CSC-103-EB-D

Line Differential Protection IED

Product Guide

BEIJING SIFANG AUTOMATION CO., LTD.

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Note: the company reserves the right to amend the instruction. If equipment does not agree with the instruction at anywhere, please contact our company in time. We will provide you with corresponding service.

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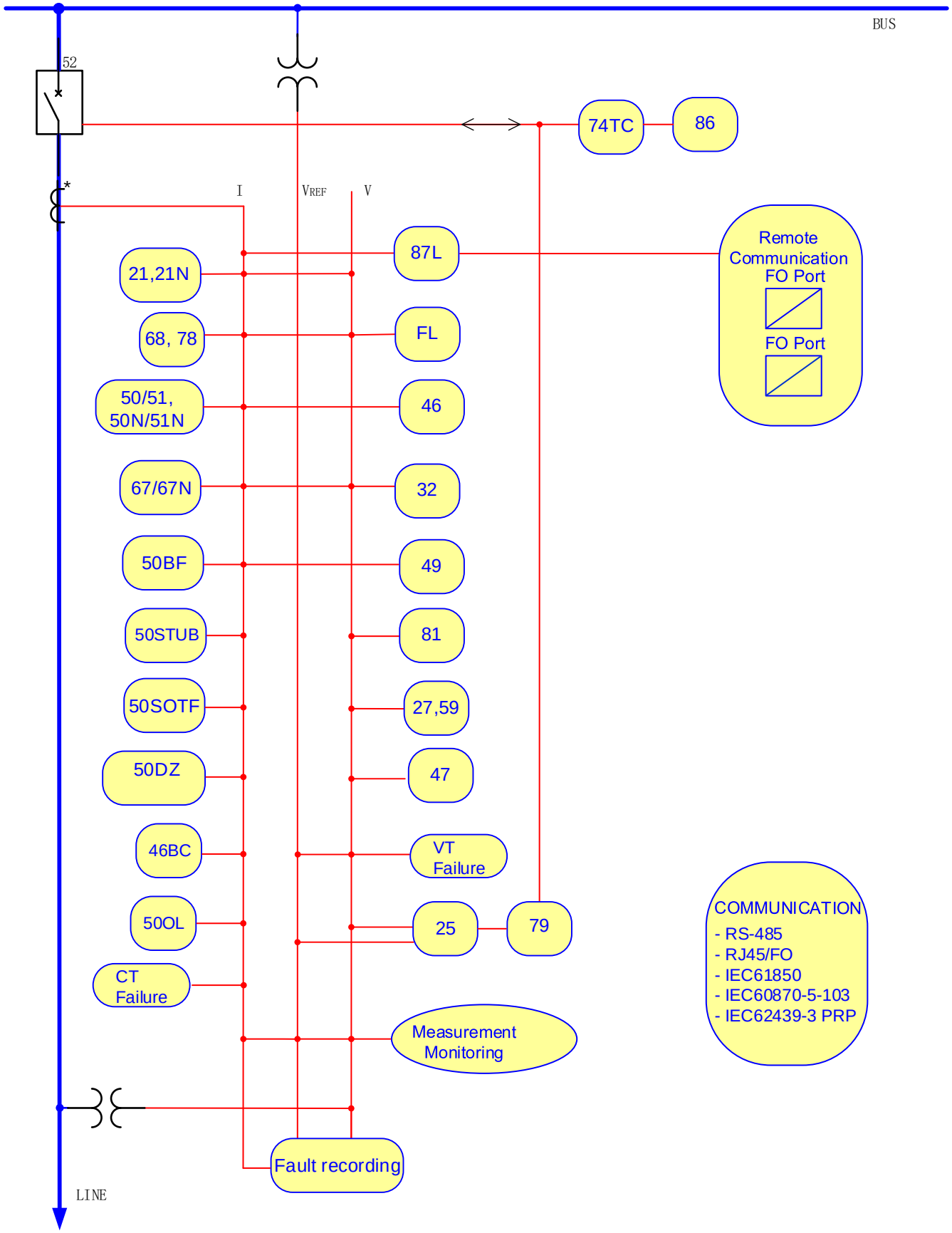
CSC-103 Line Differential Protection IED

CSC-103-EB-D is selective, reliable and high speed protection IED for line or feeder in sub-transmission grid and distribution grid, with powerful capabilities to cover following applications:

- For 35kV to 110kV transmission lines, W/O parallel lines, heavy load lines, extreme short line;
- Up to 3 terminals.
- Fully proven protection functions library;
- Customized protection function scheme, all in one or main protection unit only;
- Mixable Binary inputs & output relays / GOOSE inputs or outputs;
- Robust hardware with excellent EMC performance and IP54 protection under -40℃ to +70℃ operating temperature;

Application



Function

Function	ANSI Code	Qty.	Description
Line differential protection	87L	1	3 differential protection elements with different principle
Distance protection	21/21N	1	3 zone Polygonal characteristic Load encroachment Power swing blocking
Directional overcurrent protection	50,51,67	1	4 stages; Forward/reverse/non-directional; Definite time/ Inverse time characteristic; Inrush block
Directional earth fault protection	50N, 51N, 67N	1	4 stages; Forward/reverse/non-directional; Definite time/ Inverse time characteristic; 3 phase current inputs or single current input
Negative sequence overcurrent protection	46	1	4 stages; Definite time/ Inverse time characteristic
Undercurrent protection	37	1	1 stages; Definite time
Thermal overload	49	1	2 stages for alarm; 1 stage for tripping
Overvoltage	59	1	4 stages; Definite time / Inverse time characteristic;
Undervoltage	27	1	4 stages; Definite time / Inverse time characteristic;
Negative sequence overvoltage	47	1	4 stages; Definite time / Inverse time characteristic
Overpower protection	32	1	2 stages
Under frequency protection	81U	1	4 stages;
Over frequency protection	81O	1	4 stages;
Frequency change of rate protection	81DF	1	4 stages;
Breaker failure protection	50BF	1	2 stages; DTT in stage 2;
Dead zone protection	50DZ	1	1 stage; DTT;
Broken conductor detection	46BC	1	1 stage;
Synchro-check & Energizing check	25	1	
Auto-reclosing	79	2	4 shots;
Stub-bus overcurrent	50STUB	1	1 stage;
Switch-on-to-fault protection	50SOFT	1	1 stage;
Simple busbar protection scheme	50BB	1	
Load shedding by undervoltage	LS-27	1	
Load shedding by overload	LS-50	1	

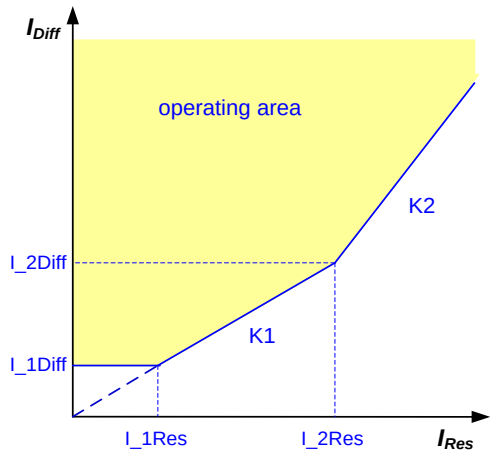
Function

Cooling load startup protection		1	
CT secondary circuit supervision		1	Enable/ disable blocking differential protection
VT secondary circuit supervision	97FF	1	
Disturbance recording		1	Max. 5s in 1 recording, up to 32 recordings;
Trip circuit supervision	74TC	1	On TCS module
Programmable logic		1	
Measurement		1	V, I, F, COSΦ, P, Q, Wp, Wq
Automation		1	

Note 1: the number in "Qty." column is the maximum quantity of function module that can be offered.

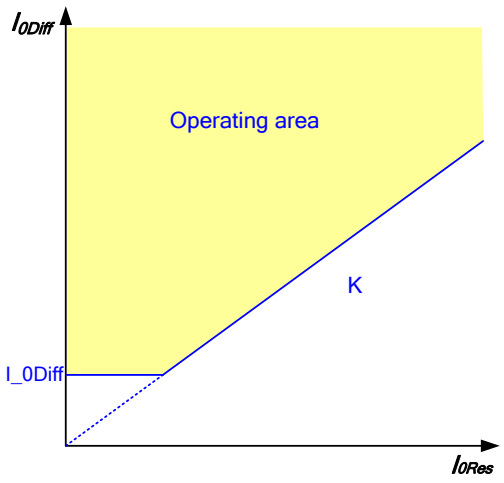
87L Line differential protection

- For HV and MV lines, and up to 3 terminals line
- 2 differential protection elements, which coordinate with each other to achieve high sensitivity and reliability with capacitive charging-current compensation and strictly phase selection during various system
  - Phase segregated differential protection



  - Zero-sequence current differential protection function

As a complement to phase segregated differential protection, the zero sequence current differential protection is used to enhance the protection sensitivity on the earth fault through high arc resistance. It always clears the fault after a delay time.



