CPM 310 G
Digital Overcurrent Protection Relay
User & Application Manual vEN.2016.03

Index

ABOUT DEMA

General Information

DEMA Role San. ve Tic. A. S. is a secondary protection relays and accessories manufacturer carrying out its activities in a plant with 2000 m² closed area in Maltepe, Istanbul, Turkey.

The plant itself inspires creativity and innovation by its high-tech infrastructure, laboratory-clean environment and the art collection it hosts.

DEMA Role San. ve Tic. A. S. has manufactured over 100,000 pieces of protection units since its foundation in 1977, and has great reputation among its clients.

The innovations history of DEMA is as follows:

- 1977 - R3AS20E: The first DMT electromechanical overcurrent protection relay in the country,
- 1985 - R1TA112: The first draw out type electromechanical overcurrent protection relay in the country with IDMT delay,
- 1990 - R1SA01: The first draw out type electromechanical earth fault protection relay in the country with DMT delay,
- 1990 - R1ST04: The first draw out type electromechanical thermal overload protection relay in the country with thermal image display,
- 1997 - MCR Series: The first draw out type electronic overcurrent protection relay series in the country with DMT and IDMT delay,
- 1997 - MVR Series: The first draw out type electronic over/undervoltage protection relay series in the country with DMT and IDMT delay,
- 2000 - IR1021: Double-flashing annunciator relay with LEDs,
- 2006 - CPM Series: The first draw out type DSP-based digital overcurrent protection relay with digital communication and LCD display features.

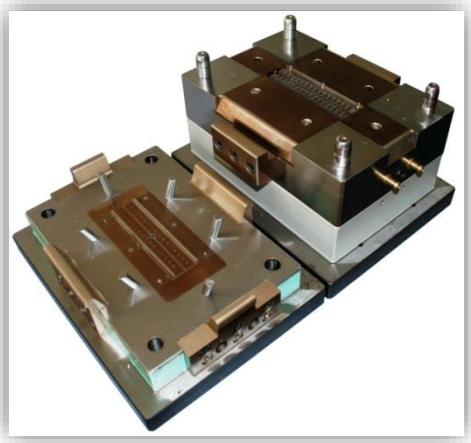
DEMA Role San. ve Tic. A. S. invests more than 10% of its total revenue into R&D projects, which clearly demonstrates DEMA's commitment into innovation.

The R&D philosophy of DEMA focuses particularly on user-friendliness, assurance of high-quality, reliability and international standards compliance of its products.

A good example on the outcomes of DEMA's R&D philosophy is the innovative features of CPM 310 series digital overcurrent protection relays – a product which introduced the most user-friendly interface yet by employing the mobile phone navigation technology into protection relays era.

Some other innovations are as follows:

- The most secure secondary shorting mechanism on the world yet, which enables under-load replaceability of overcurrent protection units more safely than ever,
- Withdrawable unit locking mechanism,
- Employment of high-frequency band measurement transformers in protection relays.



The molding workshop of DEMA is one of the most advanced facilities in its sector. The workshop works only for

- Prototyping,
- Or production molding construction for DEMA products.

The molding workshop hosts

- Wire erosion machines,
- Through erosion machines,
- Erosion drills,
- Precision grinders,
- And CNC systems worth over 3,000,000 USD of investment into production precision.

All of the metal, plastic, electro-mechanical and graphical components used in DEMA's products are designed, prototyped and manufactured in the same facility by DEMA engineers and technicians.

50% of DEMA's total revenue comes from international sales with an increasing proportion. DEMA imported to over 10 countries all over the world in 2012.

The innovative and leading policy of DEMA has been recognized and awarded by many national titles in the past years. DEMA promises its clients better solution partnership and wider range of high quality products in the future, just as provided in the past.

Product Range

1. DSP-based Digital Protection Relays

CPM 310 G	Three phase + earth overcurrent protection relay with draw-out system.
CPM 312	Three phase + earth overcurrent protection relay without draw-out system.
T4CH	4 channel PT100 digital thermistor relay.

2. Annunciating System Components

IT1-6	6-windows optical annunciator.
K 101 - A2	Multitone acoustic annunciator.
KR30	Horn Relay.
IR61K-A2	6-windows optical annunciator with relay and horn outputs in draw-out case.
IR101K-A2	10-windows optical annunciator with relay and horn outputs in draw-out case.
IR1021	10-windows double-flashing optical annunciator with relay and horn outputs in draw-out case.

3. Auxiliary Devices

KAC	Capacitor-based auxiliary supply unit.
GKR15	DC auxiliary supply supervision relay.
RY600	Auxiliary relay
ZR20	On-delay auxiliary time relay.
ZR25	Off-delay auxiliary time relay.
BR25	Flash relay
WR25	Impulse relay.
LTR-400	Lock-out relay.

For detailed information on products; please see our WEB site at www.demarelay.com, or contact us using the information in the *Contact Us* section on the next page. □

Contact Us

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□

DEMA Role San. ve Tic. A. S. Plant at Istanbul, Turkey.

INTRODUCTION

General Specifications & Advantages

DEMA proudly presents the users and modern networks a solid alternative for overcurrent protection with CPM 310 G; with the state-of-art electronic, physical and functional technology for use with (X/5) A or (X/1) A conventional type current transformers. As a DSP[1] based digital multi-function protection & control relay with 3 phase & earth overcurrent protection, DEMA CPM 310 G is tested to fulfill international standards requirements; and provides the users numerous assembly, commissioning and service advantages.

DEMA CPM 310 G Digital Overcurrent Protection Relays are type tested in internationally accredited laboratories to comply with IEC 60255, IEC 60529, IEC 60695 and IEC 60068 standards, and have been introduced into service under the guarantee of ISO9001:2008.

The general specifications of CPM 310 G are listed below to create a common sense for the product. All functions CPM 310 G offers will be examined thoroughly throughout this manual.

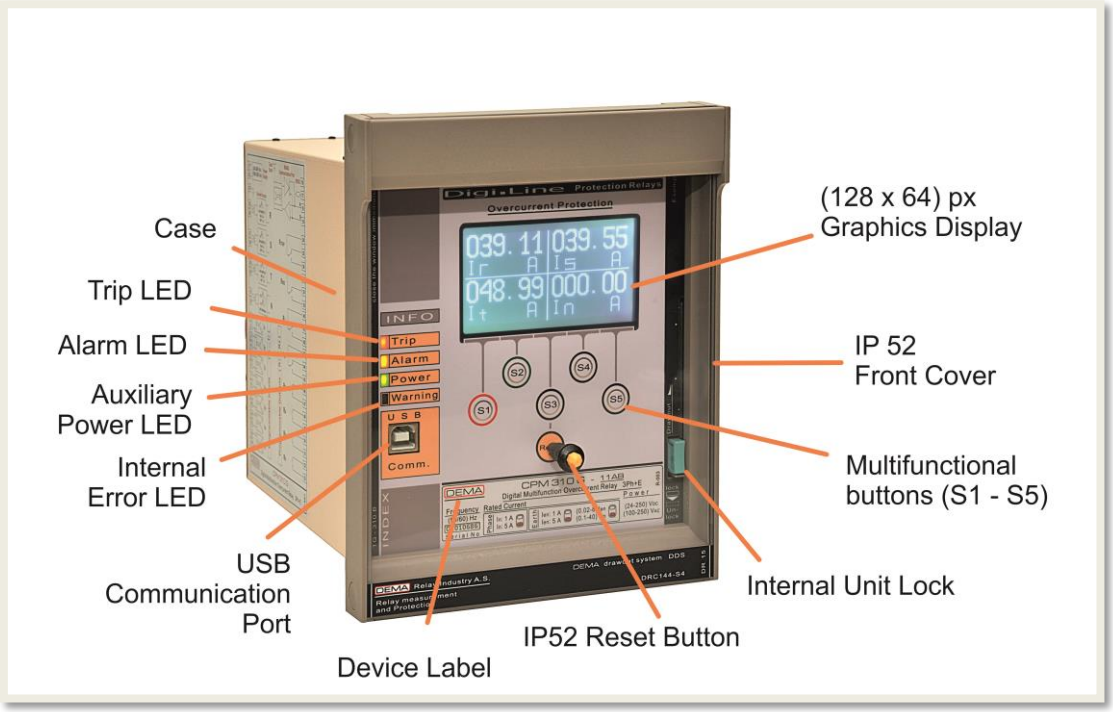
Function	ANSI Code	CPM 310 G
Phase Overcurrent – Instantaneous Trip	50	3 thresholds
Phase Overcurrent – Delayed Trip	51	3 thresholds
Earth Overcurrent – Instantaneous Trip	50N	3 thresholds
Earth Overcurrent – Delayed Trip	51N	3 thresholds
Restricted Earth Fault Protection	64N	3 thresholds
Thermal Overload Protection	49	2 thresholds
Undercurrent Protection	37	1 threshold
Negative Sequence Overcurrent Protection	46	2 thresholds
Latching	86	✓
Circuit Breaker Failure Detection	50BF	✓
Auto-reclosing	79	4-shot
Broken Conductor Detection	46 BC	✓
Temperature / Buchholz Protection	26 / 63	✓
Cold Load Pickup Function		✓
Settings Groups		2 groups
Trip Circuit Supervision	TCS	✓
Circuit Breaker Supervision and Control		✓
Blocking Logic Selectivity		✓
Delaying Logic Selectivity		✓
On Screen CB ON / OFF commanding		✓
Optic-coupled Inputs		7
Outputs (Total / SPDT / SPST)		8 / 4 / 4
Disturbance Waveform Recording		5 x 3 s
Event and Fault Records		150 records
Communication Ports		USB + RS485
(X/1) A & (X/5) A CT compatibility		✓
Frequency and Current Measurements		✓
Thermal Image Measurements		
Positive and Negative Sequence Current Measurements		✓
Auto-recloser Measurements		✓
Watchdog		✓
Self-Function-Testing		✓

[1] DSP: Digital Signal Processor.

General Specifications & Advantages

- Wide IEC, ANSI and custom delay curve support,
- DMT and IDMT delay curve support for all overcurrent protection functions,
- Annunciating functions and 7 optically coupled programmable inputs that eliminate the need to use external annunciators (e.g. to evaluate Buchholz, temperature and pressure signals).
- 8 outputs: Trip (SPDT) and watchdog (SPDT) plus 6 programmable outputs (2 SPDT + 4 SPST),
- Full screen R – S – T and N ampermeter display, measurement functions that eliminate the need to use double core CTs, external ampermeter and frequency-meters,
- X / 1 A and X / 5 A current transformer compatibility in a single unit,
- Wide setting ranges; (0.1-40) I_n current setting range, (0.01-150) s DMT delay setting range, (0.025-3.2) IDMT (TMS & RTMS) delay setting range.
- 2 independent settings groups,
- 3 independent thresholds for phase overcurrent protection,
- 3 independent thresholds for earth overcurrent protection,
- 2 independent thresholds for negative sequence overcurrent protection,
- Broken conductor sensing, trip and alarm,
- 1 threshold phase undercurrent protection,
- Thermal overload protection with thermal image according to IEC 60255-8 ed.2.0,
- Auto-recloser with 4-shots, auto-reclosing programmability for each protection function,
- Cold-load pickup function with high reliability CB-triggering,
- Blocking logic selectivity feature,
- Delaying logic selectivity feature,
- Circuit breaker failure supervision and alarming,
- Circuit breaker supervision functions: opening and closing time supervision; charging spring supervision; numerator, ΣA and ΣA^2 supervision for each pole; trip circuit supervision,
- Automatic secondary shorting,
- Quick alarm menu access and enhanced alarm explanations;
- 8 programmable alarm LEDs,
- Event and fault records up to 151 instances,
- 5 waveform records with 3 seconds duration each,
- Electro-magnetic compatibility tested for IEC directives,
- Draw-out system that enables under-load unit displacement / replacement,
- Largest LCD graphics screen in its class (128 px x 64 px); easy-to-navigate user friendly menus similar to mobile phones',
- Auxiliary supply voltage compatibility with all voltages in the field;
  U_{aux} = (24 – 240) V_{DC} / (24 – 240) V_{AC},
- IP52 front side and IP20 backside environmental protection,
- SCADA ready,
- USB and RS485 communication ports; MODBUS RTU, IEC 60870-5-103 and DEMCOM communication protocols support,
- High precision manufacturing,
- Free-of-charge PC software and accessories,
- Fast and low cost repairs thanks to the modular electronics,
- Matchless customer support, a variety of application diagrams and technical documents. □

Physical Introduction



CPM 310 G: Front View

- **Trip LED**
  Indicated with "Trip" label on the front panel of CPM 310 G. LED light is in red color. The Trip LED runs continuously as long as the trip contact is in closed position, while flashing until reset if the CB is tripped by CPM 310 G and the disturbance is cleared.

