TOSHIBA

Leading Innovation

GR-200 Series

GRT 200

Transformer 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. Process bus capability and teleprotection based upon packet-based communications are just two of the features of GR-200.

APPLICATION

GRT200 transformer protection is implemented on Toshiba's next generation GR-200 series IED platform and has been designed to provide comprehensive protection and control applications for transformers in all types of network. 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.

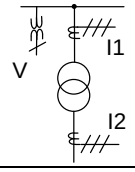
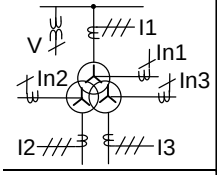
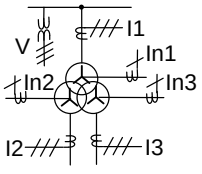
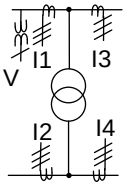
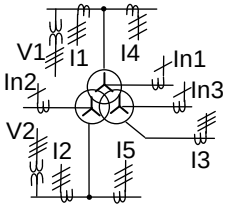
- Current differential protection is applied for fast and selective main protection for two-winding or three-winding power transformers, auto-transformers and generator-transformer units. This protection requires no interposing CTs and provides stability against magnetizing inrush, overexcitation and CT saturation.
- Up to five current inputs for the phase segregated differential protection
- Restricted earth fault protection incorporating enhanced stability against CT saturation detects internal earth faults where the transformer star point is directly or low impedance earthed.
- Comprehensive back up protections
- Bay control and monitoring functions
- 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

- Application for two-winding or three-winding power transformers, auto-transformers and generator-transformer units.
- Current differential protection is applied for fast and selective main protection. This protection requires no interposing CTs and provides stability against magnetizing inrush, overexcitation and CT saturation.
- Restricted earth fault protection detects internal earth faults where the transformer star point is directly or low impedance earthed and can be applied on high-voltage and low-voltage sides respectively.
- Time-overcurrent protection is mainly used as backup protection and can be applied on high- and low-voltage sides respectively.
- Thermal overload protection protects the transformer against thermal stress and provides two independently set levels for alarm and tripping.

GRT200 can be applied to the various kinds of transformer configuration as per the transformer configuration and applicable model:

Configuration	Analog inputs	Model
	2 x three-phase CT + 1 x one-phase VT	GRT200-1-*
	3 x three-phase CT + 3 x zero-phase CT + 1 x one-phase VT /	GRT200-2-*
	3 x three-phase CT + 3 x zero-phase CT + 1 x three-phase VT	GRT200-3-*
	4 x three-phase CT + 1 x one-phase VT	GRT200-4-*
	5 x three-phase CT + 3 x zero-phase CT + 2 x three-phase VT	GRT200-5-*

• 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 – DNP 3.0, 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
- Mixed 1A / 5A phase and neutral current inputs
- Phase and neutral CT polarity settings
- Multi range DC power supply: 24 to 48V / 48 to 110 V / 110 to 240V
- 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

FUNCTIONS

- **Protection**
  - Current differential protection for two or three winding transformers (DIF) incorporating stability against inrush, over-excitation and CT saturation
  - No interposing CTs required
  - Mixed 1A/5A inputs for phase and neutral currents
  - CT ratio, vector and zero-sequence compensation
  - Restricted earth fault protection (REF) incorporating enhanced stability against CT saturation
  - Breaker failure protection (CBF)
  - Directional / non-directional overcurrent protection for phase faults (OC)
  - Non-directional overcurrent protection for earth faults using neutral current (EFIn)
  - Directional / nondirectional overcurrent protection for earth faults using phase currents (EF)
  - Negative phase sequence overcurrent protection (OCN)
  - Thermal overload protection (THM)
  - Broken conductor protection (BCD)
  - Inrush current detector (ICD)
  - Overexcitation protection (VPH)
  - Under/over voltage protection (UV/UVS/OV/OVS)
  - Residual overvoltage protection (OVG)
  - Under/over frequency and rate of change of frequency protection (FRQ)
  - Voltage controlled overcurrent protection (OCV)
  - Trip and/or Indication of external devices (MECH. TRIP)
- **Control**
  - Circuit breaker and isolator control
  - Switchgear interlock check
  - Synchronism voltage check
- **Monitoring**
  - Status and condition monitoring of primary apparatus
  - Switchgear operation monitoring
  - Plausibility check
  - Measurement s of I, V, P, Q, S, PF, f, Wh, varh
  - VT failure detection (VTF)
  - Current and voltage circuit supervision
  - Trip circuit supervision (TCS)
- **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 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
  - 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

■ **Current Differential Protection (DIF)**

GRT200 provides fast, selective protection for two and three winding transformers. It has three phase-segregated differential elements (DIF-Stage 1), each with a dual-slope, percentage differential characteristic as shown in Figure 1. GRT200 also provides high-set unrestrained differential elements (DIF-Stage 2).

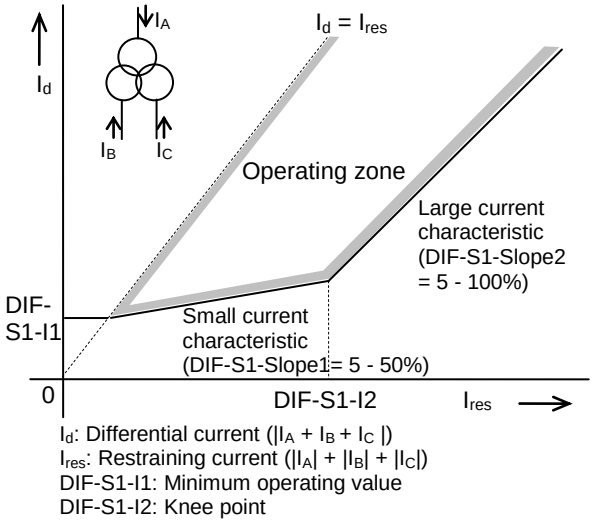


Figure 1: DIF-Stage1 characteristic

The small current characteristic provides sensitivity to low level faults. For higher level faults, the large current characteristic with increased bias compensates for the effects of CT saturation. Furthermore, GRT200 provides a CT saturation countermeasure function against a very large through-fault current.

GRT200 incorporates internal CT ratio and vector compensation, so that the relay requires no interposing CTs.

Mixed 1A/5A inputs for phase currents are available.

CT polarities for each three-phase CT can be set flexibly within GRT200 in accordance with external physical connections to each three-phase CT.

During periods of transformer energization, the use of a second harmonic restraint method blocks the relay operation.

When the transformer is overexcited due to a transient power system disturbance, the use of a fifth harmonic restraint method blocks the relay operation.

GRT200 also provides high-set unrestrained differential elements (DIF-Stage2) and ensures rapid clearance of heavy internal faults.

GRT200 provides differential current supervision functions for 87T elements to monitor erroneous differential current under normal conditions.

■ Restricted Earth Fault Protection (REF)

Employing residual current of each winding and neutral point current, restricted earth fault protection (REF) provides a highly sensitive differential protection for earth faults in a transformer which has a star point directly earthed or low impedance earthed.

The REF-DIF element has a dual slope, percentage characteristic as shown in Figure 2 and the independent elements can be applied for each transformer winding.

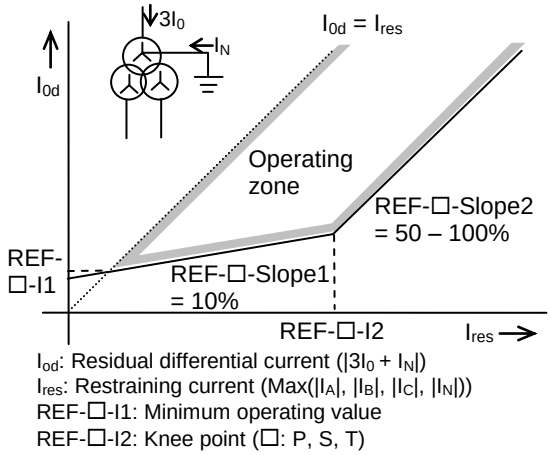


Figure 2: REF-DIF characteristic

The REF provides a directional check element REF-DEF to discriminate between internal and external faults to enhance stability against CT saturation as shown in Figure 3. The REF_DEF characteristic consists of both of the characteristics as shown in Figure 4 (a) and (b).

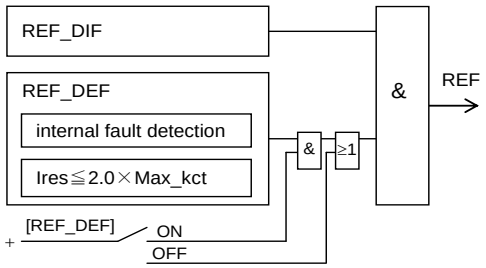


Figure 3: REF block diagram

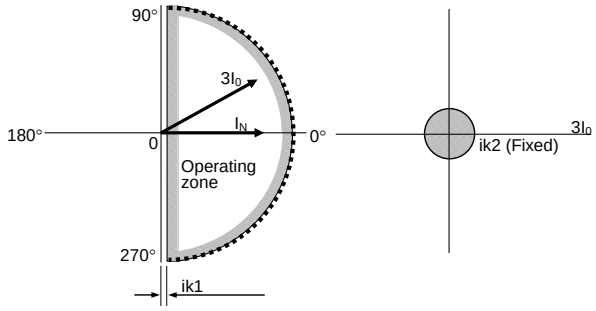


Figure 4: REF-DEF characteristic

Mixed 1A/5A inputs for phase and neutral currents are available.

CT polarities for each neutral CT can be set flexibly within GRT200 in accordance with external physical connections to each neutral CT.

■ Breaker Failure Protection (CBF)

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.

■ Overcurrent Protection (OC / EFIn / EF)

GRT200 provides up to 8 directional or non-directional overcurrent protections (OC) with inverse time and definite time for phase faults which can be applied flexibly for each transformer winding.

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 as shown in Figure 3. 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 flashing/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 the scheme switches, and overcurrent backup protection can be blocked by a binary input signal.

GRT200 provides up to 4 non-directional overcurrent protections (EFIn) with inverse time and definite time for earth faults which can be applied flexibly for each transformer winding, utilizing neutral current values observed.

GRT200 also provides up to 8 directional or non-directional overcurrent protections (EF) with inverse time and definite time for earth faults which can be applied flexibly for each transformer winding, utilizing residual current values calculated by phase currents observed.