- CT saturation detection

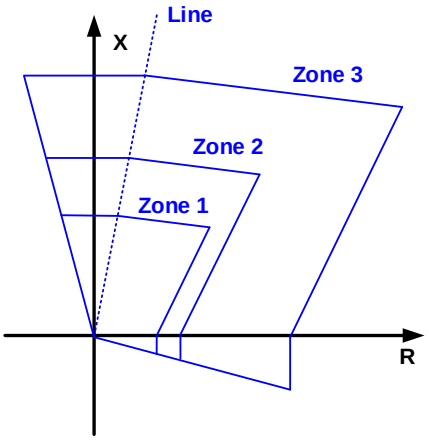
Based on current waveform principle, the

protection can discriminate the CT saturation condition. Once under this condition, the protection will use a new differential and restraint characteristic shown in the below to guarantee the security of the protection.

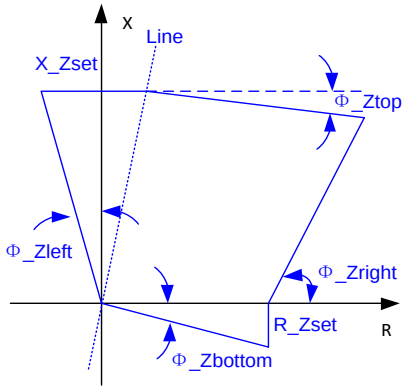
- Differential protection CT failure detection
- Automatic CT ratio compensation;
- Long-term Differential current supervision
- Up to 8 binary inputs for remote transmission command and one binary input for remote tripping command

21 Distance protection

- Full scheme protection with all phase to phase faults and phase to earth fault loops independently for each zones;
- 3 zones



- Polygon characteristic



- Power swing blocking logic, which guarantee no wrong operating during power swing, and guarantee fast operating while fault during power swing.

50BF CB failure protection

- Two trip stages (local CB and surrounding breaker tripping)
- Transfer trip command to the remote line end in stage 2
- Internal/ external initiation
- Single/ three phase CBF initiation
- Settable CB Aux contacts checking

Function

- Current criteria checking (including phase current, zero and negative sequence current)

25 Synchro-check and energizing check

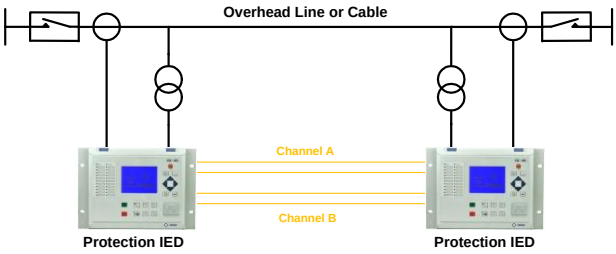
- Available for automatic reclosing (internally or externally request) and manual closing
- Based on voltage/ angle/ frequency difference
- Synchro-check modes:
  - Synchronization check
  - Energizing check, and synch-check if energizing check failure
  - Override
- Energizing check modes:
  - Dead line and dead bus
  - Dead line and live bus
  - Live line and dead bus
- Synchro-check reference voltage supervision

79 Auto-reclosing

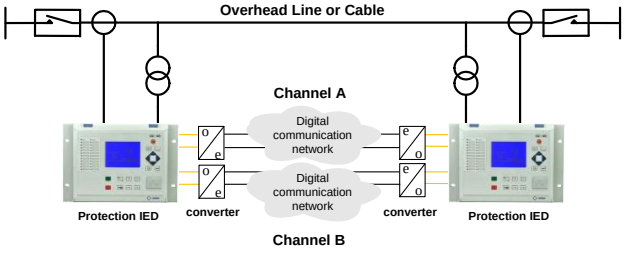
- Up to 2 AR modules to support 2 CBs in one IED
- 4 shots automatic reclosing (selectable)
- Individually settable dead time for three phase AR and single phase AR for each shot
- Internal/ external AR initiation
- Single/ three phase AR operation
- CB position ready supervision
- CB Aux. contact supervision
- Cooperation with internal synch-check and energizing check function for reclosing command

Communication

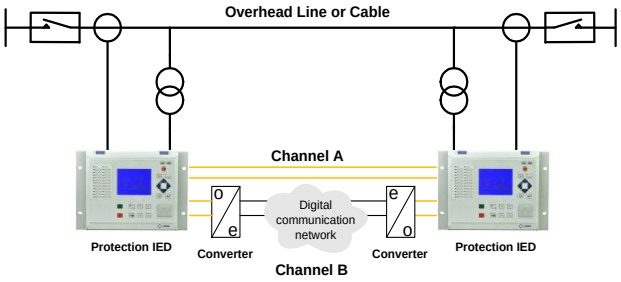
- Up to 2 fiber-optical remote communication ports, work in the redundant transmission route, with advantage of no time-delay channel switch in case of the primary channel broken
- Flexible combinations of the 4 type communication modes with 2 channels
  - Dual directly single mode fiber-optical cable connection mode, duplex LC plug



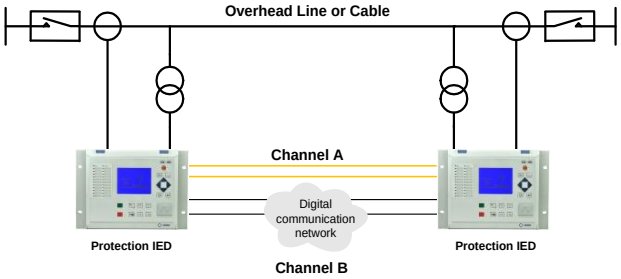
  - Single mode fiber-optical cable connection through dual communication converter with G.703 or G.703E1 interface via SDH/PDH



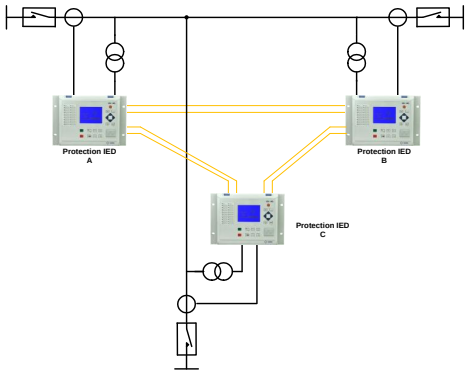
  - Single mode fiber-optical cable connection, 1 direct connection and 1 converter connection



  - 1 single mode fiber-optical cable direct connection and 1 multimode fiber-optical cable connection, LC plug with IEEE C37.94 interface via SDH/PDH

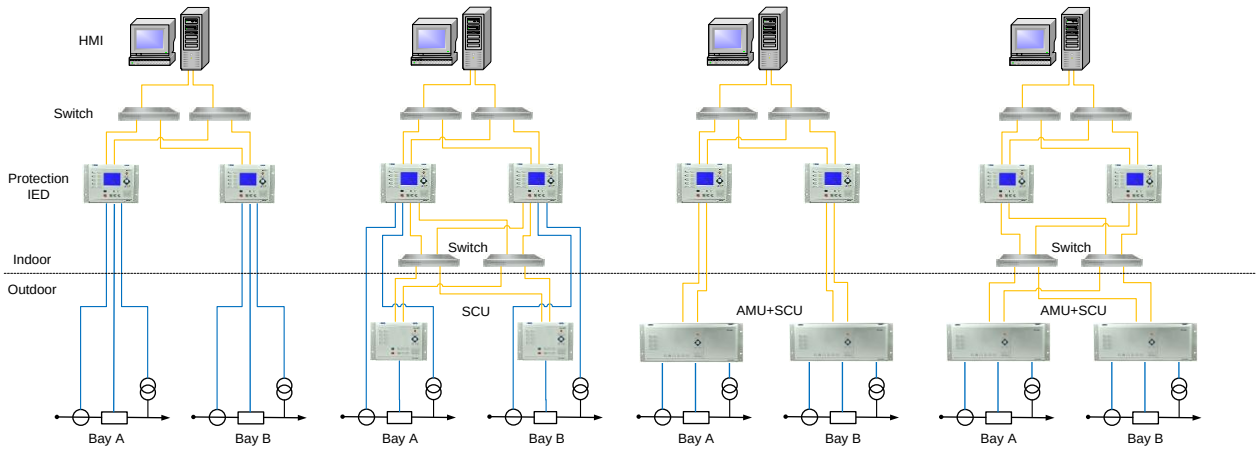


- The distance options of directly single mode fiber-optical cable connection mode:
  - < 40 km;
  - 40 – 60 km;
- Communication for “T” connection line



