MiCOM P122C

Time-Overcurrent Protection Device

P122C/EN M/B11

Version P122C H1x – Z – V2x/V3x

Technical Manual

Schneider Electric

Warning

When electrical equipment is in operation, dangerous voltage will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and cause personal injury or physical damage.

Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing.

For this reason only qualified personnel may work on or operate this device.

Qualified Personnel

are individuals who

- are familiar with the installation, commissioning, and operation of the device and of the system to which it is being connected,
- are able to perform switching operations in accordance with safety engineering standards and are authorized to energize and de-energize equipment and to isolate, ground, and label it,
- are trained in the care and use of safety apparatus in accordance with safety engineering standards,
- are trained in emergency procedures (first aid).

Note

The operating manual for this device gives instructions for its installation, commissioning, and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

Any agreements, commitments, and legal relationships and any obligations on the part of Schneider Electric, including settlement of warranties, result solely from the applicable purchase contract, which is not affected by the contents of the operating manual.

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MiCOM P122C
OVERCURRENT PROTECTION RELAY
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Application and Scope

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1. APPLICATION

The Time-Overcurrent Protection device MiCOM P122C is constructed with a compact case and intended for selective short-circuit protection in high voltage and medium voltage systems, for overload protection of transformers, cable and line sections, and as backup protection of differential or distance protection equipment.

Systems in which the MiCOM P122C relays are installed may be operated as impedance-grounded, resonant-grounded or isolated-neutral systems.

2. SCOPE

2.1 Protection and monitoring functions

The MiCOM P122C relay provides these protection and monitoring functions:

- Four-pole current measurement (A, B, C, N)
- Overcurrent protection for phases and earth, three stages each, with definite-time and inverse-time characteristics for the first and second stages
- Unbalance protection, two stages, with definite-time and inverse-time characteristics for the first stage
- Thermal overload protection
- Undercurrent/loss of load protection
- Circuit breaker failure protection
- Switching on to fault protection
- Blocking logic for reverse interlocking
- Logic selectivity
- Cold load pickup
- Circuit breaker supervision
- CT circuit supervision/broken conductor

2.2 Global functions

Further to the characteristics already listed and the extensive internal monitoring system, the MiCOM P122C provides these global functions:

- Changing the setting group
- Measurement data acquisition
- Event counters
- Event recording (signal record with real time stamp)
- Fault recording
- Starting recording
- Disturbance recording (signal record with real time stamp and the measured value of the three phase currents, the residual current or the frequency that provoked a fault)

2.3 Construction

The MiCOM P122C relay is constructed with a universal case which may be either wall surface mounted or flush mounted into a control panel as it is equipped with removable screw clamp connectors and invertible mounting brackets.

2.4 Inputs and outputs

The MiCOM P122C relay is equipped with the following inputs and outputs:

- 4 current measuring inputs
- 2 or 7 (optional) binary signal inputs (features opto coupler input) with freely configurable function assignment
- 8 output relays; 6 allow freely configurable function assignment

2.5 Interfaces

Operation and display:

- Integrated local control panel with LC-Display (2x16 alphanumeric characters)
- 8 LED indicators; 4 allow freely configurable function assignment
- 4 function keys; 2 freely assignable to the Trip order or to an output relay
- PC interface
- Communication interface to connect to a substation control system (optional)

Information is exchanged through the integrated local control panel, the PC interface, or the optional communication interface.

The optional communication interface is designed to conform to international standard IEC 60870-5-103, or it is programmed to run MODBUS™.

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Technical Data

CONTENTS

1. CONFORMITY

Applicable to MiCOM P122C Version H1 – Z – V2x/V3x.

Declaration of conformity

The product designated "MiCOM P122C Time-Overcurrent Protection Device" has been designed and manufactured in conformance with the European standards EN 60255-6 and EN 61010-1 and with the "EMC Directive" and the "Low Voltage Directive" issued by the Council of the European Community.

2. GENERAL DATA

Design

Case suitable to be surface mounted on a panel or flush mounted into a control panel.

Installation position

Vertical ± 30°

Degree of protection

IP 51 per DIN VDE 0470 and EN 60529 or IEC 529

Weight

approx. 4 kg

Dimensions

See dimensional drawings (chapter "Installation and Connection")

Connection diagram

See connection diagram (chapter "Installation and Connection")

Terminals

PC interface (X6):
DIN 41652 connector, type D-Sub, 9-pin.

Optional communication interface:

Optical fibre (X7 and X8):	F-SMA optical fibre connection per DIN 47258 or IEC 874-2 for plastic fibre or BFOC-(ST®) plug 2.5 per DIN 47254-1 or IEC 874-10 for glass fibre (ST® is a registered trademark of AT&T Lightguide Cable Connectors)
or wire leads (X9):	M2 threaded terminal ends for conductor cross sections up to 1.5 mm^2
optional binary inputs (X2):	M2.5 threaded terminal ends for conductor cross sections up to 2.5 mm^2

Other inputs and outputs (X1 and X3):
M4 threaded terminal ends, self-centering with wire protection for conductor cross-sections from 0.2 to 6 mm^2 or 2 x 2.5 mm^2

Creepage distances and clearances

Per EN 61010-1 and IEC 664-1
Pollution degree 3, working voltage 250 V,
overvoltage category III, impulse test voltage 5 kV

3. TESTS

3.1 Type test

All tests per EN 60255-6 or IEC 255-6

EMC

Interference suppression

Per EN 55022 or IEC CISPR 22, class A

1-MHz-Burst disturbance test

Per IEC 255 Part 22-1, IEC 60255-22-1 or EN 61000-4-12,
IEC 61000-4-12, class III,
common mode test voltage: 2.5 kV
differential test voltage: 1.0 kV,
test duration: > 2 s, source impedance: 200 Ω

Immunity to electrostatic discharge

Per EN 60255-22-2, IEC 60255-22-2 or EN 61000-4-2,
IEC 61000-4-2, severity level 3 and 4,
contact discharge,
single discharges: > 10,
holding time: > 5 s,
test voltage: 6 kV and 8 kV,
test generator: 50...100 MΩ, 150 pF / 330 Ω

Immunity to radiated electromagnetic energy

Per EN 61000-4-3, IEC 61000-4-3 and ENV 50204,
severity level 3 and 4,
antenna distance to tested device: > 1 m on all sides,
test field strength, frequency band 80 to 1000 MHz: 10 V / m and 30 V / m,
test using AM: 1 kHz / 80 %,
single test at 900 MHz: AM 200 Hz / 100 %

Electrical fast transient or burst requirements

Per EN 60255-22-4, IEC 60255-22-4,
EN 61000-4-4, IEC 61000-4-4,
severity level 4,
rise time of one pulse: 5 ns, impulse duration (50% value): 50 ns,
amplitude: 4 kV, burst duration:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer:4 kV, Burst-Dauer: 15 ms,
burst period: 300 ms, burst frequency: 2.5 kHz,
source impedance: 50 Ω

Surge immunity test

Per EN 61000-4-5 or IEC 61000-4-5,
insulation class 4,
testing of circuits for power supply and unsymmetrical or symmetrical lines,
open-circuit voltage, front time / time to half-value: 1.2 / 50 µs,
short circuit current, front time / time to half-value: 8 / 20 µs,
amplitude:< 4 / 2 kV, pulse frequency: 5 kHz,
source impedance: 12 / 42 Ω

Immunity to conducted disturbances induced by radio frequency fields

Per EN 61000-4-6 or IEC 61000-4-6, severity level 3,
test voltage: 10 V
frequency: 150 kHz to 80 MHz

Power frequency magnetic field immunity

Per EN 61000-4-8 or IEC 61000-4-8,
severity level 4 and 5,
frequency: 50 Hz,
field strength: 30 A / m continuous test signal or 300 A / m pulse and
100 A / m continuous test signal or 1000 A / m pulse

Alternating component (ripple) in DC auxiliary energizing quantity

Per IEC 255-11,
12 %

Insulation

Voltage test

Per IEC 255-5 or EN 61010,
2 kV AC, 60 s
Direct voltage (2.8 kV DC) must be used for the voltage test of the power supply inputs. The PC interface must not be subjected to the voltage test.

Impulse voltage withstand test

Per IEC 255-5,
front time: 1.2 μs, time to half-value: 50 μs,
peak value: 5 kV,
source impedance: 500 Ω

Mechanical robustness

Vibration test

Per EN 60255-21-1 or IEC 255-21-1, test severity class 1,
frequency range in operation: 10 to 60 Hz, 0.035 mm, 60 to150 Hz, 0.5 g,
frequency range during transport: 10 to 150 Hz, 1 g

Shock response and withstand test

Per EN 60255-21-2 or IEC 255-21-2, test severity class 1,
acceleration: 5 g / 15 g,
pulse duration: 11 ms

Seismic test

Per EN 60255-21-3 or IEC 255-21-3,
test severity class 1,
frequency range:
5 to 8 Hz, 3.5 mm / 1.5 mm, 8 to 35 Hz, 10 / 5 m/s^2, 3 $\times$ 1 cycle

3.2 Routine test

All tests per EN 60255-6 or IEC 255-6

Voltage test

Per IEC 255-5
2 kV AC, 1 s
Direct voltage (2.8 kV DC) must be used for the voltage test of the power supply inputs.
The PC interface must not be subjected to the voltage test.

Additional thermal test

100 % controlled thermal endurance test

4. ENVIRONMENTAL CONDITIONS

Environmental temperatures

Recommended temperature range: – 5 °C to + 55 °C (– 55 °F to + 131 °F)
Limit temperature range: -25 °C to +70 °C (– 13 °F to + 158 °F)

Ambient humidity range

$\leq$ 75 % relative humidity (annual mean),
56 days at $\leq$ 95 % relative humidity and 40 °C (104 °F), condensation not permissible.

Solar radiation

Direct solar radiation onto the front of the protection device must be avoided.

5. INPUTS AND OUTPUTS

5.1 Measurement inputs

Current

Nominal current I_{nom}: 1 and 5 A (adjustable)
Nominal consumption per phase: < 0.1 VA at I_{nom}
Load rating:
continuous: 4 I_{nom} (20 A)
For 10 s: 30 I_{nom} (150 A)
For 1 s: 100 I_{nom} (500 A)
Nominal surge current: 250 I_{nom} (1250 A)

Phase CTs: 5P10 5VA (typical)

Frequency

Nominal frequency f_{nom}: 50 Hz and 60 Hz (adjustable)
Operating range: 45 to 55 Hz (f_{nom}: 50 Hz) or 55 to 65 Hz (f_{nom}: 60 Hz)

5.2 Binary signal inputs

Nominal auxiliary voltage $V_{in,nom}$: 24 to 250 VDC, 100 to 230 VAC (50/60Hz)
Operating range: 0.8 to 1.1 $V_{in,nom}$ with a residual ripple of up to 12 % $V_{in,nom}$
Power consumption per input:
V_{in} = 19 to 110 VAC: 0.5 W ± 30 %
V_{in} > 110 VDC : V_{in} · 5 mA ± 30 %
V_{in} = 100 to 230 VAC: 0.5 VA ± 30 %

5.3 Output relays

Rated voltage: 250 VDC, 250 VAC
Continuous current: 5 A
Short duration current: 30 A for 0.5 s
Making capacity: 1000 W (VA) at L/R = 40 ms
Breaking capacity: 0.2 A at 220 VDC and L/R = 40 ms,
4 A at 230 VAC and cos φ= 0.4

6. INTERFACES

6.1 Local control panel

Input or output:
By using keypad with 11 keys and reading liquid crystal display (LCD) with 2 x 16 alpha numeric characters.

6.2 PC interface

RS232 interface
Transmission rate: 19200 Baud

6.3 Communication interface

Per IEC 60870-5-103 or MODBUS,
Transmission rate: 300 to 38400 Baud (adjustable)

Twisted pair wire leads

Per RS485 or RS422, 2 kV isolation
Distance to be bridged
Point to point connection: max. 1200 m
Multi point connection: max. 100 m

Plastic fibre connection

Optical wavelength: typically 660 nm
Optical output: min. -7.5 dBm
Optical sensitivity: min. -20 dBm
Optical input: max. -5 dBm
Distance to be bridged: max. 45 m [1)]

Glass fibre connection G 50/125

Optical wavelength: typically 820 nm
Optical output: min. -19.8 dBm
Optical sensitivity: min. -24 dBm
Optical input: max. -10 dBm
Distance to be bridged: max. 400 m [1)]

Glass fibre connection G 62.5/125

Optical wavelength: typically 820 nm
Optical output: min. -16 dBm
Optical sensitivity: min. -24 dBm
Optical input: max. -10 dBm
Distance to be bridged: max. 1400 m [1)]

[1)] Distance to be bridged given identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fibre attenuation.

7. INFORMATION OUTPUT

Counters, measured data and signals: see chapter "Settings and Information" and chapter "Information and control tables".

8. SETTINGS

Settings, values range and steps: see chapter "Settings and Information" and chapter "Setting tables and setting sheets".

8.1 Typical characteristic data

Global Functions

Minimum output pulse for Trip order: 0.1 to 5 s (adjustable)
Minimum output pulse for Close order: 0.1 to 5 s (adjustable)
Output pulse duration for function key 3 and 4 and order 1 and 2: 200 ms

Time overcurrent protection (phase and earth)

Shortest tripping time: approx. 15 ms
Shortest starting reset time: approx. 15 ms
(from twice the operate value to 0)
Starting resetting ratio: 0.95

Unbalance protection

Shortest tripping time: approx. 35 ms
Shortest starting reset time: approx. 20 ms
(from twice the operate value to 0)
Starting resetting ratio: 0.95

Thermal overload protection

Resetting ratio thermal trip and alarm: 0.97

Undercurrent/loss of load protection

Shortest tripping time: approx. 35 ms
Shortest starting reset time: approx. 20 ms
(from 0.8 times the operate value to nominal value)
Starting resetting ratio: 1.05

9. DEVIATIONS

9.1 Deviations of operate values

Reference conditions

Deviations based on the set value, with value set > 10 % of nominal value, with sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion $\leq$ 2 %, ambient temperature 20 °C (68 °F), and nominal aux voltage $V_{aux,nom}$.

Time overcurrent protection

Phase and residual current threshold stages: ± 2 %

Unbalance protection

Unbalance threshold stages: ± 2 %

Thermal overload protection

θ thresholds: ± 5 %

Undercurrent/loss of load protection

Threshold I<: ± 2 %

CT circuit supervision/Broken conductor

Thresholds I_{diff}, I_2/I_1: ± 2 %

9.2 Deviations of timer stages

Reference conditions

Deviations based on the set value with sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion $\leq$ 2 %, ambient temperature 20 °C (68 °F), and nominal aux voltage $V_{aux,nom}$.

Definite timer stages

± 2 % + 15 to 35 ms

Inverse timer stages

$2 \leq I/I_{ref} < 5$: ± 12.5 % + 50 ms
$5 \leq I/I_{ref} < 10$: ± 7.5 % +30 ms
$10 \leq I/I_{ref} \leq 20$: ± 5 % + 20 ms
or for thermal overload characteristic:
± 7.5 % + 15 to 35 ms

9.3 Deviations of measured data acquisition

Reference conditions

Deviations based on the set value with sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion $\leq$ 2 %, ambient temperature 20 °C (68 °F), and nominal aux voltage $V_{aux,nom}$.

Operating data measurement

Measuring input currents

± 1 %

Internally calculated positive- and negative-sequence current

± 2 %

Frequency

± 20 mHz

Fault data acquisition

Short circuit currents

± 3 %

Internal clock

With free running internal clock
deviation < 5 min per month

With external synchronization by transmission protocol (synch. interval $\leq$1 min)
deviation ± 10 ms

10. RECORDING FUNCTIONS

10.1 Event recording

Memory capacity:
max. 75 events (then the oldest event is deleted to record next event)
event is stamped with real time:
from internal clock with date

10.2 Fault recording

Memory capacity for faults issuing Trip order:
max. 5 faults (then the oldest fault is deleted to record next fault)
fault is stamped with real time:
from internal clock with date

10.3 Starting recording

Memory capacity:
max. 5 startings (then the oldest starting is deleted to record next starting)
starting is stamped with real time:
from internal clock with date

10.4 Disturbance recording

Fault values: I_A, I_B, I_C, I_N and frequency
Signals: all signals relevant to a fault
recording duration per disturbance: max. 3 s
memory capacity for disturbances:
max. 8 disturbances (then the oldest disturbance is deleted to record next disturbance)

10.5 Resolution of records

Time resolution of signals

1 ms

Time resolution of fault values

16 sampled values per period

Phase currents

Dynamic range: 40 I_{nom}
Amplitude resolution
at I_{nom} = 1 A: 19.2 mA_{rms}
at I_{nom} = 5 A: 97.6 mA_{rms}

Residual current

Dynamic range: 40 $I_{N,nom}$
Amplitude resolution
at $I_{N,nom}$ = 1 A: 19.2 mA_{rms}
at $I_{N,nom}$ = 5 A: 97.6 mA_{rms}

Dynamic range: 8 $I_{N,nom}$
Amplitude resolution
at $I_{N,nom}$ = 1 A: 4 mA_{rms}
at $I_{N,nom}$ = 5 A: 20 mA_{rms}

Dynamic range: 0.8 $I_{N,nom}$
Amplitude resolution
at $I_{N,nom}$ = 1 A: 0.4 mA_{rms}
at $I_{N,nom}$ = 5 A: 2 mA_{rms}

11. POWER SUPPLY

Nominal auxiliary voltage $V_{aux,nom}$:
24 to 250 VDC and 100 to 230 VAC

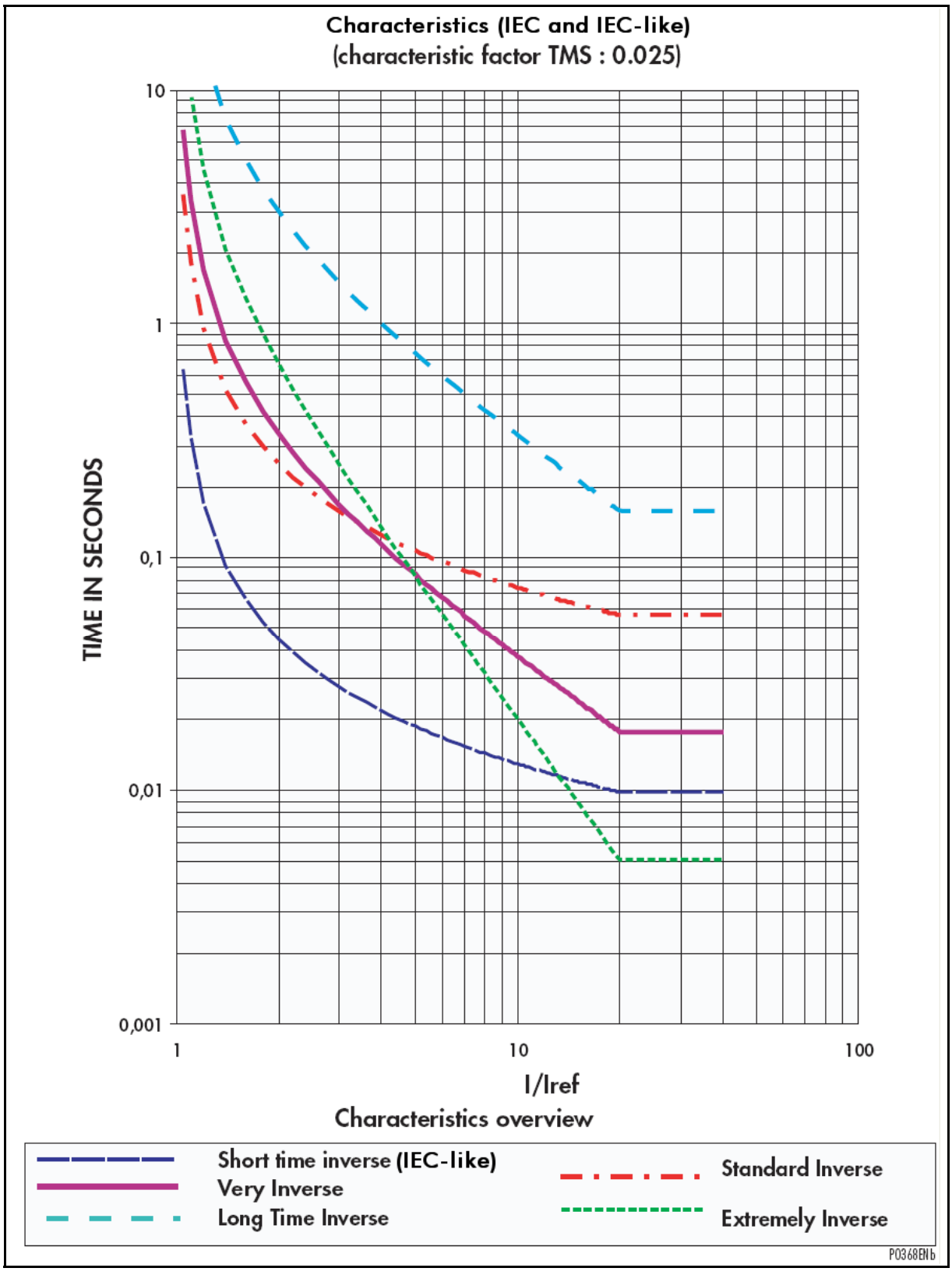
Operating range for DC voltage:
0.8 to 1.1 $V_{aux,nom}$ (with residual ripple max. 12 % $V_{aux,nom}$)
Operating range for AC voltage:
0.9 to 1.1 $V_{aux,nom}$

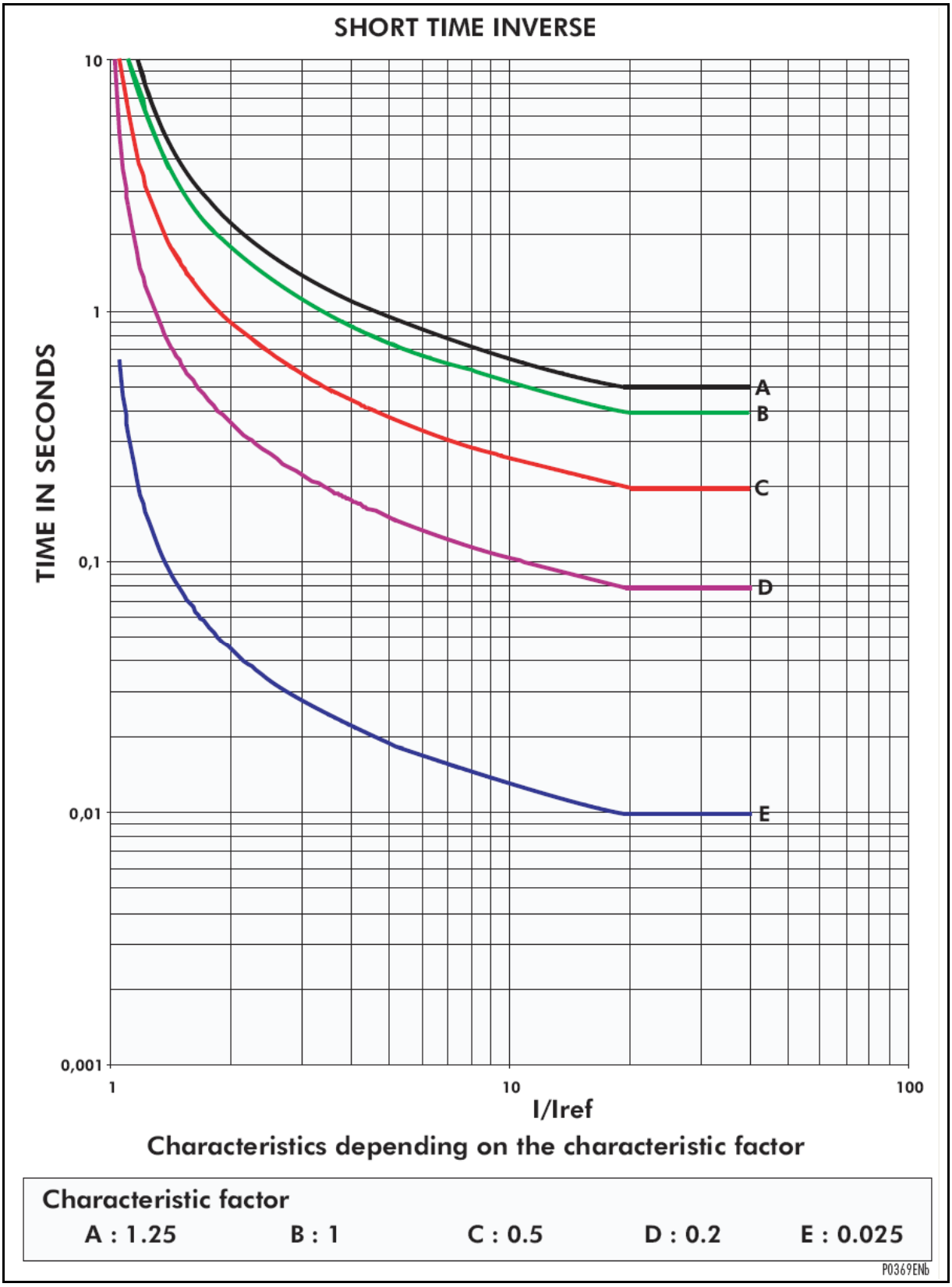
Nominal consumption
initial position: approx. 3 W or 3 VA
active position: approx. 5 W or 5 VA

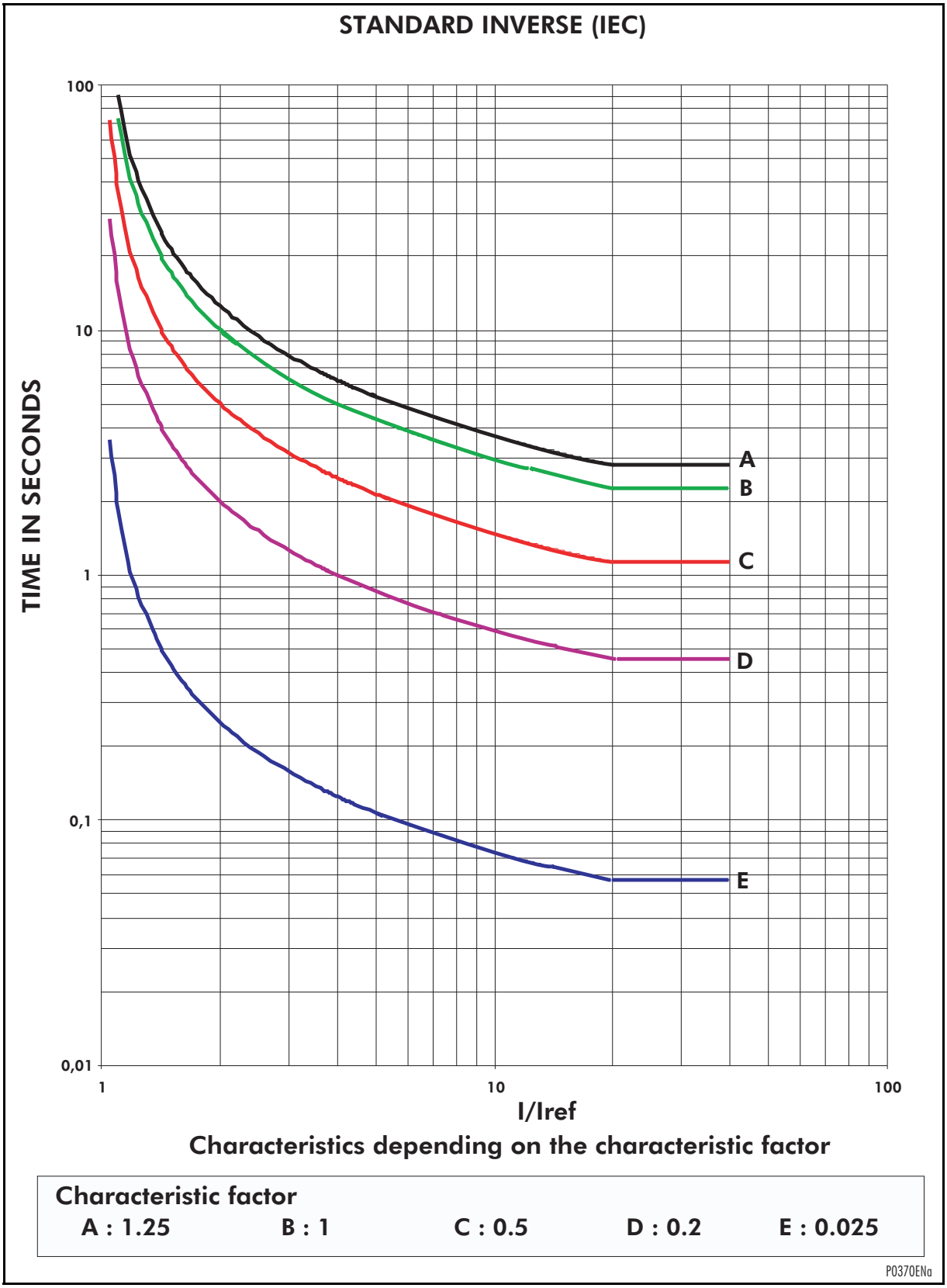
Start-up peak current < 3 A for a duration of 0.25 ms
Stored energy time 50 ms for interruption of V_{aux}

12. CHARACTERISTICS FOR INVERSE-TIME PROTECTION

12.1 Characteristics (IEC & IEC-like)

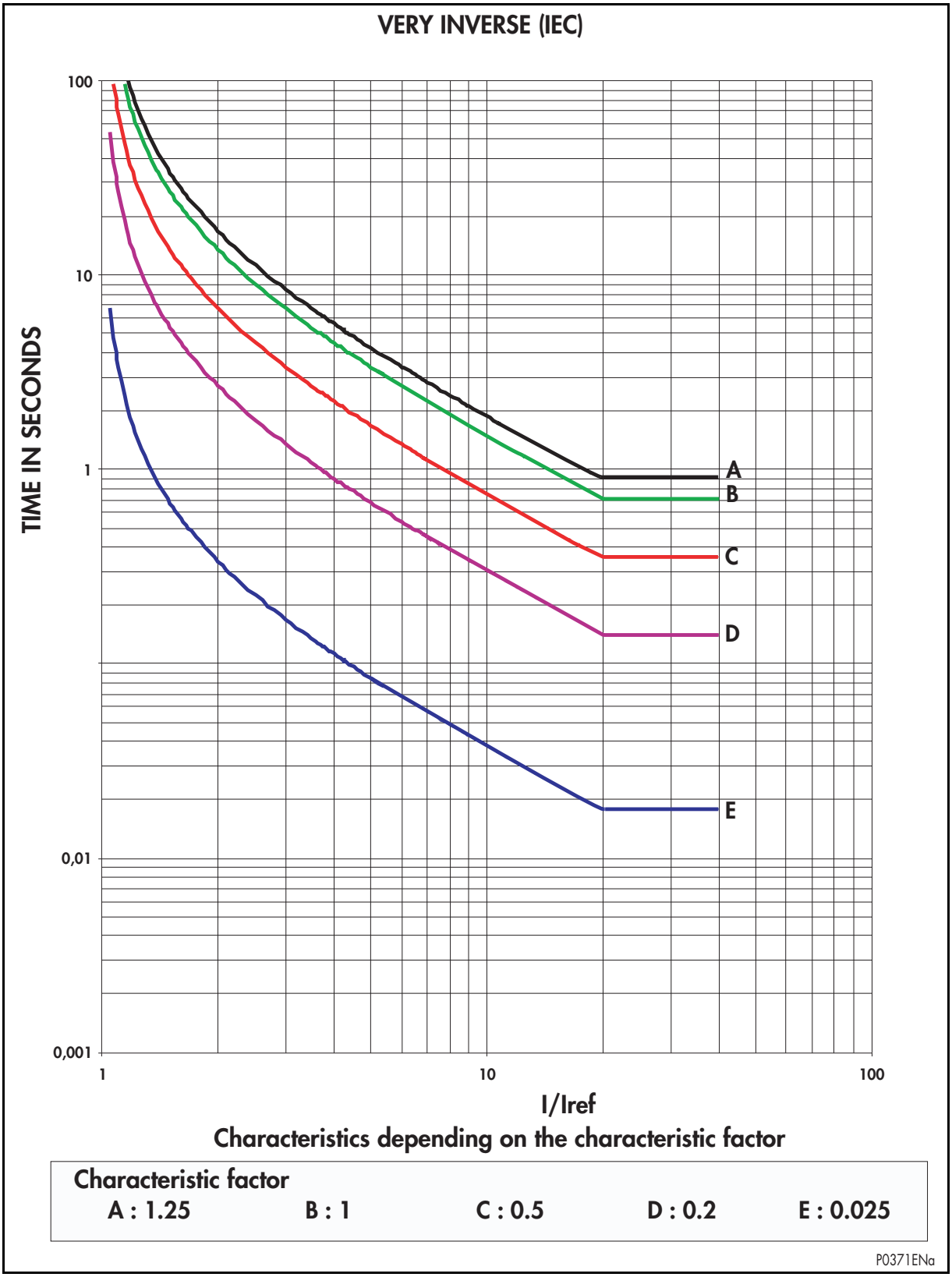


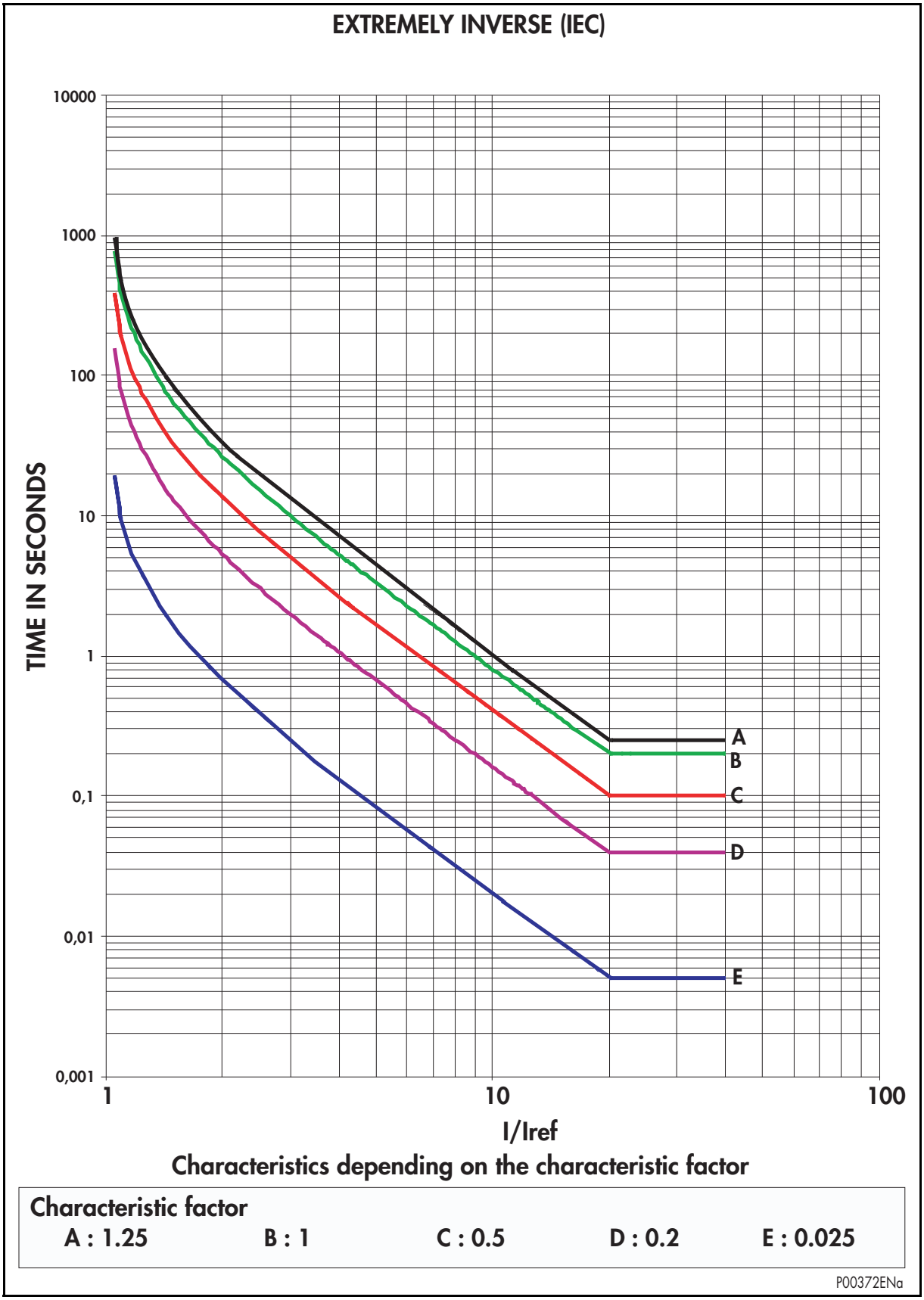

SHORT TIME INVERSE
TIME IN SECONDS
10
1
0,1
0,01
0,001
1
10
100
I/Iref
A
B
C
D
E
Characteristics depending on the characteristic factor
Characteristic factor
A : 1.25
B : 1
C : 0.5
D : 0.2
E : 0.025
P0369ENb



Characteristics depending on the characteristic factor

Characteristic factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

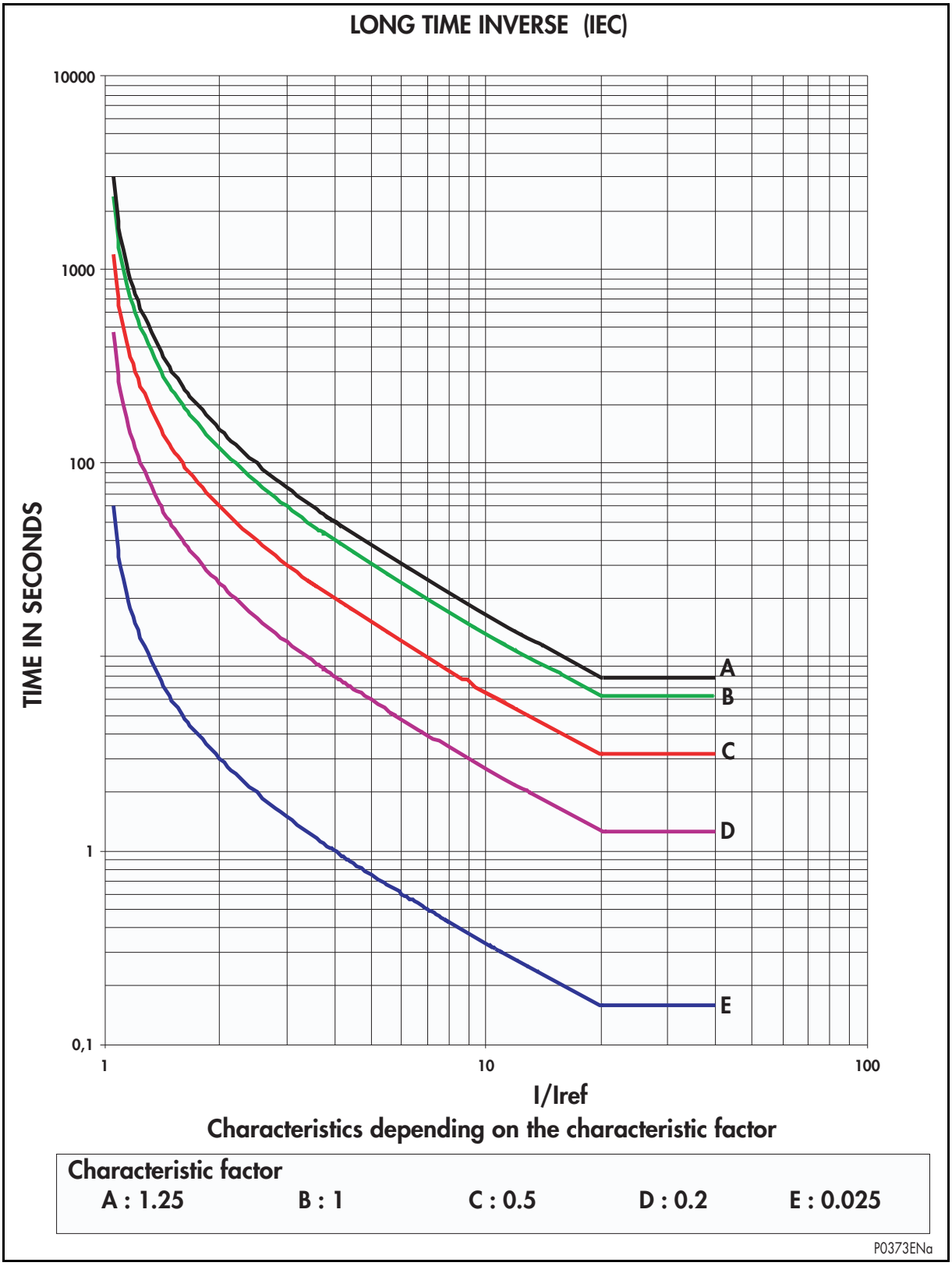

VERY INVERSE (IEC)
TIME IN SECONDS
100
10
1
0,01
0,001
1
10
100
I/Iref
A
B
C
D
E
Characteristics depending on the characteristic factor
Characteristic factor
A : 1.25
B : 1
C : 0.5
D : 0.2
E : 0.025
P0371ENa



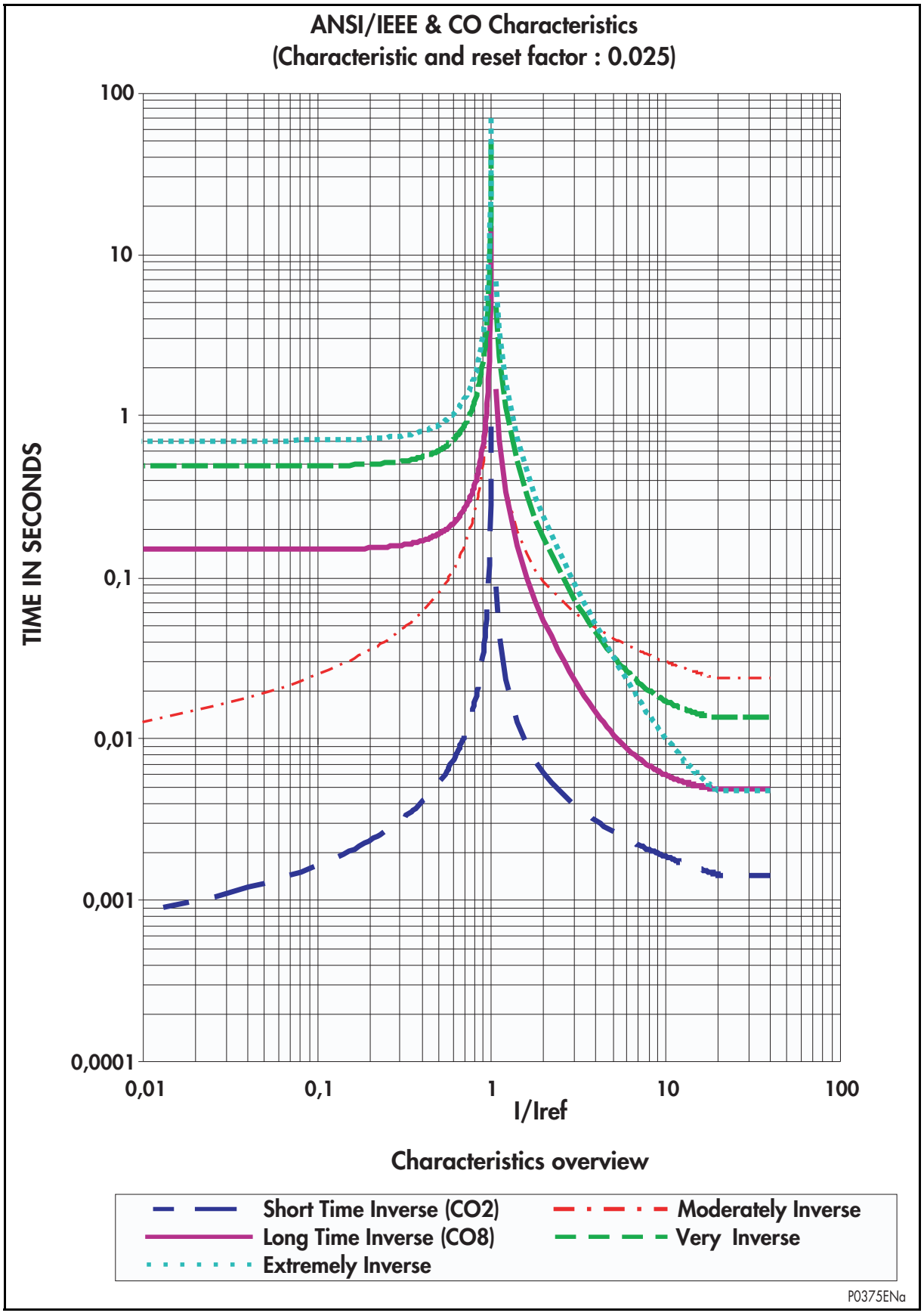
Characteristics depending on the characteristic factor

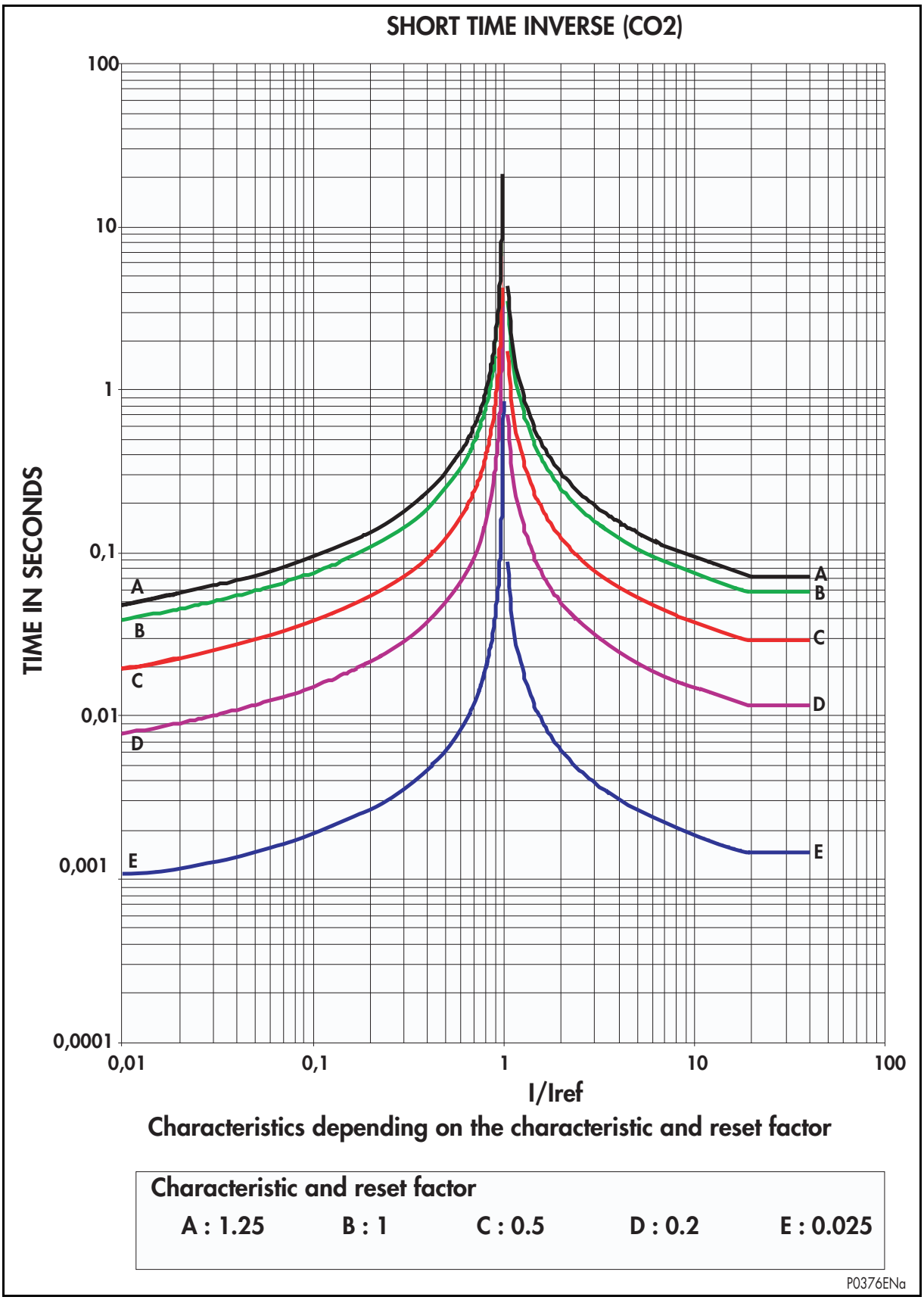
Characteristic factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

P00372ENa


LONG TIME INVERSE (IEC)
10000
1000
100
1
0,1
TIME IN SECONDS
1
10
100
I/Iref
A
B
C
D
E
Characteristics depending on the characteristic factor
Characteristic factor
A : 1.25
B : 1
C : 0.5
D : 0.2
E : 0.025
P0373ENa

12.2 ANSI/IEEE & CO characteristics

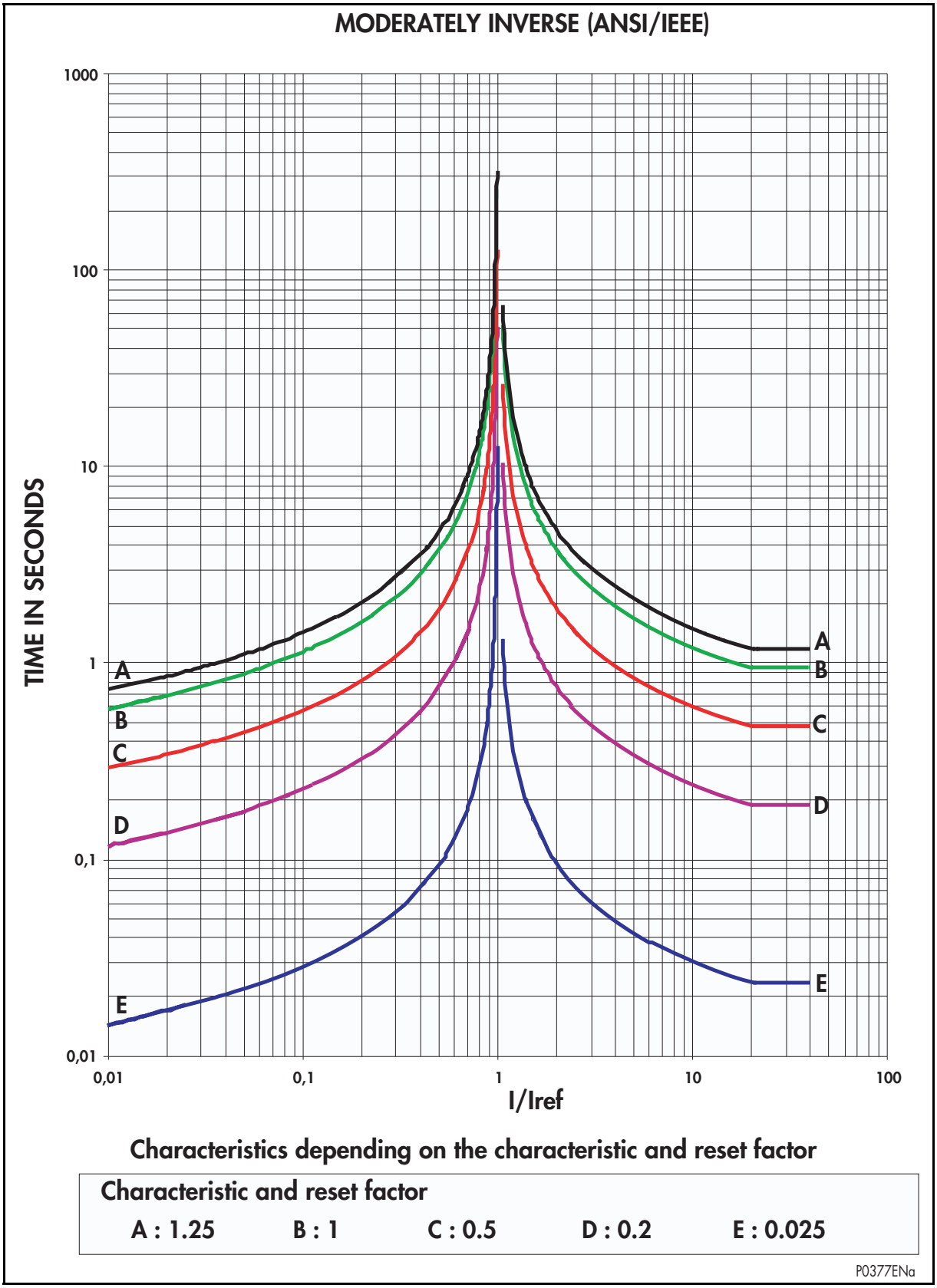




Characteristics depending on the characteristic and reset factor

Characteristic and reset factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

