Multi-function Protection and Control Device

GRE200

GR-200 series -

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.

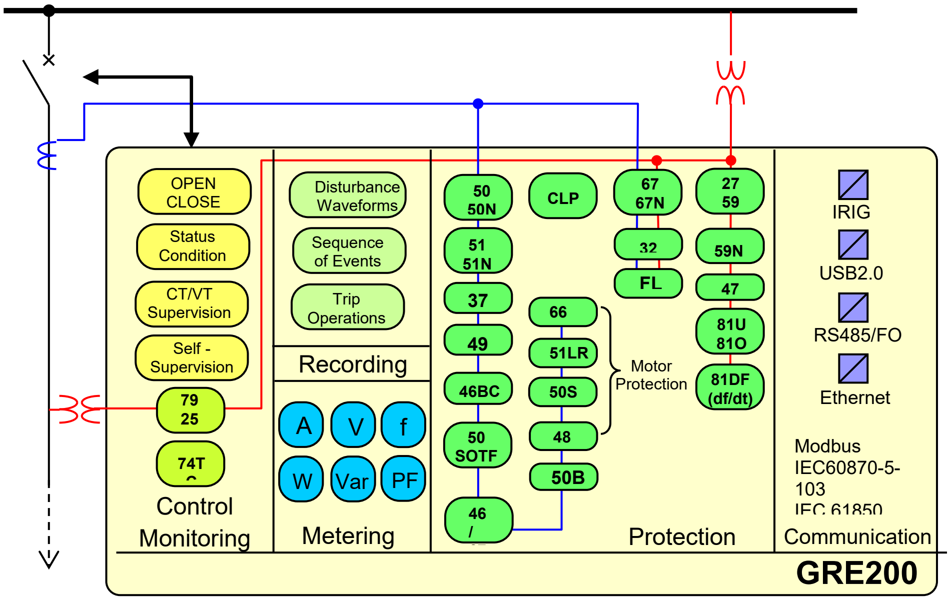
Powerful and wide application -

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

APPLICATION

The GRE200, multi-function protection & control IED is implemented on Toshiba's next generation GR-200 series IED platform and has been designed to provide comprehensive protection and control applications for transmission lines and distribution feeders 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 excellent performance, outstanding quality and operational peace of mind.

- Protection, control, metering and supervision of EHV, HV, MV and LV networks
- Typical feeder protection, including multiple, high accuracy overcurrent protection elements with inverse time and definite time delay functions, which can be independently set subject to directional control, thermal overload, under/overvoltage, under/over frequency, circuit breaker failure and motor protections
- Various models and hardware options for flexible application depending on system requirements
- Communications within substation automation systems IEC 61850-8-1 [Station bus], Modbus and Ethernet redundancy protocols IEC62439-3 PRP/HSR.



FEATURES

- Four stage non-directional and directional overcurrent protection for phase and earth faults with IDMTL or DTL.
- Polarizing voltage memory.
- Directional earth fault command protection.
- Programmable reset characteristics.
- Directional sensitive earth fault protection.
- Undercurrent protection with DTL.
- Thermal overload protection.
- Directional negative phase sequence overcurrent protection.
- Phase under/overvoltage protection.
- Zero phase sequence overvoltage (neutral voltage displacement) protection.
- Negative phase sequence overvoltage protection.
- Under / Over frequency protection.
- Frequency rate-of-change protection.
- Reverse Power protection. (32P, 32Q)
- Broken conductor detection.
- Circuit breaker fail protection.
- Cold load pick-up feature.
- Current change detection (OCD)
- Inrush current detector
- CT and VT supervision.
- Configurable binary inputs and outputs.
- Circuit breaker condition monitoring.
- Trip circuit supervision.
- Automatic self-supervision.
- Menu-based HMI system.
- Configurable LED indication.
- Metering and recording functions.
- Front-mounted USB port for communication to a local PC.
- Data communication with substation control and automation systems supported in accordance with the IEC 61850 standard.
- IRIG-B port for external clock

Feeder protection models

- Five shot, three phase auto-reclose (six trips to lockout).
- Synchronism check.
- Sequence co-ordination with in-series auto-reclosing devices.
- Fault Locator.

Motor protection models

- Motor status LED indication.
- Start protection.
- Stalled motor protection.
- Locked rotor protection.
- Restart inhibit.

- **Communication**

GRE200 complies with the requirements stipulated in various communication standards enabling reliable redundant communication.

- IEC 61850
- IEC62439-3 PRP/HSR/RSTP
- MODBUS/TCP

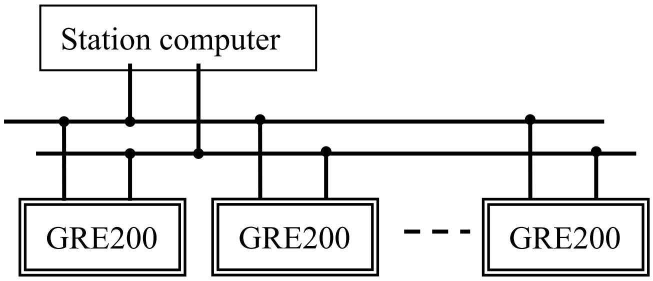


Figure 1. PRP (parallel redundancy protocol) example for LAN

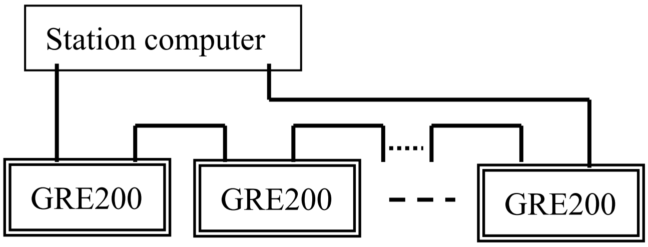


Figure 2. HSR (high-availability seamless redundancy) example for ring LAN

- **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
- Internal circuit checks using forcible signal.

APPLICATION

GRE200 is a range of fully numeric, multi-function, directional protection relays designed for feeder protection applications in medium voltage networks and backup protection in transmission and sub transmission networks.

GRE200 provides multiple, high accuracy, overcurrent protection elements (for phase and/or earth fault protection) with inverse time and definite time delay functions. All phase, earth and sensitive earth fault overcurrent elements can be independently subject to directional control.

In addition, GRE200 for feeder protection provides multi-shot, three phase auto-reclose with/without synchronism check, with independent sequences for phase fault, earth fault and sensitive earth fault. Auto-reclosing can also be triggered by external protection devices.

GRE200 for motor protection provides high accuracy motor protection elements, including thermal protection based on IEC 60255-149; motor status monitoring; locked rotor protection; restart inhibit. The thermal level calculation of the protected equipment is based on the equivalent heating phase current measurement.

GRE200 provides continuous monitoring of internal circuits and of software. In addition, monitoring of external circuits includes trip circuit supervision, CT and VT supervision and CB condition monitoring features.

A backlit LCD supports a user-friendly HMI having a menu-based operating system with programmable LEDs. Local connection of a PC is via a front-mounted USB port. The communication system allows the user to access data gathered by the relay's metering and recording functions.

Data available either via the relay HMI or communication ports includes the following functions.

- Metering
- Fault recording
- Event recording

PROTECTION FUNCTIONS

Non-Directional or Directional Phase Fault Overcurrent Protection

GRE200 can provide three phase directional overcurrent protection, each providing four independent overcurrent stages and can be set for inverse time or definite time operation. If inverse time is selected, then any one of nine curves may be chosen, including IEC and IEEE/ANSI standard characteristics, (see Figure 3). Alternatively, a user-configurable curve may be created.

These elements are immune to the effects of transformer magnetising inrush and dc offset transient over-reach.

A programmable reset feature is provided, selectable for instantaneous, definite time or dependent time operation. This feature can be used to protect against flashing fault conditions, or to grade correctly with electromechanical overcurrent relays.

All elements can be inhibited by binary input signals for operation in blocked overcurrent schemes and busbar zone blocking protection.

Figure 1 illustrates the directional characteristic, with the forward operate zone shaded. Polarisation is achieved by the 90° quadrature method, whereby the phase angle of each current is compared with the phase-to-phase voltage between the other two phases. Since the voltage inputs to the relay are connected phase–to-neutral, the polarising phase-to phase-voltages are derived internally.

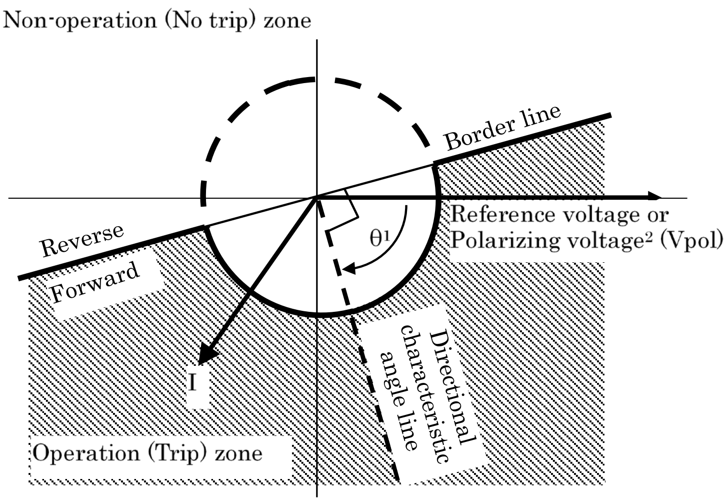


Figure 3 Directional characteristics

In the event of a close-up three phase fault, all three polarising signals will collapse below the minimum threshold. For this condition, GRE200 uses voltage memory to provide a temporary polarising signal. GRE200 maintains the polarising signal by reconstructing the pre-fault voltages.

To cover applications where a 2:1:1 current distribution may be experienced, it is possible to program the directional phase fault protection such that a trip output will only be initiated if two or more phases detect fault current in the same operate zone.

Non-Directional or Directional Earth Fault Protection

The standard directional earth fault protection is available in all models, and provides four independent overcurrent stages. Protection functionality is the same as for the phase fault elements.

Each earth fault threshold can be independently configured for directional operation, in the same manner as the phase fault elements. The system residual voltage is used as the polarising signal. This may be obtained either by direct measurement, commonly using the open delta tertiary winding of a five limb VT, or it may be derived internally by calculating the zero sequence voltage from the three phase-to-neutral voltages.

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

GRE200 can provide directional earth fault command protection by using two stages of directional earth fault elements of which one is for tripping and the other is for blocking or for current reversal detection.

Non-Directional or Directional Sensitive Earth Fault (SEF) Protection (option)

GRE200 provides directional earth fault protection with more sensitive settings for use in applications where the fault current magnitude may be very low.

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

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

The sensitive earth fault elements can be configured for directional operation in the same way as the standard earth fault pole, by polarising against the residual voltage.

Phase Undercurrent Protection

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

Thermal Overload Protection

The thermal overload feature provides protection for cables and other plant against the effects of prolonged operation under excess load conditions. A thermal replica algorithm is applied to create a model for the thermal characteristics of the protected plant. Tripping times depend not only on the level of overload current, but also on the level of prior load current, the thermal replica providing 'memory' of previous conditions.

The thermal characteristics of the system are defined by entering settings for full load current and thermal time constant. GRE200 issues a trip according to the 'cold' and 'hot' curves illustrated in Figure 4, to prevent the protected system from exceeding its thermal capacity. The cold curve tripping times are applicable when the system is first energised, while the hot curves are relevant when the system has already been carrying some prior load for a period of time. An alarm output is also available to give early warning of high load current, set as a percentage of thermal capacity.

Non-Directional or Directional Negative Phase Sequence Overcurrent Protection

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

Two independent stages are provided, each with a programmable definite time delay. The negative phase sequence overcurrent elements can be directionalised by polarising against the negative phase sequence voltage.

Under/Overvoltage Protection

Two under/voltage and two overvoltage stages are provided. In each case, the two stages can be programmed with definite time delays, and one is also available with an inverse delay.

Zero Phase Sequence Overvoltage (OVG) (Neutral Voltage Displacement) Protection

Two Zero Phase Sequence Overvoltage stages are provided for detection of earth faults in high impedance earthed or isolated systems. The two stages can be programmed with definite time delays, and one is also available with an inverse delay. The zero sequence voltage may be derived from the phase voltages, or directly measured.

Negative Phase Sequence Overvoltage Protection (OVN)

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

Under/Over frequency Protection

GRE200 provides under/over frequency protection and frequency rate-of-change protection.

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

Broken Conductor Protection

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

Circuit Breaker Fail (CBF) Protection

Two stage CBF protection provides outputs for re-tripping of the local circuit breaker and/or back- tripping to upstream circuit breakers. The CBF functions can also be initiated by external protections via a binary input if required.

Cold Load Protection

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

Switch onto Fault Protection (SOTF-OC)

The switch onto fault function is used to detect and rapidly clear faults when circuit breakers (CBs) are closed onto a pre-existing fault in the protected zone.

Inrush Current Detector (ICD)

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

PLC Function

GRE200 is provided with a PLC (Programmable Logic Control) function allowing user-configurable sequence logics on binary signals and binary inputs.

Auto-Reclose (ARC)

GRE200 provides three-phasee auto-reclose, this can be initiated from trip signals of the following:

- Phase fault
- Earth fault
- Sensitive earth fault
- External trip (initiated by a binary input)

Numbers of auto-reclose shot is settable form one to five. Each ARC shot has a programmable dead time. Sequence co-ordination is maintained between the auto-reclose sequences of in-series relays on a feeder.

Synchronism Check

For the correct operation of three-phase auto-reclose, voltage and synchronism check are necessary. Characteristics of the synchronism check element are shown in Figure 2.