Automation

- Support SV, GOOSE service of process layer application in accordance with IEC61850-8-1, -9-2, -9-2LE,
- Support MMS, GOOSE service of station layer and bay layer application in accordance with IEC61850-8-1,
- Seamless communication by PRP.
- Adaption to the existing automation system with 2 or 3 Ethernet ports or 2 serial communication ports RS-485 in one module
- Support all main protocols, include:
  - IEC 61850-8-1
  - DNP 3.0;
  - IEC 62439-3 PRP
  - IEC 60870-5-103 serial;
  - MODBUS
- Support several time synchronizing way, include:
  - IRIG-B modulated electrical/ optical;
  - Pulse;
  - SNTP;
  - IEEE 1588;
- Proven technology from thousands of operated digital substations;



Station layer: MMS/GOOSE; PRP;
Bay layer: GOOSE; PRP;

Station layer: MMS/GOOSE; PRP;
Bay layer: GOOSE; PRP;
Process layer: Process bus, GOOSE; PRP;

Station layer: MMS/GOOSE; PRP;
Bay layer: GOOSE; PRP;
Process layer: SV/GOOSE; PRP;

Station layer: MMS/GOOSE; PRP;
Bay layer: GOOSE; PRP;
Process layer: Process bus, SV/GOOSE; PRP;

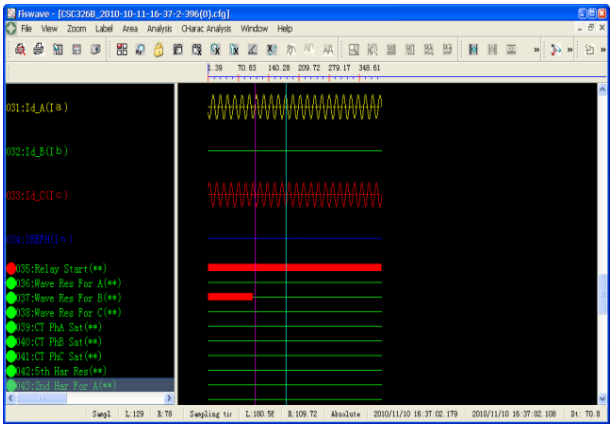
AESP tools

AESP tools is the user-friendly software tool sets. AESP covers all works for the whole life cycle of protection IEDs, include,

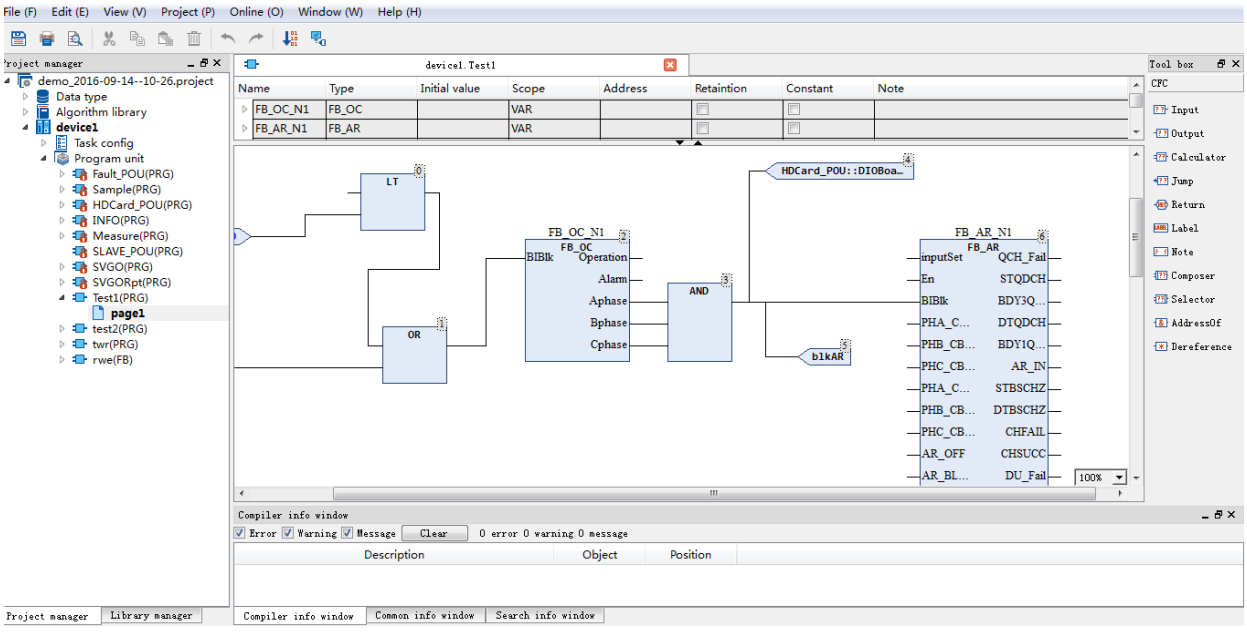
- Setting and parameter
- Disturbance analysis by Fisewave
- Monitoring
- Logic programming by Nuclide
- IED configuration by IO master;
- Single line diagram painter;
- IEC 61850 system engineering manager

Its features are as follows:

- Oriented to IEDs management of whole substation with freely configurable hierarchies based on the substation topology in real project.
- Intelligent validity checks and shadow avoid incorrect input when setting and programming
- Fault analysis with fault records in curves, circle diagrams, vector diagrams, harmonic bar, and protection characteristic diagram graphically and precise data in pointed instant.



- With integrated logic, the user can set, via a graphic interface, specific functions for the automation of switchgear or substation.
- Password-protected access for different operation and different roles;

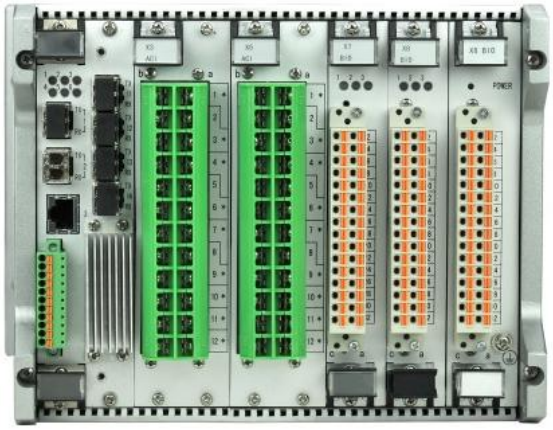


Hardware

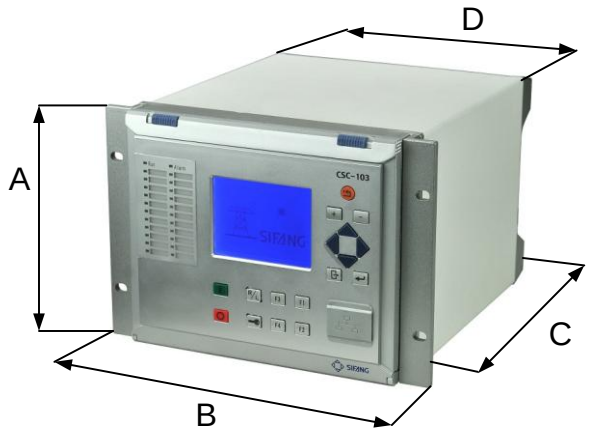
- Up to 10 AC Current Inputs and 8 Voltage Inputs, 1A/ 5A settable;
- Up to 45 Binary Inputs, include independent BIs;
- Up to 28 Output relays, with 2 switchable NO/NC contacts;
- Up to 3 Ethernet ports;
- Up to 2 RS-485 ports;
- 1 IRIG-B / Pulse time synchronization port;
- 1 RJ45 front test port
- 22 programmable LED
- Up to 4 customer defined function key;
- 4U 1/2 19” case;

