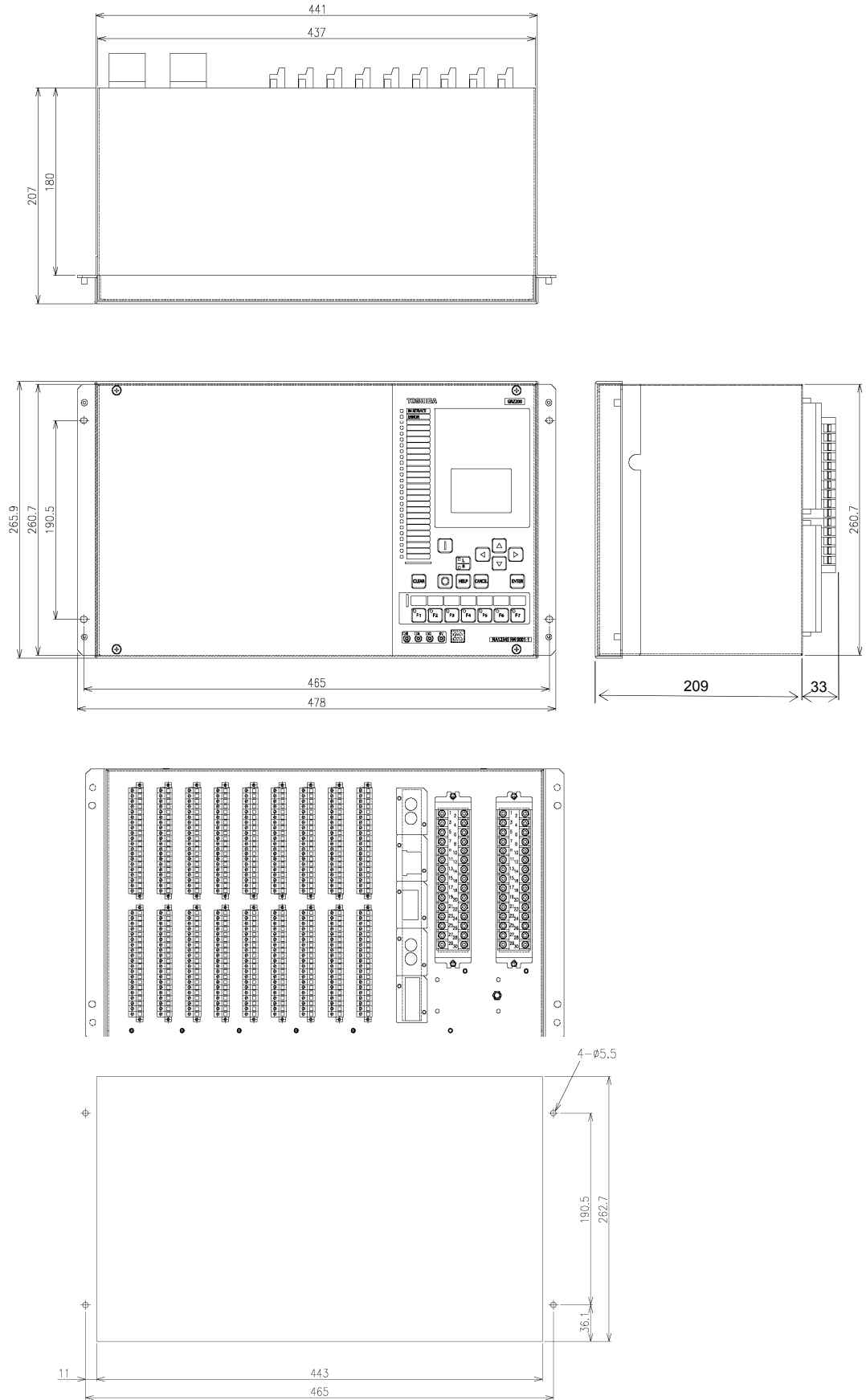