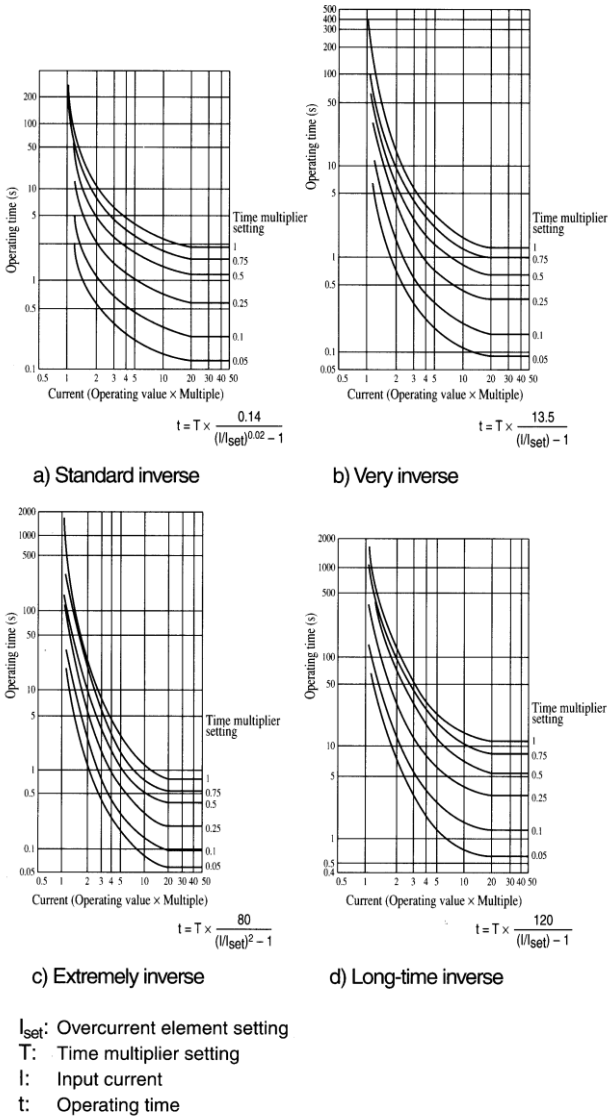


Figure 5: Characteristics of inverse time delayed overcurrent element

■ Negative Phase Sequence Overcurrent Protection (OCN)

Up to 4 negative phase sequence overcurrent protections (OCN) can be applied flexibly for each

transformer winding. OCN 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.

■ Thermal Overload Protection (THM)

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. The GRT200 issues a trip in accordance with the 'cold' and 'hot' curves specified in IEC 60255-149 to prevent the protected system from exceeding its thermal capacity. The cold curve tripping times are applicable when the system is first energized, 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.

■ Broken Conductor Detection (BCD)

GRT200 provides up to 3 broken conductor detections (BCD). Detects unbalance conditions in each transformer winding caused by an open circuited conductor. An unbalance threshold with programmable definite time delay is provided.

■ Inrush Current Detector (ICD)

The inrush current detector (ICD) is used to prevent an incorrect operation of the aforementioned OC, EF, OCN and BCD against a magnetizing inrush current during transformer energization. ICD detects second harmonic inrush currents during transformer energization.

■ Overexcitation Protection (VPH)

Alarms and tripping for overexcitation, based on a measurement of the voltage/frequency ratio are provided.

The alarm is definite time delayed whilst the characteristic may be selected as either having a definite time or an inverse time delay as shown in Figure 6.

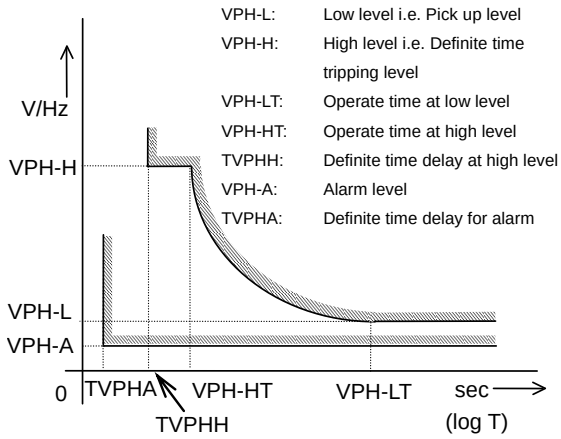


Figure 6: VPH characteristic

■ Under/Over Voltage Protection (UV / UVS / OV / OVS

GRT200 provides up to 4 stage undervoltage protections for phase-to-ground voltages (UV) and phase-to-phase voltages (UVS) respectively which can be applied flexibly for HV and LV. The protections are provided with a blocking function to prevent tripping in the event of a dead line.

GRT200 also provides up to 4 independent overvoltage protections for both phase-to-ground voltages (OV) and phase-to-phase voltages (OVS) which can be applied flexibly for HV and LV**.** All stages can be set for inverse time or definite time operation.

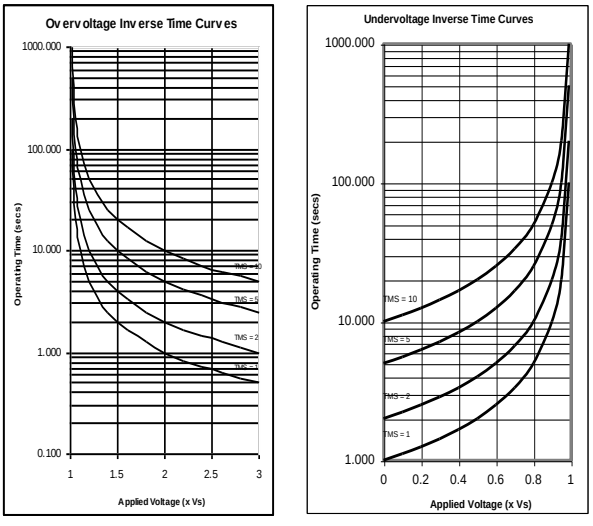


Figure 7: Inverse time characteristics

■ Zero Phase Sequence Overvoltage Protection (OVG)

Up to 4 zero phase sequence overvoltage protections (OVG) are provided for detection of earth faults in high impedance earthed or isolated systems. OVG 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.

■ Under/Over Frequency and Rate of Change of Frequency Protection (FRQ)

GRT200 provides up to 6 stage frequency protections where over/under frequency protections or rate-of-change-of-frequency protections can be selected flexibly.

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 delay timer. The rate-of-change-of-frequency protection calculates the gradient of frequency change (df/dt).

■ Voltage Controlled Overcurrent Protection (OCV)

Voltage controlled or voltage restraint inverse overcurrent protection (OCV) is equipped so that the relay can issue a trip signal in response to certain fault types on the lower voltage side when the fault current may be lower than the nominal value. The user can select either the voltage controlled OCI or the voltage restraint OCI function in addition to the normal OCI function. When voltage controlled OCI is used, only when an input voltage is lower than a setting, the OCI element functions. When voltage restraint OCI is used, the sensitivity of OCI is proportionally adjusted by the voltage input value between 20 and 100% of the voltage setting.

■ Trip and/or Indication of External Devices (MECH. TRIP)

Up to 16 external signals such as overpressure devices and Buchholz relay operations can be applied through binary input circuits. Logic can be arranged for alarms, event recording and tripping.

CONTROL

■ Switchgear Control (Option)

GRT200 provides functions for local control of switchgears from the HMI. Three-stepped operation (select-control-execute) is applied for the control of circuit breakers, isolator switches.

Switchgear control commands from the station level can also be performed through GRT200 within the application of a substation automation control system.

■ Interlock Check (Option)

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.

■ Synchronism and voltage check (Option)

GRT200 implements voltage and synchronism check used for possible manual CB closing. The Characteristic for the voltage and synchronism check is shown in Figure 8.

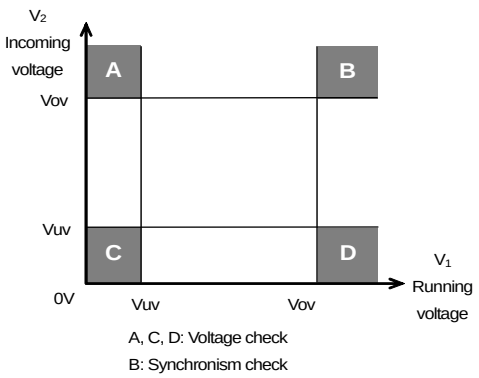


Figure 8: Voltage and Synchronism Check Zone

HMI FUNCTION

■ Front Panel

GRT200 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 characters, 8 lines LCD with back light
- Support of English language

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

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

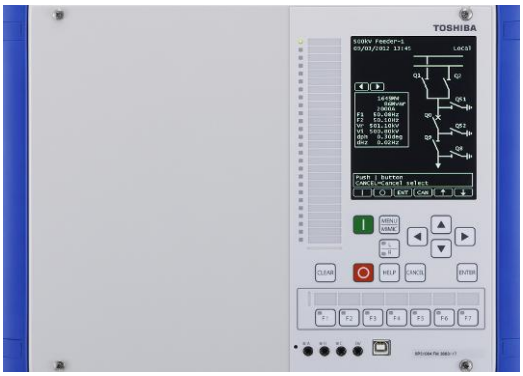


Figure 9: HMI Panel (large LCD type)

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

■ Local PC Connection

The user can communicate with GRT200 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 ±0.5% for I, V, P, Q 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 GRT200.
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 Record**

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, phase to phase, symmetrical components)

■ **Disturbance Record**

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 and Modbus® RTU are provided for the station bus.

■ **Serial Communication**

Serial port for communicating with legacy equipment or protection relays over IEC 60870-5-103 or Modbus® RTU protocol are provided. GRT200 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.

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**

GRT200 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 on in the test mode only.

TOOLS & ACCESSORY

The PC interface GR-TIEMS allows users to access GRT200 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 GRT200. Waveform data in the 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.

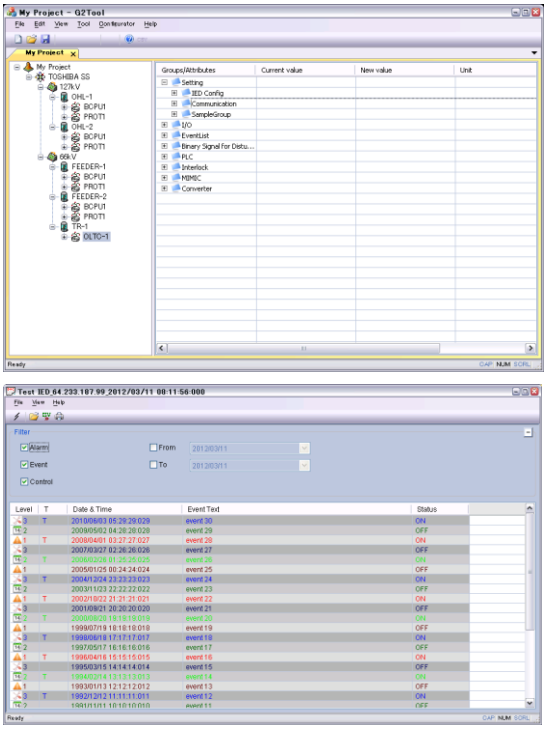


Figure 10: PC Display of GR-TIEMS

■ LCD configuration

The user can configure and customize the MIMIC data displayed on the LCD of GRT200 using GR-TIEMS software.