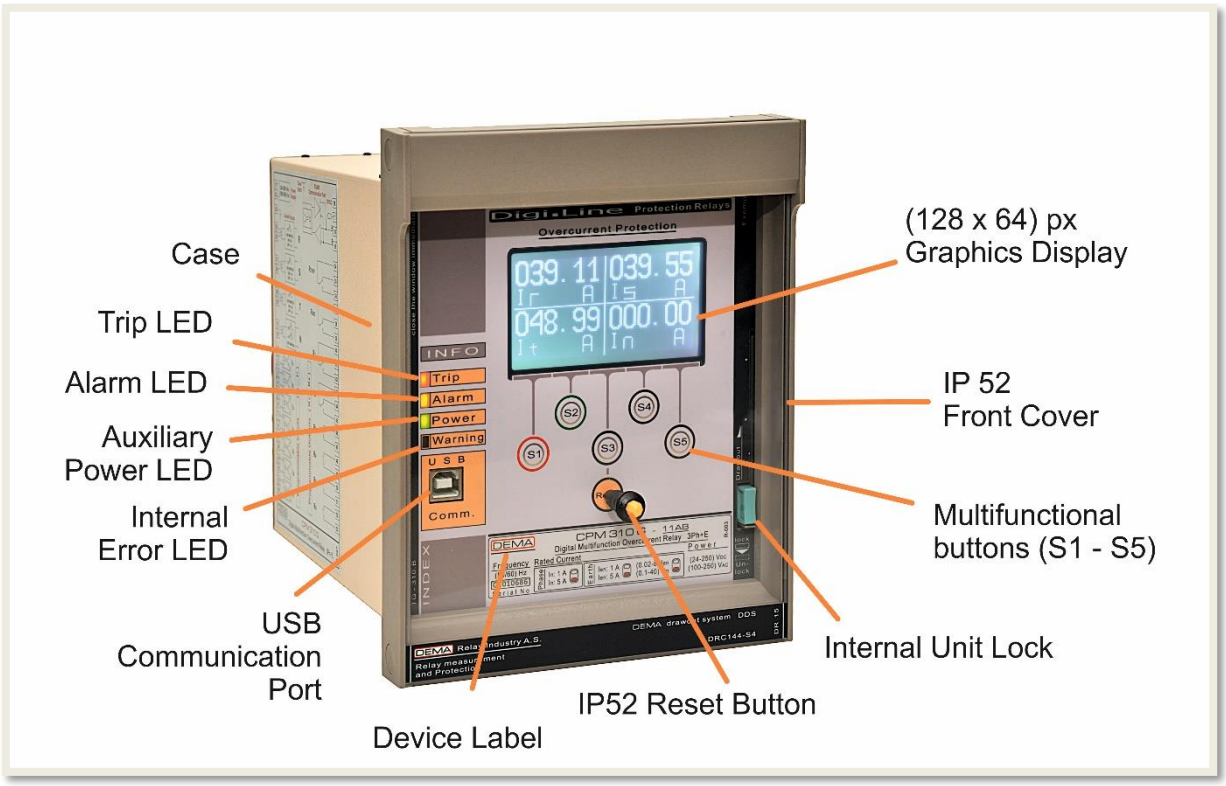
- **Alarm LED**
  Indicated with "Alarm" label on the front panel of CPM 310 G. LED light is in yellow color and runs according to configuration.

- **Auxiliary Power LED**
  Indicated with "Power" label on the front panel of CPM 310 G. LED is in green color and runs as long as the auxiliary supply is healthy.

- **Internal Error LED**
  Indicated with "Warning" label on the front panel of CPM 310 G. LED is in red color and runs if any internal error is detected.

- **USB Communication Port**
  USB communication port is the connection point for PC communications via DigiConnect software. Connection cable is supplied within the product box.

- **IP52 Front Cover**
  Internal unit is isolated from the environmental effects by the cover. The cover provides IP52 protection with its special sealing. The cover is mounted on the case via two integrated nuts. There is an external button on the transparent window of the cover that provides access to the reset button without having to remove the cover. ↺



CPM 310 G: Front View

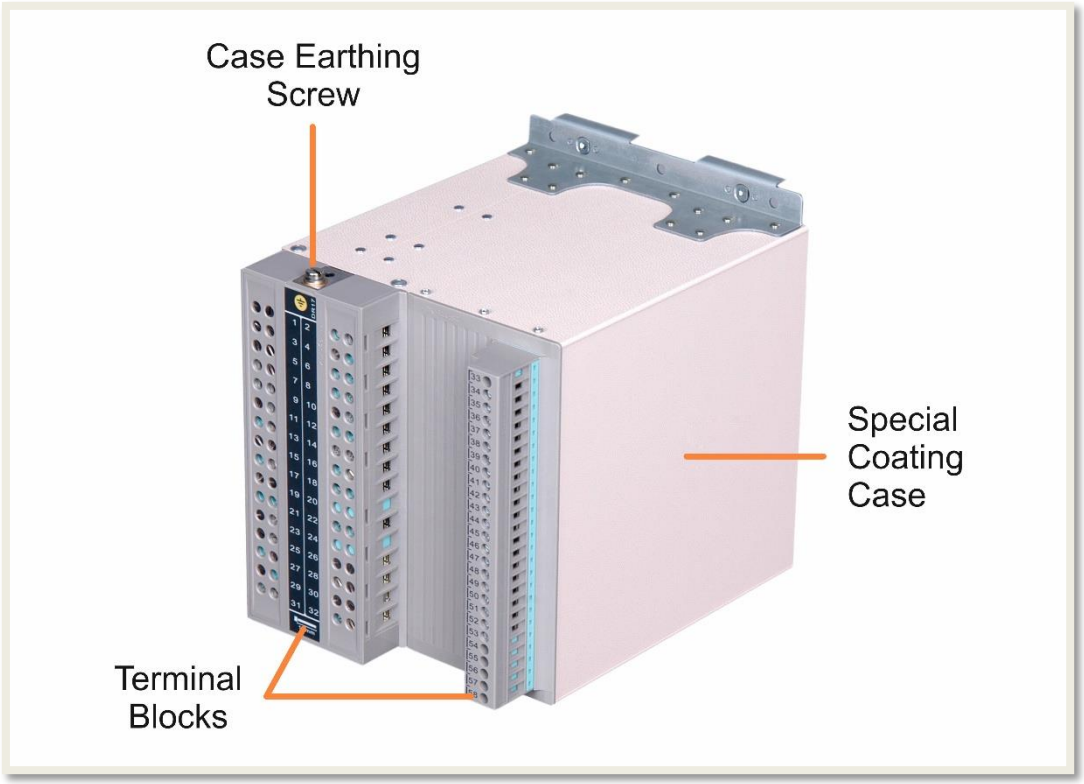
- **Graphics Display**
  128 px x 64 px backlit graphics display provides a large viewing area that ensures easy operation and readability.

- **Multifunctional Buttons (S1 – S5)**
  Similar to cell phone technology, multifunctional buttons provide easy command and navigation between the menus.

- **Internal Unit Lock**
  As a subsystem of the patented DDS (DEMA Draw out System) technology, internal unit lock provides locking and drawing out of the internal unit with ease. Locking ensures safe electrical contacts.

- **IP52 Reset Button**
  Provides access to the LED and Alarm menus. Reset button is used for viewing and resetting these menus, as well as resetting latched relays if applicable.

- **Device Label**
  The inerasable label indicates the ordering code, serial number and other information to comply with IEC standards. ↺



CPM 310 G: Rear View

- **Case Earthing Screw**
  Maximum operation safety is achieved via grounding of this earthing screw, which is the terminal point for the conductance continuity of the case and the internal unit construction.

- **Terminal Blocks**
  Made of inflammable materials, terminal blocks are designed to ensure safe connection and cabling.

- **Special Coating Case**
  Using the state-of-art coating technology against corrosion and scratching, the relay case is immune against aging and environmental effects. ↺

CPM 310 G: Internal & External Units

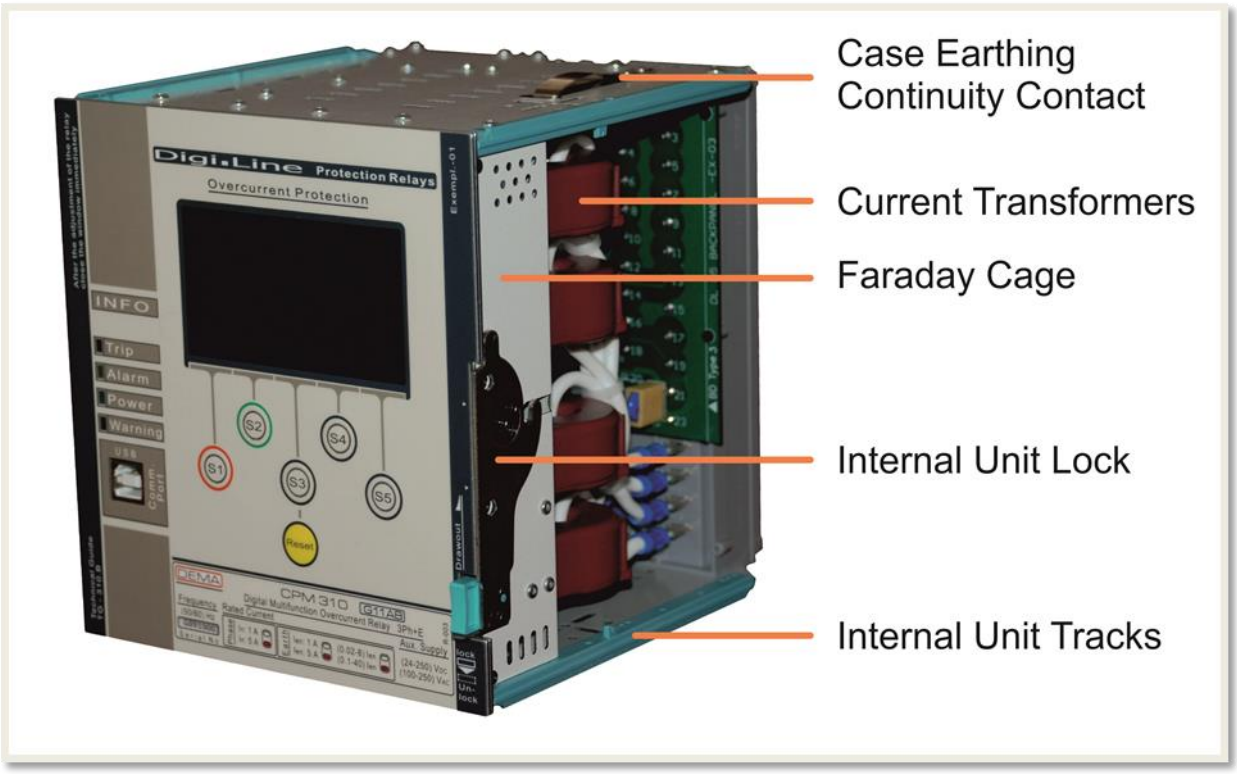
- **Circuit Diagram**
  CPM 310 G Circuit diagram is fixed on the relay case. Users do not need to keep documents for basic cabling duties on the field thanks to this inerasable diagram.

