TOSHIBA

Leading Innovation

GR-200 Series

GRB 200

Busbar 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

GRB200 low impedance differential relay for busbar protection is implemented on Toshiba's next generation GR-200 series IED platform and has been designed to provide very reliable, high speed and selective protection for various types of busbar system. This powerful and user-friendly IED will provide you with the flexibility to meet your application and engineering requirements, in addition to offering outstanding performance, high quality and operational peace of mind.

- GRB200 can be applied for various busbar systems.
  - Single busbars with/without transfer busbar
  - Double busbars with/without transfer busbar
  - Ring busbars with/without transfer busbar
  - One and a half busbar
  - Four bus-coupler busbar
- GRB200 can detect phase and earth faults on the protected busbar by employing a phase segregated current differential scheme. A maximum of 64 three-phase currents can be input from feeders, sections and bus-couplers, which can correctly distinguish between internal and external faults even in the event of CT saturation.
- Circuit breaker failure protection, end zone protection and blind zone protection are also available.
- Backup overcurrent and earth fault protections are provided as options in each bay.
- Communications
  - Within a 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

- GRB200 can be applied for various busbar systems.
  - Single busbars with/without transfer busbar
  - Double busbars with/without transfer busbar
  - Ring busbars with/without transfer busbar
  - One and a half busbar
  - Four bus-coupler busbar
- GRB200 incorporates a single central unit (CU) and bay units (BU). The CU performs current differential protection. The BU is a terminal used to acquire analogue data from each CT which is converted to digital data for transmission to the CU via optical fiber for the differential protection. The BU also receives the trip command from the CU and performs tripping of the circuit breaker. The CU can be provided with an optional voltage check element.
- Centralized or Decentralized installation is available.

A system installation example is shown in Figure 1.

• Functionality

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

• Communication

- System interface - RS485, Fiber optic, 100BASE-TX,-FX
- Multi protocol - DNP3.0, Modbus® RTU, 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
- 7 configurable 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

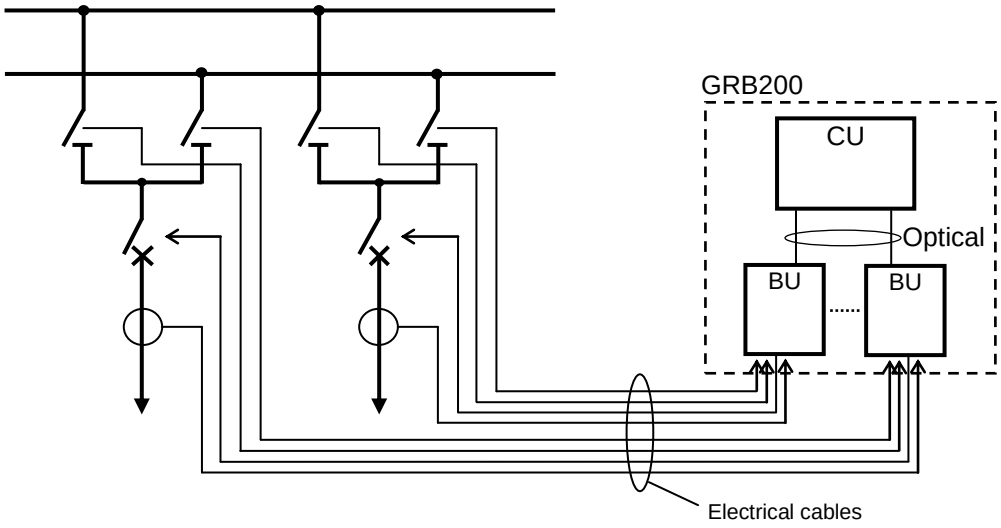


Figure 1 System Installation Example

FUNCTIONS

• Protection

- Low impedance differential protection for up to 8 discriminating zones and check zone
- Percentage restrained characteristic ensures stability against external faults
- Countermeasure for CT saturation
- Available for busbar with different CT ratio
- Dynamic busbar replica
- BU out of service
- Circuit breaker failure protection
- End zone protection and blind zone protection
- Backup Overcurrent and Earth fault protection
- Independent voltage check element (option)

• Monitoring

- CT failure detection
- Status and condition monitoring of primary apparatus
- Switchgear operation monitoring
- Plausibility check
- Measurement of I, V(option) and f
- Measurement and supervision of individual and total harmonic content up to 15th, sag, swell, interruption
- Current and voltage circuit supervision

• HMI function

- Selection of HMI: Standard LCD / large LCD
- Large LCD supports single line diagram indication or multi-language option
- 24 configurable tri-state LEDs selectable red/green/yellow
- 7 Programmable function keys for user configurable 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 by forcible signal.
- Checking internal circuit using monitoring jacks.

APPLICATIONS

PROTECTION

■ **Busbar Differential Protection**

GRB200 applies current differential protection for each individual busbar zone, which are sectioned by the bus section and buscoupler switches (discriminating zone protection), as well as for the overall busbar system (check zone protection)

The discriminating zone protection, inputs current and disconnector position signals from feeders, transformer banks, busbar sections and buscouplers which are connected to the protected zone, and outputs trip signals to all the circuit breakers of the zone. The zone covered by the discriminating zone protection depends on the busbar configuration and varies with open/close status of the disconnectors. GRB200 introduces a replica setting which identifies which circuit is connected to which zone and follows changes in busbar operation. Up to eight zone protections are available by employing relevant input currents and disconnector signals.

The check zone protection inputs currents from all feeder bays and transformer banks and performs overall differential protection for the entire busbar system and outputs trip signals to all the circuit breakers. As the protection does not use the disconnector position signals, the check zone protection is very secure against such false operation in the no-fault and through fault conditions.

By using these two protections, GRB200 ensures a very reliable protection for various types of busbar system.

Figure 2 shows a typical application to a double busbar system. DIFCH is the check zone protection which covers all busbars. DIFZA and DIFZB are the discriminating zone protections for busbars A and B respectively. The voltage elements UVSFA, UVSFB, UVGFA, UVGFB, OVGFA and OVGFB can be provided for each busbar as the voltage check function (optional).

Figure 3 shows the scheme logic with check zone protection, discriminating zone protections and voltage check function for a double busbar system.