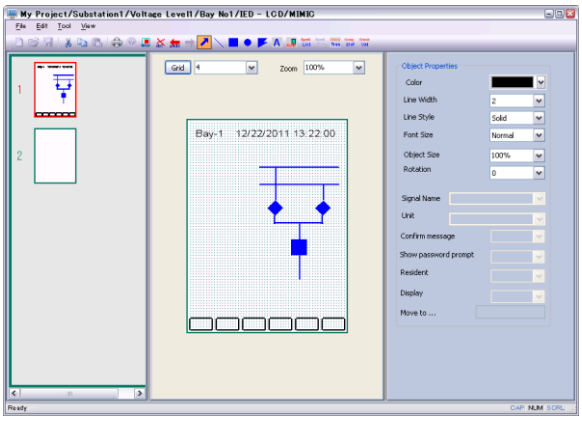


Figure 11: PC Display of MIMIC configuration

■ 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.

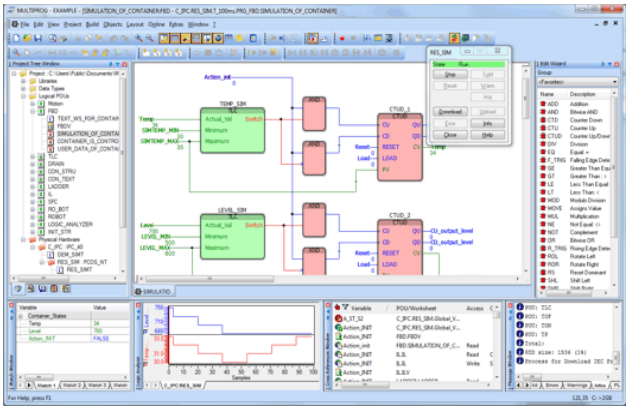


Figure 12: PC display of PLC editor

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 = 5A
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 115/220Vac (Operative range: 88 – 300Vdc or 80 – 230Vdc)
Superimposed AC ripple on DC supply	≤ 15%
Supply interruption	≤ 20ms at 110Vdc
Restart time	< 2 minutes
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)
Operate 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)
Operate 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)
Operate time	9 ms
Heavy duty 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)
Operate 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)
Sensitive current input	≥ 3A (1A rating) or 15 A (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. 12kg (1/2 size), 15kg (3/4 size), 25kg (1/1 size)
Case colour	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	IEC 61850 or Modbus® RTU
Serial communication (rear port)	
RS485	IEC 60870-5-103 or Modbus® RTU
Fiber optical	IEC 60870-5-103
Terminal Block	
CT/VT input	M3.5 Ring terminal
Binary input, Binary output	M3.5 Ring terminal

FUNCTIONIONAL DATA

Current differential protection (87T)	
Stage 1: Biased current differential element	
Minimum operating value (DIF-S1-I1)	0.10 to 1.00pu in 0.01pu steps
Small current region slope (DIF-S1-Slope1)	10 to 100% in 1% steps
Large current region slope (DIF-S1-Slope2)	10 to 200% in 1% steps
Knee point (DIF-S1-I2)	1.00 to 20.00pu in 0.01pu steps
2nd harmonic sensitivity for Inrush currents (DIF-2f)	10 to 50% in 1% steps
5th harmonic sensitivity for Overexcitation (DIF-5f)	10 to 100% in 1% steps
Operate time	Typical 25ms
Stage 2: High-set unrestrained differential element	
Overcurrent (DIF-S2-I)	2.00 to 20.00pu in 0.01pu steps
Operate time	Typical 20ms
Restricted earth fault element (87N)	
[Low-impedance scheme]	
Minimum operating value (REF-☐-I1)	0.05 to 0.50pu in 0.01pu steps
Small current region slope (REF-☐-Slope1)	10 %
Large current region slope (REF-☐-Slope2)	50 to 100% in 1% steps
Knee Point (REF-☐-I2)	0.50 to 2.00pu in 0.01pu steps
☐: P, S, T	
Non-directional and Directional Phase Overcurrent Protection (50P, 51P)	
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 degs 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 (50N, 51N, 50G, 51G, 67N)	
1st, 2nd, 3rd, 4th 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)
1st, 2nd, 3rd, 4th 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 (3I0 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
Negative Phase sequence overcurrent Protection (46)	
1st, 2nd, 3rd, 4th 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)
1st, 2nd, 3rd, 4th 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 (3I0 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
Thermal Overload Protection (49)	
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 protection (46BC)	
Broken conductor threshold	0.10 to 1.00 in 0.01 steps
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)
CBF Protection (50BF)	
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
Undervoltage Protection (27P, 27S)	

1st, 2nd 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 Overvoltage Protection (59P)	
1st, 2nd 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 (59S)	
1st, 2nd 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
Zero Phase Sequence Overvoltage (59N)	
	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
Overexcitation Protection (24)	
Pickup voltage	100.0 to 120.0V in 0.1V steps
Alarm level (A)	1.03 to 1.30pu in 0.01pu steps
High level (H)	1.10 to 1.40pu in 0.01pu steps
Low level (L)	1.05 to 1.30pu in 0.01pu steps
LT (Definite time)	1 to 600s in 1s steps
HT (Definite time)	1 to 600s in 1s steps
TVFH (Definite time)	1 to 600s in 1s steps
TVFA (Definite time)	1 to 600s in 1s steps
Start time	less than 130ms
RT (Definite time)	60 to 3600s in 1s steps
Voltage Controlled Protection (51V)	
Voltage threshold	10.0 to 120.0V in 0.1V steps
Sensitivity range	20 to 100% of voltage threshold
Frequency Protection (81U/O)	
1st - 6th under/overfrequency threshold	(F_{nom} − 10.00Hz) – (F_{nom} + 10.00Hz) 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
1st - 6th rate-of-change frequency threshold	0.1-15.0Hz/s in 0.1Hz/s steps

Synchronism check (25)	
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	0 to 150V in 1V steps
Busbar or line live check	0 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
Metering Function	
Current	Accuracy ± 0.5% (at rating)
Voltage	Accuracy ± 0.5% (at rating)
Power (P, Q, S)	Accuracy ± 0.5% (at rating)
Power factor (PF)	Accuracy ± 0.5% (at rating)
Energy (Wh, VArh)	Accuracy ± 1.0% (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

	7	8		9	A	B		C	D		E	F		G	H		J	K	L
Configurations	**G**	**R**	**T**	**2**	**0**	**0**	**-**	**1**		**-**				**-**	**0**	**0**	**-**								**0**
Analog inputs																			
2 x three-phase CT + 1 x one-phase VT (Module No. 35)								1											
Outline																			
Standard LCD / 1/3 x 19'' rack / Flush mounting											1								
Large LCD / 1/3 x 19'' rack / Flush mounting											5								
Standard LCD / 1/3 x 19'' rack / Rack mounting											E								
Large LCD / 1/3 x 19'' rack / Rack mounting											H								
Standard LCD / 1/3 x 19'' rack / Vertical flush mounting											L								
Large LCD / 1/3 x 19'' rack / Vertical flush mounting											Q								
Rated Phase Currents (Default settings) (*)																			
1A																		1	
5A																		2	
Rated Neutral Currents (Default settings)																			
None																			0

See page 25

(*) Please refer to page 26 / 27 and select the appropriate CT configuration when you require another rated current configuration.

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

Analog inputs

3 x three-phase CT + 3 x zero-phase CT + 1 x one-phase VT (Module No. 44)	2

Outline

Standard LCD	1/2 x 19'' rack	Flush mounting	2
Standard LCD	3/4 x 19'' rack	Flush mounting	3
Standard LCD	1/1 x 19'' rack	Flush/rack mounting	4
Large LCD	1/2 x 19'' rack	Flush mounting	6
Large LCD	3/4 x 19'' rack	Flush mounting	7
Large LCD	1/1 x 19'' rack	Flush/rack mounting	8
Standard LCD	1/2 x 19'' rack	Rack mounting	F
Standard LCD	3/4 x 19'' rack	Rack mounting	G
Large LCD	1/2 x 19'' rack	Rack mounting	J
Large LCD	3/4 x 19'' rack	Rack mounting	K
Standard LCD	1/2 x 19'' rack	Vertical flush mounting	M
Standard LCD	3/4 x 19'' rack	Vertical flush mounting	N
Standard LCD	1/1 x 19'' rack	Vertical flush mounting	P
Large LCD	1/2 x 19'' rack	Vertical flush mounting	R
Large LCD	3/4 x 19'' rack	Vertical flush mounting	S
Large LCD	1/1 x 19'' rack	Vertical flush mounting	T

Rated Phase Currents (Default settings) (*)

1A	1
5A	2

Rated Neutral Currents (Default settings) (*)

1A	1
5A	2

See page 25

(*) Please refer to page 26 / 27 and select the appropriate CT configuration when you require another rated current configuration.

Configurations	G	R	T	2	0	0	-	7	8	-	9	A	B	-	C	D	-	E	F	-	G	H	-	J	K	L
Analog inputs																										
3 x three-phase CT + 3 x zero-phase CT + 1 x three-phase VT (Module No. 44 and 47)								3																		
Outline																										
Standard LCD / 1/1 x 19'' rack / Flush/rack mounting											4															
Large LCD / 1/1 x 19'' rack / Flush/rack mounting											8															
Standard LCD / 1/1 x 19'' rack / Vertical flush mounting											P															
Large LCD / 1/1 x 19'' rack / Vertical flush mounting											T															
Rated Phase Currents (Default settings) (*)																										
1A																									1	
5A																									2	
Rated Neutral Currents (Default settings) (*)																										
1A																										1
5A																										2

See page 25

(*) Please refer to page 26 / 27 and select the appropriate CT configuration when you require another rated current configuration.

								7	8		9	A	B		C	D		E	F		G	H		J	K	L					
Configurations	**G**	**R**	**T**	**2**	**0**	**0**	**-**	**4**		**-**				**-**	**0**	**0**	**-**			**-**			**-**				**0**				

Analog inputs

4 x three-phase CT + 1 x one-phase VT (Module No. 44)	4

Outline

Standard LCD	1/2 x 19'' rack	Flush mounting	2
Standard LCD	3/4 x 19'' rack	Flush mounting	3
Standard LCD	1/1 x 19'' rack	Flush/rack mounting	4
Large LCD	1/2 x 19'' rack	Flush mounting	6
Large LCD	3/4 x 19'' rack	Flush mounting	7
Large LCD	1/1 x 19'' rack	Flush/rack mounting	8
Standard LCD	1/2 x 19'' rack	Rack mounting	F
Standard LCD	3/4 x 19'' rack	Rack mounting	G
Large LCD	1/2 x 19'' rack	Rack mounting	J
Large LCD	3/4 x 19'' rack	Rack mounting	K
Standard LCD	1/2 x 19'' rack	Vertical flush mounting	M
Standard LCD	3/4 x 19'' rack	Vertical flush mounting	N
Standard LCD	1/1 x 19'' rack	Vertical flush mounting	P
Large LCD	1/2 x 19'' rack	Vertical flush mounting	R
Large LCD	3/4 x 19'' rack	Vertical flush mounting	S
Large LCD	1/1 x 19'' rack	Vertical flush mounting	T

Rated Phase Currents (Default settings) (*)

1A	1
5A	2

Rated Neutral Currents (Default settings)

None	0

See page 25

(*) Please refer to page 26 / 27 and select the appropriate CT configuration when you require another rated current configuration.