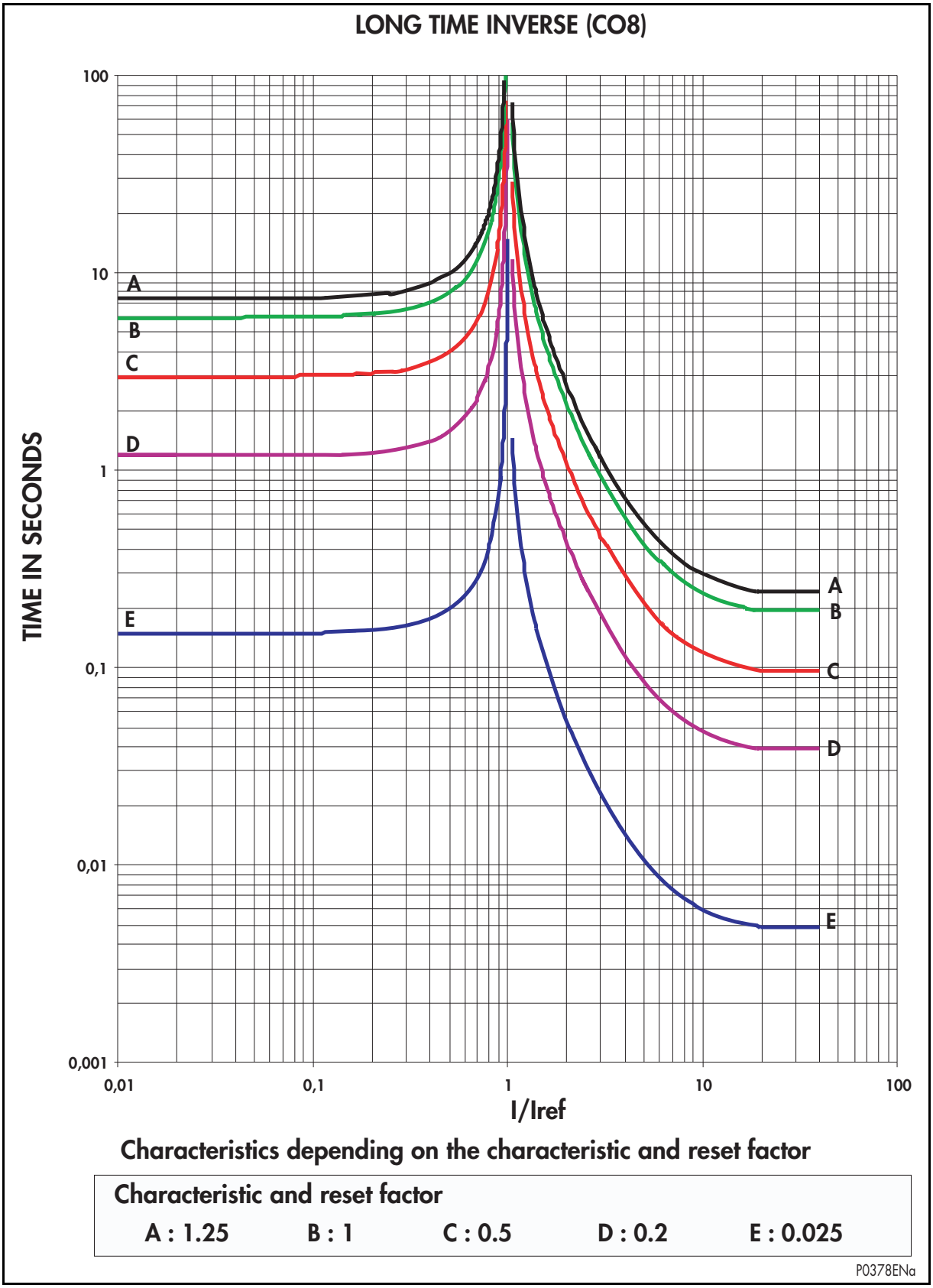
P0376ENa



Characteristics depending on the characteristic and reset factor

Characteristic and reset factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

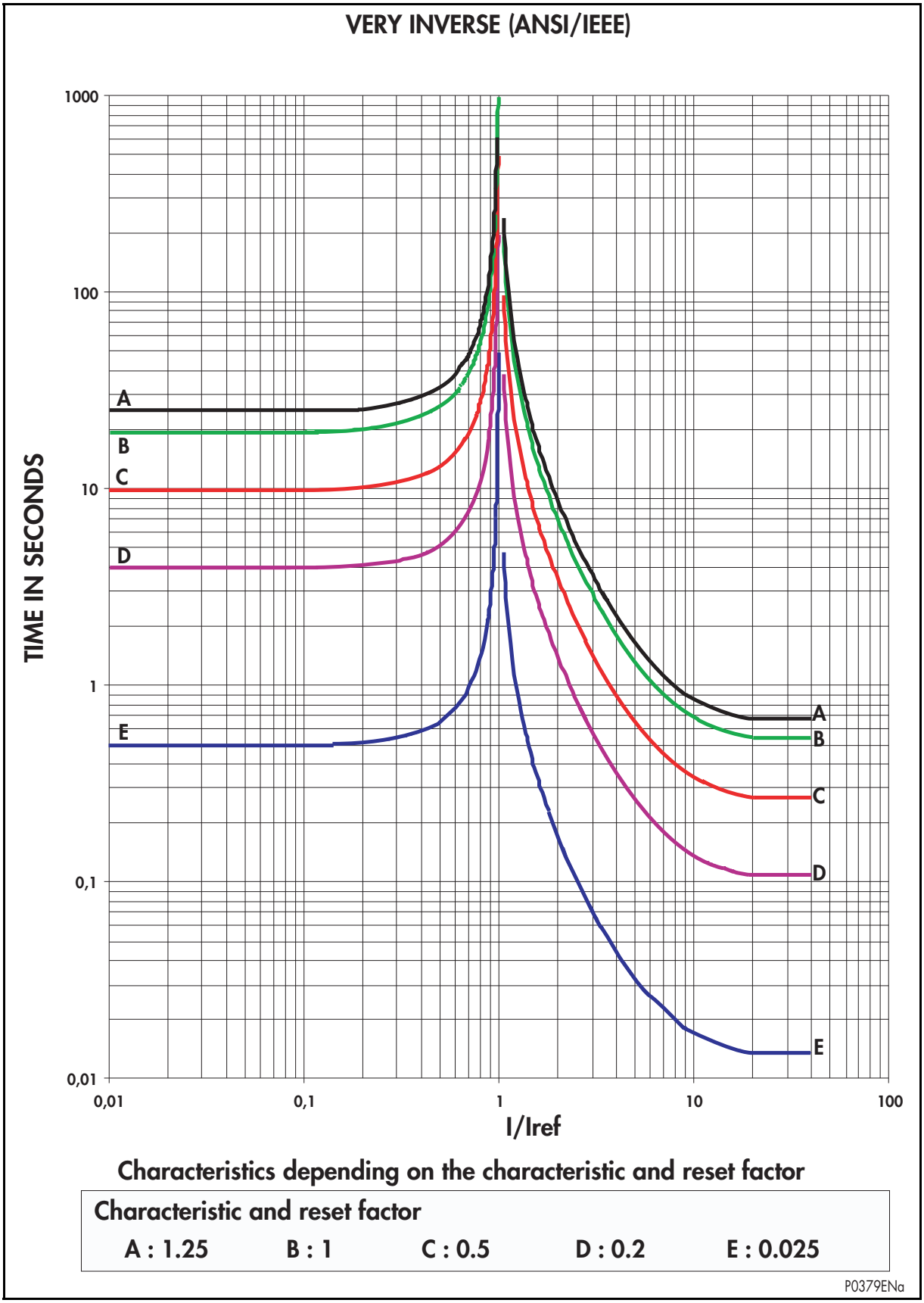
P0377ENa



Characteristics depending on the characteristic and reset factor

Characteristic and reset factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

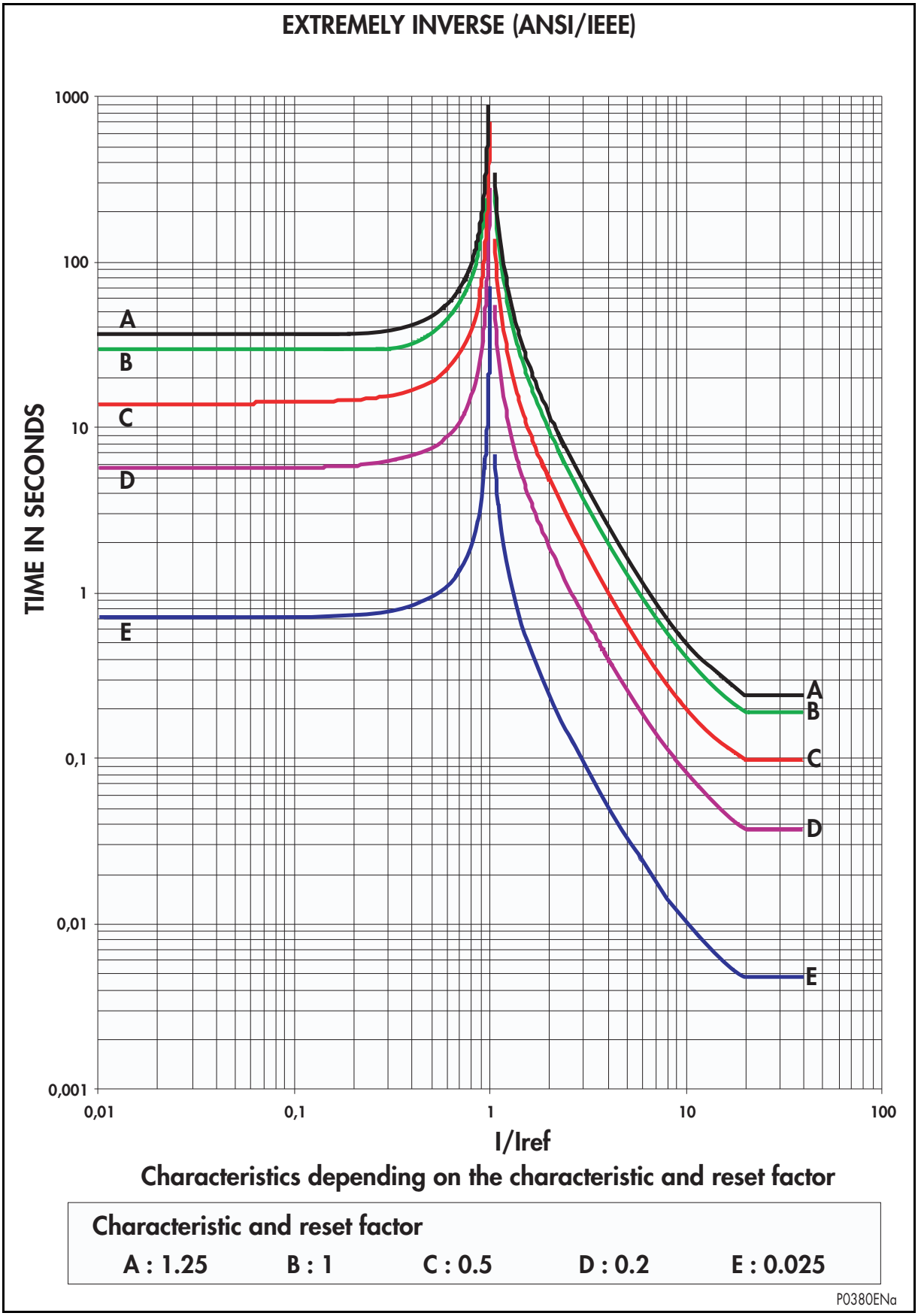
P0378ENa



Characteristics depending on the characteristic and reset factor

Characteristic and reset factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

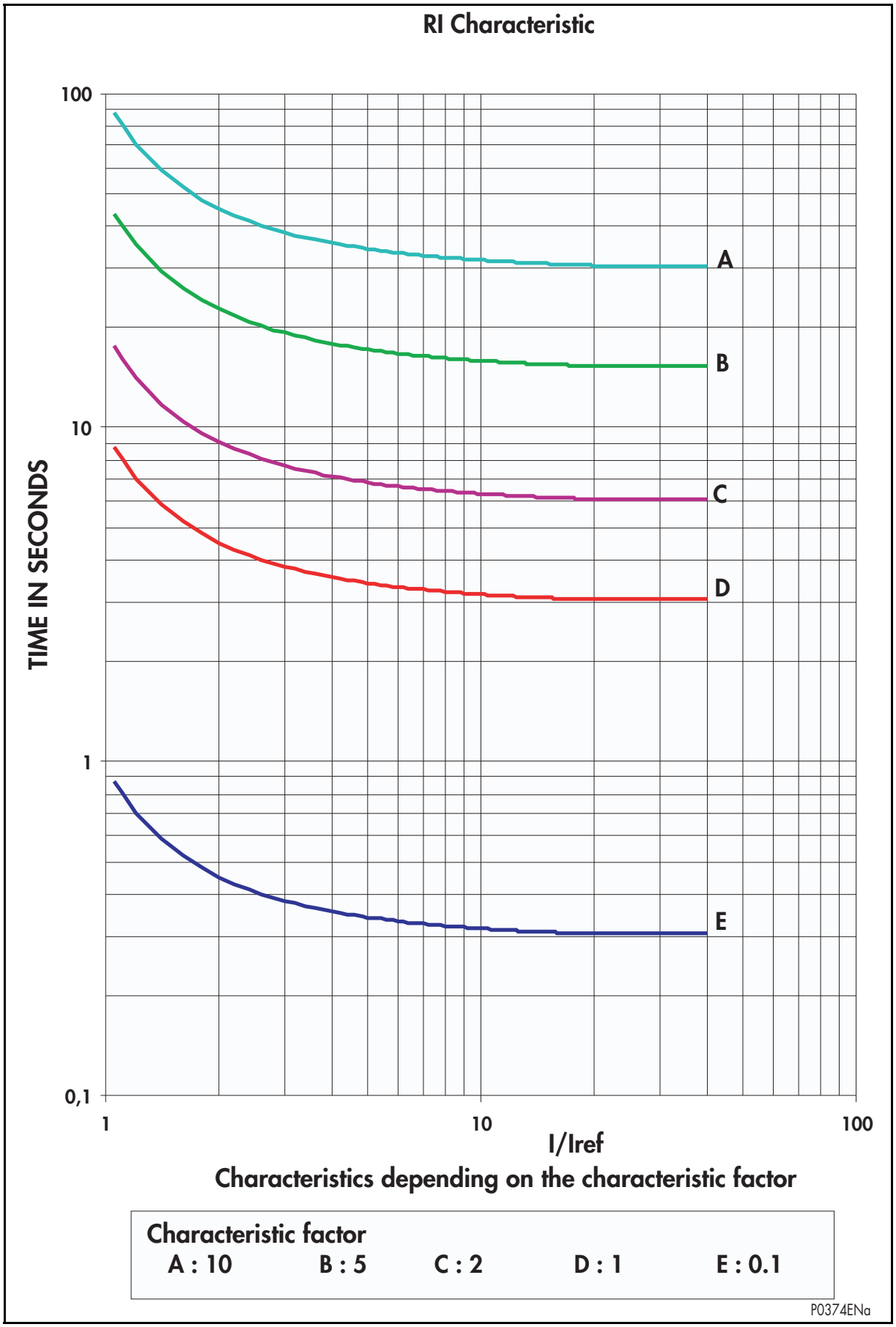
P0379ENa



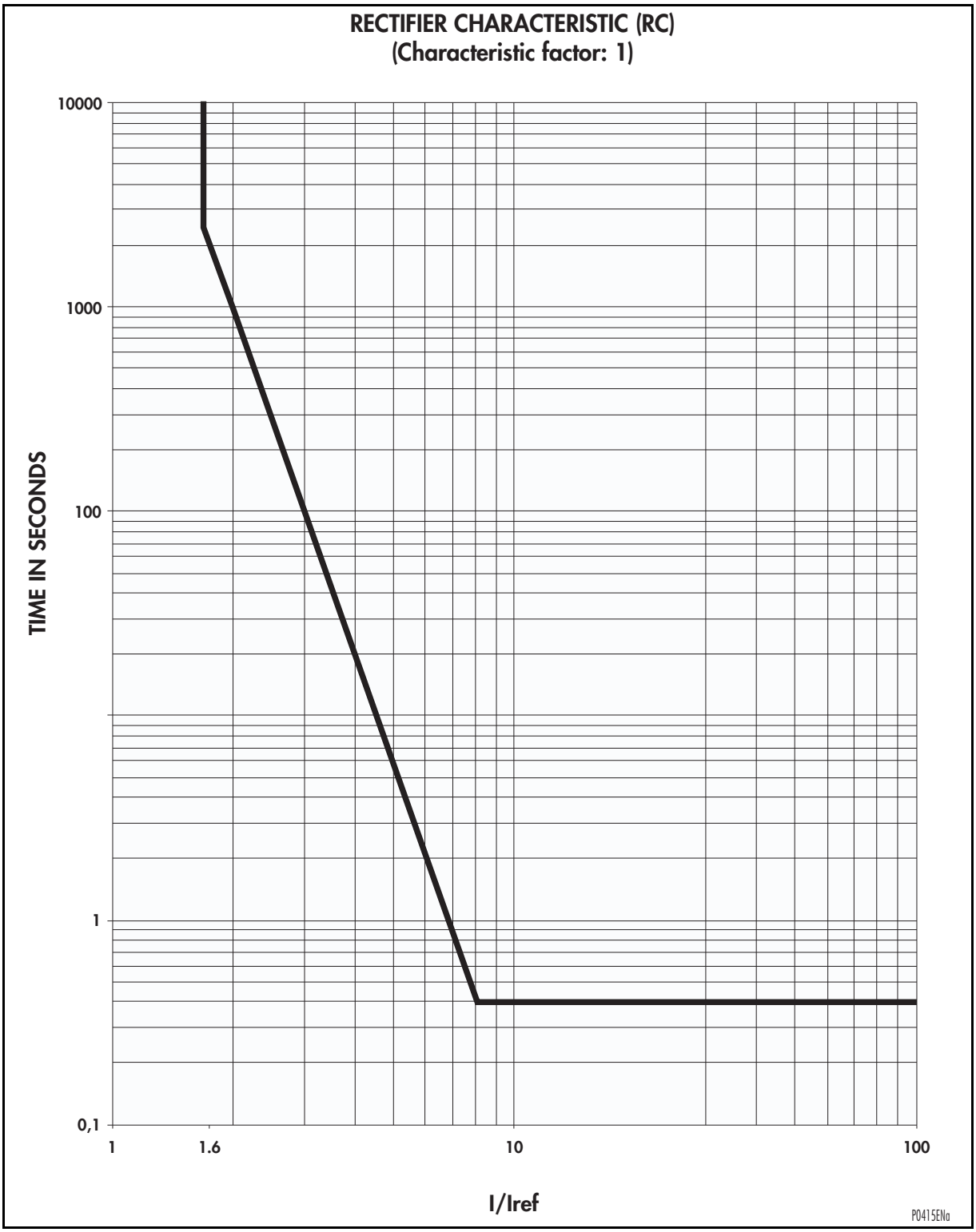
Characteristics depending on the characteristic and reset factor

Characteristic and reset factor				
A : 1.25	B : 1	C : 0.5	D : 0.2	E : 0.025

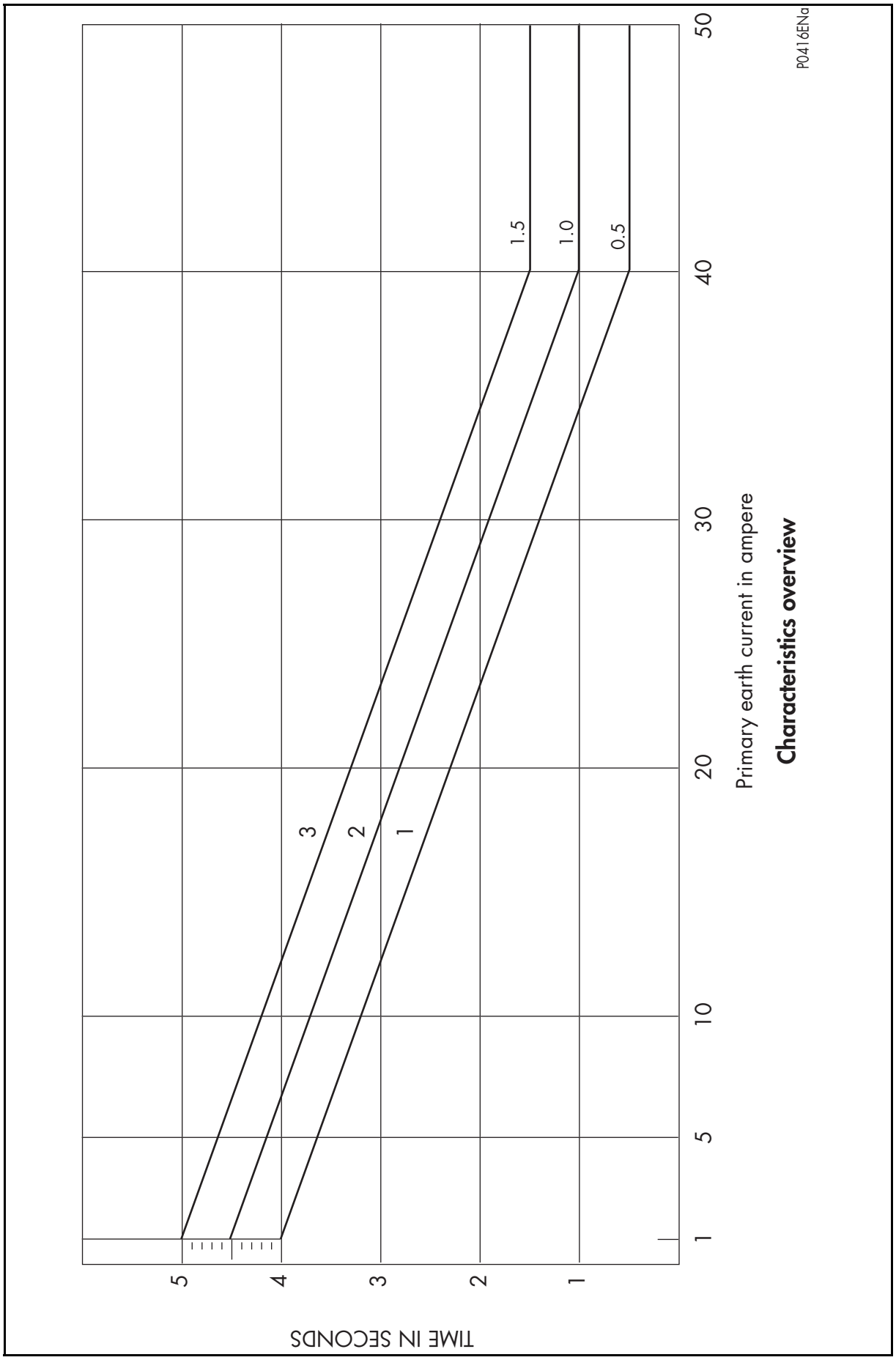
12.3 RI characteristic



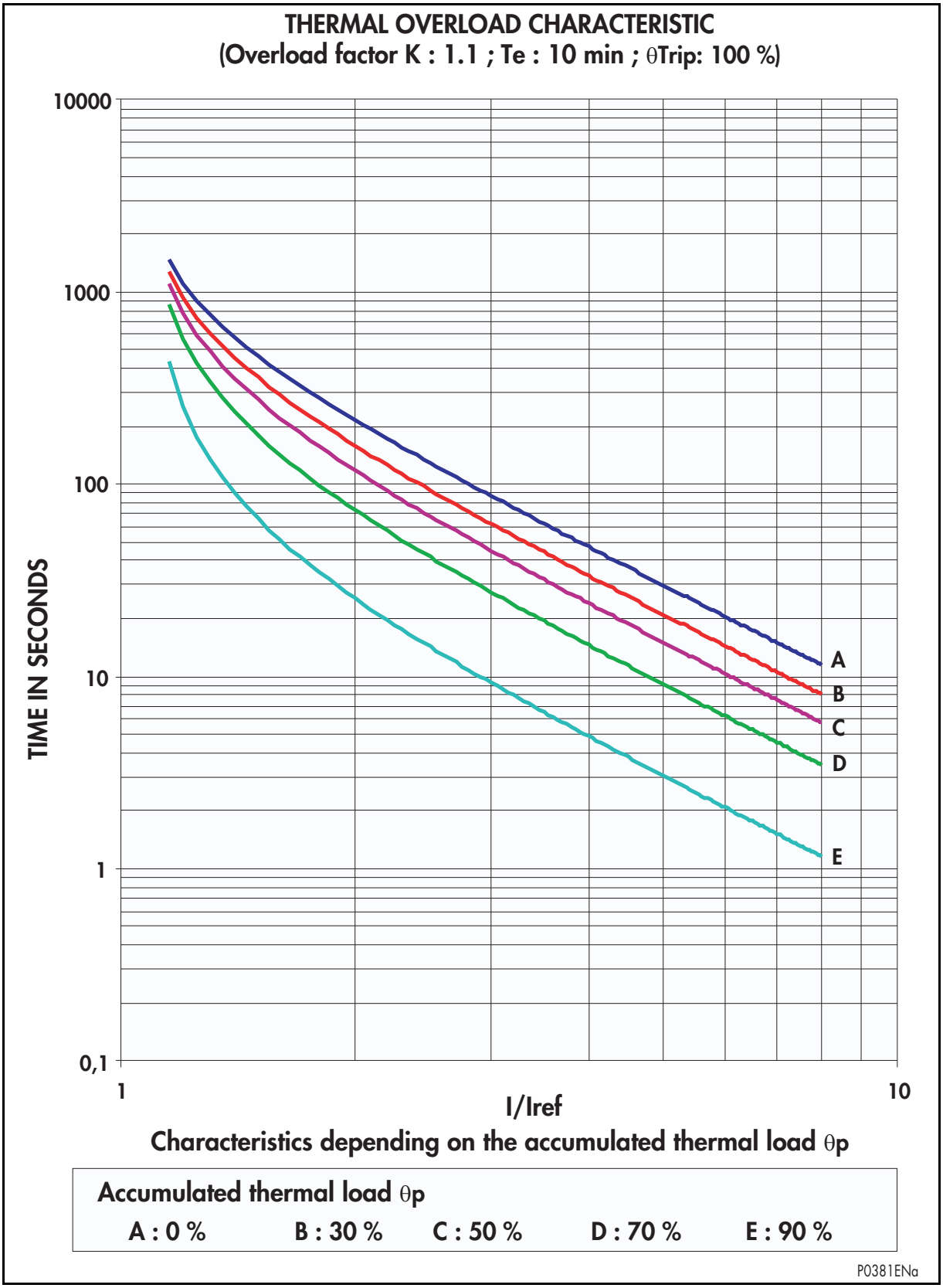
12.4 Rectifier characteristic



12.5 LABORELEC characteristics



13. THERMAL OVERLOAD CHARACTERISTICS



Installation and Connection

CONTENTS

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1. INSTALLATION

1.1 Unpacking and packing

When the MiCOM P122C relay is delivered, it is packed in a separate carton inside an outer packaging. Use care when opening a carton and unpacking a protection device, and do not use excessive force. Also make sure to remove the supporting documents and components included inside the carton together with the protection device.

After unpacking the protection device make a thorough visual inspection to confirm it is in a proper mechanical condition.

If the MiCOM P122C relay is to be shipped back, both the original inner carton and the outer packaging must be used. If no longer available make sure that the material used for packing conforms to ISO 2248 specifications for a drop height ≤ 0.8 m.

1.2 Check of nominal data and design type

The nominal data and design type of the MiCOM P122C relay are identified from the type identification label (see Figure 1). The type identification label is located on the front side of the case. An additional type identification label is located on the outside of the inner carton used to ship the MiCOM P122C relay.

<table>
<tr><td>P122C</td><td colspan="4">P122C – C00ZXXX00 – H1x – Z – V3x</td></tr>
<tr><td colspan="2"></td><td>I_{nom} : 1/5A</td><td>I_{Enom} : 1/5A</td><td>0.002 – 0.8I_{Enom}</td></tr>
<tr><td colspan="4">U_{Hnom} : 24 – 250VDC, 100 – 230VAC</td><td>XXXX/XXX</td></tr>
<tr><td colspan="4">U_{Enom} : 24 – 250VDC, 100 – 230VAC</td><td>f_{nom} : 50/60Hz</td></tr>
<tr><td colspan="3">Diagram 2070571 - Z</td><td colspan="2">FXXXXXXX</td><td rowspan="2">CE</td></tr>
<tr><td colspan="4"></td><td>MM/YY</td></tr>
</table>

FIGURE 1 : MiCOM P122C TYPE IDENTIFICATION LABEL

The type identification label shows the nominal current I_{nom}, the nominal residual current $I_{N,nom}$ ($I_{E,nom}$), the nominal auxiliary voltage $V_{aux,nom}$ ($U_{H,nom}$), the nominal input voltage $V_{in,nom}$ ($U_{E,nom}$) and the nominal frequency f_{nom}.

The MiCOM P122C relay design version can be identified from the purchase order number. A breakdown of the P/O number is given in the order information.

1.3 Location requirements

The MiCOM P122C relay is designed to conform to EN 60255-6. Therefore it is important that the installation location provides conditions as specified in chapter "Technical Data". Several important requirements are listed in the following.

Environmental conditions

- Ambient temperature: - 5 to + 55° C
- Air pressure: 800 to 1100 hPa
- Relative humidity: The relative humidity must not result in the formation of either condensation water or ice in the MiCOM P122C relay.
- Ambient humidity range (annual mean): < 75 %
- Ambient air: The ambient air must not be considerably polluted by dust, smoke, gases or vapours, or salt.

Mechanical conditions

- Vibration stress: 10 to 60 Hz, 0.035 mm and 60 to 500 Hz, 0.5 g
- Earthquake resistance 5 to 8 Hz, 3.5/1.5 mm and 8 to 35 Hz, 5/10 m/s^2, 3 x 1 cycle

Electrical conditions of auxiliary voltage for the power supply

- Operating range for DC voltage: 0.8 to 1.1 $V_{aux,nom}$ with a residual ripple of up to 12% $V_{aux,nom}$
- Operating range for AC voltage: 0.9 to 1.1 $V_{aux,nom}$

Electro magnetic conditions

Appropriate measures taken in substations must correspond to the state of the art (see, for example, the VDEW ring binder entitled "Schutztechnik" [Protective Systems], Section 8, June 1992 edition, which includes recommended measures to reduce transient overvoltages in secondary lines in high voltage substations).

1.4 Installation

The dimensions of the case and for mounting are given in Figure 5. The MiCOM P122C relay is suited to be wall surface mounted or flush mounted into a control panel.

If the MiCOM P122C relay is to be mounted into a cabinet door, special sealing measures are necessary to provide the degree of protection (IP 51) required for the cabinet.

When shipped from the factory the MiCOM P122C relay has removable terminal blocks and two mounting brackets included in the carton. If the MiCOM P122C relay is to be wall surface mounted or flush mounted into a control panel the removable terminal blocks and the mounting brackets must be positioned as shown in Figure 2:

- Flush mounted into control panel:
  After loosening the screws **C** (two on top and two on the bottom of the case) the mounting brackets **D** are attached. Place the wider side of the mounting brackets onto the front of the top and bottom sides of the case and tighten screws **C**. The four removable terminal blocks **B** are plugged into the four terminal sockets so that the screws **A** show towards the rear of the case.

- Wall surface mounted:
  After loosening the screws **E** (two on top and two on the bottom) the mounting brackets **D** are attached. Place the smaller side of the mounting brackets onto the rear of the top and bottom sides of the case and tighten screws **E**. The four removable terminal blocks **B** are plugged into the four terminal sockets so that the screws **A** show towards the front of the case.

The removable terminal blocks are permanently fixed to the terminal sockets by closing the terminals (tightening screws **A**)!

If the MiCOM P122C relay is fitted with an optional communication interface with RS485 hardware, it is recommended to fit the mounting bracket with the grounding connection on the bottom of the case.

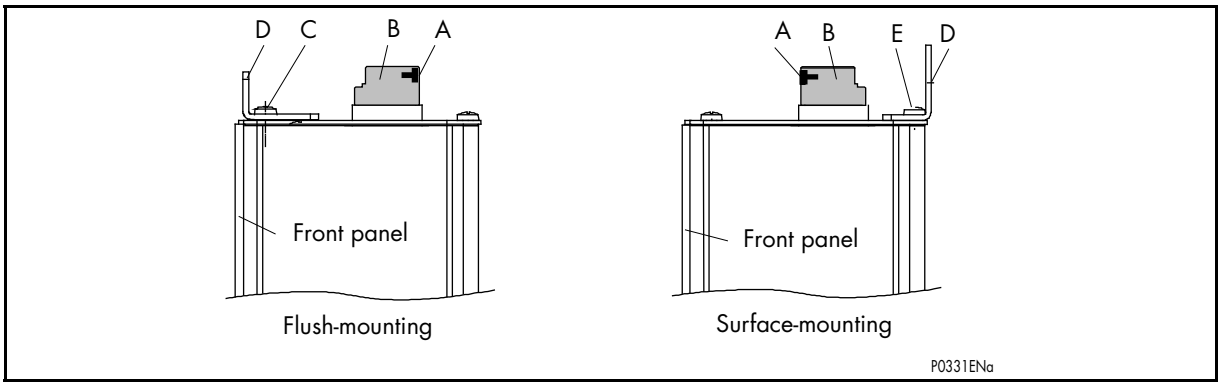

FIGURE 2 : FITTING MOUNTING BRACKETS AND REMOVABLE TERMINAL BLOCKS FOR WALL SURFACE MOUNTING OR FLUSH MOUNTING

A panel cut-out must be made if the protection device is to be fitted into a cabinet door (see Figure 5).

The panel material must not exceed 3 mm thickness.

For a case, surface mounted on a panel, the wiring to the MiCOM P122C relay is made on the front of the panel. If the wiring is to be fitted from the rear of the panel, two cut-outs above and below the terminal blocks can be made (see Figure 3).

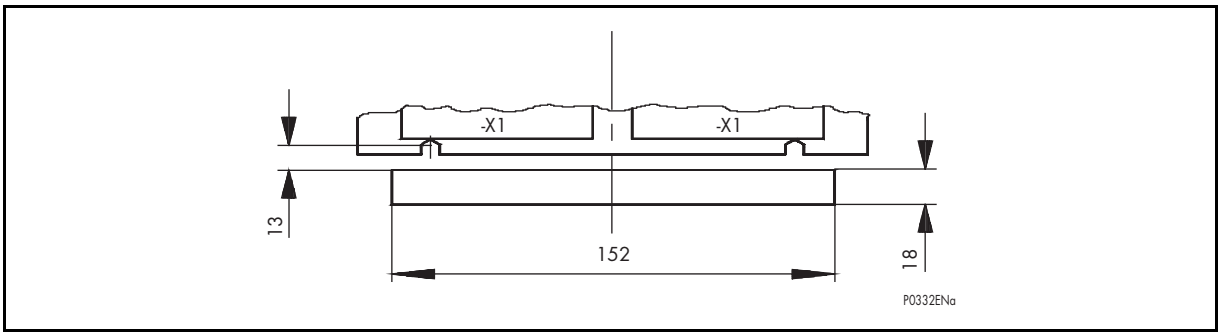

FIGURE 3 : BOTTOM CUT-OUT TO FIT WIRING TO LOWER TERMINALS

When the MiCOM P122C relay is flush mounted into a control panel, the four fixing screws included in the carton are to be used.

The edges of the cut-out and the screw heads can be covered with a cover frame that snap-fastens onto the fixing screws (see Figure 4).

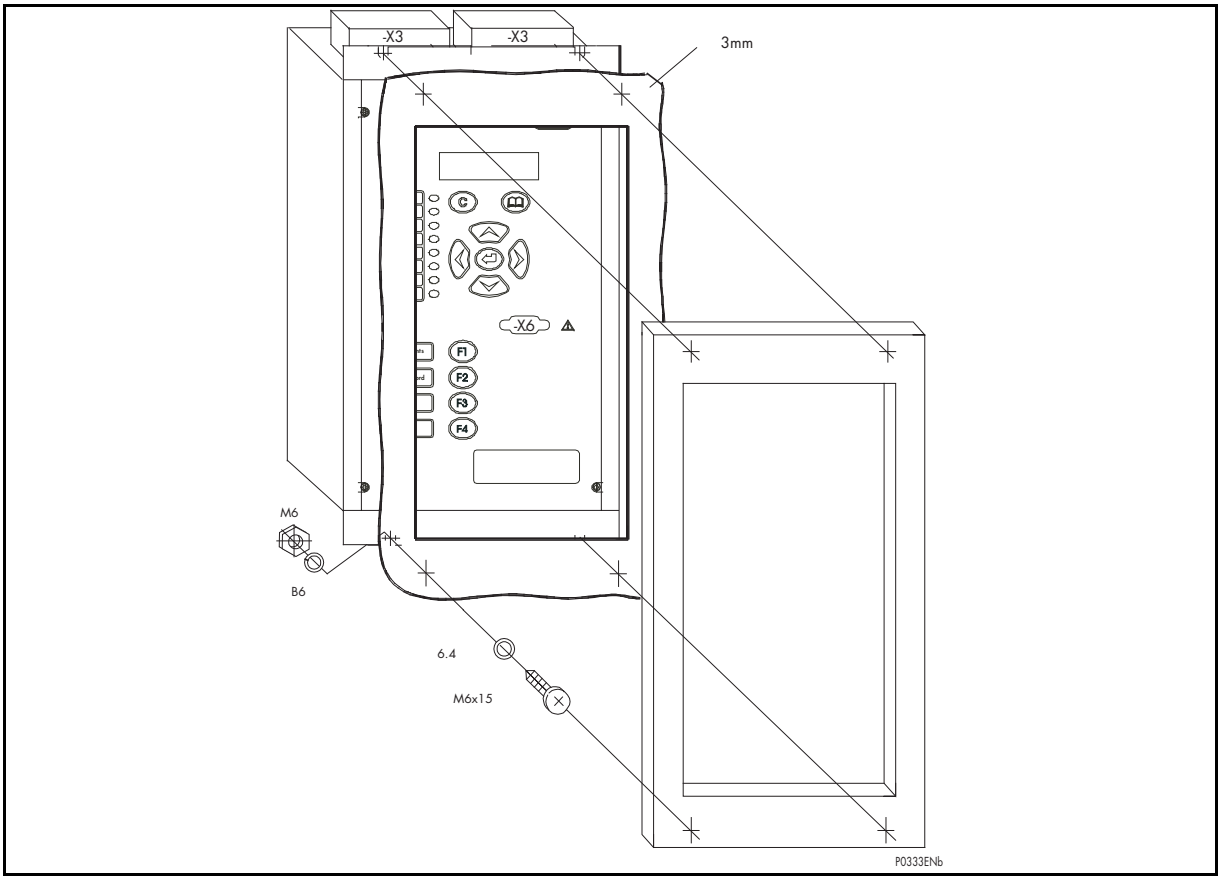

FIGURE 4 : COVER FRAME SNAP-FASTENS ONTO FIXING SCREWS

1.5 Case dimensions

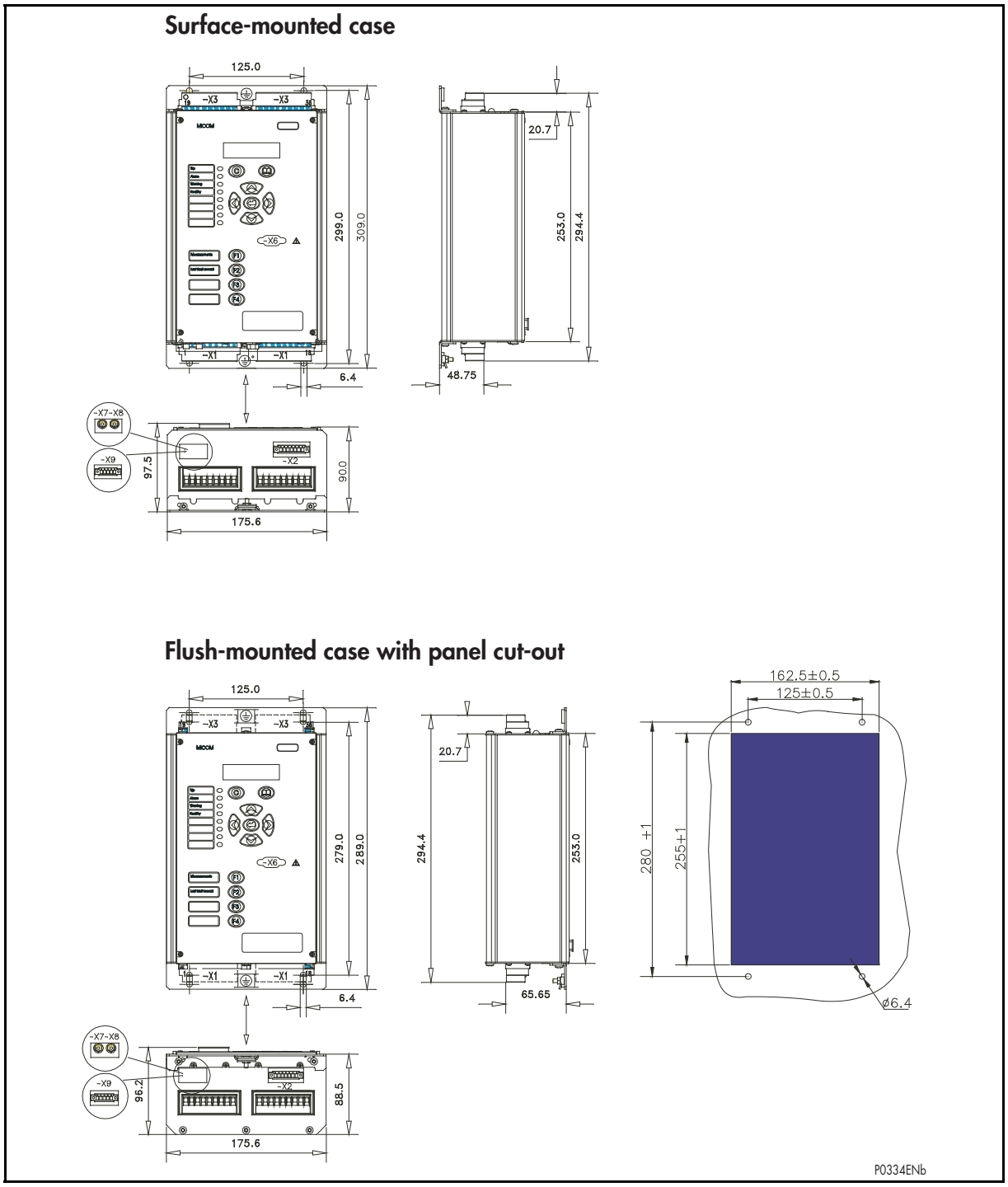

FIGURE 5 : DIMENSIONS WITH SURFACE MOUNTED AND FLUSH MOUNTED CASES

2. CONNECTION

The standard terminal blocks to connect the MiCOM P122C relay are mounted on the top and bottom sides of the case. The terminal blocks to connect the optional communication interface and the 5 optional binary inputs are mounted on the bottom side of the case.

2.1 Protective and system grounding

The case must be reliably grounded to meet protective equipment grounding requirements. Such a ground connection is an absolute requirement for proper operation of the protection device, and is considered a system grounding. Potentials which must be operationally grounded are connected to the common grounding point inside the protection device.

The mounting brackets for the MiCOM P122C relay are fitted and labelled with proper holes to connect grounding cables.

One of the mounting brackets is factory fitted with the ground connection assembly kit.

The grounding conductor must be low inductive, e.g. as short as possible. The cross section of this ground conductor must conform to applicable national standards. A minimum cross section of 2.5 mm² is required.

2.2 Connecting the auxiliary voltage

The MiCOM P122C relay can be connected to a DC power supply (voltage range: 24 to 250 VDC) or an AC power supply (voltage range: 100 to 230 VAC). A rectifier bridge is included to protect the device from incorrect polarity. For reasons of compatibility to other protection devices L+ is connected to terminal 13 (always connect L+ to terminal with lower number).

For the auxiliary supply conductor a minimum cross section of 1.5 mm² is required.

2.3 Connecting the current inputs

The MiCOM P122C relay is equipped with four current inputs to measure the three phase currents and the residual current. The current inputs have a nominal value of 1 A or 5 A, depending on the parameter cell setting.

In general copper conductors with a cross section of 2.5 mm² are sufficient to connect a current transformer to a current input on the MiCOM P122C relay. Because of the loading of the main CTs it may be necessary to install shorter copper conductors with a greater cross section between the current transformers and the current inputs on the MiCOM P122C relay. The standard CT connection may be taken from the connection scheme shown in Figure 8.

The secondary circuit of operating current transformers must not be opened! If the secondary circuit of an operating current transformer is opened, there is the danger that the resulting high voltages will endanger persons and damage the insulation. The threaded terminal block for the current transformer connection is not a shorting block! Therefore always short-circuit the current transformers before loosening the threaded terminals.

2.4 Connecting the binary signal inputs

As a standard the MiCOM P122C relay is equipped with two binary signal inputs, but it may be expanded with 5 optional binary signal inputs. The parameter cell for the binary signal inputs may be set so that they operate on either direct current signals (voltage range: 24 to 250 VDC) or alternating current signals (voltage range: 100 to 230 VAC).

A minimum conductor cross section of 1.5 mm² is required for binary signal inputs.

2.5 Connecting the output relays

The MiCOM P122C relay is equipped with 8 output relays. The Trip order is permanently assigned to the (Trip) output relay 1. The logic signal Watchdog is permanently assigned to the (WD) output relay 8. Signals can be freely allocated to output relays 2 to 7.

A minimum conductor cross section of 1.5 mm² is required for output relays.

2.6 Connecting the PC interface

The PC interface (RS232 port), located on the front side of the case, is fitted with a DIN 41652 connector, type D-Sub, 9 pin, to connect a local PC, which may be used to set parameters.

Continuous operation of the PC interface is not permitted. Consequently the socket does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101. Therefore when connecting the data transmission cable make sure that you do not touch the socket contacts.

The protection device is a data transmission device (DCE). The PC interface 9 pin D-Sub connector has the following configuration:

Pin no. 2: D1[TXD] Transmit Data

Pin no. 3: D2[RXD] Receive Data

Pin no. 5: E2[Gnd] Signal Ground

To connect the protection device to a PC use a standard shielded RS232 cable (plug & socket). Max cable distance between protection device and PC $\leq$ 15 m.

2.7 Connecting the optional communication interface

The optional communication interface is available for a continuous data transmission link of the protection device to a control and monitoring system or to a central control unit. Depending on the type of optional communication interface hardware installed, data transmission is available by optical fibre cable with an appropriate plug or by RS485 twisted pair copper conductors.

2.7.1 Optical fibre data link

To select and fabricate an optical fibre cable, special knowledge and skills are required, and are therefore not described in this operation guide.

2.7.2 RS485 interface

A RS485 data transmission link between a master and several slave devices can be established by using the optional communication interface. The communication master could be, for instance, a central control station. Devices linked to the communication master, e.g. MiCOM P122C relays, are set-up as slave devices.

The RS485 communication interface can be operated in 2-wire or 4-wire configuration by setting the appropriate parameter cell. A 2-wire data link corresponds electrically to the half-duplex mode; a 4-wire data link corresponds electrically to the full-duplex mode. Data transmission using the RS485 communication interface is always operated in a half-duplex mode. To connect the RS485 communication interface the following must be observed:

- Only twisted pair shielded cables must be used, that are common in telecommunication installations.
- At least one symmetrical twisted pair is necessary.
- Conductor insulation and shielding must only be removed from the core in the immediate vicinity of the terminal strips and connected according to national standards.
- All shielding must be connected to a broad protective ground surface at least on one end, preferably at both ends of the conductor.
- Unused conductors are grounded on one end.

When installing a 4-wire data link a cable with two symmetrical twisted pairs should be used. A 2-wire data link is shown in Figure 6, and a 4-wire data link is shown in Figure 7.

2-wire data link:

When a 2-wire data link is used with the RS485 optional communication interface on the MiCOM P122C relay, the parameter cell **Connect. RS485** must be set to **2 Wires**. The transmitter must be bridged with the receiver on all devices equipped electrically with a full duplex communication interface, e.g. relays from the MiCOM Px30 range. The two devices situated at either far end must have a 200 to 220 Ω resistor installed to terminate the data transmission conductor. In most devices, and also in the MiCOM P122C relay, a 220 Ω resistor is integrated into the RS485 interface hardware and can be connected with a wire jumper. An external resistor is therefore not necessary.

4-wire data link:

When a 4-wire data link is used with the RS485 optional communication interface on the MiCOM P122C relay, the parameter cell **Connect. RS485** must be set to **4 Wires**. Transmitter and receiver must be bridged in the device situated on one far end of the data transmission conductor. The receivers of slave devices, that have an electrically full-duplex communication interface as part of their electrical system, e.g. the P122C with the parameter cell set to **4 Wire** or relays from the MiCOM Px30 range, are connected to the transmitter of the communication master device, and the transmitters of slave devices are connected to the receiver of the master device. Devices equipped electrically with only a half duplex RS485 communication interface are connected to the transmitter of the communication master device. The last device in line (master or slave device) on the data transmission conductor must have the transmitter and receiver terminated with a 200 to 220 Ω resistor each. In most devices, and also in the MiCOM P122C relay, a 220 Ω resistor is integrated into the RS485 interface hardware and can be connected with a wire jumper. An external resistor is therefore not necessary. The second resistor must be connected externally to the protection device.

The RS485 communication interface on the MiCOM P122C relay may also be operated in a scheme differing from the above. In such a case the operating conditions must be considered when a device with an electrical full duplex RS485 communication interface is to be connected to a 2 wire data link or a protection device with an electrical half duplex RS485 communication interface is to be connected to a 4 wire data link.