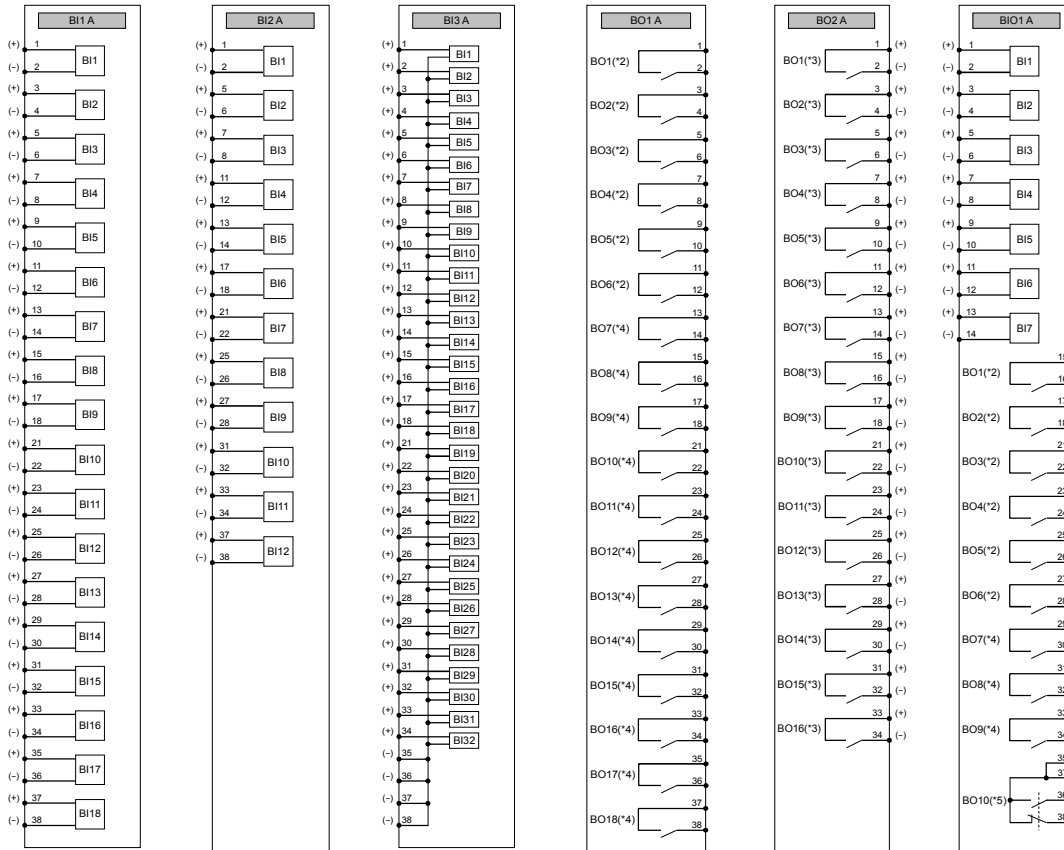


