
MORE
eXTENDED MODULAR RELAYS
XMR-D
MORE ADVANCED,
HIGH-END IEDs
FOR PROTECTING,
MONITORING AND
CONTROLLING ELECTRIC
POWER SYSTEMS.
THYTRONIC

XMR-D MOTOR AND GENERATOR PROTECTION RELAYS WITH DIFFERENTIAL FUNCTION

XMR-D is a part of XMORE platform, the complete range of IEDs for Medium Voltage application including feeder, motor, generator, transformer and capacitor bank; it is the multifunction and comprehensive Motor and Generator protection relay, including Differential element.

Thanks to Hardware and Software modularity XMR-D is flexible and scalable in term of application and performance.

ACCURATE MEASUREMENTS

Enhancements to protect and analyze power system operation in disturbance conditions:

- **Up to 12 analogue inputs**
- **32 sample for cycle Oscillography fault recording**
- **64 sample for cycle measurement for accuracy of protection element**
- **Up to 0,5 class Power and Energy measurement**

HARDWARE AND SOFTWARE MODULARITY

Customization of the product from the basic solution to the more complex configuration:

- **Plug in modules for HW expansion**
- **Licensable SW Pack**
- **I/O's cards**
- **ArcFlash module**
- **Analogue (PT100, 4-20mA) cards**
- **Communication cards**

TIME SYNCRONIZATION

Enhanced Time synchronization solution for SOE recording:

- **Precision Time Protocol PTP according to IEC1588**
- **SNTP**

COMMUNICATION SECURITY

Communication Security through redundancy protocol and Cyber Security package :

- **High available Seamless Redundancy support HSR**
- **Parallel Redundancy Protocol support PRP**
- **Rapid Spanning Tree Protocol RSTP**
- **Advanced built in Cyber Security**

NETWORK CONNECTIVITY

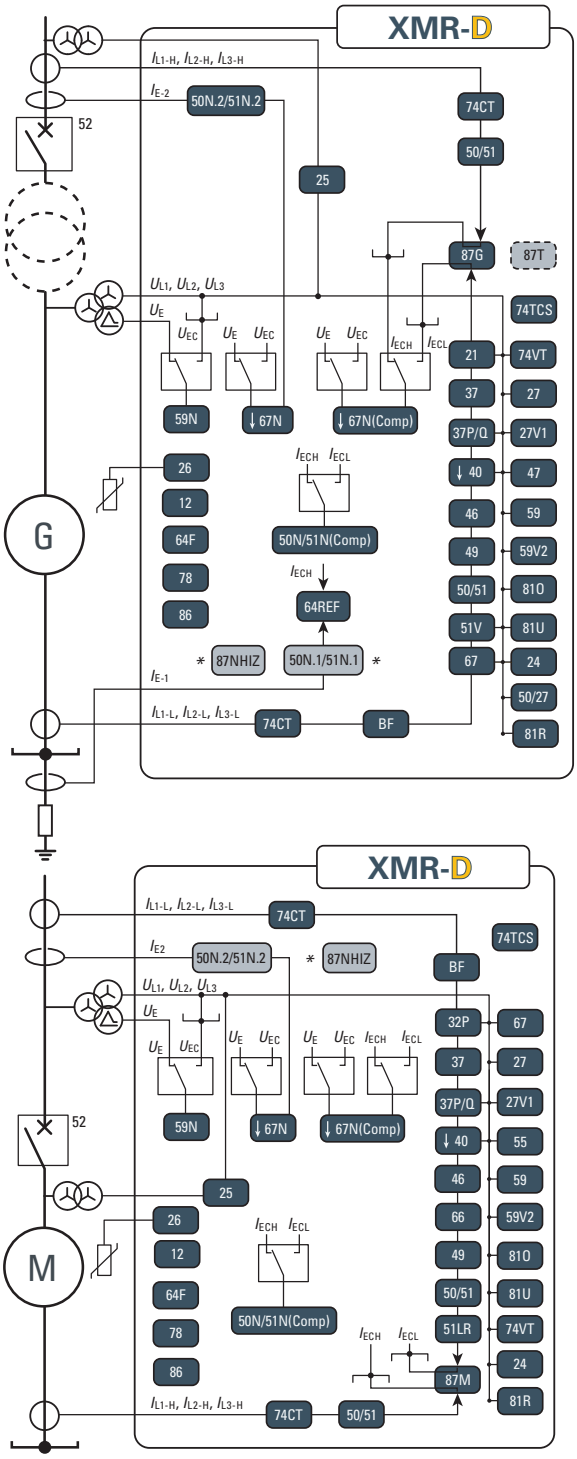
Widely implemented in Smart Grid and Substation Automation System:

- **IEC61850 Ed.2**
- **IEC 60870-5-103**
- **Modbus (Serial/TCP)**
- **DNP3 (Serial/TCP)**

AUTOMATION CONTROL & MONITORING

Enhanced tools and solutions for Grid Automation

- **IEC1131 PLC embedded**
- **Switchgear Monitoring/Control**
- **Switchgear OPEN/CLOSE local keys**
- **Multi shot Automatic Reclosing**
- **Multiple setting Profile**
- **CB health monitoring**
- **CT's and VT's monitoring**



Standard Protective & control elements

HW Pack optional configuration

21	Distance relay
24	Overflux (V/Hz)
25	Synchrocheck
26	Pt100 thermal probes
27	Undervoltage
27V1	Positive sequence undervoltage
27H-59H	100% stator earth-fault with 3rd harmonic
32P	Directional active overpower
32Q	Directional reactive overpower
37 (L - H)	Undercurrent (Side L - Side H)
37P	Directional active underpower
37Q	Directional reactive underpower
40(M/G)	Loss of excitation
46(L - H)	Negative sequence overcurrent (Side L - Side H)
46(M/G)	Negative sequence overcurrent
I2/I1 (L - H)	Negative/positive sequence current ratio (Side L - Side H)
47	Phase reversal
49(L -H)	Thermal image (Side L - Side H)
49(M/G)	Thermal image
50/27	Inadvertent energigization
50/51 (L - H)	Phase overcurrent (Side L - Side H)
50N/51N/87NHIZ .1*	Residual overcurrent/Restricted earth fault
50N/51N/87NHIZ .2*	Residual overcurrent/Restricted earth fault
50N/51N (L - H)	Calculated residual overcurrent (Side L - Side H)
51LR(48)/14	Locked rotor
51V	Phase overcurrent voltage restrain
55	Minimum power factor
59	Overvoltage
59N	Residual overvoltage
59V2	Negative sequence overvoltage
64F	Rotor earth fault
64REF 1 (H)	Low impedance restricted earth fault
64REF 2 (L)	Low impedance restricted earth fault
66	Maximum number of starting
67(Volt. Cons.)	Phase directional overcurrent
67N	Ground directional overcurrent
67N(Comp)	Ground directional overcurrent with calculated residual current
78	Out of step
DPHI	Vector jump
81O/81U	Overfrequency and underfrequency
81R	Frequency rate of change
87G-87M/87T	Double slope biased differential for generator/motor/transformer
2nd -REST (L -H)	Second harminic restrain (Side L - Side H)
BF (L - H)	Circuit breaker failure (Side L - Side H)
74VT	VT supervision
74CT (L- H)	CT supervision (Side L - Side H)
74TCS(L H)	Trip circuit supervision (Side L - Side H)
ArcFlash	ArcFlash

To enable protection:

- **Function 26** (thermometric protection with Pt100 modules)
- **Function 86** (Lock-out)
- **Arc Flash** protection function (made with arc detector)

XMR relay needs special hardware modules. So, these functions can be enabled only with the presence of the relative module.

The software is modular and the user can decide which protective functions modules need to be activated, granting the maximum flexibility, scalability and easiness of use of the device.

MEASURING INPUTS WITH INDUCTIVE CTS AND VTS

- Three phase current inputs and one residual current input, with nominal currents independently selectable at 1 A or 5 A through sw setting
- Three phase current inputs and one residual current input, with nominal currents independently selectable at 1 A or 5 A through sw setting available on external module. A suitable input is used for function 64F.
- Three phase voltage inputs with programmable nominal voltages within range 50...130 V (UR =100 V) or 200...520 V (UR =400 V) and one residual voltage input, with programmable nominal voltage within range 50...130 V (UER=100 V)

BINARY INPUTS

Up to 53 binary (depending upon configurations) inputs are available with programmable active state (active-ON/ active-OFF) and programmable timer (active to OFF/ON or ON/OFF transitions).
The reset of relay can be associated with each digital input.

OUTPUT RELAYS

Up to 31 output relays are available (changeover, make and break contacts); each relay may be individually programmed as normal state (normally energized, de-energized or pulse) and reset mode (manual or automatic).

LOCK-OUT RELAY

Master trip bistable latching relay allows the direct use in tripping circuit eliminating the need of additional auxiliary relay.

MODULAR DESIGN

In order to extend I/O capability, the Xmore hardware can be customized through internal auxiliary boards end external module:

- Output relays
- Binary inputs and external modules:
  - 8 relays and 16 digital inputs
  - Pt100 probe inputs board
  - 32 Inputs board
  - 6 Current loop output module
  - 4 Block relays module
  - High speed I/O module for Arc-Flash protection
  - Earth rotor fault protection module

BLOCKING INPUT/OUTPUTS

The output blocking circuits of one or several xMore relays, shunted together, must be connected to the input blocking circuit of the protection relay, which is installed upstream in the electric plant.

The output circuit works as a simple contact, whose condition is detected by the input circuit of the upstream protection relay.

Due to increase I/O capacity the following external expansion modules are available:

- XMRI Module 8 relays + 16 digital inputs
- XMR16 Module 16 relays
- XMID32 Module 32 digital inputs
- XMPT Module 8 PT100
- XMCI Module 6 analogue outputs (4÷20mA)

METERING

Xmore provides metering values for phase and residual currents, phase and residual voltage, making them available for reading on a display or to communication interfaces.
Input signals are sampled 64 times per period and the RMS value of the fundamental component is measured using the DFT (Discrete Fourier Transform) algorithm and digital filtering.
With DFT the RMS value of 2nd, 3rd, 4th and 5th harmonic of phase current are also measured.
On the base of the direct measurements, several calculated (min, max, average,...), phase, sequence, power, harmonic, synchro check, demand phase, demand power, demand energy and 78 function measures are processed.

MMI (MAN MACHINE INTERFACE)

The user interface comprises a membrane keyboard, a backlight LCD wide display, a touchscreen keyboard and sixteen LEDs with customizable functions.
The green OK LED indicates auxiliary power supply and self diagnostics, two LEDs are dedicated to the Start and Trip (yellow for Start, red for Trip).

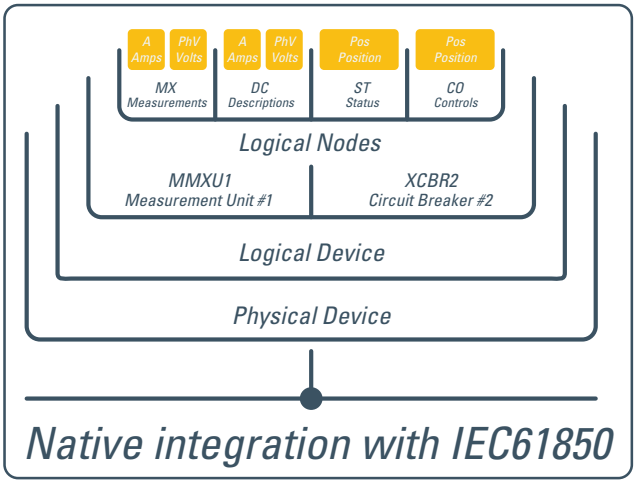
COMMUNICATION

Multiple communication interfaces are implemented:

- One Ethernet local communication front-end interface for communication with ThyVisor setup software
- Back-end interfaces for communication with remote monitoring and control systems by:
  - Multiple RS485 port
  - Ethernet TX + RS485
  - Ethernet FX with RS485
  - Double Ethernet TX
  - Double Ethernet FX
  - Double Ethernet FX with RSTP
  - Double Ethernet TX + RSTP
  - Double Ethernet FX + HSR-PRP

TWO SET POINT PROFILES (A,B)

Two independent settings groups are provided. Switching from profiles may be operated by means of MMI, binary input or communication.



CONTROL AND MONITORING

Several predefined functions are implemented:

- Activation of four set point profiles
- Phase CTs monitoring (74CT)
- Logic selectivity
- Cold load pickup (CLP) with block or setting change
- Trip circuit supervision (74TCS)
- Second harmonic restraint (inrush)
- Remote tripping
- Circuit Breaker commands and diagnostic

Moreover user defined logic must be customized in accordance with IEC 61131-3 protocol by means programmable logic controller (PLC).