- **Case**
  CPM 310 G case is made of special alloy inoxidant metal and coated with modern PVC coating techniques. Male sockets belonging to terminals are located on the back of the case.

- **Internal Unit**
  The internal unit houses the entire electronic systems, making it possible to replace the whole unit within seconds without having to black put the system. The modular design of electronic systems provides rapid and affordable maintenance & reparation in need. Critical electronic components are screened from noises in the Faraday cage inside of the unit.

- **Mounting Screws for the Cover**
  Mounting screws are fixed on the case and are employed to mount the cover on the case.

- **Internal Unit Tracks**
  High-endurance internal unit tracks provide robust draw-in and draw-out operation of the internal unit. ↺



CPM 310 G: Internal Unit – Front View

- **Case Earthing Continuity Contact**
  Provides the earthing continuity of the internal unit to the casing. The low-resistance spring contact is rated for prospected earth fault current.

- **Current Transformers**
  Transforms secondary current into useful signals to supply measurement and protection circuits with the information they need. Current transformers are integrated into the internal unit – this guarantees fast maintenance and replacement operations without having to carry out calibration procedures.

- **Faraday Cage**
  Digital signal processors, microprocessors and other critical components are safely embedded within the Faraday cage, clear of wave or field effects that may risk the performance of the relay. ↺

CPM 310 G: Internal Unit – Rear & Left Side View

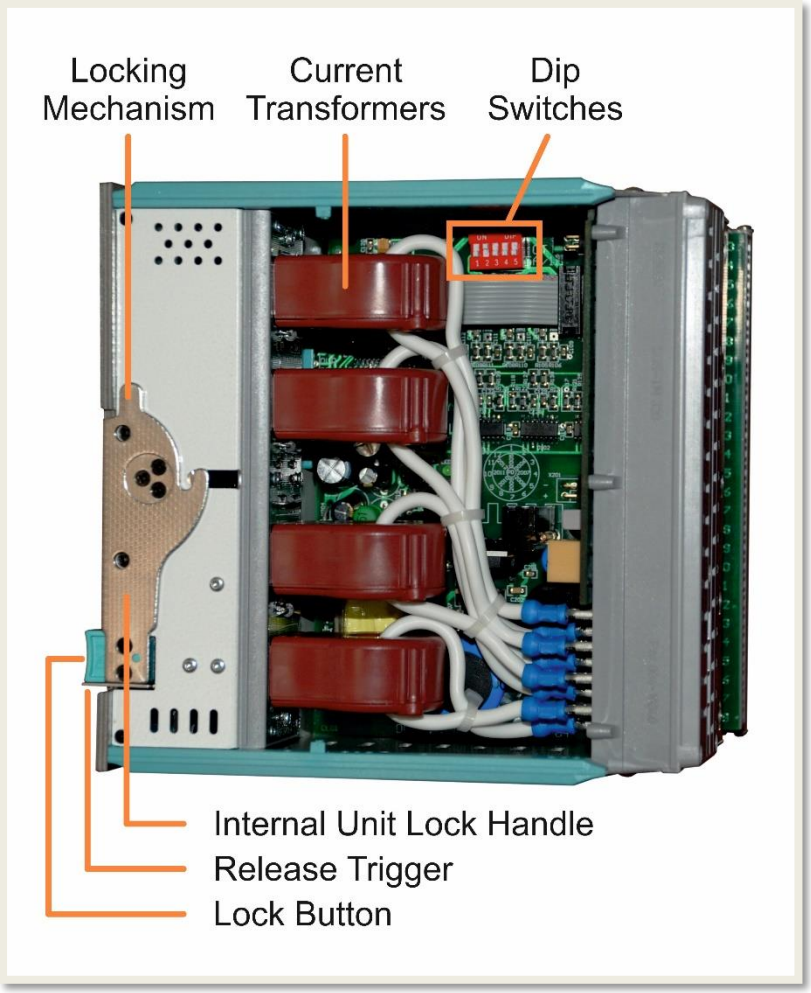
- **Internal Unit Terminal Sockets**
  Sockets make the electrical connection by locking to the plugs when the internal unit is drawn into the case. All sockets are made of inflammable material.

- **Internal Unit Tracks**
  High-endurance internal unit tracks provide robust draw-in and draw-out operation of the internal unit.

- **Faraday Cage**
  Digital signal processors, microprocessors and other critical components are safely embedded within the Faraday cage, clear of wave or field effects that may risk the performance of the relay.

- **Fuse Holder**
  The T1A fuse protecting the internal circuit is mounted on this fuse holder. The fuse ensures the protection of the internal circuits in case of any auxiliary supply faults and provides maximum service continuity. The placement of the fuse holder enables quick access and fast replacement of the fuse.

- **Real-time-clock Battery**
  Real-time clock is run by the auxiliary supply power while the relay is in service; in case of auxiliary supply shortage or internal unit drive out, real-time clock battery takes the duty over. Life expectancy of the lithium-ion battery is 10 years under normal conditions. The unit can be replaced by removing the protecting plastic cover. ↺



CPM 310 G: Internal Unit – Right Side View

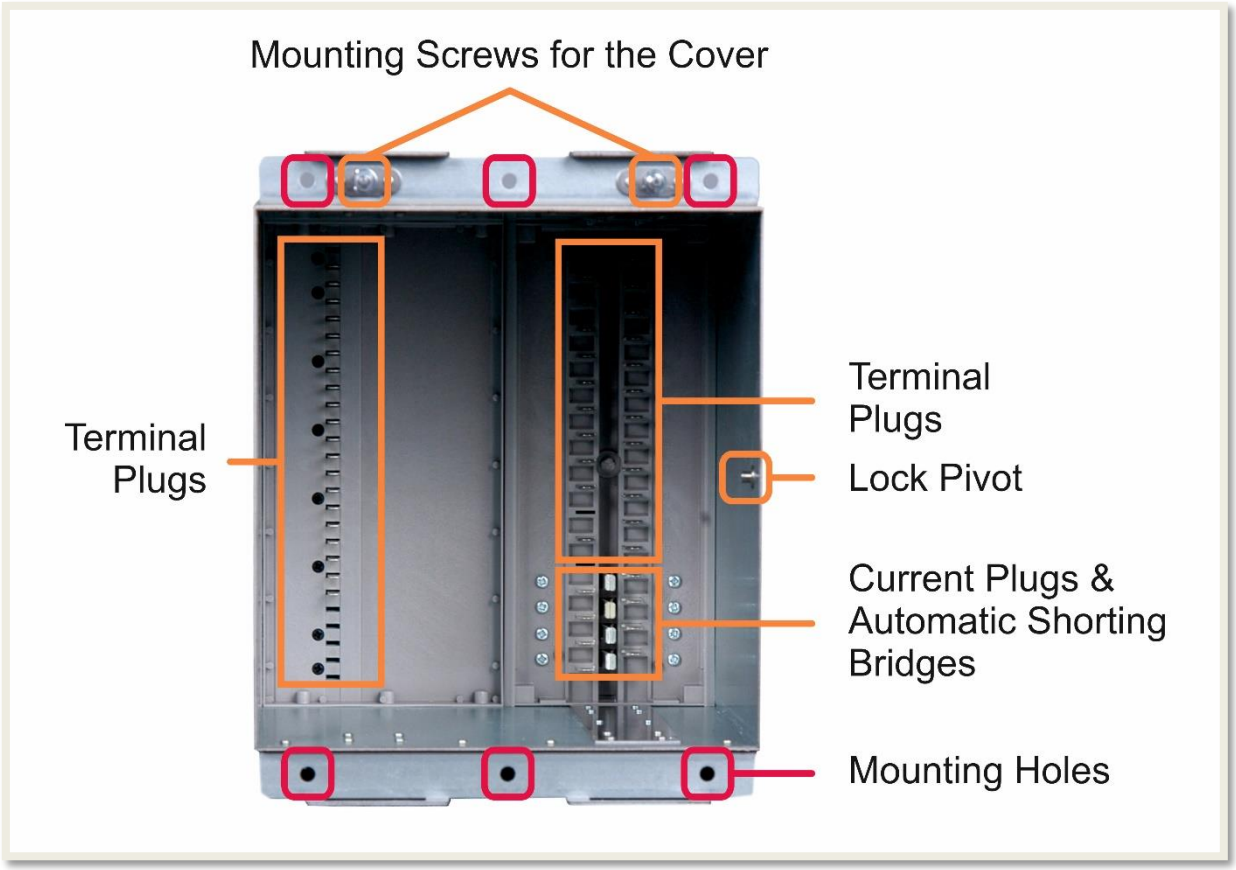
- **Locking Mechanism**
  As a subsystem of the patented DDS (DEMA Draw out System) technology, internal unit locking mechanism provides locking and drawing out of the internal unit with ease. Locking ensures safe electrical contacts.

- **Current Transformers**
  Transforms secondary current into useful signals to supply measurement and protection circuits with the information they need. Current transformers are integrated into the internal unit – this guarantees fast maintenance and replacement operations without having to carry out calibration procedures.

- **Dip Switches**
  CPM 310 G Digital Overcurrent Protection Relays can operate with X/1A or X/5A current transformers. The dip-switches shown on the image above enables the setting of the relay to work with X / 1 A or X / 5 A current transformers. The dip-switches are used also for earth fault protection setting range.

- **Internal Unit Lock Handle and Release Trigger**
  The internal unit lock handle is released by the release trigger - that enables the drawing out of the internal unit by rotating the handle in upwards direction, as shown in the above figure.

- **Lock Button**
  Lock button is used for locking the handle and the internal unit after the internal unit is drawn completely into the case. Before drawing the internal unit in, lock handle must be positioned parallel to the ground. ↺



CPM 310 G: External Unit (Case) – Front View

- **Mounting Screws for the Cover**
  The cover is mounted onto the case via these screws. Screws are embedded and fixed on the case.

- **Terminal Plugs**
  Plugs make the electrical connection by locking to the sockets when the internal unit is drawn into the case. Secondary current plugs are longer than the auxiliary plugs – this ensures the draw out of the internal unit safe from unwanted circuit breaker commands induced by the transient signals occurring while the sockets are disconnecting.

- **Lock Pivot**
  Internal unit locking mechanism locks to this pivot, providing mechanical and contacting stability.

- **Current Plugs & Automatic Shorting Bridges**
  Current plugs provide the electrical connection of the secondary circuit cabling to the internal unit circuits. When the internal unit is drawn out, the automatic secondary current bridges safely short-circuits the secondary terminals – by doing this, secondary circuit continuity is provided and open secondary circuit cases are preventing. This feature enables operators to drive out the internal unit for replacement, testing or similar purposes while the system is energized.