Figure 18 – Dimension and Panel Cut-out – 1/1 x 19” case size

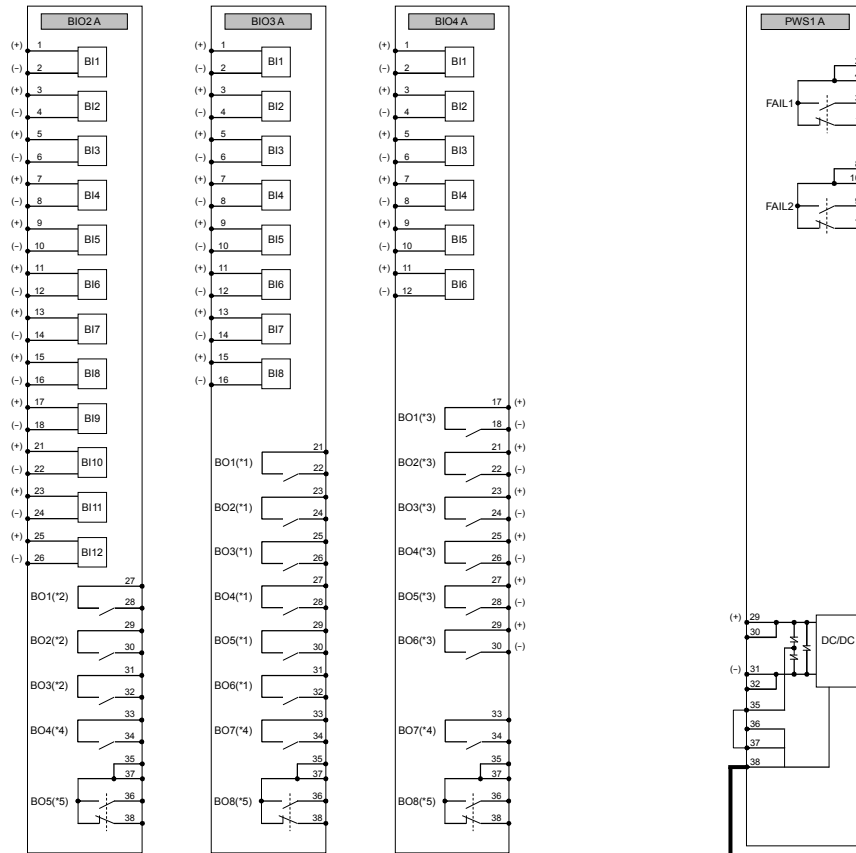
CONNECTIONS DIAGRAM



- (*1) Fast BO
- (*2) Semi-fast BO
- (*3) Heavy duty BO
- (*4) Normal BO
- (*5) Form-C BO

Figure 19 – Binary input board and binary output module for compression plug type

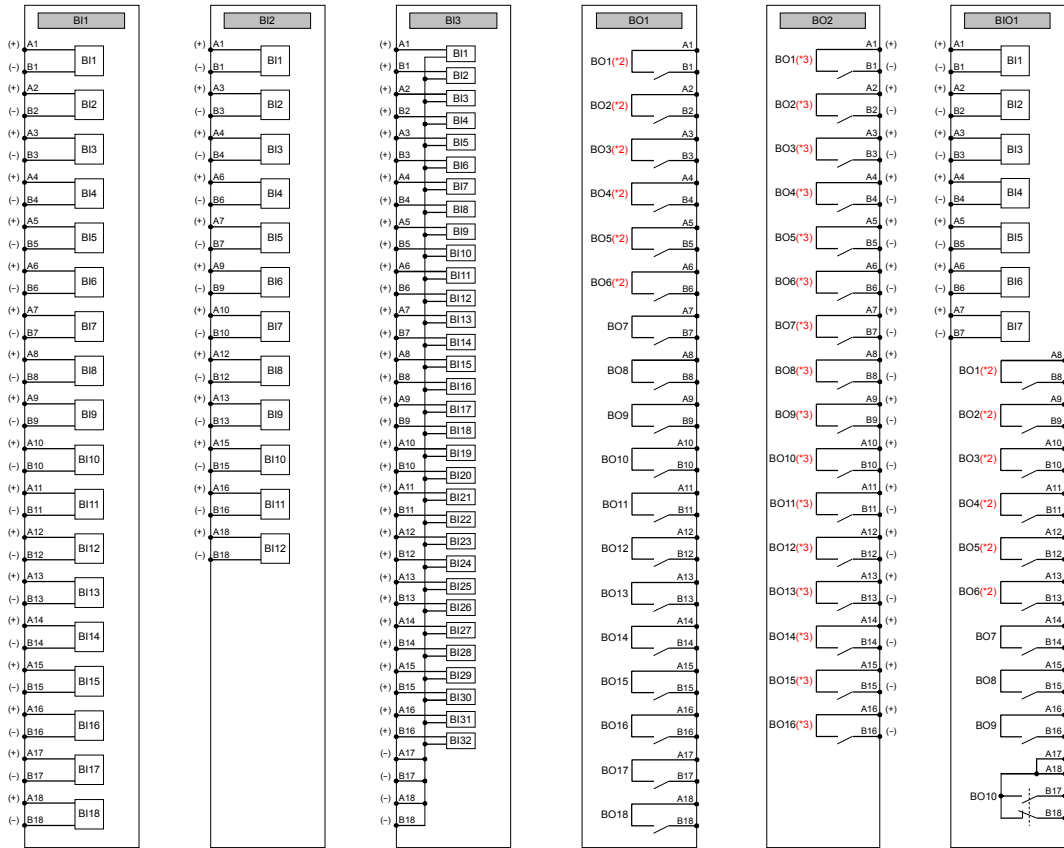
CONNECTIONS DIAGRAM



- (*1) Fast BO
- (*2) Semi-fast BO
- (*3) Heavy duty BO
- (*4) Normal BO
- (*5) Form-C BO

Figure 20 – Combined binary input and output module and DC power supply module for compression plug type