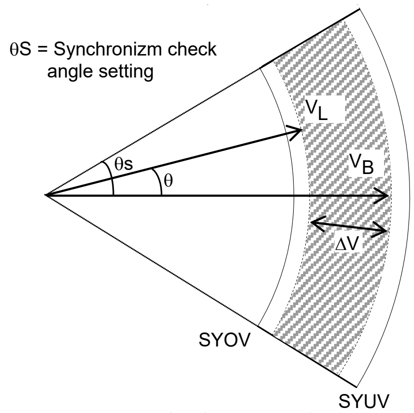


Figure 4 Synchronism check element

A detected maximum slip cycle is determined using the following equation:

$$f_{SC} = \frac{\theta s}{180° \times T_{SYN}}$$

where,

f_{SC}: slip cycle

θ_S: synchronism check angle setting

T_{SYN}: synchronism check timer setting

A frequency difference, check function, as mentioned below, is also available by the setting for the split synchronism check.

$$\Delta f = |f_{VL} - f_{VB}| \leq \Delta fs$$

where,

Δf = frequency difference

f_{VB} = frequency of busbar voltage VB

f_{VL} = frequency of line voltage VL

Δf_S= frequency difference setting

Start Protection

GRE200 provides start protection for motor failure on start up. When the start-up time exceeds the setting time, a motor failure is determined.

Stalled Motor Protection

Stalled motor protection utilises an overcurrent relay that can be set to detect current above the level of the motor breakdown torque. An input is provided to accept a signal from a zero-speed switch/tachometer to supervise the stalled motor protection to determine when the motor is in a stalled condition during starting or running

Locked Rotor Protection

GRE200 provides the locked rotor protection on motor running. Burnout of the motor can be protected by the rotor temperature prediction based on stator temperature prediction of IEC60255-149 and detection of current value.

Restart Inhibit

The restart Inhibit provides protection of motor burnout by start-up current or number-of-start-up restriction per hour. From temperature prediction of rotor and the temperature rise prediction by start-up current, when the exceeding rotor permissible temperature by start-up current, the restart inhibit function forbids motor restart.

CONTROL FUNCTIONS

Switchgear Control

GRE200 provides the facility for switchgear control on the relay front panel. Two-stepped operation (select-control) is applied for the control procedure of circuit breakers to ensure highly secure operation. An interlock check function is included for safe operation of the switchgear. Password protection is provided for the above functions.

A local/remote selector switch is also provided on the relay front panel so that remote control from station level or load dispatching centre can be chosen.

Equipment status (Open or Closed) is indicated on front LEDs and relay fascia LCD.

AUTOMATIC TRANSFER OPERATION (ATO) FUNCTIONS

Automatic transfer operation (ATO) is a function used to issue CB open and CB close commands automatically to switch the lines from which power is received, when a fault has occurred at a substation. ATO commands can be customised depending on the arrangement of the lines; hence, the user can describe them separately depending on circuit architecture.

Figure 5 illustrates an example of switching an electric power system using ATO commands. The ATO sequence is shown from Step 1 to Step 3:

(a) Step 1: Before ATO operation

Power is fed from Source-A via Line-1, whereas alternative power is fed from Source- B via Line-2.

(b) Step 2: Fault occurs on Line-1

A fault occurs on Line-1, then CB-A is tripped. Power will no longer be fed from Source-A.

(c) Step 3: ATO action

ATO function issues a CB close command to CB-T, so CB-T is closed. Accordingly, Line-1 can receive power from Source-B.

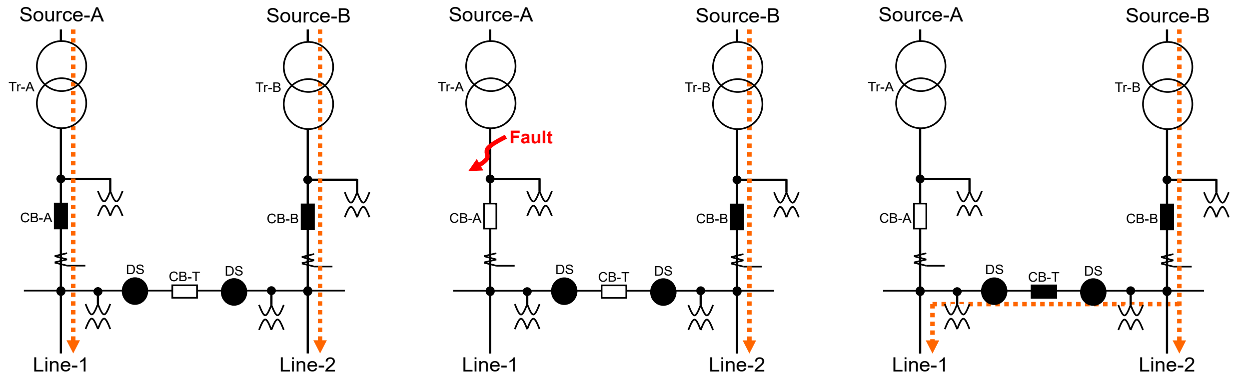
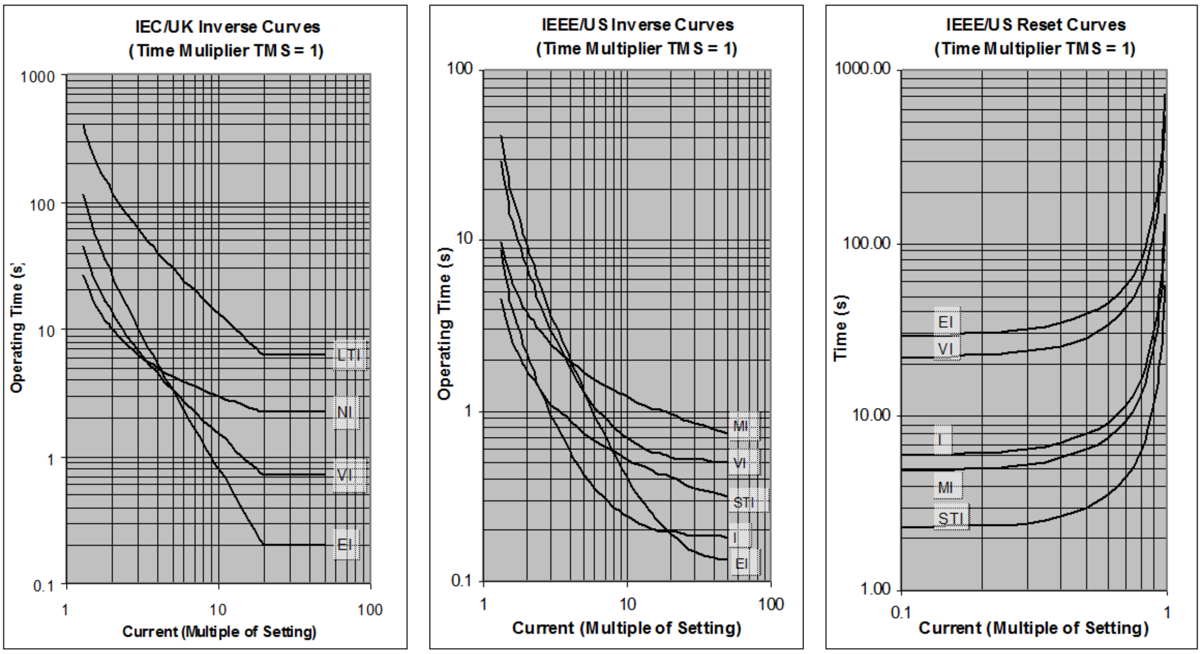


Figure 5. Example of ATO

Inverse Time Operate and Reset Curves



IDMT characteristics are defined by the following equations in accordance with IEC 60255-151.

$$t = TMS \times \left\{ \left[\frac{k}{\left(I/I_s \right)^{\alpha} - 1} \right] + c \right\}$$

Inverse time operate function

$$t = RTMS \times \left[\frac{k_r}{1 - \left(I/I_S \right)^{\beta}} \right]$$

Dependent time reset function

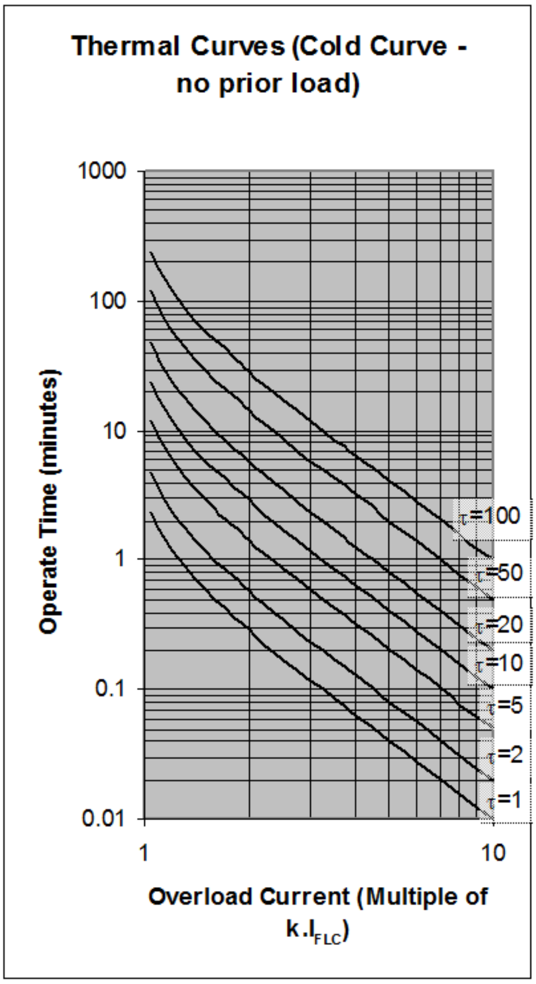
TMS setting range ; 0.010 – 1.500 in 0.001 steps
RTMS setting range ; 0.010 – 1.500 in 0.001 steps
Gs setting range :0.10 – 25.00A in 0.01A steps

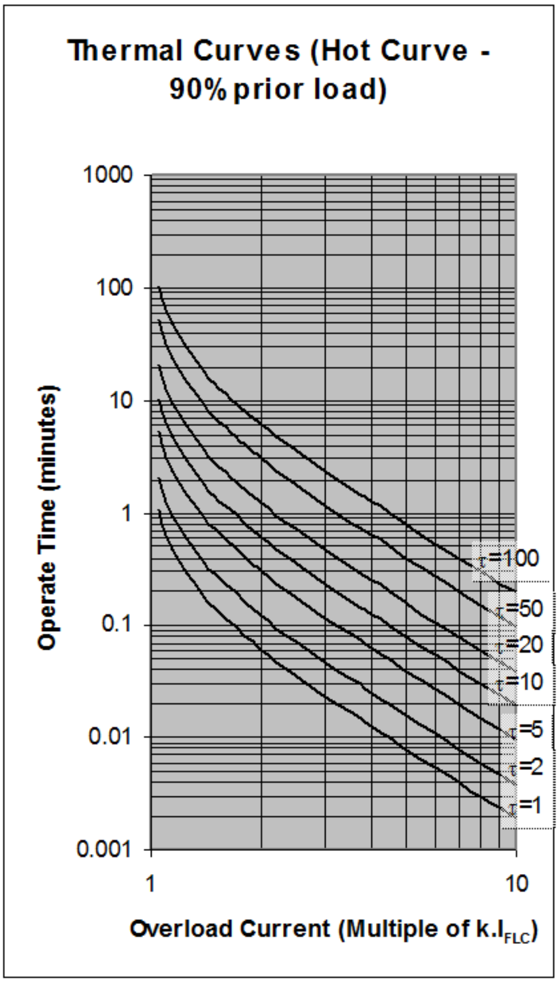
Constants for dependent time curves

Curve Type (IEC 60255-151)	Curve Description	k	α	c	t_r	β
A	**IEC Normal Inverse (NI)**	0.14	0.02	0	-	-
B	**IEC Very Inverse (VI)**	13.5	1	0	-	-
C	**IEC Extremely Inverse (EI)**	80	2	0	-	-
--	**UK Long Time Inverse (LTI)**	120	1	0	-	-
D	**IEEE Moderately Inverse (MI)**	0.0515	0.02	0.114	4.85	2
E	**IEEE Very Inverse (VI)**	19.61	2	0.491	21.6	2
F	**IEEE Extremely Inverse (EI)**	28.2	2	0.1217	29.1	2
--	**US CO8 Inverse**	5.95	2	0.18	5.95	2
--	**US CO2 Short Time Inverse**	0.02394	0.02	0.01694	2.261	2
--	**User configurable setting**	0.00 – 30.000	0.00 – 5.00	0.000 – 5.000	0.000 – 30.000	0.00 – 5.00

Figure 6. Operate and Reset Characteristics

Thermal Characteristics





Thermal characteristics are defined by the following equations in accordance with IEC 60255-149.

$$t = \tau.Ln\left[\frac{I^2}{I^2 - (k.I_{FLC})^2}\right]; \qquad t = \tau.Ln\left[\frac{I^2 - I_P^2}{I^2 - (k.I_{FLC})^2}\right]$$

'Cold' Curve **'Hot' Curve**

t = time to trip for constant overload current I (seconds)

I = overload current (largest phase current) (pu)

I_P = previous load current (pu)

$k.I_{FLC}$ (or I_θ) = thermal overload current setting (pu)

τ = thermal time constant (seconds)

Ln = natural logarithm

Figure 7. Thermal Characteristics

MONITORING FUNCTIONS

Trip Circuit Supervision

GRE200 provides a high-integrity trip circuit supervision scheme. The circuit breaker tripping control circuit can be monitored by utilising a binary input as shown in Figure 8.

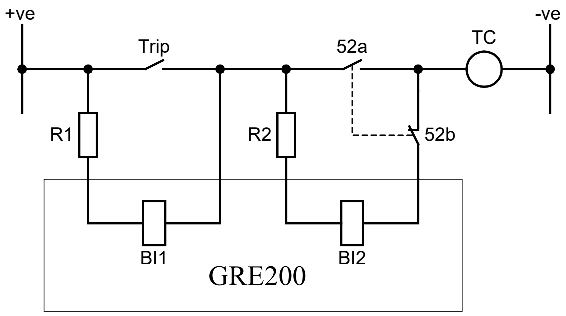


Figure 8. Trip Circuit Supervision scheme

CB Closed:

Under healthy conditions, binary input BI1 is energised via external resistor, R1. If the trip circuit becomes open circuit, BI1 resets and a Trip Circuit Fail alarm is raised.

CB Open:

Under healthy conditions, binary inputs BI1 & BI2 are energised via external resistors, R1 & R2 respectively. If the trip circuit becomes open circuit, both inputs reset and a Trip Circuit Fail alarm is raised.