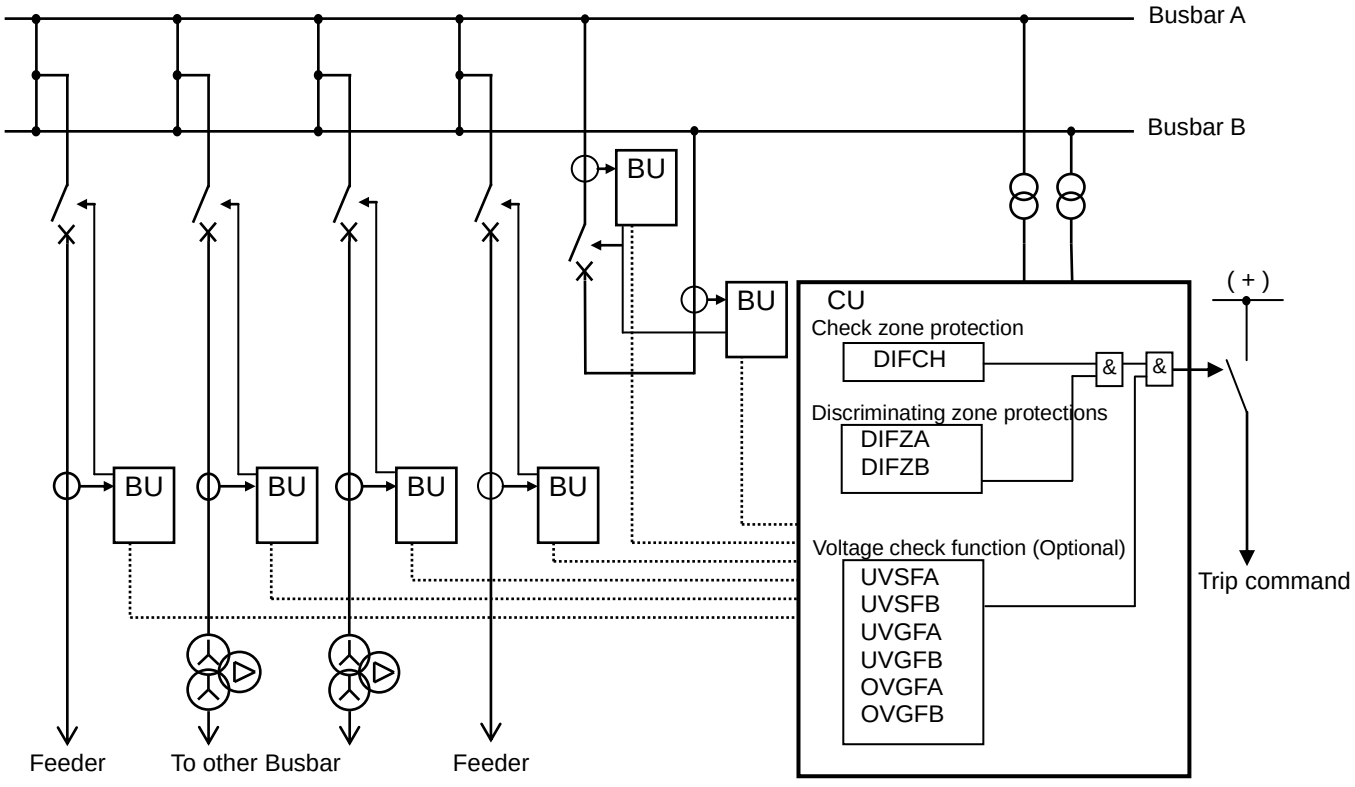


Figure 2 Typical Application to Double Busbar System

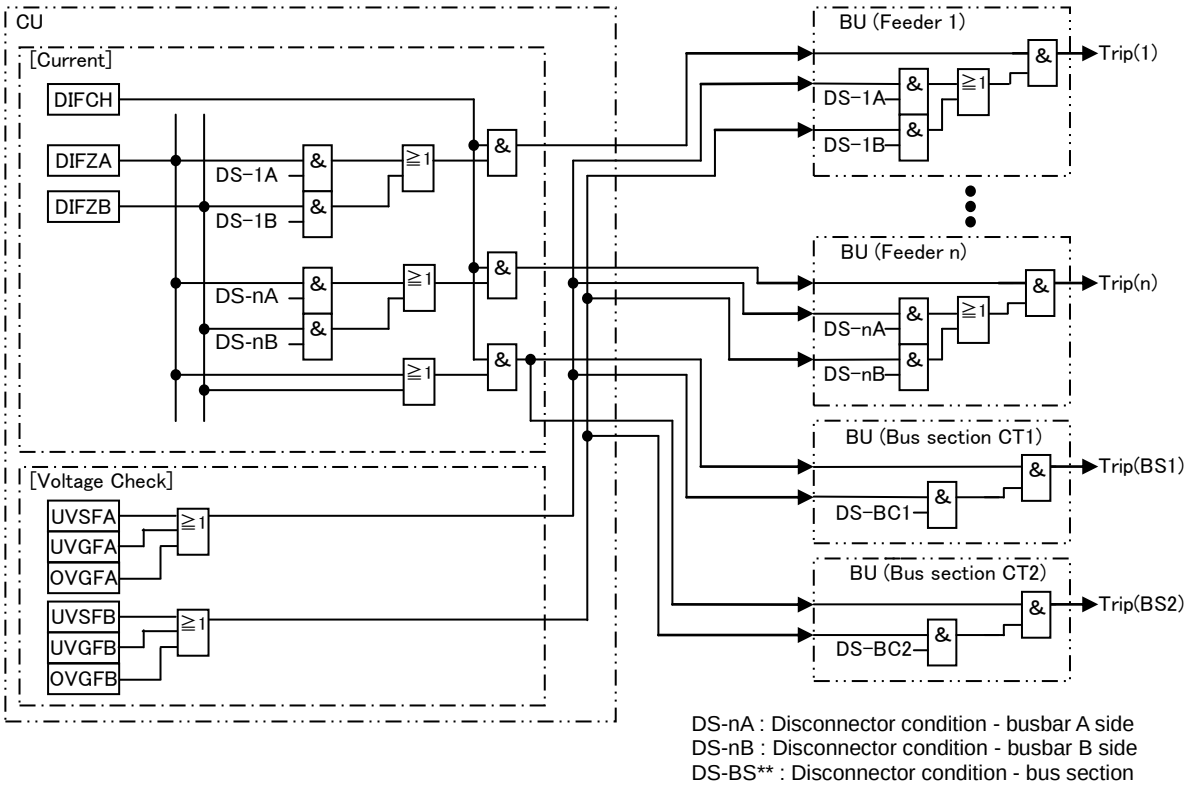


Figure 3 Scheme Logic with Check Zone, Discriminating Zone and Voltage Check

■ Discriminating zone and check zone elements

The check zone element (DIFCH) and discriminating zone elements (DIFZA - DIFZD) are based on the current differential principle and have a differential characteristic for the small current region, and a percentage restraint characteristic for the large current region to cope with erroneous differential current caused by a through-fault current.

The characteristics are shown in Figure 4, and each zone (DIFCH, DIFZA - DIFZD) and each phase (A, B, C phase) have these characteristics respectively.

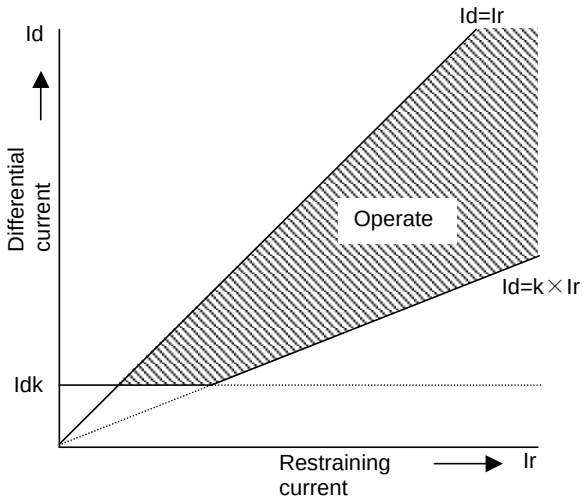


Figure 4 Characteristic of Current Differential Element

The minimum operating current (Idk) and the percent slope (k) of the restraint characteristic in the large current region are user-programmable.

CT saturation under external fault conditions can be a serious problem for busbar protection. GRB200 overcomes the CT saturation problem by using a “CT saturation detection” function. When an external fault occurs, a very large erroneous current may be caused by CT saturation. However, once the CT saturates, there is a short period of several milliseconds of non-saturation between the saturation periods in a cycle. By detecting this non-saturation period, the current differential element can be blocked to prevent false operation arising from CT saturation.

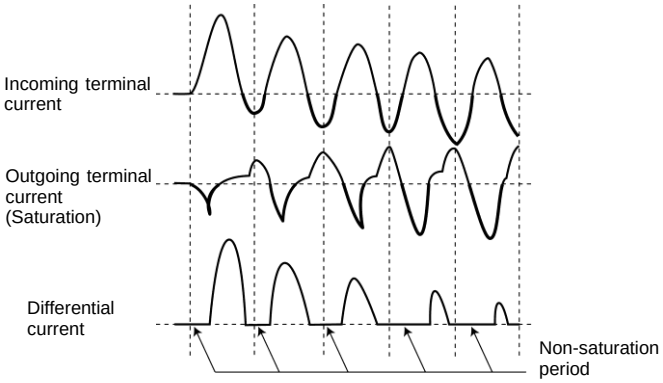


Figure 5 Waveform for CT saturation

■ Breaker Failure Protection

Phase-segregated breaker failure protection is provided for each bay and can be initiated by either an internal or external signal.

When an overcurrent element remains in operation after a tripping signal has been issued the breaker is judged to have failed and a 2 stage CBF sequence is initiated. The first stage issues a re-trip command to the circuit breaker. If this also fails then the command to backtrip adjacent circuit breakers is executed. The overcurrent element has a high-speed reset time.

GRB200 has two kinds of timer for Breaker Failure Protection. One timer is used for re-trip, the other timer is used for CBF trip.

A remote transfer trip is provided for feeder circuits.

■ End zone and Blind Zone Protection

This function is provided to cater for circumstances when a dead zone or blind zone is created between the CB and the associated CT.

End zone protection detects a fault located between the CB and the associated CT when the CB is open. Depending on the location of the CT, either the busbar section CB is tripped or an intertrip is sent to the CB at the remote end of the line.

Blind zone protection is used to detect and trip for faults located between the bus-section CB and the associated CT for the arrangement when the CT is installed on one side of the CB only.

■ BU out-of-Service Function

GRB200 provides a BU out-of-service function for maintenance purposes. When a particular BU is set to out-of-service condition, it is excluded from the operation of the protection scheme.

■ Voltage Check Function (Option)

GRB200 can enhance security against false tripping due to a failure in a CT or CT secondary circuits by the provision of a voltage check element in the form of a check relay with circuits that are independent from other circuits:

The voltage check function incorporates the following elements.

- Undervoltage element for earth fault detection
- Undervoltage element for phase fault detection
- Zero-phase overvoltage element for earth fault detection

■ Backup Overcurrent and Earth Fault Protection (Option)

Backup overcurrent and earth fault protection are provided in each bay. Each provides two stage overcurrent and earth fault protection respectively, and can be set to either a definite time or an inverse time characteristic.

The inverse time overcurrent elements are 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 definite time overcurrent protection is enabled by the instantaneous overcurrent element and pickup-delay timer.

HMI FUNCTION

■ Front Panel

GRB200 provides the following front panel options.

- Standard LCD
- Large LCD

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

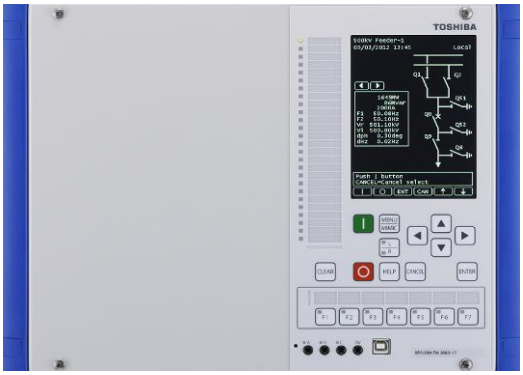


Figure 6 HMI Panel (large LCD type)

- The large LCD panel incorporates the user interfaces listed below:40 character, 40 line LCD with back light
- Support of multi language (option)
  (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 (option).

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

■ Local PC connection

The user can communicate with GRB200 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 currents, voltages (option) and frequency.

The accuracy of analog measurement is ±0.5% for I, V at rated input and ±0.03Hz for frequency measurement.

■ Status Monitoring

The open or closed status of each switchgear device and failure information concerning power apparatus and control equipment are monitored by GRB200.

Both normally open and normally closed contacts are used to monitor the 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
- Phases tripped
- Tripping mode
- Pre-fault and post-fault current and voltage data (phase, symmetrical components)

■ 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 inputs and binary signals. The data can be stored in COMTRADE format.

COMMUNICATION

■ Station bus

Ethernet port(s) for the substation communication standards IEC 61850, DNP3.0 and Modbus® RTU 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 are provided. GRB200 can function as a protocol converter to connect to a Substation Automation System.

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.

■ 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, clearing records and switching between local/remote controls.

■ Simulation and test

GRB200 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 functions can work in the Test mode only.

TOOLS & ACCESSORY

The PC interface GR-TIEMS allows users to access GRB200 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.

■ Remote Setting And Monitoring

The engineering tool supports functions to change settings and to view and analyze fault and disturbance records stored in GRB200. Waveform data in the disturbance records can be displayed, edited, measured and analyzed in detail. The advanced version of the engineering tool can provide additional and powerful analysis tools and setting calculation support functions.

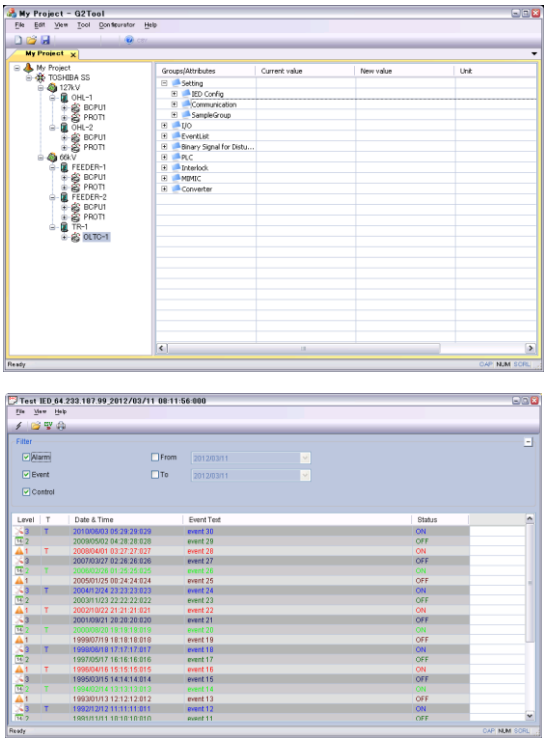


Figure 7 PC Display of GR-TIEMS

■ LCD Configuration

The user can configure and customize the MIMIC data displayed on the LCD of GRB200 using GR-TIEMS software.