- **Mounting Holes**
  The relay case is mounted on the panel or rack from these mounting holes. Connection elements needed for mounting the case is supplied within the product box. □

Protection and Reset Curves

DEMA CPM 310 G Overcurrent Protection Relays can employ and run IEC and IEEE / ANSI protection and reset curves, as well as a wide range of special curves that are mostly used when CPM 310 G units are used in the same selectivity scheme with older models of protection relays such as electromechanical relays. The wide setting ranges make CPM 310 G compatible with most of the protection and selectivity schemes currently in use worldwide.

CPM 310 G protection and reset curves, and formulas, parameters and setting ranges belonging to these are given in the below table. The Thermal Overload Protection Function is studied in detail in its dedicated section - for this, parameters and other information for thermal overcurrent protection is not given in the table. □

$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

Universal Formula for Protection Curves

$$t = \left[\frac{T_{res}}{1 - \left(\frac{I}{I_S}\right)^{\alpha}} + C\right] \times RTMS$$

Universal Formula for Reset Curves

Eğri Tipi		Koruma Eğrisi Parametreleri				Reset Eğrisi Parametreleri					Uygulanan Standart
Açıklama	Kısaltma	A	α (Açma Faktörü)	B	Ayar Aralığı	Tres	α (Reset Faktörü)	C	Ayar Aralığı	Reset Tipi	
Short Time Inverse Kısa Zamanlı Ters	IEC STI	0.05 s	0.04	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	IEC
Standard Inverse Normal Ters	IEC SI	0.14 s	0.02	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	IEC
Very Inverse Çok Ters	IEC VI	13.5 s	1	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	IEC
Extremely Inverse Aşırı Ters	IEC EI	80 s	2	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	IEC
Long Time Inverse Uzun Zamanlı Ters	IEC LTI	120 s	1	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	IEC
Semiconductor Protection Yarıiletken Koruma	SA Semic	35500 s	6	0	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	Özel Eğri SA
Definite Inverse (DI) Özel Sabite Yakın Ters (DI)	SB DI	2.96875 s	2.3	1.96875 s	TMS 0.025-3.2	-	-	-	DMT (0.04-100) s	DMT	Özel Eğri SB
Short Time Inverse (CO2) Özel Kısa Zamanlı Ters (CO2)	SC CO2	0.0092 s	0.02	0.008 s	TMS 0.025-3.2	- 6.9	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	Özel Eğri SC
Long Time Inverse (SD CO8) Özel Uzun Zamanlı Ters (SD CO8)	SD CO8	21 s	2	0.72 s	TMS 0.025-3.2	- 39.6	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	Özel Eğri SD
Standard Inverse (CO-C3H) Özel Normal Ters (CO-C3H)	SE CO-C3H	1.81 s	1.05	0.68 s	TMS 0.025-3.2	- 2.2	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	Özel Eğri SE
Moderately Inverse Ilımlı Ters	IEEE MI	0.0515 s	0.02	0.114 s	TMS 0.025-3.2	- 4.85	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	IEEE / ANSI
Very Inverse Çok Ters	IEEE VI	19.61 s	2	0.491 s	TMS 0.025-3.2	- 21.6	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	IEEE / ANSI
Extremely Inverse Aşırı Ters	IEEE EI	28.2 s	2	0.1217 s	TMS 0.025-3.2	- 29.1	- 2	- 0	DMT (0.04-100) s RTMS 0.025-3.2	DMT IDMT	IEEE / ANSI
Definite Minimum Time Sabit Zaman	DMT	-	-	-	DMT 0.01-150s	-	-	-	DMT (0.04-100) s	DMT	-
Thermal Overload Termik Aşırı Yük	*IEC Koruma Eğrileri* bölümünde incelenmiştir.										IEC

Table of CPM 310 G Protection and Reset Curves Parameters

IEC Protection Curves

"IEC (International Electro-technical Commission) *60255-3, Electrical relays - Part 3: Single input energizing quantity measuring relays with dependent or independent time"* standard describes the protection curves named as below.

1. IEC STI: IEC Short Time Inverse Curve.
2. IEC SI: IEC Standard Inverse Curve.
3. IEC VI: IEC Very Inverse Curve.
4. IEC EI: IEC Extremely Inverse Curve.
5. IEC LTI: IEC Long Time Inverse Curve.
6. IEC Thermal Overload Curve.

$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

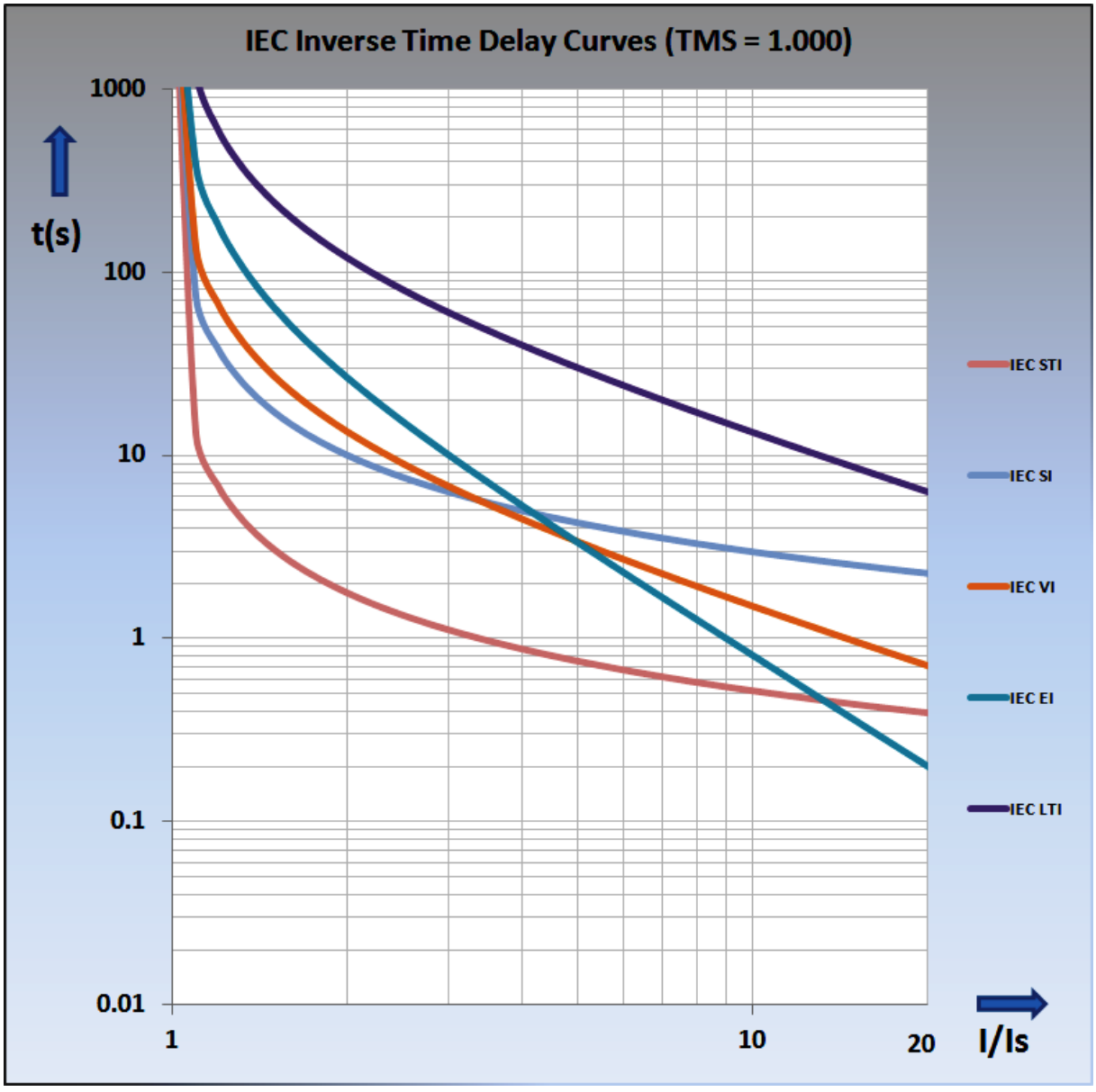
Universal trip time delay formula is given above, while IEC constants for various curves are given on the below table.

t	Trip delay (s).
A	A constant for the characteristic (s).
I	Momentary current (A).
Is	Set current threshold (A).
α	A constant for the characteristic (-).
B	A constant for the characteristic (s).
TMS	Time Multiplier Setting (-).

□

Curve Type	Trip Delay Formula	Reset Delay Setting Range
IEC STI Short Time Inverse	$t = \left[\frac{0.05\ s}{\left(\frac{I}{I_S}\right)^{0.04} - 1}\right] \times TMS,$	$tReset = DMT\ (0.04 - 100)\ s$
IEC SI Standard Inverse	$t = \left[\frac{0.14\ s}{\left(\frac{I}{I_S}\right)^{0.02} - 1}\right] \times TMS$	$tReset = DMT\ (0.04 - 100)\ s$
IEC VI Very Inverse	$t = \left[\frac{13.5\ s}{\left(\frac{I}{I_S}\right) - 1}\right] \times TMS$	$tReset = DMT\ (0.04 - 100)\ s$
IEC EI Extremely Inverse	$t = \left[\frac{80\ s}{\left(\frac{I}{I_S}\right)^{2} - 1}\right] \times TMS$	$tReset = DMT\ (0.04 - 100)\ s$
IEC LTI Long Time Inverse	$t = \left[\frac{120\ s}{\left(\frac{I}{I_S}\right) - 1}\right] \times TMS$	$tReset = DMT\ (0.04 - 100)\ s$

The image below shows the trip delay curves for all IEC characteristics with TMS = 1. TMS can be set in the range (0.025 - 3.2) for any protection function.