The Trip Circuit Fail alarm incorporates a time delay of 400ms to prevent false alarms during normal tripping operations or voltage dips and is given in the form of an output contact operation and LCD/LED indication.

Automatic Self-Supervision

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

CB (Circuit Breaker) Contact Supervision

If both CB auxiliary contacts "CB N/O contact" and "CB N/C contact" are input, the CB contact supervision function can be used. The function monitors contact conditions and if the condition of both contacts are the same (either both open or both closed), an alarm is rasied.

Circuit Breaker Condition Monitoring

The following CB condition monitoring functions are provided:

- A trip counter increments the number of tripping operations performed. An alarm is issued when the count exceeds a user-defined setting.
- An $\sum Iy$ counter increments the value of current to the power 'y', recorded at the time of issuing the tripping signal, on a phase-by-phase basis. An alarm is issued when the count for any phase exceeds a user-defined setting.
- An operating time monitor records the time between issuing the tripping signal and the phase currents falling to zero. An alarm is issued when the operate time for any phase exceeds a user-defined setting.

The CB condition monitoring functions are triggered each time a trip is issued, in addition they can be triggered by an external device via a binary input.

Motor Status Monitoring

The GRE200 provides a motor status monitoring function, the motor status LED indicates motor stopped, start-up and running. The motor status LED is off when the motor is stationary, flicker is used for start-up and the LED is lit when the motor is running.

METERING AND RECORDING

Metering

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

- Primary and secondary currents for each input.
- Positive and negative phase sequence currents.
- Ratio of negative phase sequence to positive phase sequence currents.
- Primary and secondary voltages for each input.
- Positive and negative phase sequence voltages.
- System residual voltage.
- Power frequency.
- Active and reactive power.
- Power factor.
- Peak phase power demand.
- Peak phase current demand.
- Thermal condition of system.
- Relay element output status.
- Watt-Hour
- Var-Hour
- Binary input and output status.

For motor protection:

- Thermal condition of stator and rotor.
- Motor running time.
- Start-up time of the last motor start-up.
- Maximum current during the last motor start-up.
- Number of start-ups (total, cold and hot starts).

Event Record

Records are stored for the 1024 most recent events, time-tagged to 1ms resolution. The event record is available on the relay front panel LCD and at a local or remote PC. Events are recorded as follows:

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

Fault Record

A relay trip initiates fault recording. Records are stored for the 32 most recent faults, time-tagged to 1ms resolution. The fault record is available on the relay fascia LCD and at a local or remote PC. Fault records include the following data:

- Date and time of trip operation
- Operating phase
- Protection element responsible for trip
- Measured current and voltage data

For feeder protection model:

- Auto-reclose operation
- Fault location

Disturbance Record

The relay can record analogue and binary signals, initiated by relay tripping and initiating relay elements. Post-trigger recording time can be set, and the maximum number of records which can be stored is dependent on the recording times chosen.

Fault Location

Fault location is initiated by a tripping operation and is indicated in km and % of line length. The result of fault location is stored as fault record data.

USER INTERFACE

Relay Front Panel

A user friendly interface is provided on the relay front panel. A menu-based system provides for easy programming of relay functions and access to real-time and stored data. The front panel includes the following features.

- 21 character, 8-line LCD with back light.
- 14 LEDs
  (2 fixed display for 'In service' and 'Error', and 12 configurable).
- Keypad.
  (10 operation keys and 5 function keys which enable the user to skip directly to a specific LCD screen).
- USB2.0 port for connection of local PC

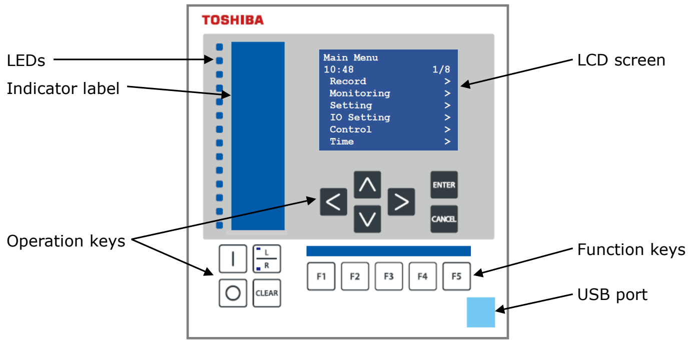


Figure 9. GRE200 Front panel

Local PC Connection

The user can communicate with the GRE200 from a local PC via the USB2.0 port on the front panel. Using GR-TIEMS software, the user can view and modify settings and analyse recorded data.

Relay Setting

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

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

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

Communication

Station bus

GRE200 can support data communication in accordance with the IEC 62439-3 standard (PRP/ HSR) via optical or electrical communication ports offering redundant LAN communication having two communication ports. In addition, Modbus/TCP can be applied.

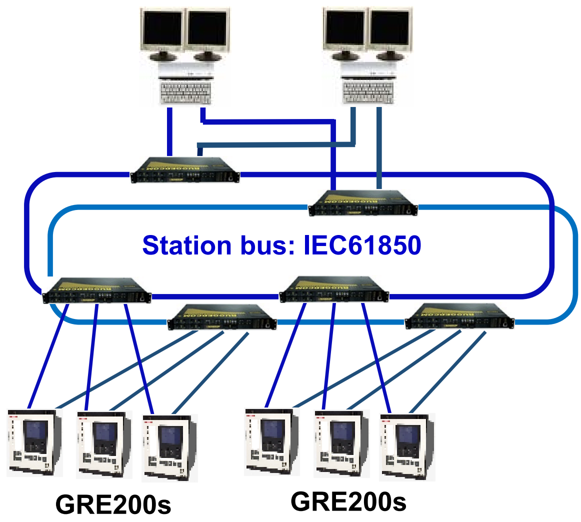


Figure 10. PRP (Parallel Redundancy Protocol)

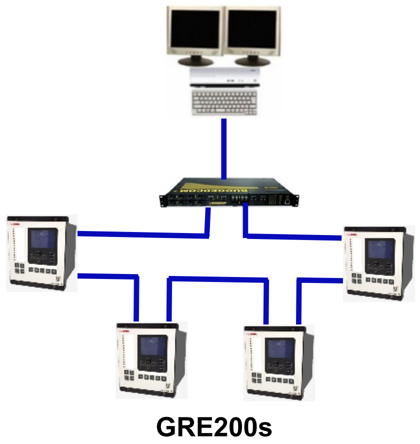


Figure 11. HSR (High-availability Seamless Redundancy) via ring-LAN

GRE200 is compliant with the IEC 61850 standard protocol. Users can select IEC 61850 Ed.1 or Ed.2.

Serial communication

Serial ports (RS485 or fiber optic) for communicating with legacy equipment or protection relays over IEC 60870-5-103 protocol are provided. Modbus can also be applied.

Binary Outputs

GRE200 provides eight or sixteen binary output contacts for tripping and alarm. Each of the programmable binary outputs is driven via a logic gate which can be programmed for OR gate or AND gate operation. Further, each output has a programmable reset characteristic, settable for instantaneous drop-off, delayed drop-off, dwell timer or for latching operation. If latching operation is selected then an operated relay must be reset by the user, either by pressing the RESET button, by energising a binary input which has been programmed for 'Remote Reset' operation, or by a communications command.

Binary Inputs

GRE200 provides fifteen or twenty-three programmable binary inputs. Each binary input is individually user-programmable for normal or inverted operation and for delayed pick-up and/or drop-off. Each input can also be used to switch relay operation to a different settings group.

TOOLS & ACCESSORY

The PC interface GR-TIEMS allows users to access GRE200 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 GRE200. 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.

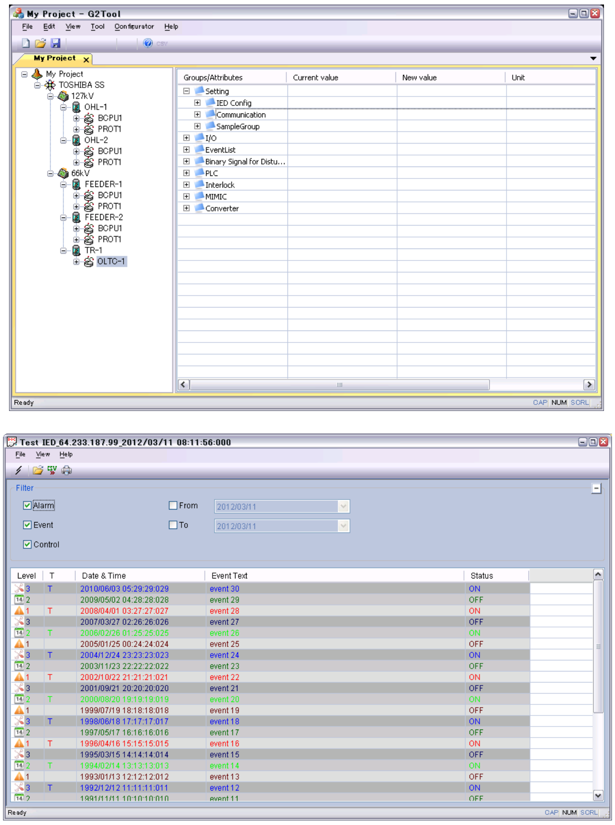


Figure 12. PC Display using GR-TIEMS

Programmable Logic Editor

The programmable logic capability allows the user to configure flexible logic for customized application and operation. Configurable binary inputs, binary outputs and LEDs are also programmed by the programmable logic editor which complies with IEC 61131-3.

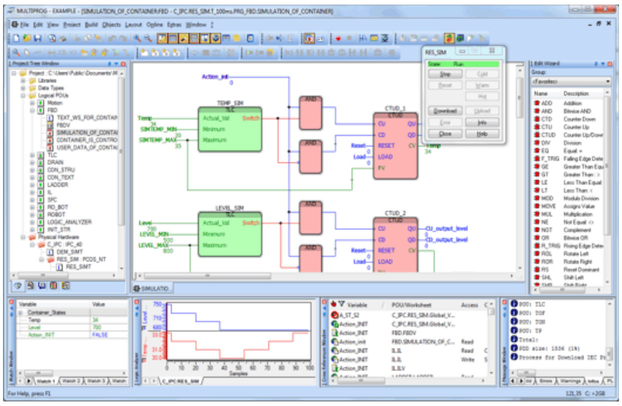


Figure 13. PC display using PLC editor

TECHNICAL DATA

Analog Inputs	
Rated current	
Phase Current (In)	1A or 5A (selectable)
Zero sequence Current (Ien)	1A or 5A (selectable)
Zero sequence Current for SEF (Isen)	0.2A
Rated voltage (Vn, Ven, Vsn)	100V to 120V
Rated Frequency	50Hz or 60Hz (selectable)
Overload Rating	
Phase Current	4 times rated current continuous 5 times rated current for 3 minutes 6 times rated current for 2 minutes 30 times rated current for 10 seconds 100 times rated current for 1 second 250 times rated current for one power cycle (20 or 16.6ms)
Zero sequence Current	Rated current continuous at In = 5A 20 times rated current for 1 second at In = 5A
Zero sequence Current for SEF	10 times rated current continuous at In =0.2A
Voltage	2 times rated voltage continuous 2.5 times rated voltage for 1 second
Burden	
Phase Current	≤ 0.2VA at In = 5A
Zero sequence Current	≤ 0.4VA at In = 5A
Zero sequence Current for SEF	≤ 0.1VA at In = 0.2A
Voltage	≤ 0.1VA at Vn
Power Supply	
Rated auxiliary voltage	24/48/60Vdc (Operative range: 19.2 – 72Vdc), 110-250Vdc (Operative range: 87.5 ~ 300Vdc) 100-240Vac (Operative range: 80 ~ 288Vac)
Superimposed AC ripple on DC supply	≤ 15%
Supply interruption	≤ 20ms at 110Vdc
Power consumption	≤ 13W (quiescent) ≤ 20W (maximum)

Binary Inputs	
Input circuit DC voltage (AC not applicable)	220Vdc rated: 154Vdc (Typ.) / 110Vdc (Min. operation) 125Vdc rated: 87.5Vdc (Typ.) / 62.5Vdc (Min. operation) 110Vdc rated: 77Vdc (Typ.) / 70Vdc (Min. operation) 55Vdc rated: 38.5Vdc (Typ.) / 27.5Vdc (Min. operation) Note: Pick-up setting is available: 55V, 110V, 125V or 220V Note: 55V setting is available only for BI1 and BI2. (*) Binary input circuit for DC voltage application only.
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.
Power consumption	≤ 0.5W per input at 220Vdc
Binary Outputs	
Normal type contacts: Make and carry Break Operating time	 8A continuously 30A, 240Vdc for 1s (L/R=5ms) 0.1A at 250Vdc (L/R=40ms) 0.2A at 125Vdc (L/R=40ms) Typically 6 ms
Alarm contacts: Make and carry Break Operating time	 8A continuously 30A, 240Vdc for 1s (L/R=5ms) 0.1A at 250Vdc (L/R=40ms) 0.2A at 125Vdc (L/R=40ms) Typically 8 ms
Durability	≥ 10,000 operations (loaded contact) ≥ 100,000 operations (unloaded contact)

Measuring input capability	
Full scale	
Three-phase current input	190A
Zero-phase sequence current input	39A
Zero-phase sequence current input for SEF	2A
Voltage input	245V
Sampling rate	48 samples / cycle (2400Hz /2880Hz for 50Hz/60Hz system)

Mechanical Design	
Installation Weight	Flush mounting Approx. 4.5 kg (1/3 size), 6.0 kg (1/2 size)
LED	
Number Colour	14 (2 fixed for “In service” and “ERROR”) Red / Yellow / Green (configurable) except “In service” (green) and “Error” (red)
Function keys	
Number	5
Local Interface	
USB Maximum cable length	Type B 2 meters (less than)
Terminal Block	
CT/VT input Binary input, Binary output	M3.5 Ring terminal (ring lug type) M3.0 Ring terminal (ring lug type)