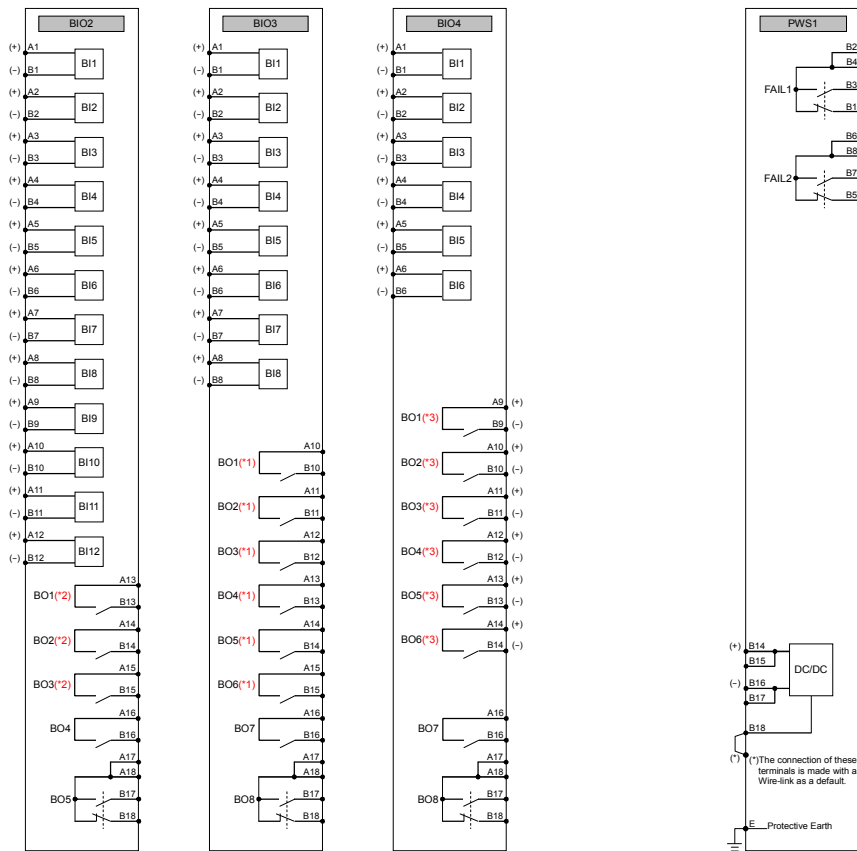
CONNECTIONS DIAGRAM



- (*1) Fast BO
- (*2) Semi-fast BO
- (*3) Heavy duty BO
- (*4) Normal BO
- (*5) Form-C BO

Figure 21 – Binary input board and binary output module for ring type

CONNECTIONS DIAGRAM

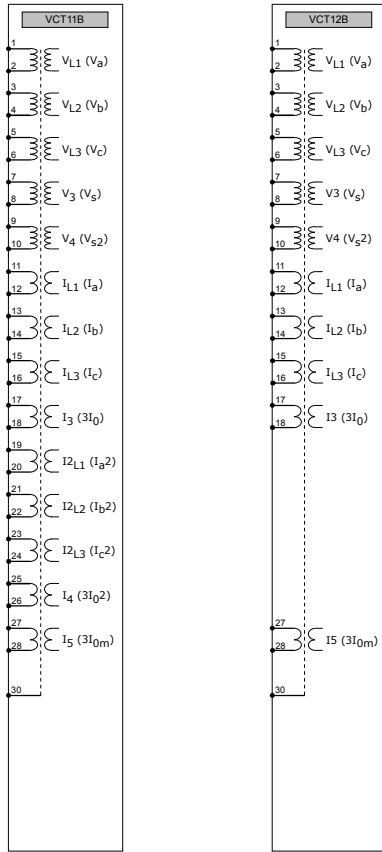


- (*1) Fast BO
- (*2) Semi-fast BO
- (*3) Heavy duty BO
- (*4) Normal BO
- (*5) Form-C BO

Figure 22 – Combined binary input and output module and DC power supply module for ring type

CONNECTIONS DIAGRAM

CT/VT module



Module no. 11
(CT x 9 + VT x 5)

Module no. 12
(CT x 5 + VT x 4)