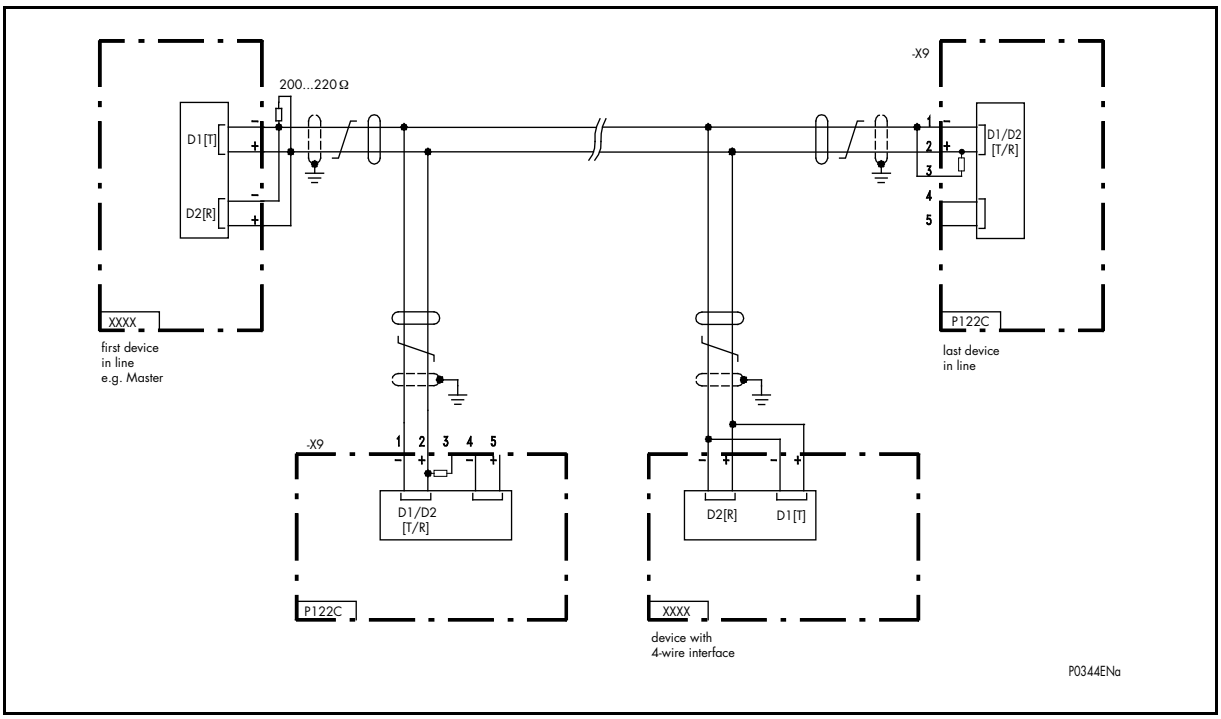

FIGURE 6 : 2-WIRE DATA LINK

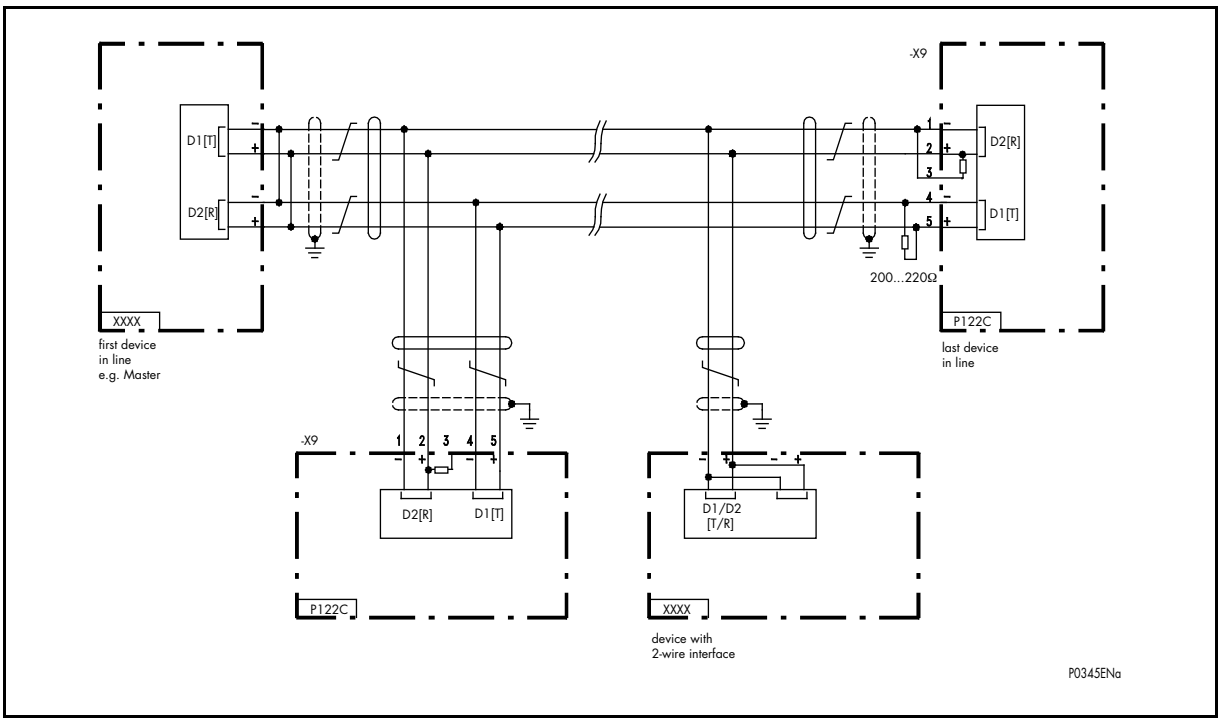

FIGURE 7 : 4-WIRE DATA LINK

2.8 Connection diagram

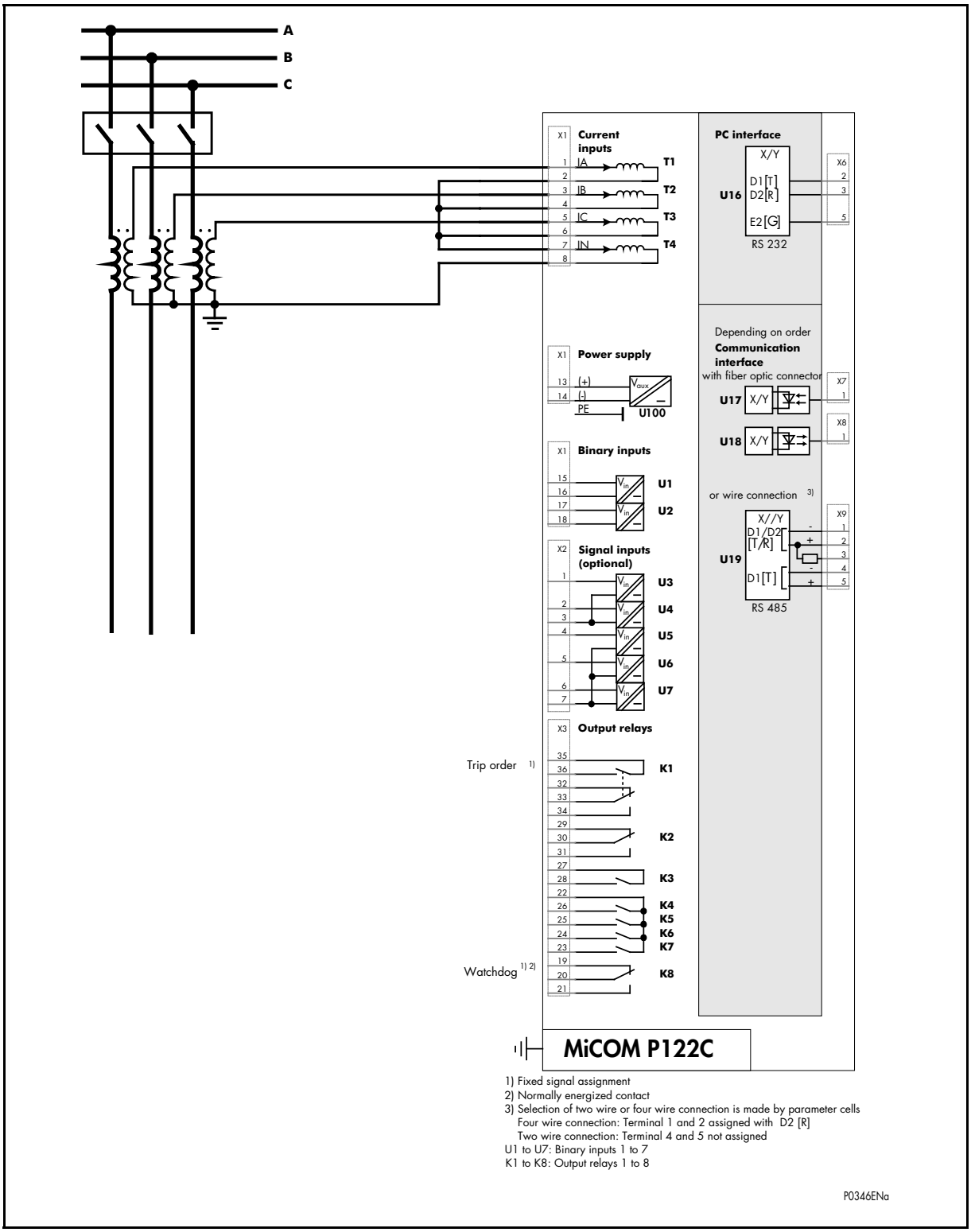

FIGURE 8 : MiCOM P122C CONNECTION DIAGRAMM (SCHEME Z)

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Control and Operation

CONTENTS

1. INTRODUCTION

1.1 Purpose of this Chapter

The chapter „Control and Operation“ is used to describe the general control and operation of individual protections of the MiCOM P122C Time-Overcurrent Protection device. Descriptions of the individual protections are structured similar to their sequence in the menu tree.

1.2 Definitions

Trip order

The Trip order is a signal sent to a circuit breaker to open the contacts connected to the protected object. The Trip order can be generated:

- automatically when an unwanted operating state is detected by the protection device,
- or manually by an operator.

Alarm

Alarms are displayed on the local control panel LCD when a deviation from the normal undisturbed operating state on the power system becomes apparent.

Acknowledgement of an alarm

When acknowledged/reset, the alarm disappears from the LCD. This is only possible after the fault that caused the alarm has been cleared.

Enabling/Disabling functions

Disabled functions, which are not needed are invisible to an operator and are not supported. Such a concept offers with just one model, a rather large functional range and broad application capabilities for the protection device as well as simple and easily accessible parameter setting and adaptation to most protection tasks to be performed.

2. DESCRIPTION OF THE MiCOM P122C TIME-OVERCURRENT PROTECTION RELAY

The MiCOM P122C is a relay from the range of numerically operating protection devices. Analogue signals are converted via current transformers (CT) and digital/binary signals are converted via opto-isolated inputs to internal relay signal levels. Analogue phase and residual current signals can be connected to inputs with programmable 1A or 5A rated signal level. Orders and signals generated internally by the protection device are available as outputs with dry relay contacts. The external auxiliary supply is connected to a power supply module with a wide operating range which provides the necessary internal voltages and can bridge supply interruptions of up to 50 ms.

The MiCOM P122C relay fits into a compact case with little mounting depth. The aluminium case is fitted with removable screw clamp connectors and invertible mounting brackets, so the relay can be either surface mounted on a panel or flush mounted into a control panel.

Information exchange between operators and protection device is carried out from the integrated local control panel. All data required for operating the protection device is entered and data important for system management is readout from the integrated local control panel. Automatically set and buffered alarms can be readout from the display without having to enter the password. All device setting parameters, measured value panels and counter contents can also be readout from the display without having to enter the password. A user pre-defined password must entered to be able to switch to the input mode and to trigger a user function and gain access to the function keys F3 and F4. Five minutes after the last change of settings has been completed the change-enabling function is automatically deactivated.

The MiCOM P122C relay obtains analogue input values with very low deviation. The relay measures true RMS values of phase currents and residual currents up to the 10^{th} harmonic in 50 Hz systems (up to the 8^{th} harmonic in 60 Hz systems).

On the local control panel the MiCOM P122C relay also includes a standard RS232 front port to connect a suitable PC and, using the support software MiCOM S1 the operator can set parameters or readout configuration parameters, cyclic measurements or buffer/memory content.

As an option the relay is fitted with an optional communication interface for RS485, optical glass or plastic fibre data transmission with IEC60870-5-103 or MODBUS™ communication protocols.

3. USER INTERFACE

3.1 Description of the local control panel

All data required for operating the protection device are entered and data important for system management are readout from the integrated local control panel. The following tasks can be handled from the local control panel:

- Readout and modification of settings
- Readout of cyclically updated measured operating measurement values, state signals and counter content
- Readout of fault records, starting records and alarms
- Resetting the device and triggering of additional control functions designed to support testing and commissioning tasks.

The local control panel is shown below:

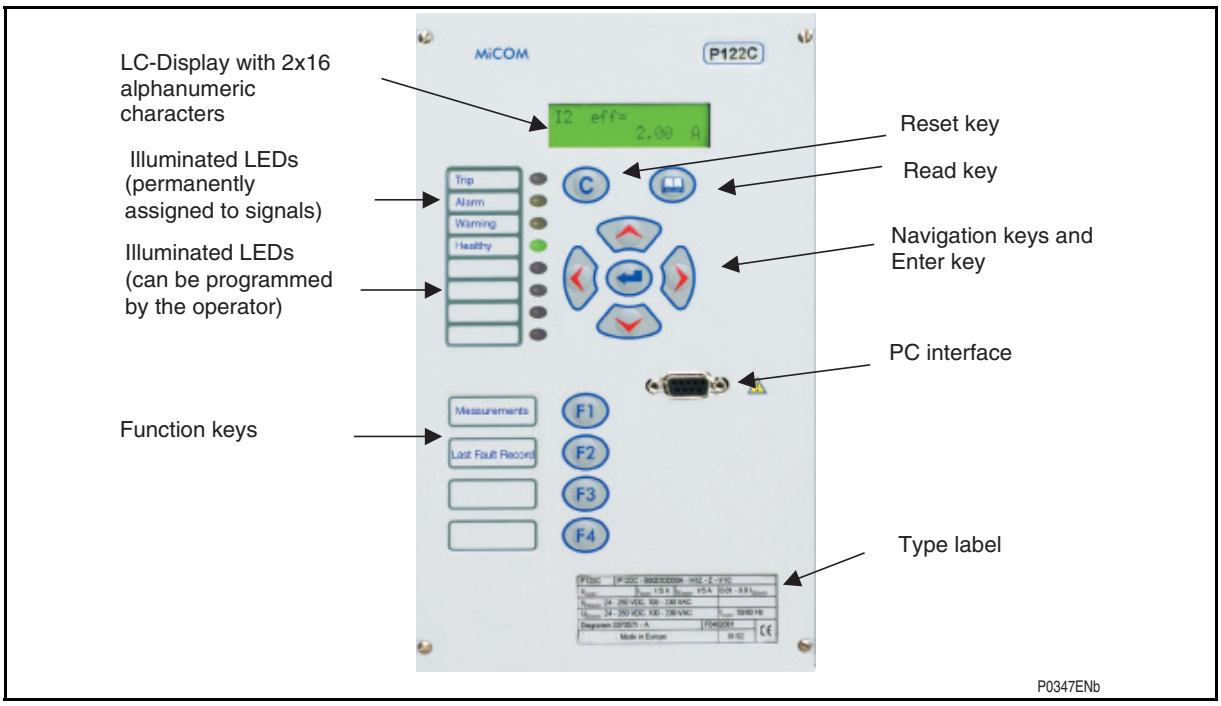


FIGURE 1: MiCOM P122C RELAY LOCAL CONTROL PANEL

The type identification label is located in the lower part of the local control panel and shows nominal electrical data, the P/O number and the serial number. The P/O number and the serial number of the relay must always be presented when contacting Schneider Electric.

A suitable PC may be connected to the RS232 front port.

The control and display elements are described in the following.

3.2 LED indicators

The relay is equipped with 8 LED indicators to display signals. They are assigned to the following functions:

LED 1 **Colour: Red** **Label: Trip**

LED 1 (Trip) is permanently assigned to the logic signal Trip order and will light up automatically when a Trip order has been issued by the protection to the Trip output relay 1. By resetting the alarm which initiated the Trip order, LED 1 (Trip) is automatically extinguished. The alarm **Latch Relay Trip** must also be reset if the Trip order is set to latching mode.

LED 2 **Colour: Amber** **Label: Alarm**

LED 2 (Alarm) is permanently assigned to the alarm memory and will light up automatically when at least one alarm has been issued by the protection device. LED 2 (Alarm) operates as follows:

- LED 2 (Alarm) will flash if one or more alarms are buffered and have not been acknowledged/read and cleared.
- After all buffered alarms have been acknowledged/read but not cleared LED 2 (Alarm) will change to constant illumination.
- As soon as all buffered alarms are acknowledged/read and cleared LED 2 (Alarm) will be extinguished.

LED 3 **Colour: Amber** **Label: Warning**

LED 3 (Warning) is permanently assigned to the internal monitoring memory and will light up automatically when at least one material alarm has been issued by the protection device. LED 3 (Warning) operates as follows:

- When a MINOR MATERIAL ALARM (typically a battery failure) is detected, LED 3 (Warning) will light up continuously.
- When a MAJOR MATERIAL ALARM is detected, LED 3 (Warning) will flash.
- LED 3 (Warning) will only be extinguished by the disappearance of the cause that provoked the internal monitoring signal.

LED 4 **Colour: Green** **Label: Healthy**

LED 4 (Healthy) is directly assigned to the auxiliary power supply and indicates that the relay has sufficient voltage available in the operating range.

LEDs 5 to 8: **Colour: Red**

LED 5 to LED 8 can be freely programmed by the operator.

3.3 Keypad

The keypad consists of 11 keys arranged in 3 groups on the local control panel:

- Navigation keys and Enter key
- Reset key and Read key
- Function keys

3.3.1 Navigation keys and Enter key

By pressing the navigation keys ⇦ ⇧ ⇩ ⇨ and reading the LCD text shown, the operator can navigate trough the menu tree where all parameter settings, measured values and operating functions are situated.
When pressed, the enter key ↵ will change to the input mode, confirm parameter value changes or trigger operating functions.

3.3.2 Reset key and Read key

In case of faulty parameter change the input mode can be left at any time by pressing the reset key C thereby rejecting changes entered. At panel level, buffered LEDs and alarms are reset by pressing the reset key C. At panel level an alarm selected by pressing the read key 📖 is cleared with the reset key C.

3.3.3 Function keys

The relay has 4 function keys available on the local control panel. Pressing function keys F1 and F2 will automatically change to the measured value panels and the last fault record. The function keys F3 and F4 may be assigned to the Trip order or they can be configured to a logic output which enables direct output control (i.e. manual closing or opening of a CB). A 200 ms pulse is generated by pressing function keys F3 or F4.

3.4 LC-Display

The integrated local control panel includes a LCD with 2x16 alphanumeric characters. The LC-Display is fitted with a back-plane illumination which is turned on by pressing any key on the keypad and will automatically turn off again after 5 minutes of keypad inactivity.

4. MENUS

The menu of the MiCOM P122C relay is organised into main menus; some main menus also include submenus. The following table shows the total content of the menus for a MiCOM P122C relay.

Main menus	Submenus				
OP PARAMETERS					
CONFIGURATION	GLOBAL SETTINGS	LOCAL INDICATION	INPUTS	INPUT MODE	OUTPUT RELAYS
	OUTPUT RELAYS MODE	LATCH OUTPUT RELAYS	LED 5	LED 6	LED 7
	LED 8	COMMUNICATION	RECORD SETTING		
AUTOMAT.CTRL	TRIP COMMAND	LATCH TRIP ORDER	CB FAILURE	SWITCH ON FAULT	SETTING GROUP SELECT
	COLD LOAD PICKUP	BLOCKING LOGIC 1	BLOCKING LOGIC 2	LOGIC SELECT 1	LOGIC SELECT 2
	CB SUPERVISION	CT SUPERVISION			
PROTECTION G1	[50/51] SHORT-CIRCUIT	[50N/51N] EARTH FAULT	[46] UNBALANCE	[49] THERMAL OVER LOAD	[37] LOSS OF LOAD
PROTECTION G2	[50/51] SHORT-CIRCUIT	[50N/51N] EARTH FAULT	[46] UNBALANCE	[49] THERMAL OVER LOAD	[37] LOSS OF LOAD
MEASUREMENTS					
EVENT COUNTERS					
CONTROL/TESTING					
RECORD	FAULT RECORD	STARTING RECORD	CB MONITORING		

TABLE 1: MENU STRUCTURE MiCOM P122C RELAY

Selecting individual menus is done with the navigation keys ⟨ ⌃ ⌄ ⟩.

4.1 Default display

During normal and undisturbed operation of the protection device the default display is a measured value panel that was selected from the submenu **LOCAL INDICATION**. Alarms are automatically displayed on the local control panel LCD when a deviation from the normal undisturbed operating state on the power system becomes apparent. A second alarm with priority is displayed when an internal monitoring signal is provoked (see section 4.13 Alarms).

4.2 Access to menus

Access to individual menus is obtained by using the navigation keys ◊ ◊ ◊ ◊.

All device setting parameters and measured value panels can be readout without having to enter the password. Access to the function keys F1 and F2 is also possible without having to enter the password.

Setting parameter cells can only be changed after the password has been entered.

4.3 Access to setting parameter cells

Access to the input mode to set parameter cells in the MiCOM P122C relay can be obtained by several means:

Direct from the local control panel: by using the keypad or connecting a PC to the PC interface (RS232 front port),

or by remote access: using the optional communication interface.

4.3.1 Password protection

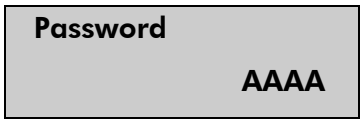
Changing from the panel level to the input mode so that setting parameter cells may be changed, or operating control parameter cells and resetting by means of the keypad on the local control panel, is password protected.

The use of function keys F3 and F4 is safeguarded by their own independent password so as to prevent unintentional or unauthorized access.

Passwords consist of four characters of upper case letters. The factory default for all passwords is set to **AAAA**. An operator can change the passwords to his own letter combination. In case a password was forgotten or lost no modifications of parameter settings buffered in the memory is possible. To obtain a copy of the password the owner can contact Schneider Electric or a local representative and present the serial number of the relay.

4.3.2 Enter password / Change parameter cells

Changing to the input mode, so that a selected setting parameter cell may be changed or to trigger a control parameter, is performed by pressing the enter key ↵. The display will automatically prompt the operator to enter the password.



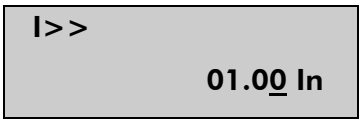
The password consists of uppercase letters from A to Z. It is entered letter by letter using the navigation keys ◊ ◊ to move forwards or backwards in the alphabet.

The navigation key ◊ is pressed after each letter so the following letter can be selected.

After the password is entered the enter key ↵ must be pressed to confirm the password entry. With a correct password entry the display will show the signal **PASSWORD OK**; if the wrong password was entered the display will show the signal **PASSWORD NOK**.

After 2 seconds, the display returns to the previous setting or control parameter cell selected from the menu. Press the enter key ↵ again to activate the input mode. A flashing cursor on the cell indicates to the operator that the input mode active.

Example: Change of the current threshold I>> (submenu **[50/51] SHORT-CIRCUIT**)



Use the navigation keys ↑ ↓ to change the existing cell setting. To select individual decimal places of numeric setting values use navigation keys ← →. Each decimal place selected is highlighted by the flashing cursor.

By pressing the enter key ↵ entered changes to settings are assigned and the input mode is left.

The reset key C can be pressed if the new setting is to be cancelled during entry. A cancelled cell setting change is displayed by the signal **UPGRADE CANCEL** and the protection device continues to operate with the old value.

A request to enter password for the function keys F3 and F4 is indicated automatically when either of them is pressed. The password is entered as described above. The function keys F3 and F4 are activated after password entry, and pressing either one must be confirmed by pressing the enter key ↵.

The passwords for the MiCOM P122C relay are global passwords, i.e. the specific password must be entered only once in order to change to the input mode or trigger the function keys F3 and F4. When a password is entered for the input mode a „**P**" appears in the menu/submenu cell display.

Passwords will be reset automatically after 5 minutes of keypad inactivity. Renewed access is then only possible after again entering the specific password.

Changing to the input mode to change setting parameter cells or to operate control parameter cells can only be performed via the operator interface where the specific password was previously entered, i.e. in order to change to the input mode at the local control panel the password must be entered from the local control panel. It is not possible to enter the password from one operator interface, i.e. the PC interface and to then change to the input mode from a different operator interface i.e. the local control panel without first entering the password from the same operator interface.

4.4 Function keys F1 to F4

Function keys F1 and F2 are permanently associated to functions. Pressing function key F1 will automatically change to the measured value panels. Pressing function key F2 will automatically change the display to the fault record with the last fault which provoked a trip.

Function keys F3 and F4 can be assigned to the Trip order or to output relays. A 200 ms pulse is generated by pressing function keys F3 or F4. Access to function keys F3 and F4 is password protected as described in the above.

Similar to the function keys F3 and F4 on the local control panel, the control signals **Order 1** and **Order 2** are available in the support software to be assigned to output relays. A 200 ms pulse is generated by the operation of these control signals.

4.5 Menu OP PARAMETERS

In this menu, the operator has access to the following information:

- Model (P122C),
- Software version of the relay,
- Active setting group,
- State of binary inputs,
- State of output relays,
- Date and time.

In this menu, the operator can also:

- enter a field designation or reference consisting of 4 characters,
- set number of available binary inputs (2 or 7 binary inputs),
- set date and time.

NOTE: The visibility and activation of setting parameter cells for binary inputs depends on the set number of available binary inputs, i.e. the relevant parameter cell should be set according to the number of binary inputs available.

4.6 Menu CONFIGURATION

The menu **CONFIGURATION** consists of individual submenus to configure the MiCOM P122C relay.

This menu **CONFIGURATION** is divided into 13 submenus:

- GLOBAL SETTINGS
- LOCAL INDICATION
- INPUTS
- INPUT MODE
- OUTPUT RELAYS
- OUTPUT RELAYS MODE
- LATCH OUTPUT RELAYS
- LED 5
- LED 6
- LED 7
- LED 8
- COMMUNICATION
- RECORD SETTING

4.6.1 Submenu **GLOBAL SETTINGS**

The submenu **GLOBAL SETTINGS** consists of the following general and extended protection function settings:

- CT Ratios
- Rotary Field Direction
- General Starting
- Nominal System Frequency
- Passwords
- Min. Output Pulse Time for Close Order and Open Order,
- Manual Control of Output Relays in Maintenance Mode
- Function Release dependent on CB Status.

CT Ratios

The CT ratio is set by entering the primary and secondary nominal current values for connected phase and earth CTs. The nominal current value for input CTs on the MiCOM P122C relay is automatically set to 1A or 5A by setting the secondary nominal current values for connected phase or earth CTs.

Rotary Field Direction

The setting for the rotary field direction of the system is either for phase sequence A-B-C or for phase sequence A-C-B.

General Starting

A general starting signal is generated from a logic OR linking of the starting signals from the phase overcurrent stages, the residual current stages and the negative-sequence current stages. The operator can select by setting if the three residual current stages **IN>, IN>>** and **IN>>>** and the negative-sequence current stages **I2>** and **I2>>** are to be included in the logic OR linking for a general starting.

The timer stage **tGS** is assigned to the general starting signal. When the timer stage duration has elapsed, the signal with the identical label **tGS** will be generated.

NOTE: If the residual current stages and the negative-sequence current stages are not set to be included in the logic OR linking for a general starting, the associated time delay signals **tIN>, tIN>>, tIN>>>, tI2>** and **tI2>>** are then automatically excluded from generating the Trip order.

Nominal System Frequency

The nominal system frequency is set in the parameter cell **Nom.Frequency**.

Passwords

The relay password is entered in the parameter cell **Password**; enter the password for function keys F3 and F4 in the parameter cell **Password F3,F4**.

Minimal Output Pulse Time for Close Order and Open Order

The timer stage **tOpen pulse** is started with the trip signal initiated by the Trip output relay 1. If the cause for a trip ends during timer stage activity the Trip output relay 1 is held until the timer stage duration elapses.

When the signal **Close Order** is sent to an output relay it is energised for at least the duration set for timer stage **tClose pulse**.

Testing Output Relays

In order to block output relays for test and commissioning purposes, the operator may set the parameter **Maintenance mode** in the menu **CONTROL/TESTING**. By enabling the parameter cell **Maintenance mode** all output relays are de-energized, so that their state is "0" and they are blocked. All functions of the MiCOM P122C relay still remain available.

With the parameter **Maintenance mode** enabled a manual test of each output relay can be performed by setting the parameter cell **Relays W7654321CMD**.

Function Release

In order to prevent unwanted trips by the loss of load element when the circuit breaker on a feeder is open, the function release for the loss of load element is dependent on the CB status, e.g. a function release is only invoked if the associated CB is energised and this is detected by the protection device. An energised CB is detected either by the binary input signal **52a** ="1" or, that at least one phase current has exceeded the threshold of the current stage **I> fct.release**. Selecting the criteria is made in the parameter cell **Function release**.

4.6.2 Submenu **LOCAL INDICATION**

With the submenu **LOCAL INDICATION** the operator can select the default display, the designated text for phase currents and the residual current or various operating modes for LEDs and alarms.

For the default display the operator can select one or more of the following measured values that will be shown on the LCD during normal and undisturbed operation:

– all three primary phase currents IA RMS, IB RMS, IC RMS and the primary residual current IN RMS,

– one of the 3 primary phase currents IA RMS, IB RMS, or IC RMS,

– the primary residual current IN RMS,

– the thermal replica of the protected object.

To display the phase currents and the residual current the operator can select various designation texts for each current. For instance, the display for phase A current can be designated with IA, I1, IL1 or IR.

The following operating modes for LEDs and alarms can be selected:

- Inst.self reset
- Reset on fault
- Battery alarm

By selecting the operating mode **Inst.self reset** the parameter cell is set to continuously self updating or storing behaviour for the starting signals.

By selecting the operating mode **Reset on fault** the parameter cell is set to automatically clear the buffer when the next fault occurs, i.e. when the next general starting or Trip order is issued or if it is to be reset manually.

The parameter cell **Battery alarm** can be set to generate a material alarm when internal monitoring by the relay has detected a RAM memory error or a battery fault.

4.6.3 Submenu **INPUTS**: Configuration of binary inputs

The MiCOM P122C relay is equipped with 2 – optionally 7 – binary inputs that can be freely configured.

NOTE: In the menu **OP PARAMETERS** the number of binary inputs must be set in the parameter cell **NB of inputs** according to the number of binary inputs available on the protection device (2 or 7).

The following signals can be assigned to binary inputs:

52a:

Detecting the CB position via a binary input, i.e. that the CB status is closed.

52b:

Detecting the CB position via a binary input, i.e. that the CB status is open.

BlockTher:

Binary input control signal to block the thermal replica in the thermal overload function. As long as the binary input signal is active, i.e. set to logic "1", the thermal replica is frozen at its present value.

θ Reset:

Binary input control signal to reset the thermal replica via a binary input.

Ext 1, Ext 2, Ext 3, Ext 4:

Binary input signals to detect various external signals.

Adjustable timer stages are associated to each of the four binary input signals. The detection of external signals may be used for different purposes, e.g. to record signals and, if necessary to transmit these via the optional communication interface to a central control system, or to detect control signals assigned to the Trip order (external Trip order). To accommodate the various applications the signals from the adjustable timer stages **tExt 1** and **tExt 2** as well as **tExt 3** and **tExt 4** are handled in different manners. An alarm is generated and appears on the local control panel when the adjustable timer stage durations **tExt 1** and **tExt 2** have elapsed. In addition the timer stage signals can be linked to the Trip order. The adjustable timer stages **tExt 3** and **tExt 4** will neither generate an alarm nor can they be linked to the Trip order. Therefore they can be used to generate operating signals.

C.L.S.:

Binary input control signal to activate the time limited changeover to selected starting thresholds as set in the submenu **COLD LOAD PICKUP**.

BlockLog1 and BlockLog2:

Binary input control signals to block the timer stages or functions selected in submenus **BLOCKING LOGIC 1** and **2**.

Log.Sel.1 and Log.Sel.2:

Binary input control signals used to replace overcurrent timer stages, selected in the submenu **LOGIC SELECT 1** or **LOGIC SELECT 2,** by logic selectivity timer stages.

CB Fail:
Binary input signal to detect a CB failure signal from a downstream CB.

Man.close:

Binary input control signal to start the switch onto fault function.

Trip Circ:

Binary input signal to monitor the CB trip circuit.

Mod.Maint:

Binary input control signal to enable/disable the maintenance mode for the output relays.

Chang.Grp:

Binary input control signal to change setting groups in one pole operating modes **Edge** and **Level** (menu **SETTING GROUP SELECT**). In order to change the setting groups with a binary input when the operating mode **Edge** is selected, the pulse or a new signal state must be active for at least 15 ms.

Group 1 and Group 2:

Binary input control signals to change the setting groups in two phase operating mode **Level 2** (menu **SETTING GROUP SELECT**). Both binary inputs must be configured in order to use them to change setting groups.

Open Ord:

Binary input control signal to manually open the CB.

Close Ord:

Binary input control signal to manually close the CB.

Reset all:

Binary input control signal for a general reset.

Dist Trig:

Binary input control signal to trigger disturbance recording.

Rst Leds:

Binary input control signal to reset all displays, i.e. all buffered LED and alarms are reset. Excepted from this reset are alarms **Latch Aux Relay** and **Latch Relay Trip**.

Rst Latch:

Binary input control signal to reset the latch of output relays and the associated alarms.

Ext reset:

Binary input control signal to reset the latch of output relays and displays. All buffered LED and alarms are reset. Resetting alarms **Latch Aux Relay** and **Latch Relay Trip** will automatically reset the latch of the Trip output relay 1 and the other output relays.

Test Mode:

Binary input control signal to activate the test mode indicator when the communication protocol IEC 60870-5-103 is used for the optional communication interface. Signals and measured values available at the optional communication interface are marked **Test Mode** when the test mode indicator is active.

Cmd Block:

Binary input control signal to activate the command blocking when the communication protocol IEC 60870-5-103 is used for the optional communication interface. Commands are rejected at the optional communication interface when the command blocking is active.

Sg/Mea.Bl

Binary input control signal to activate the signal and measures blocking when the communication protocol IEC 60870-5-103 is used for the optional communication interface. No signals and measured values are transmitted from the optional communication interface when the signal and measures blocking is active.

4.6.4 Submenu **INPUT MODE**

The logic mode can be defined for each binary input. The operator can select whether a voltage signal at the binary input (Mode: 1 ≡ H) or no voltage (Mode: 0 ≡ L) is processed as logic "1".

For the input voltage range of the binary inputs the auxiliary voltage type (DC or AC) can be set.

4.6.5 Submenu **OUTPUT RELAYS**: Configuration of output relays

The output relays 2 to 7 can be configured in the submenu **OUTPUT RELAYS**. One or more signals can be assigned to one output relay. If more than one signal is assigned to one output relay this output relay will operate if at least one of these signals takes on the logic state "1" (OR linking).

NOTE:
- Output relay 1 cannot be configured as it has the logic signal Trip order permanently assigned.
- Output relay 8 cannot be configured as it has the logic signal Watchdog permanently assigned.

4.6.6 Submenu **OUTPUT RELAY MODE**: Configuring output relay mode to NC or NO

The operating mode can be defined for each of the output relays 1 to 7. Depending on the operating mode selected the output relay will be NC or NO.

NOTE: Output relay 8 is permanently set to NC (quiescent current).

4.6.7 Submenu **LATCH OUTPUT RELAYS**: Configuring a latch

The operating mode latch can be defined for each of the output relays 2 to 7 in the submenu **LATCH OUTPUT RELAYS**, i.e. if a logic signal is generated for an output relay set to latch mode, this output relay will operate and stay latched.

NOTE: – A latched output relay can be reset by:

- acknowledging the alarm **Latch Aux Relay** or acknowledging all alarms by pressing the reset key ⓒ on the local control panel;
- setting binary input signals **Ext reset** or **Rst Latch**;
- sending an acknowledge order generated by the support software.

– On loss of auxiliary power, the output relay drops back. When the auxiliary power is turned on again the previously latched output relay will again operate, independent of the cause for the operation being present or not.

4.6.8 Submenus **LED 5**, **LED 6**, **LED 7** and **LED 8**

The four identical submenus **LED 5**, **LED 6**, **LED 7** and **LED 8** are available to configure the 4 freely configurable LEDs. The configuration permits assigning several signals to the individual LEDs.

A LED will light up when at least one such assigned signal is active (OR linking).

The LED will be extinguished when the assigned signal(s) is (are) reset or acknowledged.

The operating mode of the starting signals and latching signals assigned to LEDs can be set (submenu **LOCAL INDICATION**).

Beside the function signals, as described for each protection, there are the following general signals available:

- The signal **CB Close** is issued when the binary input signal **52a** is present.
- The signal **CB Open** is issued when the binary input signal **52b** is present.
- The broadcast signal **CB Superv.** consists of the OR linking of the signals **Trip Circ. Fail**, **CB Open Time**, **CB Close Time**, **CB Oper NB** and **Sum A n**, e.g. this broadcast signal is generated, when at least one CB supervision element has responded.

4.6.9 Submenu **COMMUNICATION**

The optional communication interface is configured with either the protocol MODBUS™ or IEC 60870-5-103 in the submenu **COMMUNICATION**. These protocols are based on a master-slave pattern. The MiCOM P122C relay can therefore be integrated, as a slave, in a digital monitoring and control system. In this system, the master, for example a PC, can be used to:

- view and modify the setting values,
- read out measured values, logic and actual signals (state change of binary inputs, output relays, change of group), fault records and disturbance records,
- set orders, i.e. manual Close or Open order, trigger disturbance recording or change the setting group.

NOTE:
- Some communication parameters can only be set from the local control panel (see chapter "Commissioning and Maintenance").
- All settings of the PC interface are predefined except the relay address, i.e. the relay address, to be set in the menu **COMMUNICATION**, is valid for both the PC interface and the optional communication interface.

4.6.10 Submenu **RECORD SETTING**: Setting of records

The submenu **RECORD SETTING** includes the parameter cells to set the disturbance records, as well as the triggered detection and the rolling detection of maximum and average primary phase current values.

Disturbance recording

The MiCOM P122C relay has the capacity to record up to 8 disturbances. Each disturbance record includes binary signals and these analogue values:

- the 3 phase currents,
- the residual/earth current,
- the system frequency.

The total disturbance record duration is determined by the set values for **Disturb Rec Pre Time** and **Disturb Rec Post Time**. For disturbance recording the set value for **Disturb Rec Pre Time** determines the record duration previous to the disturbance recording trigger order and the set value for **Disturb Rec Post Time** determines the record duration after the disturbance recording trigger order. In all cases, the total record duration cannot exceed 3 seconds.

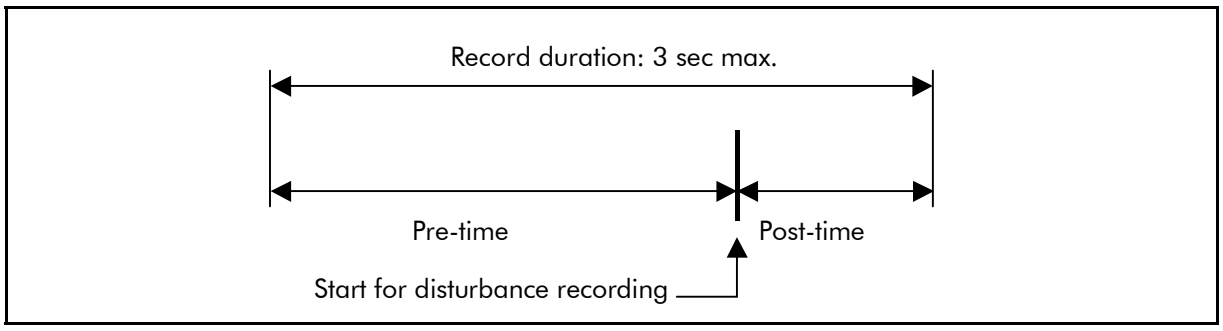


FIGURE 2: RECORD DURATION FOR A DISTURBANCE RECORD

The following three criteria, operating in parallel, can be set by the operator to trigger disturbance recording:

- **Dist. Trig Gen. Start**:
  Disturbance recording is triggered with the generating of a general starting.
- **Dist. Trig Trip:**
  Disturbance recording is triggered simultaneously with a Trip order.
- **Dist Trig other Inst**:
  Disturbance recording is triggered with the generating of any other event.
  Such other events are:
  - the signal thermal trip,
  - the timer stage **tI<** associated to the loss of load function has elapsed.

Disturbance recording can also be started …

- from the local control panel by entering the order **Disturb Trigger** (see submenu **CONTROL/TESTING**),
- with the binary input signal **Dist. Trig** (see submenu **INPUT MODE**),
- with a start order generated by the support software and sent to the relay's PC interface or the optional communication interface.

NOTE:
- If the configuration of the **Disturb Rec Pre Time** and **Disturb Rec Post Time** corresponds to total record duration of more than 3 seconds, then the **Disturb Rec Post Time** duration is automatically reduced so that the total record duration is 3 seconds.
- Disturbance recordings are organized in a first-in-first-out memory. When the next disturbance is detected and eight disturbance records are buffered, the first disturbance in (oldest disturbance record) is deleted.
- The disturbance record memory can be reset with the order **General Reset** (see submenu **CONTROL/TESTING)**.
- If the parameter cell **Dist. Trig Trip** is enabled a Trip order, issued by the Open order or by one of the function keys, will not trigger the disturbance recording.
- Disturbance records read with the support software are stored in the COMTRADE format.

Triggered detection of maximum and average values with definite-time duration

With the start of the triggered detection, maximum and average values of the three phase currents are determined during the timer stage duration **Time Window** and then buffered. These buffered values are made available in the menu **MEASUREMENTS**. The triggered detection is started by resetting the buffered values from the previous triggered detection.

Rolling detection of maximum and average values

The average values of the three phase currents are each determined during successive sub-periods, as set in the parameter cell **Sub Period**. The resulting three average phase current values are then determined from the average values of sub-periods over a number of periods. The number of sub-periods used for this procedure, e.g. the last four sub-periods, is set in the parameter cell **Num of Sub Per.**

In addition the maximum sub-period value for each of the three phase currents is calculated from the average values of the sub-periods. The calculation of the maximum sub-period values is not limited to the set number of periods, but results from the average values of the individual periods as determined since the last resetting of the maximum sub-period values buffered previously. The resulting average and maximum sub-period values are determined as follows:

$$I_{\text{rolling average}} = \frac{1}{n} \left(I_{\text{average}}(i+1-n) + I_{\text{average}}(i+2-n) + \ldots + I_{\text{average}}(i) \right)$$

$$I_{\text{max subperiod}} = \max \{ I_{\text{average}}(1), I_{\text{average}}(2), \ldots I_{\text{average}}(i) \}$$

$I_{\text{average}}(i)$ = average value of the sub-period i

i = number of sub-periods since the last resetting

n = set number of sub-periods

The resulting values are made available in the menu **MEASUREMENTS**.

4.7 Menu AUTOMAT.CTRL

The menu **AUTOMAT.CTRL** comprises 12 submenus:

- TRIP COMMAND
- LATCH TRIP ORDER
- CB FAILURE
- SWITCH ON FAULT
- SETTING GROUP SELECT
- COLD LOAD PICKUP
- BLOCKING LOGIC 1
- BLOCKING LOGIC 2
- LOGIC SELECT 1
- LOGIC SELECT 2
- CB SUPERVISION
- CT SUPERVISION

4.7.1 Submenu **TRIP COMMAND**: Configuration of the Trip order

The trip logic enables the selection of criteria to configure a Trip order. The Trip order is **permanently** assigned to the Trip output relay 1.

The timer stages **tIN>**, **tIN> int.**, **tIN>>**, **tIN>>>**, **tI2>** and **tI2>>** from the residual and the negative sequence current stages are only included in generating the Trip order if their starting signals are also set to generate a general starting signal.

The following functions are associated with generating the Trip order and operating the Trip output relay 1:

- the Trip cause statistics counter (see menu **EVENT COUNTERS**),
- the latching of the Trip output relay 1 (see submenu **LATCH TRIP ORDER**),
- the surveillance of the circuit breaker (see submenu **CB SUPERVISION**),
- the display of data relating to the circuit breaker (see submenu **CB MONITORING**),
- the recording of faults (see submenu **FAULT RECORD)**
- the triggering of disturbance record at corresponding setting (see submenu **RECORD SETTING**).

NOTE: – The **Open Order** is permanently assigned to the Trip order and does not appear in the Trip logic.

– Generating a Trip order with the **Open Order** or with the function keys F3 or F4 is assumed to be an operational switching off. Therefore the disturbance record or fault record is not triggered by such a Trip order.

– The minimal pulse time for Trip order issued to the Trip output relay 1 is set in the submenu **GLOBAL SETTING**.

4.7.2 Submenu **LATCH TRIP ORDER**: Configuring a latch

Each signal assigned to the Trip order can be set to latch the Trip output relay 1, i.e. if a logic signal is generated for the Trip output relay 1 set to latch mode the Trip output relay 1 will operate and stay latched.

NOTE: – The latched Trip output relay 1 can be reset by …

- acknowledging the alarm **Latch Relay Trip** or acknowledging all alarms by pressing the reset key ⓒ on the local control panel,
- binary input signals **Ext reset** or **Rst Latch**;
- sending an acknowledge order generated by the support software.

– On loss of auxiliary power, the Trip output relay 1 drops back and the information in regard to the latching of the Trip output relay 1 is reset internally. When the auxiliary power is turned on again the previously latched Trip output relay 1 will again operate, independent of the cause of the operation being present or not.

4.7.3 Submenu **CB FAILURE**: Circuit breaker failure protection

The circuit breaker failure protection is used to monitor, that a CB has opened inside a timer stage duration, after a Trip order is issued by the Trip output relay 1.

The protection operates with the threshold **I<BF** and the timer stage **tBF**.

The timer stage **tBF** is started by the Trip output relay 1 and then, for each phase, the first crossing out of zone by the current amplitude, as defined by **I<BF**, is detected. Upon detecting this crossing out of zone by the current amplitude, another timer stage with a fixed duration equivalent to 20 samples is started. The sampling value of the P122C relay is 32 samples/cycle. Therefore the timer stage with a fixed duration equivalent to 20 samples comes to 12.5ms at 50Hz and 10.4ms at 60Hz. As long as this 12.5ms (10.4ms) timer stage is running, the protection checks whether the current amplitude crosses out of zone again. Where the current is not suppressed by the circuit breaker pole opening, it will again cross out of zone after a half cycle, i.e. 16 samples (10ms at 50Hz).

The protection restarts the timer stage with the fixed duration of 20 samples each time it detects that the current amplitude crosses out of zone and, when it does so during a timer stage duration, it checks that this crossing is in the opposite direction to the previous crossing:

- If there is no opposed current amplitude crossing, then the protection decides that the circuit breaker pole is open.
- If there is an opposed current amplitude crossing out of zone again, then the protection decides that the circuit breaker pole is not open.

If at the end of the timer stage duration **tBF**, any of the three CB poles are not open, the protection decides on a circuit breaker failure and displays the signal **CB Fail**.

The starting signals from the three phase overcurrent stages or the three residual overcurrent stages may be blocked from operating the output relays when a CB failure is detected by setting the parameter cells **Block I>;>>;>>> BF** or **Block IN>;>>;>>>BF** to **Yes**. In case of a CB failure, this would therefore lead to the unblocking of an upstream protection device, when the starting signals from the overcurrent stages are used, e.g. for reverse interlocking.

The binary input signal **CB Fail** can be used to detect the failure of a CB assigned to a down stream protection device. If both the binary input signal **CB Fail** and signal **General Start.** are simultaneously present to the protection device, the signal **Trip by CB Fail** is displayed, and this signal may be assigned to the Trip order.

The following figure shows the operation of the CB failure protection.

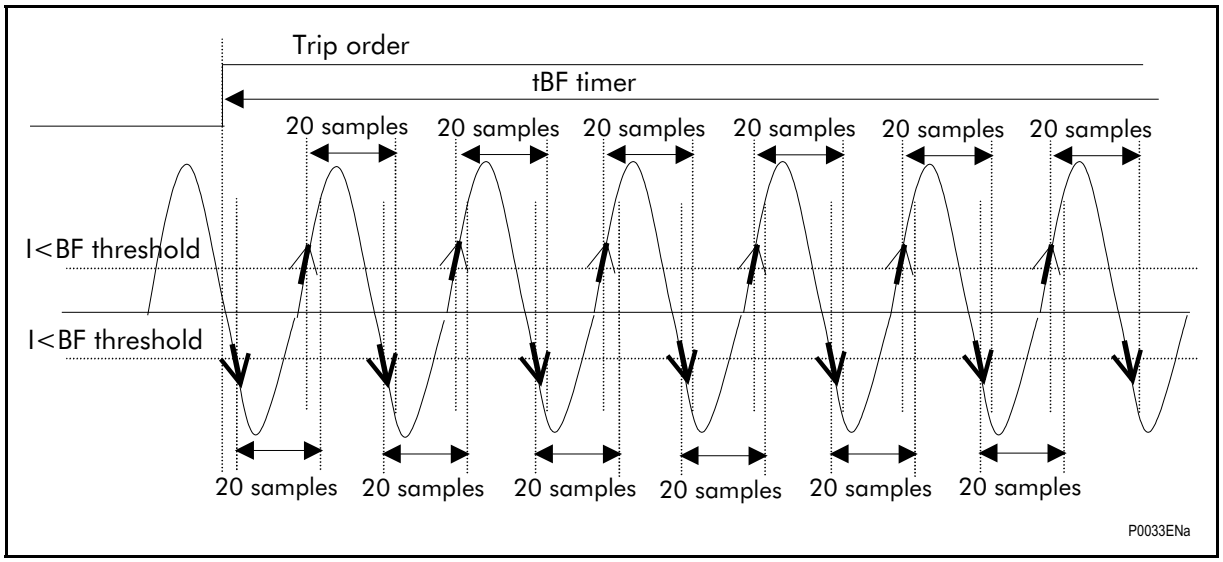


FIGURE 3: OPERATION OF THE CB FAILURE PROTECTION

Case n°1:

The figure below shows a correct opening of the circuit breaker before the timer stage duration **tBF** ends.

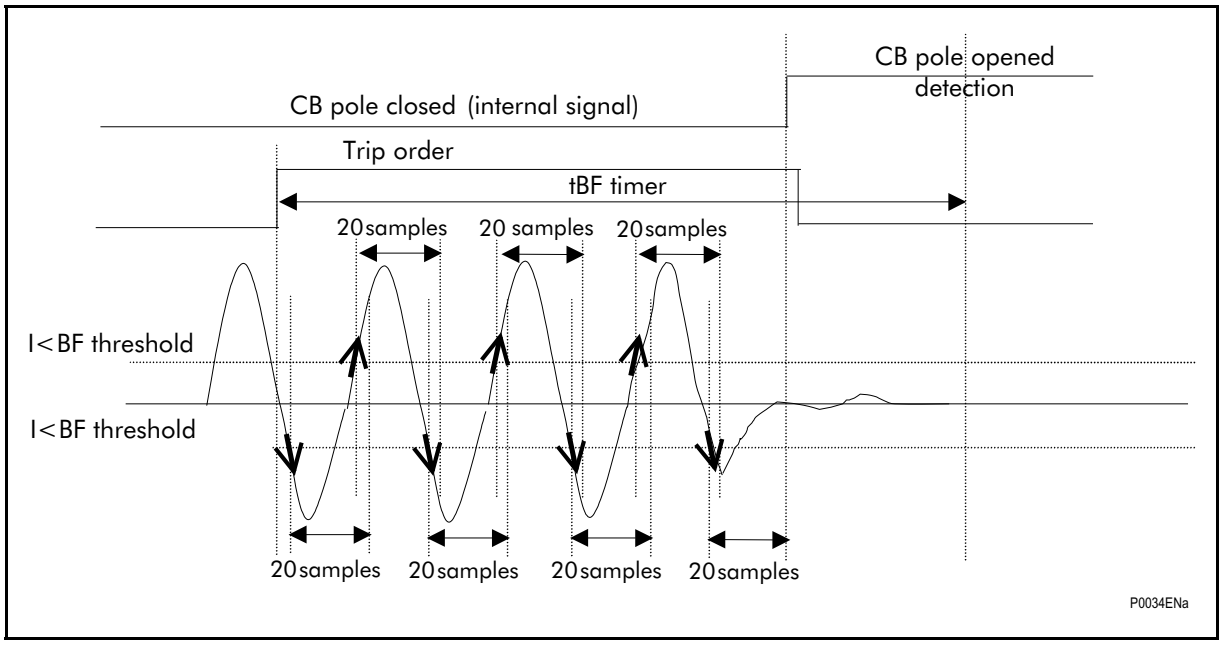


FIGURE 4: CIRCUIT BREAKER OPEN BEFORE **tBF** ENDS

Case n°2:

In the figure below the circuit-breaker does not open before timer stage duration **tBF** ends, i.e. not all CB poles are open and the protection displays the signal **CB Fail**.