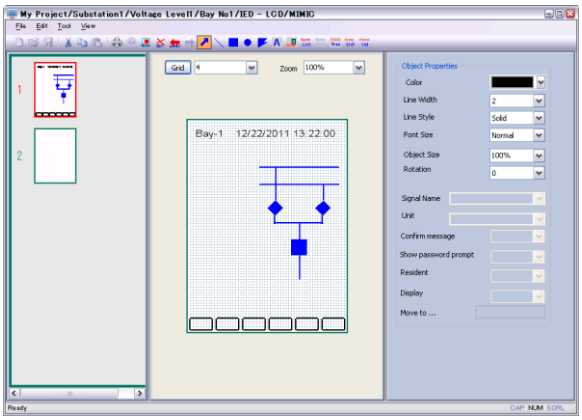


Figure 8 PC Display of MIMIC configuration

■ 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.

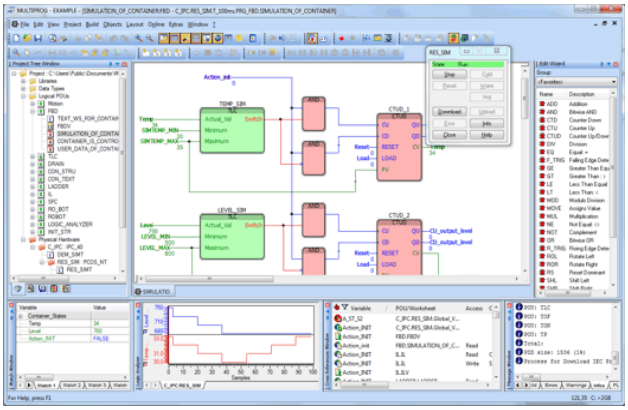


Figure 9 PC display of PLC editor

TECHNICAL DATA

HARDWARE	
Analog Inputs	
Rated current In	1A / 5A (selectable by user)
Rated voltage Vn	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	≤ 0.1VA at In = 1A, ≤ 0.2VA at In = 5°
Earth current inputs	≤ 0.3VA at In = 1A, ≤ 0.4VA at In = 5A
Sensitive earth fault inputs	≤ 0.3VA at In = 1A, ≤ 0.4VA at In = 5A
Voltage inputs	≤ 0.1VA at Vn
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	≤ 15%
Supply interruption	≤ 20ms at 110Vdc
Restart time	< 5ms
Power consumption	≤ 15W (quiescent) ≤ 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 from 14V to 154V in various steps.
Capacitive discharge immunity	10μF 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	≤ 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	0.13A, 110Vdc (L/R=40ms)
Operating time	9 ms
Hybrid contacts (10 A breaking)	
Make and carry	8A continuously
	10A, 220Vdc for 0.5s (L/R=5ms)
Break	10A, 220Vdc (L/R=20ms)
	10A, 110Vdc (L/R=40ms)
Operating time	1 ms
Durability	≥ 10,000 operations (loaded contact)
	≥ 100,000 operations (unloaded contact)
Measuring input capability	
Full scale	
Standard current input	≥ 60A (1A rating) or 300A (5A rating)
Voltage input	≥ 200V
Sampling rate	48 samples / cycle
Frequency response	< 5% deviation over range 16.7Hz to 600Hz
Mechanical Design	
Installation	Flush mounting
Weight	Approx. 10kg (1/3 size), 12kg (1/2 size), 25kg (1/1 size)
Case color	2.5Y7.5/1 (approximation to Munsell value)
LED	
Number	26 (Fixed for “In service” and “ERROR”)
Color	Red / Yellow / Green (configurable) except “In service” (green) and “Error” (red)
Function keys	
Number	7
Local Interface	
USB	Type B
Maximum cable length	2m (max.)
System Interface (rear port)	
100BASE-TX	Fast Ethernet
Physical medium	Twisted pair cable, RJ-45 connector
100BASE-FX	Fast Ethernet
Physical medium	50/125 or 62.5/125μm fibre, SC connector
Protocol	IEC61850 or Modbus® RTU
CU to BU communication	
Type:	GI optical fibre
Connector:	ST connector
Cable:	Graded-index multi-mode 50/125μs or 62.5/125μs
Serial communication (rear port)	
RS485	Protocol
	IEC 60870-5-103 or Modbus® RTU
Fiber optical	Protocol
	IEC 60870-5-103
Terminal Block	
CT/VT input	M3.5 Ring terminal
Binary input, Binary output	M3.5 terminal with 15mm stripping length (for compression type terminal)
	M3.5 Ring terminal (for ring lug type terminal)

FUNCTIONAL DATA

Current Differential Protection (87B)	
Minimum operating current (DIFCH, DIFZ):	500 to 3000A in 1A steps (CT primary amps)
% slope (SLPCH, SLPZ):	0.30 to 0.90 in 0.1 steps
Primary rating of CT:	100 to 10000A in 1A steps
Circuit Breaker Failure Protection (50BF)	
Overcurrent element (OCB):	0.1 to 2.0 times of current rating in 0.1 steps
BF timer for retrip of failed breaker:	0 to 500ms in 1ms steps
BF timer for related breaker trip:	50 to 500ms in 1ms steps
Operating time of overcurrent element	less than 20ms at 50Hz or less than 17ms at 60Hz
Resetting time of overcurrent element	less than 15ms at 50Hz or less than 13ms at 60Hz
Accuracy of overcurrent element:	±5% (±10% at I < 0.5×In)
DO/PU ratio:	0.8
Voltage Check Function	
Undervoltage element (UVGF):	20 to 60V in 1V steps
Undervoltage element (UVSF):	60 to 100V in 1V steps
Zero-phase overvoltage element (OVGF):	0.1 to 10.0V in 0.1V steps
Undervoltage change detection element (UVDF)	0.07 times voltage before fault
Phase Overcurrent Protection (50, 51)	
Definite time overcurrent element	
Pick up level (OC)	0.02 to 50.00pu in 0.01pu steps
Delay time (TOC)	0.00 to 10.00s in 0.01s steps
Operating time	typical 30ms (without delay time)
Inverse time overcurrent element	
Pick up level (OCI)	0.02 to 5.00pu in 0.01pu steps
Time multiplier (TOCI)	0.010 to 50.00 in 0.01 steps
Characteristic	IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Reset type	Definite Time or Dependent Time
Reset Definite delay	0.0 to 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS	0.010 to 50.000 in 0.001 steps
Earth Fault Protection (50N, 51N)	
Definite time overcurrent element	
Pick up level (EF)	0.02 to 50.00pu in 0.01pu steps
Delay time (TEF)	0.00 to 10.00s in 0.01s steps
Operating time	typical 30ms (without delay time)
Inverse time overcurrent element	
Pick up level (EFI)	0.02 to 5.00pu in 0.01pu steps
Time multiplier (TEFI)	0.010 to 50.00 in 0.01 steps
Characteristic	IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Reset type	Definite Time or Dependent Time
Reset Definite delay	0.0 to 300.0s in 0.1s steps
Reset Time Multiplier Setting RTMS	0.010 to 50.000 in 0.001 steps
Metering Function	

Current	Accuracy ± 0.5% (at rating)
Voltage	Accuracy ± 0.5% (at rating)
Frequency	Accuracy ± 0.03Hz
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		
CE	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]
CU (Central Unit)

	7	8	9	A	B	C	D	E	F	G	H	J	K	L
Configurations	**G**	**R**	**B**	**2**	**0**	**0**	**-**		**-**			**-**	**C**		**-**			**-**	**1**		**-**		**0**	**0**

	7	8	9	A	B	C	D	E	F	G	H	J	K	L
Central Unit														
Application of power system														
Without Voltage input	0													
With Voltage input 4ZONEs	1													
With Voltage input 8ZONEs	2													
AC Rating														
50Hz												1		
60Hz												2		
DC Rating														
110-250 Vdc or 100-220 Vac		1												
48-110 Vdc		2												
24- 48 Vdc		3												
Outline														
Standard LCD, 1/1 x 19'' rack for flush/rack mounting			4											
Large LCD, 1/1 x 19'' rack for flush/rack mounting			8											
BI/BO Module														
Refer to Number of BI/BO Table														
BI/BO Terminal Type														
Compression plug type terminal											0			
Ring lug type terminal											1			
Maximum Number of BU to Connect														
8 CH							1							
16 CH							2							
24 CH							3							
32 CH							4							
40 CH							5							
48 CH							6							
56 CH							7							
64 CH							8							
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								7						

								7	8		9	A	B		C	D		E	F		G	H		J	K	L					
Configurations	**G**	**R**	**B**	**2**	**0**	**0**	**-**			**-**				**-**	**C**		**-**			**-**	**1**		**-**		**0**	**0**					

3 ports + GPS (Note : Selectable when Communication for Protection is 0 or 1 CH.)	8	
3 ports + IRIG-B (Note : Selectable when Communication for Protection is 0 or 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 0 or 1 CH.)	F	
2 ports + IRIG-B + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 0 or 1 CH.)	G	
3 ports + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 0 or 1 CH.)	H	
3 ports + GPS + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 0 CH.)	J	
3 ports + IRIG-B + connection terminal for external I/O unit (GIO200) (Note : Selectable when Communication for Protection is 0 CH.)	K	
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 – K)		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 – K)		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 – K)		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 – K)		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.

[Hardware selection]
BU (Bay Unit)

	7	8		9	A	B		C	D		E	F		G	H		J	K	L
Configurations	**G**	**R**	**B**	**2**	**0**	**0**	**-**			**-**				**B**	**0**	**-**	**4**	**E**	**-**	**1**		**-**			**0**
Bay Unit																			
Application of power system																			
(CTx4) for 1/3x 19'' rack	1																		
(CTx4) for 1/2 x 19'' rack	2																		
AC Rating																			
50Hz																	1		
60Hz																	2		
1A																		1	
5A																		2	
DC Rating																			
110-250 Vdc or 100-220 Vac		1																	
48-110 Vdc		2																	
24- 48 Vdc		3																	
Outline																			
Standard LCD, 1/3 x 19'' rack for flush mounting				1															
Standard LCD, 1/2 x 19'' rack for flush mounting				2															
Large LCD, 1/3 x 19'' rack for flush mounting				5															
Large LCD, 1/2 x 19'' rack for flush mounting				6															
Standard LCD, 1/3 x 19'' rack for rack mounting				E															
Standard LCD, 1/2 x 19'' rack for rack mounting				F															
Large LCD, 1/3 x 19'' rack for rack mounting				H															
Large LCD, 1/2 x 19'' rack for rack mounting				J															
Standard LCD, 1/3 x 19'' rack for vertical flush mounting				L															
Standard LCD, 1/2 x 19'' rack for vertical flush mounting				M															
Large LCD, 1/3 x 19'' rack for vertical flush mounting				Q															
Large LCD, 1/2 x 19'' rack for vertical flush mounting				R															
BI/BO Module																			
Refer to Number of BI/BO Table																			
BI/BO Terminal Type																			
Compression plug type terminal															0				
Ring lug type terminal															1				
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.