Communication for Network (rear port)	
100BASE-TX/1000BASE-T Connector type Cable type	 RJ-45 CAT5e STP cable -enhanced category 5 with Shielded Twisted Pair cable
100BASE-FX Cable type Connector type Wave length	For IEC 61850-8-1 Multimode fibre, 50/125 or 62.5/125μm LC duplex type 1300nm
RS485 Cable type Connector type	For IEC 60870-5-103 Shielded twisted pair cable Push-in spring terminal (PCB connector)
Fiber optical (for serial communication) Cable type Connector type Wave length	For IEC 60870-5-103 Multimode fibre, 50/120 μ m or 62.5/125 μ m ST type 820nm
IRIG-B (for time synchronization) Cable type Connector type	 Shielded twisted pair cable Push-in spring terminal (PCB connector)

FUNCTIONAL DATA (Protection)

Non-directional or Directional Overcurrent Protection (OC1 – OC4, 4 stages)	
Definite time overcurrent threshold	0.02 – 150.00A in 0.01A steps
Inverse time overcurrent threshold	0.02 – 25.00A in 0.01A steps
Directional characteristic	Non-Directional / Forward / Reverse
Polarising voltage	1.0 V(fixed)
Characteristic angle	-90 – +90° in 1° steps
Delay type	DT / IEC-NI / IEC-VI / IEC-EI / UK-LTI / IEEE-MI / IEEE-VI / IEEE-EI / US-CO2 / US-CO8 / Original
Drop-off/pick-up ratio	10 – 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 or Directional Earth Fault Protection (EF1 – EF4, 4 stages)	
Definite time earth fault threshold	0.02 – 150.00A in 0.01A steps
Inverse time earth fault threshold	0.02 – 25.00A in 0.01A steps
Directional characteristic	Non-Directional / Forward / Reverse
Characteristic angle	-90 – +90° in 1° steps (3I0 lags for −3V0)
Polarising voltage (3V0)	0.5 – 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-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 – 300.00s in 0.01s steps
Reset Time Multiplier Setting RTMS	0.010 – 50.000 in 0.001 steps
Non-directional or Directional Sensitive Earth Fault Protection (SEF1 – SEF4, 4 stages)	
SEF threshold	0.001 – 1.000A in 0.001A steps
Directional characteristic	Non-Directional / Forward / Reverse
Characteristic angle	-90 – +90° in 1° steps (3I0 lags for −3V0)
Directional Characteristic Boundary of operation:	±87.5°
Polarising voltage	0.5 – 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-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 – 300.00s in 0.01s steps
Reset Time Multiplier Setting RTMS	0.010 – 50.000 in 0.001 steps
Residual power threshold:	0.00 – 100.00W in 0.01W steps

Non-directional or Directional Negative Sequence Phase Overcurrent Protection (OCN1 – OCN4, 4 stages)	
Definite time OCN threshold	0.02 – 150.00A in 0.01A steps
Inverse time OCN threshold	0.02 – 25.00A in 0.01A steps
Directional characteristic	Non-Directional / Forward / Reverse
Characteristic angle	-90 – +90° in 1° steps (3I0 lags for −3V0)
Polarising voltage	0.5 – 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-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 50.000 in 0.001 steps
Reset type	Definite Time or Dependent Time
Reset definite delay	0.00 – 300.00s in 0.01s steps
Reset Time Multiplier Setting RTMS	0.010 – 50.000 in 0.001 steps
Phase Undercurrent Protection (UC1, UC2, 2 stages)	
Undercurrent threshold:	0.10 – 10.00A in 0.01A steps
DTL delay	0.00 – to 300.00s in 0.01s steps
Switch onto Fault (SOTF-OC, 1 stage)	
Switch onto fault element (OCSOTF)	0.02 – 15.00A in 0.01A steps
Broken Conductor Detection (BCD 1 stage)	
Broken conductor threshold	0.10 – 1.00 in 0.01 steps
DTL delay	0.00 – 300.00s in 0.01s steps
Thermal overload Protection (THM 1 stage)	
Thermal setting (THM = k.IFLC)	0.40 – 10.00A in 0.01A steps
Time constant (τ): TTHM	0.5 – 500.0 min in 0.1min steps
Time constant (τ radiation): TTHM-rad	0.5 – 500.0 min in 0.1min steps
Thermal alarm:	50 – 100% in 1% steps
Inrush Current Detection (ICD 1 stage)	
Second harmonic ratio setting (I_{2f}/I_{1f}):	10 – 50% in 1% steps
Overcurrent thresholds:	0.10 – 25.00A in 0.01A steps
Cold Load Protection (CLP)	
Applied setting group (CLP-SG)	Group1 – Group 8 (select)
Cold load enable time (TCLP-EN)	0 – 10000s in 1s steps
Cold load reset time (TCLP-RESET)	0 – 10000s in 1s steps
Cold load drop-out current threshold (OCCLP)	0.02 – 15.00 A in 0.01A steps
Cold load drop-out time (TCLP-DO)	0.00 – 100.00s in 0.01s steps
Circuit Breaker Fail Protection (CBF Re-trip, Backup trip, 1 stage)	
Overcurrent element (OCCBF)	0.10 – 25.00A in 0.01A steps
Earth fault current element (EFCBF)	0.10 – 25.00A in 0.01A steps
CBF re-trip timer (TCBF-RE)	0.000 – 300.000s in 0.001s steps
CBF timer for related breaker trip (TCBF-TP)	0.000 – 300.000s in 0.001s steps

Phase Undervoltage Protection (UV1 – UV4, 4 stages)	
UV threshold	5.0 – 130.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-off/pick-up ratio	100 – 120% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps
Undervoltage block threshold	5.0 – 20.0V in 0.1V steps
Undervoltage block delay	0.00 – 300.00s in 0.01s steps
Phase to Phase Undervoltage Protection (UVS1 – UVS4, 4 stages)	
UVS threshold	5.0 – 130.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-off/pick-up ratio	100 – 120% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps
Undervoltage block threshold	5.0 – 20.0V in 0.1V steps
Undervoltage block delay	0.00 – 300.00s in 0.01s steps
Phase Overvoltage Protection (OV1 – OV4, 4 stages)	
OV threshold	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps
Phase to Phase Overvoltage Protection (OVS1 – OVS4, 4 stages)	
OVS threshold	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps
Earth Fault Overvoltage Protection (OVG1 – OVG4, 4 stages)	
OVG threshold	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-offt/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps
Negative Sequence Phase Overvoltage Protection (OVN1 – OVN4, 4 stages)	
OVN threshold	1.0 – 220.0V in 0.1V steps
Delay type	DTL, IDMT, Original
Drop-off/pick-up ratio	10 – 100% in 1% steps
DTL delay	0.00 – 300.00s in 0.01s steps
IDMTL Time Multiplier Setting TMS	0.010 – 100.000 in 0.001 steps
Reset delay	0.0 – 300.0s in 0.1s steps

Frequency Protection (FRQ1 – FRQ8, DFQR1 – DFQR8, 8 stages)	
FRQ (Under/Over frequency) threshold: DTL delay (TFRQ): Undervoltage block: DFRQ (Frequency rate-of-change) RCD (Rapid change detector)	-10.00 – +10.00Hz in 0.01Hz steps 0.00 – 300.00s in 0.01s steps 40.0 – 100.0V in 0.1V steps 0.1 – 15.0Hz/s in 0.1Hz/s steps 5.0 – 30.0 Hz/s in 0.1 Hz/s steps
Reverse Active Power Protection (RP1, RP2, 2 stages)	
RP threshold (RP): DTL delay (TPR): Drop-off/pick-up ratio (RP-DPR): Undervoltage block (UV-RPBLK):	-1500.0 – -5.0W in 0.1W steps 0.00 – 300.00s in 0.01s steps 50 – 98% in 1% steps 5.0 – 100.0V in 0.1V steps
Reverse Reactive Power Protection (RQ1, RQ2, 2 stages)	
RQ threshold (RQ): DTL delay (TRQ): Drop-off/pick-up ratio (RQ-DPR): Undervoltage block (UV-RQBLK):	-1500.0 – -5.0var in 0.1var steps 0.00 – 300.00s in 0.01s steps 50 – 98% in 1% steps 5.0 – 100.0V in 0.1V steps
Automatic Transfer Operation (ATO)	
Number of ATO commands Checking time for ATO ready ATO reset time Output judgement time for ATO command Pulse width of ATO command Current change detection relay (OCDATO) Prolonged time of OCDATO relay Overcurrent relay (OCATO) Undervoltage relay (UVATO1) Undervoltage relay (UVATO2)	1 – 5 0.00 – 300.00s in 0.01s steps 0.00 – 310.00s in 0.01s steps 0.00 – 300.00s in 0.01s steps 0.00 – 10.00s in 0.01s steps 0.05 – 5.00A in 0.01A steps 0.00 – 100.00s in 0.01s steps 0.02 – 150.00A in 0.01A steps 5.0 – 130.0V in 0.1V steps 5.0 – 130.0V in 0.1V steps
Motor Start Protection (Mot-StPro)	
Motor start protection time (T-Mot-StPro):	0.10 - 300.00s in 0.01s steps
Thermal overload Protection for Motor Protection (Mot-THM)	
Thermal overload current (Mot-THM): Thermal time constant (T-Mot-THM): Thermal time constant in radiation state (T-Mot-THM-rad): Thermal alarm (T-Mot-THM-Alarm):	0.40 – 10.00A in 0.01A steps 0.5 – 500.0 min in 0.1min steps 0.5 – 500.0 min in 0.1min steps 50 – 100% in 1% steps
Stalled Motor Protection (Mot-Stall)	
Overcurrent threshold (Mot-Stall-OC): DTL delay (T-Mot-Stall):	0.10 – 50.00A in 0.01A steps 0.00 – 300.00s in 0.01s steps
Locked Rotor Protection (Mot-LKRT)	
Motor start-up current (Mot-LKRT-IS): Thermal level (rate of Mot-THM) (Mot-LKRT): Allowable locked rotor time (T-Mot-LKRT):	0.10 – 100.00A in 0.01A steps 50 – 1000% in 1% steps 1 – 300s in 1s steps
Restart Inhibit Function (Mot-THSR, Mot-STPH)	
Limit number for starts per hour (Mot-STPH-Num):	1 – 60 in 1 steps

Autoreclose (ARC)	
Number of shots	1 – 5 shots
Dead time for single-phase autoreclose	0.01 – 300.00s in 0.01s steps
Dead time for three-phase autoreclose	0.01 – 300.00s in 0.01s steps
Multi-shot dead line time	0.01 – 300.00s in 0.01s steps
Reclaim time	0.0 – 600.0s in 0.1s steps
Pulse width of reclosing signal output	0.01 – 10.00s in 0.01s steps
Autoreclose reset time	0.01 – 310.00s in 0.01s steps
Reset time for developing fault	0.01 – 300.00s in 0.01s steps
Synchronism check (VCHK)	
Synchronism check angle	0° – 75° in 1° steps
UV element	10 – 150V in 1V steps
OV element	10 – 150V in 1V steps
Busbar or line dead check	0 – 150V in 1V steps
Busbar or line live check	0 – 150V in 1V steps
Synchronism check time	0.01 – 100.00s in 0.01s steps
Voltage check time	0.01 – 100.00s in 0.01s steps
Fault Locator (FL)	
Line reactance and resistance setting	0.00 – 1000.00Ω in 0.01Ω steps
Line length	0.0 to 500.0km in 0.1km steps
Correction factor of impedance between lines	50 to 150% in 1% steps
Correction factor of impedance between in each phase	50 to 150% in 1% steps
Accuracy	±0.4km (up to 20km, without fault at near end) ±2% (up to 399.9km, without fault at near end)

Accuracy	
Over current relay:	
Pick-up	≤ ±3% of setting value (at Gs≥0.2A)
Operating time with definite time	≤ Definite time + 30ms + BO operating time(*1) (at 60Hz and G/Gs≥2.0) ≤ Definite time + 35ms + BO operating time(*1) (at 50Hz and G/Gs≥2.0)
Operating time with inverse time	≤ ±12.5% of IEC 60255-151 theoretical value (at 5.0>G/Gs≥2.0 and TMS≥1) ≤ ±7.5% of IEC 60255-151 theoretical value (at 10.0> G/Gs≥5.0 and TMS≥1) ≤ ±5.0% of IEC 60255-151 theoretical value (at G/Gs≥10.0 and TMS≥1)
Under current relay:	
Pick-up	≤ ±2% of setting value (at Gs≥0.2A)
Operating time	≤ Definite time + 83ms + BO operating time(*1) (at 60Hz and G/Gs≤0.9) ≤ Definite time + 100ms + BO operating time(*1) (at 50Hz and G/Gs≤0.9)
Over voltage relay:	
Pick-up	≤ ±2% of setting value (at Gs≥5V)
Operating time with definite time	≤ Definite time + 25ms + BO operating time(*1) (at 60Hz and G/Gs≥1.5) ≤ Definite time + 30ms + BO operating time(*1) (at 50Hz and G/Gs≥1.5)
Operating time with inverse time	≤ ±5.0% of IEC 60255-127 theoretical value (at G/Gs≥1.2 and TMS≥1)
Under voltage relay:	
Pick-up	≤ ±2% of setting value (at Gs≥5V)
Operating time with definite timer	≤ Definite timer + 30ms + BO operating time(*1) (at 60Hz and G/Gs≤0.7) ≤ Definite timer + 35ms + BO operating time(*1) (at 50Hz and G/Gs≤0.7)
Operating time with inverse timer	≤ ±5.0% of IEC 60255-127 theoretical value (at 0.95≥G/Gs≥0 and TMS≥1)
Over/Under frequency relay:	
Pick-up	≤ ±0.05% of setting value (at Setting≤5.00Hz)
Operating time	≤ Definite time + 85ms + BO operating time(*1) (at 60Hz) ≤ Definite time + 100ms + BO operating time(*1) (at 50Hz)
Frequency rate of change relay:	
Pick-up	≤ ±0.05Hz/s of setting value (at Setting≤5.00Hz/s)
Operating time	≤ Definite time + 250ms + BO operating time(*1) (at 60Hz and G/Gs≥1.0) ≤ Definite time + 300ms + BO operating time(*1) (at 50Hz and G/Gs≥1.0)