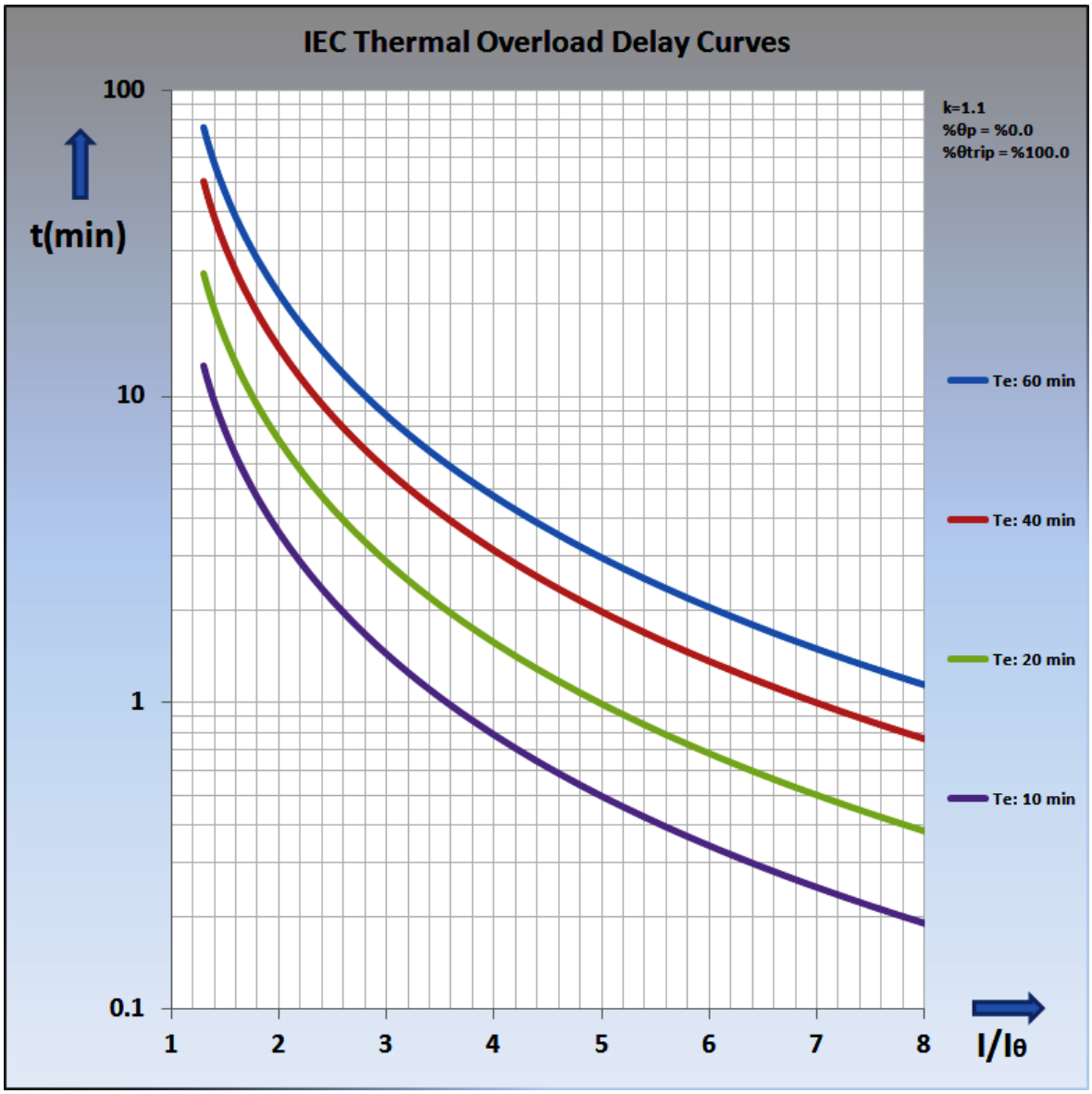


IEC Thermal Overload Protection Curve

IEC Thermal Overload Protection formula and sample curves according to this formula are given below. Formula characteristic is determined by the T_e, k, I_θ, $\%\theta_p$ and $\%\theta_{trip}$ parameters. When setting ranges for these parameters are considered, it is calculated that CPM 310 G relay can run 1,540,000 unique IEC Thermal Overload Protection curves; for its impossible to demonstrate all of the curves on a chart, sample curves are given on the below chart to express an overview of the characteristic. □

$$t = T_e \times \log_e \left[\frac{\left(\frac{I}{k \times I_\Theta}\right)^2 - \%\Theta_p}{\left(\frac{I}{k \times I_\Theta}\right)^2 - \%\Theta_{trip}} \right]$$

t	Trip time delay (minute).
T_e	Thermal Constant (minute); setting range: (1-200) m, in 1m steps.
k	Trip Threshold Translation Constant (-); setting range: (1.00-1.50), in 0.01 steps.
I	RMS value of load current (A).
I_θ	Set current (A); setting range: (0.10-3.20) In, in 0.01I_n steps.
$\%\theta_p$	Overload Pre-heating (%); setting range: (50-200) %, in 1% steps.
$\%\theta_{trip}$	Overload Trip Threshold (%); setting range: (50-200) %, in 1% steps. □



ANSI / IEEE Protection Curves

"IEEE (The Institute of Electrical and Electronics Engineers, Inc.) C37.112-2006: IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays - Description" standard describes the protection curves named as below.

1. IEEE MI: IEEE Moderately Inverse Curve.
2. IEEE VI: IEEE Very Inverse Curve.
3. IEEE EI: IEEE Extremely Inverse Curve.

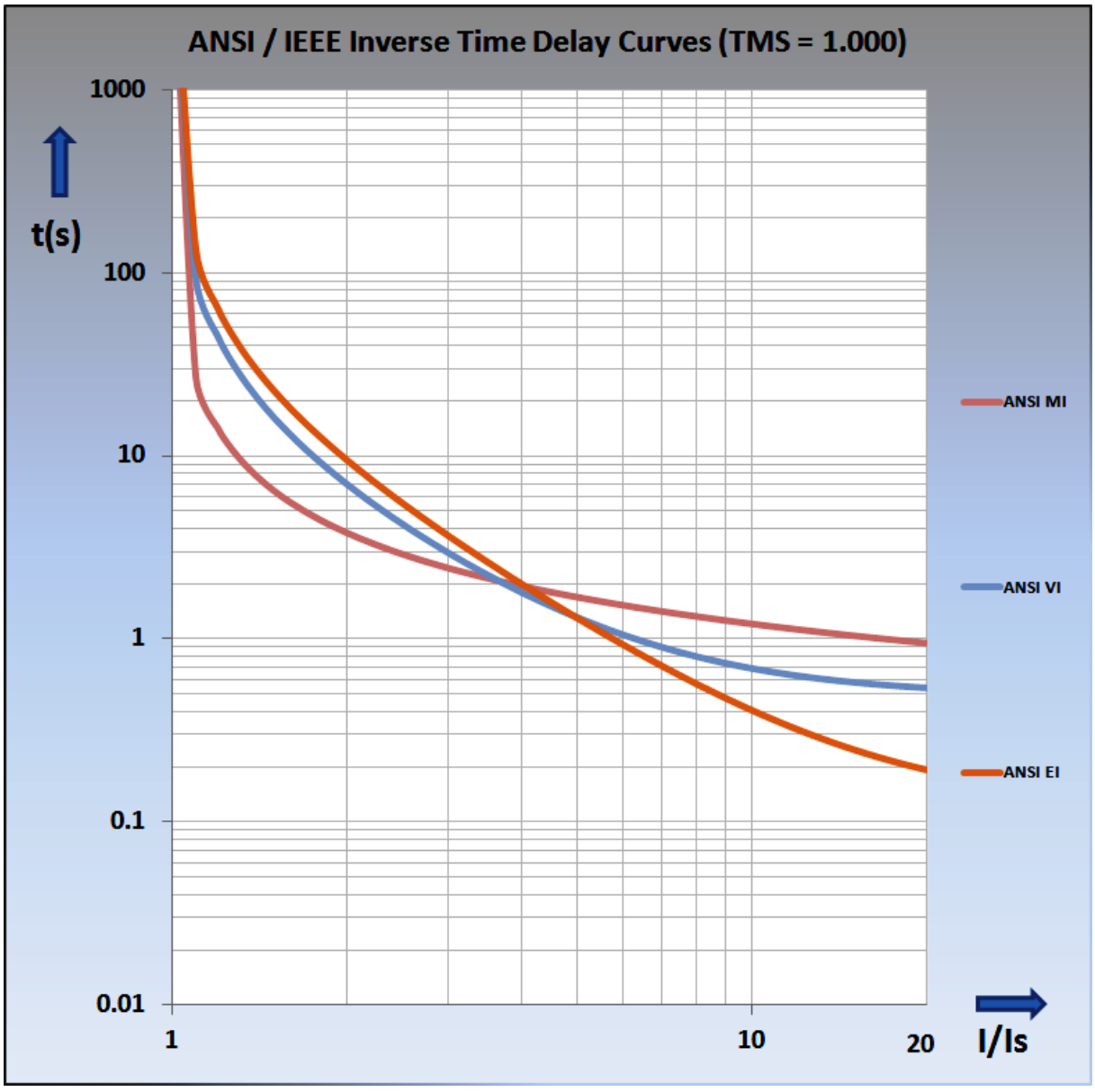
$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

Universal trip time delay formula is given above, while ANSI / IEEE constants for various curves are given on the below table.

t	Trip delay (s).
A	A constant for the characteristic (s).
I	Momentary current (A).
Is	Set current threshold (A).
α	A constant for the characteristic (-).
B	A constant for the characteristic (s).
TMS	Time Multiplier Setting (-). □

Curve Type	Trip Delay Formula	Reset Delay Setting Range
ANSI / IEEE MI Moderately Inverse	$t = \left[\frac{0.0515\ s}{\left(\frac{I}{I_S}\right)^{0.02} - 1} + 0.114\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$
ANSI / IEEE VI Very Inverse	$t = \left[\frac{19.61\ s}{\left(\frac{I}{I_S}\right)^{2} - 1} + 0.491\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$
ANSI / IEEE EI Extremely Inverse	$t = \left[\frac{28.2\ s}{\left(\frac{I}{I_S}\right)^{2} - 1} + 0.1217\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$

The image below shows the trip delay curves for all ANSI / IEEE characteristics with TMS = 1. TMS can be set in the range (0.025 - 3.2) for any protection function.



Custom Protection Curves

CPM 310 G Special Curves include inverse protection curves for electromechanical relays, constant time characteristic and reset curves. These curves are listed below.

1. SA Semic: Semiconductor Protection Curve.
2. SB DI: Definite Inverse Curve.
3. SC CO2: Short time Inverse Curve.
4. SD CO8: Long Time Inverse Curve.
5. SE CO-C3H: Standard Inverse Curve.

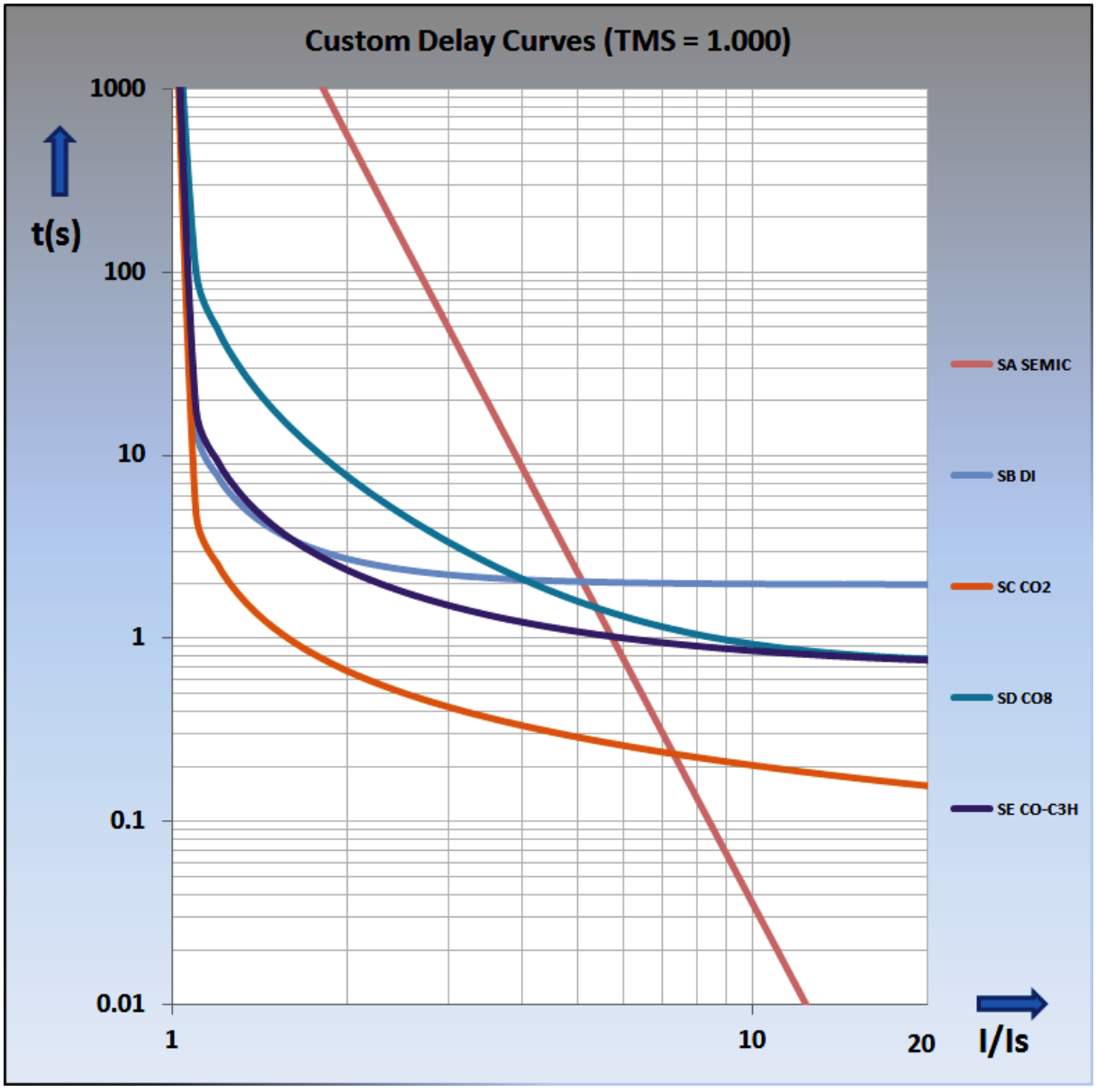
$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