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 (Set code position "9" to other than 1/3 x 19" rack - "1", "5", "E", "H", "L" and "Q")

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 (Set code position "9" to other than 1/3 x 19" rack - "1", "5", "E", "H", "L" and "Q")

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
-	-	32	10	-	6	12	-	-	**38**	1xBI3+1xDCAI2+1xBO1
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

[Software selection]
CU (Central Unit)

	1	2	3	4	5	6		7	S	G	T		E	F	U		9	V
Configurations	**G**	**R**	**B**	**2**	**0**	**0**	**-**		**0**			**-**				**-**		**E**

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)	0
Standard + IEC 61850	1
IEC 61850	2
Outline	
Assignment on position "9"	
Language	
English	E

[Software selection]
BU (Bay Unit)

	1	2	3	4	5	6		7	S	G	T		E	F	U		9	V
Configurations	**G**	**R**	**B**	**2**	**0**	**0**	**-**		**0**			**-**	**4**	**E**	**9**	**-**		**E**

Application of power system	
Assignment on position "7"	
Function Block	
Refer to Function Table	
Outline	
Assignment on position "9"	
Language	
English	E

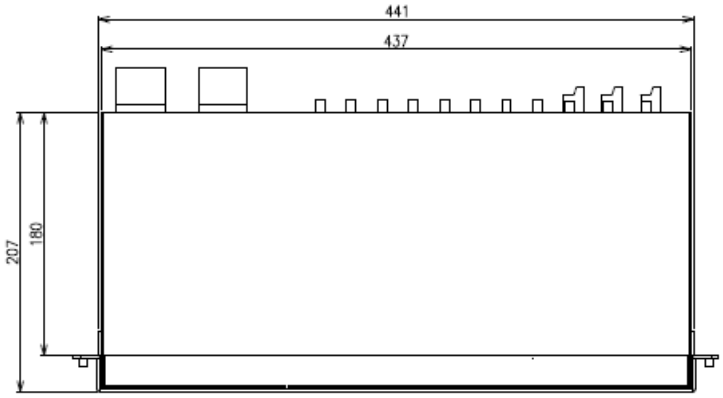
[FUNCTION TABLE]
CU (Central Unit)

Function Block	Protection function		Ordering No. (Position "G & T")	
			11	12
DIF	87	Phase-segregated current differential protection	●	●
	CTF	CT failure detection by Id		
	--	Differential current monitoring		
CBF	50BF	Circuit breaker failure protection	●	●
EFP	--	End fault protection	●	●
COMTP	--	Command trip function	●	●
FS	FS	Fail-safe function (Voltage check function)		●

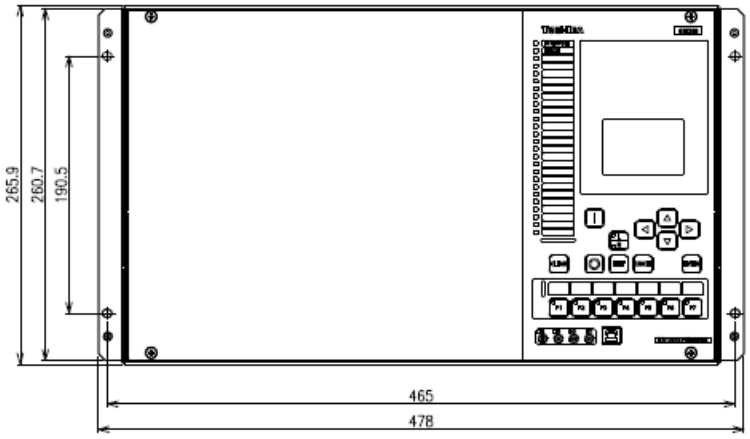
[FUNCTION TABLE]
BU (Bay Unit)

Function Block	Protection function		Ordering No. (Position "G & T")			
			11	12	13	14
DIF	87	Phase-segregated current differential protection	●	●	●	●
	CTF	CT failure detection by Id				
	--	Differential current monitoring				
CBF	50BF	Circuit breaker failure protection	●	●	●	●
EFP	--	End fault protection	●	●	●	●
COMTP	--	Command trip function	●	●	●	●
OC	50	Non-directional definite time over-current protection		●		●
	51	Non-directional inverse time over-current protection				
EF	50N	Non-directional definite time earth fault over-current protection		●		●
	51N	Non-directional inverse time earth fault over-current protection				
FS	FS	Fail-safe function (Voltage check function)			●	●

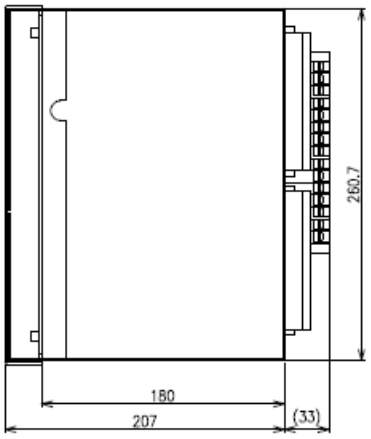
DIMENSION AND PANEL CUT-OUT (1/1 size)



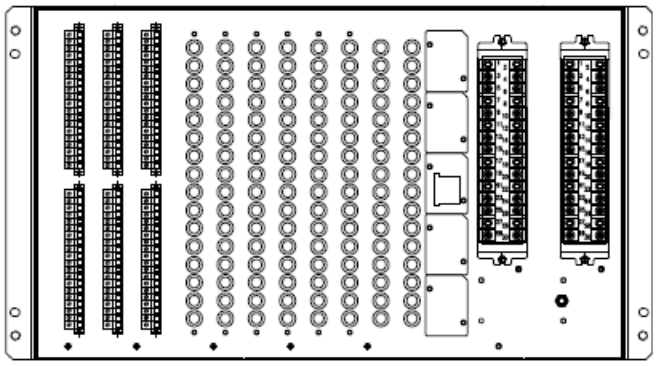
(a)Top view



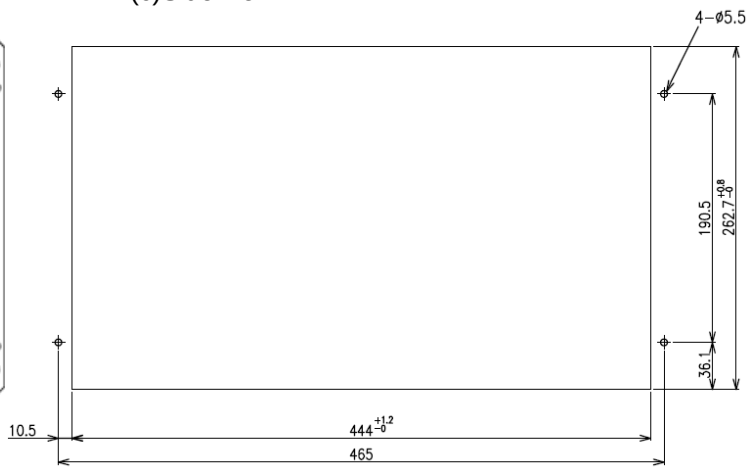
(b)Front view



(c)Side view



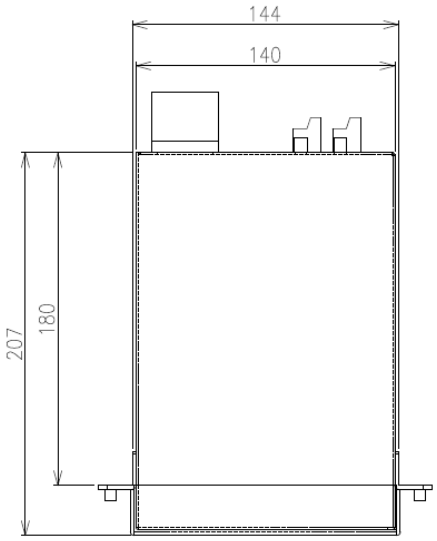
(d)Rear view



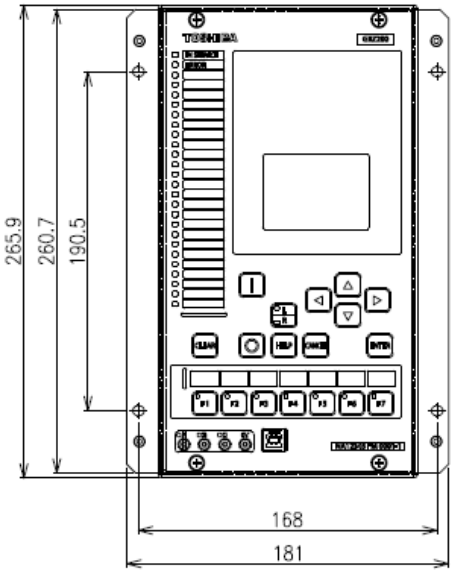
(e)Panel cut-out

Figure 10 – Dimension and Panel Cut-out – 1/1 x 19'' case size (Central Unit)

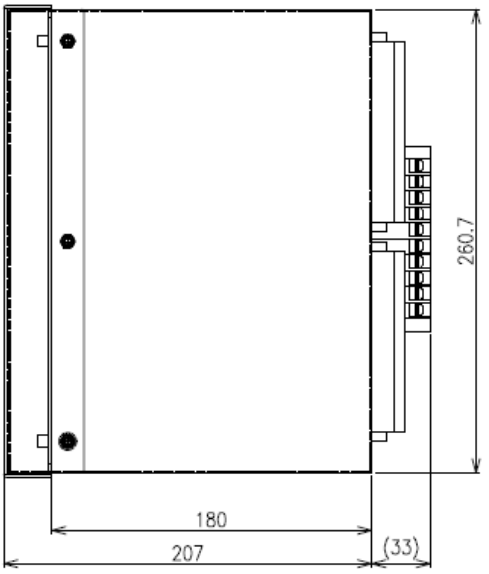
DIMENSION AND PANEL CUT-OUT (1/3 size)