Circuit Breaker

Several diagnostic, monitoring and control functions are provided:

- Health thresholds can be set; when the accumulated duty (SI or SI2t), the number of operations or the opening time exceeds the threshold an alarm is activated
- Breaker failure (BF); breaker status is monitored by means 52a-52b and/or through line current measurements
- Trip circuit supervision (74TCS)
- Breaker control; opening and closing commands can be carried out locally or remotely

Virtual I/O

Through ThyVisor tool the type of operation and links between thirty-two outputs (Virtual Output - VOUT1 ... 32) and thirty-two virtual inputs (Virtual Inputs - VIN1 ... VIN32) may be defined using RPC or IEC 61850 communication protocols over Ethernet network. Special features are:

- Availability of thirty-two inputs and thirty-two outputs independently programmable by the user
- Simplify wiring using one channel as the Ethernet
- Eliminate the need to install communication devices and / or external conversion
- Significantly reduce costs
- Dynamically change from sw connections and associated functions

The virtual I / O can be usefully employed for:

- Transmit information between protections installed in distance
- Achieve accelerated logic discrimination in which some protection elements can be blocked by the activation of the downstream protection start
- Circuit Breaker commands, Selection of setting profiles, Remote trip, etc...

Logic selectivity

With the aim of providing a fast selective protection system some protective functions may be blocked.
The selectivity logic may be accomplished by:

- output relays and logic inputs
- virtual input and output with messages on Ethernet network

To guarantee maximum fail-safety, the relay performs a run time monitoring for pilot wire continuity and pilot wire shorting. Exactly the output blocking circuit periodically produces a pulse, with small width in order to be ignored as an effective blocking signal by the input blocking circuit of the upstream protection, but suitable to prove continuity of the pilot wire.
Furthermore a permanent activation (or better, with a duration longer than a preset time) of the blocking signal is identified, as a warning for a possible short circuit in the pilot wire or in the output circuit of the downstream protection.

Cold Load Pickup (CLP)

Cold load pickup element prevents unwanted tripping in case of temporary overcurrents produced when a feeder is being connected after an extended outage (e.g. motor starting).
Two different operating modes are provided:

- Each protective element can be blocked for a setting time
- Each threshold can be increased for a setting time

Second harmonic restraint

To prevent unwanted tripping of the protective functions on transformer inrush current, the protective elements can be blocked when the ratio between the second harmonic current and the relative fundamental current is larger than a user programmable threshold. The function can be programmed to switch an output relay so as to cause a blocking protection relays lacking in second harmonic restraint.

Fault location

The integrated fault locator calculates the fault impedance and the distance to fault.
To calculate the fault distance, the per distance reactance of the line, the line length, the angle of the line impedance, and resistance are required. The results are displayed in Ω, kilometers and in percent of the line length.

Synchro-check

The following settings are provided:

- Selection of the V1 and V2 inputs (phase-to-ground, phase-to-phase, single-phase or three-phase)
- Possibility of amplitude compensation and phase shift for a power transformer between V1 and V2
- Possibility, for asynchronous networks, to calculate the advance to the closure according to the frequency difference and to the circuit breaker operate time
- Ability to thresholds adjustments in asymmetric fashion (eg, the difference between the two voltages can be adjusted with different value if V1 is greater than V2 or vice versa)

SYNCHRONIZATION METHODS

Devices that share the same file server must have synchronized clocks so that the timestamps are consistent.
Two synchronization systems are available:

- SNTP (Network Time Protocol)
- IEC 1588

SELF DIAGNOSTICS

All hardware and software functions are repeatedly checked and any anomalies reported via display messages, communication interfaces, LEDs and output relays.

EVENT STORAGE

Several useful data are stored for diagnostic purpose; the events are stored into a non volatile memory.
They are graded from the newest to the older after the “Events reading” command (ThySetter) is issued:

- Sequence of Event Recorder (SER)
  The event recorder runs continuously capturing in circular mode the last one thousend events upon trigger of binary input/output.
- Sequence of Fault Recorder (SFR)
  The fault recorder runs continuously capturing in circular mode the last twenty faults upon trigger of binary input/output and/or element pickup (start-trip)
- Trip counters

DIGITAL FAULT RECORDER (OSCILLOGRAPHY)

Upon trigger of tripping/starting of each function or external signals, the relay records in COMTRADE format:

- Oscillography with instantaneous values for transient analysis
- RMS values for long time periods analysis
- Logic states (binary inputs and output relays)

Note - A license for Digital Fault Recorder function is required.
All records are stored in non-volatile memory.

CYBERSECURITY

Cybersecurity features implemented in XMR-P help to mitigate cyber threats.

- Secured communication between XMR-P protection relays and associated tool by ***SSH*** (***S***ecure ***SH***ell) protocols
- Compliant to NERC CIP, ISO/IEC 27001:2013 and IEC62351 standard requirements
- Password based user authentication
- ***R***ole ***B***ased ***A***ccess ***C***ontrol (***RBAC***) authorization management
- Secured log storage (***Syslog*** Service)

SPECIFICATIONS

GENERAL

MECHANICAL DATA

Mounting:	flush or rack
Mass (flush mounting case)	5 kg

INSULATION TESTS

Reference standards	EN 60255-5, IEC60255-27
High voltage test 50Hz	2 kV 60 s
Impulse voltage withstand (1.2/50 ms)	5 kV
Insulation resistance	>100 MW

VOLTAGE DIP AND INTERRUPTION

Reference standards	EN 61000-4-29

EMC TESTS FOR INTERFERENCE IMMUNITY

1 MHz damped oscillatory wave	EN 60255-22-1	1 kV-2.5 kV
Electrostatic discharge	EN 60255-22-2	8 kV
Fast transient burst (5/50 ns)	EN 60255-22-4	4 kV
Conducted radio-frequency fields	EN 60255-22-6	10 V
Radiated radio-frequency fields	EN 60255-4-3	10 V/m
High energy pulse	EN 61000-4-5	2 kV
Magnetic field 50 Hz	EN 61000-4-8	1 kA/m
Damped oscillatory wave	EN 61000-4-12	2.5 kV
Ring wave	EN 61000-4-12	2 kV
Conducted common mode (0...150 kHz)	EN 61000-4-16	10 V

EMISSION

Reference standards	EN 61000-6-4 (ex EN 50081-2)
Conducted emission 0.15...30 MHz	Class A
Radiated emission 30...1000 MHz	Class A

CLIMATIC TESTS

Reference standards	IEC 60068-x, ENEL R CLI 01, CEI 50

MECHANICAL TESTS

Reference standards	EN 60255-21-1, 21-2, 21-3

SAFETY REQUIREMENTS

Reference standards	IEC60255-27
Pollution degree	3
Reference voltage	250 V
Overvoltage	III
Pulse voltage	5 kV
Reference standards	EN 60529
Protection degree:	
▸ Front side	IP54
▸ Rear side, connection terminals	IP20

ENVIRONMENTAL CONDITIONS

Ambient temperature	-25...+70 °C
Storage temperature	-40...+85 °C
Relative humidity	10...95 %
Atmospheric pressure	70...110 kPa

CERTIFICATIONS

Product standard for measuring relays	EN 50263
CE conformity	
▸ EMC Directive	2004/108/EC
▸ Low Voltage Directive	2006/95/EC
▸ Type tests	IEC 60255-6

COMMUNICATION INTERFACES

Local:

▸ Ethernet 100BaseT	100 Mbps

Network:

▸ RS485	1200...57600 bps
▸ Ethernet 100BaseT [1]	100 Mbps
Protocol	ModBus® RTU/IEC 60870-5-103/DNP3, TCP/IP, IEC61850 Level A

Note [1] Two redundant port selectable with TX + TX or FX + FX connections. The secondary port is activated in the event of failure of the primary port or by means of hw-sw switching command.

INPUT CIRCUITS

AUXILIARY POWER SUPPLY UAUX

Nominal value (range)	24 ...110 V_{AC}/V_{DC} 110...230 V_{AC}/V_{DC}
Operative range (each one of the above nominal values)	19...132 V_{AC}/V_{DC} 75 V_{AC}/V_{DC} .... 300 V_{AC}
Maximum (energized relays, Ethernet FX)	25 W (35 VA)

PHASE CURRENT INPUTS WITH INDUCTIVE CTS

▸ Rated current In	1 A or 5 A selectable by sw
▸ Permanent overload	25 A
▸ Thermal overload (1 s)	500 A
▸ Rated consumption (for any phase)	≤ 0.002 VA (In = 1 A) ≤ 0.04 VA (In = 5 A)
▸ Connections	M4 terminals

RESIDUAL CURRENT INPUT

▸ Rated current IEn	1 A or 5 A selectable by sw
▸ Permanent overload	25 A
▸ Thermal overload (1 s)	500 A
▸ Rated consumption ≤ 0.006 VA (I_{En} = 1 A), ≤ 0.012 VA (I_{En} = 5 A)	
▸ Connections	M4 terminals

VOLTAGE INPUTS WITH INDUCTIVE VTS

Reference voltage U_r	100 V or 400 V selectable on order
Nominal voltage U_n	50...130 V or 200...520 V adjustable via sw
Permanent overload / 1 s overload	1.3 U_n / 2 U_n
Rated consumption (for any phase)	≤ 0.5 VA

RESIDUAL VOLTAGE INPUT WITH INDUCTIVE VTS

Reference voltage U_{ER}	100 V
Nominal voltage U_{En}	50...130 V adjustable via sw
Permanent overload / 1s overload	1.3 U_{En} / 2 U_{En}
Rated consumption	≤ 0.5 VA

BINARY INPUTS

Quantity	7..53
Type	dry inputs
Max permissible voltage	19...265 Vac/19...300 Vdc
Max consumption, energized	3 mA

OUTPUT CIRCUITS

OUTPUT RELAYS

Quantity	7..31
Type of contacts (default):	
K1, K2	changeover (SPDT, type C)
K3, K4, K5, K6, K31 make	(SPST-NO, type A)
Rated current	8 A
Rated voltage/max switching voltage	250 Vac/400 Vac
Short duration current (0,5 s)	30 A
Make	1000 W/VA
Minimum switching load	300 mW (5 V/ 5 mA)
Breaking capacity:	
Direct current (L/R = 40 ms)	50 W
Alternating current (λ = 0,4)	1250 VA
Make	1000 W/VA
Short duration current (0,5 s)	30 A
Minimum switching load 300 mW	(5 V/ 5 mA)
Life:	
Mechanical	10^6 operations
Electrical	10^5 operations

BLOCK INPUT (LOGIC SELECTIVITY)

Quantity	1
Type	optocoupler

BLOCK OUTPUT (LOGIC SELECTIVITY)

Quantity	1
Type	optomosfet

LEDS

Quantity	21
▸ ON/fail (green)	1
▸ Start (yellow)	1
▸ Trip (red)	1
▸ Local	1
▸ Remote	1
▸ Allocatable (green/yellow/red)	16

MAIN SETTINGS

RATED VALUES (ALL VERSIONS)

B9-B10 Voltage measure	U_E or V_2
V1-V2 phase correction	0...360 °
V1 voltage measure for synchrocheck element	U_{12}/U_{L1}
Relay nominal frequency (f_n)	50, 60 Hz
Relay residual nominal current (I_{En})	1 A, 5 A
Residual CT nominal primary current (I_{Enp})	1 A...10 kA
Relay nominal voltage (phase-to-ground)	$E_n = U_n/\sqrt{3}$
Relay residual nominal voltage (calculated)	$U_{ECN} = U_n \cdot \sqrt{3} = 3 \cdot E_n$
Relay residual nominal voltage (direct measure) (U_{En})	50...130 V
Relay nominal active power (P_n)	$P_n = \sqrt{3} \cdot U_n \cdot I_n = 3 \cdot E_n \cdot I_n$
Relay nominal reactive power (Q_n)	$Q_n = \sqrt{3} \cdot U_n \cdot I_n = 3 \cdot E_n \cdot I_n$
Relay nominal apparent power (S_n)	$S_n = \sqrt{3} \cdot U_n \cdot I_n = 3 \cdot E_n \cdot I_n$
Residual primary nominal voltage (phase-to-phase)√3 (U_{Enp})	50 V...500 kV

RATED VALUES (INDUCTIVE CTS AN VTS VERSIONS)

Relay phase nominal current (I_n)	1 A, 5 A
Phase CT nominal primary current (I_{np})	1 A...10 kA
Relay nominal voltage (phase-to-phase) (U_n)	50...130 V or 200...520 V
Line VT primary nominal voltage (phase-to-phase) (U_{np})	50 V..500 kV
Line VT primary nominal voltage - side 2 (U_{n2p})	50 V..500 kV

BINARY INPUT TIMERS

ON delay time (IN1 t_{ON}...IN10 t_{ON})	0.00...100.0 s
OFF delay time (IN1 t_{OFF}, IN2 t_{OFF})	0.00...100.0 s
Logic	Active-ON/Active-OFF

RELAY OUTPUT TIMERS

Minimum pulse width	0.000...0.500 s

INPUT SEQUENCE

Phase current sequence (Side L)	(*I-Sequence L*) IL1-IL2-IL3, IL1-IL3-IL2, L2, IL1, IL3,.....
Phase current sequence (Side H)	(*I-Sequence H* IL1-IL2-IL3, IL1-IL3-IL2, L2, IL1, IL3,.....
Phase voltage sequence	V-*Sequence*) UL1-UL2-UL3, UL1-UL3-UL2, UL2-UL1-UL3, ...