Dimension of the 4U 19” case

Front view of the 4U 1/2 19” case



Rear view of the 4U 1/2 19” case



A	177
B	259.2
C	286
D	226
Unit	mm

Dimension of the 4U 1/2 19” case

Specification

AC current measurement

Item	Data
Rated current I_r IEC60255-1	1/5 A, settable
Operating range of protection CT	(0 ~ 100) I_r
Measuring range of protection CT	(0.05 ~ 40) I_r
Reading accuracy for protection CT	±2.5% I_r or 0.02I_r, at (0.05~40) I_r
Thermal withstand of protection CT IEC60255-27	4 I_r Continuously; 30 I_r for 30s 100 I_r for 1s
Range for measuring CT	(0.01 ~ 2) I_r
Reading accuracy for measuring CT	±0.5% I_r, at I>I_r ±0.5% I_r, at I≤I_r
Thermal overload capacity of measuring CT IEC60255-27	4 I_r Continuously; 30 I_r for 30s 100 I_r for 1s
Measurement range for high sensitive CT	0.005A ~ 1.2A
Reading accuracy for high sensitive CT	±0.5%I_r, at I>10%I_r ±0.5%I_r, at I≤10%I_r
Thermal withstand of high sensitive CT IEC60255-27	3A continuously 100A for 1s
Burden for current (per phase)	≤0.15VA at I_r=1A; ≤0.3VA at I_r=5A
Dynamic thermal overload capacity	250 I_r for 1.5 cycle

AC voltage measurement

Item	Data
Rated voltage $V_{r.ph-ph}$ IEC60255-1	100/110V_{ac}, settable;
Measuring range of VT V_{ph-e}	0.4V ~ 180V
Reading accuracy for VT V_{ph-ph}	＜ ±2.5% setting or 1V
Burden for voltage IEC60255-1	≤ 0.05VA, at $V_{r.\ ph-ph}$ = 110V
Thermal withstand V_{ph-e} IEC60255-27	200V, continuously; 400V for 60s.

Other measurement

Item	Data
Rated frequency	50/60Hz, settable
Measuring range of frequency	(0.9~1.1) F_r
Reading accuracy of frequency	±0.02 Hz
Reading accuracy of angle	±1°, at rated AC voltage and AC current
Reading accuracy of active power and reactive power	1%, at rated AC voltage and AC current

Binary inputs

Item	Data
Rated voltage $V_{r.aux}$ IEC60255-1	110/125/220/250 V_{dc}, settable; or 24/48V_{dc} settable;
Max. permissible voltage IEC60255-1	300V, at $V_{r.aux}$=110/125/220/250 V_{dc}; 62V, at $V_{r.aux}$ =24/48 V_{dc};
Operating threshold IEC60255-1	≥70% $V_{r.aux}$, guarantee operating ≤55% $V_{r.aux}$, guarantee not to operating
Pickup time	Approx. 1ms, intrinsic
Dropout time	Approx. 2ms, intrinsic
Burden for binary input IEC60255-1	≤0.25 W, at $V_{r.aux}$=110V_{dc} ≤0.5 W, at $V_{r.aux}$=220V_{dc}

Output relay

Item	Data
Rated contact voltage IEC60255-1	24/48/110/125/220/250V_{dc} 100/220V_{ac}
Maximum contact voltage IEC60255-1	250$V_{ac/dc}$
Mechanical endurance IEC60255-1	Unload, 10000 times Load，making, ≥ 1000 times

Specification

	Load，breaking, ≥ 1000 times
Current carrying capacity IEC60255-1	General relay: 5A continuous, 30A, 200ms on,15s off Power relay: 10A continuous, 30A, 200ms on,15s off
Making capacity IEC60255-1	General relay: 1000W, at $V_{r.aux}$=220V_{dc} L/R=40ms Power relay: 1250W, at $V_{r.aux}$=220V_{dc} L/R=40ms
Breaking capacity IEC60255-1	General relay: 30W, at $V_{r.aux}$=220V_{dc}, L/R=40ms; 0.4A, at $V_{r.aux}$=110V_{dc},, L/R≤40ms; Power relay: 55W, at $V_{r.aux}$=220V_{dc}, L/R=40ms; 0.45A, at $V_{r.aux}$=110V_{dc}, L/R≤40ms;
Contact insulation test (AC dielectric voltage) IEC60255-1	2kV_{ac}, 1min
Pick up time IEC60255-1	≤5ms
Drop off time IEC60255-1	≤10ms

Auxiliary power

Item	Data
Rated voltage $V_{r.aux}$ IEC60255-1	110V to 250$V_{dc/ac}$ 24/48V_{dc}
Input voltage range IEC60255-1	(0.8~1.2) $V_{r.aux}$
Burden for power supply unit IEC60255-1	≤20W, at quiescent ≤30W, at 50% loaded
Insulation test (AC dielectric voltage) IEC60255-1	2kV_{ac}, 1min

Ethernet communication

Item	Data
Max. ports number	3
Electrical Ethernet port type	RJ45
Maximum transmission distance of Ethernet cable	100M
Optical Ethernet port type	LC
Fiber optic cable type	Multi-mode
Optic wavelength	1310 nm
Optic received sensitivity	-33 dBm
Emitter electric level	>-20 dBm;
Maximum transmission distance of optical fiber	2kM 62.5/125μm MMF
Transmission rate for IEC61850	100Mbit/s
Transmission rate for DNP 3.0	100Mbit/s

Serial communication

Item	Data
Number	2
Port type	RS-485
Maximum transmission distance	1.0km
Voltage withstand test	500V earthing AC voltage
Transmission rate for IEC60870-5-103	Default setting 9600 bps; Minimum: 1200bps; maximum: 19200bps

Time synchronization

Item	Data
Synchronization mode	SNTP IRIG-B time sync Minute or second Pulse IEEE 1588
IRIG-B signal format	IRIG-B000
IRIG-B Port type	Twisted-pair connection or multi-mode optical fiber

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Specification

IRIG-B signal voltage level	Differential signal input/ modulated

Inter-substation communication

Item	Data
Ports number	2
Fiber optic cable type	Single-mode or multi-mode
Optic wavelength	1310 nm, single-mode 850 nm, multi-mode
Optic received sensitivity	-34 dBm
Emitter electric level	>-11 dBm, at length <40 kM >-4 dBm, at length 40~60 kM
Fiber optic connector type	LC
Data transmission rate	64 kbit/s, G703 2,048 kbit/s, G703-E1 N*64kbps, N=1~12, C37.94
Max. transmission distance	60 kM 62.5/125μm MMF

Product safety test

Item	Data
Over voltage category IEC60255-27	Category III
Pollution degree IEC60255-27	Degree 2
Insulation type IEC60255-27	Basic insulation
Degree of protection (IP) IEC60255-27 IEC60529	Front plate: IP54 Side plate:IP52 Rear plate: IP30
Power frequency high voltage withstand test IEC60255-5 EN60255-5 ANSI/IEEE C37.90 GB/T15145-2001 DL/T478-2013	2kV, 50Hz, at rated voltage > 63V, Tested on: Auxiliary power supply port; Enclosure port; Input and output ports; Functional earth port; 500V, 50Hz, at rated voltage ≤63V,
	Tested on: Communication port;
Impulse voltage IEC60255-1 IEC60255-27 EN60255-5 ANSI/IEEE C37.90 GB/T15145-2001 DL/T478-2013	5kV, at rated voltage>60V, Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports; Functional earth ports; 1kV, at rated voltage≤60V, tested on: CPU ports;
Insulation resistance IEC60255-1 IEC60255-27 EN60255-5 ANSI/IEEE C37.90 GB/T15145-2001 DL/T478-2013	≥550MΩ, 500V_{dc}
Protective bonding resistance IEC60255-27	≤0.1Ω
Fire withstand/flammability IEC60255-27	Class V0

EMC test

Item	Data
Electrostatic discharge immunity test IEC60255-26 IEC61000-4-2	Criteria A; Level IV; ±6kV contact discharge; ±8kV air gap discharge;
Radiated interference radio-frequency electromagnetic field immunity test IEC60255-26 IEC61000-4-3	Criteria A; Class IV; 10 V/m, 80%,AM (1 kHz) Frequency sweep: 80 MHz ~1 GHz; 1.4 GHz ~2.7 GHz spot frequencies (MHz): 80; 160; 380; 450; 900; 1850; 2150.
Electrical fast	Class A