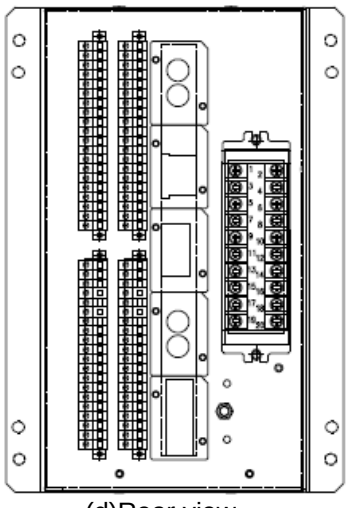
(a)Top view



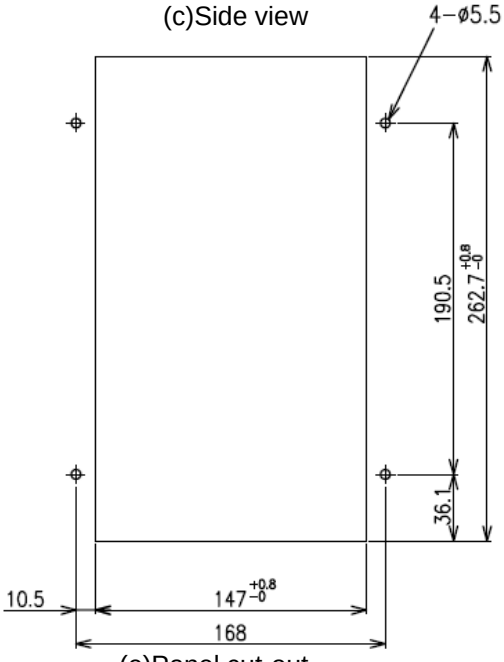
(b)Front view



(c)Side view



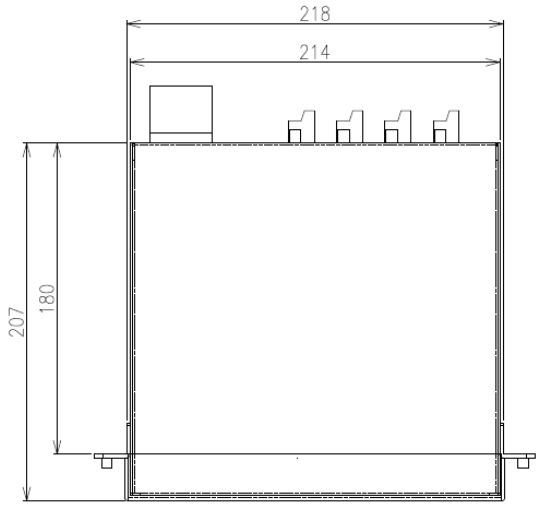
(d)Rear view



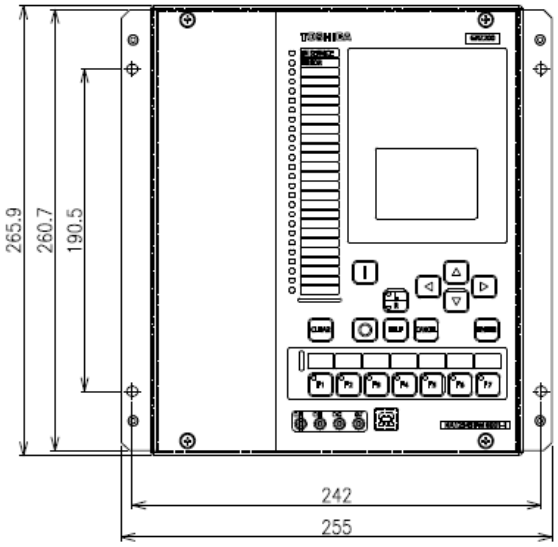
(e)Panel cut-out

Figure 11 – Dimension and Panel Cut-out – 1/3 x 19'' case size (Bay unit)

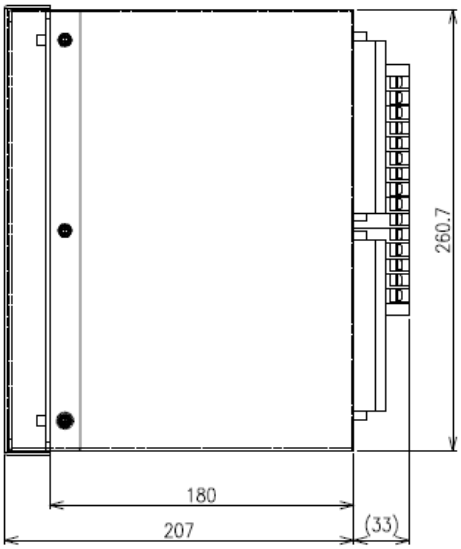
DIMENSION AND PANEL CUT-OUT (1/2 size)



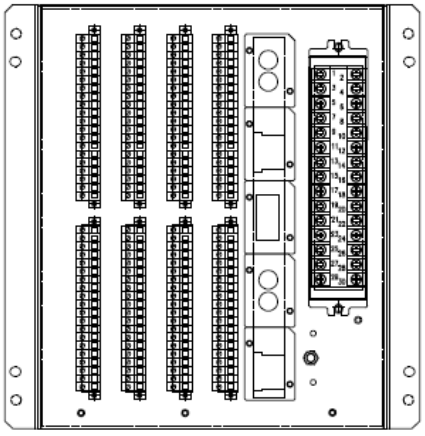
(a)Top view



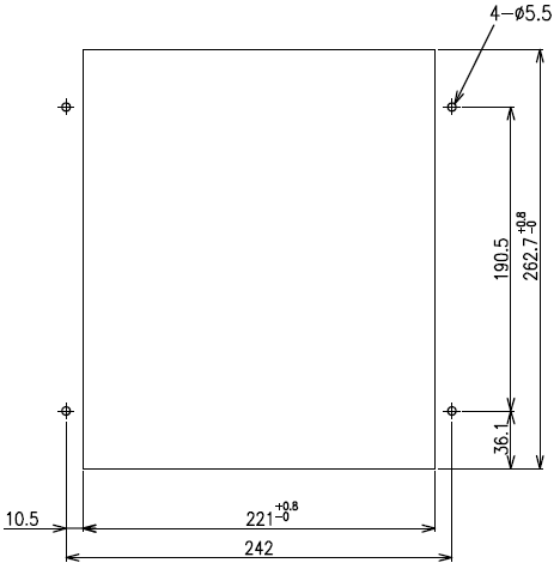
(b)Front view



(c)Side view



(d)Rear view



(e)Panel cut-out

Figure 12 – Dimension and Panel Cut-out – 1/2 x 19'' case size (Bay unit)

CONNECTIONS DIAGRAM

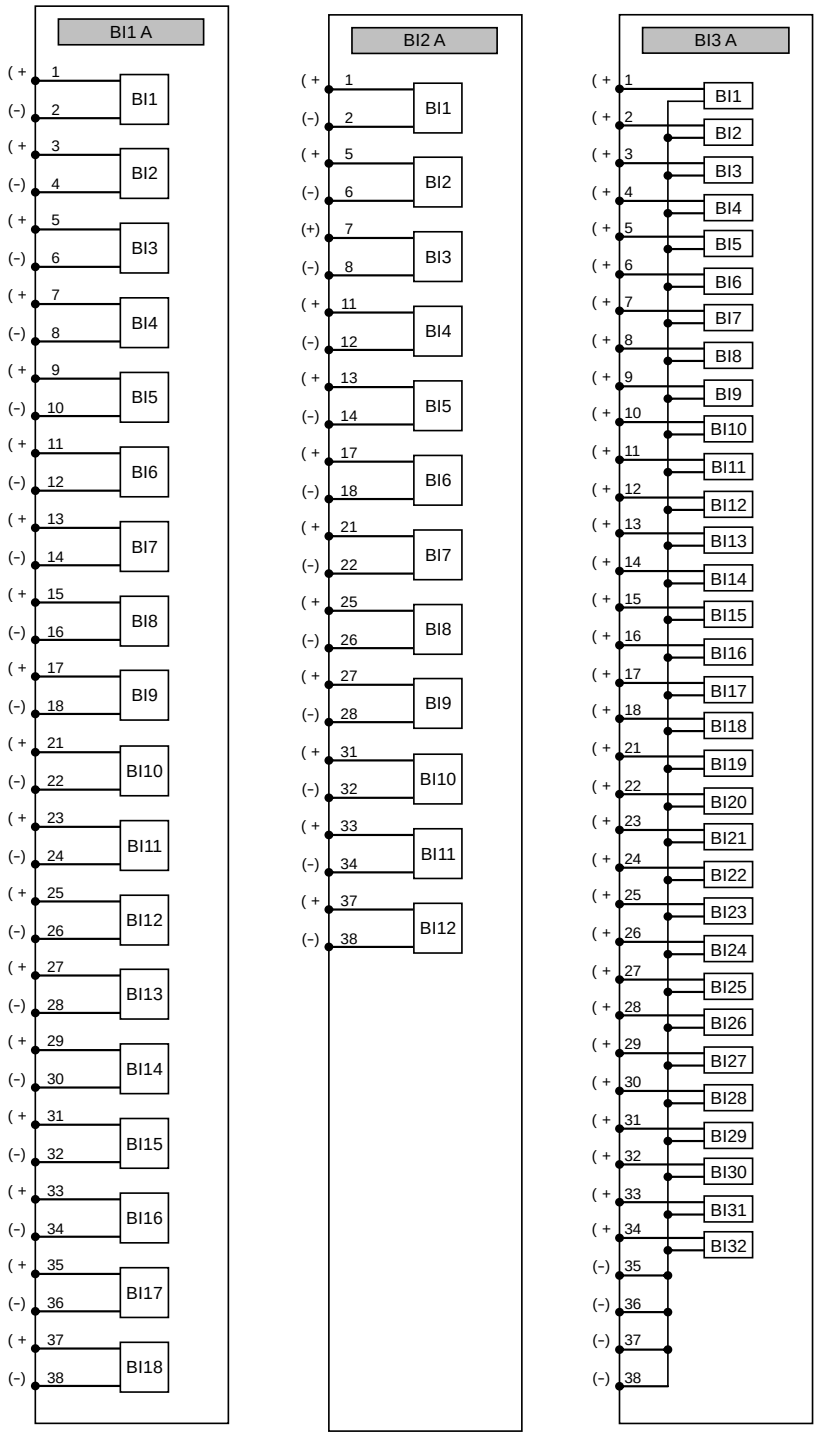
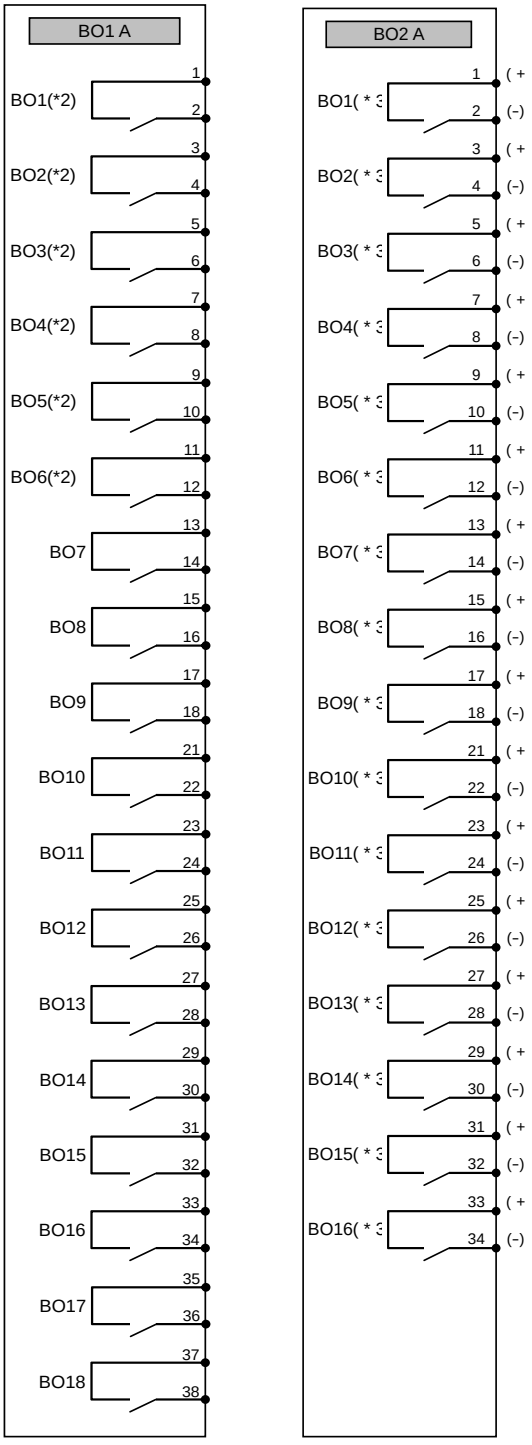