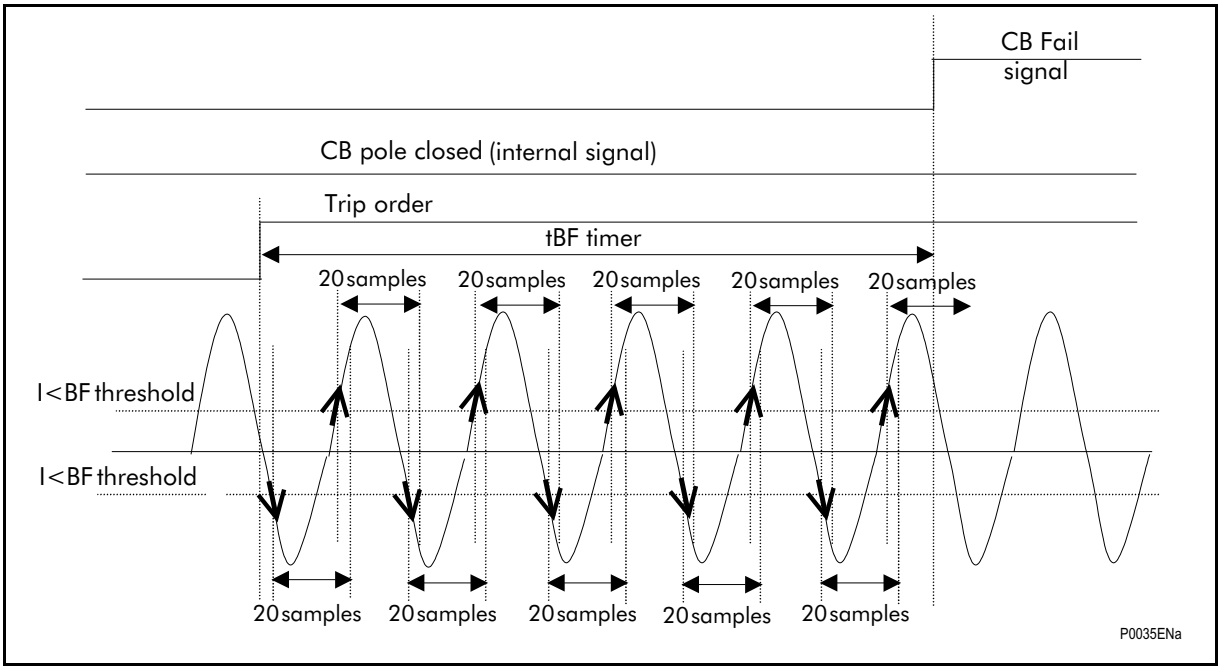


FIGURE 5: CIRCUIT BREAKER POLE NOT OPEN BEFORE **tBF** ENDS

Case n°3:

The figure below shows a correct circuit breaker opening. After fault clearance, the phase current does not decrease immediately. This is often due to the phase CT de-magnetisation.

In this case, where the CB failure protection is based solely on an undercurrent threshold, there would be a false CB failure detection.

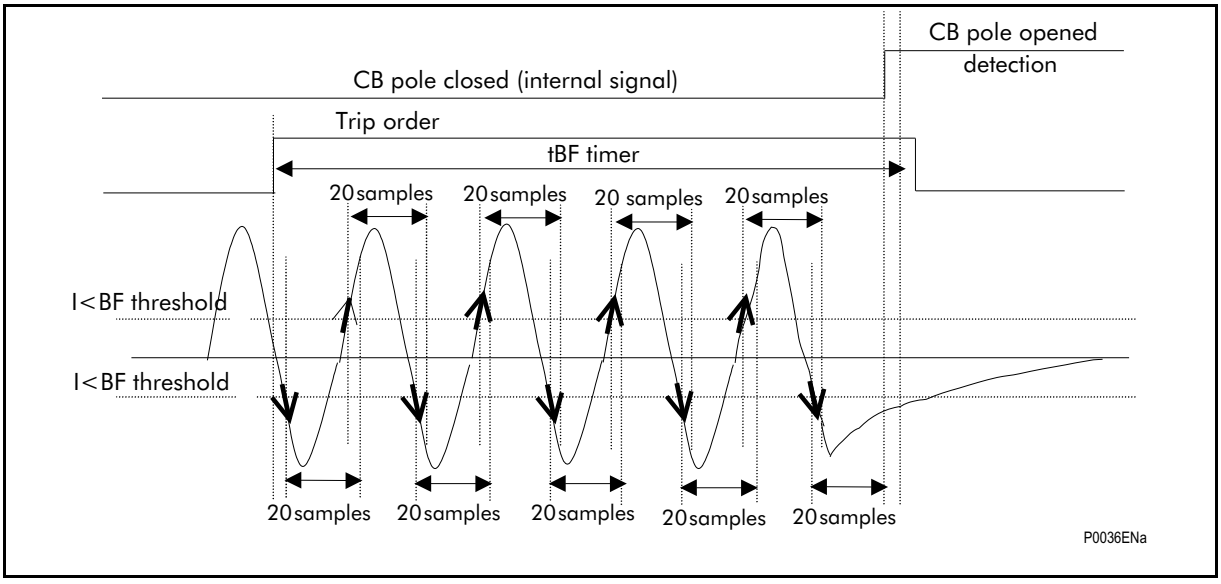


FIGURE 6: DRAG DUE TO THE PHASE CT DE-MAGNETISATION

4.7.4 Submenu **SWITCH ON FAULT**: Switching CB on to a fault

When a circuit breaker is operated manually it is possible to switch on to an existing fault. This is particularly critical as the overcurrent protection would only clear the fault after the set operate delay has elapsed. An instantaneous clearance of the faulted feeder is mandatory in such a case.

In order to guarantee such an instantaneous trip when a manual close order is issued, the manual close signal must also be wired to the binary input **Man.Close** on the MiCOM P122C relay. When the manual close order is detected the timer stage **tMan.Close** is started. By enabling the parameter cell **Trip by I>**, **Trip by I>>**, **Trip by I>>>** or **Trip by General Start.** the operator can select which of these starting signals will generate the instantaneous signal **Trip by SOTF** during the timer stage duration.

4.7.5 Submenu **SETTING GROUP SELECT**: Changing the setting group

The MiCOM P122C relay offers the operator two independent protection setting groups (see menus **PROTECTION G1** and **PROTECTION G2**). Changing from one setting group to the other can be done without interrupting the operation of the relay.

Changing from one setting group to the other is blocked if one of these states is present:

Threshold of a phase overcurrent stage (**I>, I>>, I>>>**) or residual overcurrent stage (**IN>, IN>>, IN>>>**) exceeded,

- Threshold of a current unbalance stage (**I2>, I2>>**) exceeded,
- Threshold of loss of load stage (**I<**) exceeded,
- Cold load pickup is running.

There are three operating modes available to change the setting group, i.e. **Edge** and **Level** or **Level 2** for a single or a two pole change from one setting group to the other.

Operating mode **Edge** (one pole pickup change)

If **Edge** is selected the setting group can be controlled by:

- a binary input, which must previously have been configured by the operator (binary input: **Chang.Grp**) or
- the parameter cell **Setting Group**, which is set from the local control panel, the PC interface or the optional communication interface.

Changing the setting group with a binary input takes priority over the change entered from the local control panel, i.e. when changing the setting group with a binary input, the value for the parameter cell **Setting Group** is automatically adapted.

The logic mode set in **INPUT MODE** for the binary input **Chang.Grp** must be taken into account when used to change the setting group. If the logic mode set in **INPUT MODE** for the binary input **Chang.Grp** is set to high (**1=H**) a change of setting group will occur with a rising edge; if the logic mode set in **INPUT MODE** for the binary input **Chang.Grp** is set to low (**0=L**) a change of setting group will occur with a falling edge.

Operating Mode **Level** (one pole level change)

If **LEVEL** is selected the setting group can only be controlled by the binary input **Chang.Grp** which must previously have been configured by the operator.

The following setting group will be active, depending on the logic state of the binary input **Chang.Grp**:

Logic state = "0": **PROTECTION G1** is active

Logic state = "1": **PROTECTION G2** is active

For the logic state the logic mode set in **INPUT MODE** (**1=H** or **0=L**) for the binary input **Chang.Grp** must be taken into account.

PROTECTION G1 is automatically active if no binary input is configured to **Chang.Grp.**

Operating Mode **Level 2** (two pole level change)

If **Level 2** is selected the setting group can be controlled by:

- two logic inputs which must previously have been configured by the operator (binary inputs: **Group 1** and **Group 2**), or
- the parameter cell **Setting Group**, which is set from the local control panel, the PC interface or the optional communication interface.

Should the binary inputs be used to change the setting group, the MiCOM P122C relay will first check that both binary inputs have been configured to **Group 1** and **Group 2**. If they are not configured, then the setting group selected from the parameter cell **Setting Group** will be active. The MiCOM P122C relay will also determine, if control signals present at the two binary inputs allow for an unambiguous selection of the setting group. This will only be the case if just one of the binary input control signals is set to logic "1". If both binary input control signals are set to logic "1", the setting group previously selected will remain active. The timer stage **tKeep** is started if, during the change from one setting group to the other, the input control signals should drop to zero volts, i.e. both binary inputs are set to logic "0". During the timer stage duration **tKeep** the setting group previously selected will remain active. As soon as one of the binary input control signals is set to logic "1" the associated setting group will become active. If no binary input control signal is set to logic "1" after the timer stage duration **tKeep** has elapsed, the setting group selected from the parameter cell **Setting Group** will become active.

When the auxiliary supply is switched on and none of the binary inputs, programmed to change setting groups, is set to logic "1", then the setting group selected from the parameter cell **Setting Group** will become active after the timer stage duration **tKeep** has elapsed. The last valid setting group will be active during the timer stage duration.

If the parameter cell **Keep Time** is set to **No**, the timer stage duration **tKeep** is automatically set to infinite.

For the logic state the logic mode set in **INPUT MODE** (**1=H** or **0=L**) for the binary inputs **Group 1** and **Group 2** must be taken into account.

4.7.6 Submenu **COLD LOAD PICKUP**: Cold load pickup

During a settable timer stage duration **Cold Load PU tCL**, the cold load pickup function enables the alteration of selected current thresholds of the phase and earth time delay overcurrent protections, the unbalance protection and the reference current for the thermal overload protection (i.e. when switching a transformer). The amount of alteration of set protection values, selected with the relevant parameter cells **Cold Load PU**, depends on the value set for the parameter cell **Cold Load PU Level**. The parameter cell **Cold Load PU Level** is set to the percentage of alteration in respect to the setting values of the selected protections. When the timer stage duration **Cold Load PU tCL** has elapsed, all of the relevant settings revert back to their original values.

The **Cold Load PU** can be initiated by setting these operating modes:

- Programming the binary input **C.L.S.**:
  When the input signal is set, values of selected parameter cells are altered according to the setting and the timer stage is started.
- Programming a current stage:
  If a sudden rise of current in at least one phase is detected in a feeder previously isolated, which exceeds the threshold **I>PU**, values of selected parameter cells are altered according to the setting and the timer stage is started.
- Programming a binary input signal **C.L.S.** or a current stage:
  This third operating mode is an OR linking of the first two operating modes.

The operating mode is set with the parameter cell **Detect PU**.

Example:

The overcurrent threshold **I>** is set to $1.0 \cdot I_{nom}$. The parameter cell **Cold Load PU Level** is set to 130%. If the overcurrent threshold was selected by the parameter cell **Cold Load PU I>** for a cold load pickup, the threshold is raised during the set duration by 30% to $1.3 \cdot I_{nom}$.

NOTE: The threshold **I>PU** is set in percent of **Line CT sec.**

4.7.7 Submenus **BLOCKING LOGIC 1** and **2**: Blocking timer stages with binary inputs

The blocking logic enables the selection of criteria to configure a blocking.

The selection of timer stages or protections to be blocked is made with the respective setting parameter cells of **Block.Log1**. These timer stages or protections are blocked when a logic signal is applied to the binary input **BlockLog1**.

As an alternative, timer stages or protections to be blocked can also be selected with the respective setting parameter cells of **Block.Log2**, and they are blocked when a logic signal is applied to the binary input **BlockLog2**.

Example:

The blocking logic can be used, for instance, in radial networks with single-side infeed to install reverse interlocking for busbar protection. Busbar faults are then cleared with a reduced command time. The following figure shows how a reverse interlocking is set up.

The MiCOM P122C relay situated on the infeed performs infeed protection and the MiCOM P122C relays situated on outgoing feeders 1 to n are used as outgoing feeder protection devices. The general starting signal or the starting signals from individual stages for all feeder protection devices are configured to a single output relay and are linked by an external ring line. The blocking of the timer stage **tI>>** is

configured to a binary input of the infeed protection device, which is also connected to the ring line.

The following example will show how such a reverse interlocking works. Because of the time graded tripping, the MiCOM P122C relay on the infeed operates with a trip time of 1.5s, for example, while the outgoing feeder protection devices on feeders 1 to n operate with a trip time of 1.0s. The timer stage **tI>>** of the infeed protection device is set to 0.1s (a minimum time of 0.1s is required due to the command and running times).

When the characteristics of the infeed protection are analysed, we find the following reactions:

- Outgoing feeder fault
  The protection device for the outgoing feeder in question starts and blocks timer stage **tI>>** of the infeeder protection via the ring line. The infeeder protection is blocked until the outgoing feeder protection device has cleared the fault after the timer stage duration has elapsed (here 1s). Should the outgoing feeder protection fail, a trip will be initiated at 1.5s by the timer stage **tI>** of the infeed protection.

- Busbar fault
  In the event of a fault on the busbar, none of the outgoing feeder protection devices will start. The timer stage **tI>>** of the infeeder protection will therefore not be blocked. The busbar fault will be cleared with the short duration of timer stage **tI>>** (in this case 0.1s) of the incoming feeder protection.

Reverse interlocking can also be used in combination with other protection devices.

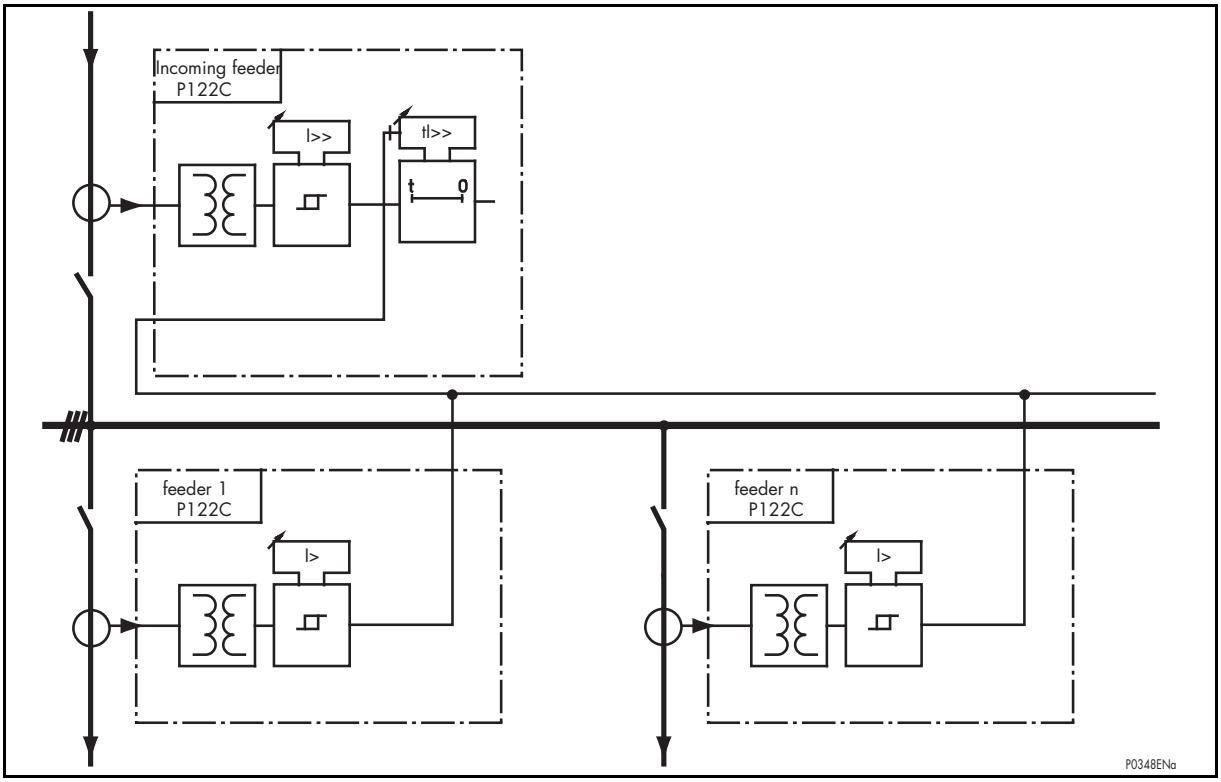


FIGURE 7: BUSBAR PROTECTION BY REVERSE INTERLOCKING

NOTE: In case a CB should fail when a fault has occurred on an outgoing feeder, the starting signals from the phase and residual overcurrent stages, assigned to output relays, may be blocked (see submenu **CB FAILURE**) in order to guarantee the reset of the blocking signal and instantaneous clearing by the infeed protection device. For such an application, starting signals from the phase and residual overcurrent stages must be configured as blocking signals to the output relay to the outgoing feeder protection device.

4.7.8 Submenus **LOGIC SELECT 1** and **2**: Logic selectivity

Logic selectivity makes possible a reduced grading time in radial feeders or the installation of reverse interlocking without having to use blocking logic.

The respective timer stages for the second and third phase and residual overcurrent stages may be replaced by the timer stages **tLog.Sel.1** or **tLog.Sel.2** by setting the binary inputs **Log.Sel.1** or **Log.Sel.1**. Selection of timer stages, that are to be replaced when the binary input signal **Log.Sel.1** is present, is made for each stage by setting an individual parameter, e.g. **Log.Sel.1 tI>>** or **Log.Sel.2 tI>>** for the second phase overcurrent stage.

Logic selectivity 1 operates independent from logic selectivity 2.

NOTE: Replacing timer stages for the second phase overcurrent stage and the second residual overcurrent stage by a logic selectivity timer stage is only possible if the operating mode **DMT** is selected.

4.7.9 Submenu **CB SUPERVISION**: Circuit breaker and trip circuit supervision

Trip circuit supervision

The trip circuit supervision function supervises trip circuit wiring continuity. Depending on the auxiliary voltage and the impedance of the CB trip coil there are various methods available to set-up a trip circuit supervision.

To set-up trip circuit supervision, the trip coil power circuit on the CB is wired to a binary input on the MiCOM P122C relay, configured as **Trip Circ**. The timer stage **tSup** is started if there is no binary input signal (no voltage) present. The signal **Trip Circ. Fail** is displayed after the timer stage duration **tSup** has elapsed. This function is inhibited when the protection device sends a Trip order or a latch relay Trip order to the circuit breaker, by operating its Trip output relay 1.

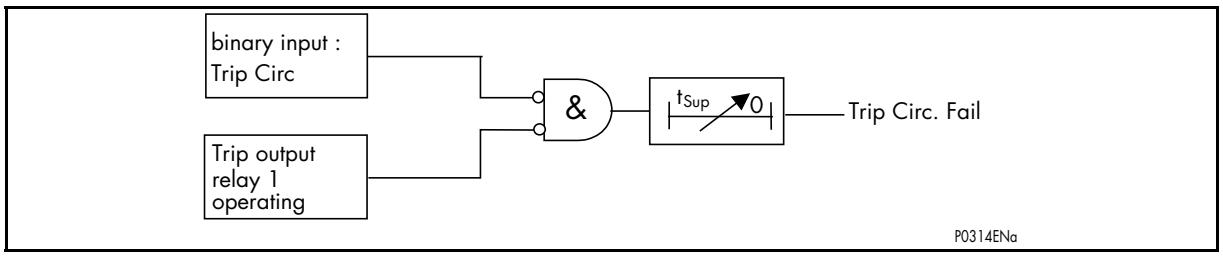


FIGURE 8: TRIP CIRCUIT SUPERVISION

The binary inputs, featured on the MiCOM P122C relay have a specific voltage/current characteristic that guarantees high immunity to interference over a large voltage range from 24VDC to 250VDC. At the same time the resistive loss at higher voltages is limited by a voltage independent current sink. With such a characteristic it is possible to supervise the trip coil power circuit on the CB, wired in series with a binary input, with a limited current flow but without switching the CB.

NOTE:
- Trip circuit supervision is not allowed when an AC auxiliary voltage is installed.
- All calculations following below are based on a DC auxiliary voltage.

Procedure 1:

Trip Circuit Supervision with Resistor in Series with Trip Coil

The binary input is wired parallel to the contacts of Trip output relay 1. Additionally a high ohmic resistor is wired in parallel to both CB aux contacts.

By monitoring the CB aux contacts, this procedure is applied, to continuously check the auxiliary voltage, the continuity of the trip circuit and the CB operation whatever the CB status (CB open or CB closed).

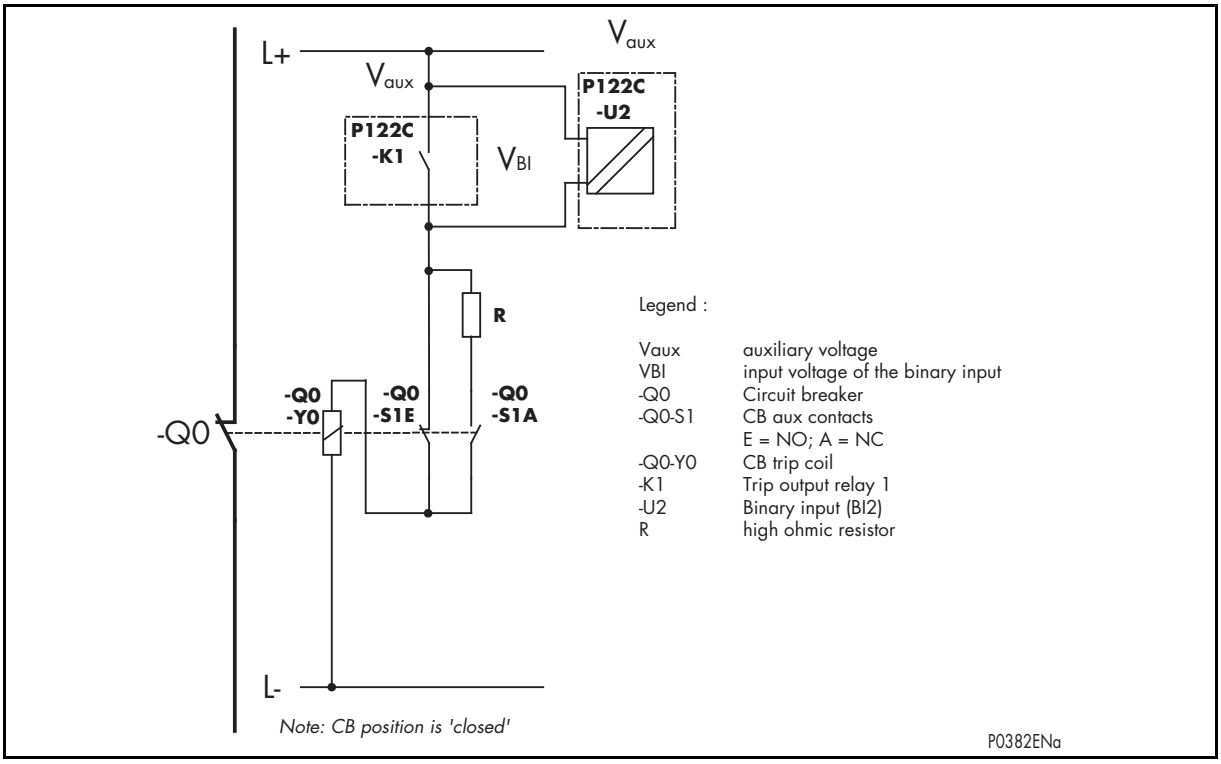


FIGURE 9: TRIP CIRCUIT SUPERVISION WITH RESISTOR ACROSS –Q0 –S1

If the CB is closed and no Trip order is set, the trip circuit is closed via the binary input and the trip coil. If the CB is open and no Trip order is set, the trip circuit is closed via the binary input, the resistor and the trip coil.

The value of the resistor to be wired into the trip circuit must be calculated according to the auxiliary voltage and the trip coil impedance. In order to calculate the resistor value two marginal conditions must be considered that limit the valid range.

When -Q0-S1A and Trip output relay 1 contacts are closed, the current flow across the resistor should not be sufficient to operate the trip coil. The following formula is used:

$$R_{min} = \left(\frac{V_{aux} - V_{coil(max)}}{V_{coil(max)}} \right) \cdot R_{coil}$$

V_{aux}	auxiliary voltage
$V_{coil(max)}$	max voltage allowed on trip coil (usually 10% of the rated voltage)
R_{coil}	Ohmic resistance value for the trip coil

When -Q0-S1A contact is closed and Trip output relay 1 contact is open, the min voltage and the min current flow across should be sufficient to operate the binary input.

$$R_{max} = \left(\frac{V_{aux} - V_{BI(min)}}{I_{BI(min)}} \right) - R_{coil}$$

$V_{BI(min)}$	min voltage to operate the binary input (= 16VDC for the P122C)
$I_{BI(min)}$	threshold current to operate binary input (= 36mA for the P122C)
R_{coil}	Ohmic resistance value for the trip coil

The resistance value is equal to the arithmetical mean from R_{min} and R_{max}:

$$R = \left(\frac{R_{min} + R_{max}}{2} \right)$$

The exact resistance value should be taken from the standard range E12 (±10 %) or E24 (±5 %).

NOTE: This procedure is not applicable for trip circuit supervision if the calculation comes to $R_{min} > R_{max}$.

The resistor R power consumption value (in Watt) is defined by the following formula:

$$P_R = \left(\frac{V_{aux}}{R + R_{coil}} \right)^2 \cdot R$$

NOTE: When defining the power consumption for resistor R it is assumed, that the threshold current ($I_{BI(min)}$) is continuously flowing through the resistor. This could, for example, be the case when the Trip output relay is latched (current flow is continuous) and the aux voltage is at 48VDC (high current characteristic). Therefore adapting the withstand is only possible when the system situation is considered.

Example:

V_{aux}	60V
$V_{coil(max)}$	6V
R_{coil}	23Ω

$$R_{min} = \left(\frac{60V - 6V}{6V}\right) \cdot 23\Omega = 207\Omega$$

$$R_{max} = \left(\frac{60V - 16V}{0.036A}\right) - 23\Omega \approx 1199\Omega$$

$$R = \left(\frac{207\Omega + 1199\Omega}{2}\right) = 703\Omega$$

Closest standard value (E24): $R = 680\Omega$

$$P_R = \left(\frac{60V}{680\Omega + 23\Omega}\right)^2 \cdot 680\Omega \geq 5W$$

NOTE: These calculations should also be performed for the max and min allowable aux voltage (worst case calculation), as they will lead to different resistor values. Usually it suffices to calculate R_{min} at max aux voltage and R_{max} at min aux voltage, and to use these values to determine R.

Procedure 2:

Trip Circuit Supervision with Resistor for CB Open

At low aux voltages the condition $R_{min} < R_{max}$ cannot be met with procedure 1 for certain trip coil impedances. In this case the supervision of the trip circuit can be performed with a simplified scheme. The trip circuit will only be supervised when the CB is closed.

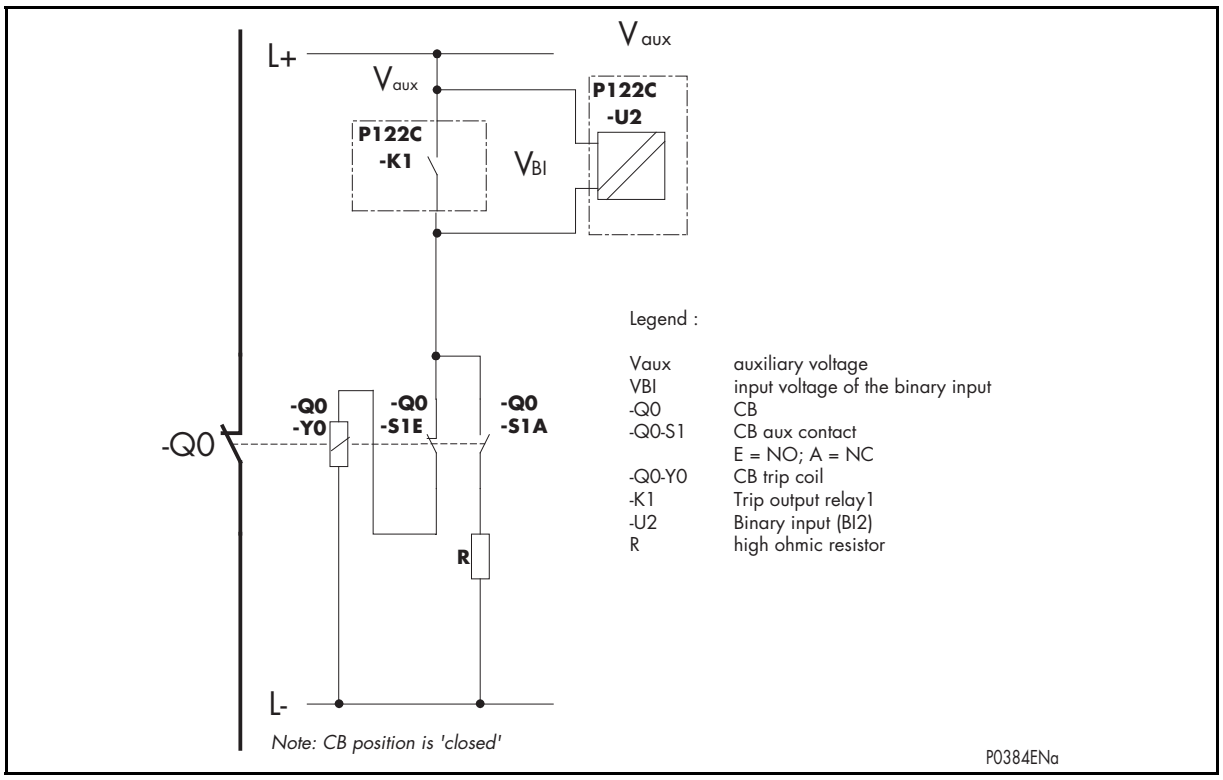


FIGURE 10: TRIP CIRCUIT SUPERVISION WITH RESISTOR FOR CB OPEN

For this procedure the resistor value and its power consumption value can be deducted direct by applying the formulas below, as only the resistor R is wired direct in series with the binary input when the CB is open.

$$R = \frac{V_{aux} - V_{BI(min)}}{I_{BI(min)}}$$

$$P_R = \frac{V_{aux}^2}{R}$$

Procedure 3:

Trip Circuit Supervision without Inserting Resistor

The trip circuit can also be supervised without inserting a resistor. With this simplified wiring the supervision of the trip circuit is performed with the CB open and closed. But only a partial section of the trip circuit is supervised.

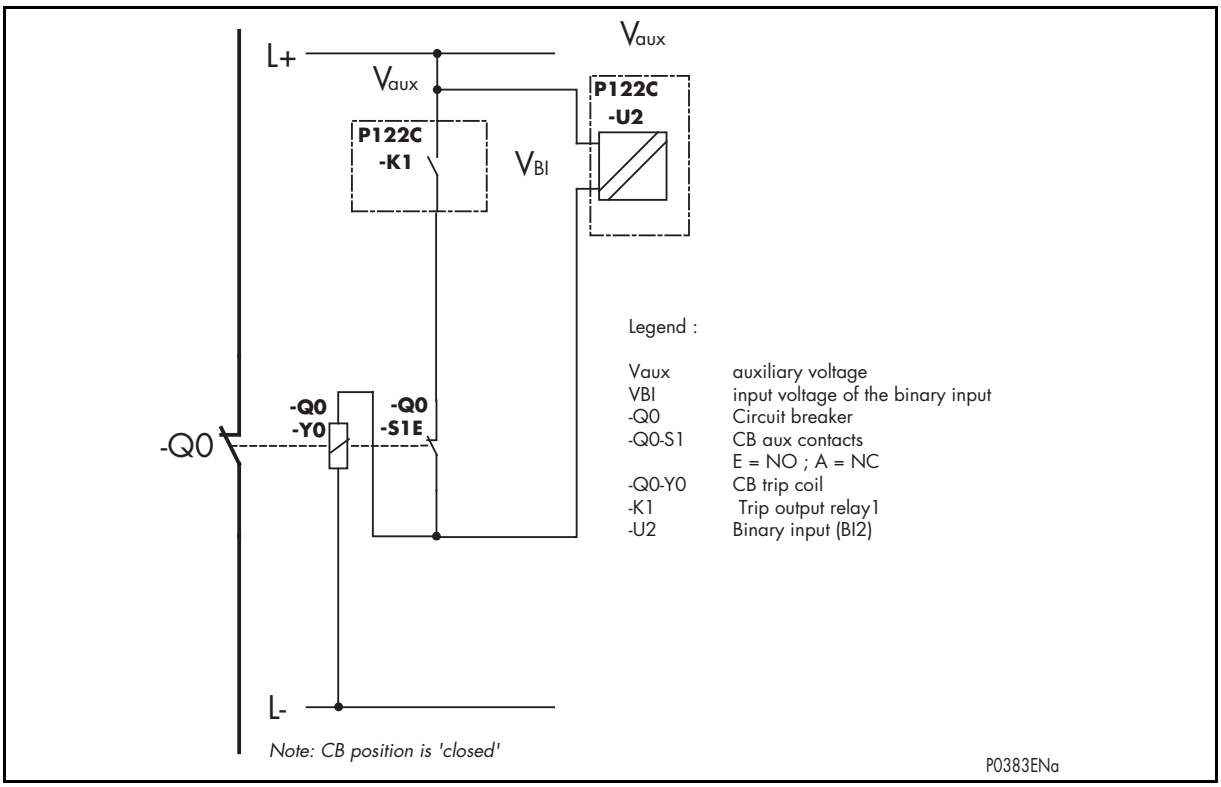


FIGURE 11: TRIP CIRCUIT SUPERVISION WITHOUT INSERTING RESISTOR

Circuit Breaker Supervision

The feature CB supervision gives the operator a strong preventive maintenance tool for a circuit breaker or for other breaking devices installed for making/breaking. The relay will monitor the following circuit breaker operations:

- Monitoring the CB breaking time:
  - When the Trip order is generated for the Trip output relay 1 the timer stage **CB Opening Time** is also initiated. If during the timer stage duration there is no return signal to the binary input **52 a**, signalling that the circuit breaker is no longer closed, the signal **CB Open Time** is displayed.
- Monitoring the CB making time:
  - When the Close order is generated for one of the output relays the timer stage **CB Closing Time** is also initiated. If during the timer stage duration there is no return signal to the binary input **52 a**, signalling that the circuit breaker is closed, the signal **CB Close Time** is displayed.
- CB trip operation number supervision:
  - The number of CB trip operations initiated by the Trip output relay 1 are recorded. When the count of CB trip operations since the last reset has reached the threshold value **CB Operation NB**, the signal **CB Opening NB** will be displayed.
- Summation of CB breaking current supervision:
  - Current flow interrupted at the time a Trip order is issued, is measured per phase and is weighted by a settable exponent (n=1 or 2). The new weighted value is then added to previous weighted values recorded since the last reset. When the summation exceeds the threshold value **Sum A n**, the signal **Sum A n** will be displayed.

4.7.10 Submenu **CT SUPERVISION**: CT circuit supervision / Broken conductor

The CT supervision will only be activated when these conditions are met:

- At least one phase current exceeds $0.05 \cdot I_{nom}$.
- No general starting is issued.

There are two operating modes are available for CT supervision. The operating mode is selected in the parameter cell **Mode CT Superv**.

The first CT supervision operating mode is based on the monitoring of the negative- to the positive-sequence current ratio at these starting condition:

$$\frac{I_{2\,Negative}}{I_{1\,Positive}} \geq I_2 / I_1 >$$

If only two CTs are installed (i.e. in compensated systems), the second CT supervision operating mode is based on the monitoring of system unbalances (differing magnitude) at these starting conditions:

$$\frac{I_{P,max} - I_{P,min}}{I_{P,max}} \geq I_{diff}>$$

$I_{P,max}$ is the highest of the two phase currents (I_A & I_C) and $I_{P,min}$ is the lowest of the two phase currents. In the second CT supervision operating mode phase current I_B is not considered.

In order to suppress transient signals the selected threshold **I2/I1>** or **Idiff>** has a timer stage **tCT** assigned, and the message **CT Fail** is displayed when this timer stage duration has elapsed.

4.8 Menus PROTECTION G1 and PROTECTION G2

The MiCOM P122C relay features two identical setting groups to adapt to differing operating conditions. In the submenu **SETTING GROUP SELECT**, three different operating modes can be selected to changeover from one to the other setting group. Each setting group includes these protections.

- [50/51] SHORT-CIRCUIT
- [50N/51N] EARTH FAULT
- [46] UNBALANCE
- [49] THERMAL OVERLOAD
- [37] LOSS OF LOAD

NOTE:
- Any protection available in the menu **PROTECTION G1** or **PROTECTION G2** can be enabled or disabled.
- Parameter cells of disabled protections are not visible on the LCD.

4.8.1 Submenu **[50/51] SHORT CIRCUIT**

The short circuit function has three phase segregated overcurrent stages available that can be enabled independently from each other.

Two of the phase overcurrent stages, **I>** and **I>>**, may be set to either definite-time or inverse-time overcurrent protection. The third phase overcurrent stage **I>>>** is always definite-time delayed.

The parameter cell **I> Delay Type** is accessed in order to set the operating mode for the first phase overcurrent stage either to **DMT**, **IDMT** or **RI**.

Operating mode DMT:

With the operating mode set to definite-time **DMT**, a starting signal is issued when the overcurrent stage **I>** is exceeded, and the timer stage **tI>** is started. When the timer stage duration **tI>** has elapsed the signal with the identical label **tI>** is issued.

Operating modes IDMT and RI:

With the operating mode for the overcurrent stage set to inverse-time **IDMT** or **RI** characteristics, the reference quantity for operate value and tripping time is the set reference current I_{ref}, which is set in the parameter cell **I>**. A starting signal is issued by the phase overcurrent stage when 1.05 times reference current (1.05·I>) is exceeded or when 1.6 times reference current (1.6·I>) for rectifier protection, with RC tripping characteristics set, is exceeded.

If the parameter cell **I> Delay Type** is set to **IDMT** the tripping characteristic may be selected by accessing the parameter cell **I> Curve**. If **RI** is set the associated tripping characteristic is automatically selected.

The factor for the tripping characteristics is set, for **IDMT**, by accessing the parameter cell **I> Tms** and, for **RI**, by accessing the parameter cell **I> K**.

If the threshold is exceeded a starting signal is generated by the overcurrent stage and, after the associated tripping characteristics delay duration has elapsed, the signal **tI>** is issued.

The tripping characteristics are listed in table 2.

The design of the second phase overcurrent stage **I>>** is equivalent to the first phase overcurrent stage **I>**, i.e. it includes the same setting features.

The third phase overcurrent stage **I>>>** is always definite-time delayed. If the threshold **I>>>** is exceeded a starting signal is generated by the overcurrent stage and the associated timer stage **tI>>>** is started. When the timer stage duration **tI>>>** has elapsed the signal with the identical label **tI>>>** is issued.

The operation of selected time delays may be blocked by a binary input control signal (see submenus **BLOCKING LOGIC 1** and **2**).

	Tripping characteristic	**Formulas for tripping characteristics**	**Factors**			**Formulas for reset characteristics**
	Tripping characteristic factor setting: Tms = 0.03...4.00		A	B	C	R
		$t = Tms \cdot \frac{A}{\left(\frac{I}{I_{ref}}\right)^{B} - 1}$				
STI	Short time inverse		0.05	0.04		
SI	Standard Inverse		0.14	0.02		
VI	Very Inverse		13.50	1.00		
EI	Extremely Inverse		80.00	2.00		
LTI	Long Time Inverse		120.00	1.00		
RC	Rectifier protection [1]		45900	5.60		
	(SI, VI, EI and LTI per IEC 255-3)					
		$t = Tms \cdot \left(\frac{A}{\left(\frac{I}{I_{ref}}\right)^{B} - 1} + C \right)$				$t_r = \frac{Rtms \cdot R}{\left(\frac{I}{I_{ref}}\right)^{2} - 1}$ Rtms = 0.025...3.200
MI	Moderately Inverse		0.0515	0.0200	0.1140	4.85
VI	Very Inverse		19.6100	2.0000	0.4910	21.60
EI	Extremely Inverse		28.2000	2.0000	0.1215	29.10
C02	Short time inverse		0.0239	0.0200	0.0169	2.26
C08	Long time inverse		5.9500	2.0000	0.1800	5.95
	(MI, VI and EI per ANSI/IEEE C37.112)					
RI	RI-Type Inverse	$t = K \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$ K = 0.05...10.00				
	A definite-time reset time is available for all inverse tripping characteristics.					

1) Available for phase and residual overcurrent

TABLE 2: INVERSE-TIME CHARACTERISTICS

NOTE: For tripping characteristics in table 2 the trip time is limited towards smaller values when the ratio I/I_{ref} becomes greater than 20.
For the rectifier protection (RC) tripping characteristics the trip time is limited towards smaller values when the ratio I/I_{ref} becomes greater than 8.

Reset logic:

The two phase overcurrent stages **I>** and **I>>** each feature reset logic.

The definite-time reset logic is available for all operating modes of the phase overcurrent stage **I>**. When the starting signal from the first phase overcurrent stage ends, the reset timer stage **I> tReset** is started and accumulation by the definite-time or inverse-time tripping characteristics up to that time is buffered during the reset time duration. If the starting signal from the first phase overcurrent stage is again issued during the reset time duration, accumulation by the definite-time or inverse-time tripping characteristics continues again. If there is no new starting signal issued from the first phase overcurrent stage during the reset time duration, the definite-time or inverse-time tripping characteristics accumulation buffer is reset when the reset time has elapsed. The operation of the reset logic is displayed in figure 12 and 13 by an example for the first phase overcurrent stage **I>** set to definite-time delay.

As an alternative to the definite-time reset logic for inverse-time tripping characteristics per IEEE/CO an inverse-time reset logic may be selected by setting the parameter cell **I> Reset Type** to **IDMT**. The reset characteristics for IEEE/CO tripping characteristics are shown in Table 2. The reset characteristic factor is set by accessing the parameter cell **I> Rtms**.

The reset logic design of the second phase overcurrent stage **I>>** is equivalent to the first phase overcurrent stage **I>**, i.e. it includes the same setting features.

NOTE: The starting signal from the first or second phase overcurrent stage is present during the reset time duration.

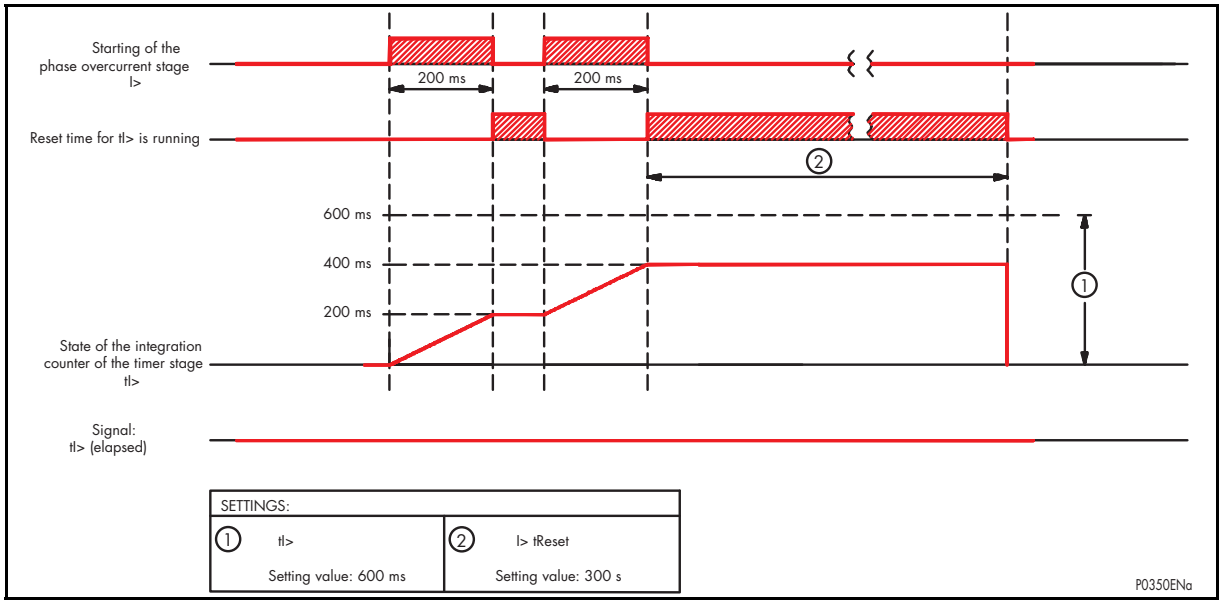


FIGURE 12: SIGNALS ISSUED WHEN THE RESET TIME DURATION FOR THE PHASE OVERCURRENT STAGE HAS ELAPSED

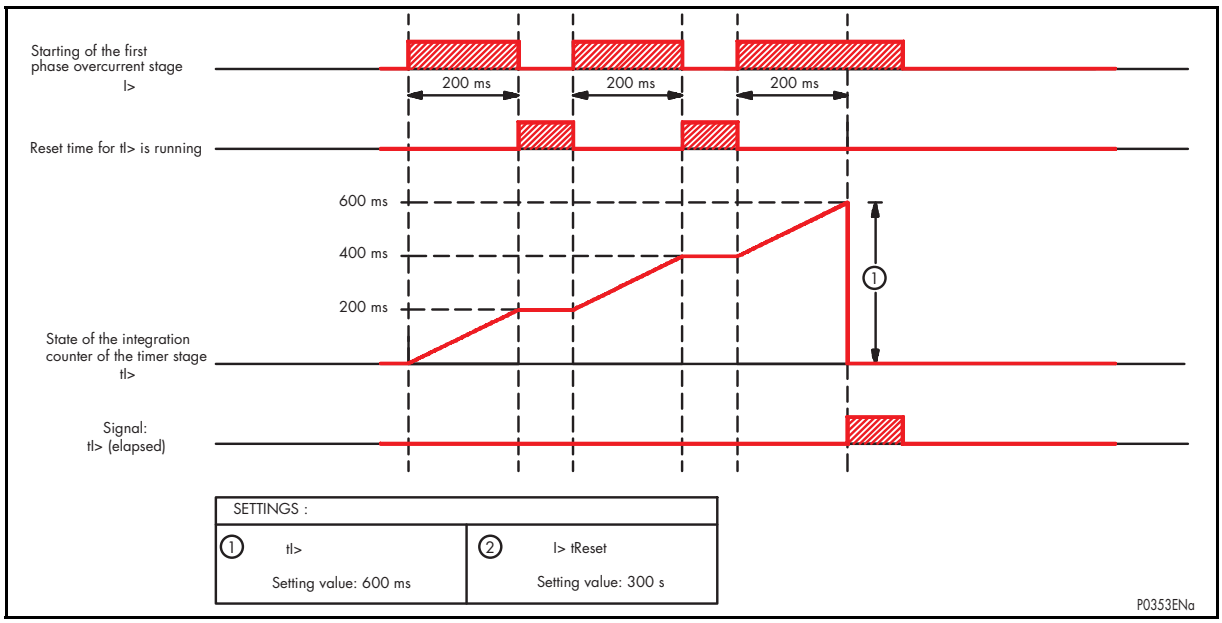


FIGURE 13: SIGNALS ISSUED WHEN THE PHASE OVERCURRENT TIMER STAGE DURATION HAS ELAPSED

4.8.2 Submenu **[50N/51N] EARTH FAULT**

The earth fault function has three residual overcurrent stages available that can be enabled independently from each other.

Two of the residual overcurrent stages, **IN>** and **IN>>**, may be set to either definite-time or inverse-time overcurrent protection. The third residual overcurrent stage **IN>>>** is always definite-time delayed.

The parameter cell **IN> Delay Type** is accessed in order to set the operating mode for the first residual overcurrent stage to either **DMT**, **IDMT**, **RI** or **LABOR**.

Operating mode DMT:

With the operating mode set to definite-time **DMT**, a starting signal is issued when the overcurrent stage **IN>** is exceeded, and the timer stage **tIN>** is started. When the timer stage duration **tIN>** has elapsed the signal with the identical label **tIN>** is issued.

Operating modes IDMT and RI:

With the operating mode for the overcurrent stage set to inverse-time **IDMT** or **RI** characteristics, the reference quantity for operate value and tripping time is the set reference current I_{ref}, which is set in the parameter cell **IN>**. A starting signal is issued by the residual overcurrent stage when 1.05 times reference current (1.05·IN>) is exceeded or when 1.6 times reference current (1.6·IN>) for the RC tripping characteristics for rectifier protection is exceeded.

If the parameter cell **IN> Delay Type** is set to **IDMT** the tripping characteristic is selected by accessing the parameter cell **IN> Curve**. If **RI** is set the associated tripping characteristic is automatically selected.

The factor for the tripping characteristics is set, for **IDMT,** by accessing the parameter cell **IN> Tms** and, for **RI**, by accessing the parameter cell **IN> K**.

If the threshold is exceeded a starting signal is generated by the overcurrent stage and, after the associated tripping characteristics delay duration has elapsed, the signal **tIN>** is issued.

The tripping characteristics for IDMT and RI are shown in table 2 (see submenu **[50/51] SHORT-CIRCUIT**).

Operating mode LABOR.:

With the operating mode for the overcurrent stage set to inverse-time **LABOR.** characteristic, the reference quantity for operate value and tripping time is the reference current I_{ref}, which is set in the parameter cell **IN>**. A starting signal is issued by the residual overcurrent stage when the reference current (IN>) is exceeded. The tripping characteristic may be selected by accessing the parameter cell **IN> Curve**.

If the threshold is exceeded a starting signal is generated by the overcurrent stage and, after the associated tripping characteristics delay duration has elapsed, the signal **tIN>** is issued.

	Tripping characteristic	Formulas for tripping characteristics	Factors	
			A	B
	according to LABORELEC	$t = A \cdot I + B$ 1)		
1	Laborelec 1		-0.0897	4.0897
2	Laborelec 2		-0.0897	4.5897
3	Laborelec 3		-0.0897	5.0897

1) The primary residual current must be considered with the formula

TABLE 3: TRIPPING CHARACTERISTICS ACCORDING TO LABORELEC

NOTE:
- The linear inverse-time characteristics according to LABORLEC are characteristics especially designed for an application where, if they are to be used, additional residual current transformer requirements and protection settings must be considered.
  - Residual current transformers with a ratio of 20 to 1.
  - Parameter cell **E/Gnd CT sec** set to **1 A**.
  - Relay model with a residual current input range of 0.01...8·INn
- In order to completely cover the protection requirements for linear inverse-time characteristics according to LABORLEC the parameter cell **IN>** should be set to 0.05·INn.
- Because of specific requirements the linear inverse-time characteristics according to LABORLEC are only available with the relay model with a residual current input range of 0.01...8·INn.

The design of the second residual overcurrent stage **IN>>** is equivalent to the first residual overcurrent stage **IN>**, with the exception of the reset logic with prolonged time duration.