POLARITY

A1-A2 (A1-A2 POL) polarity	NORMAL/REVERSE
A3-A4 (A3-A4 POL) polarity	NORMAL/REVERSE
A5-A6 (A5-A6 POL) polarity	NORMAL/REVERSE
A7-A8 (A7-A8 POL) polarity	NORMAL/REVERSE
B1-B2 (B1-B2 POL) polarity	NORMAL/REVERSE
B3-B4 (B3-B4 POL) polarity	NORMAL/REVERSE
B5-B6 (B5-B6 POL) polarity	NORMAL/REVERSE
B7-B8 (B7-B8 POL) polarity	NORMAL/REVERSE
C1-C2 (C1-C2 POL) polarity	NORMAL/REVERSE
C3-C4 (C3-C4 POL) polarity	NORMAL/REVERSE
C5-C6 (C5-C6 POL) polarity	NORMAL/REVERSE
C7-C8 (C7-C8 POL) polarity	NORMAL/REVERSE

PROTECTION FUNCTIONS

Full description about parameters, thresholds and timings ranges is available in relevant equipment documentation.

BASE CURRENT IB [1]

Base current (I_B) 0.10...2.50 I_n

Note - For the CTs versions the basic current I_B represents the rated current of the protected device (line, transformer, motor...) referred to the nominal current of the CT's. If the secondary rated current of the line CT's equals the rated current oft he relay, as usually happens, the I_B value is the ratio between the rated current of the protected element and the CT's primary rated current.

LINE [2]

Positive sequence resistance (R_{1L})	0.05...200 mZ_{NF}/km
Positive sequence reactance (X_{1L})	0.05...200 mZ_{NF}/km
Homopolar sequence resistance (R_{0L})	0.05...200 mZ_{NF}/km
Homopolar sequence reactance (X_{0L})	0.05...200 mZ_{NF}/km
Line length (L)	0.1...1000.0 km

Note 2 - The line parameters are concerning the Fault Location element (FL)

STARTING CONTROL SET

CLP Input source (*CLP Source*)	IRUN/CB
IRUN Threshold (IRUN)	0.10 I_B

UNDERIMPEDANCE - 21

Underimpedance protection is typically used to protect the generator against short-circuit between phases outwith the differential protection area 87G.
Two thresholds (**Z<, Z<<**), are available, independently adjustable with adjustable delay [**tZ<, t Z<<** (definite time)].

OVEREXCITATION - 24

(U/f)AL Element

- Alarm threshold definite time (U/f)ALdef 0.50...2.00 Un/fn
- Operating time t(U/f)ALdef 0.10...100.0 s

(U/f)> Element

- Curve type (U/f>Curve) DEFINITE, IEC/BS A, B, C

Definite time

- First threshold definite time (U/f)>def 0.50...2.00 Un/fn
- Operating time (t(U/f)>def) 0.10...100.0 s

Inverse time

- First threshold inverse time (U/f)>inv 0.50...2.00 Un/fn
- Operating time (t(U/f)>inv) 0.10...100.0 s

(U/f)>> Element

- Second threshold definite time (U/f)>>def 0.50...2.00 Un/fn
- Operating time (t(U/f)>>def) 0.10...100.0 s

SYNCHROCHECK - 25

***Common configuration*:**

- 25 Operating mode (25 Logic) 0,1,2
- Minimum stabilization time (t_{STAB}) 0.10...10.00 s
- CB Closing time ($t_{CB\text{-}CLOSE}$) 0.02...0.60 s
- Time out paralleling sequence (timeout-$_{SYNC}$) 1...20 min
- Synchro time delay (t_{SYNC}) 0.00...60.0 s
- Maximum voltage threshold ($V_{max\text{-}SYNC}$) 0.50...1.50 Un/En-Un2
- Minimum voltage threshold ($V_{min\text{-}SYNC}$) 0.20...1.50 Un/En/Un2
- V1, V2 Frequency range (f_{RANGE}) fn ±0.5...3.0 Hz
- Consistency of frequency measurement ($R_{of>SYNC}$) 0.00...0.60 Hz

Setpoints:

- Frequency difference fV1 fV2 for sync/async grids (df-GRID) 0.01...0.04 Hz
- f1>f2 Frequency difference (df12-SYNC) 0.02...0.50 Hz
- f2>f1 Frequency difference (df21-SYNC) 0.02...0.50 Hz
- V1>V2 Voltage difference (dV12-SYNC) 0.01...0.30 Un/En-Un2
- V2>V1 Voltage difference (dV21-SYNC) 0.01...0.30 Un/En-Un2
- Phase difference V2 lead V1 (dp12-SYNC) 2...30 °
- Phase difference V2 lag V1 (dp21-SYNC) 2...30 °
- Voltage V1 presence threshold (V1>-SYNC) 0.50...1.50 Un/En
- Voltage V2 presence threshold (V2>-SYNC) 0.50...1.50 Un2
- Voltage V1 absence threshold (V1<-SYNC) 0.05...0.60 Un/En
- Voltage V2 absence threshold (V2<-SYNC) 0.05...0.60 Un2
- V1>SYNC trip time (tV1>SYNC) 0.00...10.0 s
- V2>SYNC trip time (tV2>SYNC) 0.00...10.0 s
- V1<SYNC trip time (tV1<SYNC) 0.00...10.0 s
- V2<SYNC trip time (tV2<SYNC) 0.00...10.0 s
- 25 Trip state delayed time (tTrip 25 delayed) 0.00...10.0 s

THERMAL PROTECTION WITH PT100 THERMOMETRIC PROBES - 26

The measure of temperature is acquired by a MPT module with eight PT100 thermometric probes (RTD Resistive Thermal Device), for each thermometric probe an alarm (**Th$_{ALx}$**) and a trip adjustable threshold are provided (**Th>$_x$**), with adjustable operating time (**t$_{ThALx}$** and **t$_{Th>x}$**).

UNDERVOLTAGE - 27

Common configuration:

- Voltage measurement type for 27 (Utype27) Uph-ph/Uph-n
- 27 Operating logic (Logic27) AND/OR

U< Element

- U< Curve type (U<Curve) DEFINITE, INVERSE [2]

Definite time

- 27 First threshold definite time (U<def) 0.05...1.10 Un/En
- U<def Operating time (tU<def) 0.03...100.0 s

Inverse time

- 27 First threshold inverse time (U<inv) 0.05...1.10 Un/En
- U<inv Operating time (tU<inv) 0.10...100.0 s

U<< Element

Definite time

- 27 Second threshold definite time (U<<def) 0.05...1.10 Un/En
- U<<def Operating time (tU<<def) 0.03...100.0 s

POSITIVE SEQUENCE UNDERVOLTAGE - 27V1

U1< Element

- 27V1 First threshold definite time (U1<def) 0.05...1.10 En
- 27V1 Operating time (tU1<def) 0.07...100.0 s

100% STATOR EARTH FAULT WITH 3RD HARMONIC (27H - 59H)

- Configuration (UE3hmode) Minimum or Maximum
- UE3H<threshold (UE3H<def) 0.003...0.400 UEn
- Operating time (tE3H<def) 0.07...100.0 s
  0.07...0.99 s (step 0.01 s)
  10.0...100.0 s (step 0.1 s)
- UE3H>threshold (UE3H>def) 0.003...0.400 UEn
- Operating time (tE3H>def) 0.07...100.0 s
  0.07...0.99 s (step 0.01 s)
  10.0...100.0 s (step 0.1 s)
- Inhibit threshold UIN-3H<[1] 0.10...1.10 Un (step 0.01 Un)
- Inhibit threshold IIN-3H<[2] 0.05...1.50 In (step 0.01 In)
- Pickup time ≤ 0.03 s (UE3H< threshold)
  ≤ 0.04 s (UE3H> threshold)
- Dropout ratio 1.03...1.08 (27H element)
  0.95...0.98 (59H element)

DIRECTIONAL ACTIVE OVERPOWER - 32P

P1> Element

- P1> Tripping direction ($P_{1>DIR}$) P Forward/P Reverse/P Fw/Rev
- P1> Reset time delay ($t_{P1>RES}$) 0.00...100.0 s
- 32P First threshold definite time ($P_{1>def}$) 0.01...1.50 Pn
- P1>def Operating time ($t_{P1>def}$) 0.07...100.0 s

P2> Element

- P2> Tripping direction ($P_{2>DIR}$) P Forward/P Reverse/P Fw/Rev
- P2> Reset time delay ($t_{P2>RES}$) 0.00...100.0 s
- 32P Second threshold definite time ($P_{2>def}$) 0.01...1.50 Pn
- P2> Operating time ($t_{P2>def}$) 0.07...100.0 s

DIRECTIONAL REACTIVE OVERPOWER - 32Q

Q1> Element

- Q1> Tripping direction ($Q_{1>DIR}$) Q Forward/Q Reverse/Q Fw/Rev
- Q1> Reset time delay ($tQ_{1>RES}$) 0.00...100.0 s
- 32Q First threshold definite time ($Q_{1>def}$) 0.01...1.50 Qn
- Q1> Operating time ($tQ_{1>def}$) 0.07...100.0 s

Q2> Element

- Q2> Tripping direction ($Q_{2>DIR}$) Q Forward/Q Reverse/Q Fw/Rev
- Q2> Reset time delay ($t_{Q2>RES}$) 0.00...100.0 s
- 32Q Second threshold definite time ($Q_{2>def}$) 0.01...1.50 Qn
- Q2> Operating time ($t_{Q2>def}$) 0.07...100.0 s

UNDERCURRENT - 37 (SIDE L - SIDE H)

Each phase current is compared with adjustble threshold (**$I<_{def}$**), if at least one of the three currents goes down (**LOGIC OR**) or when all the three currents go down (**LOGIC AND**) the threshold a Start command is issued, after expiry of associated operate time (**$t<_{def}$**), a trip command is issued; if instead the currents exceed the threshold, the element is restored.

DIRECTIONAL ACTIVE UNDERPOWER 37P

Common configuration:

- CB-37P Enable (CB-37P) ON/OFF
- CB-37P Delay ($t_{ARM-P<}$) 0.07...300 s

P1< Element

- P1< Tripping direction ($P_{1>DIR}$) P Forward/P Reverse/P Fw/Rev
- 37P First threshold definite time ($P_{1<def}$) 0.01...1.50 Pn
- P1< Operating time ($t_{P1<def}$) 0.07...100.0 s

P2< Element

- P2< Tripping direction ($_{P1<DIR}$) P Forward/P Reverse/P Fw/Rev
- 37P Second threshold definite time ($P_{2<def}$) 0.01...1.50 Pn
- P2< Operating time ($t_{P2<def}$) 0.07...100.0 s

DIRECTIONAL REACTIVE UNDERPOWER 37Q

Common configuration:

- CB-37Q Enable (CB-37Q) ON/OFF
- CB-37Q Delay ($t_{ARM-Q<}$) 0.07...300 s

Q1< Element

- Q1< Tripping direction ($P_{1>DIR}$) P Forward/P Reverse/P Fw/Rev
- 37Q First threshold definite time ($Q_{1<def}$) 0.01...1.50 Qn
- Q1< Operating time ($t_{Q1<def}$) 0.07...100.0 s

Q2< Element

- Q2< Tripping direction ($P_{1>DIR}$) P Forward/P Reverse/P Fw/Rev
- 37Q Second threshold definite time ($Q_{2<def}$) 0.01...1.50 Qn
- Q2< Operating time ($t_{Q2<def}$) 0.07...100.0 s

LOSS OF FIELD - 40

Common configuration:

- Operating mode (Mode40) Motor/Generator
- Undervoltage threshold (USUP<) 0.50...1.00 Un

Alarm Element

- 40AL Alpha angle a 10...75°
- 40AL Operating time (t_{40AL}) 0.07...100.0 s

XC1-XD1 Element

- XC1 Absolute center coordinate (X_{C1}) 0.00...4.50 Znf
- XD1 Diameter (X_{D1}) 0.20...5.00 Znf
- XC1-XD1 Operating time ($t_{XC1-XD1}$) 0.07...100.0 s
- XC1-XD1 Reset time delay ($t_{XC1XD1-RES}$) 0.0...10.0 s

XC2-XD2 Element

- XC2 Absolute center coordinate (X_{C2}) 0.00...4.50 Znf
- XD2 Diameter (X_{D2}) 0.20...5.00 Znf
- XC2-XD2 Operating time (t_{XC2}-$_{XD2}$) 0.07...100.0 s
- XC2-XD2 Reset time delay ($t_{XC1XD2-RES}$) 0.0...10.0 s

NEGATIVE SEQUENCE OVERCURRENT FOR GENERATOR - 46MG

I_{2MGAL}> Element Definite time

- 46G Alarm threshold definite time ($I_{2MGAL>def}$) 0.03...0.50 IB
- $I_{2MGAL>def}$ Operating time ($t_{2MGAL>def}$) 0.07...100.0 s

I_{2MG}>> Element

- 46G Second threshold ($I_{2MG>>inv}$) 0.05...0.50 IB
- Heating time constant Kheat 0.1...40.0 s
- Cooling time constant Kcool 0.1...40.0 s
- Minimum operating time t_{2MIN} 0.07...100.0 s
- Maximum operating time t_{2MAX} 500...2000 s

NEGATIVE SEQUENCE FOR LINE-TRANSFORMER - 46 (SIDE L - SIDE H)

I_2> Element

- I_2> Curve type DEFINITE,
- I_2> Reset time delay ($t_2>_{RES}$) 0.00...100.0 s

Definite time

- 46LT First threshold definite time ($I_{2>def}$) 0.100...10.00 I_n
- $I_{2>def}$ Operating time ($t_2>_{def}$) 0.03...200 s