Universal trip time delay formula is given above, while special curve parameters are given on the below table.

t Trip delay (s).
A A constant for the characteristic (s).
I Momentary current (A).
Is Set current threshold (A).
α A constant for the characteristic (-).
B A constant for the characteristic (s).
TMS Time Multiplier Setting (-). □

Curve Type	Trip Delay Formula	Reset Delay Setting Range
SA Semic Semiconductor Protection	$t = \left[\frac{35500\ s}{\left(\frac{I}{I_S}\right)^{6} - 1}\right] \times TMS$	$DMT\ (0.04 - 100)\ s$
SB DI Definite Inverse	$t = \left[\frac{2.96875\ s}{\left(\frac{I}{I_S}\right)^{2.3} - 1} + 1.96875\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$
SC CO2 Short Time Inverse	$t = \left[\frac{0.0092\ s}{\left(\frac{I}{I_S}\right)^{0.02} - 1} + 0.008\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$
SD CO8 Long Time Inverse	$t = \left[\frac{21\ s}{\left(\frac{I}{I_S}\right)^{2} - 1} + 0.720\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$
SE CO-C3H Standard Inverse	$t = \left[\frac{1.81\ s}{\left(\frac{I}{I_S}\right)^{1.05} - 1} + 0.680\ s\right] \times TMS$	$DMT\ (0.04 - 100)\ s$ *or* $RTMS\ (0.025 - 3.2)$

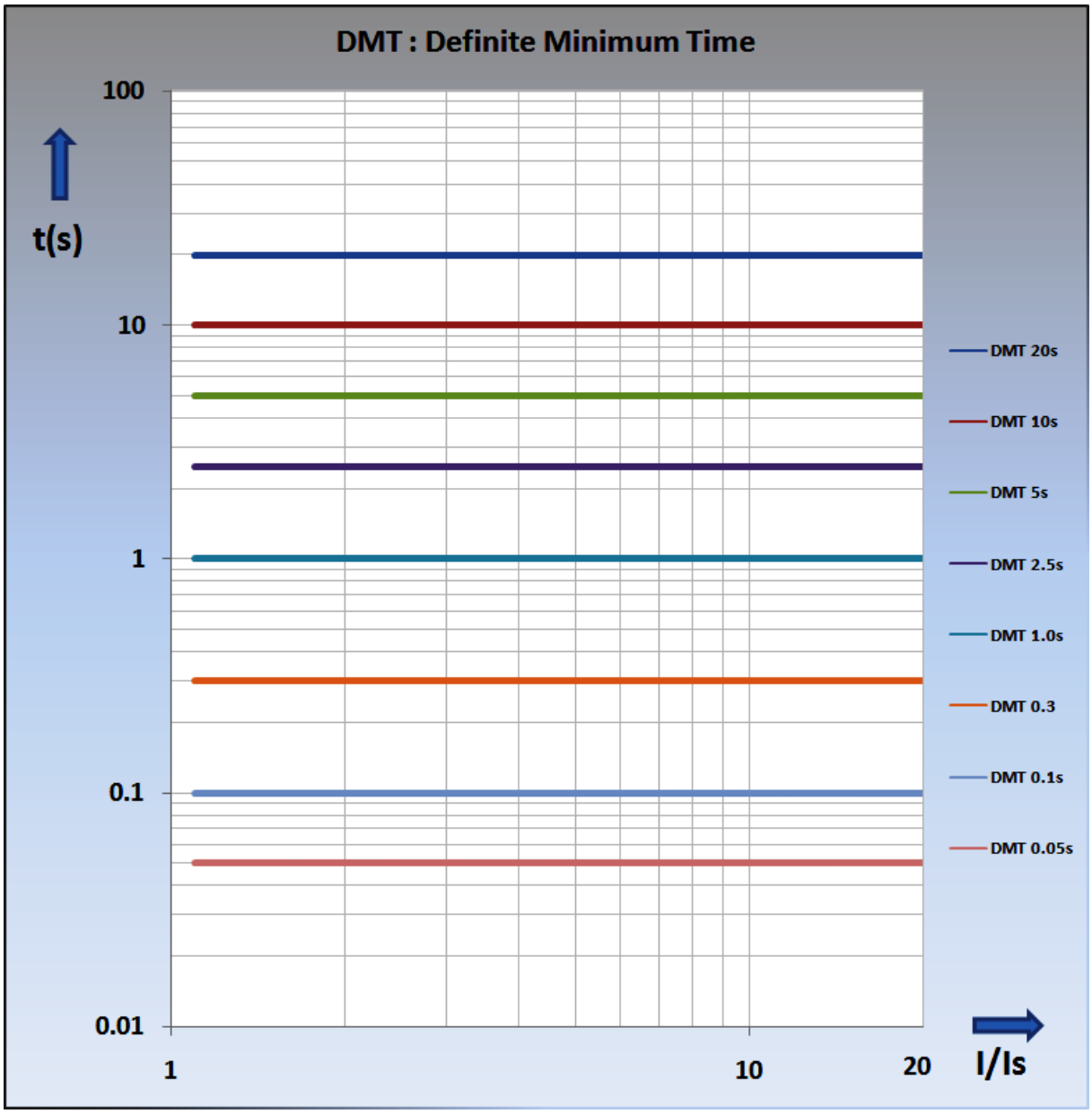
The image below shows the custom trip delay curves with TMS = 1. TMS can be set in the range (0.025 - 3.2) for any protection function.



DMT: Definite Minimum Time Characteristic

DMT characteristic is used for obtaining constant trip and reset times. There are no parameters for the DMT characteristic other than the constant trip or reset time. Characteristic notation is as follows: e.g., t = DMT 0.25s.

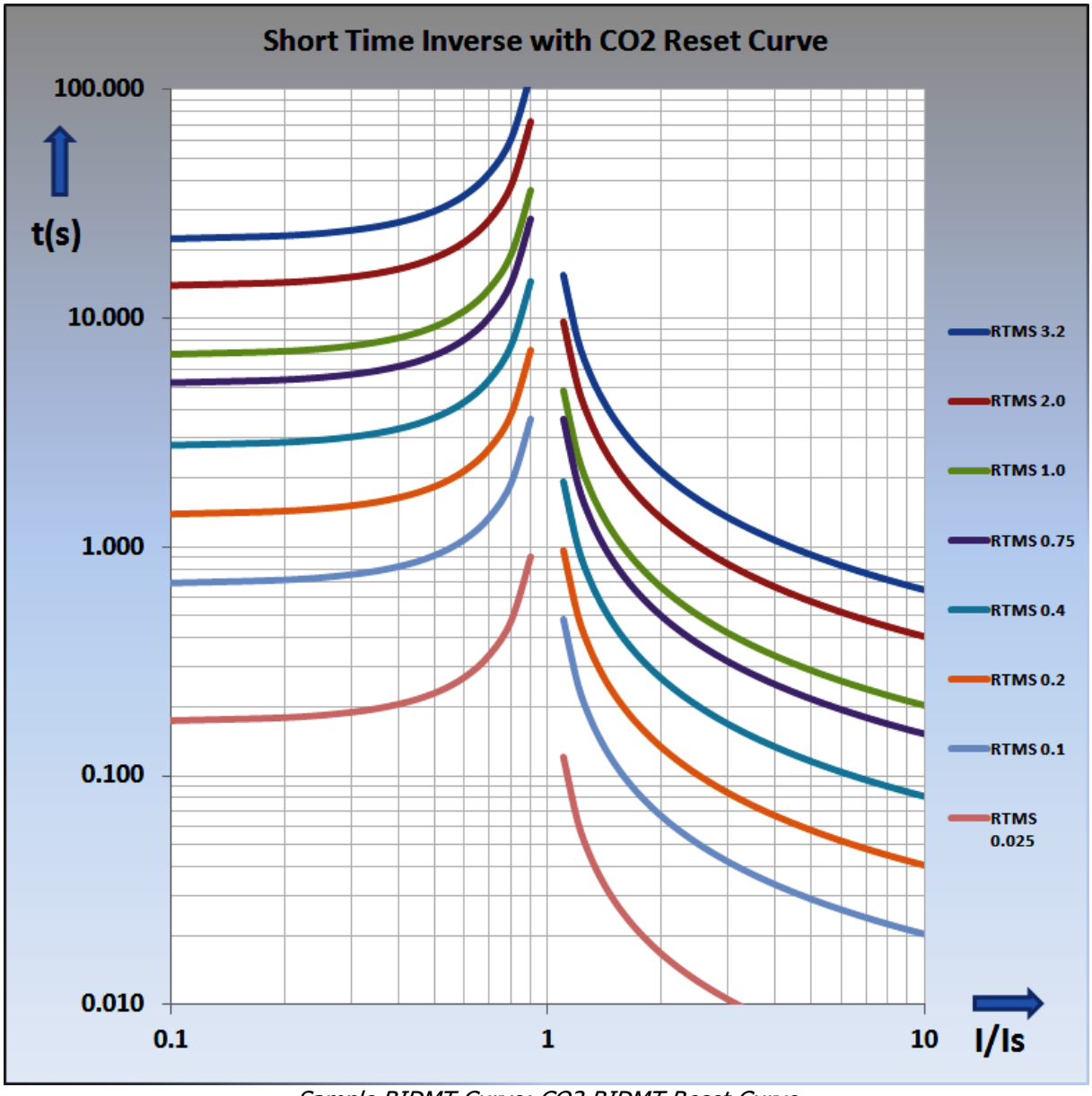
The image below shows the DMT characteristics for given current values. □



RIDMT: Reset Inverse Definite Minimum Time Characteristic

RIDMT curves are used to obtain the inverse D.M.T. resetting characteristics for IEEE/ANSI and custom curves that are needed to provide selectivity schemes when electromechanical relays are protecting a primary line in series with the one CPM 310 G protects. The RIDMT parameters differ with the tripping curve, the *Table of CPM 310 G Protection and Reset Curves Parameters* on page 22 shows these parameters. The sample image below shows the CO2 short time inverse trip characteristic and it RIDMT curve. The formula below is to calculate the reset delay for CO2 RIDMT curve. □

$$t = \left[\frac{6.9\ s}{1 - \left(\frac{I}{I_S}\right)^2}\right] \times RTMS$$



Sample RIDMT Curve: CO2 RIDMT Reset Curve
For other RIDMT curves, see the table at p.22

PACKING & LABELING INFORMATION

Packing & Labeling Information

This section explains CPM 310 G packing information, package contents and introduces the device label.