Specification

transient/burst immunity test IEC60255-26 IEC61000-4-4 ANSI/IEEE C37.90	4kV peak voltage; Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports; Functional earth port; 2kV peak voltage; Tested on: Communication port;
Surge (impact) immunity test IEC60255-26 IEC61000-4-5	Class A，Level IV 4.0kV, Line-to-earth; 2.0kV, Line-to-line; Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports; Functional earth port; 4.0kV, Line-to-earth; Tested on: Communication ports;
Test for immunity to conducted disturbances, induced by radio-frequency fields IEC60255-26 IEC61000-4-6	10 V/m, 80% AM (1 kHz) Frequency sweep: 150kHz–80MHz Spot frequencies: 27MHz and 68MHz; Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports; Functional earth port; Communication ports;
Power frequency magnetic field immunity test IEC60255-26 IEC61000-4-8	Criteria A 100 A/m Continuous; Criteria B 1000 A/m, 3s;
Power frequency	Zone A

immunity test IEC60255-26 IEC61000-4-16	300V, CM; 150V, DM; Test on: Binary input ports;
Slow damped oscillatory wave immunity test (1MHz) IEC60255-26 IEC61000-4-18 ANSI/IEEE C37.90	Class III 2.5 kV CM ; 1 kV DM; Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports; 1 kV CM; 0 kV DM; Tested on: Communication ports
Fast damped oscillatory wave immunity test IEC61000-4-18	Level 4 4 kV, at 3MHz, 10MHz, 30MHz. Tested on: Auxiliary power supply port; Current and voltage transformer ports; Input and output ports;
Pulse magnetic field immunity test IEC61000-4-9	Class V 1000A/m
Damped oscillation magnetic field immunity test IEC61000-4-10	Class V 100A/m
Conducted emission IEC60255-1 IEC60255-26 CISPR 11, CISPR 22	Class A; 0.15MHz to 0.50MHz; 0.50MHz to 30MHz; Tested on: Auxiliary power supply port; Communication ports
Radiated emission IEC 60255-1 IEC60255-26 CISPR 11, CISPR 22	Class A; 30MHz to 230MHz; 230MHz to 1GHz; Tested on: Auxiliary power supply port;
Voltage dips and voltage interruptions on DC	Criteria A 150 ms at 0% residual

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power supply IEC 60255-26 IEC 61000-4-11 IEC 61000-4-29	voltage; 200 ms at 40% residual voltage; 500 ms at 70% residual voltage; 5s at 0% residual voltage
Voltage dips and voltage interruption on AC power supply IEC 60255-26 IEC 61000-4-11 IEC 61000-4-29	Criteria A At 50 Hz: 5 cycles at 0% residual voltage; 10 cycles at 40% residual voltage,; 25 cycles at 70% residual voltage; 250 cycles at 0% residual voltage
Voltage ripple on DC power supply IEC 60255-26 IEC 61000-4-17	15% at twice rated frequency;
Gradual shutdown/ start-up for power supply IEC60255-26	5 min power off 42V_{DC} at 60 s shut down ramp 78V_{DC} at 60 s start-up ramp
Reversal of DC power supply IEC 60255-27	60 s

Mechanical test

Item	Data
Vibration response test IEC 60255-21-1 EN 60255-21-1	Class 1 Relay energized 10-60 Hz: ± 0.035 mm amplitude 60-150 Hz: 0,5 g acceleration Frequency sweep: 1 sweep cycle in each axis, 3 axis
Vibration endurance test IEC 60255-21-1 EN 60255-21-1	Class 1 Relay non-energized 10 to 150 Hz: 1 g acceleration 20 sweep cycles in each axis, 3 axis
Shock response test	Class 1
IEC 60255-21-2 EN 60255-21-2	Relay energized Duration 11 ms : 5 g acceleration 6 shocks in each axis, 3 axis
Shock withstand test IEC 60255-21-2 EN 60255-21-2	Class 1 Relay non-energized Duration 11 ms : 15 g acceleration 6 shocks in each axis, 3 axis
Bump test IEC 60255-21-2 EN 60255-21-2	Class 1 Relay non-energized Duration 16 ms : 10 g acceleration 2000 bumps in each axis, 3 axis
Sinusoidal sweep seismic test IEC 60255-21-3	Class 1 Relay energized 1-8 Hz: ± 3.5 mm amplitude (horizontal axis) 1-8 Hz: ± 1.5 mm amplitude (vertical axis) 8-35 Hz: 1g acceleration (horizontal axis) 8-35 Hz: 0,5g acceleration (vertical axis) Frequency sweep: 1 sweep cycle in each axis, 3 axis

Environmental test

Item	Data
Cold test - operational IEC 60255-27 IEC 60068-2-1	-40°C, 96 hours, relay energized
Cold test – Storage IEC 60255-27 IEC 60068-2-1	-40°C, 96 hours, relay non-energized
Dry heat test – operational IEC 60255-27 IEC 60068-2-2	+70°C, 96 hours, relay energized
Dry heat test – Storage IEC 60255-27	+70°C, 96 hours, relay non-energized

Specification

IEC 60068-2-2	
Change of temperature IEC 60255-27 IEC 60068-2-14	-40°C / +70°C, 6 cycles relay energized
Damp heat steady-state test IEC 60255-27 IEC 60068-2-78	+40°C, 93% r.h. 10 days, relay energized
Cyclic temperature with humidity test	+55°C, 93% r.h. 6 cycles, relay energized
IEC 60255-27 IEC 60068-2-30	

CE Certification

Item	Data
EMC	EN 61000-6-2 and EN 61000-6-4 (EMC steering committee 2004/108/EC)
LVD	EN 60255-27(LVD 2006/95EC)

Specification

87L, Line Differential Protection

Item	Data
Phase segregated differential protection current; Sudden-change differential protection current	0.1 I_r to 20.00 I_r ≤ ±3% or ±0.02 I_r
Operating time	40ms typically
Minimum operating time	≤ 35ms, at 200% setting, and $I_{diff} > 2I_{res}$
Differential current of zero sequence differential protection	0.05I_r to 20.00I_r ≤±3% or ±0.02I_r
Time delay of zero sequence differential protection	0.00s to 10.00s, step 0.01s ≤±1% or +130ms

21, Distance protection

Item	Data
Number of zones	3 zones
Distance characteristic	Polygonal
Resistance setting range	0.05 / I_r ~ 600 / I_r Ω, step 0.01 Ω, when I_r = 5 A / 1 A
Reactance setting range	0.05 / I_r ~ 600 / I_r Ω, step 0.01 Ω, when I_r = 5 A / 1 A
Delay time of distance zones	0.00s~60.00 s, step 0.01 s ≤±1% or ≤+20 ms, at setting time > 60 ms
Minimum operating time	≤20 ms, zone 1 at fault within 64% operating zone
Operation time	40 ms typically, zone 1 at fault within 70% operating zone
Dynamic overreaching for zone 1	≤±5%, at 0.5< SIR <30
Measuring tolerance of fault locator (not including errors caused by factors outside product)	≤+3% when fault current is greater than 0.01 I_r at metal fault, error will become bigger when fault occurs with greater transition resistance

50, 51, 67, Directional overcurrent protection

Item	Data
Definite time characteristic	
Current	0.05 Ir to 40.00 Ir ≤ ±2.5% setting or ±0.02 Ir
Time delay of definite time characteristic	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Inverse time characteristic	
Current	0.05 Ir to 40.00 Ir ≤ ±2.5% setting or ±0.02I_r
Time delay IEC Inverse IEC 60255-151	Normal inverse; Very inverse; Extremely inverse; Long time inverse ≤ ±5% or ≤ +40ms , at 2 <$I/I_{SETTING}$ < 20
Time delay IEEE/ ANSI Inverse IEEE/ ANSI C37.112	Inverse; Short time inverse; Long time inverse; Moderately inverse; Very inverse; Extremely inverse; Definite time inverse ≤ ±5% setting or ≤ +40ms, at 2 <$I/I_{SETTING}$ < 20
Time delay user-defined inverse IEEE/ANSI C37.112	$T=\left(\frac{A}{(\frac{I}{I\_SET})^P-1}+B\right)k$ ≤ ±5% setting or ≤ + 40ms, at 2 <$I/I_{SETTING}$ < 20
Time factor of characteristic, A	0.001 to 1000.0s, step 0.001s
Time delay of characteristic, B	0.00s to 100.00s, step 0.01s
Index of characteristic, P	0.01 to 10.00, step 0.01
Time constant of characteristic, k	0.025 to 1.50, step 0.001
Min inverse operate time	Instantaneous
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Directional element	