Inverse time

- 46LT First threshold inverse time ($I_2>_{inv}$) 0.100...10.00 I_n
- $I_{2>inv}$ Operating time ($t_2>_{inv}$) 0.02...60.0 s

I_2>> Element

- I_2>> Reset time delay ($t_2>>_{RES}$) 0.00...100.0 s

Definite time for CTs versions

- 46LT Second threshold definite time ($I>>_{def}$) 0.100...40.00 I_n
- $I_2>>_{def}$ Operating time ($t_2>>_{def}$) 0.03...10.00 s

NEGATIVE SEQUENCE CURRENT / POSITIVE SEQUENCE CURRENT RATIO - I2/I1 (SIDE L - SIDE H)

I_{21}> Element

- I_{21CLP}> Activation time ($t_{21CLP>}$) 0.00...100.0 s

Definite time

- I_2/I_1 First threshold definite time ($I_{21}>_{def}$) 0.10...1.00
- $I_{21}>_{def}$ Operating time ($t_{21}>_{def}$) 0.04..15000 s

PHASE REVERSAL- 47

Definite time

- Us1< threshold (Us1<) 0.05...0.30 En
- Us1> threshold (Us1>) 0.70...1.00 Un

THERMAL IMAGE FOR LINE-TRANSFORMER - 49 (SIDE L - SIDE H)

Common configuration:

- Initial thermal image $\Delta\theta_{IN}$ (Dth_{IN}) 0.0...1.0 $\Delta\theta_B$
- Reduction factor at inrush (K_{INR}) 1.0...3.0
- 49 Second harmonic restraint ($Dth_{2ndh-REST}$) OFF/ON

DthAL1 Element

- 49 First alarm threshold $\Delta\theta_{AL1}$ (Dth_{AL1}) 0.3...1.0 $\Delta\theta_B$

DthAL2 Element

- 49 Second alarm threshold $\Delta\theta_{AL2}$ (Dth_{AL2}) 0.5...1.2 $\Delta\theta_B$

Dth> Element

- 49 Trip threshold $\Delta\theta$ ($Dth>$) 1.100...1.300 $\Delta\theta_B$

THERMAL IMAGE FOR MOTOR-GENERATOR - 49MG

Common configuration:

- Initial thermal image $\Delta\theta_{IN}$ (Dth_{IN}) 0.0...1.0 $\Delta\theta_B$
- Starting overload coefficient (K_{ST}) 1.0...3.0
- Negative sequence coefficient (K_2) 0...10
- Heating time constant τ+ (T+) 1...200 min
- Cooling time constant τ- (T-) 1...6 t

DthAL1 Element

49 First alarm threshold $\Delta\theta_{AL1}$ (Dth_{AL1}) 0.3...1.0 $\Delta\theta_B$

DthAL2 Element

49 Second alarm threshold $\Delta\theta_{AL2}$ (Dth_{AL2}) 0.5...1.2 $\Delta\theta_B$

Dth> Element

49 Trip threshold Δθ (*Dth>*)	0.8... 1.5 $\Delta\theta_B$

PHASE OVERCURRENT - 50/51 (SIDE L - SIDE H)

I> Element

I> Curve type (*I>*Curve)	DEFINITE,
I_{CLP}> Activation time ($t_{CLP>}$)	0.00...100.0 s
I> Reset time delay ($t>_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50/51 First threshold definite time ($I>_{def}$)	0.100...40.0 I_n
$I>_{def}$ Operating time ($t>_{def}$)	0.04...200 s

Inverse time

50/51 First threshold inverse time ($I>_{inv}$)	0.100...20.00 I_n
$I>_{inv}$ Operating time ($t>_{inv}$)	0.02...60.0 s

I>> Element

Type characteristic	DEFINITE or I^2t
I>> Reset time delay ($t>>_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50/51 Second threshold definite time ($I>>_{def}$)	0.100...40.0 I_n
$I>>_{def}$ Operating time ($t>>_{def}$)	0.03...10.00 s

Inverse time

50/51 Second threshold inverse time ($I>>_{inv}$)	0.100...20.00 I_n
$I>>_{inv}$ Operating time (t>>$_{inv}$)	0.02...10.00 s

I>>> Element

I>>> Reset time delay (t>>>$_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50/51 Third threshold definite time ($I>>>_{def}$)	0.100...40.0 I_n
$I>>>_{def}$ Operating time (t>>>$_{def}$)	0.03...10.00 s

LOCKED ROTOR - 51LR(48)/14

I_{LR}> Element

Operating mode (*Mode 51LR>*)	With/without speed control

Inverse time

51LR First threshold inverse time ($I_{LR}>_{inv}$)	0.80...8.00 I_B
Motor starting current I-MOT-ST (I_{MOT-ST})	0.80...15.00 I_B
$I_{LR}>_{inv}$ Operating time ($t_{LR}>_{inv}$)	1.00...200 s

I_{LR}>> Element

Operating mode (*Mode 51LR>>*)	With/without speed control

Definite time

51LR Second threshold definite time ($I_{LR}>>_{def}$)	0.90...8.00 I_B
$I_{LR}>>_{def}$ Operating time ($t_{LR}>>_{def}$)	0.10...200 s

INADVERTENT ENERGIZATION (50+27)

IUE> threshold	0.05...4.00 In
UUE< threshold	0.10...1.00 En
Time delay trip tUE>	0.0...10.0 s
Reset time delay (tUE-RES)	0.00...10.00 s
Dropout ratio	0.95...0.98 (IUE> threshold) 1.02...1.05(UUE> threshold)
Reset time	≤ 0.05 s
Overshoot time	0.03 s
Reference values rest:	0 (IUE> threshold) rest: 1.2 (UUE> threshold) trip: 1.5 IUE> (IUE> threshold) trip: 0.8UUE>(UUE> threshold)
Pickup accuracy	± 4% ± 1% In ± 3% ± 0.05% En
Operate time accuracy	5% or ± 10 ms

VOLTAGE RESTRAINT OVERCURRENT - 51V

Common configuration:

Operating mode (Mode51V)	
Voltage restraint threshold ($U_{-I/U}$<)	0.10...1.00 U_n
Voltage controlled first threshold ($U_{-I/U-1}$<)	0.10...1.00 U_n
Voltage controlled second threshold ($U_{-I/U-2}$<)	0.10...1.00 U_n
Reduction factor (K)	0.10...1.00

$I_{-I/U}$> Element

$I_{-I/U}$> Reset time delay (t-$_{I/U}>_{RES}$)	0.00...100.0 s

Definite time

51V First threshold definite time (I-$_{I/U>def}$)	0.20...10.00 I_n
51V Operating time (t-$_{I/U}>_{def}$)	0.07...100.0 s

$I_{-I/U}$>> Element

51V Reset time delay (t-$_{I/U}>>_{RES}$)	0.00...100.0 s

Definite time

51V Second threshold definite time (I-$_{I/U>def}$>)	0.20...20.00 I_n
51V Operating time (I-$_{I/U}>>_{def}$)	0.07...100.0 s

RESIDUAL OVERCURRENT - 50N/51N OR HIGH IMPEDANCE RESTRICTED EARTH FAULT - 87N (1 - 2)

I_E> Element

I_E> Curve type (I_E>Curve)	DEFINITE,
I_E> Reset time delay ($t_E>_{RES}$)	0.00...100.0 s

Definite time

50N/51N First threshold definite time ($I_E>_{def}$)	0.005...10.00 I_{En}
$I_E>_{def}$ within CLP ($I_{ECLP>def}$)	0.005...10.00 I_{En}
$I_E>_{def}$ Operating time ($t_E>_{def}$)	0.04...200 s

Inverse time

50N/51N First threshold inverse time ($I_E>_{inv}$)	0.005...2.00 I_{En}
$I_E>_{inv}$ within CLP ($I_{ECLP>inv}$)	0.005...2.00 I_{En}
$I_E>_{inv}$ Operating time ($t_E>_{inv}$)	0.02...60.0 s

I_E>> Element

I_E>> Reset time delay ($t_E>>_{RES}$)	0.00...100.0 s

Definite time

50N/51N Second threshold definite time ($I_E>>_{def}$)	0.005...10.00 I_{En}
$I_E>>_{def}$ within CLP ($I_{ECLP>>def}$)	0.005...10.00 I_{En}
$I_E>>_{def}$ Operating time ($t_E>>_{def}$)	0.03...10.00 s

I_E>>> Element

I_{ECLP}>>> Reset time delay ($t_E>>>_{RES}$)	0.00...100.0 s

Definite time

50N/51N Third threshold definite time ($I_E>>>_{def}$)	0.005...10.00 I_{En}
$I_{ECLP}>>>_{def}$ within CLP ($I_{ECLP>>>def}$)	0.005...10.00 I_{En}
$I_{ECLP}>>>_{def}$ Operating time ($t_E>>>_{def}$)	0.03...10.00 s

CALCULATED RESIDUAL OVERCURRENT - 50N(COMP)/51N(COMP) (SIDE L - SIDE H)

I_{EC}> Element

I_{EC}> Curve type (I_{EC}>Curve)	DEFINITE,
I_{Ec}> Reset time delay ($t_{EC}>_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50N(Comp)/51N(Comp) First threshold ($I_{EC}>_{def}$)	0.100...40.0 I_n
$I_{EC}>_{def}$ within CLP ($I_{ECCLP>def}$)	0.100...40.0 I_n
$I_{EC}>_{def}$ Operating time ($t_{EC}>_{def}$)	0.04...200 s

Inverse time

50N(Comp)/51N(Comp First threshold ($I_{EC}>_{inv}$)	0.100...20.00 I_n
$I_{EC}>_{def}$ within CLP ($I_{ECCLP>inv}$)	0.100...20.00 I_n
$I_{EC}>_{inv}$ Operating time ($t_{EC}>_{inv}$)	0.02...60.0 s

I_{EC}>> Element

I_{Ec}>> Reset time delay ($t_E>>_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50N(Comp)/51N(Comp) Second threshold ($I_{EC}>>_{def}$)	0.100...40.0 I_n
$I_{EC}>>_{def}$ within CLP ($I_{ECCLP>>def}$)	0.100...40.0 I_n
$I_{EC}>>_{def}$ Operating time ($t_{EC}>>_{def}$)	0.03...10.00 s

I_{EC}>>> Element

I_{EC}>>> Reset time delay ($t_{EC}>>>_{RES}$)	0.00...100.0 s

Definite time for CTs versions

50N(Comp)/51N(Comp) Third threshold ($I_{EC}>>>_{def}$)	0.100...40.0 I_n
$I_{ECLP}>>>_{def}$ within CLP ($I_{ECLP>>>def}$)	0.100...40.0 I_n
$I_{EC}>>>_{def}$ Operating time ($t_{EC}>>>_{def}$)	0.03...10.00 s

MINIMUM POWER FACTOR - 55

Common configuration:

- CB-55 Delay ($t_{ARM\text{-}CPhi}$<) 0.07...300 s

CPhi1< Element

- CPhi1< Tripping direction (CPhi1<$_{DIR}$) CosPhi Lag/CosPhi Lead/Lag/CosPhi Lag-Lead
- 55 First threshold definite time (CPhi1<$_{def}$) 0.10...0.99
- CPhi1< Operating time (t_{CPhi1}<$_{def}$) 0.04...100.0 s

CPhi2< Element

- CPhi2< Tripping direction (CPhi2<$_{DIR}$) CosPhi Lag/CosPhi Lead/Lag/CosPhi Lag-Lead
- 55 Second threshold definite time (CPhi2<$_{def}$) 0.10...0.99
- CPhi2< Operating time (t_{CPhi2}<$_{def}$) 0.04...100.0 s

OVERVOLTAGE - 59

Common configuration:

- Voltage measurement type for 59 (Utype59) [1] $U_{ph\text{-}ph}/U_{ph\text{-}n}$
- 59 Operating logic (Logic59) AND/OR

U> Element

- U> Curve type (U>Curve) DEFINITE / INVERSE [2]

Definite time

- 59 First threshold definite time (U>$_{def}$) 0.50...1.50 U_n/E_n
- U>$_{def}$ Operating time (t_U>$_{def}$) 0.03...100.0 s

Inverse time

- 59 First threshold inverse time (U>$_{inv}$) 0.50...1.50 U_n/E_n
- U>$_{inv}$ Operating time (t_U>$_{inv}$) 0.10...100.0 s

U>> Element

Definite time

- 59 Second threshold definite time (U>>$_{def}$) 0.50...1.50 U_n/E_n
- U>>$_{def}$ Operating time (t_U>>$_{def}$) 0.03...100.0 s

RESIDUAL OVERVOLTAGE - 59N

Common configuration:

- Residual voltage measurement for 59N- direct/calc.[3] U_E /U_{EC}
- 59N Operating mode from 74VT internal (*74VTint59N*) OFF/Block
- 59N Operating mode from 74VT external (*74VText59N*) OFF/Block

U_E> Element

- U_E> Curve type (U_E>Curve) DEFINITE, INVERSE
- U_E> Reset time delay ($t_{UE>RES}$) 0.00...100.0 s

Definite time

- 59N First threshold definite time (U_E>$_{def}$) 0.01...0.70 U_{En}
- U_E>$_{def}$ Operating time (t_{UE}>$_{def}$) 0.07...100.0 s