		7	8		9	A	B		C	D		E	F		G	H		J	K	L
Configurations	**G R T 2 0 0 -**	**5**		**-**				**-**	**0**	**0**	**-**			**-**			**-**			
Analog inputs																				
5 x three-phase CT + 3 x zero-phase CT + 2 x three-phase VT (Module No. 44 and 48)		5																		
Outline																				
Standard LCD	1/1 x 19'' rack	Flush/rack mounting			4															
Large LCD	1/1 x 19'' rack	Flush/rack mounting			8															
Standard LCD	1/1 x 19'' rack	Vertical flush mounting			P															
Large LCD	1/1 x 19'' rack	Vertical flush mounting			T															
Rated Phase Currents (Default settings) (*)																				
1A																			1	
5A																			2	
Rated Neutral Currents (Default settings) (*)																				
1A																				1
5A																				2

See page 25

(*) Please refer to page 26 / 27 and select the appropriate CT configuration when you require another rated current configuration.

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

DC rating

110 - 240 Vdc/Vac	1
48 - 110 Vdc	2
24 - 48 Vdc	3

BI/BO Module

Refer to Number of BI/BO Table	

Number of Serial and/or Ethernet Communication and/or Time Sync 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
3 ports + GPS	8
3 ports + IRIG-B	9

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

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

Function Block (linked with software selection)

See function table of software selection	

BI/BO Terminal Type

Compression plug type terminal	0
Ring lug type terminal	1

Rated Frequency (Default setting)

50Hz	1
60Hz	2

CT configuration

Rated phase currents

2 x three-phase CT (When position "7" = 1)

1CT group (1Ia, 1Ib, 1Ic)	2CT group (2Ia, 2Ib, 2Ic)	Ordering No. (Position "K")
1A	1A	**1**
5A	5A	**2**
1A	5A	**A**
5A	1A	**J**

3 x three-phase CT (When position "7" = 2 or 3)

1CT group (1Ia, 1Ib, 1Ic)	2CT group (2Ia, 2Ib, 2Ic)	3CT group (3Ia, 3Ib, 3Ic)	Ordering No. (Position "K")
1A	1A	1A	**1**
5A	5A	5A	**2**
1A	1A	5A	**6**
1A	5A	1A	**A**
1A	5A	5A	**E**
5A	1A	1A	**J**
5A	1A	5A	**N**
5A	5A	1A	**S**

4 x three-phase CT (When position "7" = 4)

1CT group (1Ia, 1Ib, 1Ic)	2CT group (2Ia, 2Ib, 2Ic)	3CT group (3Ia, 3Ib, 3Ic)	4CT group (4Ia, 4Ib, 4Ic)	Ordering No. (Position "K")
1A	1A	1A	1A	**1**
5A	5A	5A	5A	**2**
1A	1A	1A	5A	**4**
1A	1A	5A	1A	**6**
1A	1A	5A	5A	**8**
1A	5A	1A	1A	**A**
1A	5A	1A	5A	**C**
1A	5A	5A	1A	**E**
1A	5A	5A	5A	**G**
5A	1A	1A	1A	**J**
5A	1A	1A	5A	**L**
5A	1A	5A	1A	**N**
5A	1A	5A	5A	**Q**
5A	5A	1A	1A	**S**
5A	5A	1A	5A	**U**
5A	5A	5A	1A	**W**

5 x three-phase CT (When position "7" = 5)

1CT group (1Ia, 1Ib, 1Ic)	2CT group (2Ia, 2Ib, 2Ic)	3CT group (3Ia, 3Ib, 3Ic)	4CT group (4Ia, 4Ib, 4Ic)	5CT group (5Ia, 5Ib, 5Ic)	Ordering No. (Position "K")
1A	1A	1A	1A	1A	**1**
5A	5A	5A	5A	5A	**2**
1A	1A	1A	1A	5A	**3**
1A	1A	1A	5A	1A	**4**
1A	1A	1A	5A	5A	**5**
1A	1A	5A	1A	1A	**6**
1A	1A	5A	1A	5A	**7**
1A	1A	5A	5A	1A	**8**
1A	1A	5A	5A	5A	**9**
1A	5A	1A	1A	1A	**A**
1A	5A	1A	1A	5A	**B**
1A	5A	1A	5A	1A	**C**
1A	5A	1A	5A	5A	**D**
1A	5A	5A	1A	1A	**E**
1A	5A	5A	1A	5A	**F**
1A	5A	5A	5A	1A	**G**
1A	5A	5A	5A	5A	**H**
5A	1A	1A	1A	1A	**J**
5A	1A	1A	1A	5A	**K**
5A	1A	1A	5A	1A	**L**
5A	1A	1A	5A	5A	**M**
5A	1A	5A	1A	1A	**N**
5A	1A	5A	1A	5A	**P**
5A	1A	5A	5A	1A	**Q**
5A	1A	5A	5A	5A	**R**
5A	5A	1A	1A	1A	**S**
5A	5A	1A	1A	5A	**T**
5A	5A	1A	5A	1A	**U**
5A	5A	1A	5A	5A	**V**
5A	5A	5A	1A	1A	**W**
5A	5A	5A	1A	5A	**X**
5A	5A	5A	5A	1A	**Y**

Rated neutral currents

(When position "7" = 2 or 3 or 5)			Ordering No. (Position "L")
1NCT	2NCT	3NCT	
1A	1A	1A	**1**
5A	5A	5A	**2**
1A	1A	5A	**6**
1A	5A	1A	**A**
1A	5A	5A	**E**
5A	1A	1A	**J**
5A	1A	5A	**N**
5A	5A	1A	**S**

Number of 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
Other Configuration									**ZZ**	To be specified at ordering

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

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

4 x I/O modules

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

5 x I/O modules

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
Other Configuration									**ZZ**	To be specified at ordering

6 x I/O modules

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
Other Configuration									**ZZ**	To be specified at ordering

7 x I/O modules

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
Other Configuration									**ZZ**	To be specified at ordering

8 x I/O modules

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
Other Configuration									**ZZ**	To be specified at ordering

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

[Software Ordering]

	1	2	3	4	5	6		7	S	G	T		E	F	U		9	V
Configurations	**G**	**R**	**T**	**2**	**0**	**0**	**-**		**0**			**-**				**-**		
Analog inputs																		
Assignment on position "7"																		
Function Block																		
Refer to Function Table																		
Number of Serial and/or Ethernet Communication and/or Time Sync Port(s)																		
Assignment on position "E"																		
Selection of Serial and/or Ethernet Communication Port(s)																		
Assignment on position "F"																		
Protocol																		
Standard (IEC 60870-5-103, Modbus, DNP 3.0)															0			
Standard + IEC 61850															1			
IEC 61850															2			
Outline																		
Assignment on position "9"																		
Language																		
English																		E

FUNCTION TABLE

Function Block	Description		Ordering No. (Position 'G & T')											
			11	12	1A	1B	13	14	15	16	17	18	19	21
DIF (87)	Current differential protection		●		●				●		●		●	
REF (87N)	Low-impedance restricted earth fault protection		-		●				●		-		●	
OC (50/51/67)	Non-directional definite / inverse time overcurrent protection	8 stages	●		●				●		●		●	
	Directional definite / inverse time overcurrent protection		-		-						-			
EF (50G/51G/ 67G)	Non-directional definite / inverse time earth fault protection (using phase currents)	8 stages	●		●				●		●		●	
	Directional definite / inverse time overcurrent protection (using phase currents)		-		-						-			
EFIn (50N/51N)	Non-directional definite / inverse time earth fault protection (using neutral current)	4 stages	-		●				●		-		●	
OCN (46)	Non-directional negative-sequence overcurrent protection	4 stages	●		-	●	●		●		●		●	
	Directional negative- sequence overcurrent protection		-		-		-				-			
BCD (46BC)	Broken conductor protection		●		-		●		●		●		●	
THM (49)	Thermal overload protection	THM trip THM alarm	●		-	●	●		●		●		●	
ICD	Inrush current detector function		●		●		●		●		●		●	
CBF (50BF)	Circuit breaker failure protection	CBF re-trip CBF trip	●		-		●		●		●		●	
UV (27)	Phase under-voltage protection	4 stages	-		-		-		●		-		●	
UVS (27S)	Phase-to-phase under-voltage protection	4 stages	-		-		-		●		-		●	
OV (59)	Phase over-voltage protection	4 stages	-		-		-		●		-		●	
OVS (59S)	Phase-to-phase over-voltage protection	4 stages	-		-		-		●		-		●	
OVG (59G)	Residual overvoltage protection	4 stages	●(#)		-		●(#)		●(#)		●(#)		●(#)	
FRQ/DFRQ (81U/81O)	Under-frequency / Over-frequency / Rate of change of frequency protection	6 stages	●(*)		-		●(*)		●(*)		●(*)		●(*)	
VPH (24)	Over-excitation protection	V/f trip V/f alarm	●(*)		-	●(*)	●(*)		●(*)		●(*)		●(*)	
VTF	VT failure supervision		-		-				●		-		●	
OCV (51V)	Voltage controlled overcurrent protection		-		-				●		-		●	
MECH. TRIP	Trip and/or Indication of external devices	32 stages	●		●				●		●		●	
Control	Switching Control Interlock function		-	●	-			●	-	●	-	●	-	●
			2 x three-phase CT + 1 x one-phase VT		3 x three-phase CT + 3 x zero-phase CT + 1 x one-phase VT				3 x three-phase CT + 3 x zero-phase CT + 1 x three-phase VT		4 x three-phase CT + 1 x one-phase VT		5 x three-phase CT + 3 x zero-phase CT + 2 x three-phase VT	
			Basic		Standard 1				Standard 2		Standard 3		Standard 4	
				+ Control				+ Control		+ Control		+ Control		+ Control (Full)