The third residual overcurrent stage **IN>>>** is always definite-time delayed. If the threshold **IN>>>** is exceeded a starting signal is generated by the overcurrent stage and the associated timer stage **tIN>>>** is started. When the timer stage duration **tIN>>>** has elapsed the signal with the identical label **tIN>>>** is issued.

The operation of selected time delays may be blocked by a binary input control signal (see submenus **BLOCKING LOGIC 1** and **2**).

NOTE: If the residual current stages are not set to issue a general starting when their thresholds are exceeded, the associated time delayed signals **tIN>**, **tIN> int.**, **tIN>>** and **tIN>>>** are then automatically excluded from generating the Trip order.

Reset logic:

The two residual overcurrent stages **IN>** and **IN>>** each feature reset logic.

Definite-time reset logic is available for the residual overcurrent stage **IN>** with the operating mode set to **DMT**, **IDMT** or **RI**. When the starting signal from the first residual overcurrent stage ends, the reset timer stage **IN> tReset** is started and accumulation by the definite-time or inverse-time tripping characteristics up to that time is buffered during the reset time duration. If the starting signal from the first residual overcurrent stage is again issued during the reset time duration, accumulation by the definite-time or inverse-time tripping characteristics continues again. If there is no new starting signal issued from the first residual overcurrent stage during the reset time duration, the definite-time or inverse-time tripping characteristics accumulation buffer is reset when the reset time has elapsed. The operation of the reset logic is displayed in figure 12 and 13 by an example for an overcurrent stage set to definite-time tripping characteristic (see submenu **[50/51] SHORT-CIRCUIT**).

Besides the operating mode for the reset logic as described above (**Normal**), there is a second operating mode with a prolonged accumulation (**Interm**) available for the definite-time tripping characteristic. The first (**Normal**) or second (**Interm**) operating mode for the definite-time reset logic is set by accessing the parameter cell **IN> Rst Type DMT**. If the definite-time reset logic is set to the second operating mode **Interm**, and the starting signal from the first residual overcurrent stage **IN>** ends, the reset timer stage **IN> tReset int.** and the timer stage **IN> tProl int.** are started, which will prolong the charging of the accumulation buffer by the set value of the timer stage **IN> tProl int**. The result of the accumulation is compared with the set value of the timer stage **tIN> int**. If the timer stage duration has elapsed and if a general starting is present then the signal **tIN> int.** is issued. The operation of the reset logic with prolonged accumulation is displayed in figure 14 and 15.

As an alternative to the definite-time reset logic for inverse-time tripping characteristics per IEEE/CO an inverse-time reset logic may be selected by setting the parameter cell **IN> Reset Type** to **IDMT**. The reset characteristics for IEEE/CO tripping characteristics are shown in Table 2 (see submenu **[50/51] SHORT-CIRCUIT**). The reset characteristic factor is set by accessing the parameter cell **IN> Rtms**.

The reset logic design of the second residual overcurrent stage **IN>>** is equivalent to the first residual overcurrent stage **IN>**, with the exception of the reset logic with prolonged accumulation.

NOTE
- The starting signal from the first or second residual overcurrent stage is present during the reset time duration
- If the operating mode is set to **Interm** the timer stage **tIN> int.** is the significant timer stage, that includes reset logic. With the operating mode is set to **Interm** the timer stage **tIN>** is also always available.

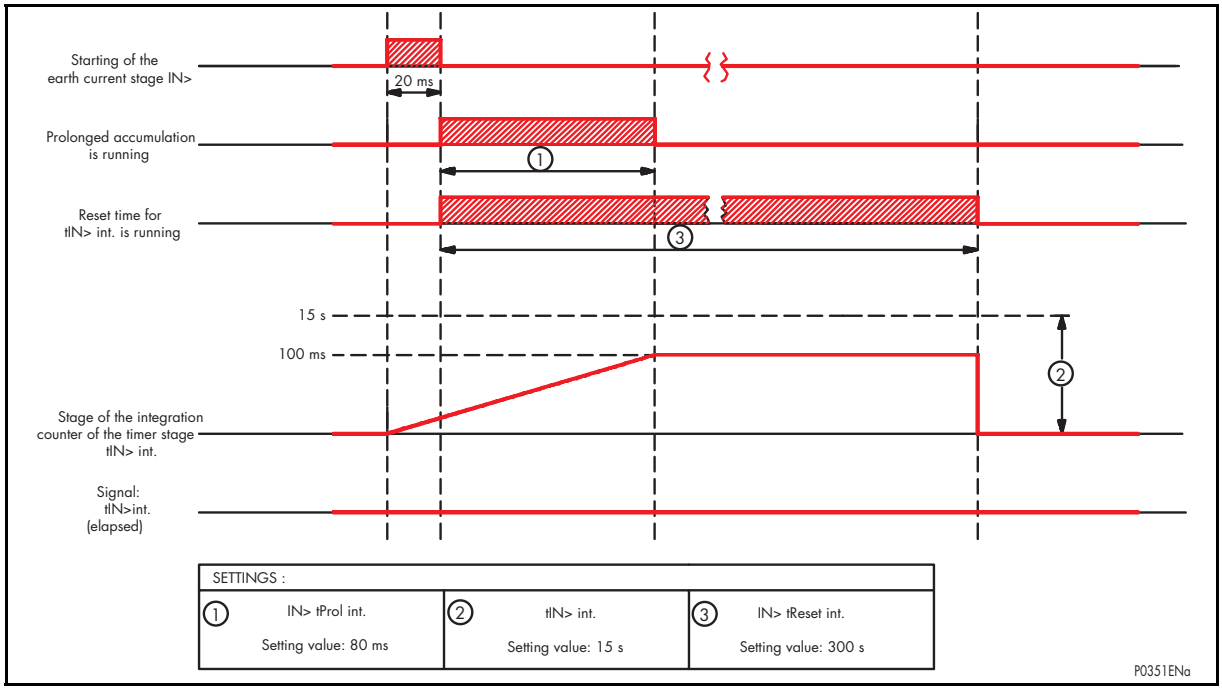


FIGURE 14: SIGNAL SEQUENCE IF THE LIMIT VALUE FOR THE ACCUMULATIVE VALUE FOR PROLONGED RESET LOGIC IS NOT REACHED

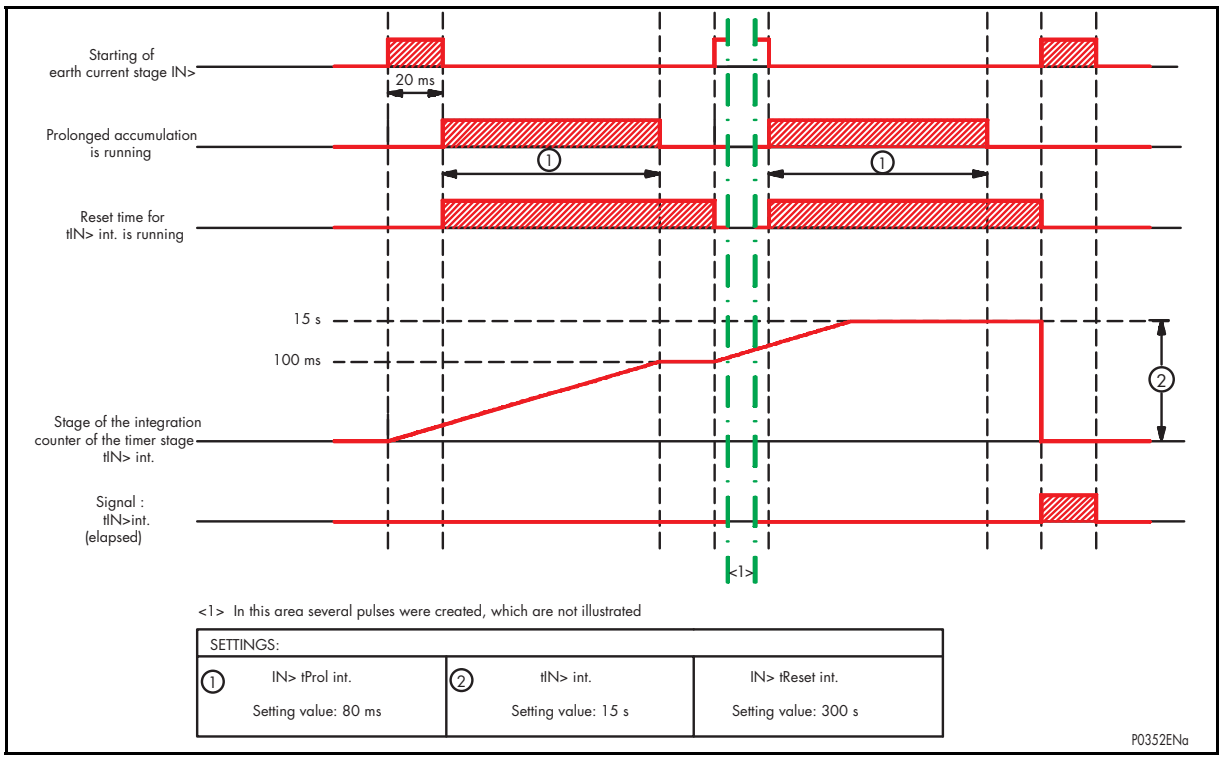


FIGURE 15: SIGNAL SEQUENCE IF THE LIMIT VALUE FOR THE ACCUMULATIVE VALUE FOR PROLONGED RESET LOGIC IS REACHED

4.8.3 Submenu **[46] UNBALANCE**: Unbalance protection

The unbalance protection has two negative-sequence overcurrent stages available that can be independently enabled.

The first negative-sequence overcurrent stage **I2>** may be set to either definite-time or inverse-time characteristics. The second negative-sequence overcurrent protection stage **I2>>** is always definite-time delayed.

The parameter cell **I2> Delay Type** is accessed in order to set the operation mode for the first negative-sequence overcurrent stage to either **DMT**, **IDMT** or **RI**.

Operating mode DMT:

With the operating mode set to definite-time **DMT**, a starting signal is issued when the negative-sequence overcurrent stage **I2>** is exceeded, and the timer stage **tI2>** is started. When the timer stage duration **tI2>** has elapsed the signal with the identical label **tI2>** is issued.

Operating modes IDMT and RI:

With the operating mode set to inverse-time **IDMT** or **RI** characteristics, the reference quantity for operate value and tripping time is the set reference current I_{ref}, which is set in the parameter cell **I2>**. A starting signal is issued by the negative-sequence overcurrent stage when 1.05 times reference current (1.05·I2>) is exceeded.

If the parameter cell **I2> Delay Type** is set to **IDMT** the tripping characteristic is selected by accessing the parameter cell **I2> Curve**. If **RI** is set the associated tripping characteristic is automatically selected.

The factor for the tripping characteristics is set, for **IDMT**, by accessing the parameter cell **I2> Tms** and, for **RI**, by accessing the parameter cell **I2> K**.

If the threshold is exceeded a starting signal is generated by the negative-sequence overcurrent stage and, after the associated tripping characteristics delay duration has elapsed, the signal **tI2>** is issued.

The tripping characteristics are listed in table 2 (see submenu **[50/51] SHORT-CIRCUIT**).

The second negative-sequence overcurrent protection stage **I2>>** is always definite-time delayed. If the threshold **I2>>** is exceeded a starting signal is generated by the negative-sequence overcurrent stage and the associated timer stage **tI2>>** is started. When the timer stage duration **tI2>>** has elapsed the signal with the identical label **tI2>>** is issued.

The operation of selected time delays may be blocked by a binary input control signal (see submenus **BLOCKING LOGIC 1** and **2**).

NOTE: If the negative-sequence overcurrent stages are not set to issue a general starting when their thresholds are exceeded, the associated time delayed signals **tI2>** and **tI2>>** are then automatically excluded from generating the Trip order.

Reset logic:

The first negative-sequence overcurrent stage feature reset logic.

Definite-time reset logic is available for the negative-sequence overcurrent stage **I2>** with the operating mode set to **IDMT** or **RI**. When the starting signal from the first negative-sequence overcurrent stage **I2>** ends, the reset timer stage **I2> tReset** is started and accumulation by the definite-time or inverse-time tripping characteristics up to that time is buffered during the reset time duration. If the starting signal from the first negative-sequence overcurrent stage is again issued during the reset time duration, accumulation by the definite-time or inverse-time tripping characteristics continues again. If there is no new starting signal issued from the first negative-sequence overcurrent stage during the reset time duration, the definite-time or inverse-time tripping characteristics accumulation buffer is reset when the reset time has elapsed. The operation of the reset logic is displayed in figure 12 and 13 by an example for an overcurrent stage set to definite-time tripping characteristics (see submenu **[50/51] SHORT-CIRCUIT**).

As an alternative to the definite-time reset logic for inverse-time tripping characteristics per IEEE/CO an inverse-time reset logic may be selected by setting the parameter cell **I2> Reset Type** to **IDMT**. The reset characteristics for IEEE/CO tripping characteristics are shown in Table 2 (see submenu **[50/51] SHORT-CIRCUIT**). The reset characteristic factor is set by accessing the parameter cell **I2> Rtms**.

NOTE: The starting signal from the first negative-sequence overcurrent stage is present during the reset time duration.

4.8.4 Submenu **[49] THERMAL OVERLOAD**: Protection against thermal overload conditions

By enabling the **Thermal Overload Funct.**, thermal overload protection may be implemented for cables and transformers.

Based on a maximum measured value from the three phase currents, a first order thermal replica, according to IEC 255-8, is tracked. The tripping time is determined by the set thermal time constant **Te** for the protected object, the set threshold value **θ Trip** and the set value for the overload factor **K**, and is dependent on the accumulated thermal load θ_p. The reference current is set in the parameter cell **Iref**. The thermal trip signal **Therm Overload** is issued when the threshold is reached.

$$t = T_e \cdot \ln \frac{\left(\frac{I}{K \cdot I_{ref}}\right)^2 - \theta_p}{\left(\frac{I}{K \cdot I_{ref}}\right)^2 - \theta_{Trip}}$$

The warning signal **θ Alarm** may be issued according to the set threshold of **θ Alarm**.

NOTE:
- It is possible to consider the max. permissible continuous thermic current for the protected object to determine the trip time, either from the setting of the trip threshold value or the setting of the overload factor.
- If the setting of the overload factor is used the trip threshold value must be set to 100%.
- If the setting of the trip threshold value is used the overload factor must be set to 1.00.

Example:

Exceeding the max. permissible continuous thermic current should lead to a trip of the thermal overload function. The max. permissible continuous thermic current value is 120% of I_{ref} for the protected object.

Setting values if the setting of the overload factor is used:

Overload factor **K**: 1.20

Threshold value θ **Trip**: 100 %

Setting values if the setting of the trip threshold is used:

Overload factor **K**: 1.00

Threshold value θ **Trip**: $1.20^2 \cdot 100\ \% = 144\ \%$

4.8.5 Submenu **[37] LOSS OF LOAD**: Protection against undercurrent/loss of load conditions

By enabling **I< Function**, it is possible to monitor the load taken up by a protected object. In order to eliminate the issuance of unwanted Trip orders, the loss of load function is only activated if the associated circuit breaker is closed. A closed CB can be detected either from the CB closed position signal present at the binary input (52a) or by a current criteria, which is set by accessing the parameter cell **Function release** (see submenu **GLOBAL SETTINGS**). If the loss of load function is released and the max. phase current should drop below the set threshold **I<** for the timer stage duration **tI<**, then the signal with the identical label **tI<** is issued.

NOTE:
- If the current criteria is used to release the loss of load function,
  - it is recommended that the threshold for **I> fct.release** (see submenu **GLOBAL SETTINGS**) is set to below 0.05·In only for exceptional requirements.
  - that in order to obtain an unambiguous operation the threshold of the current stage **I<** to detect an undercurrent/a loss of load is set well above the threshold set in **I> fct.release**.

4.9 Menu MEASUREMENTS

The menu **MEASUREMENTS** provides these measured values:

- Phase currents **IA Rms**, **IB Rms**, **IC Rms** and residual current **IN Rms**,
- **I0 Zero**, **I1 Positive** and **I2 Negative**,
- **I2/I1 Ratio** (ratio in percent of the negative- to the positive-sequence current),
- **Frequency**,
- **Max Ph Current** (buffered max phase current),
- **IN - fn** (buffered component of residual current harmonics),
- **Thermal State** (state of the thermal replica),
- **Max. & Average IA, B, C Rms** (three phases maximum and average current values detected by triggering during a definite-time window),
- **Rolling Average & Max. Subperiod IA, B, C Rms** values for the three phase currents.

Min thresholds are clearly defined for the display of some measured values. When these min thresholds are not exceeded, measured current values show a compulsory value of zero and the display for frequency is set to „****“ (no measured value).

Primary and rated phase current and residual current values are displayed as true root-mean-square (rms) values. For a 50 Hz system, the harmonics are taken into account up to the 10th order; for a 60 Hz system the harmonics are taken into account up to the 8th order. The display for individual phase currents is released above the min threshold of $0.03 \cdot I_{nom}$.

Primary and rated values for the symmetrical components are calculated from the fundamental component of the phase currents and the residual current according to these formulas:

$$\underline{I}_1 = 1/3 \cdot (\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C)$$

$$\underline{I}_2 = 1/3 \cdot (\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C)$$

$$\underline{I}_0 = 1/3 \cdot \underline{I}_N$$

in which: $\underline{a} = e^{i120^\circ}$ $\underline{a}^2 = e^{i240^\circ}$

The display for positive-sequence and negative-sequence components of the current is released above the min threshold of $0.03 \cdot I_{nom}$.

Display of frequency measurement is only released when the following condition is met:

- At least one phase current exceeds $0.1 \cdot I_{nom}$.

The measured value **I2/I1 Ratio** shows the ratio in percent of the negative-sequence to the positive-sequence components of the currents.

The value **Max Ph Current** is the true rms value for the max phase current buffered after the last reset of the measured value. Measured values displayed on the local control panel LCD can be reset manually by pressing the reset key ⓒ.

The measured value **IN – fn** is the buffered component of residual current harmonics resulting by subtracting the fundamental value from the rms value of the residual current. This measured value is obtained as an instantaneous value. A manual reset

and a re-triggering of the measuring process with the measured value selected are made by pressing the reset key ⓒ.

The thermal replica displayed on the local control panel LCD by selecting the measured value **Thermal State** can be reset manually by pressing the reset key ⓒ.

The maximum and average current values for each of the three primary phase currents detected by triggering during a definite-time window (e.g. **Max. IA Rms** and **Average IA Rms**) are buffered (see submenu **RECORD SETTING**). A manual reset and a re-triggering of the measuring process, with the reset parameter cell **Rst.Max&Average** selected, are made by pressing the reset key ⓒ.

Rolling average values or maximum sub-period values for each of the three primary phase currents (e.g. **Rolling Average IA Rms** and **Max. Subperiod IA Rms**) are continuously determined over a set number of sub-periods (see submenu **RECORD SETTING**) or since the last resetting of the maximum sub-period values buffered previously. With the reset parameter cell **Rst.Roll.Average** selected for the rolling average values or **Rst.MaxSubperiod** selected for the maximum sub-period values, a manual reset is made by pressing the reset key ⓒ.

NOTE: Various designation texts may be selected from the local control panel to display the phase currents (e.g. phase A current: **IA**, **I1**, **IL1** or **IR**) or the residual current (see submenu **LOCAL INDICATION**). It is therefore possible that the text displayed on the local control panel LCD in the menu **MEASUREMENTS** differs from the text as described in this Operation guide.

4.10 Menu EVENT COUNTERS

In the menu **EVENT COUNTERS** there are counters available for the following events:

- the total number of general starting signals,
- the total number of Trip orders,
- the total number of individual causes that issued a Trip order.

The event counters of individual causes that issue a Trip order provide information in regard to tripping statistics.

All event counters are reset by selecting the menu parameter cell **Reset Counters** and then pressing the reset key ©.

NOTE:
- Event counters of individual causes that issue a Trip order will only be considered if they also cause the Trip output relay 1 to operate.
- Operational Trip orders initiated with the function keys and the Open order are not considered by the event counters.

4.11 Menu CONTROL/TESTING

The operator has several control and test functions available in the menu **CONTROL/TESTING**:

- **General Reset**
- **Close Order** & **Open Order** (issue CB close or open order)
- **Disturb Trigger** (trigger disturbance recording)
- **Maintenance mode**
- **Block. CB-Meas.** (block counters in **CB MONITORING**)

The parameter cell **General Reset** will reset the following buffered information:

- LED and alarm signals
- all event counters in the menu **EVENT COUNTERS**
- Disturbance records
- Fault records
- Starting records
- Event records
- Measured value **Max Ph Current**
- CB monitoring record **CB Open Time** and **CB Close Time**

The resetting of a latched Trip output relay 1 or latched output relays is not influenced by the reset order issued to alarms by the **General Reset** signal.

The operator can use the parameter cells **Close Order** & **Open Order** to manually switch the associated circuit breaker on and off. The signal **Open Order** is permanently assigned to the Trip order and does not appear in the trip logic.

The parameter cell **Disturb Trigger** will trigger disturbance recording (as described in the submenu **RECORD SETTING**).

The parameter cell **Maintenance mode** can be used to block output relays if maintenance or commissioning work is to be performed. By enabling the parameter cell **Maintenance mode** all output relays are de-energized, so that their state is "0" and they are blocked. All functions of the MiCOM P122C relay still remain available.

With the parameter cell **Maintenance mode** enabled a manual test of each output relay can be performed by setting the parameter cell **Relays W7654321CMD** (submenu **GLOBAL SETTINGS**).

When the parameter cell **Maintenance mode** is enabled or disabled all buffered alarm and LED signals are automatically reset.

When the parameter **Block. CB-Meas.** is activated, the counters with values for the summation of circuit breaker phase breaking currents and the total number of Trip orders in the submenu **CB MONITORING** are frozen in their present state. This will prevent distortion of counter values when scheduled maintenance work is being carried out on the MiCOM P122C relay.

4.12 Menu RECORD

The **RECORD** menu comprises these submenus:

- FAULT RECORD
- STARTING RECORD
- CB MONITORING

4.12.1 Submenu **FAULT RECORD**

The submenu **FAULT RECORD** contains a collection of data on each of the five last faults registered, that caused a Trip order to be issued by the MiCOM P122C relay to the Trip output relay 1.

For each fault the P122C will record the following information:

- **Record number**
- **Fault Time**
- **Fault Date**
- **Active Set Group**
- **Faulted Phase** (phase/s where fault/s occurred)
- **Trip by** (alarm signal that caused the Trip order)
- **Magnitude** (the measured value, that was instrumental in causing the Trip order)
- **I_A, I_B, I_C Magnitude** (the 3 phase currents),
- **I_N Magnitude** (the residual/earth current).

Fault records are accessible:

- from the local control panel,
- from the PC interface using the support software MiCOM S1, or the optional communication interface to remotely readout the event records.

Fault number 5 is always the latest fault to be detected and recorded. Data for each individual fault is displayed by selecting the fault number (1 to 5) on the local control panel.

NOTE:
- The measured values detected and recorded in the submenu **FAULT RECORD** are filtered fundamental wave values of the currents.
- Fault records are organized in a first-in-first-out memory. When the next fault is detected and five fault records are buffered, the first fault in (oldest fault record) is deleted.
- When a Trip order is issued to the Trip output relay 1 by an open order or with the function keys, there is no recording in the submenu **FAULT RECORD**.
- When no fault information is measured the display will show „****“ (no measured value).

4.12.2 Submenu **STARTING RECORD**

The submenu **STARTING RECORD** includes a list of data pertaining to the last five starting signals from overcurrent stages. Only such starting signals from overcurrent stages are considered for recording if, according to their setting, they also lead to a general starting (see submenu **GLOBAL SETTING**).

The MiCOM P122C relay records the following data for each starting from an overcurrent stage that leads to a general starting:

- **Number** (the starting number),
- **Hour** (the starting time),
- **Date** (the starting date),
- **Origin** (the starting overcurrent stage),
- **Start.duration** (the starting duration),
- **Dur.t elapsed** (duration until associated time delay has elapsed),
- **Trip** (information, if a Trip order has been issued by the overcurrent stage).

The starting records from the submenu **STARTING RECORD** may be accessed from the local control panel.

Starting number 5 is the last starting from an overcurrent stage to be recorded. Each individual starting is displayed by selecting the starting number (1 to 5) on the local control panel.

NOTE: The starting records are organized in a first-in-first-out memory. When five starting records are buffered, the first starting in (oldest starting record) is deleted with the next starting.

4.12.3 Submenu **CB MONITORING**: Recording of CB information

This submenu will present information on the circuit breaker to the operator. The following information is recorded:

- **CB Open Time** (Last CB open time)
- **CB Close Time** (Last CB close time)
- **CB Open NB** (total number of operations by Trip output relay 1)
- **Sum A n I_A, I_B, I_C** (summation of the current flow interrupted per phase and weighted by a settable exponent n)

NOTE:
– When the parameter **Block. CB-Meas.** is activated (see menu **CONTROL/TESTING**), the counters with values for the summation of circuit breaker phase breaking currents and the total number of trip operations are frozen in their present state (i.e. when scheduled maintenance work is being carried out).
– When no individual information is measured the display will show „****“ (no measured value).

4.13 Alarms

Alarms are displayed direct on the local control panel LCD and have priority over the default display. Individual events that caused an alarm to be issued are listed in chronological order and can be selected for display by pressing the read key 📖.

The alarms are classified into two categories:

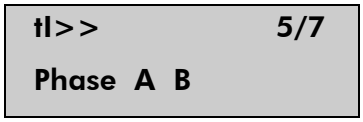
- Alarms which are issued when a deviation from the normal undisturbed operating state on the power system becomes apparent (**ALARMS**).
- MATERIAL ALARMS issued by the internal monitoring when a hardware or software fault has been detected (**HARDWARE ALARMS**).

4.13.1 ALARMS

Alarms, which are issued when a deviation from the normal undisturbed operating state on the power system becomes apparent, are listed and described in chapter "Settings and Information". If more than one alarm is detected, they are written to memory in the order of their appearance. Individual alarms are listed in reverse chronological order (i.e. the oldest alarm first, the most recent last) and can be selected for display by pressing the read key 📖. Each alarm is numbered and the total number of recorded alarms is also shown in the display.

Example:

This alarm shows that the time delay of the second phase current stage has elapsed after a phase A and phase B starting. This alarm is the 5th out of total of 7.



Alarms are reset by pressing the reset key Ⓒ. The operator can reset each alarm on the display individually by pressing the reset key Ⓒ, or he can reset all alarms by navigating to the end of the list and selecting the parameter cells **Clear LED Alarms** or **Clear All Alarms** and then pressing the reset key Ⓒ. When the parameter cell **Clear All Alarms** is selected and the reset key Ⓒ is pressed, the alarms as well as the latched Trip output relay 1 and latched output relays are also reset.

NOTE:
- If the cause that provoked an alarm has not been cleared the alarm cannot be reset.
- If an alarm has not been reset, it will not be possible to view the default display programmed by the operator.

4.13.2 MATERIAL ALARMS issued by the internal monitoring (**HARDWARE ALARMS**)

The safety and availability of the MiCOM P122C relay can be improved by a cyclic auto test procedure of both hardware and software. Each time the MiCOM P122C relay is switched on, auto-diagnostic tests are initiated: These tests deal with the output relays (operating tests), the microprocessor, the memories (EEPROM checksum calculation, RAM tests) and the internal voltages.

MATERIAL ALARMS are divided into 2 groups:

- MINOR MATERIAL ALARM:
  Faults that cause a MINOR MATERIAL ALARM are classified as non-serious (i.e. **BATTERY FAIL**, **CLOCK EROR**, **RAM ERROR**).
- MAJOR MATERIAL ALARM:
  Faults that cause a MAJOR MATERIAL ALARM are classified as serious and will impair the functional safety of the relay (i.e. **EEPROM ERROR DATA**, **DEFAULT SETTINGS**, **EEPROM ERROR CALIBR.**, **ANA ERROR**, **RELAYS ERROR**).

Each of these faults will immediately issue a MATERIAL ALARM signal on the LCD. If a MAJOR MATERIAL ALARM is detected, logic signal **Watchdog** (WD is permanently assigned to the quiescent current output relay 8) is issued and all output relays are de-energized.

Display of MATERIAL ALARMS is in reverse chronological order. Individual MATERIAL ALARMS are listed in reverse chronological order (i.e. the oldest alarm first, the most recent last) and can be selected for display by pressing the read key 📖. Each MATERIAL ALARM is numbered and the total number of recorded MATERIAL ALARMS is also shown in the display.

All minor material alarms except **RAM ERROR** are continuously updated, i.e. the alarm is automatically reset when the cause is cleared. All MAJOR MATERIAL ALARMS are buffered and can only be reset by restarting the MiCOM P122C relay after the cause that provoked such MAJOR MATERIAL ALARMS has been cleared.

MATERIAL ALARMS are displayed direct on the local control panel LCD and have priority over the default display and alarms.

Further information on MATERIAL ALARMS issued by the internal monitoring (**HARDWARE ALARMS**) can be found in chapter "Commissioning and Maintenance".

NOTE: If a MAJOR MATERIAL ALARM is detected, logic signal **Watchdog** is issued and all latched output relays are de-energized.

5. ADDITIONAL FUNCTIONS

5.1 Event recording

The event records store 75 state changes in a non-volatile memory with an accuracy of 1ms. The protection device will tag each event buffered with the date, time and designation.

These events are buffered:

- Modification of the setting of one or more parameter cells
- Change of state of binary inputs and output relays
- Change of state of operating signals, alarms or material alarms
- Carrying out of operator orders

Event records can be readout from the PC interface (RS232 front port) using a PC with the support software MiCOM S1 or the optional communication interface. The buffered event records readout also includes the five fault records for the last five faults with a Trip order.

NOTE: Event records are organized in a first-in-first-out memory. When the next event is detected and 75 events are buffered the first event in (oldest event recorded) is deleted.

6. CONNECTING A PC TO THE PC INTERFACE: LOCAL COMMUNICATIONS

6.1 Configuration

The RS232 front port on the MiCOM P122C relay is fitted with a DIN 41652 connector, type D-Sub, 9 pin, to connect a local PC (max distance 15m).

Continuous operation of the PC interface is not permitted.

The connecting cable from the RS232 front port on the protection device to a PC must have the pin configuration as described in figure 16 below:

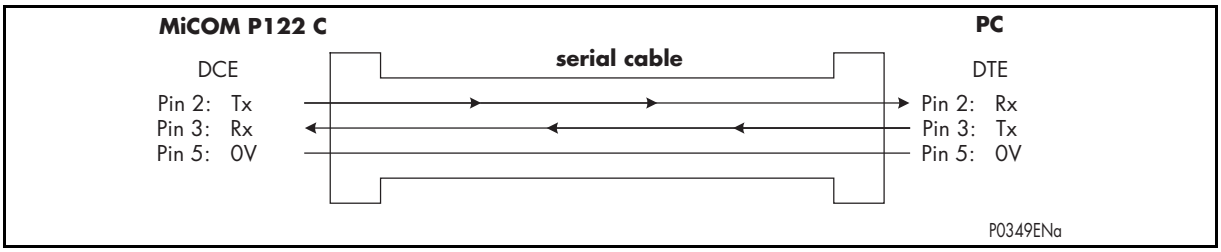


FIGURE 16: SERIAL RS232 CABLE

6.2 Set-up of RS232 communication

RS232 communication between the protection device and a PC has these settings:

Protocol	MODBUS
Baud Rate	19 200 bit/s
Address	Protection device address is set in submenu **COMMUNICATION**
Message format	11 bit – 1 start bit, 8 information bit, 1 bit even, 1 stop bit.

Except for the protection device address all communication settings are predefined for the MiCOM P122C.

Settings and Information

CONTENTS

1. MENU OP PARAMETERS

OP PARAMETERS	Menu **OP PARAMETERS** Access to the operating parameter cells is gained by pressing the navigation key ⊖.
Device Type **P122C**	Displays the MiCOM applicable relay model.
Reference **AAAA**	Setting the reference code of the relay (e.g. bay designation). Modifying the application reference (4 characters) is made by pressing the enter key ↵ and then selecting the individual characters with the navigation keys ⊗ ⊕ and ⊖ ⊖. At the end of entering, press ↵ to validate the reference.
Software version **3.F**	Displays the current version of the software (version 3.F for example).
NB of inputs **2 Inputs**	Setting the number of binary inputs available on the protection device (2 or 7) in order to activate associated setting values and signals.
Active Group **1**	Displays the active setting group: – Value "1": Protection group 1 active – Value "2": Protection group 2 active
Input **7654321** **Status** **0000000** **Input** **21** **Status** **00**	Displays the actual state of the (7 or 2) binary inputs. The binary inputs are numbered from 1 to 7 (or 1 to 2) reading from the right. The actual state of the binary inputs is displayed as: – Value "0": Zero voltage signal is present – Value "1": Voltage signal is present
Relay **7654321** **Status** **0000000**	Displays the actual state of the output relays. The output relays are numbered from 1 to 7 reading from the right. The actual state is displayed as: – Value "0": The output relay is de-energised – Value "1": The output relay is energised
Date **07/02/03**	Setting and display of date. e.g. 7th February 2003
Time **16:35:30**	Setting and display of time. To modify the time press ↵ then using to ⊕ enter the required value. Enable your choice using ↵ with this example the time is : 4pm, 35 minutes, 30 seconds

2. MENU CONFIGURATION

2.1 Submenu GLOBAL SETTINGS

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
GLOBAL SETTINGS	Submenu **GLOBAL SETTINGS** To select the wanted submenu press navigation keys ⊖ ⊕. Access to the parameter cells is gained by pressing the navigation key ⊘.
Line CT primary **1000 A**	Setting of the primary rated current of the phase CT for phase current measurements. Setting range: 1 ... 1000 ... 9999 A; in steps of 1 A
Line CT sec **1 A**	Setting of the secondary rated current of the phase CT for phase current measurements. This is also the rated current for the phase current inputs. Setting range: 1 A or 5 A
E/Gnd CT primary **1000 A**	Setting of the primary rated current of the earth CT for residual current measurements. Setting range: 1 ... 1000 ... 3000 A; in steps of 1 A
E/Gnd CT sec **1 A**	Setting of the secondary rated current of the earth CT for residual current measurements. This is also the rated current for the earth current input. Setting range: 1 A or 5 A
Phase Sequence **A-B-C**	Setting of the phase sequence or rotary field direction. Setting range: A-B-C A-C-B
General starting **w. IN/I2**	Displays whether the thresholds of the residual current stages and the negative-sequence current stages will issue a general starting. If not, the associated operate delayed signals are not involved in issuing the Trip order. Setting range: w. IN/I2 w/o. IN/I2
tGS **0 ms**	Setting of the general starting signal delay timer stage duration. Setting range: 0 … 100 s; in steps of 10 ms
Nom. Frequency **50 Hz**	Setting of the network frequency. Setting range: 50 Hz or 60 Hz

Password
* * * *
Password
AAAA

Setting of password set by the operator.

Modifying the password (4 letters) is made by pressing the enter key ↵ and then selecting the individual characters with the navigation keys ◄ ► and letter by letter using ▲ ▼ to go up or down in the alphabet. At the end of entering, press ↵ to validate the password.
NEW PASSWORD OK is then displayed.
The password is initially set in the factory to: AAAA

Password F3,F4
* * * *
Password F3,F4
AAAA

Setting of password for function keys F3 and F4 set by the operator.

Modifying the password (4 letters) is made by pressing the enter key ↵ and then selecting the individual characters with the navigation keys ◄ ► and letter by letter using ▲ ▼ to go up or down in the alphabet.
NEW PASSWORD OK is then displayed.
The password is initially set in the factory to: AAAA

tOpen pulse
100 ms

Selection of min timer stage period that Trip output relay 1 is energised by a Trip order.
Setting range: 0.1 ... 5 s; in steps of 0.05

tClose pulse
100 ms

Selection of min. timer stage period for a close order.
Setting range: 0.1 ... 5 s; in steps of 0.05

Relays	**W7654321**
CMD	**00000000**

Selection of output relays to be energised/de-energised when Maintenance mode is enabled.

Function release
I>Funct.

Setting the criterion to detect an energised feeder in order to release the loss of load/I< function:
- I>Funct. (current flow criterion)
- Pos CB (binary input signal 52a)

I> fct.release
0.05 In

Setting of the current stage threshold if the parameter cell function release is set to I>Funct.
Setting range: 0.03 ... 0.05 ... 0.15 In; in steps of 0.01

2.2 Submenu LOCAL INDICATION

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⌵.
LOCAL INDICATION	Submenu **LOCAL INDICATION** To select the wanted submenu press navigation keys ⟨ ⟩. Access to the parameter cells is gained by pressing the navigation key ⌵.
Default display **IB Rms**	Setting of default display during normal undisturbed operating state. The measured value or a group of measured values may be selected using the navigation keys ⌃ ⌵.
Phase A Text **1**	Setting of text to be used on the local control panel with the display of measured phase A current values. The text to be used for phase A may be selected by using the navigation keys ⌃ ⌵: A / <u>1</u> / L1 / R
Phase B Text **2**	Setting of text to be used on the local control panel with the display of measured phase B current values. The text to be used for phase B may be selected by using the navigation keys ⌃ ⌵: B / <u>2</u> / L2 / S
Phase C Text **3**	Setting of text to be used on the local control panel with the display of measured phase C current values. The text to be used for phase C may be selected by using the navigation keys ⌃ ⌵: C / <u>3</u> / L3 / T
E/Gnd Text **E**	Setting of text to be used on the local control panel with the display of measured earth current values. The text to be used for earth currents may be selected by using the navigation keys ⌃ ⌵: N / <u>E</u> / 0
Inst.self reset **No**	Setting the mode for starting signals assigned to LEDs and alarms to be self resetting or stored.
Reset on fault **Yes**	Setting the reset mode to manually or automatically clear illuminated LEDs and stored alarms when a fault is detected.
Battery alarm **Yes**	Enabling/Disabling internal monitoring (HARDWARE ALARMS) to issue a material alarm if a RAM memory error or a battery error is detected.

2.3 Submenu INPUTS

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
INPUTS	Submenu **INPUTS** To select the wanted submenu press navigation keys ⊖ ⊕. Access to set the input parameter cells is gained by pressing the navigation key ⊘.
Input 1 **None**	Setting of function to be assigned to binary input 1.
Input 2 **None**	Setting of function to be assigned to binary input 2.
Input 3 **None**	Setting of function to be assigned to binary input 3.
Input 4 **None**	Setting of function to be assigned to binary input 4.
Input 5 **None**	Setting of function to be assigned to binary input 5.
Input 6 **None**	Setting of function to be assigned to binary input 6.
Input 7 **None**	Setting of function to be assigned to binary input 7.
tExt 1 **0.0 s**	Setting of operate delay duration for binary input signal Ext 1. Setting range: 0 ... 200 s; in steps of 0.01
tExt 2 **0.0 s**	Setting of operate delay duration for binary input signal Ext 2. Setting range: 0 ... 200 s; in steps of 0.01
tExt 3 **0.0 s**	Setting of operate delay duration for binary input signal Ext 3. Setting range: 0 ... 200 s; in steps of 0.01
tExt 4 **0.0 s**	Setting of operate delay duration for binary input signal Ext 4. Setting range: 0 ... 200 s; in steps of 0.01

2.4 Submenu INPUT MODE

CONFIGURATION

Menu **CONFIGURATION**
Access to the submenu level is gained by pressing the navigation key ⊘.

INPUT MODE

Submenu **INPUT MODE**
Access to set the mode for the binary inputs is gained by pressing the navigation key ⊘.

Inputs	**7654321**
1=H/0=L	**1111111**

Inputs	**21**
1=H/0=L	**11**

Setting of the mode for binary inputs (7 or 2):
Value "0": No voltage is processed as logic "1"
Value "1": A voltage signal is processed as logic "1"

Voltage input	**DC**

Setting of the selected voltage input for the binary inputs.
Setting range: AC or <u>DC</u>

2.5 Submenu OUTPUT RELAYS

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
OUTPUT RELAYS	Submenu **OUTPUT RELAYS** Access to set the parameter cells of the output relays is gained by pressing the navigation key ⊘. When at least one of the signals or orders is present the allocated output relay is energised.
I> **765432** **000000**	Allocating the phase overcurrent 1st stage starting signal to the selected output relay(s). The signal is allocated by setting a 1 under the selected output relay(s) 2 to 7 . The output relays are numbered reading from the right.
tI> **765432** **000000**	Allocating the phase overcurrent 1st stage time delayed signal to the selected output relay(s).
I>> **765432** **000000**	Allocating the phase overcurrent 2nd stage starting signal to the selected output relay(s).
tI>> **765432** **000000**	Allocating the phase overcurrent 2nd stage time delayed signal to the selected output relay(s).
I>>> **765432** **000000**	Allocating the phase overcurrent 3rd stage starting signal to the selected output relay(s).
tI>>> **765432** **000000**	Allocating the phase overcurrent 3rd stage time delayed signal to the selected output relay(s).
IN> **765432** **000000**	Allocating the residual overcurrent 1st stage starting signal to the selected output relay(s).
tIN> **765432** **000000**	Allocating the residual overcurrent 1st stage time delayed signal to the selected output relay(s).
tIN> int. **765432** **000000**	Allocating the residual overcurrent 1st stage time delayed signal, with DMT reset logic set to prolonged accumulation, to the selected output relay(s).
IN>> **765432** **000000**	Allocating the residual overcurrent 2nd stage starting signal to the selected output relay(s).
tIN>> **765432** **000000**	Allocating of the residual overcurrent 2nd stage time delayed signal to the selected output relay(s).

IN>>>	**765432**
	000000

Allocating the residual overcurrent 3rd stage starting signal to the selected output relay(s).

tIN>>>	**765432**
	000000

Allocating the residual overcurrent 3rd stage time delayed signal to the selected output relay(s).

tI<	**765432**
	000000

Allocating the undercurrent/loss of load stage time delayed signal to the selected output relay(s).

I2>	**765432**
	000000

Allocating the unbalance fault 1st stage starting signal to the selected output relay(s).

tI2>	**765432**
	000000

Allocating the unbalance fault 1st stage time delayed signal to the selected output relay(s).

I2>>	**765432**
	000000

Allocating the unbalance fault 2nd stage starting signal to the selected output relay(s).

tI2>>	**765432**
	000000

Allocating the unbalance fault 2nd stage time delayed signal to the selected output relay(s).

Therm	**765432**
Alarm	**000000**

Allocating the thermal alarm signal to the selected output relay(s).

Therm	**765432**
Trip	**000000**

Allocating the thermal trip signal to the selected output relay(s).

Trip Circ.	**765432**
Fail	**000000**

Allocating the trip circuit failure signal to the selected output relay(s).

CB Oper	**765432**
NB	**000000**

Allocating the signal, issued by the CB trip operations counter when set threshold is reached or exceeded, to the selected output relay(s).

Sum	**765432**
A n	**000000**

Allocating the signal, issued when set threshold of the summation of current flow in Amp interrupted is exceeded, to the selected output relay(s).

CB Open	**765432**
Time	**000000**

Allocating the signal, issued when the set CB opening timer stage duration is exceeded, to the selected output relay(s).

CB Close	**765432**
Time	**000000**

Allocating the signal, issued when the set CB closing timer stage duration is exceeded, to the selected output relay(s).

CB Fail	**765432** **000000**

Allocating the CB failure signal, issued when the timer stage duration tBF has elapsed and not all 3 poles on the CB have opened, to the selected output relay(s).

Close Order	**765432** **000000**

Allocating the manual close order to the selected output relay(s).

Trip Order	**765432** **000000**

Allocating the manual Trip order to the selected output relay(s).

tExt 1	**765432** **000000**

Allocating the time delayed signal from the binary input signal Ext 1 to the selected output relay(s).

tExt 2	**765432** **000000**

Allocating the time delayed signal from the binary input signal Ext 2 to the selected output relay(s).

tExt 3	**765432** **000000**

Allocating the time delayed signal from the binary input signal Ext 3 to the selected output relay(s).

tExt 4	**765432** **000000**

Allocating the time delayed signal from the binary input signal Ext 4 to the selected output relay(s).

Group 1 Active	**765432** **000000**

Allocating the signal, showing that protection group 1 is active, to the selected output relay(s).

Group 2 Active	**765432** **000000**

Allocating the signal, showing that protection group 2 is active, to the selected output relay(s).

FB F3	**765432** **000000**

Allocating function key F3 to the selected output relay(s).

FB F4	**765432** **000000**

Allocating function key F4 to the selected output relay(s).

Input 1	**765432** **000000**

Allocating the binary input 1 state signal to the selected output relay(s).

Input 2	**765432** **000000**

Allocating the binary input 2 state signal to the selected output relay(s).

Input 3	**765432** **000000**

Allocating the binary input 3 state signal to the selected output relay(s).

Input 4	**765432** **000000**

Allocating the binary input 4 state signal to the selected output relay(s).

Input 5	**765432** **000000**

Allocating the binary input 5 state signal to the selected output relay(s).

Input 6	**765432** **000000**

Allocating the binary input 6 state signal to the selected output relay(s).

Input 7	**765432** **000000**

Allocating the binary input 7 state signal to the selected output relay(s).

General Start	**765432** **000000**

Allocating the general starting signal to the selected output relay(s).

tGS	**765432** **000000**

Allocating the general starting time delayed signal to the selected output relay(s).

CT Fail	**765432** **000000**

Allocating the signal, issued when a CT failure / Broken conductor has been detected, to the selected output relay(s).

Warning	**765432** **000000**

Allocating the signal, issued when a material alarm was detected by internal monitoring, to the selected output relay(s).

Alarm	**765432** **000000**

Allocating the signal, issued when an alarm because of a deviation from the normal undisturbed operating state of the power system was generated, to the selected output relay(s).

Starting GF	**765432** **000000**

Allocating the ground fault starting signal to the selected output relay(s).

Trip by CB Fail	**765432** **000000**

Allocating the signal issued by the CB failure protection to the selected output relay(s).

Phase A Start	**765432** **000000**

Allocating the line selective phase A overcurrent starting signal to the selected output relay(s).

Phase B Start	**765432** **000000**

Allocating the line selective phase B overcurrent starting signal to the selected output relay(s).

Phase C Start	**765432** **000000**

Allocating the line selective phase C overcurrent starting signal to the selected output relay(s).

Therm	**765432**
Block	**000000**

Allocating the signal, issued when the thermal replica is blocked, to the selected output relay(s).

Reset	**765432**
Therm	**000000**

Allocating the signal, issued when the thermal replica is reset, to the selected output relay(s).

Order 1	**765432**
	000000

Allocating order 1 to the selected output relay(s).

Order 2	**765432**
	000000

Allocating order 2 to the selected output relay(s).

Trip by	**765432**
SOTF	**000000**

Allocating the Trip order signal, issued by the switch CB on to fault function, to the selected output relay(s).

2.6 Submenu OUTPUT RELAYS MODE

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
OUTPUT RELAYS MODE	Submenu **OUTPUT RELAYS MODE** Access to set the parameter cells of the output relays mode is gained by pressing the navigation key ⊘.
Relay 1 **NO**	Configuring output relay 1 mode to NO or NC.
Relay 2 **NO**	Configuring output relay 2 mode to NO or NC.
Relay 3 **NO**	Configuring output relay 3 mode to NO or NC.
Relay 4 **NO**	Configuring output relay 4 mode to NO or NC.
Relay 5 **NO**	Configuring output relay 5 mode to NO or NC.
Relay 6 **NO**	Configuring output relay 6 mode to NO or NC.
Relay 7 **NO**	Configuring output relay 7 mode to NO or NC.