Inverse time

- 59N First threshold inverse time (U_E>$_{inv}$) 0.01...0.50 U_{En}
- U_E>$_{inv}$ Operating time (t_{UE}>$_{inv}$) 0.10...100.0 s

U_E>> Element

- U_E>> Reset time delay ($t_{UE>>RES}$) 0.00...100.0 s
- 59N Second threshold definite time (U_E>>$_{def}$) 0.01...0.70 U_{En}
- U_E>>def Operating time (t_{UE}>>$_{def}$) 0.07...100.0 s

NEGATIVE SEQUENCE OVERVOLTAGE - 59V2

U_2> Element

Definite time

- 59V2 First threshold definite time (U_2>$_{def}$) 0.01...0.50 E_n
- U_2>$_{def}$ Operating time (t_{U2}>$_{def}$) 0.07...100.0 s

ROTOR EARTH FAULT- 64F

RFAL< Element:

First threshold definite time (RFAL<def) 0.50...50.00 kΩ
Operating time (tRF<def) 0.07...9.99 s
10.0...100.0 s

RFAL<< Element:

Second threshold definite time (RFAL<<def) 0.50...20.00 kΩ
Operating time (tRF<<def) 0.07...0.99 s
10.0...100.0 s

LOW IMPEDANCE RESTRICTED EARTH FAULT - 64REF

Minimum threshold (IREF>) 0.05...2.00 I_{En}
Intentional delay (tREF>) 0.03...60.00 s

MAXIMUM NUMBER OF STARTINGS (RESTART INHIBITION) - 66

Operating mode (*Type66*) NST/TST
Control window (t_C) 1...60 min
N_{ST} (Starts inside t_C) 1...30
T_{ST} (Cumulative start time inside t_C) 1...600 s
66 Inhibition time (t_{IN}) 0...60 min

DIRECTIONAL PHASE OVERCURRENT - 67 (VOLT. CONS)

Common configuration:

- 67 Operating mode (Mode67) I/I.cos
- 67 Operating logic (Logic67) 1/3 / 2/
- 67 Operating mode from 74VT internal OFF/Block/Not directional
- 67 Operating mode from 74VT external (74VText67) OFF/Block/Not directional

I_{PD}> Element

- IPD> Curve type (IPD>Curve) DEFINITE,
- I_{PD}> Reset time delay (t_{PD}>$_{RES}$) 0.00...100.0 s

Definite time for CTs versions

- 67 First threshold definite time (IPD>def) 0.100...40.0 In
- IPD>def characteristic angle (ThetaPD>def) 0...359°
- IPD>def within CLP (IPDCLP>def) 0.100...40.0 In
- IPD>def Operating time (tPD>def) 0.05...200 s

Inverse time

- 67 First threshold inverse time (I_{PD}>$_{inv}$) 0.100...10.0 I_n
- I_{PD}>$_{inv}$ characteristic angle ($Theta_{PD>inv}$) 0...359°
- I_{PD}>$_{inv}$ within CLP ($I_{PDCLP>inv}$) 0.100...10.0 I_n
- I_{PD}>$_{inv}$ Operating time (t_{PD}>$_{inv}$) 0.02...60.0 s

I_{PD}>> Element

- I_{PD}> Curve type (I_{PD}>>Curve) DEFINITE,
- I_{PD}>> Reset time delay (t_{PD}>>$_{RES}$) 0.00...100.0 s

Definite time for CTs versions

- 67 Second threshold definite time (I_{PD}>>$_{def}$) 0.100...40.0 I_n
- I_{PD}>>$_{def}$ characteristic angle ($Theta_{PD>>def}$) 0...359°
- I_{PD}>>$_{def}$ within CLP ($I_{PDCLP>>def}$) 0.100...40.0 I_n
- I_{PD}>>$_{def}$ Operating time (t_{PD}>>$_{def}$) 0.05...200 s

Inverse time

- 67 Second threshold inverse time (I_{PD}>>$_{inv}$) 0.100...10.0 I_n
- I_{PD}>>$_{inv}$ characteristic angle ($Theta_{PD>>inv}$) 0...359°
- I_{PD}>>$_{inv}$ within CLP ($I_{PDCLP>>inv}$) 0.100...10.0 I_n
- I_{PD}>>$_{inv}$ Operating time (t_{PD}>>$_{inv}$) 0.02...60.0 s

I_{PD}>>> Element

- I_{PD}>>> Reset time delay (t_{PD}>>>$_{RES}$) 0.00...100.0 s

Definite time for CTs versions

- 67 Third threshold definite time (I_{PD}>>>$_{def}$) 0.100...40.0 I_n
- I_{PD}>>>$_{def}$ characteristic angle ($Theta_{PD>>>def}$) 0...359°
- I_{PD}>>>$_{def}$ within CLP ($I_{PDCLP>>>def}$) 0.100...40.0 I_n
- I_{PD}>>>$_{def}$ Operating time (t_{PD}>>>$_{def}$) 0.05...10.00 s

I_{PD}>>>> Element

- I_{PD}>>>> Reset time delay (t_{PD}>>>>$_{RES}$) 0.00...100.0 s

Definite time for CTs versions

- 67 Fourth threshold definite time (I_{PD}>>>>$_{def}$) 0.100...40.0 I_n
- I_{PD}>>>>$_{def}$ characteristic angle ($Theta_{PD>>>>def}$) 0...359°
- I_{PD}>>>>$_{def}$ within CLP ($I_{PDCLP>>>>def}$) 0.100...40.0 I_n
- I_{PD}>>>>$_{def}$ Operating time (t_{PD}>>>>$_{def}$) 0.05...10.00 s

DIRECTIONAL EARTH FAULT - 67N

Common configuration:

- 67N Operating mode (*Mode67N*) *I/I·cos*
- Residual voltage measurement type for 67N - direct/calculated (*3VoType67N*) [3] U_E / U_{EC}
- 67N Multiplier of threshold for insensitive zone (*M*) 1.5...10.0
- 67N Operating mode from 74VT internal (*74VTint67N*) OFF/Block/Not directional

- 67N Operating mode from 74VT external (*74VText67N*) OFF/Block/Not directional

IED> Element

- I_{ED}> Curve type — DEFINITE
- I_{ED}> Reset time delay ($t_{ED>RES}$) — 0.00...100.0 s

Definite time

67N First threshold definite time ($I_{ED>def}$ - $U_{ED>def}$)

- Residual current pickup value — 0.002...10.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>def}$ Operating time ($t_{ED>def}$) — 0.05...200 s

Inverse time

67N First threshold inverse time ($I_{ED>inv}$ - $U_{ED>inv}$)

- Residual current pickup value — 0.002...2.00 I_{ED}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>inv}$ Operating time ($t_{ED>inv}$) — 0.02...60.0 s

I_{ED}>> Element

- I_{ED}> Curve type (I_{ED}>>Curve) — DEFINITE
- I_{ED}>> Reset time delay ($t_{ED>>RES}$) — 0.00...100.0 s

Definite time

67N Second threshold definite time ($I_{ED>>def}$ - $U_{ED>>def}$)

- Residual current pickup value — 0.002...10.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>>def}$ within CLP ($I_{EDCLP>>def}$) — 0.002...10.00 I_{En}
- $I_{ED>>def}$ Operating time ($t_{ED>>def}$) — 0.05...10.00 s

Inverse time

67N Second threshold inverse time ($I_{ED>>inv}$ - $U_{ED>>inv}$)

- Residual current pickup value — 0.002...2.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>inv}$ within CLP ($I_{EDCLP>>inv}$) — 0.002...2.00 I_{En}
- $I_{ED>inv}$ Operating time ($t_{ED>>inv}$) — 0.02...10.00 s

I_{ED}>>> Element

- CLP Activation time ($t_{EDCLP>>>}$) — 0.00...100.0 s
- I_{ED}>>> Reset time delay ($t_{ED>>>RES}$) — 0.00...100.0 s

Definite time

67N Third threshold definite time ($I_{ED>>>def}$ - $U_{ED>>>def}$)

- Residual current pickup value — 0.002...10.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>>>def}$ within CLP ($I_{EDCLP>>>def}$) — 0.002...10.00 I_{En}
- $I_{ED>>>def}$ Operating time ($t_{ED>>>def}$) — 0.05...10.00 s

I_{ED}>>>> Element

- CLP Activation time ($t_{EDCLP>>>>}$) — 0.00...100.0 s
- I_{ED}>>>> Reset time delay ($t_{ED>>>>RES}$) — 0.00...100.0 s

Definite time

67N Fourth threshold definite time ($I_{ED>>>>def}$ - $U_{ED>>>>def}$)

- Residual current pickup value — 0.002...10.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>>>>def}$ within CLP ($I_{EDCLP>>>>def}$) — 0.002...10.00 I_{En}
- $I_{ED>>>>def}$ Operating time ($t_{ED>>>>def}$) — 0.05...10.00 s

IED>>>>> Element

- CLP Activation time ($t_{EDCLP>>>>>}$) — 0.00...100.0 s
- I_{ED}>>>>> Reset time delay ($t_{ED>>>>>RES}$) — 0.00...100.0 s

Definite time

67N Fifth threshold definite time ($I_{ED>>>>>def}$ - $U_{ED>>>>>def}$)

- Residual current pickup value — 0.002...10.00 I_{En}
- Residual voltage pickup value — 0.004...0.500 U_{En}
- Characteristic angle — 0...359°
- Half operating sector — 1...180°
- $I_{ED>>>>>def}$ within CLP ($I_{EDCLP>>>>>def}$) — 0.002...10.00 I_{En}
- $I_{ED>>>>>def}$ Operating time ($t_{ED>>>>>def}$) — 0.05...10.00 s

Intermittent ground faults discrimination

- Start 59N reset time delay ($t_{ED>6RRIC59N}$) — 0.01...2.00 s
- Start 67N reset time delay ($t_{ED>6RRIC67N}$) — 0.01...2.00 s
- Residual voltage threshold ($I_{ED>6-UE>}$) — 0.040...1.500
- Operate time ($t_{ED>6}$) — 0.05...60.0 s
- Maximum failure time for inhibition ($t_{ED>6Inb}$) — 0.05...60.0 s
- Inhibition holding time ($t_{ED>61s}$) — 0.05...60.0 s

Evolutive ground faults discrimination

- Start 59N reset time delay ($t_{ED>7RRIC}$) — 0.01...2.00 s
- Observation activation delay ($t_{ED>7RAO}$) — 0.01...2.00 s
- Residual voltage threshold ($I_{ED>7-UE>}$) — 0.040...1.500 U_{En}
- Observation time ($t_{ED>7-O}$) — 0.05...60.0 s

OUT OF STEP - 78

Setpoints

- 78 threshold delta AL — 0 ....180 deg (step 1 deg)
- 78 threshold delta TR — 0 ....180 deg (step 1 deg)
- 78 Reset time delay — 0.05...30.00 s (step 0.01 s)
- Alarm 1 Operating time — 0 ...500 ms (step 1 ms)
- Alarm 1 Hold time — 0 ...1000 ms (step 1 ms)
- TripA Hold time — 0 ...1000 ms (step 1 ms)
- TripB Hold time — 0 ...1000 ms (step 1 ms)
- 78 threshold Zone A — 1 ... 20 (step 1)
- 78 threshold Zone B — 1 ... 20 (step 1)

Blocking parameters

- 78 I_2> threshold — 0.05 ...5.00 IB (0.01 IB)
- 78 I_1< threshold — 0.10 ...4.00 IB (0.01 IB)
- 78 U> threshold — 0.50 ...1.50 Un (0.01 Un)

OVERFREQUENCY - 81O

f> Element

Definite time

- 81O First threshold definite time ($f>_{def}$) — 1.000....1.200 f_n
- $f>_{def}$ Operating time ($t_{f>def}$) — 0.05...100.0 s

f>> Element

Definite time

- 81O Second threshold definite time ($f>>_{def}$) — 1.000....1.200 f_n
- $f>>_{def}$ Operating time ($t_{f>>def}$) — 0.05...100.0 s

UNDERFREQUENCY - 81U

f< Element

Definite time

- 81U First threshold definite time ($f<_{def}$) — 0.800...1.000 f_n
- $f<_{def}$ Operating time ($t_{f<def}$) — 0.05...100.0 s

f<< Element

Definite time

- 81U Second threshold definite time ($f<_{def}$) — 0.800...1.000 f_n
- $f<_{def}$ Operating time ($t_{f<def}$) — 0.05...100.0 s

f<<< Element

Definite time

- 81U Third threshold definite time ($f<_{def}$) — 0.800...1.000 f_n
- $f<_{def}$ Operating time ($t_{f<def}$) — 0.05...100.0 s

f<<<< Element

Definite time

- 81U Fourth threshold definite time ($f<_{def}$) — 0.800...1.000 f_n
- $f<_{def}$ Operating time ($t_{f<def}$) — 0.05...100.0 s