Specification

Angle range of operating area	170°
Characteristic angle	0° to 90°, step 1° ≤ ±1°, at phase to phase voltage >2V
Inrush current blocking element	
Max. current setting without inrush current blocking	0.05 I_r to 40.00 I_r ≤ ±2% setting or ±0.02I_r
Ratio of second harmonics to fundamental current	0.07 to 0.50, step 0.01
Time period of cross phases blocking	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤+40ms

50N, 51N, 67N Directional earth fault protection

Item	Data
Current inputs	Three phase currents or single current
Definite time characteristic	
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02 I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Inverse time characteristic	
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay IEC Inverse IEC 60255-151	Normal inverse; Very inverse; Extremely inverse; Short time inverse Long time inverse ≤ ±5% setting or ≤ + 40ms, at 2 <I/$I_{SETTING}$ < 20
Time delay IEEE/ANSI inverse IEEE/ANSI C37.112	Inverse; Short time inverse; Long time inverse; Moderately inverse; Very inverse; Extremely inverse; Definite inverse ≤ ±5% setting or ≤ + 40ms, at
	2 <I/$I_{SETTING}$ < 20
Time delay user-defined inverse IEEE/ANSI C37.112	$T=\left(\frac{A}{(\frac{I}{I\_SET})^P-1}+B\right)k$ ≤ ±5% setting or ≤ + 40ms, at 2 <I/$I_{SETTING}$ < 20
Time factor of characteristic, A	0.001 to 1000.0s, step 0.001s
Time delay of characteristic, B	0.00s to 100.00s, step 0.01s
Index of characteristic, P	0.01 to 10.00, step 0.01
Time constant of characteristic, k	0.025 to 1.500, step 0.001
Min inverse operate time	instantaneous
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Zero sequence directional element	
Operating area range	160°;
Characteristic angle	0° to 90°, step 1° ≤ ±1°, at 3U0≥1V
Negative sequence directional element	
Operating area range	160°
Characteristic angle	0° to 90°, step 1° ≤ ±1°, at 3U2≥2V

46, Negative-sequence overcurrent protection

Item	Data
Definite time characteristic	
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02 I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Inverse time characteristic	
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay IEC Inverse IEC 60255-151	Normal inverse; Very inverse; Extremely inverse; Short time inverse Long time inverse ≤ ±5% setting or ≤+ 40ms, at

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	2 <I/$I_{SETTING}$ < 20
Time delay IEEE/ANSI inverse IEEE/ANSI C37.112	Inverse; Short time inverse; Long time inverse; Moderately inverse; Very inverse; Extremely inverse; Definite inverse ≤ ±5% setting or ≤ +40ms, at 2 <I/$I_{SETTING}$ < 20,
Time delay user-defined inverse IEEE/ANSI C37.112	$T=\left(\frac{A}{(\frac{I}{I\_SET})^P-1}+B\right)k$ ≤ ±5% setting or ≤ + 40ms, at 2 <I/$I_{SETTING}$ < 20
Time factor of characteristic, A	0.001 to 1000.0s, step 0.001s
Time delay of characteristic, B	0.00s to 100.00s, step 0.01s
Index of characteristic, P	0.01 to 10.00, step 0.01
Time constant of characteristic, k	0.025 to 1.500, step 0.001
Min inverse operate time	instantaneous
Reset ratio	≥ 0.95
Reset time	≤ 40 ms

49, Thermal overload protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Heating time constant	6-9999 s
Cooling time constant	0.1-10
IEC low temperature curve IEC 60255-149	$t=\tau\ln\left\{\frac{I_{eq}^2}{I_{eq}^2-I_\theta^2}\right\}$ ≤ ±5% setting or ≤+40ms
IEC high temperature curve IEC 60255-149	$t=\tau\ln\left\{\frac{I_{eq}^2-I_P^2}{I_{eq}^2-I_\theta^2}\right\}$ ≤ ±5% setting or ≤+40ms

59, Overvoltage protection

Item	Data
Voltage input	Phase to phase voltage or phase to earth voltage
Definite time characteristic	
phase-to-earth voltages	40.0V to 100.0 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Phase to phase voltage	80.0V to 200.0 V, step 0.01 V ≤ ± 2.5% setting or ± 1V
Reset ratio	0.95 to 1, step 0.01 ≤ ±3 % setting
Time delay	0.00s to 120.00s, step 0.01s ≤ ±1 % setting or ≤ +50ms, at 120% voltage setting
Reset time	≤ 40ms
Inverse time characteristic	
phase-to-earth voltages	40.0V to 100.0 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Phase to phase voltage	80.0V to 200.0 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Time delay IEC Inverse IEC 60255-127	Normal inverse; Very inverse; Extremely inverse; Short time inverse; Long time inverse; ≤ ±5% setting or ≤ + 50ms, at 2 <U/U_{set} < 20
Time delay IEEE/ANSI inverse IEEE/ANSI C37.112	Inverse; Short time inverse; Long time inverse; Moderately inverse; Very inverse; Extremely inverse; Definite inverse ≤ ±5% setting or ≤ +50ms, at 2 <U/U_{set} < 20
Time delay user-defined inverse IEEE/ANSI C37.112	$t=\left[\frac{A}{\left[\frac{U_\Phi}{Uset}\right]^P-1}+B\right]\cdot T$ ≤ ±5% setting or ≤ +50ms, at 2 <U/Uset < 20.
Time factor of characteristic, A	0.001 to 10.000, step 0.001
Time delay of	0.00s to 100.00s, step 0.01s

Specification

characteristic, B	
Index of characteristic, P	0.01 to 10.00, step 0.01
Time constant of characteristic, T	0.025 to 1.500, step 0.001
Min inverse operate time	instantaneous
Reset ratio	≥ 0.95
Reset time	≤ 40ms

47, Negative-sequence overvoltage protection

Item	Data
Voltage input	Calculated from 3 phase to earth voltages
Definite time characteristic	
Voltage	40 to 100 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1 % setting or ≤ +50ms, at 120% voltage setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms
Inverse time characteritic	
Voltage	1 to 100 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Time delay IEC Inverse IEC 60255-127	Normal inverse; Very inverse; Extremely inverse; Short time inverse; Long time inverse; ≤ ±1% setting or ≤ + 50ms, at 120% voltage setting
Time delay IEEE/ANSI inverse IEEE/ANSI C37.112	Inverse; Short time inverse; Long time inverse; Moderately inverse; Very inverse; Extremely inverse; Definite inverse ≤ ±1% setting or ≤ +50ms, at 120% voltage setting
Time delay user-defined inverse IEEE/ANSI C37.112	$t = \left[\frac{A}{\left[\frac{U_\Phi}{\text{Uset}}\right]^P - 1} + B\right] \cdot T$ ≤ ±1% setting or ≤ +50ms, at 120% voltage setting
Time factor of characteristic, A	0.001 to 10.000, step 0.001
Time delay of characteristic, B	0.00s to 100.00s, step 0.01s
Index of characteristic, P	0.01 to 10.00, step 0.01
Time constant of characteristic, T	0.025 to 1.500, step 0.001
Min inverse operate time	instantaneous
Reset ratio	≥ 0.95
Reset time	≤ 40ms

27, Undervoltage protection

Item	Data
Voltage input	Phase to phase voltages or phase to earth voltages
Permitted current setting	0.04-40.00 I_r, step 0.01A ≤ ±2.5% setting or ±0.02I_r
Definite time characteristic	
phase-to-earth voltages	5.0 to 75.0 V, step 0.1 V ≤ ±2.5% setting or ± 1 V
Phase to phase voltage	10.0 to 150.0 V, step 0.1 V ≤ ±2.5% setting or ±1 V
Reset ratio	1.00 to 2.00, step 0.01
Time delay	0.00s to 120.00s, step 0.01s ≤ ±1 % setting or ≤ +50ms， at 80% voltage setting
Reset time	≤ 40ms
Inverse time characteritic	
phase-to-earth voltages	5.0 to 75.0 V, step 0.1 V ≤ ±2.5% setting or ± 1V
Phase to phase voltage	10.0 to 150.0 V, step 0.1 V ≤ ±2.5% setting or ± 0.1V
Time delay IEC Inverse IEC 60255-127	Curve 1 Curve 2 Curve 3 ≤ ±1 % setting or ≤ +50ms，