2.7 Submenu LATCH OUTPUT RELAYS

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊲⊳.
LATCH OUTPUT RELAYS	Submenu **LATCH OUTPUT RELAYS** Access to set the parameter cells of the output relays to latch mode is gained by pressing the navigation key ⊲⊳.
Latch Relay 2 **No**	Enabling/Disabling latch mode of output relay 2. Setting range: Yes or No
Latch Relay 3 **No**	Enabling/Disabling latch mode of output relay 3. Setting range: Yes or No
Latch Relay 4 **No**	Enabling/Disabling latch mode of output relay 4. Setting range: Yes or No
Latch Relay 5 **No**	Enabling/Disabling latch mode of output relay 5. Setting range: Yes or No
Latch Relay 6 **No**	Enabling/Disabling latch mode of output relay 6. Setting range: Yes or No
Latch Relay 7 **No**	Enabling/Disabling latch mode of output relay 7. Setting range: Yes or No

2.8 Submenus LED 5, LED 6, LED 7 and LED 8

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
LED 5	Submenus **LED 5**, **LED 6**, **LED 7** and **LED 8** To select the specific LED submenu press navigation keys ⊖ ⊕. The selection list cells for LED 6, LED 7 and LED 8 are identical to selection list cells for LED 5. Access to the selection list cells is gained by pressing the navigation key ⊘. A LED will light up when at least one allocated signal is present.
I> **No**	Enabling/Disabling the phase overcurrent 1st stage starting signal allocated to LED 5. Setting range: Yes or No
tI> **No**	Enabling/Disabling the phase overcurrent 1st stage time delayed signal allocated to LED 5. Setting range: Yes or No
I>> **No**	Enabling/Disabling the phase overcurrent 2nd stage starting signal allocated to LED 5. Setting range: Yes or No
tI>> **No**	Enabling/Disabling the phase overcurrent 2nd stage time delayed signal allocated to LED 5. Setting range: Yes or No
I>>> **No**	Enabling/Disabling the phase overcurrent 3rd stage starting signal allocated to LED 5. Setting range: Yes or No
tI>>> **No**	Enabling/Disabling the phase overcurrent 3rd stage time delayed signal allocated to LED 5. Setting range: Yes or No
IN> **No**	Enabling/Disabling the residual overcurrent 1st stage starting signal allocated to LED 5. Setting range: Yes or No
tIN> **No**	Enabling/Disabling the residual overcurrent 1st stage time delayed signal allocated to LED 5. Setting range: Yes or No
tIN> int. **No**	Enabling/Disabling the residual overcurrent 1st stage time delayed signal, with DMT reset logic set to prolonged accumulation, allocated to LED 5. Setting range: Yes or No
IN>> **No**	Enabling/Disabling the residual overcurrent 2nd stage starting signal allocated to LED 5. Setting range: Yes or No

tIN>> **No**	Enabling/Disabling the residual overcurrent 2nd stage time delayed signal allocated to LED 5. Setting range: Yes or No
IN>>> **No**	Enabling/Disabling the residual overcurrent 3rd stage starting signal allocated to LED 5. Setting range: Yes or No
tIN>>> **No**	Enabling/Disabling the residual overcurrent 3rd stage time delayed signal allocated to LED 5. Setting range: Yes or No
Therm Overload **No**	Enabling/Disabling the thermal trip signal allocated to LED 5. Setting range: Yes or No
θ **Alarm** **No**	Enabling/Disabling the thermal alarm signal allocated to LED 5. Setting range: Yes or No
CB Fail **No**	Enabling/Disabling the CB failure signal, issued when the timer stage duration tBF has elapsed and not all 3 poles on the CB have opened, allocated to LED 5. Setting range: Yes or No
CT Failure **No**	Enabling/Disabling the signal, issued when a CT failure / Broken conductor has been detected, allocated to LED 5. Setting range: Yes or No
I2> **No**	Enabling/Disabling the unbalance fault 1st stage starting signal allocated to LED 5. Setting range: Yes or No
tI2> **No**	Enabling/Disabling the unbalance fault 1st stage time delayed signal allocated to LED 5. Setting range: Yes or No
I2>> **No**	Enabling/Disabling the unbalance fault 2nd stage starting signal allocated to LED 5. Setting range: Yes or No
tI2>> **No**	Enabling/Disabling the unbalance fault 2nd stage time delayed signal allocated to LED 5. Setting range: Yes or No
tI< **No**	Enabling/Disabling the undercurrent/loss of load timer stage signal allocated to LED 5. Setting range: Yes or No
Phase A Start. **No**	Enabling/Disabling the line selective phase A overcurrent starting signal allocated to LED 5. Setting range: Yes or No
Phase B Start. **No**	Enabling/Disabling the line selective phase B overcurrent starting signal allocated to LED 5. Setting range: Yes or No

Phase C Start. **No**	Enabling/Disabling the line selective phase C overcurrent starting signal allocated to LED 5. Setting range: Yes or No
CB Superv. **No**	Enabling/Disabling the CB supervision broadcast signal allocated to LED 5. Setting range: Yes or No
tExt 1 **No**	Enabling/Disabling the timer stage signal of the binary input signal Ext 1 allocated to LED 5. Setting range: Yes or No
tExt 2 **No**	Enabling/Disabling the timer stage signal of the binary input signal Ext 2 allocated to LED 5. Setting range: Yes or No
tExt 3 **No**	Enabling/Disabling the timer stage signal of the binary input signal Ext 3 allocated to LED 5. Setting range: Yes or No
tExt 4 **No**	Enabling/Disabling the timer stage signal of the binary input signal Ext 4 allocated to LED 5. Setting range: Yes or No
Mode Maint. **No**	Enabling/Disabling the maintenance mode signal allocated to LED 5. Setting range: Yes or No
Starting GF **No**	Enabling/Disabling the ground fault starting signal allocated to LED 5. Setting range: Yes or No
General Start. **No**	Enabling/Disabling the general starting signal allocated to LED 5**.** Setting range: Yes or No
tGS **No**	Enabling/Disabling the general starting timer stage signal allocated to LED 5. Setting range: Yes or No
Group 1 Active **No**	Enabling/Disabling the signal, showing that protection group 1 is active, allocated to LED 5. Setting range: Yes or No
Group 2 Active **No**	Enabling/Disabling the signal, showing that protection group 2 is active, allocated to LED 5. Setting range: Yes or No
Reset Therm **No**	Enabling/Disabling the signal, issued when the thermal replica is reset, allocated to LED 5. Setting range: Yes or No
Therm Block **No**	Enabling/Disabling the signal, when the thermal replica is blocked, allocated to LED 5. Setting range: Yes or No

Trip by CB Fail **No**	Enabling/Disabling the signal, issued by the CB failure protection, allocated to LED 5. Setting range: Yes or No
Input 1 **No**	Enabling/Disabling the binary input 1 state signal allocated to LED 5. Setting range: Yes or No
Input 2 **No**	Enabling/Disabling the binary input 2 state signal allocated to LED 5. Setting range: Yes or No
Input 3 **No**	Enabling/Disabling the binary input 3 state signal allocated to LED 5. Setting range: Yes or No
Input 4 **No**	Enabling/Disabling the binary input 4 state signal allocated to LED 5. Setting range: Yes or No
Input 5 **No**	Enabling/Disabling the binary input 5 state signal allocated to LED 5. Setting range: Yes or No
Input 6 **No**	Enabling/Disabling the binary input 6 state signal allocated to LED 5. Setting range: Yes or No
Input 7 **No**	Enabling/Disabling the binary input 7 state signal allocated to LED 5. Setting range: Yes or No
Trip by SOTF **No**	Enabling/Disabling the Trip order signal, issued by the switch CB on to fault function, allocated to LED 5. Setting range: Yes or No
CB Close **No**	Enabling/Disabling the CB closed signal, issued when the binary input signal 52a is present, allocated to LED 5. Setting range: Yes or No
CB Open **No**	Enabling/Disabling the CB open signal, issued when the binary input signal 52b is present, allocated to LED 5. Setting range: Yes or No

2.9 Submenu COMMUNICATION

Communication protocol according to IEC 60870-5-103

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
COMMUNICATION	Submenu **COMMUNICATION** Access to set the communication parameter cells is gained by pressing the navigation key ⊘.
Relay Addr.(CU) **1**	Setting of the relay address (CU) set for the PC interface and the optional communication interface. Setting range: 1 ... 254
Communication **Yes**	Enabling/Disabling the optional communication interface.
Baud Rate **19200 Bd**	Setting of the baud rate for the optional communication interface. 300 ; 600 ; 1200 ; 2400 ; 4800 ; 9600 ; 19200 or 38400 baud
Parity **Even**	Setting of the parity for the optional communication interface: Without or Even or Odd
Relay Addr.(PU) **1**	Setting of the relay address (PU) for the optional communication interface. Relay addresses CU and PU must be set to the same value. Setting range: 1 ... 255
Connect. RS485 **2 Wires**	Setting of the type of wiring used for the RS485 data link: 2 Wires or 4 Wires
Line idle state **Light On**	Setting the line idle state for the fibre optic data link: Light On or Light Off
Spont. Sign **None**	Setting if transmission of spontaneous signals is permitted using the optional communication interface: None All IEC Only
Command Block. **Yes**	Commands are rejected at the optional communication interface when the command blocking is active. Setting range: Yes or No
Signals/Measures **Block. No**	No signals and measured values are transmitted from the optional communication interface when the signals and measures blocking is active. Yes or No

Test Mode **No**	When the test mode is activated, signals and measured values are transmitted by the optional communication interface with the stamp test mode. Setting range: Yes or <u>No</u>
Transm.Enab.Cycl **Dat** **None**	Setting if cyclic transmission of measured values is permitted, using the optional communication interface: <u>None</u> ASDU3.1 ASDU3.4 ASDU9 Prv ASDU3.1&4 ASDU9&3.4 ASDU9&Prv
Delta I **0.03 In**	Setting of the delta I factor, where a measured current value is transmitted over the optional communication interface, if it deviates by the delta I factor from the current value last transmitted.
Delta f **0.02 fn**	Setting of the delta f factor, where a measured frequency value is transmitted over the optional communication interface, if it deviates by the delta f factor from the frequency value last transmitted.
Delta Priv.Meas **0.03**	Setting of the delta factor, where a private data telegram is transmitted over the optional communication interface, if a measured value deviates by the delta factor from the measured value last transmitted.
Delta t **1 mn**	Setting of the time period after which all measured values are to be transmitted over the optional communication interface, if no data transmission has occurred because of the other delta conditions.

Communication protocol according to MODBUS

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊲⊳.
COMMUNICATION	Submenu **COMMUNICATION** Access to set the communication parameter cells is gained by pressing the navigation key ⊲⊳.
Relay Addr. **1**	Setting of the relay address set for the PC interface and the optional communication interface. Setting range: 1 ... 255
Communication **Yes**	Enabling/Disabling the optional communication interface. Setting range: Yes or No
Baud Rate **19200 Bd**	Setting of the baud rate for the optional communication interface. 300 ; 600 ; 1200 ; 2400 ; 4800 ; 9600 ; 19200 or 38400 baud
Parity **Even**	Setting of the parity for the optional communication interface: Without or Even or Odd
Stop bits **1**	Setting of the number of stop bits: 1 / 2
Connect. RS485 **2 Wires**	Setting of the type of wiring used for the RS485 data link: 2 Wires or 4 Wires
Line idle state **Light On**	Setting the line idle state for the fibre optic data link: Light On or Light Off
Date format **Private**	Setting of the data format: Private or IEC

2.10 Submenu RECORD SETTING

CONFIGURATION	Menu **CONFIGURATION** Access to the submenu level is gained by pressing the navigation key ⊘.
RECORD SETTING	Submenu **RECORD SETTING** Access to set the recording parameter cells is gained by pressing the navigation key ⊘.
Disturb Rec Pre **Time 1.0 s**	Setting of the record duration previous to the disturbance recording trigger order. Setting range: 0.1 ... 1.0 ... 3.0 s; in steps of 0.1s
Disturb Rec Post **Time 2.0 s**	Setting of the record duration after the disturbance recording trigger order. Setting range: 0.1 ... 2.0 ... 3.0 s; in steps of 0.1s
Dist Trig Gen. **Start Yes**	Enabling/Disabling that a general start will trigger disturbance recording. Setting range: Yes or No
Dist Trig other **Inst No**	Enabling/Disabling that other clearly defined events will trigger disturbance recording. Setting range: Yes or No
Dist Trig Trip **Yes**	Enabling/Disabling that a Trip order will trigger disturbance recording. Setting range: Yes or No
Time Window **5 mn**	Setting of the time window for the triggered detection of maximum and average values of the three phase currents with definite-time duration. Setting range: 5, 10, 15, 30 or 60 min
Sub Period **1 mn**	Setting of the sub-period duration, during which the average values of the three phase currents are each determined. Setting range: 1 ... 60 min
Num of Sub Per. **1**	Setting of the number of sub-periods to determine the three rolling average phase current values. Setting range: 1 ... 24

3. MENU AUTOMAT.CTRL

3.1 Submenu TRIP COMMAND

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
TRIP COMMAND	Submenu **TRIP COMMAND** Access to set the selection list cells for the trip command is gained by pressing the navigation key ⊘.
tI> **No**	Enabling/Disabling the phase overcurrent 1st stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tI>> **No**	Enabling/Disabling the phase overcurrent 2nd stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tI>>> **No**	Enabling/Disabling the phase overcurrent 3rd stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tIN> **No**	Enabling/Disabling the residual overcurrent 1st stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tIN> int. **No**	Enabling/Disabling the residual overcurrent 1st stage time delayed signal, with DMT reset logic set to prolonged accumulation, assigned to the Trip order. Setting range: Yes or No
tIN>> **No**	Enabling/Disabling the residual overcurrent 2nd stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tIN>>> **No**	Enabling/Disabling the residual overcurrent 3rd stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tI< **No**	Enabling/Disabling the undercurrent/loss of load timer stage signal assigned to the Trip order. Setting range: Yes or No
tI2> **No**	Enabling/Disabling the unbalance fault 1st stage time delayed signal assigned to the Trip order. Setting range: Yes or No
tI2>> **No**	Enabling/Disabling the unbalance fault 2nd stage time delayed signal assigned to the Trip order. Setting range: Yes or No
Therm Overload **No**	Enabling/Disabling the thermal trip signal, issued by the thermal overload protection, assigned to the Trip order. Setting range: Yes or No

tExt 1 **No**	Enabling/Disabling the timer stage of the binary input signal Ext 1 assigned to the Trip order. Setting range: Yes or No
tExt 2 **No**	Enabling/Disabling the timer stage of the binary input signal Ext 2 assigned to the Trip order. Setting range: Yes or No
FB F3 **No**	Enabling/Disabling the function key F3 assigned to the Trip order. Setting range: Yes or No
FB F4 **No**	Enabling/Disabling the function key F4 assigned to the Trip order. Setting range: Yes or No
Trip by CB Fail **No**	Enabling/Disabling the Trip signal, issued by the CB failure protection, assigned to the Trip order. Setting range: Yes or No
Trip by SOTF **No**	Enabling/Disabling the Trip signal, issued by the switch CB on to fault function, assigned to the Trip order. Setting range: Yes or No
CT fail **No**	Enabling/Disabling the signal, issued by the CT circuit supervision/Broken conductor protection, assigned to the Trip order. Setting range: Yes or No

3.2 Submenu LATCH TRIP ORDER

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊲⊳.
LATCH TRIP ORDER	Submenu **LATCH TRIP ORDER** Access to set the selection list cells for the latch trip order is gained by pressing the navigation key ⊲⊳.
Latch tI> **No**	Enabling/Disabling the latching of the Trip order issued by the phase overcurrent 1st stage time delayed signal. Setting range: Yes or No
Latch tI>> **No**	Enabling/Disabling the latching of the Trip order issued by the phase overcurrent 2nd stage time delayed signal. Setting range: Yes or No
Latch tI>>> **No**	Enabling/Disabling the latching of the Trip order issued by the phase overcurrent 3rd stage time delayed signal. Setting range: Yes or No
Latch tIN> **No**	Enabling/Disabling the latching of the Trip order, issued by the residual overcurrent 1st stage time delayed signal. Setting range: Yes or No
Latch tIN> int. **No**	Enabling/Disabling the latching of the Trip order issued by the residual overcurrent 1st stage time delayed signal, with DMT reset logic set to prolonged accumulation. Setting range: Yes or No
Latch tIN>> **No**	Enabling/Disabling the latching of the Trip order issued by the residual overcurrent 2nd stage time delayed signal. Setting range: Yes or No
Latch tIN>>> **No**	Enabling/Disabling the latching of the Trip order issued by the residual overcurrent 3rd stage time delayed signal. Setting range: Yes or No
Latch tI< **No**	Enabling/Disabling the latching of the Trip order issued by the undercurrent/loss of load timer stage signal. Setting range: Yes or No
Latch tI2> **No**	Enabling/Disabling the latching of the Trip order issued by the unbalance fault 1st stage time delayed signal. Setting range: Yes or No
Latch tI2>> **No**	Enabling/Disabling the latching of the Trip order issued by the unbalance fault 2nd stage time delayed signal. Setting range: Yes or No
Latch Therm Overload **No**	Enabling/Disabling the latching of the Trip order issued by the thermal overload protection. Setting range: Yes or No

Latch tExt 1 **No**	Enabling/Disabling the latching of the Tip order issued by the timer stage signal of the binary input Ext 1. Setting range: Yes or No
Latch tExt 2 **No**	Enabling/Disabling the latching of the Tip order issued by the timer stage signal of the binary input Ext 2. Setting range: Yes or No
Latch FB F3 **No**	Enabling/Disabling the latching of the Trip order issued by a function key F3 signal. Setting range: Yes or No
Latch FB F4 **No**	Enabling/Disabling the latching of the Trip order issued by a function key F4 signal. Setting range: Yes or No
Latch Trip by CB Fail **No**	Enabling/Disabling the latching of the Trip order issued by the CB failure protection signal. Setting range: Yes or No
Latch Trip by SOTF **No**	Enabling/Disabling the latching of the Trip order issued by the switch CB on to fault function. Setting range: Yes or No
Latch CT fail **No**	Enabling/Disabling the latching of the Trip order issued by the CT circuit supervision/Broken conductor protection. Setting range: Yes or No

3.3 Submenu CB FAILURE

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊲⊳.
CB FAILURE	Submenu **CB FAILURE** Access to set the CB failure parameter cells is gained by pressing the navigation key ⊲⊳.
CB Fail **Funct Yes**	Enabling/Disabling the CB failure function. Setting range: Yes or <u>No</u>
I< BF **10%In**	Setting of the current stage or zone to detect a CB failure. Setting range: 2 ... <u>10</u> ... 100% In; in steps of 1
tBF **130 ms**	Setting of the timer stage duration, during which a CB failure is to be detected. Setting range: 0.03 ... <u>0.13</u> ... 10 s; in steps of 0.01
Block I>;>>;>>> **BF No**	Enabling/Disabling the blocking of starting signals, from the three phase overcurrent stages, from operating output relays when a CB failure is detected. Setting range: Yes or <u>No</u>
Block IN>;>>;>>> **BF No**	Enabling/Disabling the blocking of starting signals, from the three residual overcurrent stages, from operating output relays when a CB failure is detected. Setting range: Yes or <u>No</u>

3.4 Submenu SWITCH ON FAULT

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
SWITCH ON FAULT	Submenu **SWITCH ON FAULT** Access to set the parameter cells for the switch CB on to fault function is gained by pressing the navigation key ⊘.
Switch on Fault Funct Yes	Enabling/Disabling the switch CB on to fault function. Setting range: Yes or No
tMan.Close 1.0 s	Setting of timer stage duration during which the switch CB on to fault function is active. Setting range: 0.00 ...1.0 ... 10 s; in steps of 0.01
Trip by I> No	Enabling/Disabling that the phase overcurrent 1st stage starting signal will generate the instantaneous signal Trip by SOTF. Setting range: Yes or No
Trip by I>> Yes	Enabling/Disabling that the phase overcurrent 2nd stage starting signal will generate the instantaneous signal Trip by SOTF. Setting range: Yes or No
Trip by I>>> No	Enabling/Disabling that the phase overcurrent 3rd stage starting signal will generate the instantaneous signal Trip by SOTF. Setting range: Yes or No
Trip by General Start. No	Enabling/Disabling that a general starting signal will generate the instantaneous signal Trip by SOTF. Setting range: Yes or No

3.5 Submenu SETTING GROUP SELECT

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊲⊳.
SETTING GROUP SELECT	Submenu **SETTING GROUP SELECT** Access to select the setting group cells is gained by pressing the navigation key ⊲⊳.
Change Group mode Edge	Setting of the operating mode for selecting the setting group: – Edge – Level – Level 2
Setting Group 1	Selecting the setting group, with the operating mode Edge or Level 2, from the local control panel. Setting range: 1 / 2
Keep Time Yes	Enabling/Disabling the timer stage keep time. This parameter is only visible if operating mode Level 2 was selected: Yes: See setting value for tKeep No: Set value for tKeep to ∞
tKeep 0.01s	The timer stage duration tKeep is only used if the setting group selection is made with two binary input control signals. If during selection there is a time interval where the voltage for both binary input control signals disappears, the change over will be delayed for the timer stage period tKeep. Setting range: 0.01 ... 65 s; in steps of 0.01

3.6 Submenu COLD LOAD PICKUP

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
COLD LOAD PICKUP	Submenu **COLD LOAD PICKUP** Access to select the parameter cells for the cold load pickup is gained by pressing the navigation key ⊘.
Cold Load Pickup **Yes**	Enabling/Disabling the cold load pickup function. Setting range: Yes or No
Detect PU **Input + I**	Setting of the operating mode to detect a cold load pickup: – Log.Input – Input + I – Trans I
I> PU **10%In**	Setting of current threshold to detect a sudden rise of current in at least one phase to enable the cold load pickup function. The current stage is only available if operating mode Trans I or Input + I is selected.
Cold Load PU **I>** **No**	Enabling/Disabling the phase overcurrent 1st stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **I>>** **No**	Enabling/Disabling the phase overcurrent 2nd stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **I>>>** **No**	Enabling/Disabling the phase overcurrent 3rd stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **IN>** **No**	Enabling/Disabling the residual overcurrent 1st stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **IN>>** **No**	Enabling/Disabling the residual overcurrent 2nd stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **IN>>>** **No**	Enabling/Disabling the residual overcurrent 3rd stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **I2>** **No**	Enabling/Disabling the unbalance fault 1st stage for a cold load pickup. Setting range: Yes or No
Cold Load PU **I2>>** **No**	Enabling/Disabling the unbalance fault 2nd stage for a cold load pickup. Setting range: Yes or No

Cold Load PU	
Iref	No

Enabling/Disabling the reference current of the thermal overload protection for a cold load pickup.
Setting range: Yes or No

Cold Load PU	
Level	100 %

Setting of the percentage of alteration in respect to the setting values of the selected thresholds during a cold load pickup.
Setting range: 20 ... 100 ... 500 % ; in steps of 1

Cold Load PU	
tCL	0.0 s

Setting of timer stage duration during which the cold load pickup is active.
Setting range: 0.0 ... 3600 s; in steps of 0.1

3.7 Submenu BLOCKING LOGIC 1

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
BLOCKING LOGIC 1	Submenu **BLOCKING LOGIC 1** Access to the parameter cells is gained by pressing the navigation key ⊘.
Block.Log1 **tI>** **No**	Enabling/Disabling the phase overcurrent 1st stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tI>>** **No**	Enabling/Disabling the phase overcurrent 2nd stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tI>>>** **No**	Enabling/Disabling the phase overcurrent 3rd stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tIN>** **No**	Enabling/Disabling the residual overcurrent 1st stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tIN> i.** **No**	Enabling/Disabling the residual overcurrent 1st stage time delay, with the DMT reset logic set to prolonged accumulation, assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tIN>>** **No**	Enabling/Disabling the residual overcurrent 2nd stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tIN>>>** **No**	Enabling/Disabling the residual overcurrent 3rd stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tI2>** **No**	Enabling/Disabling the unbalance fault 1st stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tI2>>** **No**	Enabling/Disabling the unbalance fault 2nd stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tI<** **No**	Enabling/Disabling the undercurrent/loss of load stage time delay assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **Therm** **No**	Enabling/Disabling the thermal overload protection assigned to blocking logic 1. Setting range: Yes or No
Block.Log1 **tExt 1** **No**	Enabling/Disabling the binary input signal Ext 1 time delay assigned to blocking logic 1. Setting range: Yes or No

Block.Log1	
tExt 2	**No**

Enabling/Disabling the binary input signal Ext 2 time delay from assigned to blocking logic 1.
Setting range: Yes or No

Block.Log1	
tCT	**No**

Enabling/Disabling the CT supervision/Broken conductor stage time delay assigned to blocking logic 1.
Setting range: Yes or No

3.8 Submenu BLOCKING LOGIC 2

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
BLOCKING LOGIC 2	Submenu **BLOCKING LOGIC 2** Access to the parameter cells is gained by pressing the navigation key ⊘.
Block.Log2 **tI>** **No**	Enabling/Disabling the phase overcurrent 1st stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tI>>** **No**	Enabling/Disabling the phase overcurrent 2nd stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tI>>>** **No**	Enabling/Disabling the phase overcurrent 3rd stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tIN>** **No**	Enabling/Disabling the residual overcurrent 1st stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tIN> i.** **No**	Enabling/Disabling the residual overcurrent 1st stage time delay, with DMT reset logic set to prolonged accumulation, assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tIN>>** **No**	Enabling/Disabling the residual overcurrent 2nd stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tIN>>>** **No**	Enabling/Disabling the residual overcurrent 3rd stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tI2>** **No**	Enabling/Disabling the unbalance fault 1st stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tI2>>** **No**	Enabling/Disabling the unbalance fault 2nd stage time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tI<** **No**	Enabling/Disabling the undercurrent/loss of load time delay assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **Therm** **No**	Enabling/Disabling the thermal overload protection assigned to blocking logic 2. Setting range: Yes or No
Block.Log2 **tExt 1** **No**	Enabling/Disabling the binary input signal Ext 1 time delay assigned to blocking logic 2. Setting range: Yes or No

Block.Log2	
tExt 2	**No**

Enabling/Disabling the binary input signal Ext 2 time delay assigned to blocking logic 2.
Setting range: Yes or No

Block.Log2	
tCT	**No**

Enabling/Disabling the CT supervision/Broken conductor stage time delay assigned to blocking logic 2.
Setting range: Yes or No

3.9 Submenu LOGIC SELECT 1

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⌵.
LOGIC SELECT 1	Submenu **LOGIC SELECT 1** Access to the logic selectivity 1 parameter cells is gained by pressing the navigation key ⌵.
Log.Sel.1 tI>> **No**	Enabling/Disabling the phase overcurrent 2nd timer stage to be replaced by the logic selectivity 1 timer stage. Setting range: Yes or No
Log.Sel.1 tI>>> **No**	Enabling/Disabling the phase overcurrent 3rd timer stage to be replaced by the logic selectivity 1 timer stage. Setting range: Yes or No
Log.Sel.1 tIN>> **No**	Enabling/Disabling the residual overcurrent 2nd timer stage to be replaced by the logic selectivity 1 timer stage. Setting range: Yes or No
Log.Sel.1 tIN>>> **No**	Enabling/Disabling the residual overcurrent 3rd timer stage to be replaced by the logic selectivity 1 timer stage. Setting range: Yes or No
tLog.Sel.1 **0 ms**	Setting of the logic selectivity 1 timer stage duration that, if activated by an input control signal, replaces timer stages selected and enabled in the above 4 parameter cells.

3.10 Submenu LOGIC SELECT 2

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊲⊳.
LOGIC SELECT 2	Submenu **LOGIC SELECT 2** Access to the logic selectivity 2 parameter cells is gained by pressing the navigation key ⊲⊳.
Log.Sel.2 tI>> **No**	Enabling/Disabling the phase overcurrent 2nd timer stage to be replaced by the logic selectivity 2 timer stage. Setting range: Yes or No
Log.Sel.2 tI>>> **No**	Enabling/Disabling the phase overcurrent 3rd timer stage to be replaced by the logic selectivity 2 timer stage. Setting range: Yes or No
Log.Sel.2 tIN>> **No**	Enabling/Disabling the residual overcurrent 2nd timer stage to be replaced by the logic selectivity 2 timer stage. Setting range: Yes or No
Log.Sel.2 tIN>>> **No**	Enabling/Disabling the residual overcurrent 3rd timer stage to be replaced by the logic selectivity 2 timer stage. Setting range: Yes or No
tLog.Sel.2 **0 ms**	Setting of the logic selectivity 2 timer stage duration that, if activated by an input control signal, replaces timer stages selected and enabled in the above 4 parameter cells.

3.11 Submenu CB SUPERVISION

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⊘.
CB SUPERVISION	Submenu **CB SUPERVISION** Access to set the CB supervision parameter cells is gained by pressing the navigation key ⊘.
Trip Circuit Superv Yes	Enabling/Disabling the trip circuit supervision function. Setting range: Yes or No
tSup 2.0 s	Setting of the trip circuit supervision timer stage. Setting range: 0.1 ... 2 ... 10 s; in steps of 0.01
CB Opening Time Superv Yes	Enabling/Disabling the CB opening time supervision. Setting range: Yes or No
CB Opening Time 150 ms	Setting of the max. duration allowed for circuit breaker to open. Setting range: 0.05 ... 0.15 ... 1 s; in steps of 0.05
CB Closing Time Superv Yes	Enabling/Disabling the CB closing time supervision. Setting range: Yes or No
CB Closing Time 150 ms	Setting of the max. duration allowed for circuit breaker to close. Setting range: 0.05 ... 0.15 ... 1 s; in steps of 0.05.
CB Operation NB Superv Yes	Enabling/Disabling the CB operation number supervision. Setting range: Yes or No
CB Operation NB 7500	Setting of the max. number of tripping operations allowed for circuit breaker to perform. Setting range: 0 ... 7500 ... 50000 ; in steps of 50
Sum A n Superv Yes	Enabling/Disabling the supervision of the summation current flow, in Amp, interrupted Setting range: Yes or No.
Sum A n 6 MA	Setting of the max. summation value of the weighted current flow, in Amp, interrupted. Setting range: 0 ... 6 ... 4000 MA^n; in steps of 1
n 1	Setting of the exponent for weighing current flow. Setting range: 1 ... 2; in steps of 1

3.12 Submenu CT SUPERVISION

AUTOMAT.CTRL	Menu **AUTOMAT.CTRL** Access to set the automatic control parameter cells is gained by pressing the navigation key ⌓.
CT SUPERVISION	Submenu **CT SUPERVISION** Access to set the current transformer circuit/Broken conductor supervision parameter cells is gained by pressing the navigation key ⌓.
CT Superv **Yes**	Enabling/Disabling the CT circuit supervision. Setting range: Yes or No
Mode CT Superv **I2/I1**	Setting of the operating mode for the CT supervision to fit the CT: – Imax/Imin (monitoring phase A and C) – I2/I1 (monitoring phase A, B and C)
Idiff> **0.30 Imax**	Setting of the threshold for the CT supervision with operating mode set to Imax/Imin. Setting range: 0.25 ... 0.3 ... 0.5 Imax; in steps of 0.05
tCT **5 s**	Setting of the CT supervision timer stage. Setting range: 0.00 ... 5.00... 500.00 s; in steps of 0.01
I2/I1> **20 %**	Setting of the threshold for the CT supervision with operating mode set to I2/I1. Setting range: 20 ... 100% ; in steps of 1

4. MENUS PROTECTION G1 AND PROTECTION G2

4.1 Submenu [50/51] SHORT CIRCUIT

PROTECTION G1	Menus **PROTECTION G1** and **PROTECTION G2** Access to select the setting group cells is gained by pressing the navigation key ⊘.
[50/51] SHORT-CIRCUIT	Submenu **SHORT-CIRCUIT** Access to set the phase overcurrent protection parameter cells is gained by pressing the navigation key ⊘.

4.1.1 Phase overcurrent 1st stage

I> Function **Yes**	Enabling/Disabling the phase overcurrent 1st stage function. Setting range: Yes or <u>No</u>
I> **1.0 In**	Setting of the threshold or reference current for the phase overcurrent 1st stage. Setting range: 0.1 ... <u>1.0</u> ... 40 In; in steps of 0.01
I> Delay Type **DMT**	Setting of the operating mode for the phase overcurrent 1st stage. Setting range: <u>DMT</u>, IDMT or RI

4.1.2 Phase overcurrent 1st stage with operating mode set to DMT

I> Delay Type **DMT**	Operating mode of the phase overcurrent 1st stage is set to DMT characteristic.
tI> **1.0 s**	Setting of the phase overcurrent 1st timer stage duration. Setting range: 0.0 ... <u>1.0</u> ... 150 s; in steps of 0.01
I> tReset **0.0 s**	Setting of the reset timer duration for the phase overcurrent 1st stage. Setting range: <u>0.0</u> ... 600 s; in steps of 0.01

4.1.3 Phase overcurrent 1st stage with operating mode set to IDMT

I> Delay Type **IDMT**	Operating mode of the phase overcurrent 1st stage is set to IDMT characteristic.
I> Curve **IEC SI**	Setting of the tripping characteristic for the phase overcurrent 1st stage. Setting range: IEC STI; IEC SI; IEC VI; IEC EI; IEC LTI; CO2; IEEE MI; CO8; IEEE VI; IEEE EI; RC
I> Tms **1.00**	Setting of the tripping characteristic factor for the selected tripping characteristic for the phase overcurrent 1st stage. Setting range: 0.03 ... 1.00 ...4.00; in steps of 0.01

Definite-time reset logic for IEC/RC characteristics

I> tReset **0.0 s**	Setting of the reset timer duration for the phase overcurrent 1st stage with IEC or RC characteristics. Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic for IEEE/CO characteristics

I> Reset Type **DMT**	Operating mode of the reset logic, for the phase overcurrent 1st stage with IEEE or CO characteristics, is set to DMT reset logic.
I> tReset **0.0 s**	Setting of the reset timer duration, when reset logic is set to DMT, for the phase overcurrent 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

Inverse-time reset logic for IEEE/CO characteristics

I> Reset Type **IDMT**	Operating mode of the reset logic, for the phase overcurrent 1st stage with IEEE or CO characteristics, is set to IDMT reset logic.
I> Rtms **0.025**	Setting of the reset characteristic factor, when reset logic is set to IDMT, for the phase overcurrent 1st stage. Setting range: 0.025 ... 3.200; in steps of 0.025

4.1.4 Phase overcurrent 1st stage with operating mode set to RI

I> Delay Type **RI**	Operating mode of the phase overcurrent 1st stage is set to RI.
I> K **1.00**	Setting of the tripping characteristic factor for the RI tripping characteristic for the phase overcurrent 1st stage. Setting range: 0.05 ... 1.00 ... 10.0; in steps of 0.005
I> tReset **0.0 s**	Setting of the reset timer duration for the phase overcurrent 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

4.1.5 Phase overcurrent 2nd stage

I>> Function **Yes**	Enabling/Disabling the phase overcurrent 2nd stage function. Setting range: Yes or No
I>> **4.0 In**	Setting of the threshold or reference current for the phase overcurrent 2nd stage. Setting range: 0.1 ... 4.0 ... 40 In; in steps of 0.01
I>> Delay Type **DMT**	Setting the operating mode for the phase overcurrent 2nd stage. Setting range: DMT, IDMT or RI

4.1.6 Phase overcurrent 2nd stage with operating mode set to DMT

I>> Delay Type **DMT**	Operating mode of the phase overcurrent 2nd stage is set to DMT.
tI>> **1.0 s**	Setting of the phase overcurrent 2nd timer stage duration. Setting range: 0.0 ... 1.0 ... 150 s; in steps of 0.01
I>> tReset **0.0 s**	Setting of the 2nd phase overcurrent reset timer stage duration. Setting range: 0.0 ... 600 s; in steps of 0.01

4.1.7 Phase overcurrent 2nd stage with operating mode set to IDMT

I>> Delay Type **IDMT**	Operating mode of the phase overcurrent 2nd stage is set to IDMT.
I>> Curve **IEC SI**	Setting of the tripping characteristic for the phase overcurrent 2nd stage. Setting range: IEC STI; IEC SI; IEC VI; IEC EI; IEC LTI; CO2; IEEE MI; CO8; IEEE VI; IEEE EI; RC

I>> Tms 1.00

Setting of the tripping characteristic factor for the selected tripping characteristic for the phase overcurrent 2nd stage.
Setting range: 0.03 ... 1.00 ...4.00; in steps of 0.01

Definite-time reset logic for IEC/RC characteristics

I>> tReset 0.0 s

Setting of the reset timer duration for the phase overcurrent 2nd stage with IEC or RC characteristic.
Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic for IEEE/CO characteristics

I>> Reset Type DMT

Operating mode of the reset logic, for the phase overcurrent 2nd stage with IEEE or CO characteristic, is set to DMT reset logic.

I>> tReset 0.0 s

Setting of the reset timer duration, when reset logic is set to DMT, for the phase overcurrent 2nd stage.
Setting range: 0.0 ... 600 s; in steps of 0.01

Inverse-time reset logic for IEEE/CO characteristics

I>> Reset Type IDMT

Operating mode of the reset logic, for the phase overcurrent 2nd stage with IEEE or CO characteristic, is set to IDMT reset logic.

I>> Rtms 0.025

Setting of the reset characteristic factor, when reset logic is set to IDMT, for the phase overcurrent 2nd stage.
Setting range: 0.025 ... 3.200; in steps of 0.025

4.1.8 Phase overcurrent 2nd stage with operating mode set to RI

I>> Delay Type **RI**	Operating mode of the phase overcurrent 2nd stage is set to RI.
I>> K **1.00**	Setting of the tripping characteristic factor for the RI tripping characteristic for the phase overcurrent 2nd stage. Setting range: 0.05 ... 1.00 ... 10.0; in steps of 0.005
I>> tReset **0.0 s**	Setting of the reset timer duration for the phase overcurrent 2nd stage. Setting range: 0.0 ... 600 s; in steps of 0.01

4.1.9 Phase overcurrent 3rd stage

I>>> Function **Yes**	Enabling/Disabling the phase overcurrent 3rd stage function. Setting range: Yes or No
I>>> **4.0 In**	Setting of the phase overcurrent 3rd stage threshold. Setting range: 0.1 ... 4.0 ... 40 In; in steps of 0.01
tI>>> **500 ms**	Setting of the phase overcurrent third timer stage. Setting range: 0.0 ... 0.5 ... 150 s; in steps of 0.01

4.2 Submenu [50N/51N] EARTH FAULT

PROTECTION G1	Menus **PROTECTION G1** and **PROTECTION G2** Access to select the setting group cells is gained by pressing the navigation key ⌯.
[50N/51N] EARTH FAULT	Submenu **EARTH FAULT** Access to set the residual overcurrent protection parameter cells is gained by pressing the navigation key ⌯.

4.2.1 Residual overcurrent 1st stage

IN> Function **Yes**	Enabling/Disabling the residual overcurrent 1st stage function. Setting range: Yes or <u>No</u>
IN> **0.25 INn**	Setting of the threshold or reference current for the residual overcurrent 1st stage. Setting range: 0.1 ... <u>1.0</u> ... 40 INn; in steps of 0.01 or 0.01 ... <u>0.25</u> ... 8 INn; in steps of 0.001 or 0.002 ... <u>0.025</u> ... 0.8 INn; in steps of 0.001
IN> Delay Type **DMT**	Setting the operating mode for the residual overcurrent 1st stage. Setting range: <u>DMT</u>, IDMT, RI or LABOR.

4.2.2 Residual overcurrent 1st stage with operating mode set to DMT

IN> Delay Type **DMT**	Operating mode of the residual overcurrent 1st stage is set to DMT characteristic.
tIN> **1.0 s**	Setting of the residual overcurrent 1st timer stage duration. Setting range: 0.0 ... 1.0 ... 150 s; in steps of 0.01
IN> Rst Type DMT **Normal**	Setting the operating mode of the DMT reset timer for the residual overcurrent 1st stage. Setting range: Normal or Interm

Definite-time reset logic

IN> Rst Type DMT **Normal**	Operating mode of the DMT reset logic for the residual overcurrent 1st stage is set to normal reset logic.
IN> tReset **0.0 s**	Setting of the DMT reset timer duration, when set to normal, for the residual overcurrent 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic with prolonged accumulation

IN> Rst Type DMT **Interm**	Operating mode of the DMT reset logic for the residual overcurrent 1st stage is set to prolonged accumulation.
IN> tReset int. **0.0 s**	Setting of the reset timer duration, with the DMT reset logic set to prolonged accumulation, for the residual overcurrent 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01
IN> tProl int. **0.08 s**	Setting of the prolongation timer duration, with the DMT reset logic set to prolonged accumulation, for the residual overcurrent 1st stage. Setting range: 0.01 ... 0.08 ... 10 s; in steps of 0.01
tIN> int. **1.0 s**	Setting of the residual overcurrent 1st timer stage duration with the DMT reset logic set to prolonged accumulation. Setting range: 0.0 ... 1.0 ... 150 s; in steps of 0.01

4.2.3 Residual overcurrent 1st stage with operating mode set to IDMT

IN> Delay Type **IDMT**	Operating mode of the residual overcurrent 1st stage is set to IDMT characteristic.
IN> Curve **IEC SI**	Setting of the tripping characteristic for the residual overcurrent 1st stage. Setting range: IEC STI; IEC SI; IEC VI; IEC EI; IEC LTI; CO2; IEEE MI; CO8; IEEE VI; IEEE EI; RC
IN> Tms **1.00**	Setting of the tripping characteristic factor for the selected tripping characteristic for the residual overcurrent 1st stage. Setting range: 0.03 ... 1.00 ... 4.00; in steps of 0.01

Definite-time reset logic for IEC/RC characteristics

IN> tReset **0.0 s**	Setting of the reset timer duration for the residual overcurrent 1st stage with IEC or RC characteristics. Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic for IEEE/CO characteristics

IN> Reset Type **DMT**	Operating mode of the reset logic, for the residual overcurrent 1st stage with IEEE or CO characteristic, is set to DMT reset logic.
IN> tReset **0.0 s**	Setting of the reset timer duration, when reset logic is set to DMT, for the residual overcurrent 1st stage. Setting range: 0.0 ... 1.0 ... 600 s; in steps of 0.01

Inverse-time reset logic for IEEE/CO characteristics

IN> Reset Type **IDMT**	Operating mode of the reset logic, for the residual overcurrent 1st stage with IEEE or CO characteristic, is set to IDMT reset logic.
IN> Rtms **0.025**	Setting of the reset characteristic factor, when reset logic is set to IDMT, for the residual overcurrent 1st stage. Setting range: 0.025 ... 3.200; in steps of 0.025

4.2.4 Residual overcurrent 1st stage with operating mode set to RI

IN> Delay Type **RI**	Operating mode of the residual overcurrent 1st stage is set to RI characteristic.
IN> K **1.00**	Setting of the tripping characteristic factor for the RI tripping characteristic for the residual overcurrent 1st stage. Setting range: 0.05 ... 1.00 ... 10.0; in steps of 0.005
IN> tReset **0.0 s**	Setting of the reset timer duration for the residual overcurrent 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

4.2.5 Residual overcurrent 1st stage with operating mode set to LABOR.

IN> Delay Type **LABOR.**	Operating mode of the residual overcurrent 1st stage is set to LABOR. characteristic.
IN> Curve **1**	Setting of the tripping characteristic for the residual overcurrent 1st stage. Setting range: 1 ; 2 ; 3

4.2.6 Residual overcurrent 2nd stage

IN>> Function **Yes**	Enabling/Disabling the residual overcurrent 2nd stage function. Setting range: Yes or <u>No</u>
IN>> **0.25 INn**	Setting of the threshold or reference current for the residual overcurrent 2nd stage. Setting range: 0.1 ... <u>1.0</u> ... 40 INn; in steps of 0.01 or 0.01 ... <u>0.25</u> ... 8 INn; in steps of 0.001 or 0.002 ... <u>0.025</u> ... 0.8 INn; in steps of 0.001
IN>> Delay Type **DMT**	Setting the operating mode for the residual overcurrent 2nd stage. Setting range: <u>DMT</u>, IDMT, RI or LABOR.

4.2.7 Residual overcurrent 2nd stage with operating mode set to DMT

IN>> Delay Type **DMT**	Operating mode of the residual overcurrent 2nd stage is set to DMT characteristic.
tIN>> **1.0 s**	Setting of the residual overcurrent 2nd timer stage duration. Setting range: 0.0 ... <u>1.0</u> ... 150 s; in steps of 0.01
IN>> tReset **0.0 s**	Setting of the reset timer duration for the residual overcurrent 2nd stage. Setting range: <u>0.0</u> ... 600 s; in steps of 0.01

4.2.8 Residual overcurrent 2nd stage with operating mode set to IDMT

IN>> Delay Type	IDMT

Operating mode of the residual overcurrent 2nd stage is set to IDMT characteristic.

IN>> Curve	IEC SI

Setting of the tripping characteristic for the residual overcurrent 2nd stage.
Setting range: IEC STI; IEC SI; IEC VI; IEC EI; IEC LTI; CO2; IEEE MI; CO8; IEEE VI; IEEE EI; RC

IN>> Tms	1.00

Setting of the tripping characteristic factor for the selected tripping characteristic for the residual overcurrent 2nd stage.
Setting range: 0.03 ... 1.00 ... 4.00; in steps of 0.01

Definite-time reset logic for IEC/RC characteristics

IN>> tReset	0.0 s

Setting of the reset timer duration for the residual overcurrent 2nd stage with IEC or RC characteristic.
Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic for IEEE/CO characteristics

IN>> Reset Type	DMT

Operating mode of the reset logic, for the residual overcurrent 2nd stage with IEEE or CO characteristic, is set to DMT reset logic.

IN>> tReset	0.0 s

Setting of the reset timer duration, when reset logic is set to DMT, for the residual overcurrent 2nd stage.
Setting range: 0.0 ... 600 s; in steps of 0.01

Inverse-time reset logic for IEEE/CO characteristics

IN>> Reset Type	IDMT

Operating mode of the reset logic, for the residual overcurrent 2nd stage with IEEE or CO characteristics, is set to IDMT reset logic.

IN>> Rtms	0.025

Setting of the reset characteristic factor, when reset logic is set to IDMT, for the residual overcurrent 2nd stage.
Setting range: 0.025 ... 3.200; in steps of 0.025

4.2.9 Residual overcurrent 2nd stage with operating mode set to RI

IN>> Delay Type **RI**	Operating mode of the residual overcurrent 2nd stage is set to RI characteristic.
IN>> K **1.00**	Setting of the tripping characteristic factor for the RI tripping characteristic for the residual overcurrent 2nd stage. Setting range: 0.05 ... 1.00 ... 10.0; in steps of 0.005
IN>> tReset **0.0 s**	Setting of the reset timer duration for the residual overcurrent 2nd stage. Setting range: 0.0 ... 600 s; in steps of 0.01

4.2.10 Residual overcurrent 2nd stage with operating mode set to LABOR.

IN>> Delay Type **LABOR.**	Operating mode of the residual overcurrent 2nd stage is set to LABOR. characteristic.
IN>> Curve **1**	Setting of the tripping characteristic for the residual overcurrent 2nd stage. Setting range: 1; 2; 3

4.2.11 Residual overcurrent 3rd stage

IN>>> Function **Yes**	Enabling/Disabling the 3rd overcurrent stage function. Setting range: Yes or No
IN>>> **0.25 INn**	Setting of the residual overcurrent 3rd stage threshold. Setting range: 0.1 ... 1.0 ... 40 INn; in steps of 0.01 or 0.01 ... 0.25 ... 8 INn; in steps of 0.001 or 0.002 ... 0.025 ... 0.8 INn; in steps of 0.001
tIN>>> **1.0 s**	Setting of the residual overcurrent 3rd timer stage duration. Setting range: 0.0 ... 1.0 ... 150 s; in steps of 0.01

4.3 Submenu [46] UNBALANCE

PROTECTION G1	Menus **PROTECTION G1** and **PROTECTION G2** Access to select the setting group cells is gained by pressing the navigation key ⊘.
[46] UNBALANCE	Submenu **UNBALANCE** Access to set the unbalance fault parameter cells is gained by pressing the navigation key ⊘.

4.3.1 Unbalance fault 1st stage

I2> Function **Yes**	Enabling/Disabling the unbalance fault 1st stage. Setting range: Yes or <u>No</u>
I2> **0.3 In**	Setting of the threshold or reference current for the unbalance fault 1st stage. Setting range: 0.1 ... <u>0.3</u> ... 40 In; in steps of 0.01
I2> Delay Type **DMT**	Setting the operating mode for the unbalance fault 1st stage. Setting range: <u>DMT</u>, IDMT or RI

4.3.2 Unbalance fault 1st stage with operating mode set to DMT

I2> Delay Type **DMT**	Operating mode of the unbalance fault 1st stage is set to DMT characteristic.
tI2> **4.0 s**	Setting of the unbalance fault 1st timer stage duration. Setting range: 0.0 ... <u>4.0</u> ... 150 s; in steps of 0.01

4.3.3 Unbalance fault 1st stage with operating mode set to IDMT

I2> Delay Type **IDMT**	Operating mode of the unbalance fault 1st stage is set to IDMT characteristic.
I2> Curve **IEC SI**	Setting of the tripping characteristic for the unbalance fault 1st stage. Setting range: IEC STI; IEC SI; IEC VI; IEC EI; IEC LTI; CO2; IEEE MI; CO8; IEEE VI; IEEE EI
I2> Tms **1.00**	Setting of the tripping characteristic factor for the selected tripping characteristic for the unbalance fault 1st stage. Setting range: 0.03 ... 1.00 ... 4.00; in steps of 0.01

Definite-time reset logic for IEC characteristics

I2> tReset **0.0 s**	Setting of the reset timer duration for the unbalance fault 1st stage with IEC characteristic. Setting range: 0.0 ... 600 s; in steps of 0.01

Definite-time reset logic for IEEE/CO characteristics

I2> Reset Type **DMT**	Operating mode of the reset logic, for the unbalance fault 1st stage with IEEE or CO characteristic, is set to DMT reset logic.
I2> tReset **0.0 s**	Setting of the reset timer duration, when reset logic is set to DMT, for the unbalance fault 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

Inverse-time reset logic for IEEE/CO characteristics

I2> Reset Type **IDMT**	Operating mode of the reset logic, for the unbalance fault 1st stage with IEEE or CO characteristic, is set to IDMT reset logic.
I2> Rtms **0.025**	Setting of the reset characteristic factor, when reset logic is set to IDMT, for the unbalance fault 1st stage. Setting range: 0.025 ... 3.200; in steps of 0.025

4.3.4 Unbalance fault 1st stage with operating mode set to RI

I2> Delay Type **RI**	Operating mode of the unbalance fault 1st stage is set to RI characteristic.
I2> K **1.0**	Setting of the tripping characteristic factor for the RI tripping characteristic for the unbalance fault 1st stage. Setting range: 0.05 ... 1.0 ... 10.0; in steps of 0.005
I2> tReset **0.0 s**	Setting of the reset timer duration for the unbalance fault 1st stage. Setting range: 0.0 ... 600 s; in steps of 0.01

4.3.5 Unbalance fault 2nd stage

I2>> Function **Yes**	Enabling/Disabling the unbalance fault 2nd stage. Setting range: Yes or No
I2>> **0.5 In**	Setting of the unbalance fault 2nd stage threshold. Setting range: 0.1 ... 0.5 ... 40 In; in steps of 0.01
tI2>> **1.0 s**	Setting of the unbalance fault 2nd timer stage duration. Setting range: 0.0 ... 1.0 ... 150 s; in steps of 0.01

4.4 Submenu [49] THERMAL OVERLOAD

PROTECTION G1	Menus **PROTECTION G1** and **PROTECTION G2** Access to select the setting group cells is gained by pressing the navigation key ⌯.
[49] THERMAL OVER LOAD	Submenu **THERMAL OVERLOAD** Access to set the thermal overload parameter cells is gained by pressing the navigation key ⌯.
Therm Overload Funct. Yes	Enabling/Disabling the thermal overload function. Setting range: Yes or <u>No</u>
Iref 1.0 In	Setting of the reference current. Setting range: 0.1 ... <u>1.0</u> ... 3.20 In; in steps of 0,01
Te 20 mn	Setting of the thermal time constant for the protected object. Setting range: 1 ... <u>20</u> ... 200 min; in steps of 1
K 1.15	Setting of the overload factor. Setting range: 1 ... <u>1.15</u> ... 1.5; in steps of 0.01
θ Trip 100 %	Setting of the thermal trip threshold value. Setting range: 50 ... <u>100</u> ... 200 % ; in steps of 1
θ Alarm Yes	Enabling/Disabling the thermal alarm threshold. Setting range: Yes or <u>No</u>
θ Alarm 80 %	Setting of the threshold for the thermal alarm; when the thermal replica exceeds the threshold a thermal alarm is issued. Setting range: 50 ... <u>80</u> ... 200 % ; in steps of 1

4.5 Submenu [37] LOSS OF LOAD

PROTECTION G1	Menus **PROTECTION G1** and **PROTECTION G2** Access to select the setting group cells is gained by pressing the navigation key ⊲⊳.
[37] LOSS OF LOAD	Submenu **LOSS OF LOAD** Access to set the undercurrent/loss of load protection parameter cells is gained by pressing the navigation key ⊲⊳.
I< Function **Yes**	Enabling/Disabling the undercurrent/loss of load protection. Setting range: Yes or <u>No</u>
I< **0.3 In**	Setting of the undercurrent/loss of load stage threshold. Setting range: 0.05 ... <u>0.3</u> ... 1 In; in steps of 0.01
tI< **20.0 s**	Setting of the undercurrent/loss of load timer stage duration. Setting range: 0.0 ... <u>20</u> ... 150 s; in steps of 0.01

5. MENU MEASUREMENTS

MEASUREMENTS	Menu **MEASUREMENTS** Access to the measurements parameter cells is gained by pressing the navigation key ⌯.
IA Rms **0.00 A**	Display of the true rms value of phase A primary current.
IB Rms **0.00 A**	Display of the true rms value of phase B primary current.
IC Rms **0.00 A**	Display of the true rms value of phase C primary current.
IN Rms **0.00 A**	Display of the true rms value of the primary residual current.
IA Rms Sec **0.000 In**	Display of the true rms value of phase A secondary current rated to the nominal relay current I_{nom}.
IB Rms Sec **0.000 In**	Display of the true rms value of phase B secondary current rated to the nominal relay current I_{nom}.
IC Rms Sec **0.000 In**	Display of the true rms value of phase C secondary current rated to the nominal relay current I_{nom}.
IN Rms Sec **0.000 INn**	Display of the true rms value of the residual secondary current rated to the nominal relay current $I_{N,nom}$.
I1 Positive **0.00 A**	Display of the positive sequence primary current.
I1 Positive Sec **0.000 In**	Display of the positive sequence secondary current rated to the nominal relay current I_{nom}.
I2 Negative **0.00 A**	Display of the negative sequence primary current.
I2 Negative Sec **0.000 In**	Display of the negative sequence secondary current rated to the nominal relay current I_{nom}.
I2/I1 Ratio **0 %**	Display of the ratio in percent of the negative-sequence to the positive-sequence components of the currents.

I0 Zero **0.00 A**	Display of the zero sequence primary current.
I0 Zero Sec **0.000 INn**	Display of the secondary zero sequence current rated to the nominal relay current $I_{N,nom}$.
Frequency *** * * ***	Display of the frequency of the power system in Hz.
Max Ph Current **CLR=[C] 50.00 A**	Display of the primary true rms value of the max phase current stored. To clear the stored value press reset key ⓒ.
IN - fn **CLR=[C] 0.00 A**	Display of the stored component of the residual current harmonics. To reset and re-trigger the measuring process press reset key ⓒ.
Thermal State **CLR=[C] 0 %**	Display of the thermal replica state. To clear the stored value of the thermal replica state press reset key ⓒ.
Rst.Max&Average **CLR=[C]**	To reset and re-trigger the measuring process of the maximum and average current values for each of the three primary phase currents during a definite time duration press reset key ⓒ.
Max. IA Rms **0.00 A**	Display of the max. value for the phase A primary current, determined during a triggered detection with definite time duration.
Max. IB Rms **0.00 A**	Display of the max. value for the phase B primary current, determined during a triggered detection with definite time duration.
Max. IC Rms **0.00 A**	Display of the max. value for the phase C primary current, determined during a triggered detection with definite time duration.
Average IA Rms **0.00 A**	Display of the average value for the phase A primary current, determined during a triggered detection with definite time duration.
Average IB Rms **0.00 A**	Display of the average value for the phase B primary current, determined during a triggered detection with definite time duration.
Average IC Rms **0.00 A**	Display of the average value for the phase C primary current, determined during a triggered detection with definite time duration.
Rst.MaxSubperiod **CLR=[C]**	To reset the maximum sub-period values determined for the primary phase currents press reset key ⓒ.