FREQUENCY RATE OF CHANGE - 81R

df> Element

- df> Operating mode (df>mode) — Module/Positive/Negative

Definite time

- 81R First threshold definite time ($df>_{def}$) — 0.1...10.0 Hz/s
- $df>_{def}$ Operating time ($tdf>_{def}$) — 0.00...100.0 s

df>> Element

- df>> Operating mode (df>>mode) — Module/Positive/Negative

Definite time

- 81R First threshold definite time ($df>_{def}$) — 0.1...10.0 Hz/s
- $df>>_{def}$ Operating time ($tdf>>_{def}$) — 0.00...100.0 s

df>>> Element

- df>>> Operating mode (df>>>mode) Module/Positive/Negative

Definite time

- 81R First threshold definite time (df>>>$_{def}$) 0.1...10.0 Hz/s
- df>>>$_{def}$ Operating time (tdf>>>$_{def}$) 0.00...100.0 s

df>>>> Element

- df>>>> Operating mode (df>>>>mode) Module/Positive/Negative

Definite time

- 81R First threshold definite time (df>>>>def) 0.1...10.0 Hz/s
- df>>>>def Operating time (tdf>>>>$_{def}$) 0.00...100.0 s

DIFFERENTIAL - 87G-87M-87T

Harmonic restraint (87T)

- 87T Second harmonic restraint threshold (2nd-REST>) 10...80% Id (step 1% Id)
- 87T Fifth harmonic restraint threshold (5th-REST>) 10...80% Id (step 1% Id)
- 87T Harmonic restraint intentional reset time delay (tH-RES) 0.00...10.00 s (step 0.01 s)
- 87T Cross phase harmonic restraint enable (CROSS H-RES) ON/OFF

CT saturation detector (87M-87G-87T)

- Saturation detector enable ($S_{at\text{-}Det}$) ON/OFF
- Saturation detector intentional reset time delay ($t_{Sat\text{-}Det\text{-}RES}$) 0.00...0.50 s (step 0.01 s)

Id>> Element (87M-87G-87T)

- Second threshold (I_d>>) 0.50...30.00 I_{nref} (step 1.00 I_{nref})
- Second threshold operating time I_d>> (t_d>>) 0.03 s

VECTOR JUMP - (DPHI)

D_{PHI}> Element

dphi> Operating mode (Mode-dphi>) Module/Positive/Negative

Definite time

dphi> First threshold (dPHI>def) 1...30 °
dphi> Reset time delay (dPHI>RES) 0.00...100.0 s

BREAKER FAILURE - BF

BF Phase current threshold (I_{BF}>) 0.05...1.00 I_n
BF Residual current threshold (I_{EBF}>) 0.01..2.00 I_{En}
BF Time delay (t_{BF}) 0.06...10.00 s

SELECTIVE BLOCK - BLOCK2

Selective block IN:

- BLIN Max activation time for phase prot. ($t_{B\text{-}IPh}$) 0.10...10.00 s
- BLIN Max activation time for ground prot. ($t_{B\text{-}IE}$) 0.10...10.00 s

Selective block OUT:

- BLOUT Dropout time delay for phase elements ($t_{F\text{-}IPh}$) 0.00...1.00 s
- BLOUT Drop-out time delay for ground elements ($t_{F\text{-}IE}$) 0.00...1.00 s

INTERNAL SELECTIVE BLOCK - BLOCK4

- Output internal selective block dropout time for phase protections ($t_{F\text{-}IPh}$) 0.00...10.00 s
- Output internal selective block dropout time for ground protections ($t_{F\text{-}IE}$) 0.00...10.00 s

SECOND HARMONIC RESTRAINT - 2ndh-REST (SIDE L - SIDE H)

Second harmonic restraint threshold (I_{2ndh}>) 10...50 %
I_{2ndh}> Reset time delay ($t_{2ndh>RES}$) 0.00...100.0 s

VT SUPERVISION - 74VT

74VT Negative sequence overvoltage threshold ($U_{2VT>}$) 0.05...0.50 E_n
74VT Negative sequence overvoltage threshold ($I_{2VT>}$) 0.05...0.50 I_n
74VT Phase undervoltage threshold ($U_{VT<}$) 0.05...0.50 E_n
74VT Minimum change of current threshold 74VT ($D_{IVT<}$) 0.05...0.50 I_n
74VT Undercurrent inhibition threshold ($I_{VT<}$) 0.100...40.0 I_n
74VT Alarm time delay ($t_{VT\text{-}AL}$) 0.0...10.0 s

CT SUPERVISION - 74CT (SIDE L - SIDE H)

74CT Threshold (*S*<) 0.10...0.95
74CT Overcurrent threshold (*I**) 0.10...1.00 I_n
S< Operating time (t_S<) 0.03...200 s

CIRCUIT BREAKER SUPERVISION - 74 TCS

Number of CB trips (*N.Open*) 0...10000
Cumulative CB tripping currents (*SumI*) 0...5000 I_n
CB opening time for I^2t calculation (t_{break}) 0.05...1.00 s
Cumulative CB tripping I^2t (*SumI^2t*) 0...5000 I_n^2.s
CB max allowed opening time (t_{break}>) 0.05...1.00 s

PILOT WIRE DIAGNOSTIC

BLOUT1 Diagnostic pulses period OFF - 0.1-1-5-10-60-120 s
BLIN1 Diagnostic pulses control time interval (PulseBLIN1) OFF - 0.1-1-5-10-60-120 s

DEMAND MEASURES

Fixed demand period (t_{FIX}) 1...60 min
Rolling demand period (t_{ROL}) 1...60 min
Number of cycles for rolling on demand ($N._{ROL}$) 1...24

ARC FLASH (SIDE L - SIDE H)

Measure Mode (ARC Measure) 1...4 samples
Minimum pulse width 10...2000 ms (step 1 ms)
Enable ArcFlash IL 0.10...40.00 In (step 0.01 In)
Enable ArcFlash IE 0.01...10.00 In (step 0.01 In)
Test fibers timer 0...240s (step 1s)

METERING & RECORDING

Full description about measures is available in relevant equipment documentation.

Typology	Measure	Symbol
Direct	Locked frequency	f_L
	Phase to Phase voltage frequency	f_{U12}, f_{U23}, f_{U31}
	Phase currents (Side L - SideH)	I_{L1L}, I_{L2L}, I_{L3L}
		I_{L1H}, I_{L2H}, I_{L3H}
	RMS value of fundamental comp. for phase currents (Side L)	I_{L1Lrms}, I_{L2Lrms}, I_{L3Lrms}
	RMS value of fundamental comp. for phase voltages	U_{L1}, U_{L2}, U_{L3}
	V_2 voltage	V_2
	RMS value of fundamental com. for residual current 1	I_{E1}
	RMS value of fundamental com. for residual current 2	I_{E2}
	RMS value of fundamental com. for residual voltage	U_E
L1 phase	Compensated phase current (Side L - Side H)	I_{L2cL}
		I_{L2cH}
	Stabilization phase current	I_{SL2}
	Differential phase current	I_{DL2}
	2nd harmonic of differential phase current	$I_{DL2\text{-}2nd}$
	5th harmonic of differential phase current	$I_{DL2\text{-}2th}$
L2 phase	Compensated phase current (Side L - Side H)	I_{L3cL}
		I_{L3cH}
	Stabilization phase current	I_{SL3}
	Differential phase current	I_{DL3}
	2nd harmonic of differential phase current	$I_{DL3\text{-}2nd}$
	5th harmonic of differential phase current	$I_{DL3\text{-}2th}$
L3 phase	Compensated phase current (Side L - Side H)	I_{L1cL}
		I_{L1cH}
	Stabilization phase current	I_{SL1}
	Differential phase current	I_{DL1}
	2nd harmonic of differential phase current	$I_{DL1\text{-}2nd}$
	5th harmonic of differential phase current	$I_{DL1\text{-}2th}$
Calculated	Phase-to-phase voltages	U_{12}, U_{23}, U_{31}
	Calculated residual voltage	U_{EC}
	Calculated residual current (Side L - Side H)	I_{ECL}
		I_{ECH}
	Stabilization current (Side H)	I_{ESH}
	Thermal image	DThetaL
		DThetaH
		DThetaMG
	Flux $U_{max/f}$	U/f
	Frequency rate of change	df/dt
	Field to ground resistence	RF
	Maximum current between I_{L1L}-I_{L2L}-I_{L3L}	I_{LmaxL}
	Minimum current between I_{L1L}-I_{L2L}-I_{L3}	I_{LminL}
	Average current between I_{L1L}-I_{L2L}-I_{L3}	I_{LL}
	Maximum current between I_{L1H}-I_{L2H}-I_{L3H}	I_{LmaxH}
	Minimum current between I_{L1H}-I_{L2H}-I_{L3H}	I_{LminH}
	Average current between I_{L1H}-I_{L2H}-I_{L3H}	I_{LH}
	Maximun RMS current between I_{L1Lrms}-I_{L2Lrms}-I_{L3Lrms}	$I_{LmaxL\text{-}rms}$
	Minimum RMS current between I_{L1Lrms}-I_{L2Lrms}-I_{L3Lrms}	$I_{LminL\text{-}rms}$
	Average current between I_{L1Lrms}-I_{L2Lrms}-I_{L3Lrm}	I_L
	Maximum voltage between U_{L1}-U_{L2}-U_{L3}	U_{Lmax}
	Minimum voltage between U_{L1}-U_{L2}-U_{L3}	U_{Lmin}
	Average voltage between U_{L1}-U_{L2}-U_{L3}	U_L
	Maximum voltage between U_{12}-U_{23}-U_{31}	U_{max}
	Minimum voltage between U_{12}-U_{23}-U_{31}	U_{min}
	Average voltage between U_{12}-U_{23}-U_{31}	U

Typology	Measure	Symbol	
Displacement	Displacement angle of I_{L1L} respect to U_{L1}	PhiL1	
	Displacement angle of I_{L2L} respect to U_{L2}	PhiL2	
	Displacement angle of I_{L3L} respect to U_{L3}	PhiL3	
	Displacement angle of I_{L1L} respect to U_{23}	Alpha1	
	Displacement angle of I_{L2L} respect to U_{31}	Alpha2	
	Displacement angle of I_{L3L} respect to U_{12}	Alpha3	
	Displacement angle of U_E respect to I_{E2}	PhiE	
	Displacement angle of U_{EC} respect to I_{E2}	PhiEC	
	Displacement angle of U_E respect to I_{ECL} /I_{ECH}	PhiE-$I_{EC(L/H)}$	
	Displacement angle of U_{EC} respect to I_{ECL} /I_{ECH}	PhiEC-$I_{EC(L/H)}$	
Sequence	Positive sequence current (Side L)	I_{1L}	
	Negative sequence current (Side L)	I_{2L}	
	Negative sequence/positive sequence current ratio (Side L)	I_{2L}/I_{1L}	
	Positive sequence current (Side H)	I_{1H}	
	Negative sequence current (Side H)	I_{2H}	
	Negative sequence/positive sequence current ratio (Side H)	I_{2H}/I_{1H}	
	Positive sequence voltage	U_1	
	Negative sequence voltage	U_2	
Power	Total active power	P	
	Total reactive power	Q	
	Total apparent power	S	
	Power factor	cosPhi	
	L_1, L_2, L_3 Phase active powers	P_{L1}, P_{L2}, P_{L3}	
	L_1, L_2, L_3 Phase reactive powers	Q_{L1}, Q_{L2}, Q_{L3}	
	L_1, L_2, L_3 Phase power factor	$CosPhiL_{1...3}$	
Impedance	Resistive component of L_1 phase impedance	R_{L1}	
	Reactive component of L_1 phase impedance	X_{L1}	
	L_1 phase impedance	Z_{L1}	
	Phase to Phase impedance	Z_{12}, Z_{23}, Z_{31}	
2nd Harmonic	2nd harmonic of phase currents (Side L - Side H)	$I_{L1L...3\text{-}2nd}$	$I_{L1H...3\text{-}2nd}$
	Max of the 2nd harmonic phase currents/Fundamental component percentage ratio I_{2nd} /I_L (Side L - Side H)	I_{2nd_L}/I_{LL}	I_{2nd_H}/I_{LH}
3rd Harmonic	3rd harmonic of phase currents (Side L - Side H)	$I_{L1L...3\text{-}3rd}$	$I_{L1H...3\text{-}3rd}$
	3rd harmonic of residual currents (I_{E1} - I_{E2})	$I_{E1\text{-}3rd}$	$I_{E2\text{-}3rd}$
	3rd harmonic of residual voltage	$U_{E\text{-}3rd}$	
4th Harmonic	4th harmonic of phase currents (Side L - Side H)	$I_{L1L...3\text{-}4th}$	$I_{L1H...3\text{-}4th}$
5th Harmonic	5th harmonic of phase currents (Side L - Side H)	$I_{L1L...3\text{-}5th}$	$I_{L1H...3\text{-}5th}$
Synchro check	V_1 voltage	V_1	
	V_2 voltage	V_2	
	V_1 frequency	fV_1	
	V_2 frequency	fV_2	
	V_1 V_2 voltage difference	DV	
	V_1 V_2 frequency difference	Df	
	Displacement angle of V_2 respect to V_1	Phi V_1V_2	
Demand phase (Side L - Side H)	Phase fixed currents demand	$I_{L1...3FIXL}$	$I_{L1...3FIXH}$
	Phase rolling currents demand	$I_{L1...3ROLL}$	$I_{L1...3ROLH}$
	Phase peak currents demand	$I_{L1...3MAXL}$	$I_{L1...3MAXH}$
	Phase minimum currents demand	$I_{L1...3MINL}$	$I_{L1...3MINH}$
Demand power	Fixed active power demand	P_{FIX}	
	Fixed reactive power demand	Q_{FIX}	
	Rolling active power demand	P_{ROL}	
	Rolling reactive power demand	Q_{ROL}	
	Maximum active power demand	P_{MAX}	
	Maximum reactive power demand	Q_{MAX}	
	Minimum active power demand	P_{MIN}	
	Minimum reactive power demand	Q_{MIN}	