Figure 23 – CT/VT module

EXTERNAL CONNECTIONS DIAGRAM

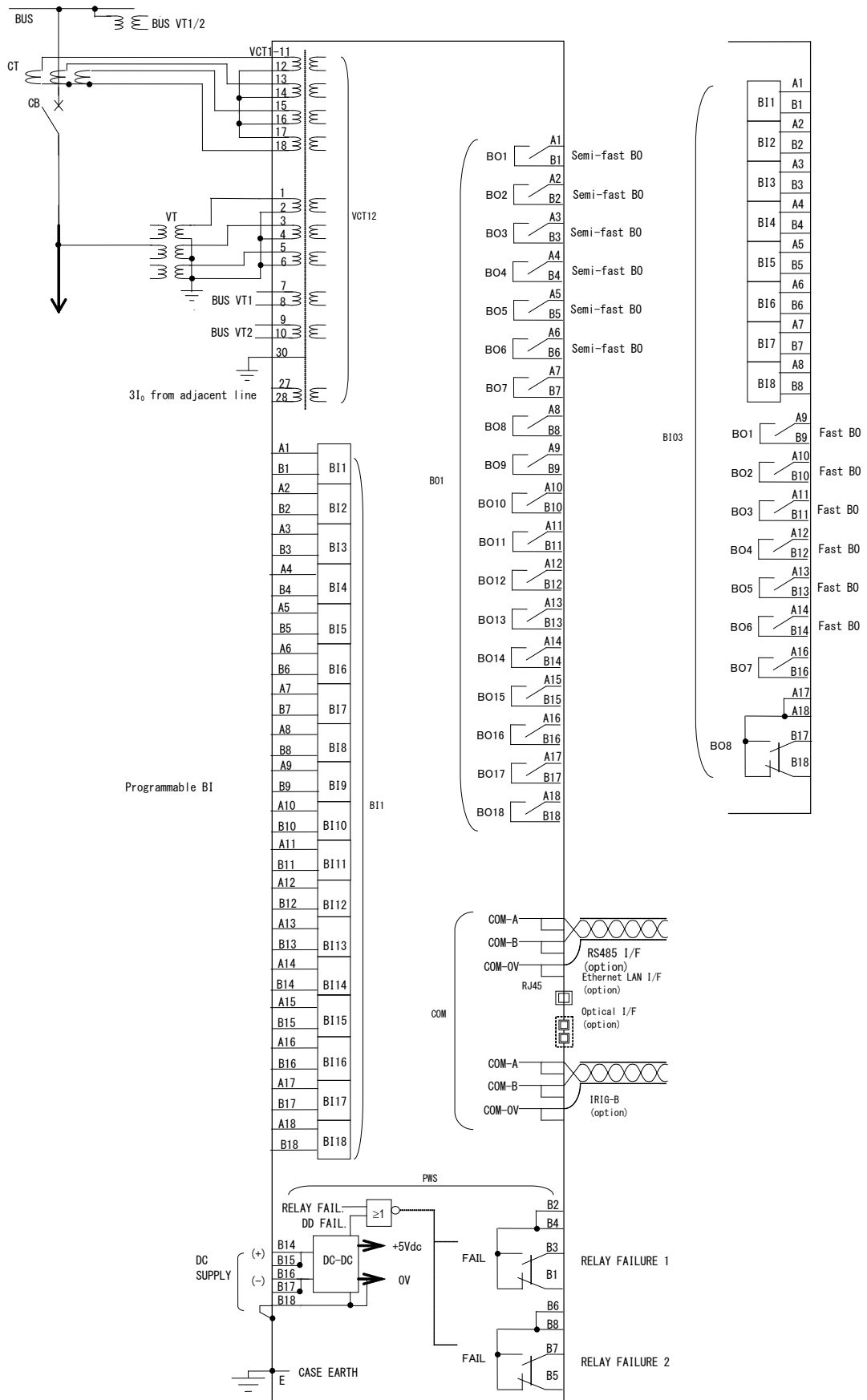


Figure 24 – Typical external connection diagram (PCT: No.12, IO: B11, BO1 and BIO3)

TOSHIBA

TOSHIBA CORPORATION

Social Infrastructure Systems Company

72-34, Horikawa-cho, Saiwai-Ku, Kawasaki 212-8585, Japan

Tel +81-44-331-1462 Fax +81-44-548-9540

<http://www.toshiba-relays.com>

- The information given in this catalog is subject to change without notice.
- The information given in this catalog is as of 24 Sep 2013.
- The information given in this catalog is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.
- Toshiba does not take any responsibility for incidental damage (including loss of business profit, business interruption, loss of business information and other pecuniary damage) arising out of the use or disability to use the products.