Packing Information

Case Dimensions	(17 x 20 x 24) (cm) [width x height x depth]	
Case Type	Carton box with IP50 sealing.	
Gross Weight	3.4 kg	
Package Contents	CPM 310 G Digital Overcurrent Protection Relay	1 piece
	USB Communications Cable	1 piece
	Mounting Elements	1 set
	CPM 310 G Quick Guide	1 sheet
	CD that contains DigiConnect PC Program and CPM 310 G User & Application Manual	1 CD

Labels

CPM 310 G products arrive with 2 labels: package label and unit label.

The package label gives the following info.

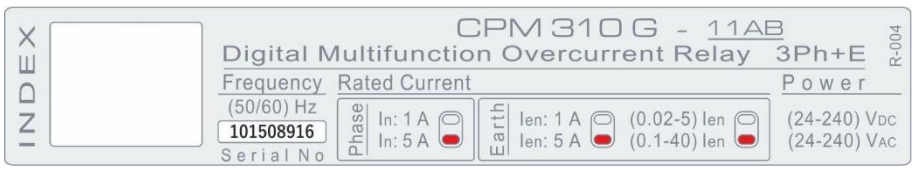
Manufacturer Logo	*DEMA*
Product Name	*CPM 310 G*
Product Description	*Digital Multifunction Overcurrent Relay 3Ph + E*
Unit Serial Number	*G1234567*

The unit label located on the front side of the relay gives the following info.

Manufacturer Logo	*DEMA*
Product Name	*CPM 310 G*
Ordering Code [2]	*11AB*
Product Description	*Digital Multifunction Overcurrent Relay, 3Ph + E*
Rated Frequency	*50 Hz / 60 Hz*
Unit Serial Number	*G0910001*
Nominal Phase Current	*1 A / 5 A*
Nominal Earth Current	*1 A / 5 A*
Earth Protection Setting Range	*(0.02 - 5) I_{en} / (0.1-40) I_{en}*
Auxiliary Supply Voltage	*(24-240) V_{DC} / V_{AC}*

The default settings for the *Nominal Phase Current*, *Nominal Earth Current* and *Earth Protection Setting Range* are marked in red. As seen on the below label; default values are: *Nominal Phase Current In = 5A*, *Nominal Earth Current Ien = 5A,* and *Earth Protection Setting Range = (0.1-40) I_{en}* .

The settings for the mentioned parameters can be changed via dip-switch settings if needed, as described in the dedicated section *Dip-switch Settings* at p.47. If any changes are made on dip-switches, it is highly recommended that the relevant red markings are erased gently with a soft cloth damped with alcohol and remarked to demonstrate the actual setting; this will prevent misinterpretations. □



[2] Ordering codes are given at p.219.

OPERATING MANUAL

General Principles

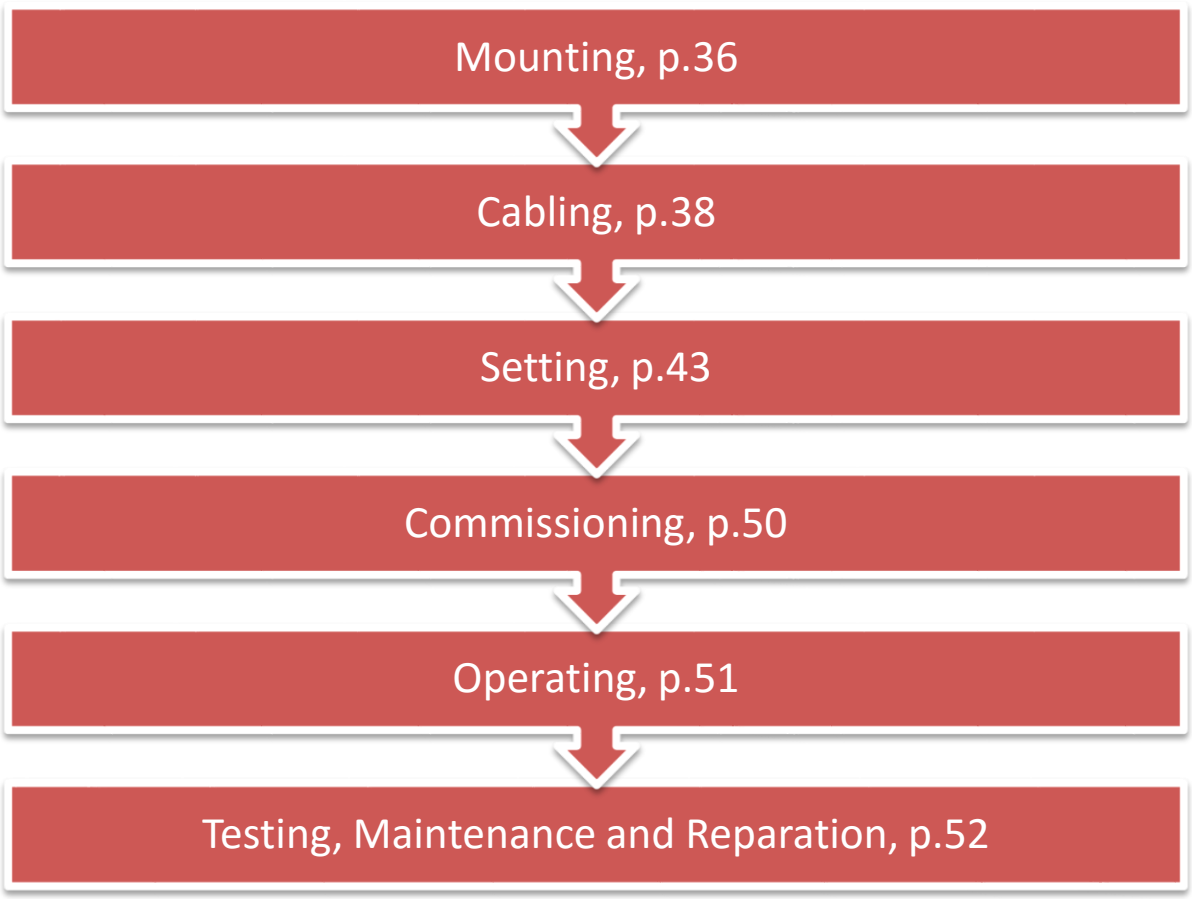
Operating manual describes all operating procedures for CPM 310 G relays; starting from the mounting and cabling stages to maintenance and test procedure.

Operation stages are shown on the below figure to visualize handling of the product free of problems. Each stage is discussed thoroughly at the belonging section.

For feed-back on the operation manual, or technical assistance requests, please do not hesitate to call our technical support department.

Product Manager	Elec. Eng. Necati Ozbey
Phone	(+90) (216) 352 77 34
	(+90) (216) 352 77 35
Fax.	(+90) (216) 442 17 95
e-mail	necati@demarelay.com
WEB	www.demarelay.com

□



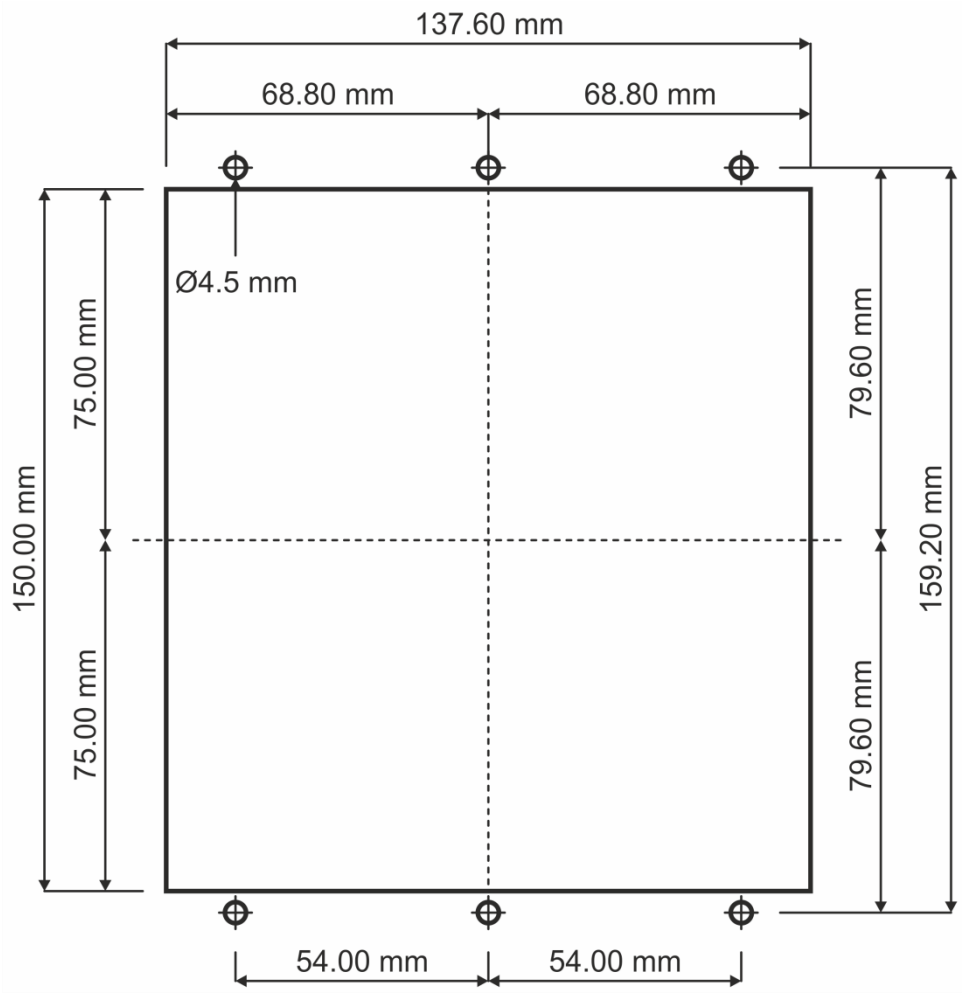
Mounting

The following pages describe the mounting of CP 310 G case – for CPM 310 G relays are designed with draw-out system, the internal and external units can be handled independently during the mounting and cabling processes.

PANEL CUT-OUT

Flush mounting requires processing of the panel – the drawing below gives dimensions needed for the cut-out. The dimensions on the drawing are determined taking standard electrostatic coating thickness into consideration.

- If the cut-out is processed at the panel manufacturing stage, please prepare the cut-out with the dimensions given below. Electrostatic coating thickness will not prevent the correct mounting of the case.
- If the cut-out is to be processed on an existing panel; please prepare the cut-out with the dimensions given below, and pay heed to these instructions:
    - The cut-out edges and the mounting holes should be fine treated after the cutting process to prevent the case coating from scratching and to perform a level mounting.
    - The cut-out edges should be treated with anti-corrosive coatings and paint against oxidation. ↺



Cut-out Drawing

MOUNTING THE CASE

Mounting of the relay case on the prepared panel is done as described below.