Typology	Measure	Symbol
Energy	Positive active energy	E_A+
	Negative active energy	E_A-
	Total active energy	E_A
	Positive reactive energy	E_Q+
	Negative reactive energy	E_Q-
	Total reactive energy	E_Q
78 Function	Impedance	ZN
	Resistive component impedance	RN
	Reactive component impedance	XN
	CosPhi impedance	CosPhi
	78 Angle	Delta
	Frequecy rate of change angle	fDelta
	Discrimination threshold zone A/B	Zone
	Zone A number of transition	NA
	Zone B number of transition	NB
PT100	Temperature Pt1...Pt8	T1...T8

EVENT RECORDING (SER)

Number of events 1000
Recording mode circular

Trigger:

- Start/Trip of enabled protection or control element
- Binary inputs switching (OFF/ON or ON/OFF)

Data recorded:

- Counter (resettable by ThyVisor) 0...10^9
- Time stamp Date and time

FAULT RECORDING (SFR)

Number of faults 20
Recording mode circular

Trigger:

- Output relays of enabled protection or control element (OFF-ON)
- External trigger (binary inputs) IN1-1...IN1-16, IN2-1...IN2-16

DIGITAL FAULT RECORDER (DFR)

File format COMTRADE
Records depending on setting
Recording mode circular
Sampling rate 32 samples per cycle

Trigger setup(*)

- Pre-trigger time 0.05...1.00 s
- Post-trigger time 0.05...60.00 s

Set sample channels(*)

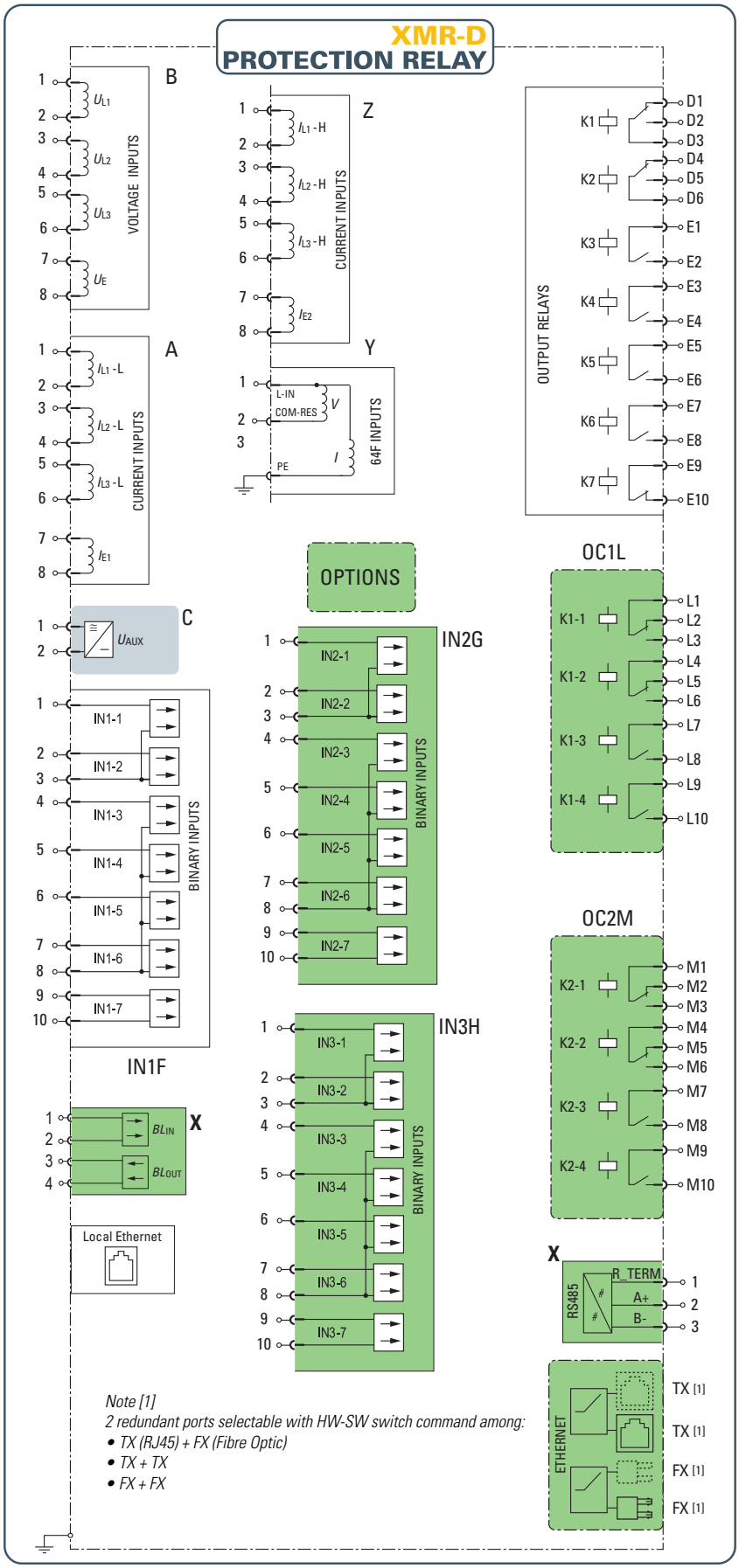
- Instantaneous phase currents i_{L1}, i_{L2}, i_{L3}
- Instantaneous residual current i_E

Number of settable analogue channels(*) ***from 1 up to 12***

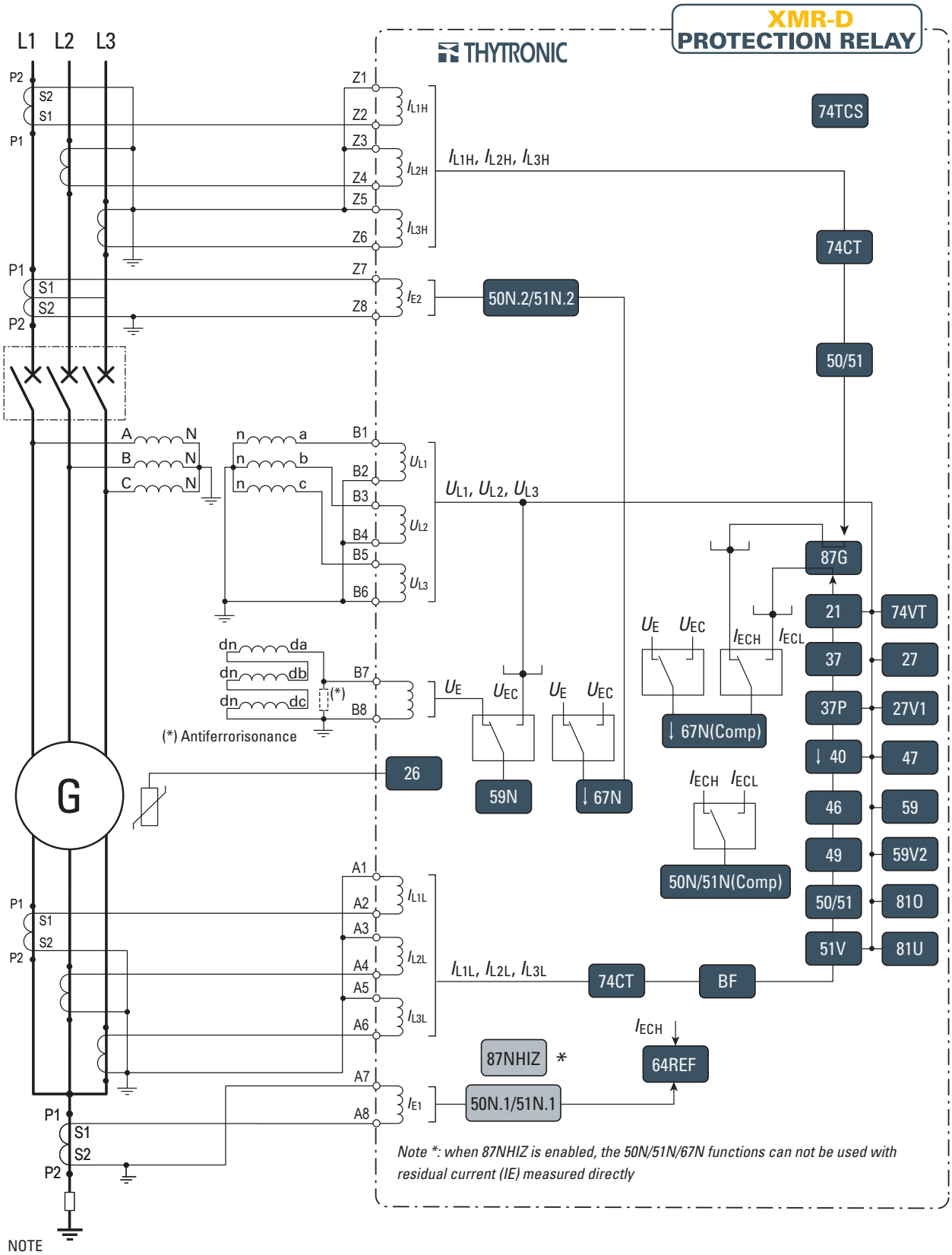
Number of settable digital channel(*) ***from 1 ut to 12:***

(*) Consult equipment manual for associated parameters description.

INPUT/OUTPUT BASIC SCHEME



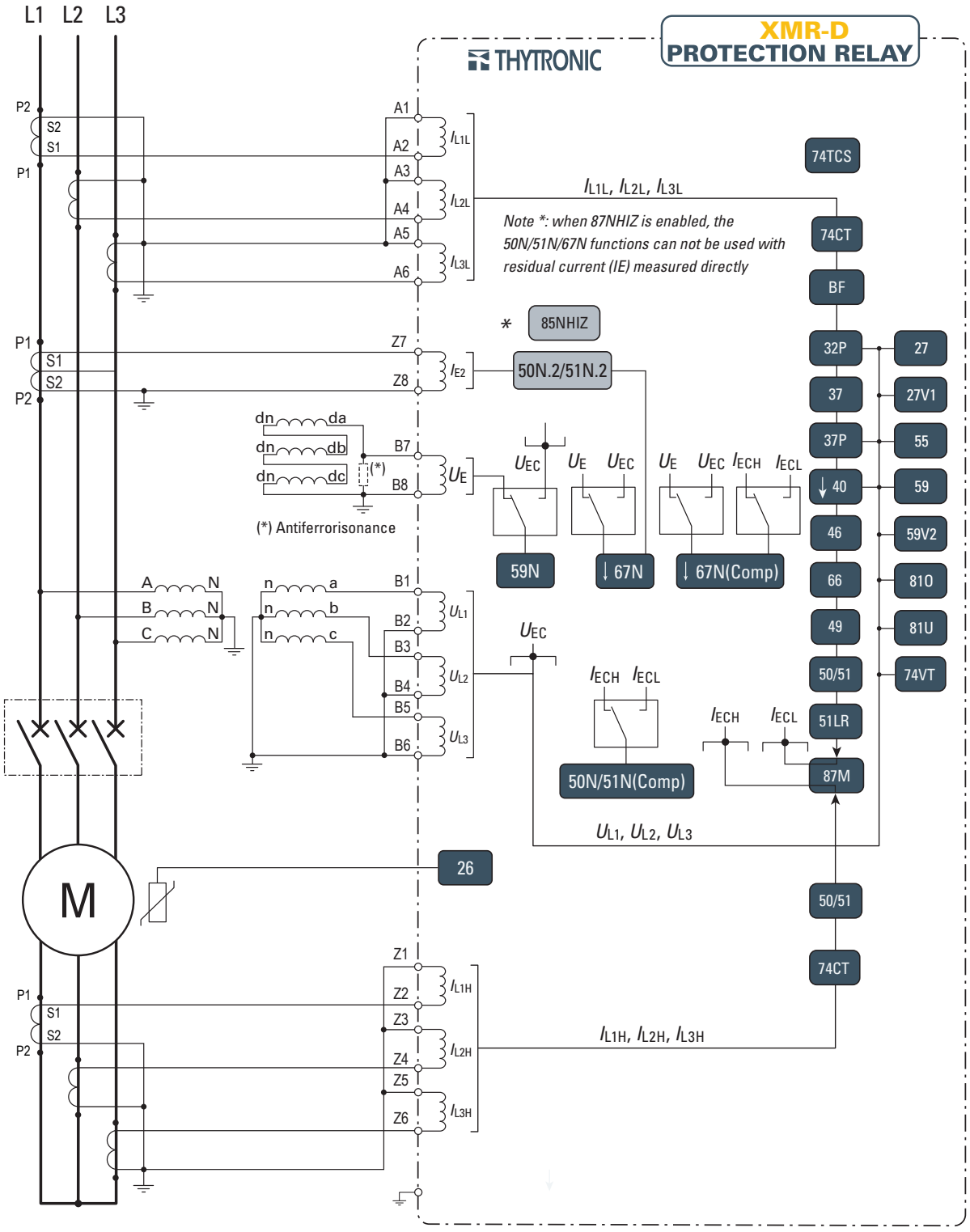
PROTECTIVE FUNCTIONS



NOTE
Incoming currents must be connected to relay reference amperometric input terminals; outgoing currents must be connected to protection relay amperometric output terminals.
Incoming currents in relay reference terminals are considered positive, while the outgoing ones are considered negative.
CONVENTION - CT's P1 polarity is indicated towards protected component.