(*) Available for phase-to-phase or phase-to-ground voltage inputs

(#) Available for zero-sequence voltage input

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

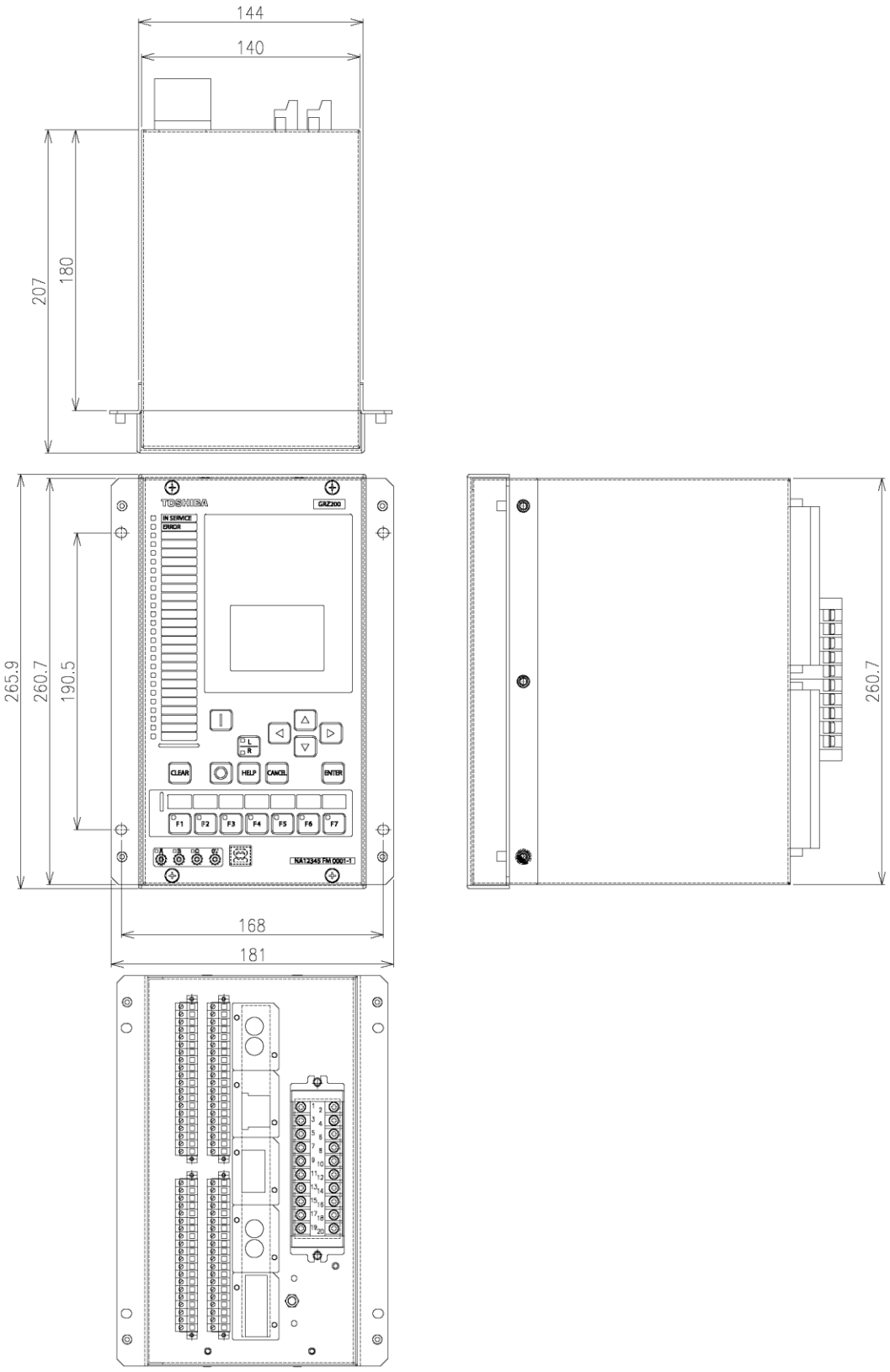


Figure 11 – Dimension and Panel Cut-out – 1/3 x 19'' case size

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

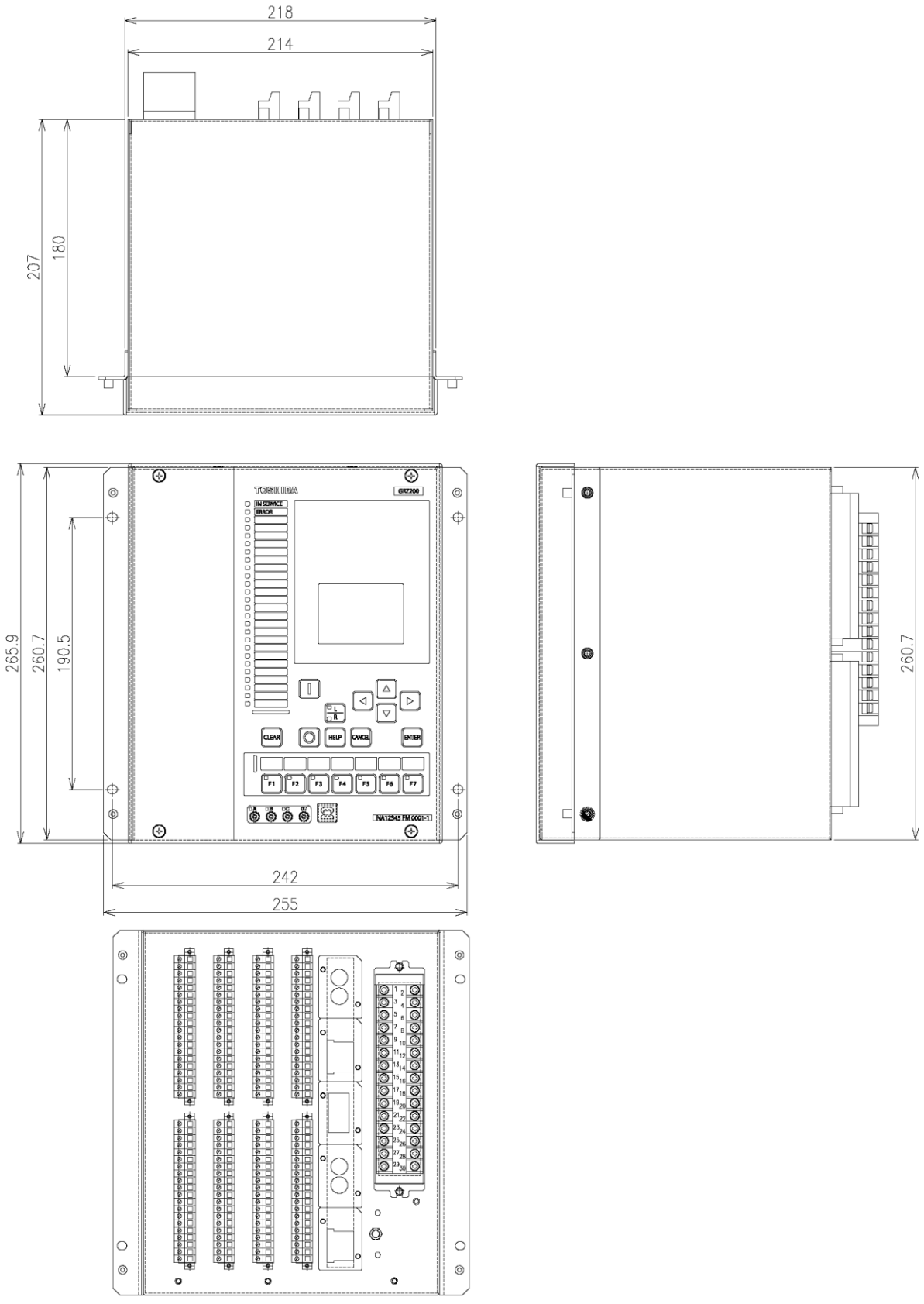