Max. Subperiod **IA Rms 0.00 A**	Display of the maximum sub-period value for phase A primary current.
Max. Subperiod **IB Rms 0.00 A**	Display of the maximum sub-period value for phase B primary current.
Max. Subperiod **IC Rms 0.00 A**	Display of the maximum sub-period value for phase C primary current.
Rst.Roll.Average **CLR=[C]**	To reset the rolling average values determined for the primary phase currents press reset key ⓒ.
Rolling Average **IA Rms 0.00 A**	Display of the rolling average value for phase A primary current.
Rolling Average **IB Rms 0.00 A**	Display of the rolling average value for phase B primary current.
Rolling Average **IC Rms 0.00 A**	Display of the rolling average value for phase C primary current.

NOTE: Various designation texts may be selected from the local control panel to display the phase currents (e.g. phase A current: **IA**, **I1**, **IL1** or **IR**) or the residual current (see submenu **LOCAL INDICATION**). It is therefore possible that the text displayed on the local control panel LCD in the menu **MEASUREMENTS** differs from the text as described in this Operation guide.

6. MENU EVENT COUNTERS

EVENT COUNTERS	Menu **EVENT COUNTERS** Access to the event counters cells is gained by pressing the navigation key ⌯.
Reset Counters **CLR=[C]**	To clear all stored counter values press reset key ⓒ.
General Start **NB 0**	Display of the counter for the total number of general startings.
Total Trip NB **0**	Display of the counter for the total number of protection Trip orders issued by Trip output relay 1. Operational Trip orders are not considered by the counter.
tExt 1;2 Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the time delayed signals from the binary inputs Ext 1 and Ext 2.
tI>;>>;>>> Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the time delayed signals from the phase overcurrent stages.
tIN>;>>;>>>Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the time delayed signals from the residual overcurrent stages.
tI2>;tI2>> Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the time delayed signals from the unbalance fault stages.
tI< Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the time delayed signal from the undercurrent/loss of load timer stage.
Therm Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the thermal overload signal.
CB Fail Trip **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the CB failure protection.
Trip onto fault **NB 0**	Display of the counter for the number of Trip output relay 1 operations initiated by the switch CB on to fault function signal.

7. MENU CONTROL/TESTING

CONTROL/TESTING	Menu **CONTROL/TESTING** Access to the control or testing parameter cells is gained by pressing the navigation key ⌯.
General Reset **not execute**	The following information is reset: – stored LED and alarm signals, – disturbance records and fault records, – starting records, – event records and event counters, – measured value Max Ph Current, – CB monitoring: CB open and close time. Setting range: not execute or execute
Open Order **not execute**	An open order is issued manually from the local control panel. The open order is permanently assigned to the Trip output relay 1. Setting range: not execute or execute
Close Order **not execute**	A close order is issued manually from the local control panel. Setting range: not execute or execute
Disturb Trigger **not execute**	Disturbance recording is triggered from the local control panel. Setting range: not execute or execute
Maintenance mode **No**	Enabling/Disabling the maintenance mode to block and to test output relays. Setting range: Yes or No
Block. CB-Meas. **No**	Enabling/Disabling the blocking of the counters with values for the summation of circuit breaker weighted phase breaking currents and the total number of CB trip operations. Setting range: Yes or No

8. MENU RECORD

8.1 Submenu FAULT RECORD

RECORD	Menu **RECORD** Access to the data stored in the record cells is gained by pressing the navigation key ⊘.
FAULT RECORD	Submenu **FAULT RECORD** Access to the data stored in the fault record cells is gained by pressing the navigation key ⊘.
Record Number **5**	Selection of the fault record by setting the record number. Setting range: 1 to 5
Fault Time **16:39:48:57**	Display of the time when the fault occurred.
Fault Date **07/02/03**	Display of the date when the fault occurred.
Active Set Group **1**	Display of the setting group active when the fault occurred.
Faulted Phase **A B C**	Display of the phase(s) where the fault was detected.
Trip by **tI>>**	Display of the cause that led to a Trip order.
Magnitude **1.351 kA**	Display of the magnitude that was instrumental in causing a Trip order.
IA Magnitude **1.345 kA**	Display of the phase A primary current magnitude at the time of the fault.
IB Magnitude **1.351 kA**	Display of the phase B primary current magnitude at the time of the fault.
IC Magnitude **1.332 kA**	Display of the phase C primary current magnitude at the time of the fault.
IN Magnitude **0.75 A**	Display of the residual primary current magnitude at the time of the fault.

8.2 Submenu STARTING RECORD

RECORD	Menu **RECORD** Access to the data stored in the record cells is gained by pressing the navigation key ⊲⊳.
STARTING RECORD	Submenu **STARTING RECORD** Access to the data stored in the starting record cells is gained by pressing the navigation key ⊲⊳.
Number **5**	Selection of the starting record by setting the record number. Setting range: 1 to 5
Hour **16:39:48:57**	Display of the time when the starting occurred.
Date **19/02/03**	Display of the date when the starting occurred.
Origin **I>**	Display of the starting stage.
Start.duration **650 ms**	Display of the starting duration.
Dur.t elapsed **600 ms**	Display of the elapsed time duration of associated time delay.
Trip **Yes**	Information, if a Trip order has been issued by the stage.

8.3 Submenu CB MONITORING

RECORD	Menu **RECORD** Access to the data stored in the record cells is gained by pressing the navigation key ⊘.
CB MONITORING	Submenu **CB MONITORING** Access to the data stored in the CB monitoring cells is gained by pressing the navigation key ⊘.
CB Open Time **0 ms**	Display of the duration last needed by the CB to open, initiated by the Trip output relay 1.
CB Close Time **0 ms**	Display of the duration last needed by the CB to close.
CB Open NB **CLR=[C] 0**	Display of the total number of CB trip operations, initiated by the Trip output relay 1. To clear the stored counter value press reset key ⓒ.
Reset Sum A n **CLR=[C]**	To clear the memory with the summation of CB weighted phase breaking currents press reset key ⓒ.
Sum A n IA **0 E00**	Display of the summation of CB weighted primary phase A breaking current. (Example: 6 E03 = 6000 A^n)
Sum A n IB **0 E00**	Display of the summation of CB weighted primary phase B breaking current.
Sum A n IC **0 E00**	Display of the summation of CB weighted primary phase C breaking current.

9. ALARMS

ALARMS	Alarms are displayed automatically when at least one deviation from the normal undisturbed operating state of the power system is detected. Individual alarm signals can be selected for display by pressing the record key 📖.
Phase A **Start.**	Phase A overcurrent starting signal is issued. (self updating or stored [1])
Phase B **Start.**	Phase B overcurrent starting signal is issued. (self updating or stored [1])
Phase C **Start.**	Phase C overcurrent starting signal is issued. (self updating or stored [1])
Starting GF	Residual overcurrent starting signal is issued. (self updating or stored [1])
General **Start.**	General starting signal issued by phase overcurrent stage starting signals and, if operating mode is set, by the residual overcurrent stage and unbalance fault stage starting signals. (self updating or stored [1])
tGS	Timer stage signal tGS assigned to the general starting is issued. (stored [1])
Starting **I>**	Phase overcurrent 1st stage starting signal is issued. (self updating or stored [1])
tI> **Phase ...**	Phase overcurrent 1st stage time delayed signal with display of the faulted phase(s) is issued. (stored [1])
Starting **I>>**	Phase overcurrent 2nd stage starting signal is issued. (self updating or stored [1])
tI>> **Phase ...**	Phase overcurrent 2nd stage time delayed signal with display of the faulted phase(s) is issued. (stored [1])
Starting **I>>>**	Phase overcurrent 3rd stage starting signal is issued. (self updating or stored [1])
tI>>> **Phase ...**	Phase overcurrent 3rd stage time delayed signal with display of the faulted phase(s) is issued. (stored [1])

Starting IN>	Residual overcurrent 1st stage starting signal is issued. (self updating or stored [1])
tIN>	Residual overcurrent 1st stage time delayed signal is issued. (stored [1])
tIN> int.	Residual overcurrent 1st stage time delayed signal, with the operating mode set to prolonged reset logic, is issued. (stored [1])
Starting IN>>	Residual overcurrent 2nd stage starting signal is issued. (self updating or stored [1])
tIN>>	Residual overcurrent 2nd stage time delayed signal is issued. (stored [1])
Starting IN>>>	Residual overcurrent 3rd stage starting signal is issued. (self updating or stored [1])
tIN>>>	Residual overcurrent 3rd stage time delayed signal is issued. (stored [1])
Starting I2>	Unbalance fault 1st stage starting signal is issued. (self updating or stored [1])
tI2>	Unbalance fault 1st stage time delayed signal is issued. (stored [1])
Starting I2>>	Unbalance fault 2nd stage starting signal is issued. (self updating or stored [1])
tI2>>	Unbalance fault 2nd stage time delayed signal is issued. (stored [1])
tI< Phase ...	Undercurrent/loss of load timer stage signal with display of the faulted phase is issued. (stored [1])
Thermal Alarm	Thermal alarm is issued. (self updating)
Therm Over-load	Thermal overload signal is issued. (stored [1])

Therm. Block.	Thermal replica is blocked by a binary input control signal. (self updating)
tExt1	Timer stage signal of the binary input signal Ext 1 is issued. (stored [1])
tExt2	Timer stage signal of the binary input signal Ext 2 is issued. (stored [1])
CB Failure	CB failure signal issued when tBF is exceeded and not all three CB poles have opened. (stored [1])
Trip by CB Failure	Trip order signal issued by the CB failure protection detecting the failure of a down stream CB. (stored [1])
Trip by SOTF	Trip order signal, issued when switching on to fault. (stored [1])
Trip Circ Fail	Signal issued when a failure in the trip circuit is detected. (stored [2])
CB Open Time	Signal issued when the CB opening time duration is exceeded after the CB was de-energised. (stored [2])
CB Close Time	Signal issued when the CB closing time duration is exceeded after the CB was energised. (stored [2])
CB Opening NB	Signal issued when the CB opening counter threshold value is exceeded. (stored [2])
Sum A n	Signal issued when the threshold value of the summation of current flow in Amps interrupted is exceeded. (stored [2])
CT Fail	Signal issued by the CT supervision/Broken conductor. (stored [2])
Maintenance Mode	Signal issued when the maintenance mode is enabled. (self updating)
Latch Relay	Signal issued when one or more output relays are set to latch mode (output relays 2 to 7). (self updating)

Latch Relay Trip	Signal is issued when Trip output relay 1 is set to latch mode. (self updating)
Clear LED Alarms	To clear stored alarms and LEDs press reset key ⓒ. Excepted are alarms assigned to latched output relays or the Trip output relay 1.
Clear All Alarms	To clear stored alarms and illuminated LEDs press reset key ⓒ.

1) The selected operating modes of the alarms must be considered (see below).
2) Can only be cleared manually.

NOTE: The setting of the following operating modes will determine the characteristics of the alarms:

- Starting signals can be set to have a "self updating" behaviour (see submenu **LOCAL INDICATION: Inst.self reset**). Otherwise they will have a "storing" behaviour.
- The operating mode **Reset on fault** can be set to clear stored alarms and illuminated LEDs (see submenu **LOCAL INDICATION: Reset on fault**). Otherwise clearing alarms and illuminated LEDs must be done manually.

10. MATERIAL ALARMS ISSUED BY THE INTERNAL MONITORING

HARDWARE ALARMS	Hardware alarms are displayed automatically when at least one material alarm is detected by the internal monitoring. Individual hardware alarm signals can be selected for display by pressing the record key 📖.
CLOCK ERROR	Internal clock has failed. (minor material alarm)
RAM ERROR	Error of non-volatile RAM detected. (minor material alarm)
BATTERY FAIL	Insufficient battery voltage detected. (minor material alarm)
EEPROM ERROR DATA	Checksum error detected in data memory area of EEPROM. (major material alarm)
DEFAULT SET-TINGS	Loss of parameter settings because of reset to default. (major material alarm)
EEPROM ERROR CALIBR.	Checksum error detected in calibration data memory area of EEPROM. (major material alarm)
ANA ERROR	Fault detected in processing line of analogue input channels or internal voltages. (major material alarm)
RELAYS ERROR	Fault detected in control circuit to output relay. (major material alarm)

Communication

CONTENTS

1. MODBUS PROTOCOL

This protection device features a MODBUS™ RTU data transmission link by using the optional communication interface equipped with either RS485 or fibre optic communication hardware. The MODBUS communication characteristics supported by the protection device are described in this document. But this document can not be seen as an alternative to the careful study of specific documentation pertaining to the operation of a data link utilizing the MODBUS™ protocol.

1.1 MODBUS communication characteristics

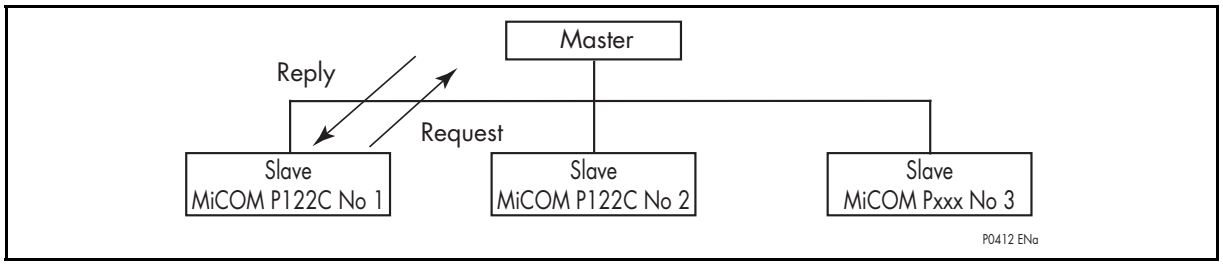
1.1.1 MODBUS network characteristics

The MODBUS protocol is based on a master-slave principle with the protection device as the slave device.

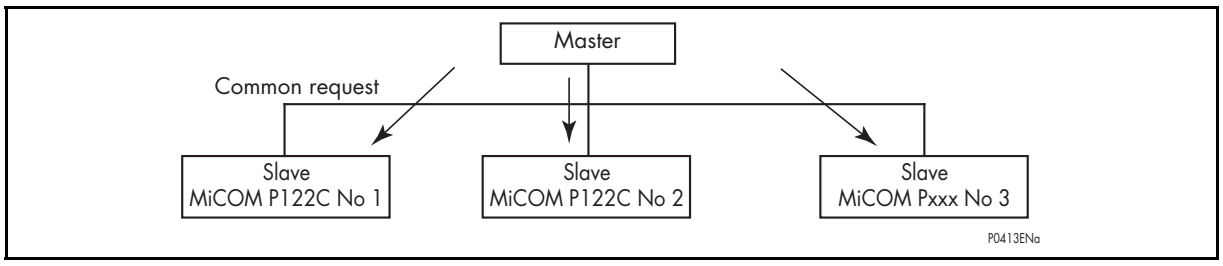
The MODBUS protocol allows a master device to read and to write data bit by bit or word by word and to access the event recordings in the slave device.

Access to the network can be:

– either by a request for data / receive data procedure



– or by a broadcast message sent simultaneously by the master to all slaves.



In this case

– the broadcast message is a compulsory write order,

– there is no response from the slaves,

– the protocol is in RTU mode. Each byte of the data frame is hexadecimal encoded.

– 2 bytes CRC16 check sum for the complete frame content are attached to the end of each data frame.

1.1.2 Parameters for the MODBUS connection

The parameters and characteristics for the MODBUS connection are as follows:

– Shielded twisted pair RS485 (2 kV, 50 Hz) or fibre optic communication connection;

– MODBUS line protocol in RTU mode;

– The baud rate is set from the local control panel on the protection device:

Baud Rate
300
600
1200
2400
4800
9600
19200
38400

– The transmission mode is configured from the local control panel by setting the parity and number of stop bits:

Transmission mode
1 start / 8 bits / 1 stop: total 10 bits
1 start / 8 bits / even parity / 1 stop: total 11 bits
1 start / 8 bits / odd parity / 1 stop: total 11 bits
1 start / 8 bits / 2 stop: total 11 bits

1.1.3 Synchronisation of message exchanges

Any character received after a silence on the line of more than or equal to a transmission time of 3 bytes is considered as a frame start.

1.1.4 Message validity check

The validation of a frame is performed with a 16-bit cyclical redundancy check (CRC).
The generator polynomial is:

$1 + x^2 + x^{15} + x^{16}$ = 1010 0000 0000 0001 binary = A001h

1.1.5 Address of protection device with MODBUS communication

In order to integrate a protection device into a control and monitoring system, the address must be set from the local control panel. The address may be selected from the range of 1 to 255. The address 0 is reserved for broadcast messages.

1.2 MODBUS functions available in the protection device

Protection device data may be read or modified by using function codes. Following are the available function codes. Function codes to read from or write into parameter cells in the protection device are described in the following.

The MODBUS functions implemented in the protection device are:

	Designation	***MODBUS Descriptor***
Function 1 or 2:	Reading of n bits	*01 Read Coil status* *02 Read Input Status*
Function 3 or 4:	Reading n words	*03 Read Holding Registers* *04 Read Input Registers*
Function 5:	Writing 1 bit	*05 Force Single Coil*
Function 6:	Writing 1 word	*06 Preset Single Register*
Function 7:	Fast reading of 8 bits	*07 Read Exception Status*
Function 8:	Reading of the diagnostics counters	*08 Diagnostics*
Function 11:	Reading of the event counter	*11 Fetch Comm Event Ctr*
Function 15:	Writing n bits	*15 Force Multiple Coil*
Function 16:	Writing n words	*16 Preset Multiple Regs*

1.3 Description of the MODBUS protocol

MODBUS is a master-slave protocol where every exchange involves a master devices request for data and a slave devices response with data.

1.3.1 Frame size received by the protection device (slave)

Frame transmitted by the master (request for data):

Slave address	Function code	Data	CRC16
1 byte	1 byte	n bytes	2 bytes

Slave address:

The slave address is in the range from 1 to 255.

Function code:

Requested MODBUS function (1 to 16).

Data:

Contains the values from the requested MODBUS register.

CRC16:

CRC16 value calculated by the master.

NOTE: The protection device does not respond to globally broadcast frames sent out by the master.

1.3.2 Format of frames transmitted by the protection device

Frame transmitted by the protection device (response):

Slave address	Function code	Data	CRC16
1 byte	1 byte	n bytes	2 bytes

Slave address:

The slave address is in the range from 1 to 255.

Function code:

Processed MODBUS function (1 to 16).

Data:

Contains the response data to the masters request for data.

CRC16:

CRC16 value calculated by the slave.

1.3.3 Message validity check

When the slave receives a request for data from the master, it validates the frame:

- If the CRC is incorrect, the frame is discarded as invalid. The slave does not reply to the request for data. The master must retransmit its request for data. With the exception of a broadcast message, this is the only case where the slave does not reply to a request for data from the master.
- If the CRC is correct but the slave can not process the request for data, it sends an exception response to the master.

Exception frame sent by the protection device (response):

Slave address	Function code	Error code	CRC16
1 byte	1 byte	1 byte	2 bytes

Slave address:

The slave address is in the range from 1 to 255.

Function code:

The function code returned by the slave in the exception response frame is the code in which the most significant bit (bit 7) is forced to 1.

Error code:

Among the 8 exception codes of the MODBUS protocol, the protection device manages two:

- Code 01: Function code unauthorised or unknown.
- Code 03: A value from the data field is unauthorised (incorrect code).
  - Control of data being read.
  - Control of data being written.
  - Control of data address.
  - Length of request for data message.

CRC16:

The CRC16 value is calculated by the slave.

1.4 Description of the MODBUS function code content

1.4.1 Function code 03 - Read holding registers

Function code 03 is used to read binary and analogue data sets that have the attribute "read/write" or "read only" and to transmit events and disturbance recordings. A max. number of 120 analogue data sets can be read. When reading binary data, bundles of n·16 data sets must be requested. The max. for n is 120.

REQUEST FOR DATA	
Slave address	xx
Function	03
Starting address Hi	Register number of the 1st data set
Starting address Lo	minus basic register
No. of points Hi	Number of
No. of points Lo	data sets
CRC Lo	xx
CRC Hi	xx

RESPONSE WITH DATA	
Slave address	xx
Function	03
Byte count (data)	Number of data bytes
Data 1 Hi	Register content
Data 1 Lo	
...	
Data n Hi	
Data n Lo	
CRC Lo	xx
CRC Hi	xx

NOTE: The "Word address" used in sections 1.5 to 1.7 correspond with "Starting address" and "No. of points".

1.4.2 Function code 04 - Read input register

Function code 04 is used to read binary and analogue data sets that have the attribute "read/write" or "read only" and to transmit events and disturbance recordings. When a read order is sent, a max. number of 120 analogue data sets can be read. When reading binary data, bundles of n·16 data sets must be requested. The max. for n is 120.

REQUEST FOR DATA	
Slave address	xx
Function	04
Starting address Hi	Register number of the 1st data set minus basic register
Starting address Lo	(Word address)
No. of points Hi	Number of
No. of points Lo	data sets
CRC Lo	xx
CRC Hi	xx

RESPONSE WITH DATA	
Slave address	xx
Function	04
Byte count (data)	Number of data bytes
Data 1 Hi	Register content
Data 1 Lo	
...	
Data n Hi	
Data n Lo	
CRC Lo	xx
CRC Hi	xx

1.4.3 Function code 06 - Preset single register

Function code 06 is used to write analogue data sets that have the attribute "read/write" and to confirm the transmission of events and disturbance recordings.

REQUEST FOR DATA	
Slave address	xx
Function	06
Register address Hi	Register number of the data set minus basic register
Register address Lo	(Word address)
Preset data Hi	xx
Preset data Lo	xx
CRC Lo	xx
CRC Hi	xx

RESPONSE WITH DATA	
Slave address	xx
Function	06
Register address Hi	Register number of the data set minus basic register
Register address Lo	(Word address)
Preset data Hi	xx
Preset data Lo	xx
CRC Lo	xx
CRC Hi	xx

1.4.4 Function code 16 - Preset multiple registers

Function code 16 is used to synchronise the clock and to issue orders to transmit the information sets with the disturbance recordings.

REQUEST FOR DATA	
Slave address	xx
Function	16
Starting address Hi	Register number of the 1st data set minus basic register
Starting address Lo	(Word address)
No. of registers Hi	Number of registers
No. of registers Lo	
Byte count	xx
Data 1 Hi	Register content
Data 1 Lo	
...	
Data n Hi	Register content
Data n Lo	
CRC Lo	xx
CRC Hi	xx

RESPONSE WITH DATA	
Slave address	xx
Function	16
Starting address Hi	Register number of the 1st data set minus basic register
Starting address Lo	(Word address)
No. of registers Hi	Number of registers
No. of registers Lo	
CRC Lo	xx
CRC Hi	xx

1.4.5 Function code 15 – Force multiple coils

Function code 15 is used to transmit bit frames (On/Off information from data points). The message can be made up of any number of bytes. The most significant byte contains the least significant bit and is transmitted as the first data byte. Each least significant bit is placed on the LSB position in the byte.

REQUEST FOR DATA	
Slave address	xx
Function	15
Coil address Hi	Address of the least significant bit
Coil address Lo	(Word address)
Quantity of coils Hi	Number of bit data
Quantity of coils Lo	
Byte count	xx
Force data Hi	Register content
Force data Lo	
CRC Lo	xx
CRC Hi	xx

RESPONSE WITH DATA	
Slave address	xx
Function	15
Starting address Hi	Address of the least significant bit
Starting address Lo	(Word address)
Quantity of coils Hi	Number of bit data
Quantity of coils Lo	
CRC Lo	xx
CRC Hi	xx

1.5 MODBUS request definition used to retrieve disturbance records (Function code 03)

To retrieve a disturbance record, the following requests must be sent in the exact given order:

1. (optional): Request for the number of disturbance records available in the NV RAM (= non volatile RAM).
2. To retrieve the data of one channel:
   - 2a) (compulsory): Sending a service request specifying the record number and the channel number which are to be retrieved.
   - 2b) (compulsory): Requests to retrieve the data of a disturbance record channel as often as is necessary.
   - 2c) (compulsory): Request to retrieve the index frame.
3. Repeat the same operation as described in item 2 for each channel.

1.5.1 Request number of disturbance records available in the NV RAM.

Slave address	Function code	Word address	Word number	CRC
xx	03h	3Dh 00	00 24h	xx.....xx

This request may be answered by an error message with the error code:

EVT_NOK (0F): No record available.

NOTE: If the number of records available is less than the maximum, that was specified for the protection device, the unused words in the response will be filled with zeros.

1.5.2 Service request

This service request shall be sent previous to the retrieval of the sampled data from a disturbance record channel. It allows to specify the record number and the channel number which are to be retrieved. This service request also makes available the number of samples in the channel.

Slave address	Function code	Word address	Word number	CRC
xx	03h	Refer to "Telegram Documentation"	00 0Bh	xx.....xx

This request may be answered by an error message. Two error codes are possible:

CODE_DEF_RAM (02): NV RAM failure

CODE_EVT_NOK (03): NV RAM has no disturbance record available.

1.5.3 Request to retrieve data of a disturbance record channel

Slave address	Function code	Word address	Word number	CRC
xx	03h	Refer to "Telegram Documentation"	1 to 7Dh	xx.....xx

This request may be answered by an error message. Two error codes are possible:

CODE_DEP_DATA (04): The requested sample number is greater than the number of samples in the specified channel.

CODE_SERV_NOK (05): The record number and the channel number have not been specified by a service request.

NOTE: This type of request can retrieve up to125 words. A sample is encoded as one word (16 bits).

1.5.4 Request to retrieve an index frame

Slave address	Function code	Word address		Word number		CRC
xx	03h	22h	00	00	07h	xx.....xx

This event record request may be answered by an error message with the error code:

CODE_SERV_NOK (05): The record number and the channel number have not been specified by a service request.

1.6 MODBUS request definition used to retrieve event records (Function code 03)

Two ways can be followed to retrieve an event:

1. Request to retrieve oldest non-acknowledged event
2. Request to retrieve a specific event

1.6.1 Request to retrieve oldest non-acknowledged event

Slave address	Function code	Word address		Word number		CRC
xx	03h	36h	00	00	09h	xx.....xx

This event record request may be answered by an error message with the error code:

EVT_EN_COURS_ECRIT (5): An event is just being written to the NV RAM.

NOTE: On event record retrieval, two possibilities exist regarding event acknowledgement:
a) Automatic event acknowledgement on event record retrieval.
b) Non-automatic event acknowledgement on event record retrieval.

a) Automatic event acknowledgement on event record retrieval:

Bit 12 of this remote control frame (format F9 – mapping address 0400h) is set to 0. On event record retrieval, this event is acknowledged.

b) Non-automatic event acknowledgement on event record retrieval:

Bit 12 of this remote control frame (format F9 – mapping address 0400h) is set to 1. On event record retrieval, this event is not acknowledged.

To acknowledge this event, a further remote control order must be sent to the slave. Bit 13 of this remote control order frame (format F9 – mapping address 0400h) is set to 1.

1.6.2 Request to retrieve a specific event record

Slave address	Function code	Word address	Word number	CRC
xx	03h	Refer to "Telegram Documentation"	00 09h	xx.....xx

This event record request may be answered by an error message with the error code:

EVT_EN_COURS_ECRIT (5): An event is just being written to the NV RAM.

NOTE: This event record retrieval does not acknowledge this event.

1.7 MODBUS request definition used to retrieve fault records (Function code 03)

Two ways can be followed to retrieve a fault record (fault record with Trip order):

1. Request to retrieve oldest non-acknowledged fault record
2. Request to retrieve a specific fault record

1.7.1 Request to retrieve oldest non-acknowledge fault record

Slave address	Function code	Word address	Word number	CRC
xx	03h	3Eh 00	00 0Fh	xx.....xx

NOTE: On fault record retrieval, two possibilities exist regarding fault acknowledgement:
a) Automatic fault acknowledgement on fault record retrieval
b) Non-automatic fault acknowledgement on fault record retrieval

a) Automatic fault acknowledgement on fault record retrieval:

Bit 12 of this remote control frame (format F9 – mapping address 0400h) is set to 0. On fault record retrieval, this fault is acknowledged.

b) Non-automatic fault acknowledgement on fault record retrieval:

Bit 12 of this remote control frame (format F9 – mapping address 0400h) is set to 1. On fault record retrieval, this fault is not acknowledged.

To acknowledge this fault, a further remote control order must be sent to the slave. Bit 14 of this remote control frame (format F9 – mapping address 0400h) is set to 1.

1.7.2 Request to retrieve a specific fault record

Slave address	Function code	Word address	Word number	CRC
xx	03h	Refer to "Telegram Documentation"	00 0Fh	xx.....xx

NOTE: This fault record retrieval does not acknowledge this fault.

2. PROTOCOL IEC 60870-5-103

This protection device features an IEC 60870-5-103 data transmission link by using the optional communication interface equipped with either RS485 or fibre optic communication hardware. The following document mainly describes the specific manufacturer definitions in the frame of the IEC 60870-5-103 which are, in general, supported by the protection device. This document can not be seen as an alternative to the careful study of the standard IEC 60870-5-103 and of references listed therein.

2.1 Protocol characteristics

The protocol is based on a master-slave principle with the protection device as the slave device. Communication between master and slaves is controlled by addresses. The message format defined in the standard IEC 60870-5-103 enables the exchange of compatible range data and private range data. The data exchange supports these features:

- Commands sent from the master to a slave,
- Transmission of spontaneous signals from slaves to the master,
- Transmission of disturbance data from slaves to the master,
- Transmission of measurands from slaves to the master,
- Transmission of buffer content from slaves to the master (only private range),
- Transmission of broadcast messages from the master sent to all slaves (e.g. clock synchronisation).

2.1.1 Parameters for the communication interface

These parameters are to be set for the communication interface:

- **Baud Rate**
- Communications address

  Station address = **Relay Addr.(CU)** = Octet Comm Address

  Relay address = **Relay Addr.(PU)** = Common Address of ASDU
- Message format
  - **Parity** = **Without** or **Even** or **Odd**
  - permanently set are
    8 data bits and 1 stop bit

  The normal setting according to the standard is 8E1 = 8 data bit, even parity, 1 stop bit.
- **Command Block.**
  The command blocking should be deactivated, so that the protection device will not reject commands received from the communication interface.
  (**Command Block.** = **No**)
- **Signals/MeasuresBlock.**
  The signals and measured values blocking should be deactivated, so that the protection device can send spontaneous signals and cyclic measured values over the communication interface.
  (**Signals/Measures Block.** = **No**)

- **Connect. RS485**
  This parameter cell should be set if a communication link with twisted pair wires is used.
  The parameters cell can be set to either **2 Wires** or **4 Wires** depending on the electrical communication link.

- **Line idle state**
  This parameter cell should be set, if a fibre optic communication data link is installed. Master and slave have to be set to the same line idle state. The line idle state is set to High ("1") = **Light On** or **Light Off**.

2.1.2 Slave addresses

The slave addresses are in the range from 1 to 254. The address 255 is reserved for the broadcast message.

2.1.3 Communication rules

The protocol controls the communication based on the master-slave principle. A slave can only send data, if it has received a request for data from the master. The message format FT1.2 and the transmission link procedure are defined in the standard IEC60870-5-103 and associated documentation. In the compatible range section the standard lists rules and designations, that are valid irrespective of manufacturer or device design. The private range allows access to identify information valid only for a specific protection device or an equipment range. In general the data logged by the protection device and selected for transmission is subdivided into two priority classes. Data with high priority, class 1 data, are all spontaneous signals issued by the protection device during process monitoring and by operator control operations. Data with low priority, class 2 data, are all cyclic measured values.

General rules and definitions are described in the relevant documentation of the standard, and are not pursued here any further.

2.1.4 Data content in the compatible range

Which signals and procedures, defined by the standard are supported by the protection device, can be found in the section "List of signals".

Commands defined in the standard are:

- Request for class 1 data
- Request for class 2 data
- Spontaneous signals
- Individual commands, e.g. change setting group
- General interrogation
- Transmission of disturbance data
- Transmit compatible measured values

2.1.5 Data content in the private range

In order to support specific functions provided by a protection device, the standard IEC 60870-5-103 specifies ranges of identifiers to define private messages. Definitions of these messages are described in the document "Communication Architecture (ACA), Part 4: Communication based on IEC 60870-5-103". Messages read from and written into parameter cells and messages with cyclic measured values from the protection device are described in the following.

To transmit data from specific functions provided by the protection device, and not defined by the standard IEC 60870-5-103, function bytes and information numbers have been issued according to private range specification of the standard (see section "Telegram Documentation").

2.2 IEC protocol messages

The message format FT1.2 (see IEC 60870-5-2), as defined by the standard IEC 60870-5-103, identifies three message types:

- frame with fixed length
- frame with variable length
- single character E5H designated “Acknowledge”

2.2.1 Frames with fixed length

A frame with a fixed length is used to control the communication link. Both master and slave send such frames. The control direction and the function of the link layer accessed are made available by the control field of this frame. This control field is also used, with the same context and encoding, by the frames with variable length. Transmission functions are invoked and the communication link is controlled by semaphores in order to eliminate loss of data and duplicate signals.

Start 10H	
Control field	see IEC 60870-5-2, section 5.1.2
Station address	"Octet Comm Address" = **Relay Addr.(CU)** (communication unit)
Check sum	determined from: control field + station address + ASDU
End 16H	

2.2.2 Frames with variable length

Frames with variable length are used to send commands and to transmit all signals and data recorded by the protection device.

Message frame		**Start 68H**	
		Length in hex	determined from: control field + station address + ASDU
		Length in hex	(repetition of length)
		Start 68H	
	Link User Data	**Control field**	see IEC 60870-5-2, section 5.1.2
		Station address	"Octet Comm Address" = **Relay Addr.(CU)** (communication unit)
		ASDU	see below
Message frame		**Check sum**	determined from: control field + station address + ASDU
		End 16H	

Each line is made up of an octet = one byte.

2.2.3 Structure of an application service data unit = ASDU

Application Service Data Unit (ASDU)	*Data Unit Identifier*	*Data Unit Type*	**Type identification**	TYP	
			Variable structure qualifier	VSQ	
			Cause of transmission	COT	
			Common address of ASDU	ADR	"Octet Comm Address" = **Relay Addr.(PU)** (processing unit)
	Information object	*Information Object Identifier*	**Function type**	FUN	or matrix point y-value
			Information number	INF	or matrix point x-value
			Set of information elements		"Data" to be transported
			Information object time tag		

Each line is made up of an octet = one byte.

2.2.4 Exceptions in the private range

Under certain conditions a command from the compatible range or the private range may not be carried out by the protection device. In such a case the command is rejected and a rejection message is sent back. There are no detailed signal codes defined in the standard for such a case. In order to provide a reason for the rejection, a message structure (ASDU) and certain signal codes are defined in the private range. They are described in the document "Communication Architecture (ACA), Part 4: Communication based on IEC 60870-5-103" and "List of Causes of Rejections", file: XXFKT46A_EN.PDF.

2.2.5 Commands in the private range

Read parameter cell value

Direction: Control direction

Structure of telegram: Read parameter cell

Byte values	**Description**
8CH	TYP
81H	VSQ
00H	COT
Common address of ASDU	ADR
00H ... FFH	FUN or y-component of the PID
00H ... FFH	INF or y-component of the PID

The protection device then sends the current value from the parameter cell given in the command message.

The reply is only sent, if **Command Block.** and **Signals/MeasuresBlock.** are both set to **No**. If **Command Block.** or **Signals/MeasuresBlock.** are set to **Yes**, the protection device replies with a reject message (see “Exceptions in the private range”).

The protection device may also reply with a message with definite length and/or reject the command.

The command is carried out, regardless of the test mode.

Write parameter cell value

Direction: Control direction

Structure of telegram: Write binary parameter cell value ASDU 232

Byte values	**Description**
E8H	TYP
81H	VSQ
00H	COT
Common address of ASDU	ADR
00 ... FFH	FUN or y-component of the PID
00 ... FFH	INF or y-component of the PID
01H / 02H	DCO = UI2 [1..2] <1,2>
00H	

DCO = Double command
DCO = 01H: disable
DCO = 02H: enable

Direction: Control direction

Structure of telegram: Write analogue parameter cell value ASDU 144

Byte values	**Description**
90H	TYP
81H	VSQ
00H	COT
Common address of ASDU	ADR
00 ... FFH	FUN or y-component of the PID
00 ... FFH	INF or y-component of the PID
Value low	Value
Value high	

The analogue value is equal to the slaves parameter cell value.

The protection device then sends the current value from the parameter cell given in the command message, with the pre-determined message and according to the "Telegram Documentation", as confirmation of receipt of command.

The reply is only sent, if **Command Block.** and **Signals/MeasuresBlock.** are both set to **No**. If **Command Block.** or **Signals/MeasuresBlock.** are set to **Yes**, the protection device replies with a reject message (see "Exceptions in the private range").

The protection device may also reply with a message with definite length and/or reject the command.

The command is carried out, regardless of the test mode.

Transmitting a binary signal

Direction: Monitor direction

Structure of telegram: Binary signal ASDU 105

Byte values	**Description**
69H	TYP
81H	VSQ
xxH	COT see IEC 60870-5-103 table 5 or below
Common address of ASDU	ADR
00 ... FFH	FUN or y-component of the PID
00 ... FFH	INF or y-component of the PID
01H / 02H	DPI = UI2 [1..2] <1,2>
00H	
msLow	Time tag in the format CP32Time2a (see IEC 60870-5-4)
msHigh	
IV 0 mmmmmm	
SU 00 hhhhh	

COT = (private range)
45H – remote setting of parameter cell via communication interface
46H – operator setting from local control panel;
7FH – operator setting via PC interface.

DPI = double point information
DPI = 01H: OFF
DPI = 02H: ON

Transmitting an analogue value with time tag

Direction: Monitor direction

Structure of telegram: Analogue value with time tag ASDU 17

Byte values	**Description**
11H	TYP
81H	VSQ
xxH	COT see IEC 60870-5-103 table 5 or below
Common address of ASDU	ADR
00 ... FFH	FUN or y-component of the PID
00 ... FFH	INF or y-component of the PID
Value low	Value
Value high	
msLow	Time tag in the format CP32Time2a (see IEC 60870-5-4)
msHigh	
IV 0 mmmmmm	
SU 00 hhhhh	

PID = Parameter identification, parameter address

ms = milliseconds

IV = invalid; shows if time stamp is subject to clock synchronisation

mmmmmm = 6 digit hex decimal number to indicate minutes

SU = daylight saving time flag; SU = 1: time indication for daylight saving time

hhhhh = 6 digit hex decimal number to indicate hours

COT = (private range)
45H – remote setting of parameter cell via communication interface
46H – operator setting from local control panel;
7FH – operator setting via PC interface.

2.2.6 Cyclic measured values

Cyclic measured values are transmitted with the ASDU 3 (ASDU 3.1 ... 3.4) or ASDU 9, depending on the protection device settings of the parameter cells.

Depending on the protection device settings, a set of measurands may also be configured in the private range, or it is possible to have a predefined set of measurands transmitted. The arrangement of the measurands in the telegram in the private range is documented in section "Measurands in the private range".

Measurands per IEC 60870-5-103

Direction: Monitor direction

Structure of telegram: Cyclic measured values ASDU 3

Byte values	**Description**
03H	TYP
01H ... xxH	VSQ: Number of information elements
02H	COT see IEC 60870-5-103 table 5: cyclic transmission
Common address of ASDU	ADR
x0H	FUN see IEC 60870-5-103 chapter 7.2.5.1
see below	INF see IEC 60870-5-103 table 14, Type 3.1...3.4
Measured value Low	CP16 {OV, ER, RES, MVAL} per IEC 60870-5-4
Measured value High	
...	

Type of measured value message	**INF dec**	**INF hex**	**VSQ**	**Measured values sequence in the message**
3.1	144	90H	01H	I
3.2	145	91H	02H	I, V
3.3	146	92H	04H	I, V, P, Q
3.4	147	93H	02H	I_N, V_{N-G}

Direction: Monitor direction

Structure of telegram: Cyclic measured values ASDU 9

Byte values	**Description**
09H	TYP
09H	VSQ: Number of information elements
02H	COT see IEC 60870-5-103 table 5: cyclic transmission
Common address of ASDU	ADR
x0H	FUN see IEC 60870-5-103 section 7.2.5.1
94H	INF
Measured value Low	Current L_1
Measured value High	
Measured value Low	Current L_2
Measured value High	
Measured value Low	Current L_3
Measured value High	
Measured value Low	Voltage L_{1-E}
Measured value High	
Measured value Low	Voltage L_{2-E}
Measured value High	
Measured value Low	Voltage L_{3-E}
Measured value High	
Measured value Low	Active power P
Measured value High	
Measured value Low	Reactive power Q
Measured value High	
Measured value Low	Frequency f
Measured value High	

All measurements are transmitted as CP16 {OV, ER, RES, MVAL} per IEC 60870-5-4.

Numbers format CP16 - Compound information element 16 bits
see IEC 60860-5-4

As an alteration of the original definition the standard IEC 60870-5-103 stipulates that bit 3, e.g. the valence 2^{-13}, is to be masked, i.e. bit 3 is always zero. Therefore the values range is changed to:

$(-1) \ldots (+1 - 2^{-12})$

Written as a binary number:

Bit:	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*
	S	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	RES	ERROR	OVER-FLOW
		MVAL												0		
		MSB												LSB		
	High - Byte								Low - Byte							

MSB = Most significant bit
LSB = Least significant bit
Sign S = bit 8
MVAL = bit 7 ... bit 4;
RES = bit 3
Error = bit 2
Overflow = bit 1

As defined in IEC 60870-5-103, section 7.2.6.8 the maximum of a measured value is either ±1.2 times or ±2.4 times the rated value. The multiplication factor is – in principle – determined separately for each measured value.

For this protection device the multiplication factor is defined in section "List of signals".

For a simplified calculation of a measured value the following procedure may be applied:

- A measured value is valid when neither the ERROR bit nor the OVERFLOW bit are set.
- The RES bit must be zero.
- The measured value MVAL is shifted by 3 bits to the right, and the now empty bits are set to zero; the sign remains the same.
- The new value obtained is interpreted as an integer and divided by 4096 to determine the actual measured value to be transmitted, and which will lie in the range as given in the above table. As a result a measured value –1 or ±0.xxx is obtained.

or

- The complete measured value in the message is interpreted as an integer, converted to a decimal number and then divided by 32768.
  (A division by 8 is carried out by shifting the measured value by 3 bits to the right.
  The second division by 4096 results in a total division by 8•4096 = 32768.)
- This resulting value is now multiplied by the multiplication factor, as defined for this measured value, and by the rated value of the measured variable.

As an example, the rated value is set to 1 A for a current (rated value of the CT as set in the protection device parameter cell).

The frequency value transmitted in the ASDU 9 is the rated value of the system frequency, as set in the protection device parameter cell.

For all other measured values the max. range value is to be set as the rated value for the parameter cell of the measured value to be transmitted. The max. range value can be identified from the documentation of parameters for the protection device.

Measurands in the private range

Measurands in the private range are transmitted with the ASDU 3. Number and sequence of individual measured values are governed by the protection device.

3. LIST OF SIGNALS

3.1 Communication interface per IEC 60870-5-103

This section is an exact copy of section 8 of the standard IEC 60870-5-103. The squares in the left hand column indicate features, information and functions as listed in the standard IEC 60870-5-103. Features, information and functions supported by this protection devices are marked by an X.

Abbreviations listed with parameters show their assignment to menu branches. Their designation is listed in a table at the end of this chapter.

3.2 Inter-operability

3.2.1 Physical layer

Electrical interface

x	EIA RS-485	
x	Number of loads	32 for one device

Note: EIA RS 485 defines the loads in such a manner, that 32 loads can be operated on one line. A detailed description can be found in the standard EIA RS-485, section 3.

Optical interface

x	Glass fibre	
x	Plastic fibre	
x	F-SMA type connector	for plastic fibre
x	BFOC/2.5 type connector	for glass fibre

Transmission speed

x	9 600 bit/s
x	19 200 bit/s

3.2.2 Link layer

No selection option is possible for the link layer.

3.2.3 Application layer

Transmission mode for application data

Mode 1 (least significant octet first) as defined in clause 4.10 of IEC 60870-5-4 is used exclusively in this companion standard.

Common address of ASDU

x	One COMMON ADDRESS of ASDU (identical to station address)
	More than one COMMON ADDRESS of ASDU

Selection of standard information numbers in monitor direction

System functions in monitor direction

	INF	Semantics
x	<0>	End of general interrogation
x	<0>	Time synchronisation
x	<2>	Reset FCB
x	<3>	Reset CU
x	<4>	Start / restart
	<5>	Power on

Status indication in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
	<16>	Auto-reclose active		
	<17>	Teleprotection active		
	<18>	Protection active		
x	<19>	LED reset	084 276	ALARM: Clear LED Alarms
x	<20>	Monitor direction blocked	084 281	COMM: Signals/Measures Block.
x	<21>	Test mode	084 289	COMM: Test Mode
x	<22>	Local parameter setting	084 278	MAIN: Local parameter setting
x	<23>	Characteristic 1	084 279	PSS: Group 1 Active
x	<24>	Characteristic 2	084 280	PSS: Group 2 Active
	<25>	Characteristic 3		
	<26>	Characteristic 4		
x	<27>	Auxiliary input 1	084 041	INP: Ext 1
x	<28>	Auxiliary input 2	084 048	INP: Ext 2
x	<29>	Auxiliary input 3	084 098	INP: Ext 3
x	<30>	Auxiliary input 4	084 099	INP: Ext 4

Monitoring signals in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
x	<32>	Measured supervision I	084 264	MCSUP: CT Failure
	<33>	Measured supervision V		
	<35>	Phase sequence supervision		
x	<36>	Trip circuit supervision	084 118	CBSUP: Trip Circ. Fail
	<37>	I>> back-up operation		
	<38>	VT fuse failure		
	<39>	Teleprotection disturbed		
x	<46>	Group warning	084 096	SFMON: Warning
x	<47>	Group alarm	084 089	SFMON: Watchdog

Earth fault indications in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
	<48>	Earth fault L_1		
	<49>	Earth fault L_2		
	<50>	Earth fault L_3		
	<51>	Earth fault forward, i.e. line		
	<52>	Earth fault reverse, i.e. busbar		

Fault indications in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
x	<64>	Start /pick-up L1	084 132	IP>: Phase A Start.
x	<65>	Start /pick-up L2	084 133	IP>: Phase B Start.
x	<66>	Start /pick-up L3	084 134	IP>: Phase C Start.
x	<67>	Start /pick-up N	084 275	IN>: Starting GF
x	<68>	General trip	--- ---	TRIP: Trip order
	<69>	Trip L1		
	<70>	Trip L2		
	<71>	Trip L3		
	<72>	Trip I>> (back-up operation)		
	<73>	Fault location X in ohms		
	<74>	Fault forward/line		
	<75>	Fault reverse/busbar		
	<76>	Teleprotection signal transmitted		
	<77>	Teleprotection signal received		
	<78>	Zone 1		
	<79>	Zone 2		
	<80>	Zone 3		
	<81>	Zone 4		
	<82>	Zone 5		
	<83>	Zone 6		
x	<84>	General start/pick-up	084 100	MAIN: General starting
x	<85>	Breaker failure	084 116	CBF: CB Fail
	<86>	Trip measuring system L1		

	INF	Semantics	Schneider Electric Designations Address	Descriptor
☐	<87>	Trip measuring system L2		
☐	<88>	Trip measuring system L3		
☐	<89>	Trip measuring system E		
x	<90>	Trip I>	084 145	IP>: tI>
x	<91>	Trip I>>	084 020	IP>: tI>>
x	<92>	Trip IN>	084 021	IN>: tIN>
x	<93>	Trip IN>>	084 022	IN>: tIN>>

Auto-reclose indications in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
☐	<128>	CB 'on' by AR		
☐	<129>	CB 'on' by long-time AR		
☐	<130>	AR blocked		

Measurands in monitor direction

	INF	Semantics	Schneider Electric Designations Address	Descriptor
x	<144>[1]	Measurand I	000 048/049	MEAS: $I_{A\ Rms}$
	<145>[2]	Measurands I, V		
	<146>[3]	Measurands I, V, P, Q		
x	<147>[4]	Measurands I_N, V_{EN}	000 054/055	MEAS: $I_{N\ Rms}$ not measured
x	<148>[5]	Measurands $I_{L1,2,3}$, $V_{L1,2,3}$, P, Q, f	000 048/049 000 050/051 000 052/053	MEAS: $I_{A\ Rms}$ MEAS: $I_{B\ Rms}$ MEAS: $I_{C\ Rms}$ not measured not measured not measured not measured not measured 000 062 MEAS: Frequency

Generic functions in monitor direction

	INF	Semantics
	<240>	Read headings of all defined groups
	<241>	Read values or attributes of all entries of one group
	<243>	Read directory of a single entry
	<244>	Read value or attribute of a single entry
	<245>	General interrogation of generic data
	<249>	Write entry with confirmation
	<250>	Write entry with execution
	<251>	Write entry abort

[1] Only when COMM: Transm.Enab. cycl. data is set at "*ASDU 3.1 per IEC*"
[2] Only when COMM: Transm.Enab. cycl. data is set at "*ASDU 3.2 per IEC*"
[3] Only when COMM: Transm.Enab. cycl. data is set at "*ASDU 3.3 per IEC*"
[4] Only when COMM: Transm.Enab. cycl. data is set at "*ASDU 3.4 per IEC*"
[5] Only when COMM: Transm.Enab. cycl. data is set at "*ASDU 9 per IEC*"

Selection of standard information numbers in control direction

System functions in control direction

	INF	Semantics
x	<0>	Initiation of general interrogation
x	<0>	Time synchronisation

General commands in control direction

			Schneider Electric Designations	
	INF	Semantics	Address	Descriptor
	<16>	Auto-recloser on/off		
	<17>	Teleprotection on/off		
	<18>	Protection on/off		
x	<19>	LED reset	084 260	ALARM: Clear LED Alarms
x	<23>[6]	Activate characteristic 1	001 009	PSS: Setting Group
x	<24>[7]	Activate characteristic 2	001 009	PSS: Setting Group
	<25>[8]	Activate characteristic 3		
	<26>[9]	Activate characteristic 4		

[6] Switches PSS: Select Setting Group to "Setting Group 1"
[7] Switches PSS: Select Setting Group to "Setting Group 2"
[8] Switches PSS: Select Setting Group to "Setting Group 3"
[9] Switches PSS: Select Setting Group to "Setting Group 4"

Generic functions in control direction

	INF	Semantics
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	General interrogation of generic data
☐	<248>	Write entry
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry abort

Basic application functions

x	Test mode
x	Blocking of monitor direction
x	Disturbance data
☐	Generic services
x	Private data

Miscellaneous

Measured values are transmitted with both ASDU 3 and ASDU 9. As defined in IEC 60870-5-103, section 7.2.6.8, the maximum MVAL can be either 1.2 or 2.4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Measured value	Max. MVAL = nom. value multiplied by		
	1.2	or	2.4
Current A			x
Current B			x
Current C			x
Voltage A-G			
Voltage B-G			
Voltage C-G			
Active Power P			
Reac. Power Q			
Frequency			x
Voltage A-B			

3.3 Measurands in the private range

In the private range the protection device transmits a measurand with a permanent list of measured values. The message ASDU 3 is used for transmission.