Figure 13 – Binary input board module for Compression plug type terminal

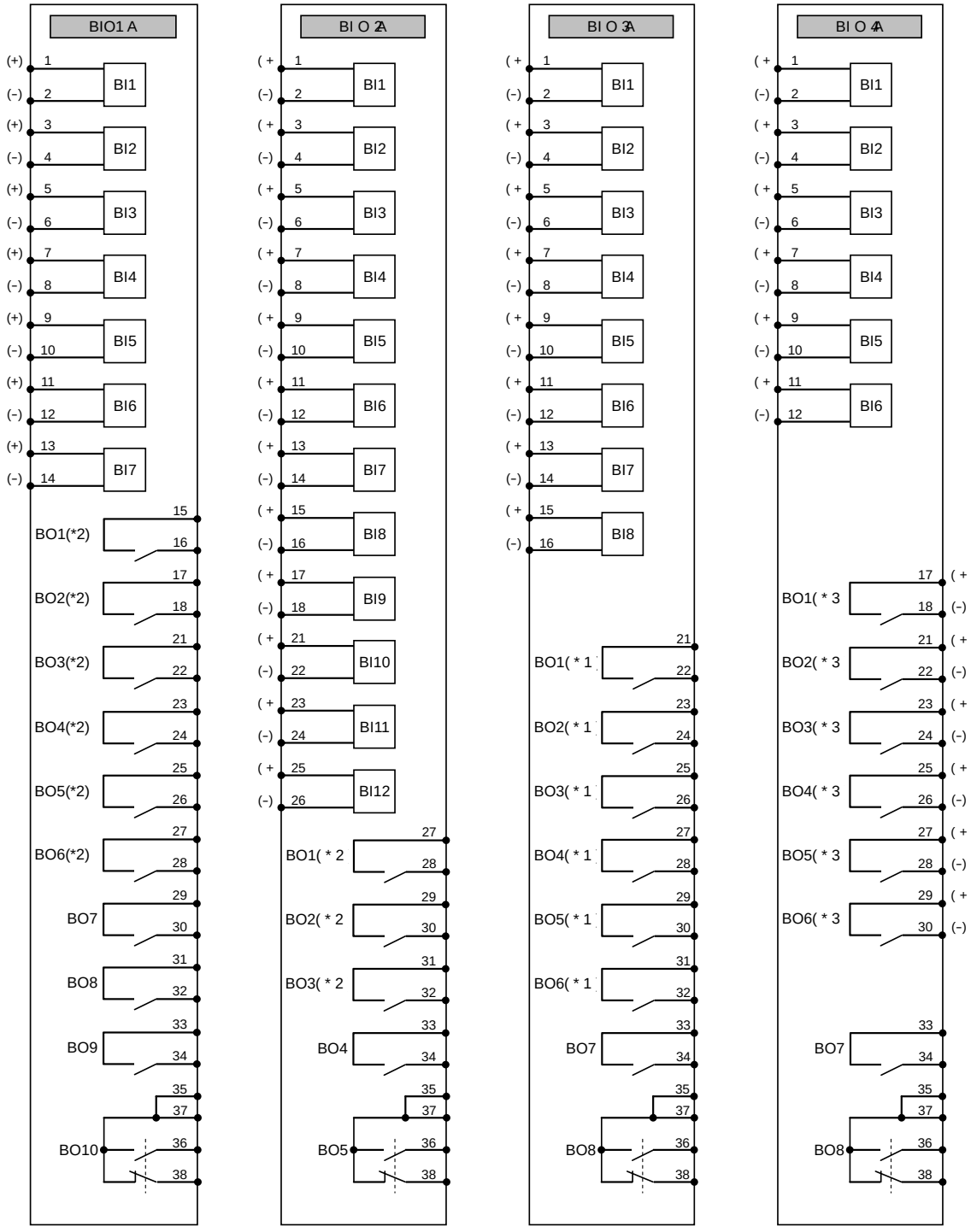
CONNECTIONS DIAGRAM



(*2) Semi-fast BO
(*3) Hybrid BO

Figure 14 – Binary output board module for Compression plug type terminal

CONNECTIONS DIAGRAM



(*1) Fast BO
(*2) Semi-fast BO
(*3) Hybrid BO

Figure 15 – Combined binary input and output module for Compression plug type terminal

CONNECTIONS DIAGRAM

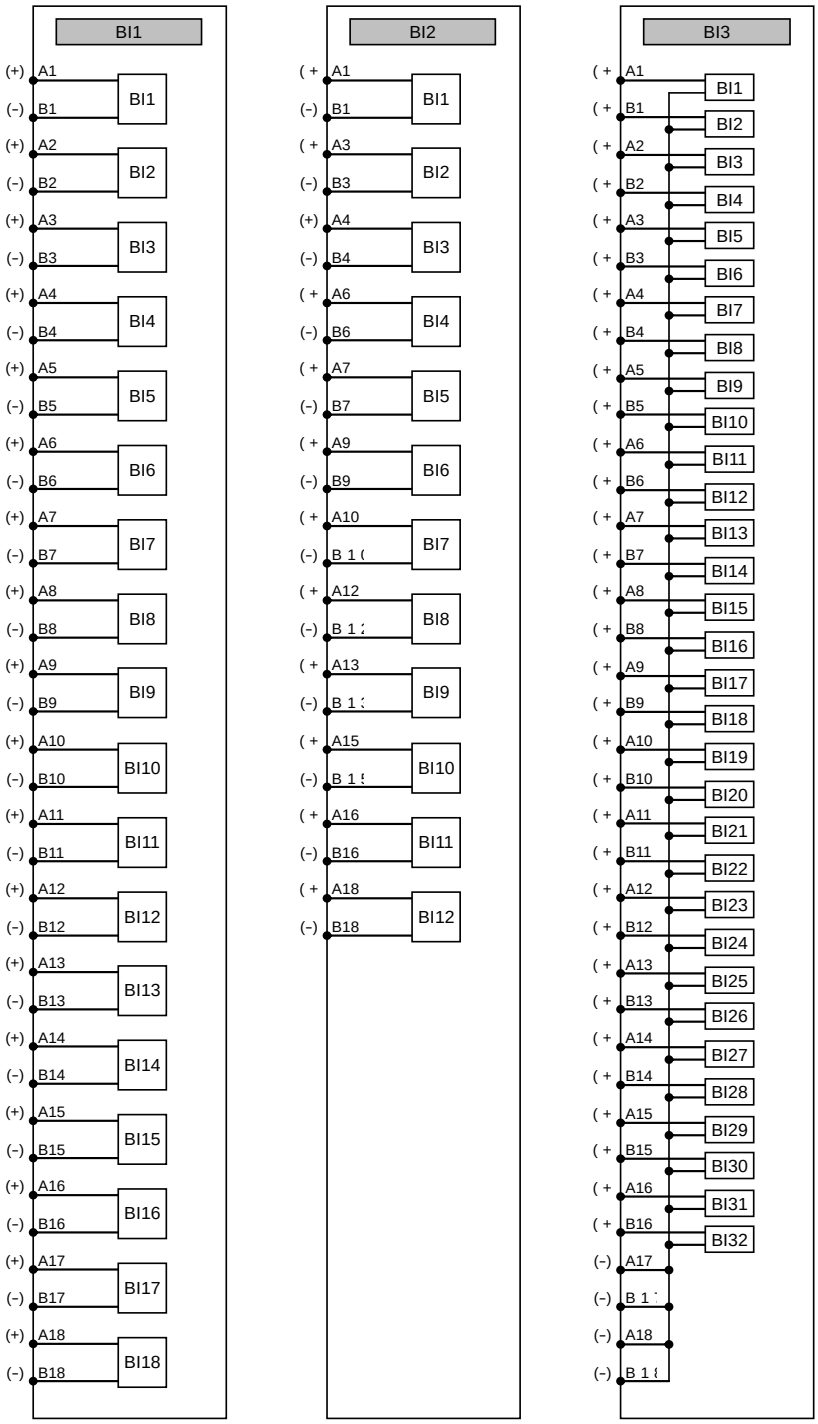
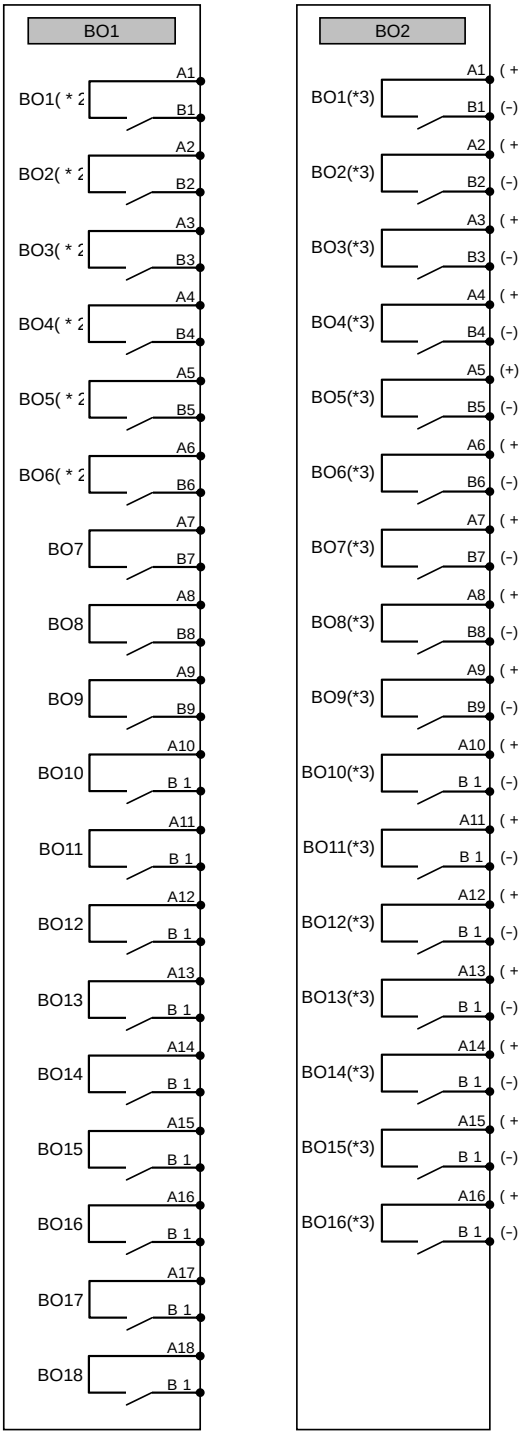