Differential Protection - Generator

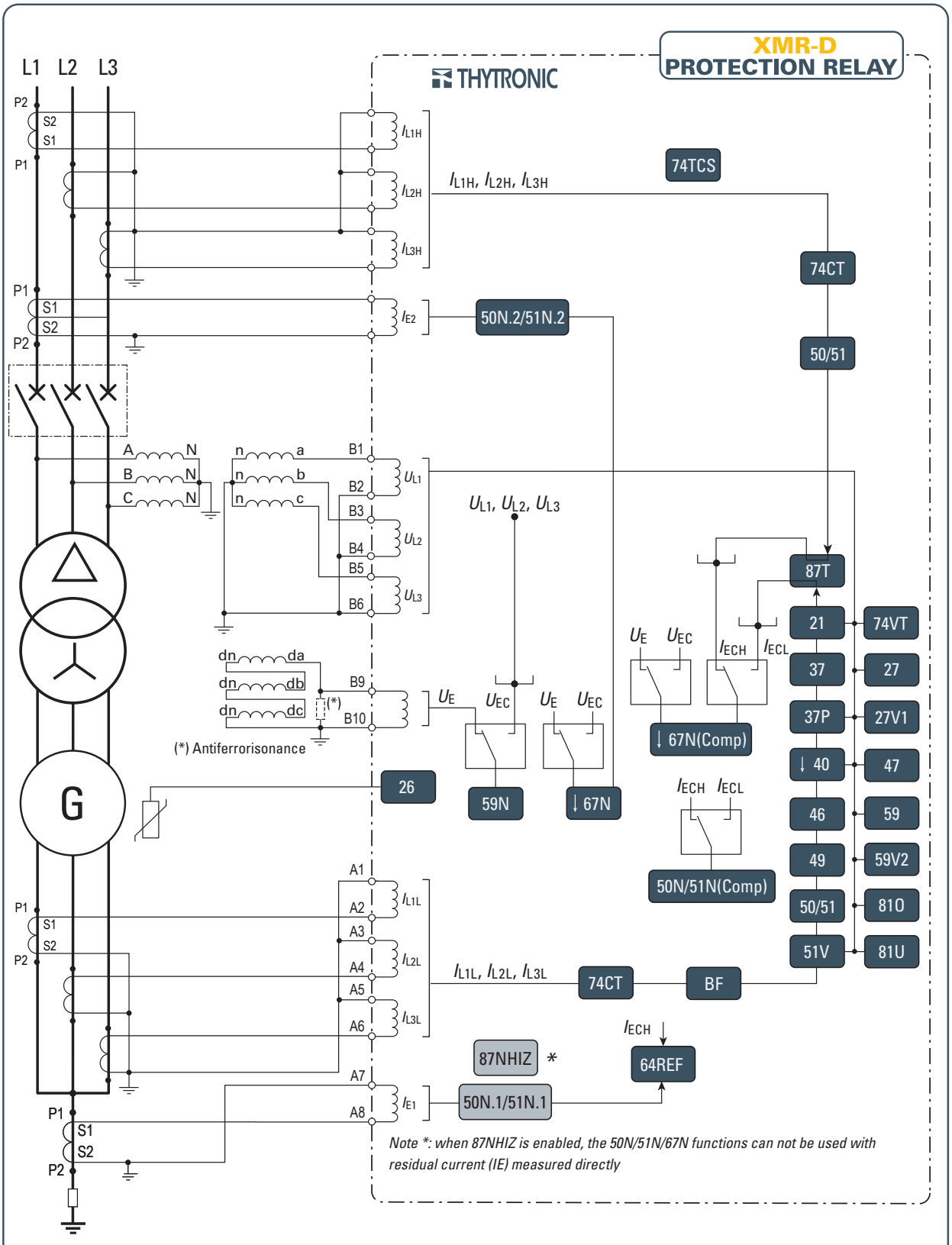
PROTECTIVE FUNCTIONS



NOTE
Incoming currents must be connected to relay reference amperometric input terminals; outgoing currents must be connected to protection relay amperometric output terminals.
Incoming currents in relay reference terminals are considered positive, while the outgoing ones are considered negative.
CONVENTION - CT's P1 polarity is indicated towards protected component.

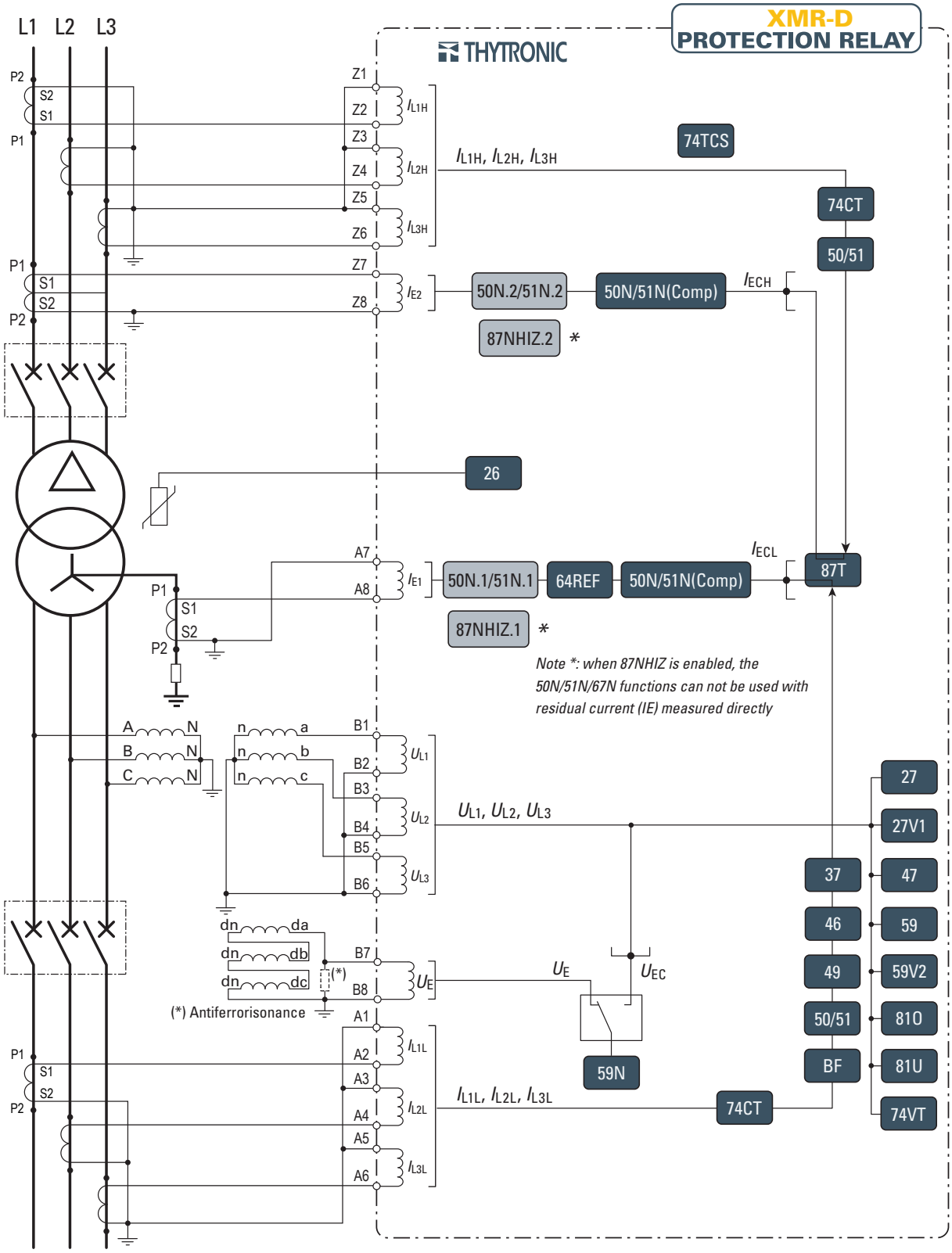
Differential Protection - Motor

PROTECTIVE FUNCTIONS



NOTE
Incoming currents must be connected to relay reference amperometric input terminals; outgoing currents must be connected to protection relay amperometric output terminals.
Incoming currents in relay reference terminals are considered positive, while the outgoing ones are considered negative.
CONVENTION - CT's P1 polarity is indicated towards protected component.

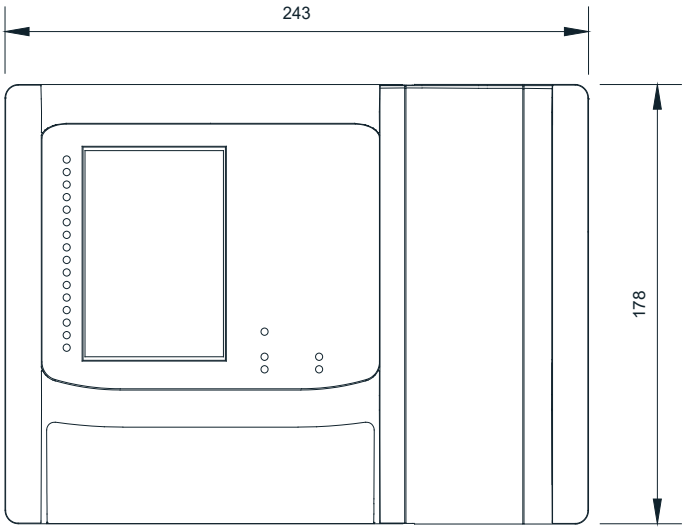
Differential Protection - Transformer - Generator

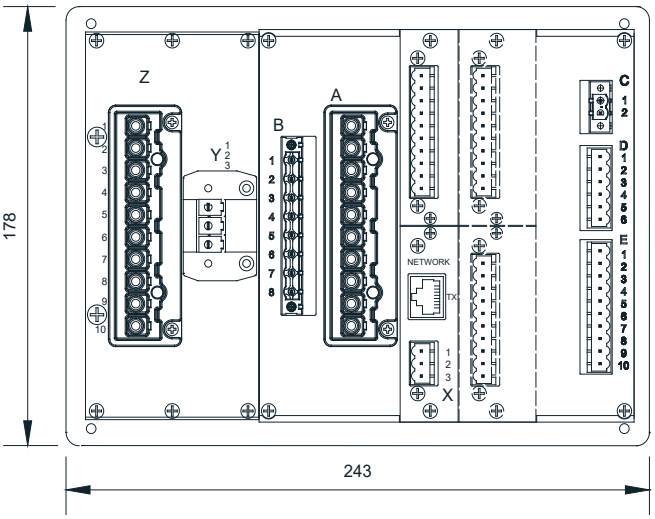


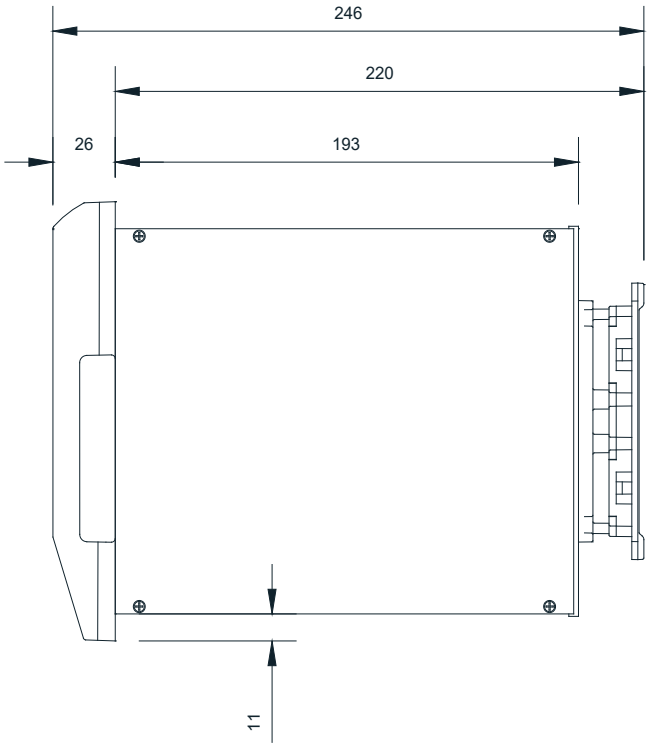
NOTE
Incoming currents must be connected to relay reference amperometric input terminals; outgoing currents must be connected to protection relay amperometric output terminals.
Incoming currents in relay reference terminals are considered positive, while the outgoing ones are considered negative.
CONVENTION - CT's P1 polarity is indicated towards protected component.

Differential Protection - 2 Coils Transformer

DIMENSIONS







In relation to the evolution of materials and technical standards, THYTRONIC reserves the to modify without notice data and dimensions inside this data sheet

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