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	at 80% voltage setting
Time delay user-defined curve IEC 60255-127	$t = \left[\frac{A}{1-\left[\frac{U}{Uset}\right]^P} + B\right] \cdot T$ ≤ ±1 % setting or ≤ +50ms，at 80% voltage setting
Time factor of characteristic, A	0.001 to 10.000, step 0.001
Time delay of characteristic, B	0.00s to 100.00s, step 0.01s
Index of characteristic, P	0.010 to 10.000, step 0.005
Time constant of characteristic, T	0.025 to 1.500, step 0.001
Min inverse operate time	instantaneous
Reset ratio	1.00 to 2.00, step 0.01
Reset time	≤ 40ms

32, Directional overpower protection

Item	Data
Power	0W to 500W ≤ ±3% setting or ±0.5Pn
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1 % setting or ≤ +40ms at 120% operating setting
Reset time	≤ 55ms

50CBF, Circuit breaker failure protection

Item	Data
Phase current Negative sequence current Zero sequence current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay of stage 1	0.00s to 100.00 s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Time delay of stage 2	0.00s to 100.00 s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms

50DZ, Dead zone protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms

50STUB, STUB protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms

62PD, Pole discrepancy protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms

46BC, Broken conductor protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset time	≤ 40ms

Specification

Reset ratio	≥ 0.95
Reset time	≤ 40ms

81U, Under frequency protection

Item	Data
Frequency	45.00 to 50.00Hz, step 0.01Hz at F_r = 50Hz 54.00 to 60.00Hz, step 0.01Hz at F_r = 60Hz ≤ ± 20mHz
Time delay	0.1s to 100.00 s, step 0.01s ≤ ±1.5% setting or ≤+60 ms, at 80% setting
Reset Δf = | f_{set} - f_{reset} |	Approx. 20mHz
Change of rate Δf/Δt	0.3 to 20Hz/s ≤±0.5Hz/s
Voltage	10 to 120V, step 0.01V ≤±2.5% setting or ± 1V
Current	0 to 10I_r ≤±2.5% setting or +0.01I_r

81O, Over frequency protection

Item	Data
Frequency	50.00 to 55.00Hz, step 0.01Hz at F_r = 50Hz 60.00 to 66.00Hz, step 0.01Hz at F_r = 60Hz ≤ ± 20mHz
Time delay	0.1s to 100.00 s, step 0.01s ≤ ±1.5% setting or ≤ +60 ms, at 80% setting
Reset Δf = | f_{set} - f_{reset} |	Approx. 20mHz
Voltage	10 to 120V, step 0.01V ≤±2.5% setting or ± 1V

81DF, Frequency change rate protection

Item	Data
Change of rate Δf/Δt	0.3 to 20Hz/s ≤± 0.5 Hz/s
Time delay	0.1s to 100.00s, step 0.01s ≤ ±1.5% setting or ≤ +60 ms
Upper limit of frequency change rate	0.1 to 50Hz/s ≤±0.5Hz/s
Lower limit of frequency change rate	0.1 to 50Hz/s ≤±0.5Hz/s
voltage	10 to 120V, step 0.01V ≤±2.5% setting or ± 1V

50SOTF, Switch onto fault protection

Item	Data
Current	0.05 I_r to 40.00 I_r ≤ ±2.5% setting or ±0.02I_r
Time delay	0.00s to 100.00s, step 0.01s ≤ ±1% setting or ≤ +40 ms, at 200% operating setting
Reset ratio	≥ 0.95
Reset time	≤ 40ms

25, Synchro-check & energizing check

Item	Data
Modes of Synchro-check	▪ Synchronization check ▪ Energizing check, and synchronous check after energizing check failure ▪ Override
Modes of Energizing check	▪ Dead line & dead bus ▪ Live line & dead bus ▪ Dead line & live bus
Max dead voltage setting at energizing check mode (Phase to earth voltage)	10V to 50 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Min live voltage setting at synchronization check mode (Phase to earth voltage)	30V to 65 V, step 0.01 V ≤ ±2.5% setting or ± 1V
ΔV- voltage difference (Phase to earth voltage)	1V to 40 V, step 0.01 V ≤ ±2.5% setting or ± 1V
Δf- frequency difference (f2>f1; f2<f1)	0.02 to 2.00Hz, step 0.01Hz ≤ ±20mHz
Δα- angle difference (α2>α1; α2<α1)	1 ° to 80 °, step of 0.01 ° ≤ ±3°
Maximum synchronous check broadening time	0.02s to 100.00 s, step 0.01s

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	≤ ±1.5% setting or ≤ +60 ms
Disable synchronization check time	0.05s to 100.00 s, step 0.01s ≤ ±1% setting or ≤ +50 ms

79, Auto-reclosing

Item	Data
Shots of reclosing	1 to 4
Reclosing initiated inputs	Internal protection startups External binary input
Dead time for each shot of reclosing	0.05s~600.00s, step of 0.01 s ≤ ±1% setting or ≤ +50 ms
Reclosing confirmation time	0.10 s~100.00s, step of 0.01 s ≤ ±1% setting or ≤ +40 ms
Reclosing charging time	0.05 s~100.00s, step of 0.01 s ≤ ±1% setting or +50 ms
Equal breaking time	0.10 s~100.00s, step of 0.01 s ≤ ±1% setting or ≤ +50 ms
Disable	0.05s to 100.00 s, step 0.01s

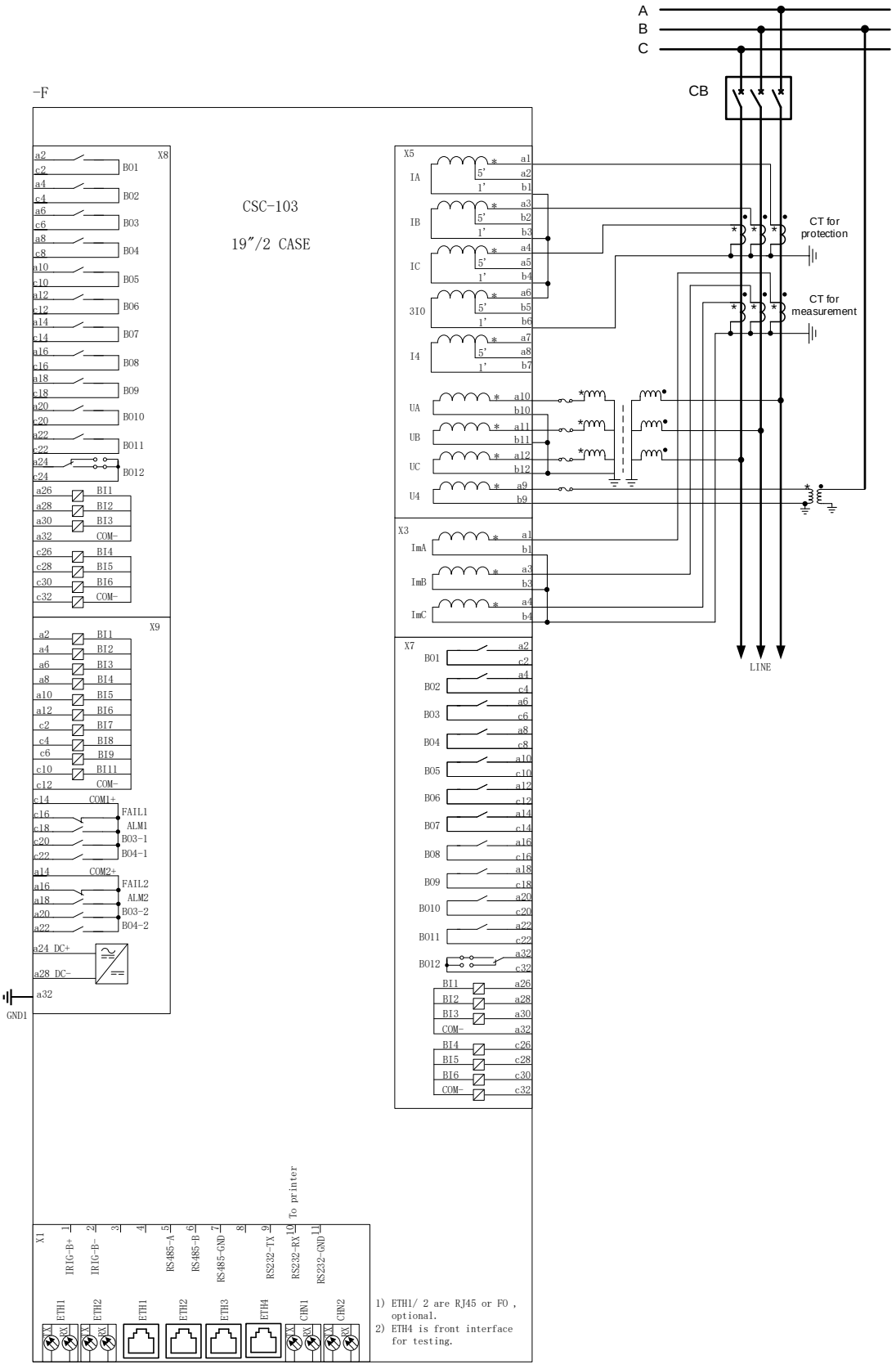
synchronization check time	≤ ±1% setting or ≤ +50 ms