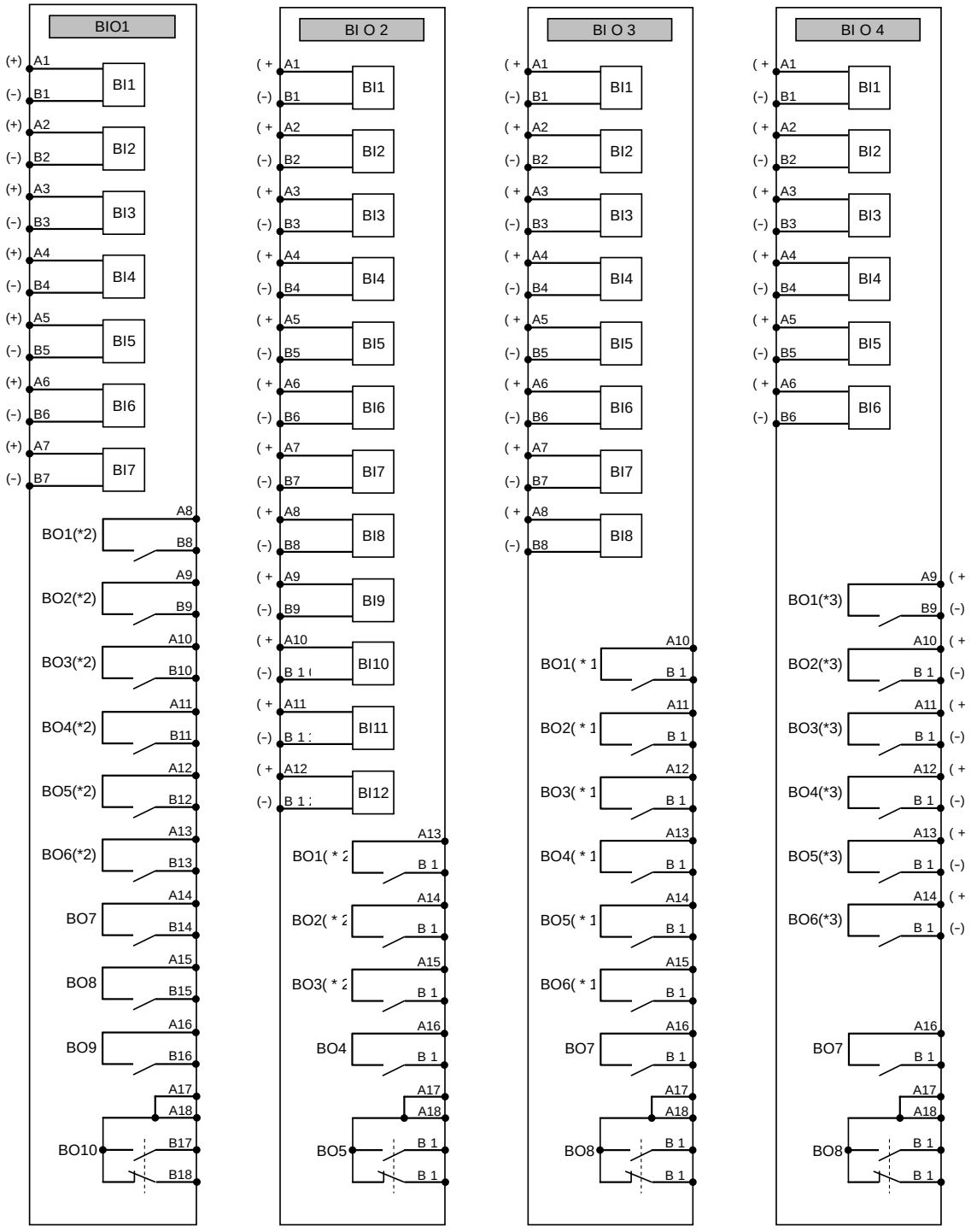
Figure 16 – Binary input board module for Ring lug type terminal



(*2) Semi-fast BO
(*3) Hybrid BO

Figure 17 – Binary output board module for Ring lug type terminal

CONNECTIONS DIAGRAM



(*1) High speed BO
(*2) Semi-fast BO
(*3) Hybrid BO

Figure 18 – Combined binary input and output module for Ring lug type terminal

CONNECTIONS DIAGRAM

CT/VT Module

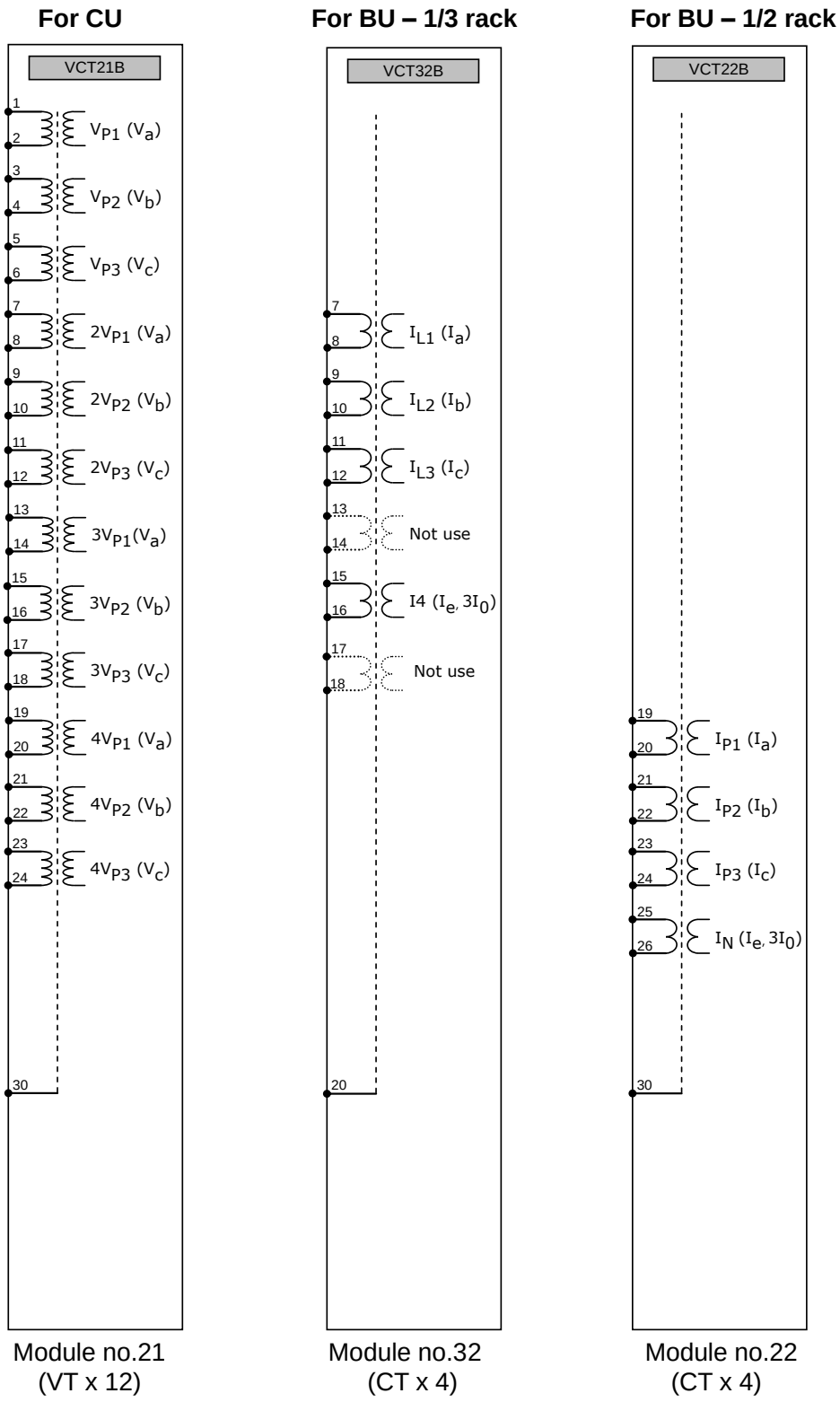
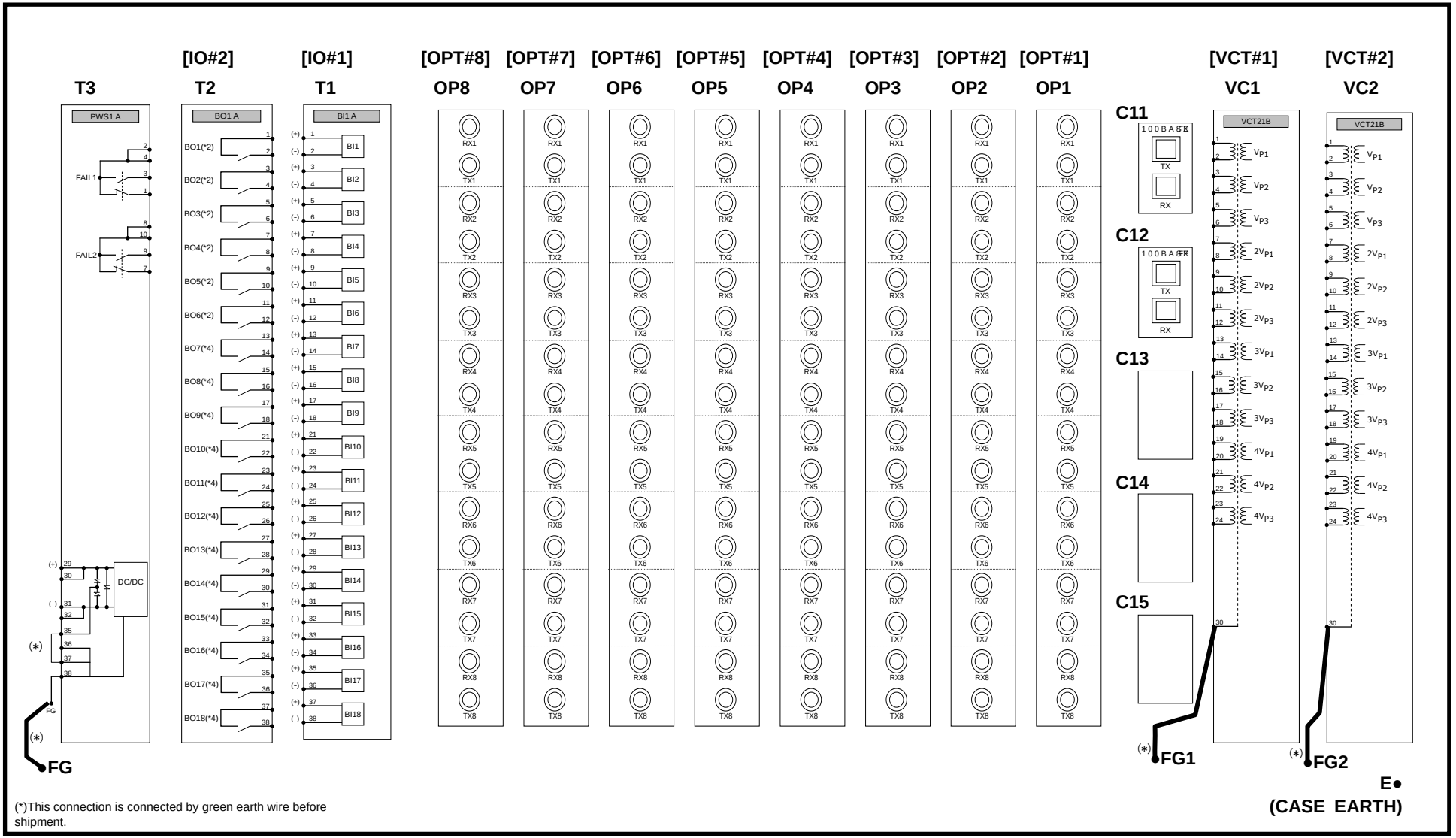