Figure 12 – Dimension and Panel Cut-out – 1/2 x 19'' case size

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

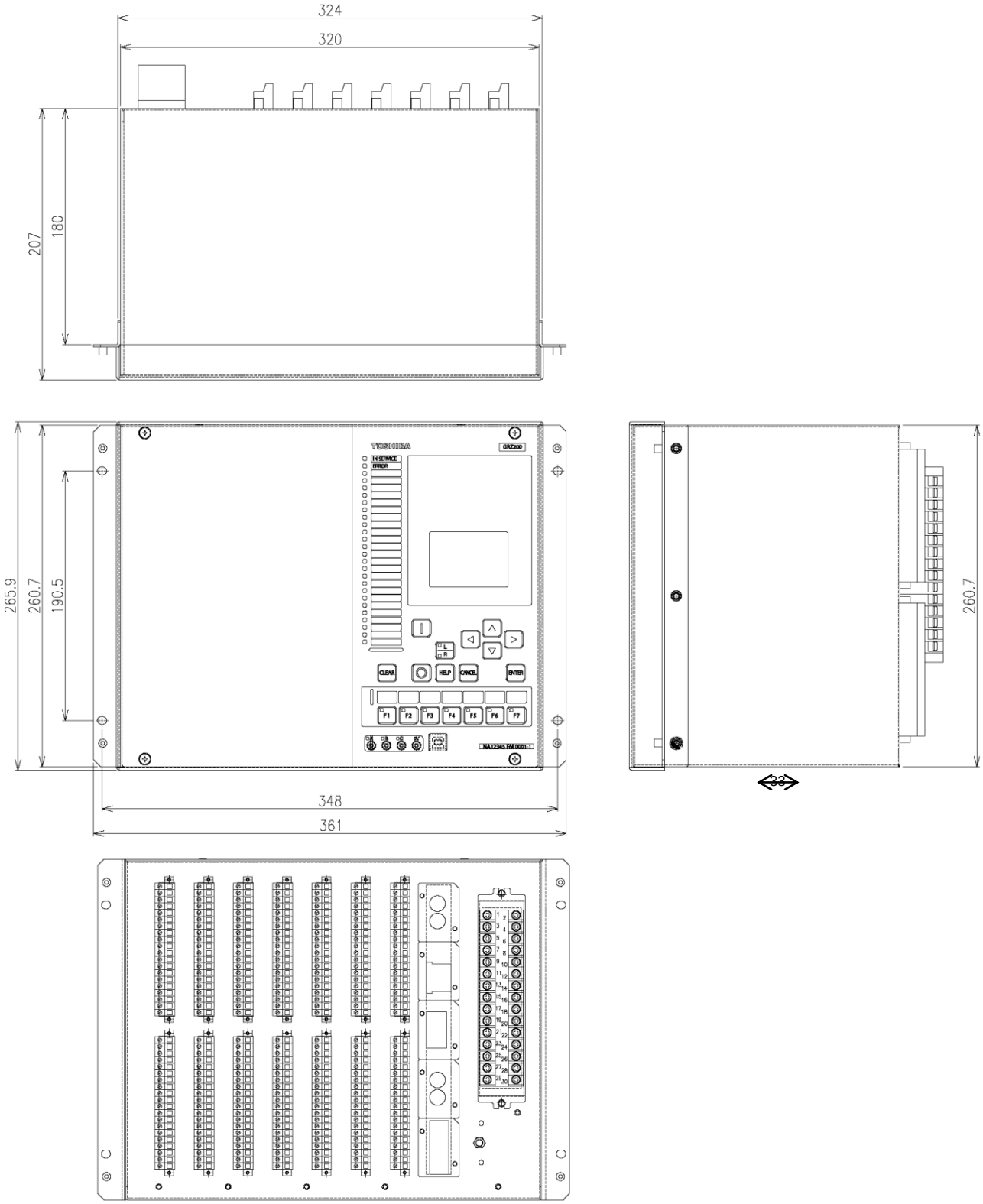


Figure 13 – Dimension and Panel Cut-out – 3/4 x 19'' case size

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

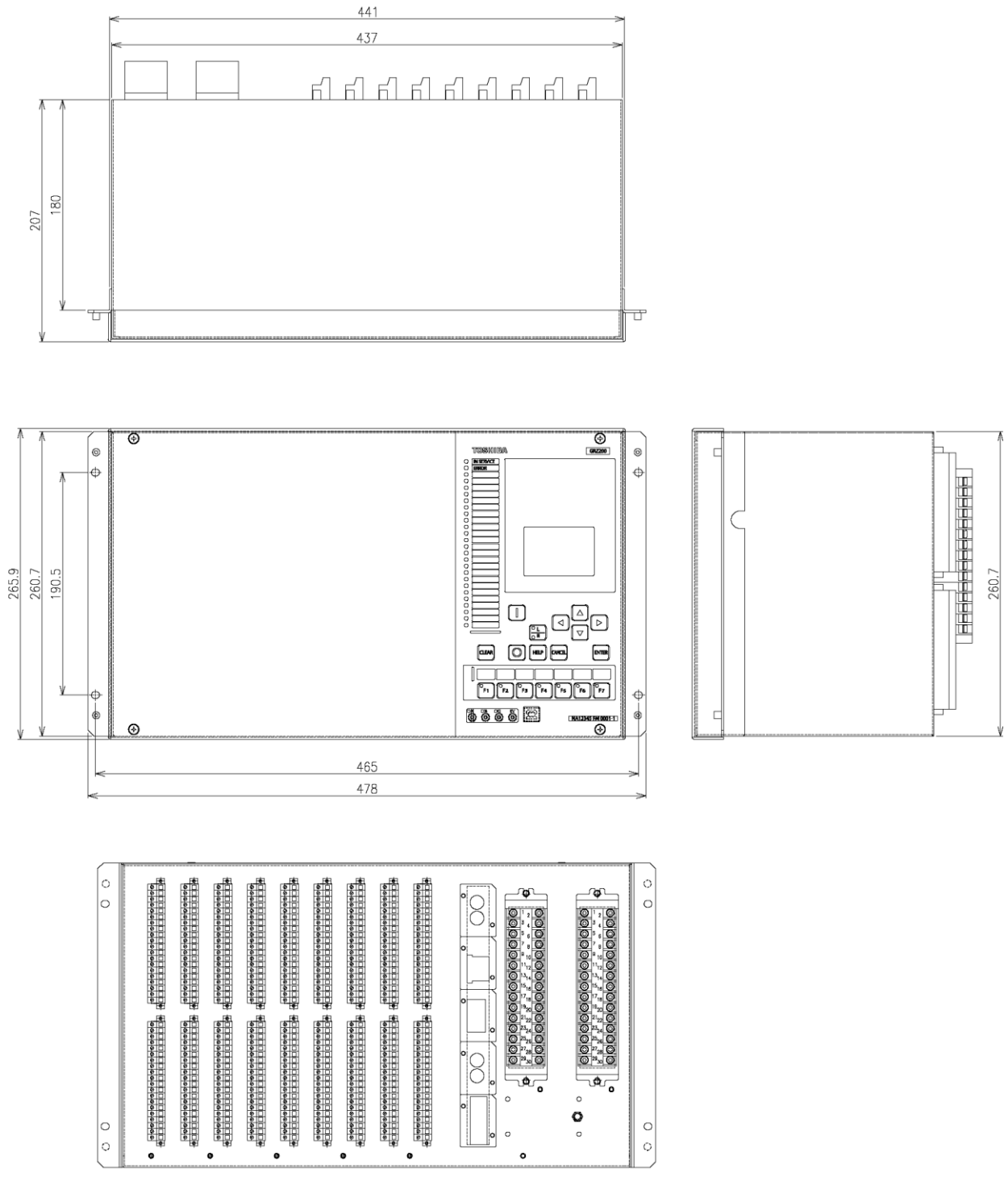
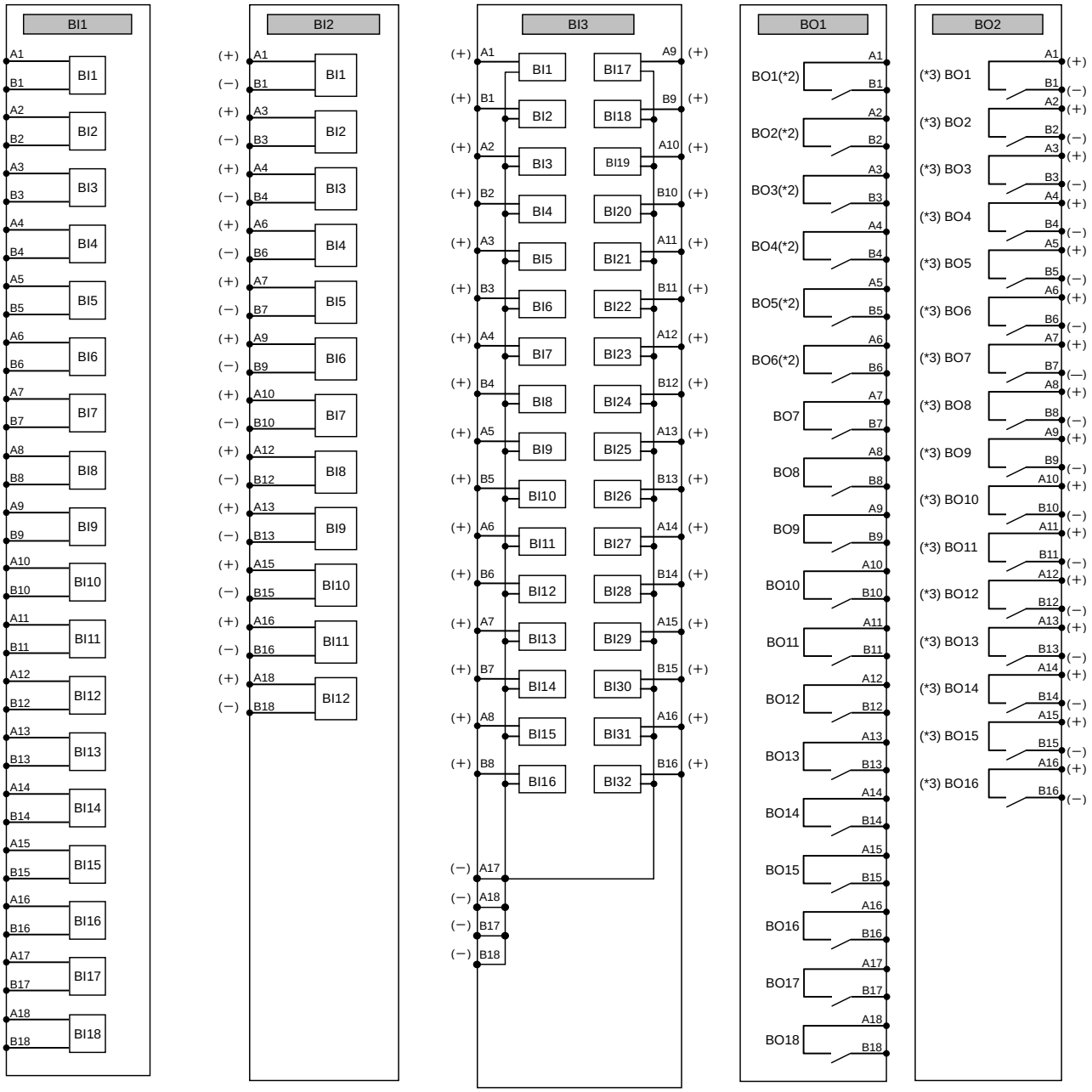