97FF, VT secondary circuit supervision

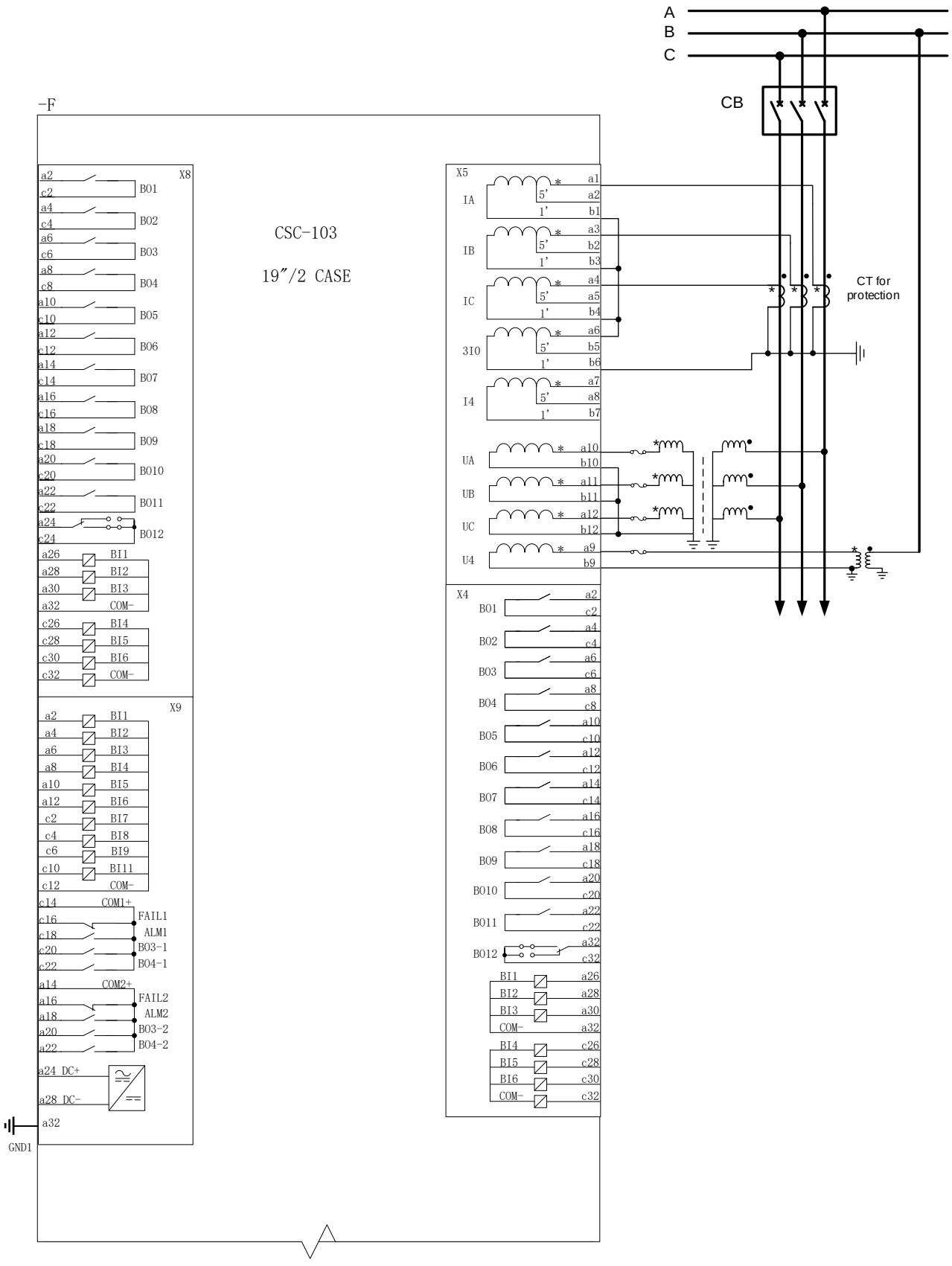
Item	Data
Phase current	0.05 I_r to 1.0 I_r, step 0.01A ≤ ±3% setting or ±0.02 I_r
Zero or negative sequence current	0.05 I_r to 1.0 I_r, step 0.01A ≤ ±5% setting or ±0.02 I_r
Phase to earth voltage	7.0V to 20.0V, step 0.01V ≤ ±3% setting or ± 1 V
Phase to phase voltage	10.0V to 30.0V, step 0.01V ≤ ±3% setting or ± 1 V
Operating phase to earth voltage	40.0V to 65.0V, step 0.01V ≤ ±3% setting or ± 1 V

Connection

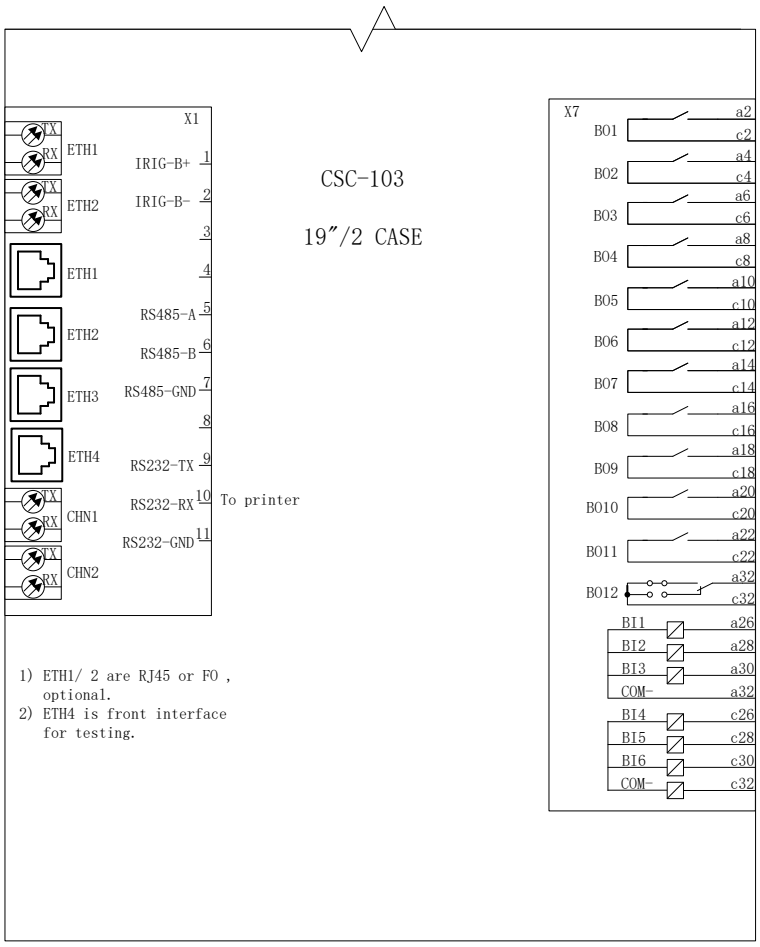
Typical configure 1



Typical configure 2



Connection



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Typical configure 3