(*1)Typically 6ms

FUNCTIONAL DATA (Control)

Metering Function	
Current:	
Phase current and Zero sequence current	Accuracy: ±2% of 5A (at current value < 5A) Accuracy: ±2% (at 5A ≤ current value ≤ 20A)
Zero sequence current for SEF	Accuracy: ±2% of 0.2A (at current value < 0.2A) Accuracy: ±2% (at 0.2A ≤ current value ≤ 0.8A)
Voltage	Accuracy ± 0.5% (at rating)
Power (P, Q)	Accuracy ± 2.0% (at rating when power quantities being fed)
Energy (Wh, varh)	Accuracy ± 2.0% (at rating)
Frequency	Accuracy ± 0.03%
GPS Time Synchronisation	
Protocol	SNTP

ENVIRONMENTAL PERFORMANCE

Atmospheric Environment		
Temperature	IEC 60068-2-1/2 IEC 60068-2-14	Operating range:–25°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 IP40 for top panel IP20 for rear panel
Mechanical Environment		
Vibration	IEC 60255-21-1 Class 2	Response - Class 2 Endurance - Class 2
Shock and Bump	IEC 60255-21-2 Class 2	Shock Response Class 2 Shock Withstand Class 2 Bump Class 2
Seismic	IEC 60255-21-3 Class 2	Class 2
Electrical Environment		
Dielectric Withstand	IEC 60255-27	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 60255-27 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 Level 4 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 Level 3 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 Level 4 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
	IEEE C37.90.2-2004	Field strength 35V/m for frequency sweep of 80MHz to 1GHz.
Fast Transient Disturbance	IEC 60255-22-4 Class A IEC 61000-4-4 IEC 60255-26 Ed 3 Zone A	5 kHz and 100kHz, 5/50ns disturbance Auxiliary supply and input / output ports: 4 kV Communications ports: 4 kV
Surge Immunity	IEC 60255-22-5 IEC 61000-4-5 Level 4 IEC 60255-26 Ed 3 Zone A	1.2/50μs surge in common/differential modes: Auxiliary supply and input / output ports: 4, 2, 1, 0.5 kV / 2, 1, 0.5 kV Communications ports: up to 4, 2, 1, 0.5 kV / 0 kV
Surge Withstand	IEEE C37.90.1-2012	2.5kV, 1MHz damped oscillatory wave 4kV, 5/50ns fast transient
Conducted RF Electromagnetic Disturbance	IEC 60255-22-6 IEC 61000-4-6 Level 3 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 Class A IEC 61000-4-16 Level 4 IEC 60255-26 Ed 3 Zone A	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 Level 5 IEC 60255-26 Ed 3	Field applied at 50/60Hz with strengths of: 100A/m continuously, 1000A/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 1GHz to 3GHz:<76dB(uV/m) peak or <56dB(uV/m) average 3GHz to 6GHz:<80dB(uV/m) peak or <60dB(uV/m) average Measured at a distance of 3 m

Performance and Functional Standards		
Category		**Standards**
General		
Common requirements		IEC 60255-1
Data Exchange		IEC 60255-24 / IEEE C37.111 (COMTRADE)
Product Safety		IEC 60255-27
European Commission Directives		
CE	2014/30/EU	Compliance with the European Commission Electromagnetic Compatibility Directive is demonstrated according to EN 60255-26: 2013.
	2014/35/EU	Compliance with the European Commission Low Voltage Directive for electrical safety is demonstrated according EN 60255-27:2014.

Ordering information (1/5)

[Hardware selection (1/3 case)]

							Positions																		
							7	8	-	9	A	B	-	C	D	-	E	F	-	G	H	-	J	K	L
Configurations	G	R	E	2	0	0	-			-	1	M	1	-	0	0	-			-	5	1	-	A	A	0

Selection	Position	Code
DC rated voltage		
110-250Vdc or 100-240Vac†[1]	8	1
Outline		
Standard LCD,1/3 case×19”rack	9	1
VCT type		
VCT3A: 3×CT, 1×EFCT, 5×VT	7	1
VCT3B: 3×CT, 1×SEFCT, 5×VT	7	2
Binary IO modules (Number# of circuits)		
1×BI1+1×BO1 (IN#: 15, OUT#: 8) for 1/3 case	A B	M 1
1×BI1+1×BO2 (IN#: 15, OUT#: 6) for 1/3 case	A B	M A
Network module (System communication and time-synch.)		
See “Communication port table”	E F	
Software functions†[2]		
See ”Functional table”	G	5
BI/BO Terminal Type		
Ring plug type terminal	H	1
System Frequency		
50Hz / 60Hz (selectable)	J	A
AC rated current		
1A / 5A (selectable)	K	A

†[1] Operation of PWS module is possible with an AC source (100 –240Vac), but IED operation is not guaranteed.
†[2] Selected using the table on Page 27.

Ordering information (2/5)

[Hardware selection (1/2 case)]

		Positions																		
		7	8	-	9	A	B	-	C	D	-	E	F	-	G	H	-	J	K	L
Configurations	G R E 2 0 0			-	2	M		-	0	0	-			-	5	1	-	A	A	0
VCT type																				
VCT3A: 3×CT, 1×EFCT, 5×VT		1																		
VCT3B: 3×CT, 1×SEFCT, 5×VT		2																		
DC rated voltage																				
110-250Vdc or 100-240Vac†[1]			1																	
Outline																				
Standard LCD,1/2 case×19”rack					2															
Binary IO modules (Number# of circuits)																				
1×BI1+1×BO1+1×BIO1 (IN#:23,OUT#:16)for 1/2 case						M	2													
1×BI1+1×BO1+2×BIO1 (IN#:31,OUT#:24)for 1/2 case						M	3													
Network module **(System communication and time-synch.)**																				
See “Communication port table”																				
Software functions†[2]																				
See ”Functional table”															5					
BI/BO Terminal Type																				
Ring plug type terminal																1				
System Frequency																				
50Hz / 60Hz (selectable)																		A		
AC rated current																				
1A / 5A (selectable)																			A	

†[1] Operation of PWS module is possible with an AC source (100 –240Vac), but IED operation is not guaranteed.
†[2] Selected using the table on Page 26.

Ordering information (3/5)

Communication port Table

[Hardware selection]

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

Positions E	Positions F	Serial ports, and/or Ethernet ports, and/or Time Synch ports: RS485	Fiber optical	100Base-FX	100Base-TX/ 1000Base-T	IRIG-B	Remark
L	6	–	–	2	–	–	Etherner ports for PRP/HSP/RSTP
L	D	1	–	2	–	–	
L	L	–	–	–	2	–	
L	P	1	–	–	2	–	

[Software selection]

							Positions											
								7	S	G	T		E	F	U		9	V
Configurations	G	R	E	2	0	0	-		0	5		-				-		E

Application of power system
- Assignment at ‘7’ position†[1]

Function block
- See Function table†[2] — 5

Network / Time Sync. module
- Assignment at ‘E’ position†[3]
- Assignment at ‘F’ position†[3]

Protocol
- IEC 61850 or Modbus or IEC60870-5-103†[4] — 1
- IEC 61850 — 2

Outline
- Assignment at ‘9’ position†[5]

Language
- English — E

†[1]Selection made at position ‘7’ in ‘Hardware selection’ on page 25 or 26.
†[2]Selection made using ‘Function tables’ on page 28.
†[3]Selection made at ‘E’ and ‘F’ positions under ‘Hardware selection’ on page 25 or 26.
†[4]Protocols, IEC61850, Modbus, or IEC60870-5-103 can be selected by user settings.
IEC61850 for LAN ports, Modbus for LAN ports (TCP) or for serial port (RS485, FO), or IEC60870-5-103 for serial port which depends on “E’ and ‘F’ positions under ‘Hardware selection.
†[5]Selection made at positon ‘9’ under ‘Hardware selection’ on page 25 or 26.

Ordering information (4/5)
[Function table for Software]

Function Block		Description	Ordering code. (Position “G & T”) 51	52
[VCT type; available IED case sizes]				
1 at position “7”	VCT3A	3×CT, 1×CT(for EF), 5×VT	●	
2 at position “7”	VCT3B	3×CT, 1×CT(for SEF), 5×VT		●
[Relay application]				
50/51/67	OC (4 stages)	Non-directional definite / inverse time overcurrent protection Directional definite / inverse time overcurrent protection	●	●
50N/51N/67N	EF (4 stages)	Non-directional definite / inverse time overcurrent protection Directional definite / inverse time overcurrent protection	●	●
–	DEFCAR	Command protection with EF and directional-EF schemes	●	●
50N/51N/67N	SEF (4 stages)	Sensitive earth fault protection (4 steps; non-directional) Sensitive earth fault protection (4 steps; directional)	–	●
46	OCN (4 stages)	Negative sequence over-current protection (non-directional)	●	●
		Negative sequence over-current protection (directional)	●	●
37	UC	Under-current protection	●	●
50SOTF	SOTF-OC	Switch onto fault protection	●	●
46BC	BCD	Broken conductor protection	●	●
49	THM	Thermal overload protection (THM trip, THM alarm)	●	●
--	ICD	Inrush current detection function	●	●
--	CLP	Cold load protection	●	●
50BF	CBF	Circuit breaker fail protection (CBF re-trip, CBF-trip)	●	●
27	UV (4 stages)	Under-voltage protection (phase-to-neutral)	●	●
27S	UVS (4 stages)	Under-voltage protection (phase-to-phase)	●	●
59	OV (4 stages)	Over-voltage protection (phase-to-neutral)	●	●
59	OVS (4 stages)	Over-voltage protection (phase-to-phase)	●	●
59N	OVG (4 stages)	Earth fault over-voltage protection	●	●
47	OVN (4 stages)	Negative-sequence over-voltage protection	●	●
81U/81O	FRQ	Under frequency /Over frequency	●	●
	DFRQ (8 stages)	Rate of change of frequency (df/dt)		
--	VTF	VT failure detection	●	●
--	CTF	CT failure detection	●	●
79	ARC	Autoreclose (reclosing relay in three-phase; up to five trials)	●	●
94	TRC	Three-phase trip circuit (for single CB)	●	●
--	PROT-COMMON	Protection common switches/switchgear with relay applications	●	●
25	VCHK	Synchronism check relay	●	●
21FL	FL	Fault locator (single-end)	●	●
--	ATO	Automatic transfer operation	●	●
OCD	OCDATO	Current changing detection relay for ATO	●	●
UV	UVATO	Undervoltage relay for ATO	●	●
OC	OCATO	Overcurrent relay for ATO	●	●
--	MOT	Motor protection	●	●
--	REVPOW	Reverse power protection	●	●

Ordering information (5/5)

[Function table for Software]

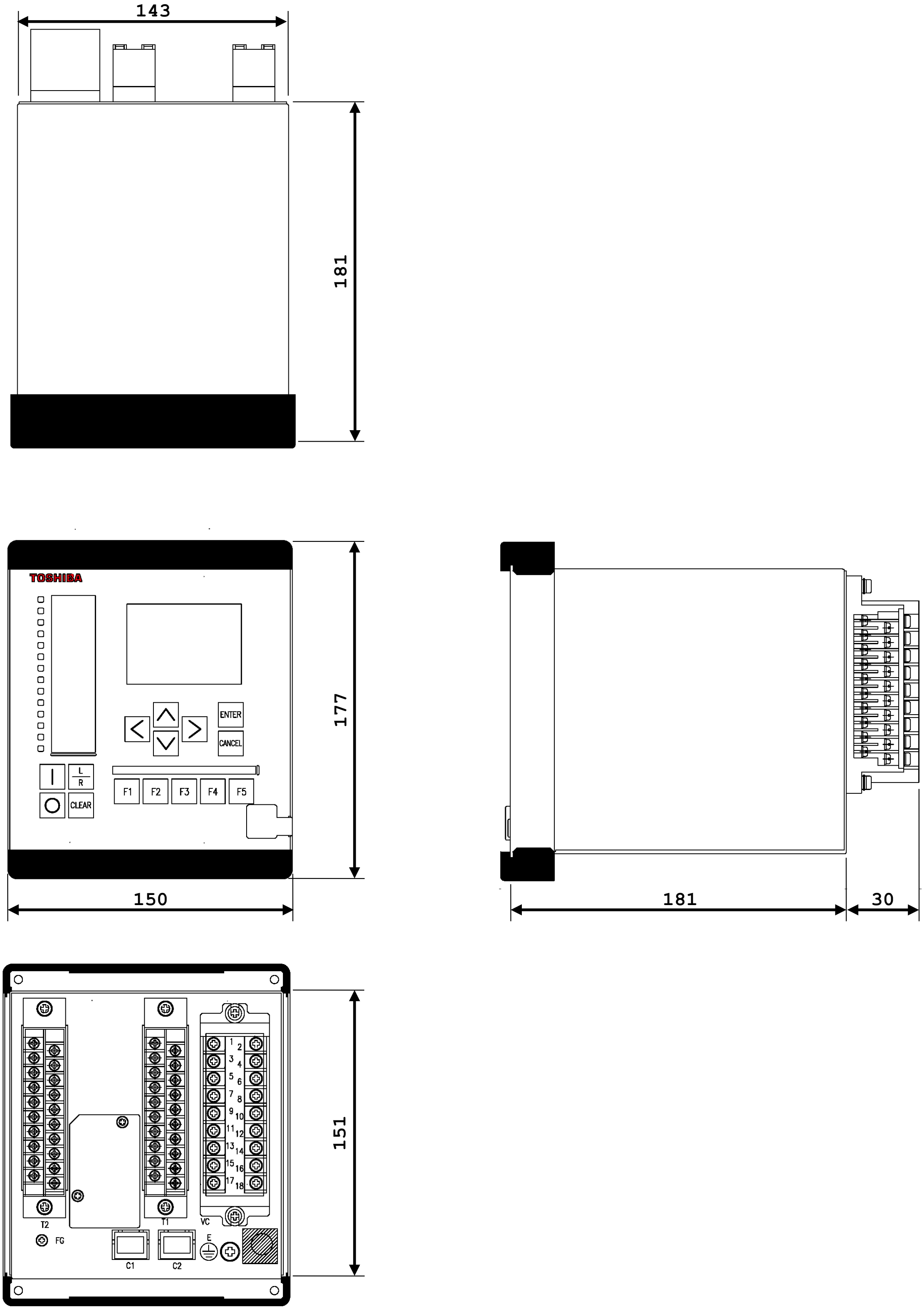
Function Block		Description		Ordering code (Position "G & T")	
				51	52
[VCT type; available IED case sizes]					
1 at position "7"		VCT3A	3×CT, 1×CT(for EF), 5×VT	●	
2 at position "7"		VCT3B	3×CT, 1×CT(for SEF), 5×VT		●
[Controls]					
General ctrl.	CMNCTRL	Common controls		●	●
	LEDR	LED reset		●	●
	GCNT	Counter function for general		●	●
	MDCTRL	Mode control function		●	●
	L/R	Local and remote control		●	●
Ctrl. & monitoring application	DPOS	Double positon device function		●	●
	ILK	Software interlock function		●	●
[Monitoring]					
--	MES	Measurement		●	●
--	Demand	Demand metering		●	●
--	Statistics	Statistics displaying		●	●
[Recording]					
--	DRT	Disturbance recorder		●	●
[Automatic supervision]					
--	TCS	TRC supervision		●	●
--	Sigma Iy	Alarm for interruption capability of CB		●	●

●: Applied,
-: Not applied.