Function byte (FUN):	168	A8H
Information number (INF):	208	D0H

Measured values are entered in the message in sequence as listed in the following table:

Position in message	Parameter	Address	Nominal value	Factor
1.	MEAS: $I_{A\ Rms}$	000 048	0.00..4.00 E05 A	2.4
2.	MEAS: $I_{B\ Rms}$	000 050	0.00..4.00 E05 A	2.4
3.	MEAS: $I_{C\ Rms}$	000 052	0.00..4.00 E05 A	2.4
4.	MEAS: $I_{N\ Rms}$	000 054	High range: 0.00..1.20 E05 A Normal range: 0.00..2.40 E04 A Sensitive range: 0.00..2.40 E03 A	2.4
5.	MEAS: $I_{0\ Zero}$	000 137	High range: 0.00..4.00 E04 A Normal range: 0.00..8.00 E03 A Sensitive range: 0.00..8.00 E02 A	2.4
6.	MEAS: I1 Positive	000 076	0.00..4.00 E05 A	2.4
7.	MEAS: I2 Negative	000 074	0.00..4.00 E05 A	2.4
8.	MEAS: I_N - f_n	000 072	High range: 0.00..1.20 E05 A Normal range: 0.00..2.40 E04 A Sensitive range: 0.00..2.40 E03 A	2.4
9.	MEAS: Max Ph Current	000 141	0.00..4.00 E05 A	2.4
10.	MEAS: Rolling Average $I_{A\ Rms}$	000 097	0.00..4.00 E05 A	2.4
11.	MEAS: Rolling Average $I_{B\ Rms}$	000 099	0.00..4.00 E05 A	2.4
12.	MEAS: Rolling Average $I_{C\ Rms}$	000 101	0.00..4.00 E05 A	2.4
13.	MEAS: Thermal State	000 058	0..2500 %	2.4

3.4 Abbreviations used

Following are abbreviations used in above tables with listed parameters, so they may be associated to the menu tree.

Abbreviation	Menu / Submenu
ALARM	**ALARMS**
TRIP	**TRIP COMMAND**
MEAS	**MEASUREMENTS**
INP	**INPUTS**
MAIN	**GLOBAL SETTINGS**
IN>	**EARTH FAULT**
IP>	**SHORT-CIRCUIT**
COMM	**COMMUNICATION**
CBSUP	**CB SUPERVISION**
CBF	**CB FAILURE**
MCSUP	**CT SUPERVISION**
PSS	**SETTING GROUP SELECT**
SFMON	**HARDWARE ALARMS**

4. TELEGRAM DOCUMENTATION

Documentation pertaining to data messages is available as an Excel© file[10], and may be ordered separately.

[10] © Microsoft Corporation

Commissioning and Maintenance

CONTENTS

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1. SAFETY INSTRUCTIONS

The protection device must be reliably grounded before the auxiliary voltage is turned on.

The case is grounded using the appropriate bolt and nut on the mounting bracket as the ground connection. The cross section of this ground conductor must conform to applicable national standards. A minimum conductor cross section of 2.5 mm^2 is required.

Before working on the protection device itself or in the space where the protection device is connected, always disconnect the protection device from the supply.

The secondary circuit of operating current transformers must not be opened! If the secondary circuit of an operating current transformer is opened, there is the danger that the resulting high voltages will endanger people and damage the insulation.

The threaded terminal block for current transformer connection is not a shorting block. Therefore always short-circuit the current transformers before loosening the threaded terminals.

Continuous operation of the PC interface is not permitted. Consequently the socket does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101. Therefore when connecting the connecting cable make sure that you do not touch the socket contacts.

Application of analogue signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter “Technical Data“).

2. COMMISSIONING TESTS

2.1 Preparation

After the MiCOM P122C relay has been installed and connected as described in chapter "Installation and Connection", the commissioning procedure can begin.

Before turning on the power supply voltage, the following items must be checked again:

- Is the protection device connected to the protective ground at the specified location?
- Does the nominal voltage of the battery agree with the nominal auxiliary voltage of the protection device?
- Are the current transformer connections, grounding and phase sequences correct?

After the wiring work is completed, check the system to make sure it is properly isolated. The conditions given in VDE 0100 must be satisfied.

Once all checks have been made, the power supply voltage may be turned on. After voltage has been applied, the protection device starts up. During start-up, various start-up tests are carried out. The LED indicator labelled **Healthy** will be illuminated. After approximately 2 s the MiCOM P122C relay is ready for operation. This is indicated by the display of a measured value shown on the LCD.

Once the password has been entered, all settings can be performed. The procedure for entering settings from the local control panel is described in chapter "Control and Operation".

It is suggested that during the entry of settings for the MiCOM P122C relay, the operator enables the parameter cell **Maintenance mode** (menu **CONTROL/TESTING**) so as to deactivate all output relays.

If the operator wishes to use the PC interface to set the MiCOM P122C relay, readout records or measurements, he must first perform these settings from the local control panel:

- **Password** (submenu **GLOBAL SETTINGS**)
- **NB of inputs** (menu **OP PARAMETERS**)
- **Relay Addr.** (submenu **COMMUNICATION**) if the communication protocol according to MODBUS is used for the communication interface
- **Relay Addr. (CU)** (submenu **COMMUNICATION**) if the communication protocol according to IEC 60870-5-103 is used for the communication interface

The baud rate and the telegram format are predefined for the PC interface.

Depending on the communication protocol, if the operator wishes to use the optional communication interface to set the MiCOM P122C relay, readout records or measurements, he must first perform these settings in the submenu **COMMUNICATION** from the local control panel:

Communication protocol according to IEC 60870-5-103:

- **Communication**
- **Relay Addr. (PU)**
- **Baud Rate**
- **Parity**
- **Connect. RS485**
- **Line idle state**
- **Command Block.**
- **Signals/Measures Block.**

Communication protocol according to MODBUS:

- **Communication**
- **Baud Rate**
- **Parity**
- **Stop bits**
- **Connect. RS485**
- **Line idle state**
- **Date format**

NOTE:

– Displaying and activating the parameters of the 2 or 7 binary inputs depends on the setting in parameter cell **NB of inputs** (menu **OP PARAMETERS**).

– This parameter cell can only be set from the local control panel.

After the settings have been made, the following checks should be carried out again:

- Does the function assignment of the binary signal inputs agree with the terminal connection diagram?
- Has the correct operating mode been selected for the binary signal inputs?
- Does the function assignment of the output relays agree with the terminal connection diagram?
- Has the correct operating mode been selected for the binary output relays?
- Have all settings been performed correctly?

2.2 Tests

By using the signals and displays generated by the MiCOM P122C relay, it is possible to determine whether the protection device is correctly set and properly interconnected with the station. Signals are indicated by output relays, alarms and LEDs and are entered into the event records. In addition, the state of the binary inputs and relay outputs can be checked by selecting the appropriate signal (menu **OP PARAMETERS**).

The parameter cell **Maintenance mode** provides an useful tool for tests available to the operator. By enabling the maintenance mode all output relays are de-energized, so that their logic state is "**0**" and they are blocked. All functions of the MiCOM P122C relay still remain available, e.g. for testing. The operator can perform a test of a protection without accidentally energising an output relay. With the maintenance mode enabled the operator can manually energise the output relays by setting the parameter cell **Relays W7654321CMD** (submenu **GLOBAL SETTINGS**). The enabled maintenance mode is indicated by an alarm signal.

If during the test of a protection the circuit breaker is not to be energised, all output relays may be disabled by setting the parameter cell **Maintenance mode** (menu **CONTROL/TESTING**) to No. If during the test of a protection the circuit breaker is to be energised, a manual Trip order may be issued with the **Open Order** or the function keys F3 or F4. Using the local control panel to issue an order or the function keys is password protected (see chapter "Control and Operation").

NOTE: An open order by the function keys can only be issued if function key F3 or F4 has been assigned to the Trip order.

If the MiCOM P122C relay is connected to a substation control level using the communication protocol IEC 60870-5-103, it is advisable to enable the **Test Mode** (submenu **COMMUNICATION**) during the test of a protection. The telegrams are then identified accordingly (cause of transmission: test mode).

2.3 Checking the binary signal inputs

By selecting the corresponding state signal (menu **OP PARAMETERS**), it is possible to determine whether the signal present at the binary input is recognised correctly by the protection device. The values displayed show the following state:

"0": No voltage present.

"1": Voltage signal is present.

This display appears regardless of the mode selected for the binary signal input.

2.4 Checking the output relays

For test purposes it is possible to energise the output relays. The operator must first set the logic state of the output relays to "0" by disabling the maintenance mode (menu **CONTROL/TESTING**). With the parameter cell **Maintenance mode** enabled a manual test of each output relay can be performed by setting the parameter cell **Relays W7654321CMD** (submenu **GLOBAL SETTINGS**). Changing parameters is password protected (see chapter "Control and Operation").

Before starting the test, open any triggering circuits to external devices so that no inadvertent switching operations will take place.

2.5 Checking current measuring inputs

By applying appropriate analogue signals as measuring variables to the measuring inputs, the operator can check via the operating data displays (menu **MEASUREMENTS**) whether the MiCOM P122C relay detects the analogue signals with the specified accuracy.

IA Rms Sec: Display of the updated phase A current referred to the nominal protection device current I_{nom}

IB Rms Sec: Display of the updated phase B current referred to the nominal protection device current I_{nom}

IC Rms Sec: Display of the updated phase C current referred to the nominal protection device current I_{nom}

IN Rms Sec: Display of the updated residual current I_N referred to the nominal protection device residual current $I_{N,nom}$

Application of analogue signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter "Technical Data").

2.6 Checking the protection

Two setting groups with parameter subsets are stored in the MiCOM P122C relay, one of which is active. Before checking the protection, the operator should determine which setting group is active. The active setting group is displayed in the parameter cell **Active Group** (menu **OP PARAMETERS**).

When testing the MiCOM P122C relay with a testing device, the parameter cell **CT Superv** should be disabled (submenu **CT SUPERVISION**), since it would otherwise always operate and thus, depending on the setting, issue alarm signals.

2.6.1 Checking the overcurrent protection for phase and earth

Testing the overcurrent protection can only be carried out if the following conditions are met:

- The overcurrent stage to be tested must be enabled (submenus **SHORT-CIRCUIT** and **EARTH FAULT**).
- The parameter cell **General starting** (submenu **GLOBAL SETTINGS**) must be set to **w. IN/I2** so that the residual overcurrent stages can be considered.

The overcurrent stages and the associated time delays can be checked by applying appropriate analogue signals as measuring variables to the measuring inputs. With the operating mode set to inverse-time characteristic, the time delays are dependent on the tripping characteristic selected (see table with inverse-time characteristics in chapter "Control and Operation").

Application of analogue signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter "Technical Data").

2.6.2 Checking the unbalance protection

Testing the unbalance protection can only be carried out if the following conditions are met:

- The unbalance stage to be tested must be enabled (submenu **UNBALANCE**).
- The parameter cell **General starting** (submenu **GLOBAL SETTINGS**) must be set to **w. IN/I2** so that the unbalance stages can be considered.

The unbalance stages and the associated time delays can be checked by applying appropriate analogue signals as measuring variables to the measuring inputs. With the operating mode set to inverse-time characteristic, the time delays are dependent on the tripping characteristic selected (see table with inverse-time characteristics in chapter "Control and Operation").

Application of analogue signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter "Technical Data").

2.6.3 Checking the thermal overload function

The thermal overcurrent stage and the associated time delay can be checked by applying appropriate analogue signals as measuring variables to the measuring inputs. Testing can only be carried out if the following condition is met:

- The thermal overload function is enabled (submenu **THERMAL OVERLOAD**).

Application of analogue signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter "Technical Data").

The current status of the thermal replica can be displayed and cleared by accessing the measurement value cell **Thermal State** (menu **MEASUREMENTS**). In order to test the thermal overload function, the current status of the thermal replica must first be cleared. For the test run the thermal replica is first cleared and then test current is applied and increased in one step from 0 to a value according to the requirement as given below. The tripping time is given by this formula:

$$t = T_e \cdot \ln \frac{\left(\frac{I}{K \cdot I_{ref}}\right)^2}{\left(\frac{I}{K \cdot I_{ref}}\right)^2 - \theta_{trip}} \qquad \text{with the test current} \quad I > K \cdot I_{ref} \cdot \sqrt{\theta_{trip}}$$

2.7 Completion of commissioning

Before the MiCOM P122C relay is released for operation, the operator should make sure that the following steps have been taken:

- All memories have been reset.
  (**General Reset**, menu **CONTROL/TESTING**, carried out. Stored measured values, menus **MEASUREMENTS** and **CB MONITORING**, cleared)
- Latched Trip order and latched output relays are reset.
  (**Latch Relay Trip** and **Latch Relay** in alarms)
- Blocking of output relays has been cancelled by deactivation.
  (**Maintenance Mode**; menu **CONTROL/TESTING**, setting: No)
- Enable parameter cell **CT Superv**, if it was disabled for testing purposes.
  (**CT Superv**, submenu **CT SUPERVISION**, setting: Yes)

After completing commissioning work, only the green LED labelled **Healthy** should be illuminated and the LCD should not show any alarms.

The operator should also make sure that all test connections have been removed and the original wiring, according to the wiring scheme, has been restored.

3. TROUBLE SHOOTING

In the following possible problems, their causes and corrective measures are described. This is intended as a general orientation only and, if in doubt and to be on the safe side, the MiCOM P122C relay should be returned to the manufacturer. Please follow the instructions given in chapter "Installation and Connection" pertaining to unpacking and packing.

3.1 LC-Display and green LED labelled Healthy do not operate

The following testing procedure should be run:

- Check if the supply voltage is present at the protection device terminals (terminal 13 and 14).
- Check that the magnitude of the auxiliary voltage is correct. The MiCOM P122C relay is protected against damage resulting from polarity reversal.

Before continuing with further testing procedures, disconnect the power supply. Dangerous high voltage may be present in certain components positioned behind the local control panel!

- Check that both ends of the connecting cable between the input/output module and the processor module are plugged in (to gain access remove local control panel). Make sure the connector positions are correct. Do not bend the connecting cables!

3.2 Red LED labelled Warning illuminated

Identify the specific problem by reading out the internal monitoring signal memory; hardware alarms are automatically displayed on the LC-Display. The hardware alarms function considers minor material alarms and major material alarms.

3.2.1 Minor material alarms

When a minor material alarm is detected, the red LED **Warning** will light up continuously.

Minor material alarm	Designation	Corrective measure
CLOCK EROR	Internal clock has failed.	Set date and time
RAM ERROR	Error of non-volatile RAM detected.	Reset the material alarm using the reset order in the support software or by switching the aux power supply to the protection device off and on again; check battery
BATTERY ERROR	Insufficient battery voltage detected.	Check battery (discharged or improperly mounted)

All minor material alarms except **RAM ERROR** are continuously updated, i.e. the alarm is automatically reset when the cause is cleared.

3.2.2 Major material alarms

When a major material alarm is detected, LED 3 (**Warning**) will flash and the signal **Watchdog** is issued to the quiescent current output relay 8. The output relays 1 to 7 are deactivated, so that their state is "0" and they are blocked to prevent unwanted issuance of signals e.g. the Trip order.

Major material alarm	Designation	Corrective measure
EEPROM ERROR DATA	Checksum error detected in data memory area of the EEPROM	Restart the protection device and carry out parameter settings / ship MiCOM device back to Schneider Electric Services
DEFAULT SETTINGS	Loss of parameter settings because of reset to default	Carry out parameter settings
EEPROM ERROR CALIBR.	Checksum error detected in the calibration data memory area of the EEPROM	Ship MiCOM device back to Schneider Electric Services
ANA ERROR	Fault detected in processing line of analogue input channels or internal voltages	Restart the protection device / ship MiCOM device back to Schneider Electric Services
RELAYS ERROR	Fault detected in control circuit to output relay	Restart the protection device / ship MiCOM device back to Schneider Electric Services

All major material alarms, with the exception of **DEFAULT SETTINGS**, are stored and can only be reset by restarting the protection device (by switching the aux power supply off and on again) after the cause that provoked such major material alarms has been cleared.

When the major material alarm **EEPROM ERROR DATA** is issued, all parameter settings are reset to their default by restarting the protection device. When the protection device is restarted a second time the material alarm signal is reset but only, if the cause that provoked the material alarm is cleared. A reset of the parameter settings to their default because of an **EEPROM ERROR DATA** or an update of the protection software is displayed by the major material alarm signal **DEFAULT SETTINGS**. This major material alarm signal is automatically reset when the protection device parameter settings are carried out. Before the protection device is released for operation a complete and proper setting of all protection device parameter cells must be assured!

Should these corrective measures and a restart of the protection device not lead to a positive result as well as to the clearance of the fault(s), then the MiCOM device must be shipped back to Schneider Electric Services, including a report on the apparent fault(s). Please follow the instructions given in chapter "Installation and Connection" pertaining to unpacking and packing.

4. MAINTENANCE

The MiCOM P122C relay is a low maintenance device. The components used in the protection devices are selected to meet severe requirements. Recalibration is not necessary.

4.1 Battery

The MiCOM P122C relay is equipped with a lithium battery to provide non-volatile memory storage of event data and the uninterrupted internal clock operation should the power supply fail. It is suggested to replace the lithium battery after approximately 10 years of operation.

The lithium battery can be replaced without using a soldering iron. Maintenance work must be carried out by trained personnel only, and the auxiliary voltage must be turned off while the work is being performed.

The lithium battery is mounted on the processor module.

Dangerous high voltage may be present in certain components positioned behind the local control panel! The auxiliary voltage must be turned off before opening the protection device.

The processor module is connected to the input/output module by two plug-in connecting cables. Make sure the connector positions are correct. Do not bend the connecting cables!

To replace the lithium battery, only a type ½AA with 3.6V may be used.

4.2 Scheduled functional testing

The MiCOM P122C relay is used as a safety device and must therefore undergo scheduled functional testing. The first functional tests should be carried out approximately 6 to 12 months after commissioning. Additional functional tests should performed at intervals of two to three years - four years at the maximum.

The MiCOM P122C relay incorporates in its system a very extensive self-monitoring function for hardware and software. Nonetheless, there are a number of sub functions that cannot be checked by the self-monitoring feature without running a test from the protection device terminals. The respective protection device specific properties and setting parameters must be observed in such cases.

In particular, almost all of the control and signalling circuits, that are wired to the protection device from the outside, are not included in the check by the self-monitoring function, except the CB trip circuit which is continuously supervised.

It is suggested, that the counters for the summation of the current flow interrupted per phase and the total number of operations by Trip output relay 1 (submenu **CB MONITORING**) be blocked by enabling the parameter cell **Block. CB-Meas.** (menu **CONTROL/TESTING**), so as to prevent the counter values from being corrupted with data produced during a test run with testing equipment connected. This parameter cell must be disabled after maintenance is completed.

Before starting the test, open any triggering circuits to external devices or enable the parameter cell **Maintenance mode** so that no inadvertent switching operations will take place.

4.2.1 Analogue input circuits

In conjunction with the CT supervision, the protection device can in many cases detect deviations depending on the parameter settings for sensitivity. However, it is still necessary to perform tests from the protection device terminals in order to make sure that the analogue measuring circuits are functioning correctly.

The best way to carry out a static test of the analogue input circuits is to check the primary measured operating data accessible in the measurements cells (menu **MEASUREMENTS**) or to use suitable testing equipment.

An important factor in evaluating protection device performance is long-term performance behaviour based on a comparison with previous measurements.

Further tests of the analogue inputs are not necessary.

4.2.2 Binary inputs

The binary inputs are not checked by the self-monitoring function. However, a testing function is integrated into the software so that the state of each input can be read out (menu **OP PARAMETERS**). This check should be performed for each input being used and can be carried out, if necessary, without disconnecting any protection device wiring.

4.2.3 Binary outputs

With respect to binary outputs, the integrated self-monitoring function includes the energising of the relay coils of all the output relays. There is no monitoring function for the external contact circuit except the CB trip circuit. In this case, the output relays must be energised by way of protection device functions or integrated test functions. For these testing purposes, energising the output relays is integrated into the software through a special control function (menu **CONTROL/TESTING** and submenu **GLOBAL SETTINGS**).

4.2.4 PC interface and optional communication interface

The complete communication system, including the connecting link, is always totally monitored as long as a link is established through the support software or the communication protocol.

5. STORAGE

The protection devices must be stored in a dry and clean environment. A temperature range of –25°C to +70°C (–13°F to +158°F) must be maintained during storage (see chapter "Technical Data"). The relative humidity must be controlled so that neither condensation nor ice formation will result.

Setting Tables and Setting Sheets

CONTENTS

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1. SETTING TABLES AND SETTING SHEETS

1.1 Substation reference

Substation: _____

Bay designation: _____

1.2 Protection device data

MiCOM device type	P122C
P/O number	P122C-
F-number	F-
Inom	A~
IN,nom	A~
Vaux,nom	V
Communication protocol	
Language	

1.3 Menu OP PARAMETERS

Parameter	**Default**	**Values range**	**Setting**
Reference	AAAA	AAAA...9999	
NB of inputs	2	2 Inputs or 7 Inputs	
Date	01/01/94	00/00/00...31/12/99	
Time	00:00:00	00:00:00...23:59:59	

1.4 Menu CONFIGURATION

1.4.1 Submenu **GLOBAL SETTINGS**

Parameter	**Default**	**Values range**	**Setting**
Line CT primary	1000	1...9999 A	
Line CT sec	1	1 A or 5 A	
IN/Gnd CT primary	1000	1...3000 A	
IN/Gnd CT sec	1	1 A or 5 A	
Phase Sequence	A-B-C	A-B-C or A-C-B	
General starting	w. IN/I2	w. IN/I2 or w/o. IN/I2	
tGS	0.00	0.00...100.00 s	
Nom. Frequency	50 Hz	50 Hz or 60 Hz	
Password	AAAA	AAAA...ZZZZ	
Password F3,F4	AAAA	AAAA...ZZZZ	
tClose pulse	0.10	0.10...5.00 s	
tOpen pulse	0.10	0.10...5.00 s	
Relays CMD	00000000	00000000...11111111	
Function release	I>Funct.	Pos CB or I>Funct.	
I> fct.release	0.05	0.03..0.15 In	

1.4.2 Submenu **LOCAL INDICATION**

Parameter	Default	Values range	Setting
Default display	IB Rms	IA Rms IB Rms IC Rms IN Rms IA, B, C, N Therm St.	
Phase A Text	1	A / 1 / L1 / R	
Phase B Text	2	B / 2 / L2 / S	
Phase C Text	3	C / 3 / L3 / T	
E/Gnd Text	E	N / E / 0	
Inst.self reset	No	Yes or No	
Reset on fault	Yes	Yes or No	
Battery alarm	Yes	Yes or No	

1.4.3 Submenu **INPUTS**

Parameter	Default	Values range		Setting
Input 1	None	None	Trip Circ	
Input 2	None	Ext reset	Rst Leds	
Input 3	None	52a	Rst Latch	
Input 4	None	52b	Mod.Maint	
Input 5	None	CB Fail	BlockTher	
Input 6	None	Ext 1	Chang.Grp	
Input 7	None	Ext 2	Group 1	
		Ext 3	Group 2	
		Ext 4	Open Ord	
		BlockLog1	Close Ord	
		BlockLog2	Reset all	
		Dist Trig	Man.Close	
		C.L.S.	Test Mode	
		Log.Sel.1	Cmd Block	
		Log.Sel.2	Sg/Mea.Bl	
		θ Reset		
tExt 1	0.00	0.00...200.00 s		
tExt 2	0.00	0.00...200.00 s		
tExt 3	0.00	0.00...200.00 s		
tExt 4	0.00	0.00...200.00 s		

1.4.4 Submenu **INPUT MODE**

Parameter	Default	Values range	Setting
Inputs 1=H/0=L	1111111 11	0000000...1111111 for 7 inputs 00...11 for 2 inputs	
Voltage input	DC	AC or DC	

1.4.5 Submenu **OUTPUT RELAYS**

Selection	Default	Values range	Output relays setting					
			RL 7	RL 6	RL 5	RL 4	RL 3	RL 2
I>	No (0)	No or Yes (0/1)						
tI>	No (0)	No or Yes (0/1)						
I>>	No (0)	No or Yes (0/1)						
tI>>	No (0)	No or Yes (0/1)						
I>>>	No (0)	No or Yes (0/1)						
tI>>>	No (0)	No or Yes (0/1)						
IN>	No (0)	No or Yes (0/1)						
tIN>	No (0)	No or Yes (0/1)						
tIN> int.	No (0)	No or Yes (0/1)						
IN>>	No (0)	No or Yes (0/1)						
tIN>>	No (0)	No or Yes (0/1)						
IN>>>	No (0)	No or Yes (0/1)						
tIN>>>	No (0)	No or Yes (0/1)						
tI<	No (0)	No or Yes (0/1)						
I2>	No (0)	No or Yes (0/1)						
tI2>	No (0)	No or Yes (0/1)						
I2>>	No (0)	No or Yes (0/1)						
tI2>>>	No (0)	No or Yes (0/1)						
Therm Trip	No (0)	No or Yes (0/1)						
Therm Alarm	No (0)	No or Yes (0/1)						
Trip Circ. Fail	No (0)	No or Yes (0/1)						
CB Oper NB	No (0)	No or Yes (0/1)						
Sum A n	No (0)	No or Yes (0/1)						
CB Open Time	No (0)	No or Yes (0/1)						
CB Close Time	No (0)	No or Yes (0/1)						
CB Fail	No (0)	No or Yes (0/1)						
Close Order	No (0)	No or Yes (0/1)						
Trip Order	No (0)	No or Yes (0/1)						
tExt 1	No (0)	No or Yes (0/1)						
tExt 2	No (0)	No or Yes (0/1)						
tExt 3	No (0)	No or Yes (0/1)						
tExt 4	No (0)	No or Yes (0/1)						
Group 2 Active	No (0)	No or Yes (0/1)						
Group 1 Active	No (0)	No or Yes (0/1)						
FB F3	No (0)	No or Yes (0/1)						
FB F4	No (0)	No or Yes (0/1)						
Input 1	No (0)	No or Yes (0/1)						
Input 2	No (0)	No or Yes (0/1)						
Input 3	No (0)	No or Yes (0/1)						
Input 4	No (0)	No or Yes (0/1)						
Input 5	No (0)	No or Yes (0/1)						
Input 6	No (0)	No or Yes (0/1)						
Input 7	No (0)	No or Yes (0/1)						
General Start	No (0)	No or Yes (0/1)						
tGS	No (0)	No or Yes (0/1)						
CT Fail	No (0)	No or Yes (0/1)						
Warning	No (0)	No or Yes (0/1)						
Alarm	No (0)	No or Yes (0/1)						
Starting GF	No (0)	No or Yes (0/1)						
Trip by CB Fail	No (0)	No or Yes (0/1)						
Phase A Start.	No (0)	No or Yes (0/1)						

Selection	Default	Values range	Output relays setting					
			RL 7	RL 6	RL 5	RL 4	RL 3	RL 2
Phase B Start.	No (0)	No or Yes (0/1)						
Phase C Start.	No (0)	No or Yes (0/1)						
Therm Block	No (0)	No or Yes (0/1)						
Reset Therm	No (0)	No or Yes (0/1)						
Order 1	No (0)	No or Yes (0/1)						
Order 2	No (0)	No or Yes (0/1)						
Trip by SOTF	No (0)	No or Yes (0/1)						

1.4.6 Submenu **OUTPUT RELAY MODE**

Parameter	Default	Values range	Setting
Relay 1	NO	NO or NC	
Relay 2	NO	NO or NC	
Relay 3	NO	NO or NC	
Relay 4	NO	NO or NC	
Relay 5	NO	NO or NC	
Relay 6	NO	NO or NC	
Relay 7	NO	NO or NC	

1.4.7 Submenu **LATCH OUTPUT RELAYS**

Parameter	Default	Values range	Setting
Latch Relay 2	No	Yes or No	
Latch Relay 3	No	Yes or No	
Latch Relay 4	No	Yes or No	
Latch Relay 5	No	Yes or No	
Latch Relay 6	No	Yes or No	
Latch Relay 7	No	Yes or No	

1.4.8 Submenus **LED 5**, **LED 6**, **LED 7** and **LED 8**

Selection	**Default**	**Values range**	**LED setting**			
			LED 5	**LED 6**	**LED 7**	**LED 8**
I>	No	Yes or No				
tI>	No	Yes or No				
I>>	No	Yes or No				
tI>>	No	Yes or No				
I>>>	No	Yes or No				
tI>>>	No	Yes or No				
IN>	No	Yes or No				
tIN>	No	Yes or No				
tIN> int.	No	Yes or No				
IN>>	No	Yes or No				
tIN>>	No	Yes or No				
tI>>>	No	Yes or No				
IN>>>	No	Yes or No				
tIN>>>	No	Yes or No				
Therm Overload	No	Yes or No				
Θ Alarm	No	Yes or No				
CB Fail	No	Yes or No				
CT Failure	No	Yes or No				
I2>	No	Yes or No				
tI2>	No	Yes or No				
I2>>	No	Yes or No				
tI2>>	No	Yes or No				
tI<	No	Yes or No				
Phase A Start.	No	Yes or No				
Phase B Start.	No	Yes or No				
Phase C Start.	No	Yes or No				
CB Superv.	No	Yes or No				
tExt 1	No	Yes or No				
tExt 2	No	Yes or No				
tExt 3	No	Yes or No				
tExt 4	No	Yes or No				
Mode Maint.	No	Yes or No				
Starting GF	No	Yes or No				
General Start.	No	Yes or No				
tGS	No	Yes or No				
Group 1 Active	No	Yes or No				
Group 2 Active	No	Yes or No				
Reset Therm	No	Yes or No				
Therm Block	No	Yes or No				
Trip by CB Fail	No	Yes or No				
Input 1	No	Yes or No				
Input 2	No	Yes or No				
Input 3	No	Yes or No				
Input 4	No	Yes or No				
Input 5	No	Yes or No				
Input 6	No	Yes or No				
Input 7	No	Yes or No				
Trip by SOTF	No	Yes or No				
CB Close	No	Yes or No				
CB Open	No	Yes or No				

1.4.9 Submenu **COMMUNICATION**

Communication protocol according to IEC 60870-5-103

Parameter	**Default**	**Values range**	**Setting**
Relay Addr.(CU)	1	1...254	
Communication	No	Yes or No	
Baud Rate	19200	300 Bd 600 Bd 1200 Bd 2400 Bd 4800 Bd 9600 Bd 19200 Bd 38400 Bd	
Parity	Even	Without or Even or Odd	
Relay Addr.(PU)	1	1...255	
Connect. RS485	2 Wires	2 Wires or 4 Wires	
Line idle state	Light On	Light On or Light Off	
Spont. Sign	None	None All IEC Only	
Command Block.	Yes	Yes or No	
Signals/Measures Block.	No	Yes or No	
Test Mode	No	Yes or No	
Transm.Enab. CyclDat	None	None ASDU3.1 ASDU3.4 ASDU9 Prv ASDU3.1&3.4 ASDU9&3.4 ASDU9&Prv	
Delta I	0.03	0.0…0.15 In	
Delta f	0.02	0.0...0.02 fn	
Delta Priv.Meas	0.03	0.0...0.15	
Delta t	1	0...15 min	

Communication protocol according to MODBUS

Parameter	**Default**	**Values range**	**Setting**
Relay Addr.	1	1...255	
Communication	No	Yes or No	
Baud Rate	19200	300 600 1200 2400 4800 9600 19200 38400	
Parity	Even	Without or Even or Odd	
Stop bits	1	1 / 2	
Connect. RS485	2 Wires	2 Wires or 4 Wires	
Line idle state	Light On	Light On or Light Off	
Date format	Private	Private or IEC	

1.4.10 Submenu **RECORD SETTING**

Parameter	**Default**	**Values range**	**Setting**
Disturb Rec Pre Time	1.0	0.1...3.0 s	
Disturb Rec Post Time	2.0	0.1...3.0 s	
Dist Trig Gen. Start	Yes	Yes or No	
Dist Trig other Inst	No	Yes or No	
Dist Trig Trip	Yes	Yes or No	
Time Window	5	5, 10, 15, 30 or 60 min	
Sub Period	1	1...60 min	
Num of Sub Per.	1	1...24	

1.5 Menu AUTOMAT.CTRL

1.5.1 Submenus **TRIP COMMAND** and **LATCH TRIP ORDER**

Selection	Default	Values range	Setting	
			Trip Command	Latch Trip Order
tI>	No	Yes or No		
tI>>	No	Yes or No		
tI>>>	No	Yes or No		
tIN>	No	Yes or No		
tIN> int.	No	Yes or No		
tIN>>	No	Yes or No		
tIN>>>	No	Yes or No		
tI<	No	Yes or No		
tI2>	No	Yes or No		
tI2>>	No	Yes or No		
Therm Overload	No	Yes or No		
tExt 1	No	Yes or No		
tExt 2	No	Yes or No		
FB F3	No	Yes or No		
FB F4	No	Yes or No		
Trip by CB Fail	No	Yes or No		
Trip by SOTF	No	Yes or No		
CT fail	No	Yes or No		

1.5.2 Submenu **CB FAILURE**

Parameter	Default	Values range	Setting
CB Fail Funct	No	Yes or No	
I< BF	10	2...100 %In	
tBF	0.13	0.03...10.00 s	
Block I>;>>;>>> BF	No	Yes or No	
Block IN>;>>;>>>BF	No	Yes or No	

1.5.3 Submenu **SWITCH ON FAULT**

Parameter	Default	Values range	Setting
Switch on Fault Funct	No	Yes or No	
tMan.Close	1.00	0.00...10.00 s	
Trip by I>	No	Yes or No	
Trip by I>>	Yes	Yes or No	
Trip by I>>>	No	Yes or No	
Trip by General Start.	No	Yes or No	

1.5.4 Submenu **SETTING GROUP SELECT**

Parameter	**Default**	**Values range**	**Setting**
Change Group mode	Edge	Edge Level Level 2	
Setting Group	1	1 / 2	
Keep Time	Yes	Yes or No	
tKeep	0.01	0.01...65.00 s	

1.5.5 Submenu **COLD LOAD PICKUP**

Parameter	**Default**	**Values range**	**Setting**
Cold Load Pickup	No	Yes or No	
Detect PU	Input + I	Log.Input Input + I Trans I	
I> PU	10	10...200 %In	
Cold Load PU I>	No	Yes or No	
Cold Load PU I>>	No	Yes or No	
Cold Load PU I>>>	No	Yes or No	
Cold Load PU IN>	No	Yes or No	
Cold Load PU IN>>	No	Yes or No	
Cold Load PU IN>>>	No	Yes or No	
Cold Load PU I2>	No	Yes or No	
Cold Load PU I2>>	No	Yes or No	
Cold Load PU Iref	No	Yes or No	
Cold Load PU Level	100	20...500 %	
Cold Load PU tCL	0.0	0.0...3600.0 s	

1.5.6 Submenu **BLOCKING LOGIC 1**

Parameter	Default	Values range	Setting
Block.Log1 tI>	No	Yes or No	
Block.Log1 tI>>	No	Yes or No	
Block.Log1 tI>>>	No	Yes or No	
Block.Log1 tIN>	No	Yes or No	
Block.Log1 tIN> i.	No	Yes or No	
Block.Log1 tIN>>	No	Yes or No	
Block.Log1 tIN>>>	No	Yes or No	
Block.Log1 tI2>	No	Yes or No	
Block.Log1 tI2>>	No	Yes or No	
Block.Log1 tI<	No	Yes or No	
Block.Log1 Therm	No	Yes or No	
Block.Log1 tExt1	No	Yes or No	
Block.Log1 tExt2	No	Yes or No	
Block.Log1 tCT	No	Yes or No	

1.5.7 Submenu **BLOCKING LOGIC 2**

Parameter	Default	Values range	Setting
Block.Log2 tI>	No	Yes or No	
Block.Log2 tI>>	No	Yes or No	
Block.Log2 tI>>>	No	Yes or No	
Block.Log2 tIN>	No	Yes or No	
Block.Log2 tIN> i.	No	Yes or No	
Block.Log2 tIN>>	No	Yes or No	
Block.Log2 tIN>>>	No	Yes or No	
Block.Log2 tI2>	No	Yes or No	
Block.Log2 tI2>>	No	Yes or No	
Block.Log2 tI<	No	Yes or No	
Block.Log2 Therm	No	Yes or No	
Block.Log2 tExt1	No	Yes or No	
Block.Log2 tExt2	No	Yes or No	
Block.Log2 tCT	No	Yes or No	

1.5.8 Submenu **LOGIC SELECT 1**

Parameter	Default	Values range	Setting
Log.Sel.1 tI>>	No	Yes or No	
Log.Sel.1 tI>>>	No	Yes or No	
Log.Sel.1 tIN>>	No	Yes or No	
Log.Sel.1 tIN>>>	No	Yes or No	
tLog.Sel.1	1.00	0.00...150.00 s	

1.5.9 Submenu **LOGIC SELECT 2**

Parameter	Default	Values range	Setting
Log.Sel.2 tI>>	No	Yes or No	
Log.Sel.2 tI>>>	No	Yes or No	
Log.Sel.2 tIN>>	No	Yes or No	
Log.Sel.2 tIN>>>	No	Yes or No	
tLog.Sel.2	1.00	0.00...150.00 s	

1.5.10 Submenu **CB SUPERVISION**

Parameter	Default	Values range	Setting
Trip Circuit Superv	No	Yes or No	
tSup	2.00	0.10...10.00 s	
CB Opening Time Superv	No	Yes or No	
CB Opening Time	0.15	0.05...1.00 s	
CB Closing Time Superv	No	Yes or No	
CB Closing Time	0.15	0.05...1.00 s	
CB Operation NB Superv	No	Yes or No	
CB Operation NB	7500	0...50000	
Sum A n Superv	No	Yes or No	
Sum A n	6	0...4000 MA^n	
n	1	1 / 2	

1.5.11 Submenu **CT SUPERVISION**

Parameter	Default	Values range	Setting
CT Superv	No	Yes or No	
Mode CT Superv	I2/I1	I2/I1 or Imax/Imin	
Idiff>	0.30	0.25...0.50 Imax	
tCT	5.00	0.00...500.00 s	
I2/I1>	20	20...100 %	

1.6 Menus PROTECTION G1 and PROTECTION G2

1.6.1 Submenu **[50/51] SHORT CIRCUIT**

Parameter	**Default**	**Values range**	**Setting**	
			Protection G1	**Protection G2**
I> Function	No	Yes or No		
I>	1.00	0.10…40.00 In		
I> Delay Type	DMT	DMT, IDMT or RI		
I> Curve	IEC SI	IEC STI / IEC SI / IEC VI / IEC EI / IEC LTI / CO2 / IEEE MI / CO8 / IEEE VI / IEEE EI / RC		
I> Tms	1.00	0.03...4.00		
I> K	1.00	0.05...10.00		
tI>	1.00	0.00...150.00 s		
I> Reset Type	DMT	DMT or IDMT		
I> Rtms	0.025	0.025...3.200		
I> tReset	0.00	0.00...600.00 s		
I>> Function	No	Yes or No		
I>>	4.00	0.10…40.00 In		
I>> Delay Type	DMT	DMT, IDMT or RI		
I>> Curve	IEC SI	IEC STI / IEC SI / IEC VI / IEC EI / IEC LTI / CO2 / IEEE MI / CO8 / IEEE VI / IEEE EI / RC		
I>> Tms	1	0.03...4.00		
I>> K	1	0.05...10.00		
tI>>	0.50	0.00...150.00 s		
I>> Reset Type	DMT	DMT or IDMT		
I>> Rtms	0.025	0.025...3.200		
I>> tReset	0.00	0.00...600.00 s		
I>>> Function	No	Yes or No		
I>>>	4.00	0.10…40.00 In		
tI>>>	0.50	0.00...150.00 s		

1.6.2 Submenu **[50N/51N] EARTH FAULT**

Parameter	**Default**	**Values range**	**Setting**	
			Protection G1	**Protection G2**
IN> Function	No	Yes or No		
IN>	1.00 0.250 0.025	0.10...40.00 INn 0.010...8.000 INn 0.002...0.800 INn		
IN> Delay Type	DMT	DMT, IDMT, RI or LABOR [1]		
IN> Curve	IEC SI or 1	for IDMT: IEC STI / IEC SI / IEC VI / IEC EI / IEC LTI / CO2 / IEEE MI / CO8 / IEEE VI / IEEE EI / RC for LABOR.: 1 / 2 / 3 [1]		
IN> Tms	1.00	0.03...4.00		
IN> K	1.00	0.05...10.00		
tIN>	1.00	0.00...150.00 s		
tIN> int.	1.00	0.00...150.00 s		
IN> Reset Type	DMT	DMT or IDMT		
IN> Rtms	0.025	0.025...3.200		
IN> Rst Type DMT	Normal	Normal or Interm		
IN> tReset	0.00	0.00...600.00 s		
IN> tReset int.	0.00	0.00...600.00 s		
IN> tProl int.	0.08	0.01...10.00 s		
IN>> Function	No	Yes or No		
IN>>	1.00 0.250 0.025	0.10...40.00 INn 0.010...8.000 INn 0.002...0.800 INn		
IN>> Delay Type	DMT	DMT, IDMT, RI or LABOR [1]		
IN>> Curve	IEC SI or 1	for IDMT: IEC STI / IEC SI / IEC VI / IEC EI / IEC LTI / CO2 / IEEE MI / CO8 / IEEE VI / IEEE EI / RC for LABOR.: 1 / 2 / 3 [1]		
IN>> Tms	1.00	0.03...4.00		
IN>> K	1.00	0.05...10.00		
tIN>>	1.00	0.00...150.00 s		
IN>> Reset Type	DMT	DMT or IDMT		
IN>> Rtms	0.025	0.025...3.200		
IN>> tReset	0.00	0.00...600.00 s		
IN>>> Function	No	Yes or No		
IN>>>	1.00 0.250 0.025	0.10...40.00 INn 0.010...8.000 INn 0.002...0.800 INn		
tIN>>>	1.00	0.00...150.00 s		

1) Available only on relay models with residual current input range: 0.01...8 INn

1.6.3 Submenu **[46] UNBALANCE**

Parameter	**Default**	**Values range**	**Setting**	
			Protection G1	**Protection G2**
I2> Function	No	Yes or No		
I2>	0.30	0.10…40.00 In		
I2> Delay Type	DMT	DMT, IDMT or RI		
I2> Curve	IEC SI	IEC STI / IEC SI / IEC VI / IEC EI / IEC LTI / CO2 / IEEE MI / CO8 / IEEE VI / IEEE EI		
I2> Tms	1.00	0.03...4.00		
I2> K	1.00	0.05...10.00		
tI2>	4.00	0.00...150.00 s		
I2> Reset Type	DMT	DMT or IDMT		
I2> Rtms	0.025	0.025...3.200		
I2> tReset	0.00	0.00...600.00 s		
I2>> Function	No	Yes or No		
I2>>	0.50	0.10…40.00 In		
tI2>>	1.00	0.00...150.00 s		

1.6.4 Submenu **[49] THERMAL OVERLOAD**

Parameter	**Default**	**Values range**	**Setting**	
			Protection G1	**Protection G2**
Thermal Overload Funct.	No	Yes or No		
Iref	1.00	0.10…3.20 In		
Te	20	1...200 min		
K	1.15	1.00...1.50		
θ Trip	100	50...200 %		
θ Alarm	No	Yes or No		
θ Alarm	80	50...200 %		

1.6.5 Submenu **[37] LOSS OF LOAD**

Parameter	**Default**	**Values range**	**Setting**	
			Protection G1	**Protection G2**
I< Function	No	Yes or No		
I<	0.30	0.05…1.00 In		
tI<	20.00	0.00...150.00 s		

Information and Control Tables

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1. INFORMATION AND CONTROL TABLES

1.1 Menu OP PARAMETERS

Signal	Default	Values range
Device Type	P122C	P122C
Software version	2. or 3., resp.	2.A...2.Z or 3.A…3.Z, resp.
Active Group	-	1 / 2
Input Status	-	0 / 1 (low / high)
Relay Status	-	0 / 1 (inactive / active)

1.2 Menu MEASUREMENTS

Measured data	Default	Values range
IA Rms	-	0.00...400000.00 A
IB Rms	-	0.00...400000.00 A
IC Rms	-	0.00...400000.00 A
IN Rms	-	0.00...120000.00 A (high range) 0.00...24000.00 A (normal range) 0.00...2400.00 A (sensitive range)
IA Rms Sec	-	0.000...40.000 In
IB Rms Sec	-	0.000...40.000 In
IC Rms Sec	-	0.000...40.000 In
IN Rms Sec	-	0...40.000 A (high range) 0...8.000 A (normal range) 0...0.800 A (sensitive range)
I1 Positive	-	0.00...400000.00 A
I1 Positive Sec	-	0.000...40.000 In
I2 Negative	-	0.00...400000.00 A
I2 Negative Sec	-	0.000...40.000 In
I2/I1 Ratio	-	0...9999 %
I0 Zero	-	0.00...40000.00 A (high range) 0.00...8000.00 A (normal range) 0.00...800.00 A (sensitive range)
I0 Zero Sec	-	0.00...13.33 INn (high range) 0.00...2.66 INn (normal range) 0.000...0.266 INn (sensitive range)
Frequency	-	45.00...65.00 Hz
Max Ph Current	-	0.00...400000.00 A (clear with reset key ⓒ)
IN - fn	-	0.00...120000.00 A (high range) 0.00...24000.00 A (normal range) 0.00...2400.00 A (sensitive range) (Clear/trigger with reset key ⓒ)
Thermal State	-	0...65535 % (clear with reset key ⓒ)
Rst.Max&Average	-	(Clear/trigger with reset key ⓒ)
Max. IA Rms	-	0.00...400000.00 A
Max. IB Rms	-	0.00...400000.00 A
Max. IC Rms	-	0.00...400000.00 A
Average IA Rms	-	0.00...400000.00 A
Average IB Rms	-	0.00...400000.00 A
Average IC Rms	-	0.00...400000.00 A
Rst.MaxSubperiod	-	Clear max. sub-period values with reset key ⓒ
Max. Subperiod IA Rms	-	0.00...400000.00 A
Max. Subperiod IB Rms	-	0.00...400000.00 A
Max. Subperiod IC Rms	-	0.00...400000.00 A
Rst.Roll.Average	-	Clear rolling average values with reset key ⓒ
Rolling Average IA Rms	-	0.00...400000.00 A
Rolling Average IB Rms	-	0.00...400000.00 A
Rolling Average IC Rms	-	0.00...400000.00 A

NOTE: Various designation texts may be selected from the local control panel to display the phase currents (e.g. phase A current: **IA**, **I1**, **IL1** or **IR**) or the residual current (see submenu **LOCAL INDICATION**). It is therefore possible that the text displayed on the local control panel LCD in the menu **MEASUREMENTS** differs from the text as described in this Operation guide.

1.3 Menu EVENT COUNTERS

Counter/Command	Default	Values range
Reset Counters	-	Clear event counters with reset key ⓒ
General Start NB	-	0...65535
Total Trip NB	-	0...65535
tExt 1;2 Trip NB	-	0...65535
tI>;>>;>>> Trip NB	-	0...65535
tIN>;>>;>>>Trip NB	-	0...65535
tI2>;tI2>> Trip NB	-	0...65535
tI< Trip NB	-	0...65535
Therm Trip NB	-	0...65535
CB Fail Trip NB	-	0...65535
Trip onto fault NB	-	0...65535

1.4 Menu CONTROL/TESTING

Command	Default	Values range
General Reset	not execute	not execute or execute
Open Order	not execute	not execute or execute
Close Order	not execute	not execute or execute
Disturb Trigger	not execute	not execute or execute
Maintenance mode	No	Yes or No
Block. CB-Meas.	No	Yes or No

1.5 Menu RECORD

1.5.1 Submenu **FAULT RECORD**

Parameter	**Default**	**Values range**
Record Number	5	1...5
Fault Time	-	00:00:00:00...23:59:59:99
Fault Date	-	00/00/00...31/12/99
Active Set Group	-	1 / 2
Faulted Phase	-	A B C
Trip by	-	See selection Trip command
Magnitude	-	Depending on the fault
IA Magnitude	-	0.00...400000.00 A
IB Magnitude	-	0.00...400000.00 A
IC Magnitude	-	0.00...400000.00 A
IN Magnitude	-	0.00...120000.00 A (high range) 0.00...24000.00 A (normal range) 0.00...2400.00 A (sensitive range)

1.5.2 Submenu **STARTING RECORD**

Parameter	**Default**	**Values range**
Number	5	1...5
Hour	-	00:00:00:00...23:59:59:99
Date	-	00/00/00...31/12/99
Origin	-	I>, I>>, I>>>, IN>, IN>>, IN>>>, I2>, I2>>
Start.duration	-	0.00...99999.99 s
Dur.t elapsed	-	0.00...99999.99 s
Trip	-	Yes or No

1.5.3 Submenu **CB MONITORING**

Measured data/Command	**Default**	**Values range**
CB Open Time	-	0.05...10.00 s
CB Close Time	-	0.05...10.00 s
CB Open NB	-	0..50000 (clear with reset key Ⓒ)
Reset Sum A n	-	Clear Sum A^n with reset key Ⓒ
Sum A n IA	-	0...4000 E06 A^n
Sum A n IB	-	0...4000 E06 A^n
Sum A n IC	-	0...4000 E06 A^n

1.6 ALARMS

Signals	Default	Signalling behaviour
Phase A Start.	-	self updating or stored [1]
Phase B Start.	-	self updating or stored [1]
Phase C Start.	-	self updating or stored [1]
Starting GF	-	self updating or stored [1]
General Start.	-	self updating or stored [1]
tGS	-	stored [1]
Starting I>	-	self updating or stored [1]
tI> Phase …	-	stored [1]
Starting I>>	-	self updating or stored [1]
tI>> Phase …	-	stored [1]
Starting I>>>	-	self updating or stored [1]
tI>>> Phase …	-	stored [1]
Starting IN>	-	self updating or stored [1]
tIN>	-	stored [1]
tIN> int.	-	stored [1]
Starting IN>>	-	self updating or stored [1]
tIN>>	-	stored [1]
Starting IN>>>	-	self updating or stored [1]
tIN>>>	-	stored [1]
Starting I2>	-	self updating or stored [1]
tI2>	-	stored [1]
Starting I2>>	-	self updating or stored [1]
tI2>>	-	stored [1]
tI< Phase …	-	stored [1]
Thermal Alarm	-	self updating
Therm Overload	-	stored [1]
Therm. Block.	-	self updating
tExt1	-	stored [1]
tExt2	-	stored [1]
CB Failure	-	stored [1]
Trip by CB Failure	-	stored [1]
Trip by SOTF	-	stored [1]
Trip Circ Fail	-	stored [2]
CB Open Time	-	stored [2]
CB Close Time	-	stored [2]
CB Opening NB	-	stored [2]
Sum A n	-	stored [2]
CT Fail	-	stored [2]
Maintenance Mode	-	self updating
Latch Relay	-	self updating
Latch Relay Trip	-	self updating

1) The selected operating modes must be considered
2) Can only be cleared manually

Command	Default	Values range
Clear LED Alarms	-	Clear signals with reset key Ⓒ
Clear All Alarms	-	Clear signals and latched relays with reset key Ⓒ

1.7 Material alarms issued by internal monitoring

Signals	Default	Designation
CLOCK ERROR	-	minor material alarm
RAM ERROR	-	minor material alarm
BATTERY FAIL	-	minor material alarm
EEPROM ERROR DATA	-	major material alarm
DEFAULT SETTINGS	-	major material alarm
EEPROM ERROR CALIBR.	-	major material alarm
ANA ERROR	-	major material alarm
RELAYS ERROR	-	major material alarm

Customer Care Centre

http://www.schneider-electric.com/sites/corporate/en/support/contact/customer-care-contact.page

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