Figure 14 – Dimension and Panel Cut-out – 1/1 x 19” case size

CONNECTIONS DIAGRAM

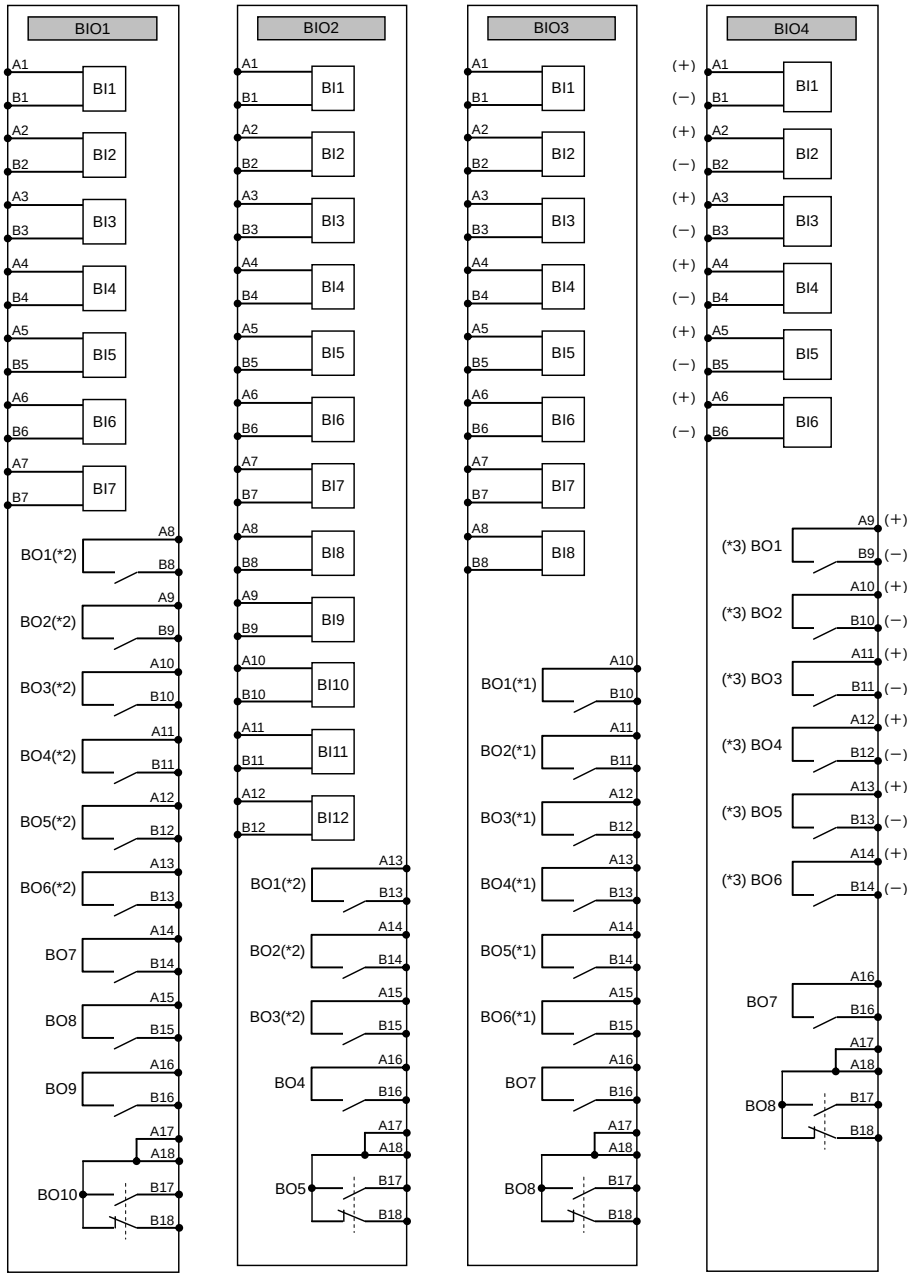


(*2) Semi-fast BO

(*3) Hybrid BO

Figure 15 – Binary input board and binary output module

CONNECTIONS DIAGRAM



(*1) Fast BO

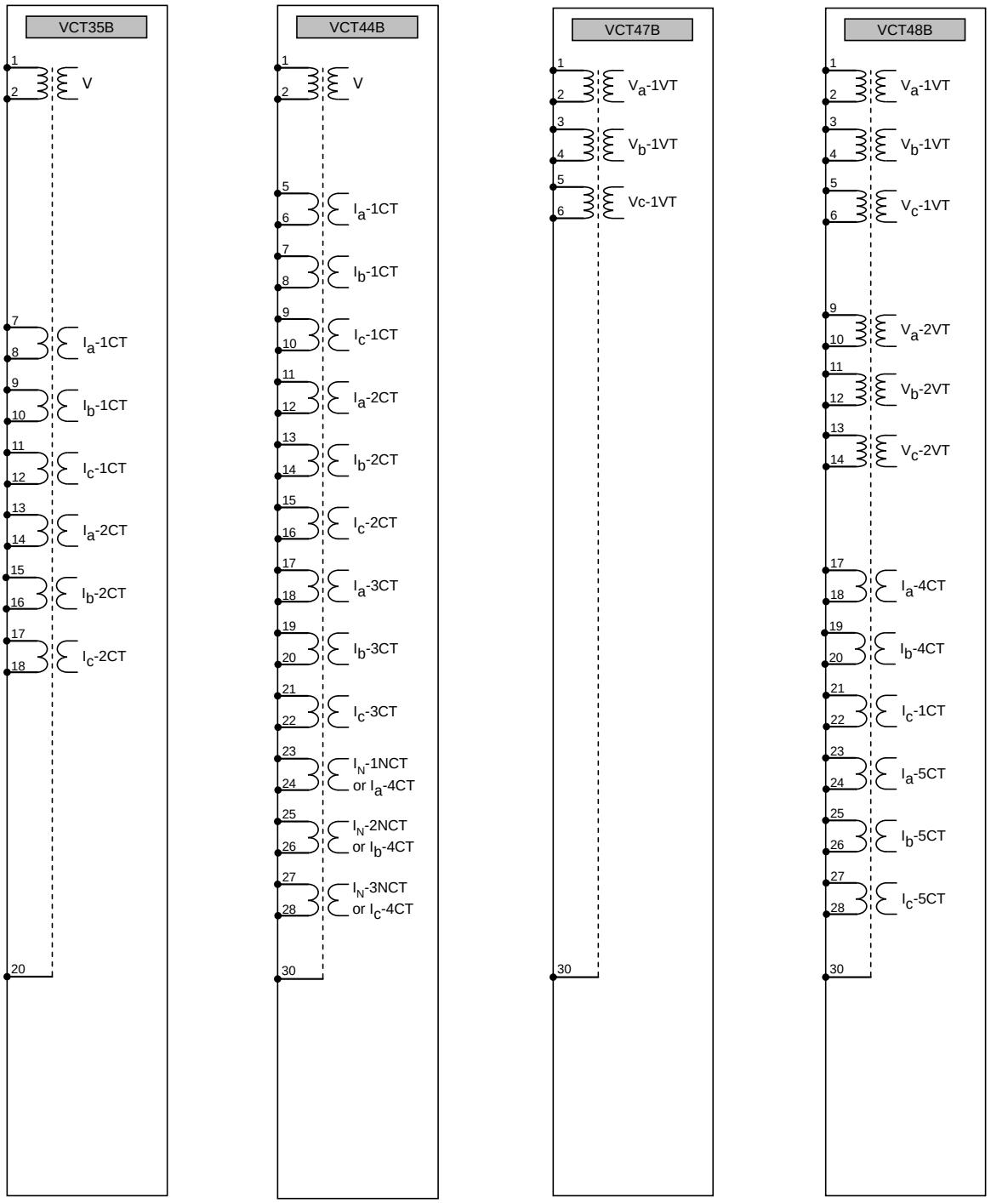
(*2) Semi-fast BO

(*3) Hybrid BO

Figure 16 – Combined binary input and output module

CONNECTIONS DIAGRAM

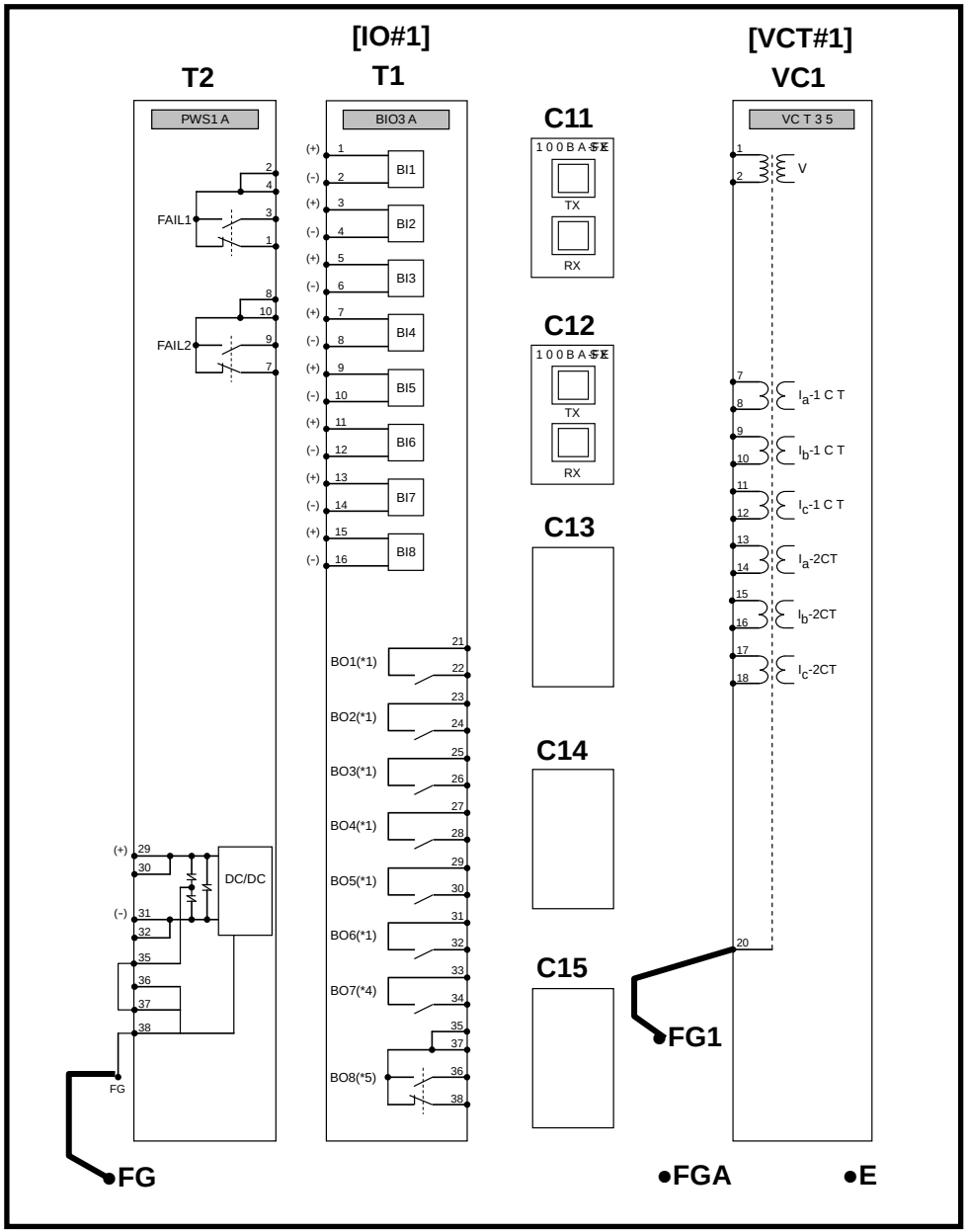
CT/VT module



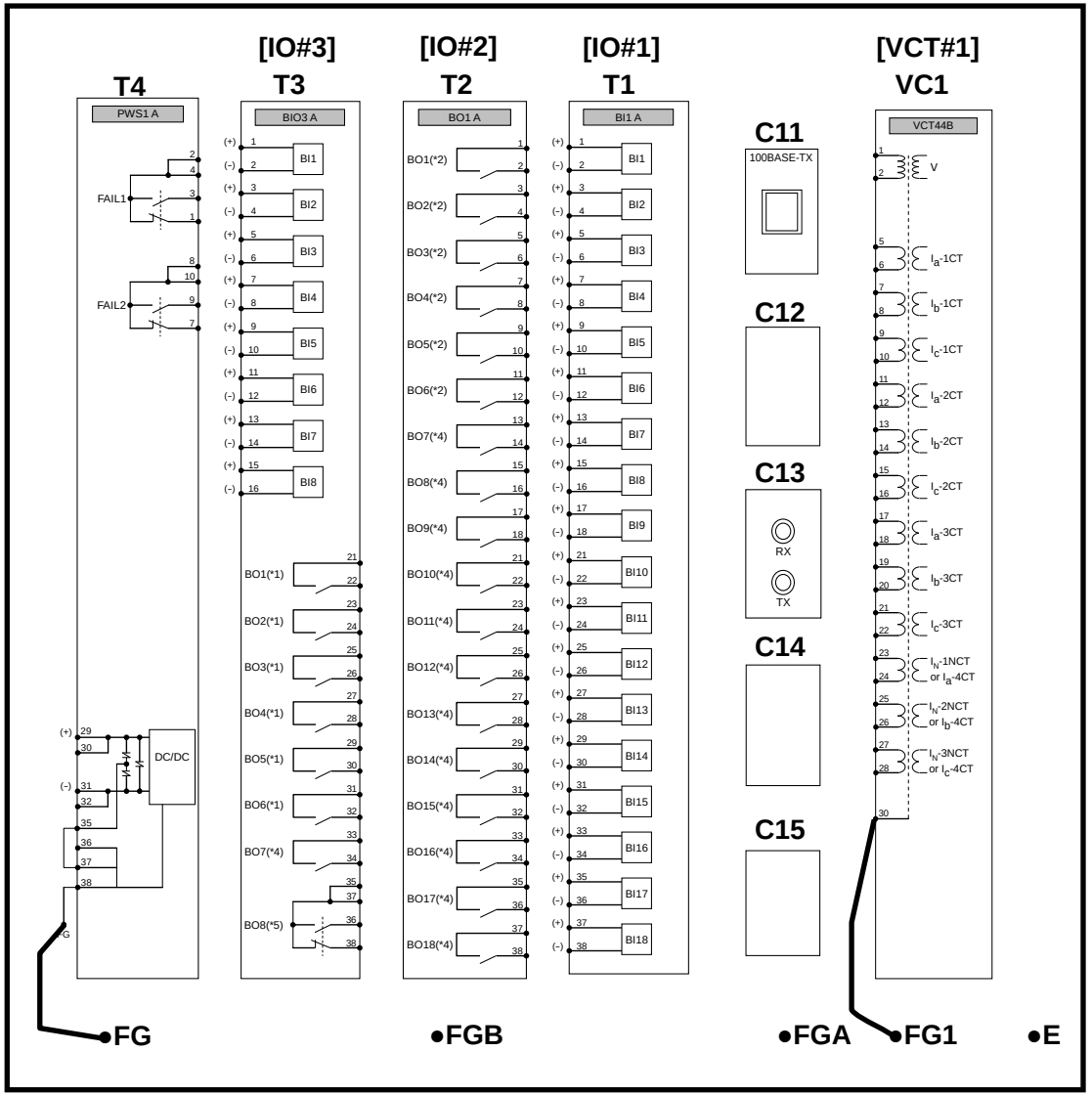
Module No.35	Module No.44	Module No.47	Module No.48