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

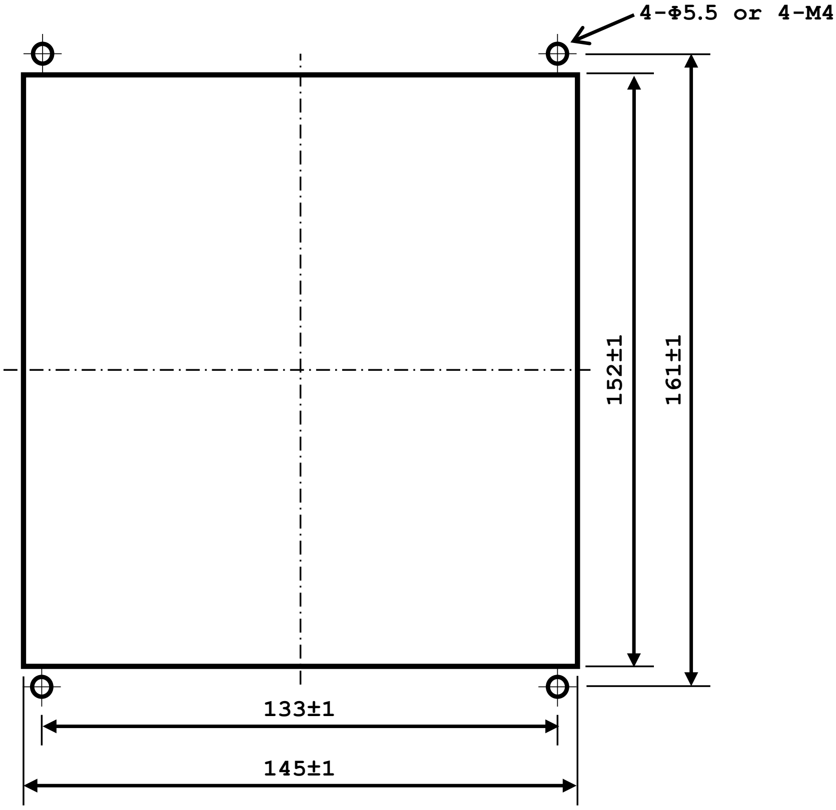
1/3 size case

1. Trihedral figure (1/3×19 inches)



Note: Dimensions shown in millimetres

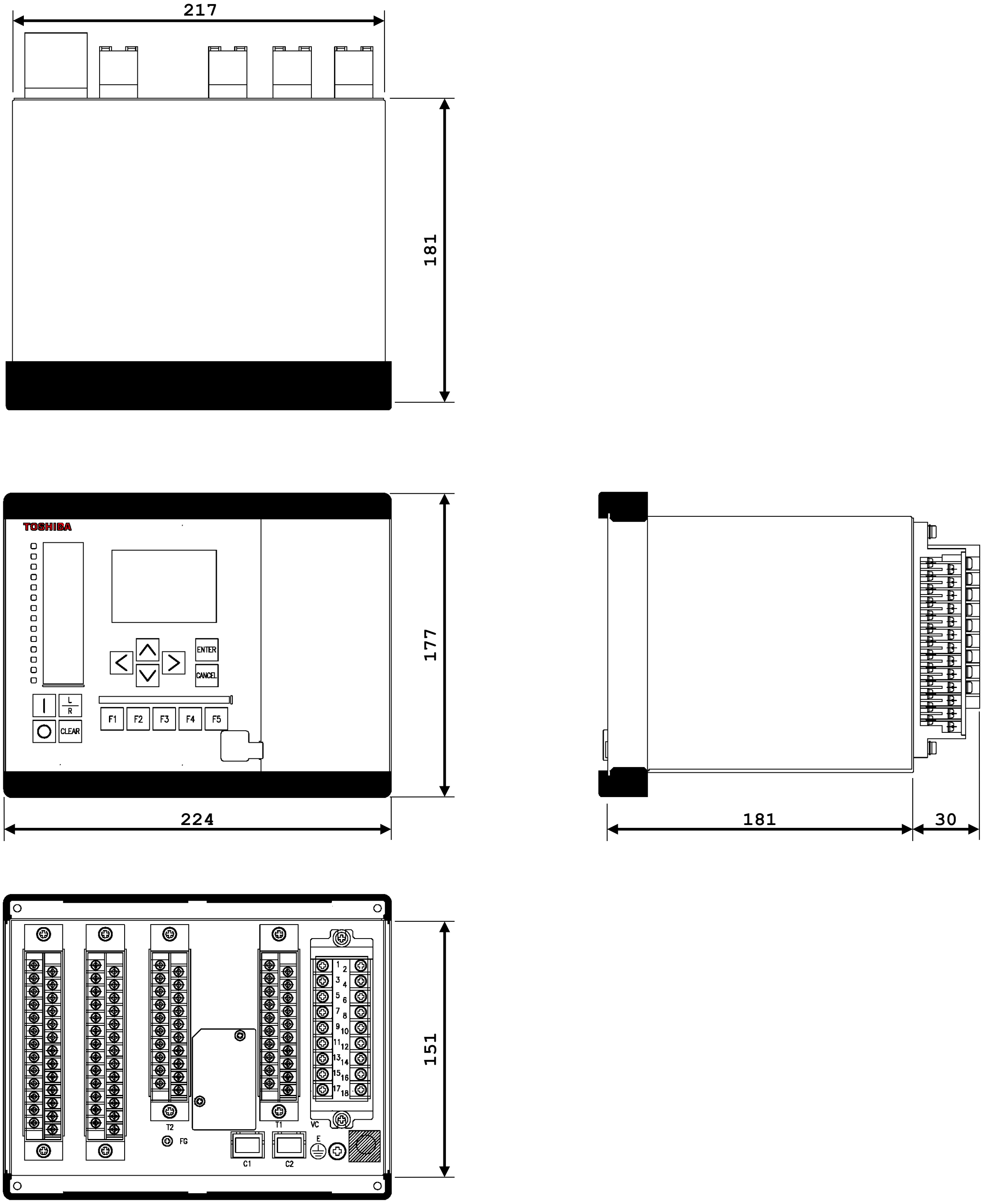
2. Panel cut out figure (1/3×19 inches)