Figure 19 – CT/VT module

EXTERNAL CONNECTIONS DIAGRAM

CU (Central Unit) – 1/1 size



(*)This connection is connected by green earth wire before shipment.

Figure 20 – Typical external connection diagram (VCT: No.21B x 2, IO: BI1A, BO1A)

EXTERNAL CONNECTIONS DIAGRAM

BU (Bay Unit) – 1/3 size

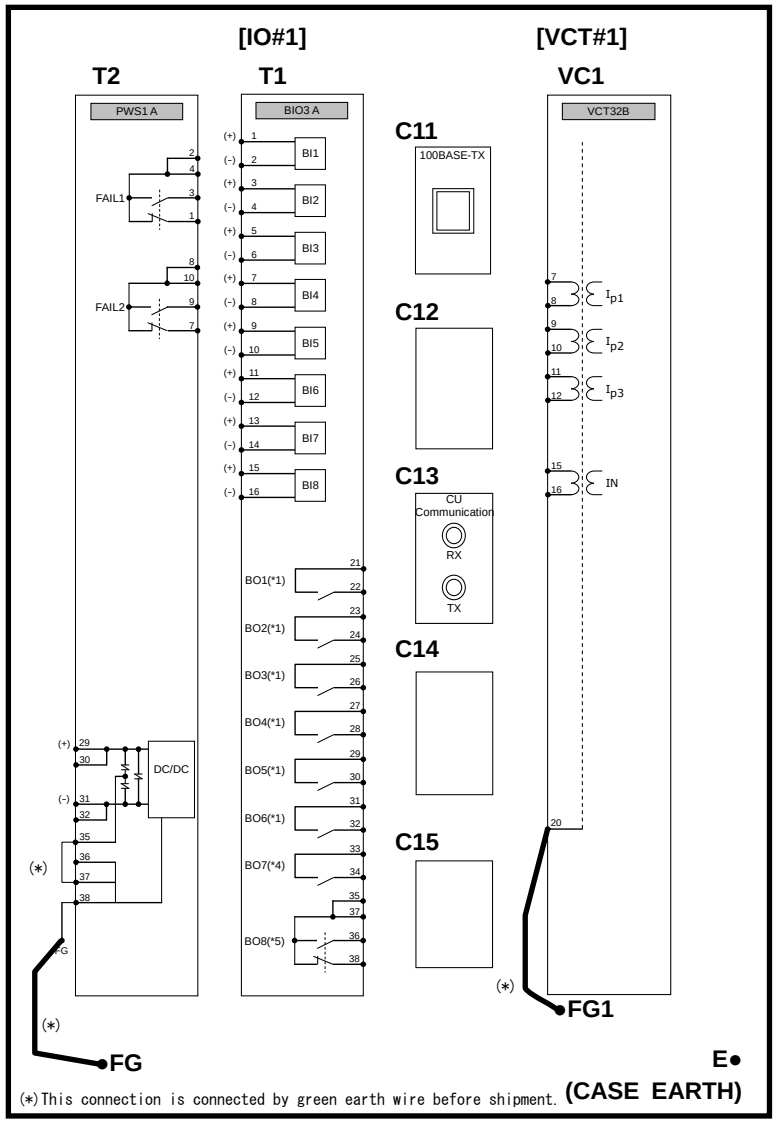


Figure 21 – Typical external connection diagram (VCT: No.22B, IO: BIO3A)

EXTERNAL CONNECTIONS DIAGRAM

BU (Bay Unit) – 1/2 size

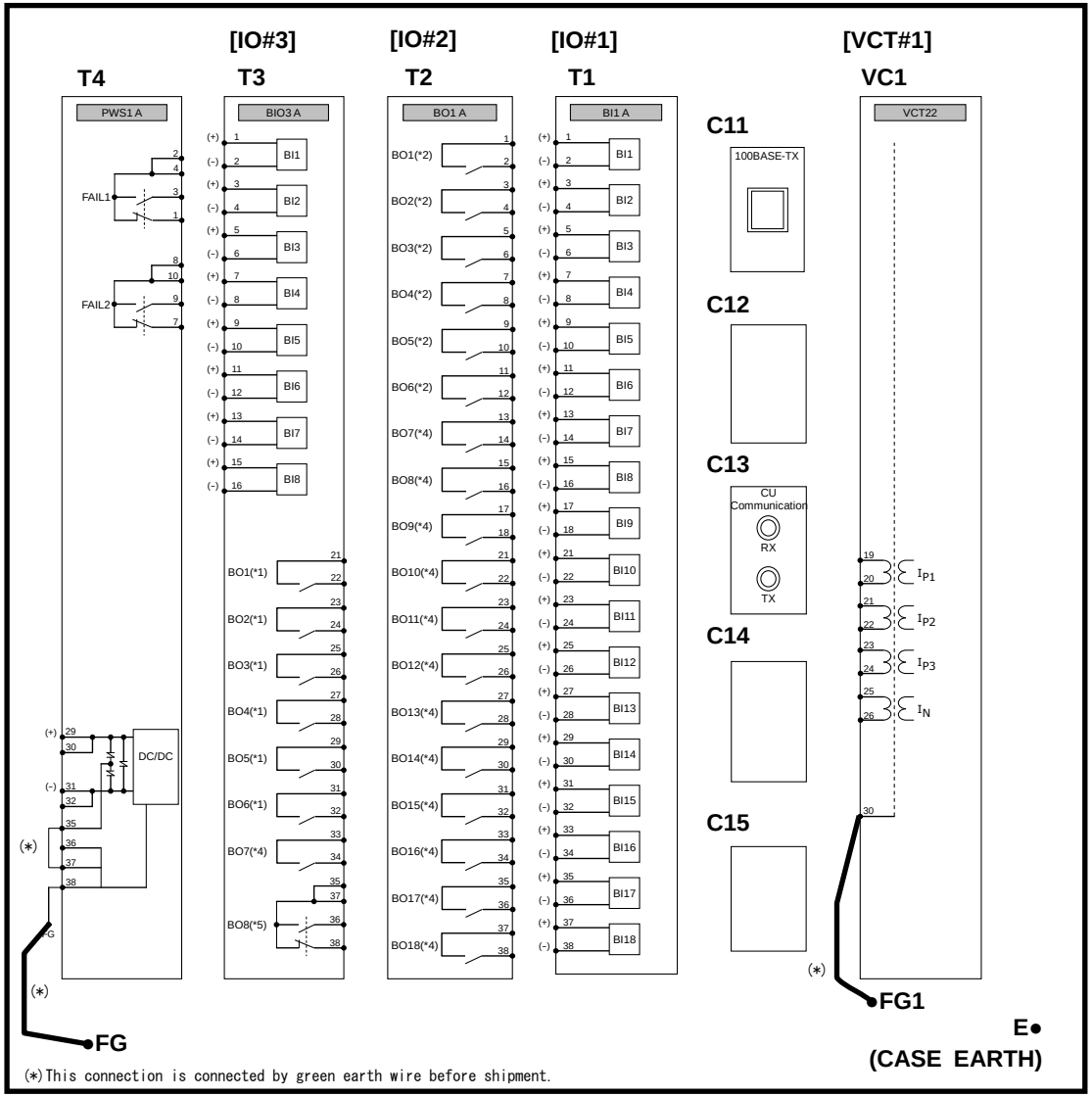


Figure 22 – Typical external connection diagram (VCT: No.22B, IO: BI1A, BO1A, BIO3A)

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