(CT x 6 + VT x 1)	(CT x 12 + VT x 1)	(VT x 3)	(CT x 6 + VT x 6)
Only for 1/3 rack	For 1/2, 3/4 and 1/1	Only for 1/1 rack	Only for 1/1 rack

Figure 17 – CT/VT module

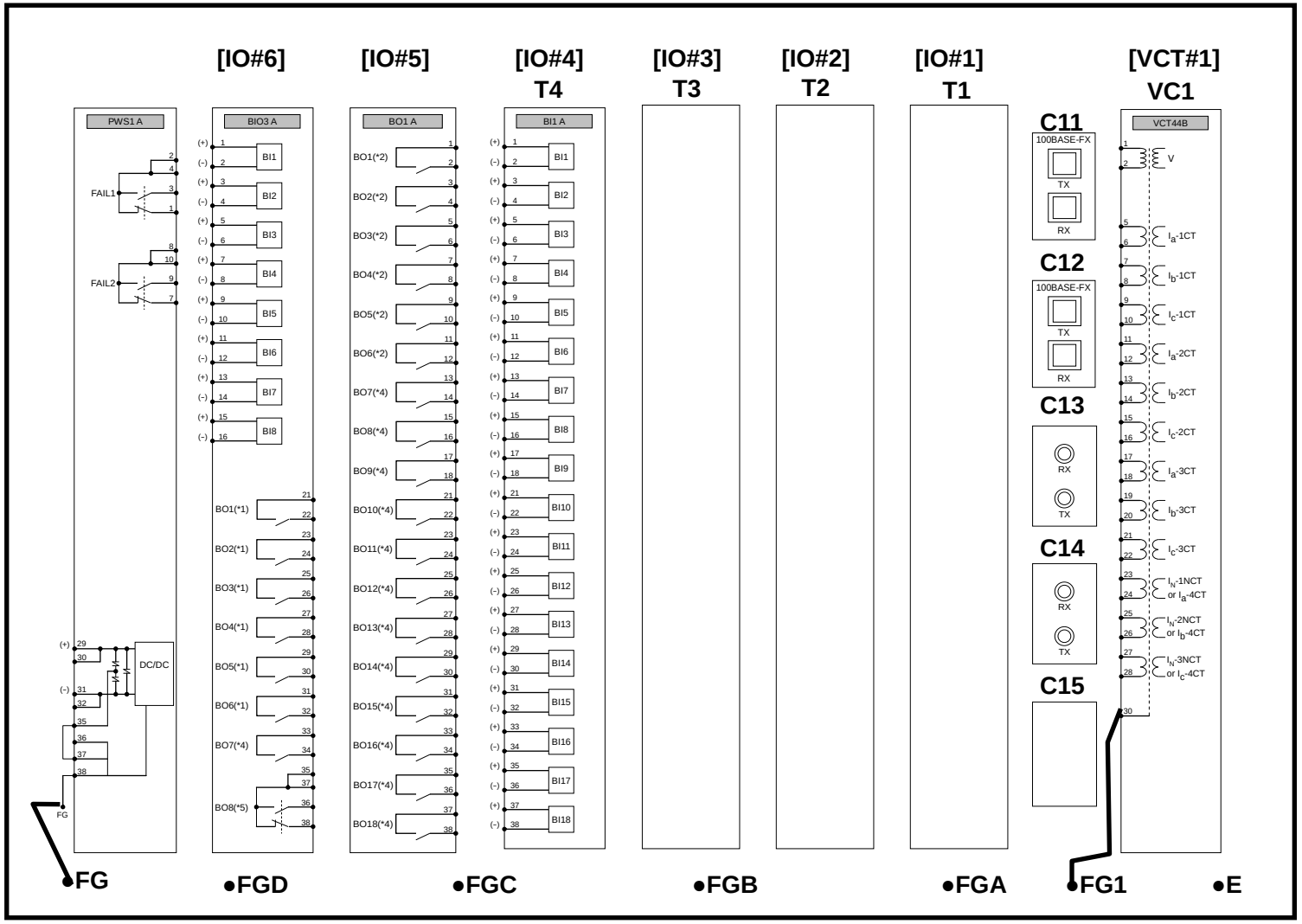
Typical arrangement of each module (1/3 rack size)



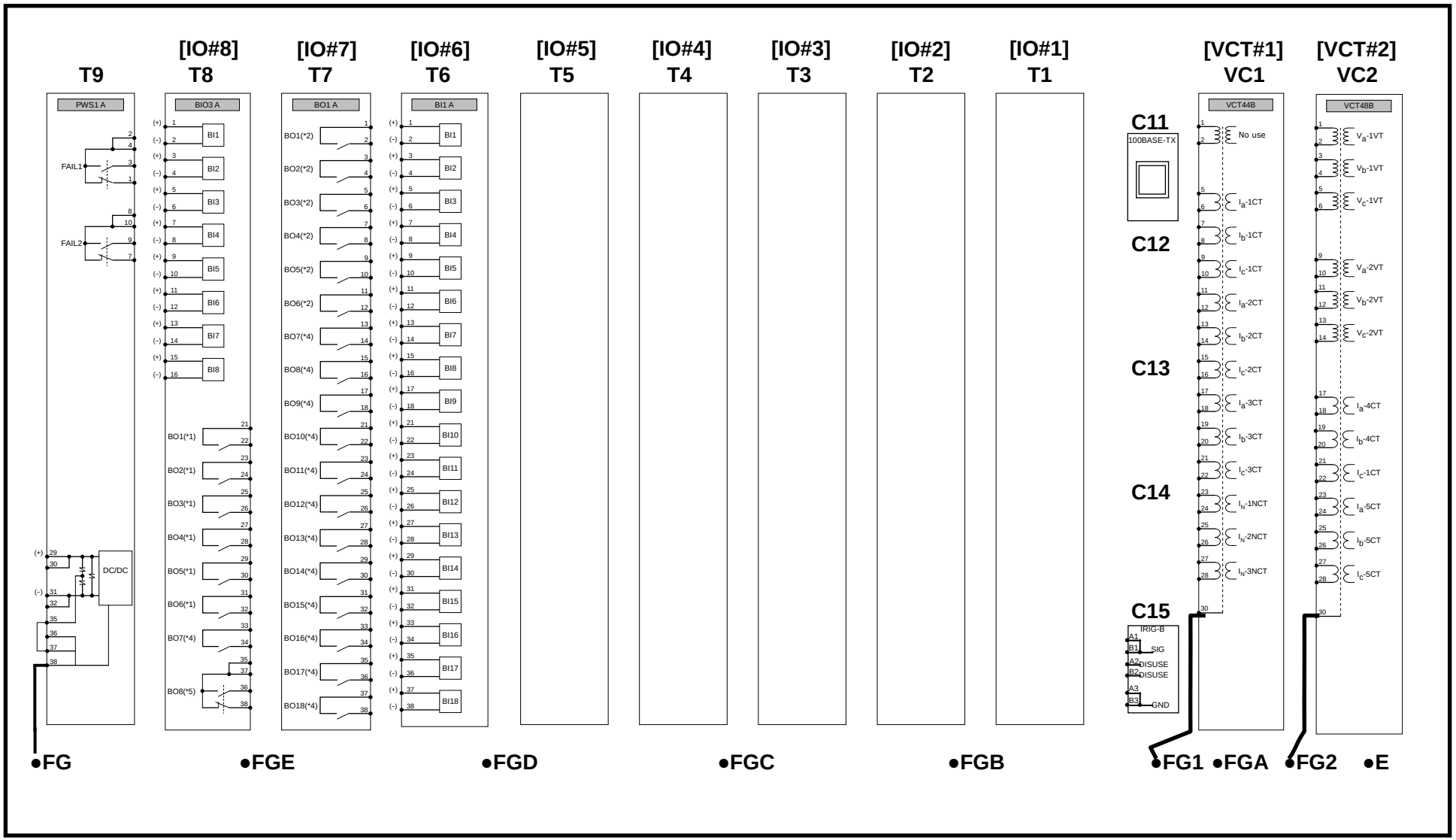
Typical arrangement of each module (1/2 rack size)



Typical arrangement of each module (3/4 rack size)



Typical arrangement of each module (1/1 rack size)



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