Note: Dimensions shown in millimetres

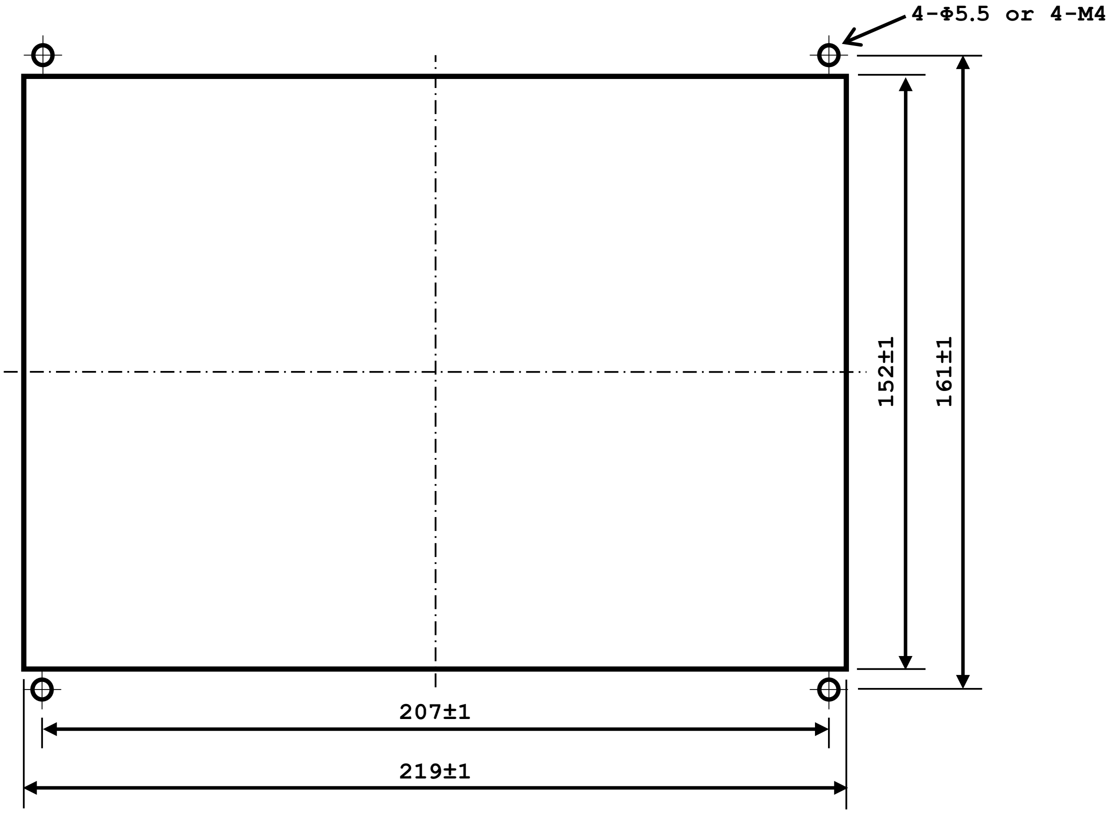
1/2 size case

1. Trihedral figure (1/2×19 inches)



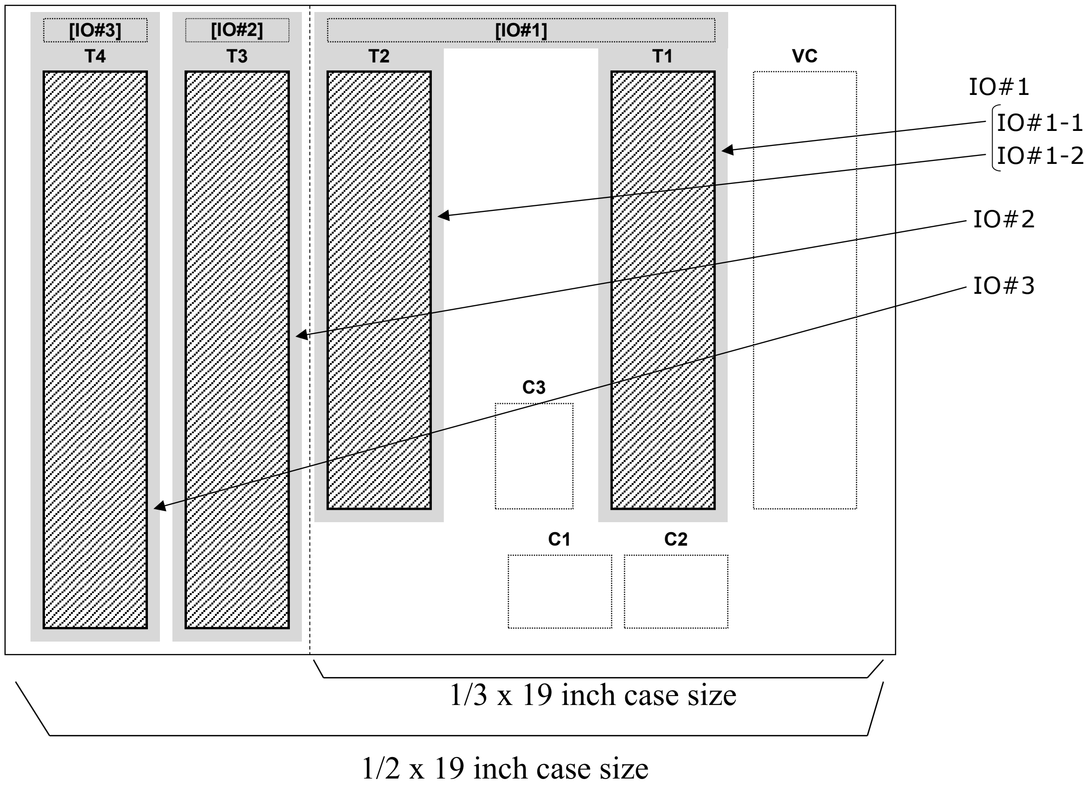
Note: Dimensions shown in millimetres

2. Panel cut out figure (1/2×19 inches)

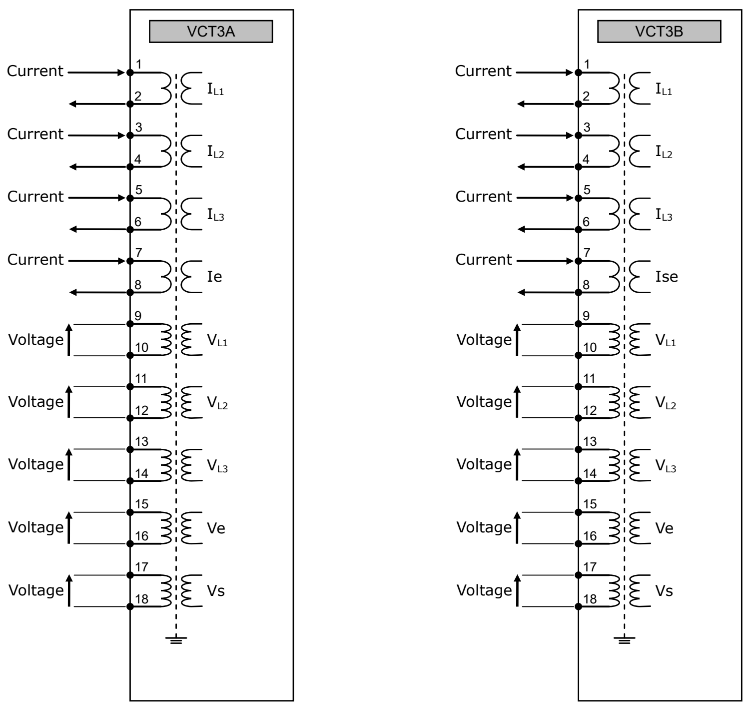


Note: Dimensions shown in millimetres

LOCATION of MODULES



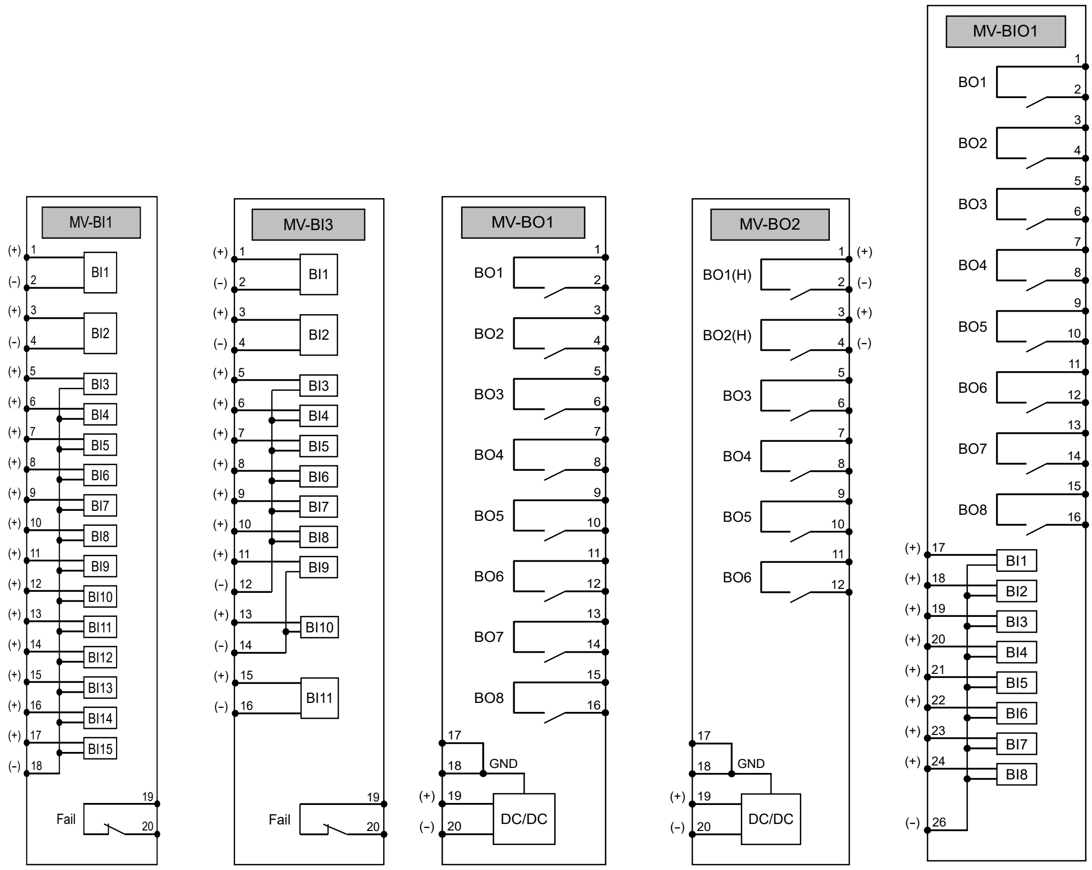
CONNECTIONS DIAGRAM (VCT)



BIO MODULES

BIO modules	Number of binary inputs		Number of binary outputs			DC / DC converter equipped	Note
	Independent -negative terminal type	Common -negative terminal type	Normal type	Hybrid type	For fail alarm		
MV-BI1	2	13	–	–	1	–	Used for IO#1-1
MV-BI3	3	8	–	–	1		Used for IO#1-1
MV-BO1	–	–	8	–	–	✓	Used for IO#1-2
MV-BO2	–	–	4	2	–	✓	Used for IO#1-2
MV-BIO1	–	8	8	–	–	–	Used for IO#2 or IO#3

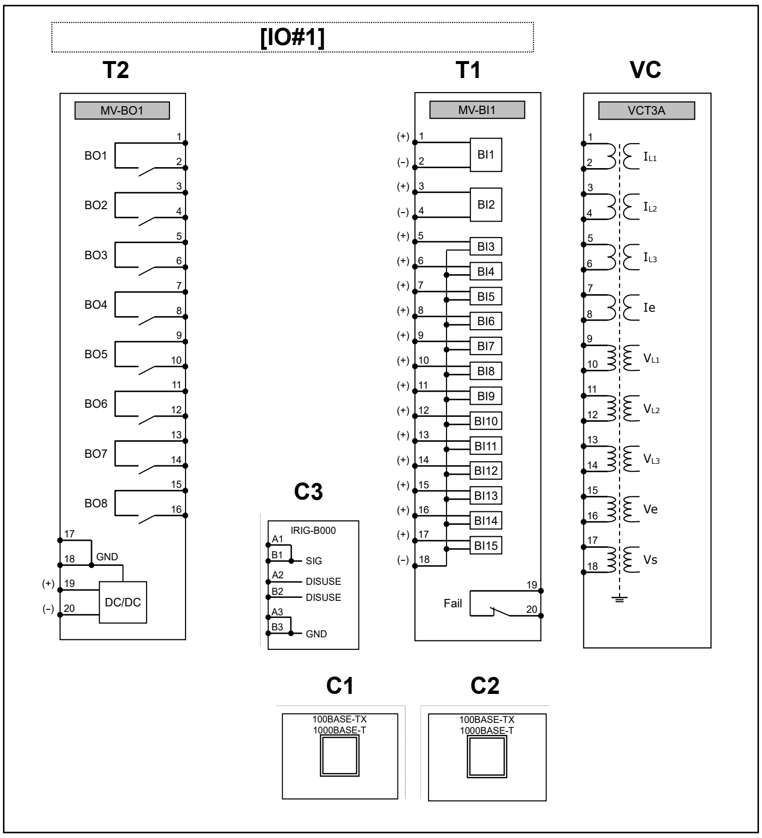
–: Not applicable



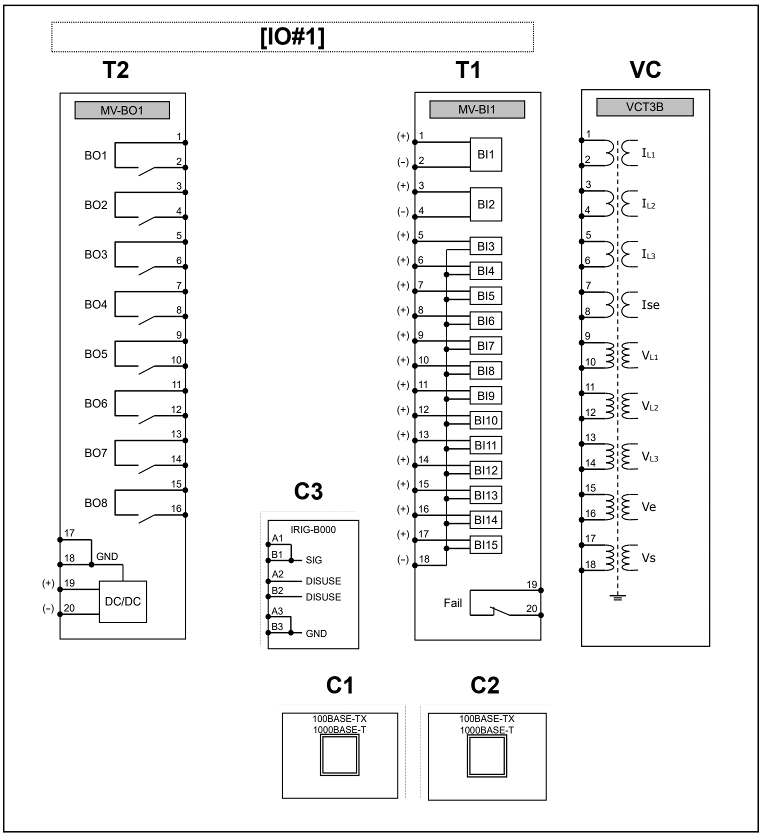
TYPICAL EXTERNAL CONNECTIONS

1/3 case size:

GRE200-11-1M1-00-LL-51-AA0 (VCT3A: 3CTs+EFCT+5VTs, MV-BI1: 15BIs, MV-BO1: 8BOs)



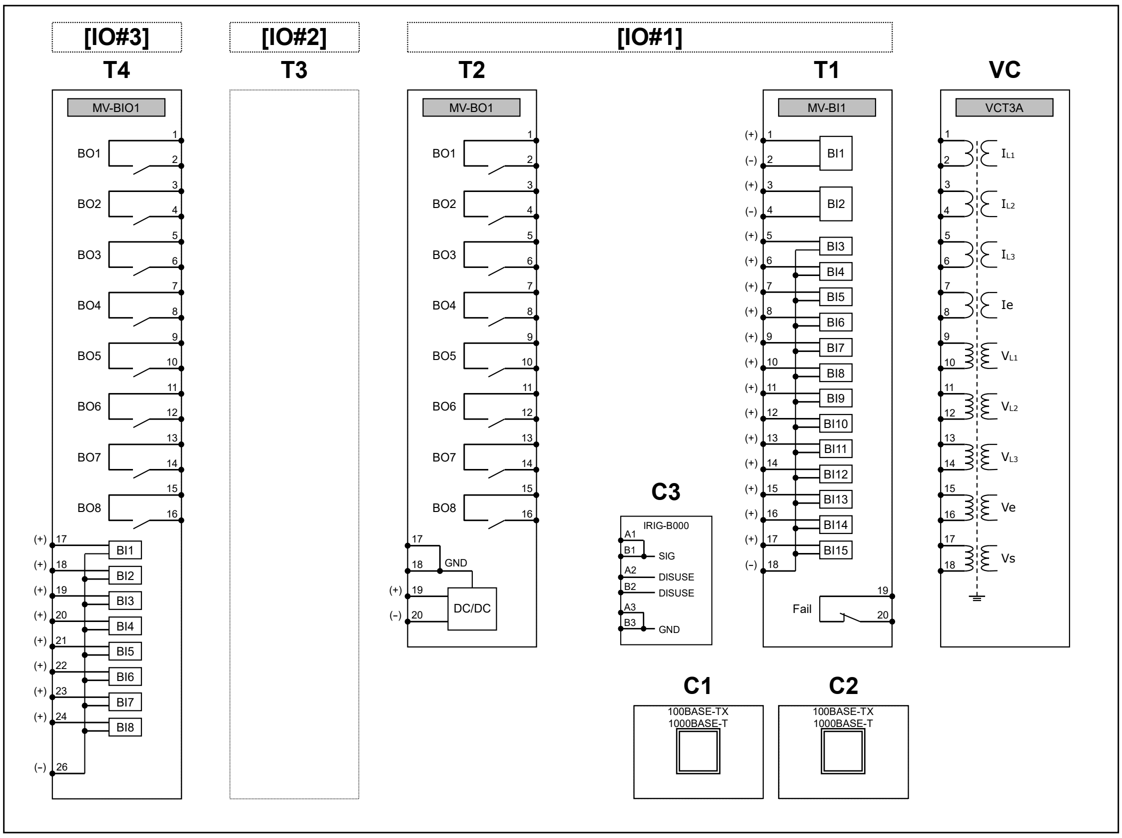
GRE200-21-1M1-00-LL-51-AA0 (VCT3B: 3CTs+SEFCT+5VTs, MV-BI1: 15BIs, MV-BO1: 8BOs)



1/2 case size:

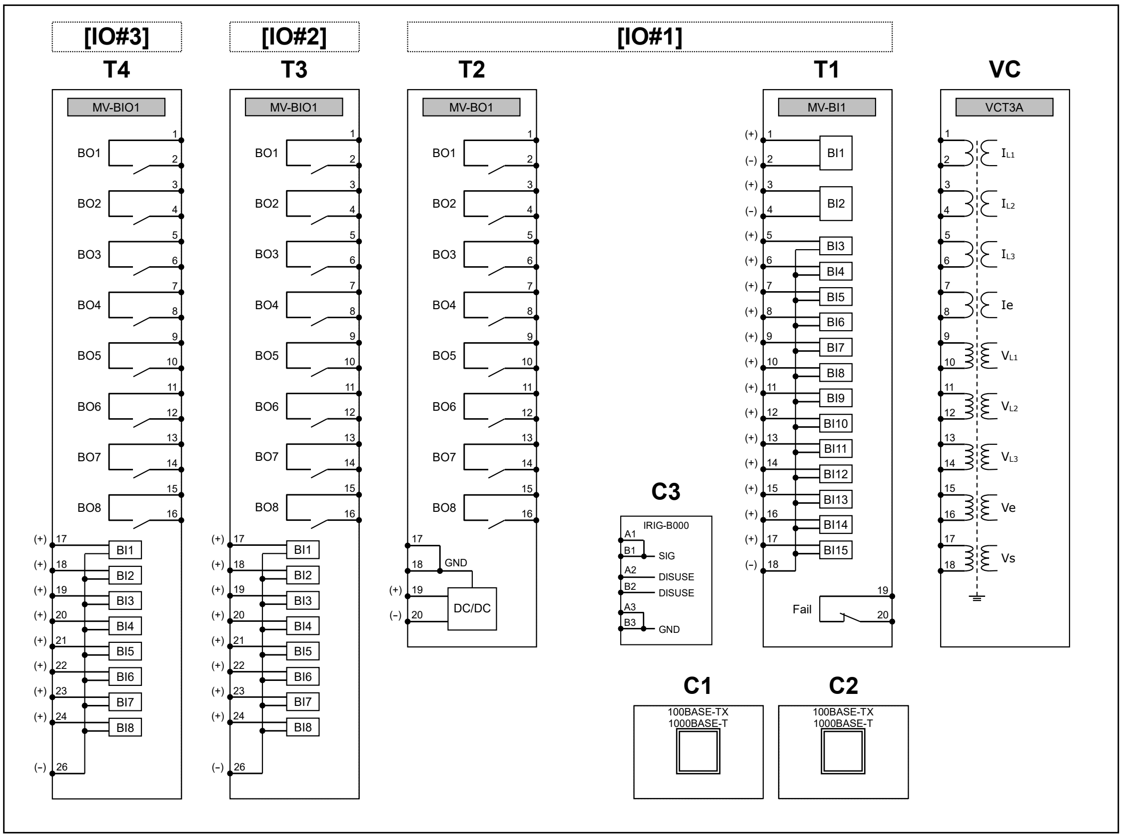
GRE200-11-2M2-00-LL-51-AA0

(VCT3A:4CTs+5VTs, MV-BI1:15BIs, MV-BO1:8BOs, MV-BIO1: 8BIs+8BOs)



GRE200-11-2M3-00-LL-51-AA0

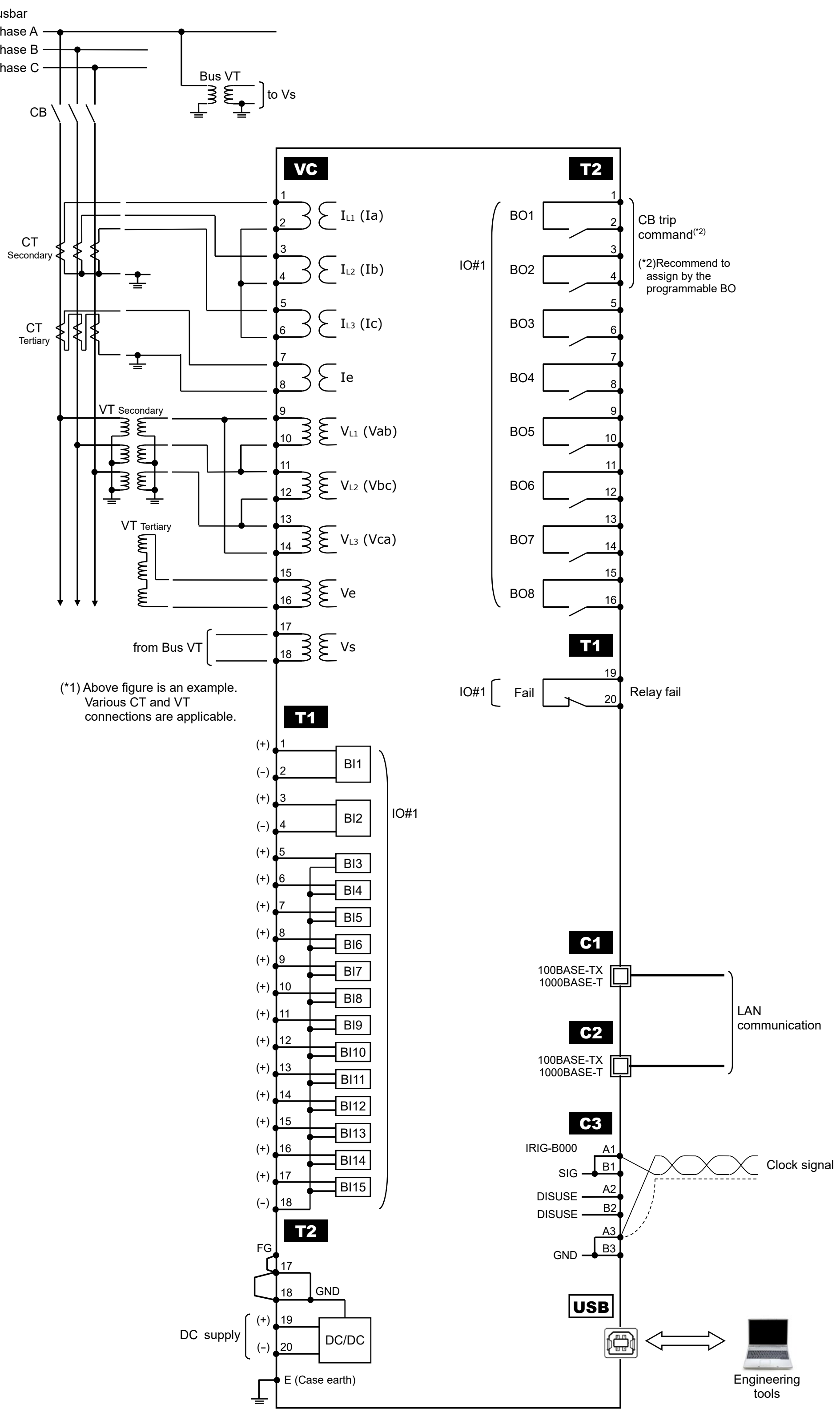
(VCT3A:4CTs+5VTs, MV-BI1:15BIs, MV-BO1:8BOs, 2xMV-BIO1: 16BIs+16BOs)



Typical external connection diagram

GRE200-11-1M1-00-LL-51-AA0

-1/3 case size
-VCT type: VCT3A (3×CTs + EFCT + 5×VTs)
-Binary IO modules: 1×BI1 (15×BIs) +1×BO1 (8 ×BOs)
-Network / Time Sync. module: 100Base-TX/1000Base-T



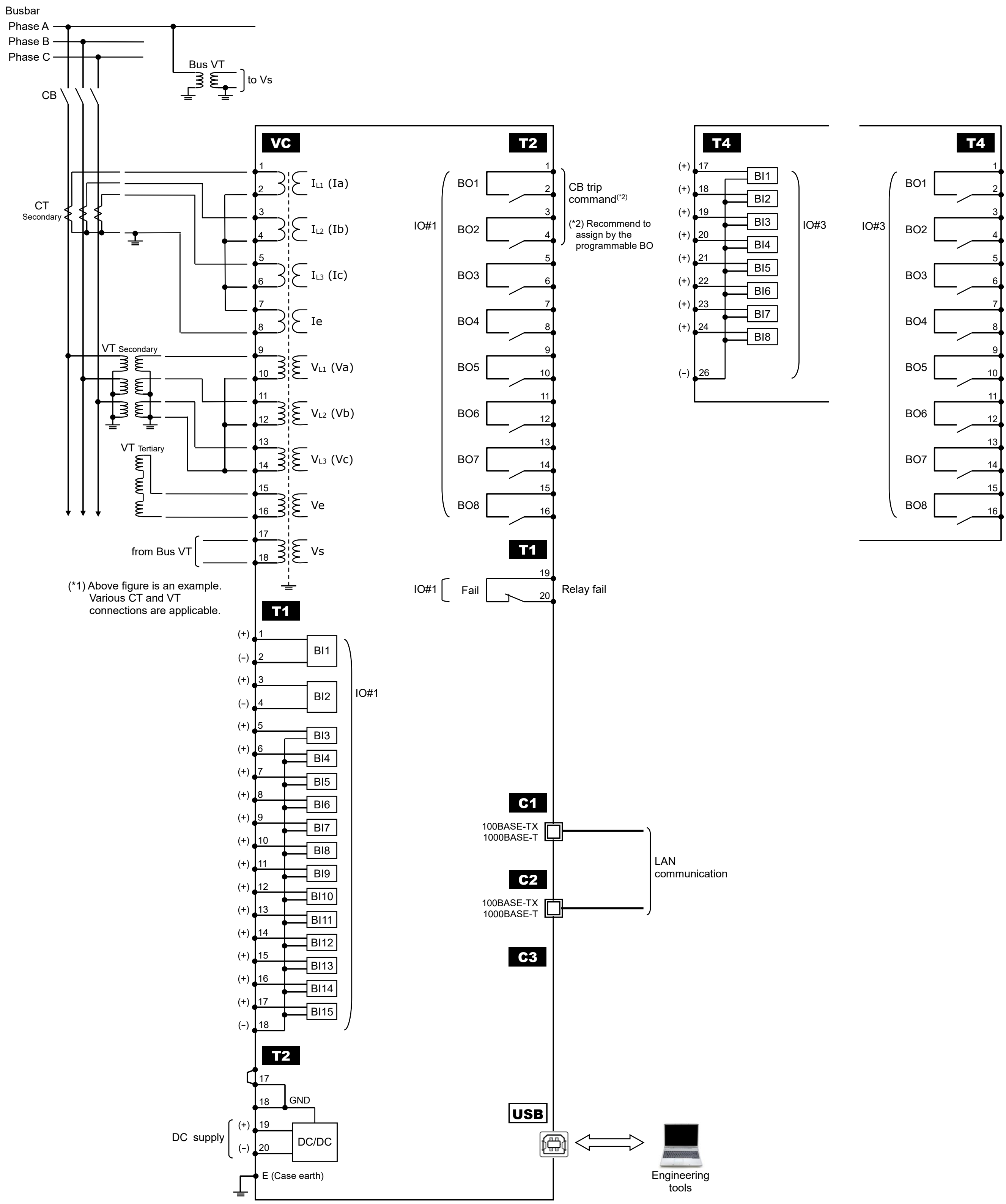
GRE200-11-2M2-00-LL-51-AA0

-1/2 case size

-VCT type: VCT3A (3 × CTs + EFCT + 5 × VTs)

-Binary IO modules: 1×BI1 (15 × BIs) + 1×BO1 (8 × BOs) + BIO1 (8 × BIs + 8 × BOs)

-Network / Time Sync. module: 100Base-TX/1000Base-T



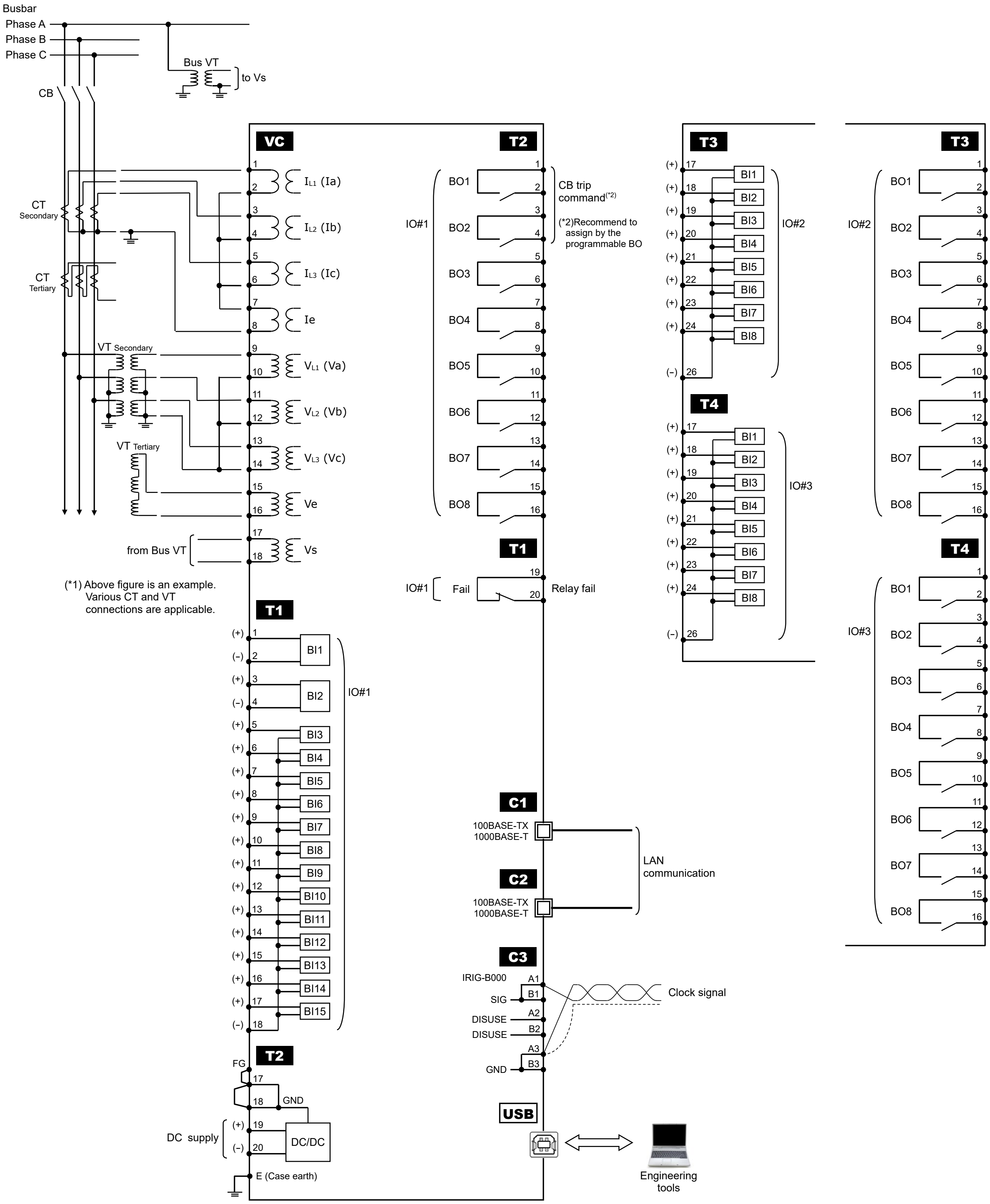
GRE200-11-2M3-00-LL-51-AA0

-1/2 case size

-VCT type: VCT3A (3 × CTs + EFCT + 5 × VTs)

-Binary IO modules: 1×BI1 (15 × BIs) + 1×BO1 (8 × BOs) + 2×BIO1 (16 × BIs + 16 × BOs)

-Network / Time Sync. module: 100Base-TX/1000Base-T



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