1. Open the relay cover; preferably drive out the internal unit for easier mounting. If the internal unit is drawn out, take all precautions to prevent dusting and damaging of the unit.
2. Place the case into the cut-out.
3. Use the supplied 5 sets of M4 custom screws, standard M4 nuts and washers to fix the case onto the panel. Drive the screws from the front first, and then tighten the nuts on the washers from the backside of the panel.
    - Make sure that the supplied custom screws are used for mounting. Using any other screws may result in sealing failure and loss of protection degree of the cover!
    - Make sure that all 5 mounting holes are screwed and tightened. Mounting the case from lesser points may result in mechanical stresses and bending on the case construction due to any possible deformations on the panel. Such inappropriate applications may harden driving the internal unit into or out of the case.
4. Always use torque drivers when working with the relay. Apply (0.69 – 0.82) N·m torque when tightening the nuts.

MOUNTING THE INNER UNIT AND THE COVER

1. Rotate the lock handle to provide an approximate degree of 90 between the handle and the internal unit. Drive the internal unit into the case until the unit fits well, the press the lock button to lock the unit in place. This will ensure healthy electrical connection between the internal unit and the case.
2. Place the bottom part of the cover into its place on the case first, and then close the cover on the case. Make sure the cover fits in its place and the sealing is provided between the cover and the case. Tighten the mounting element on the cover.
    - 0.20 N·m torque is sufficient to provide IP52 protection when tightening the mounting elements on the cover. Never apply torque values higher than 0.29 N·m! This may damage the mounting elements and may lead the cover out of service! □

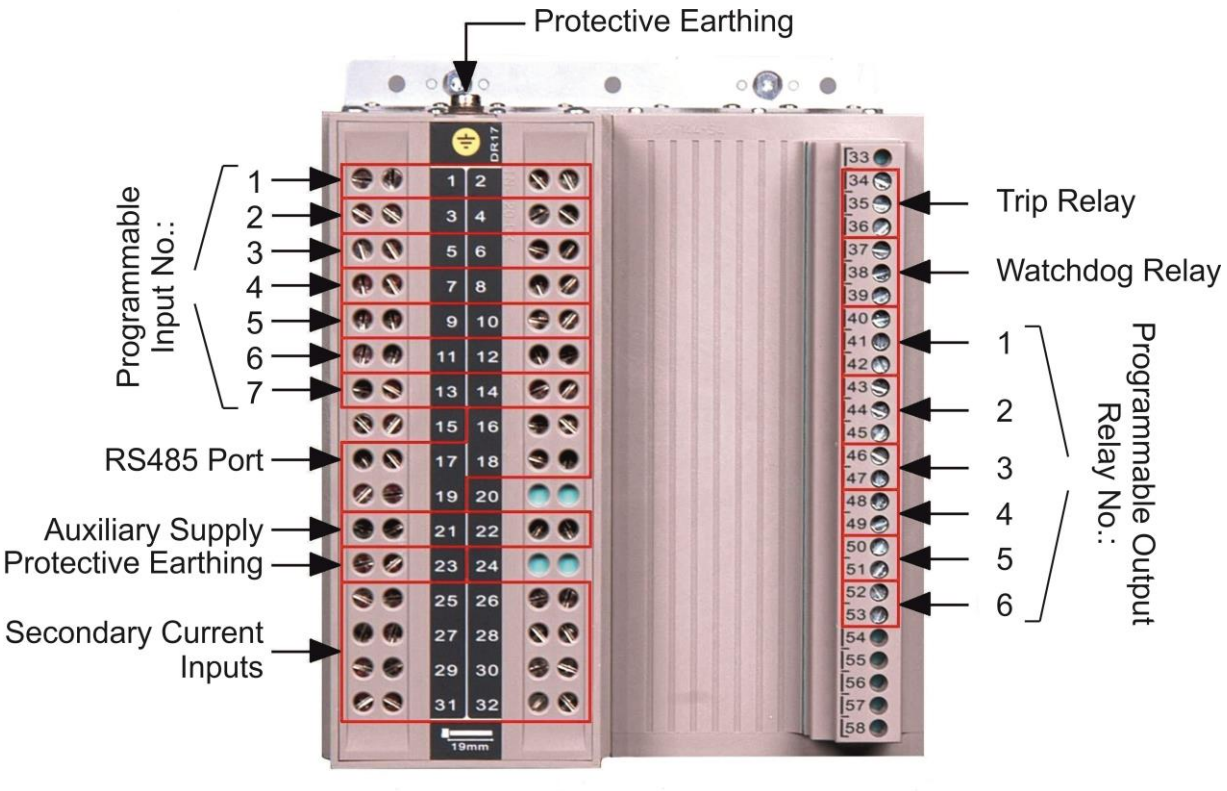
Mounting Holes

Cabling

The following pages describe the cabling procedure of DEMA CPM 310 G Digital Overcurrent Protection Relays. The critical points to be considered about the connections will also be clarified.

CABLING DIAGRAM

The picture below shows the rear view of CPM 310 G, where terminals are located. As shown on the picture; programmable inputs, RS 485 serial communications port, auxiliary power supply terminals, inner circuit earthing terminals and secondary current inputs are located on the left terminal group; trip relay, watchdog relay and programmable output terminals are located on the right terminal group. Case earthing point is located on the upper side of the case, just above the left terminal group.



Rear View and Terminals Legend

CPM 310 G circuit diagram is located on the right side of the relay case when viewed from the front, and this diagram is given also in the following pages; on the other hand, the picture above will provide support for cabling practice by explaining the grouping logic of the terminals. ↺

Terminal numbers and descriptions are given on the table below.

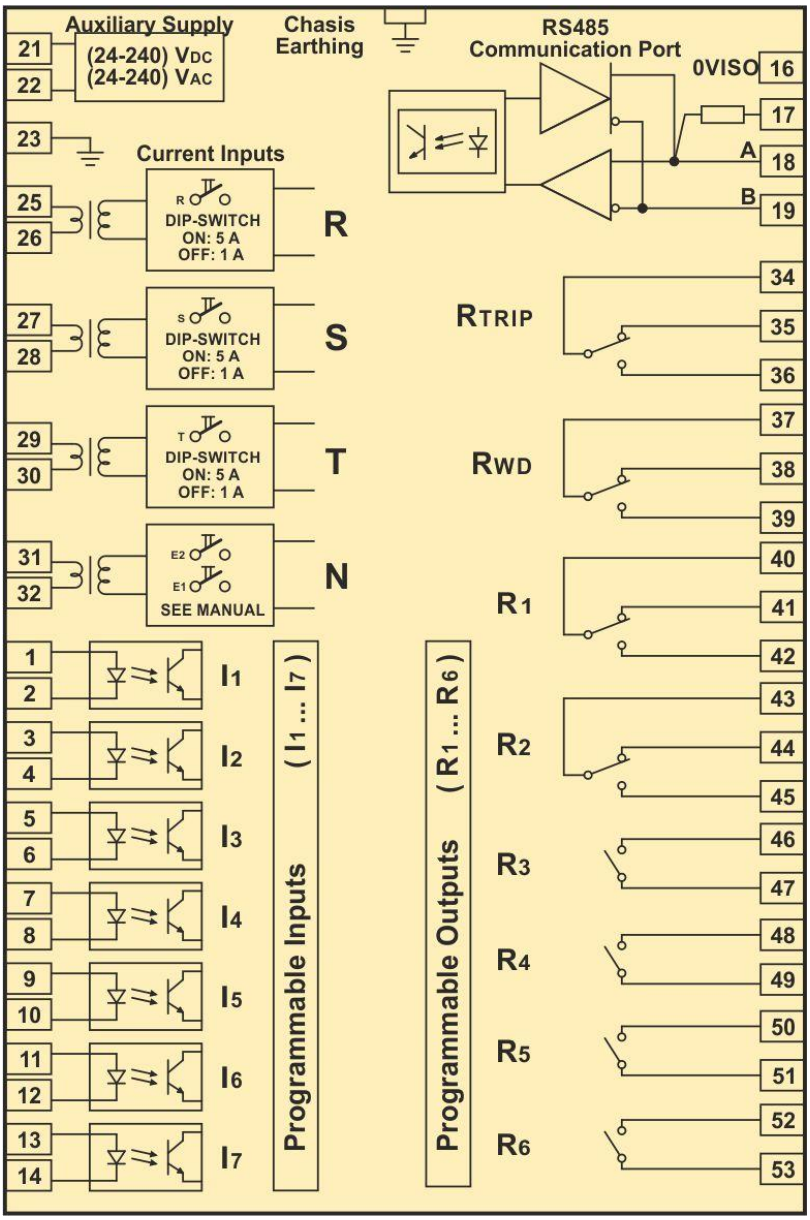
Terminal No.	Terminal Description	Notes
	Inputs	
1	Programmable Input 1	-
2	Programmable Input 1, common terminal	DC (+)
3	Programmable Input 2	-
4	Programmable Input 2, common terminal	DC (+)
5	Programmable Input 3	-
6	Programmable Input 3, common terminal	DC (+)
7	Programmable Input 4	-
8	Programmable Input 4, common terminal	DC (+)
9	Programmable Input 5	-
10	Programmable Input 5, common terminal	DC (+)
11	Programmable Input 6	-
12	Programmable Input 6, common terminal	DC (+)
13	Programmable Input 7	-
14	Programmable Input 7, common terminal	DC (+)
15	Not used.	-
	RS 485	
16	RS 485, 0VISO	Reference voltage.
17	RS 485, Termination Resistance.	-
18	RS 485, A terminal.	-
19	RS 485, B terminal.	-
20	Not used.	-
	Auxiliary Supply and Earthing	
21	Auxiliary Supply Terminal	DC (-) or AC neutral.
22	Auxiliary Supply Terminal	DC (+) or AC phase.
23	Internal Circuit Earthing Terminal	-
24	Not used.	-
	Secondary Current Terminals	
25	Current Input Terminal for Phase R	(1/5)A
26	Terminal for Current Bridge	-
27	Current Input Terminal for Phase S	(1/5)A
28	Terminal for Current Bridge	-
29	Current Input Terminal for Phase T	(1/5)A
30	Terminal for Current Bridge	-
31	Current Output Terminal for Neutral Point	(1/5)A
32	Terminal for Current Bridge	-
33	Not used.	-
	Outputs	
34	Trip signal common terminal	DC (+)
35	Trip signal N/C terminal	DC (+) out.
36	Trip signal N/O terminal	DC (+) out.
37	Watchdog common terminal	DC (+) or AC phase.
38	Watchdog N/C terminal	Alarm / Signal output.
39	Watchdog N/O terminal	Alarm / Signal output.
40	Programmable Output 1 Common Termin	DC (+)
41	Programmable Output 1 N/C Terminal	DC (+) out.
42	Programmable Output 1 N/O Terminal	DC (+) out.
43	Programmable Output 2 Common Termin	DC (+)
44	Programmable Output 2 N/C Terminal	DC (+) out.
45	Programmable Output 2 N/O Terminal	DC (+) out.
46	Programmable Output 3 Common Termin	DC (+)
47	Programmable Output 3 N/O Terminal	DC (+) out.
48	Programmable Output 4 Common Termin	DC (+)
49	Programmable Output 4 N/O Terminal	DC (+) out.
50	Programmable Output 5 Common Termin	DC (+)
51	Programmable Output 5 N/O Terminal	DC (+) out.
52	Programmable Output 6 Common Termin	DC (+)
53	Programmable Output 6 N/O Terminal	DC (+) out.
54	Not used.	
55	Not used.	
56	Not used.	
57	Not used.	
58	Not used.	

CPM 310 G Terminal Explanations

CAUTION!

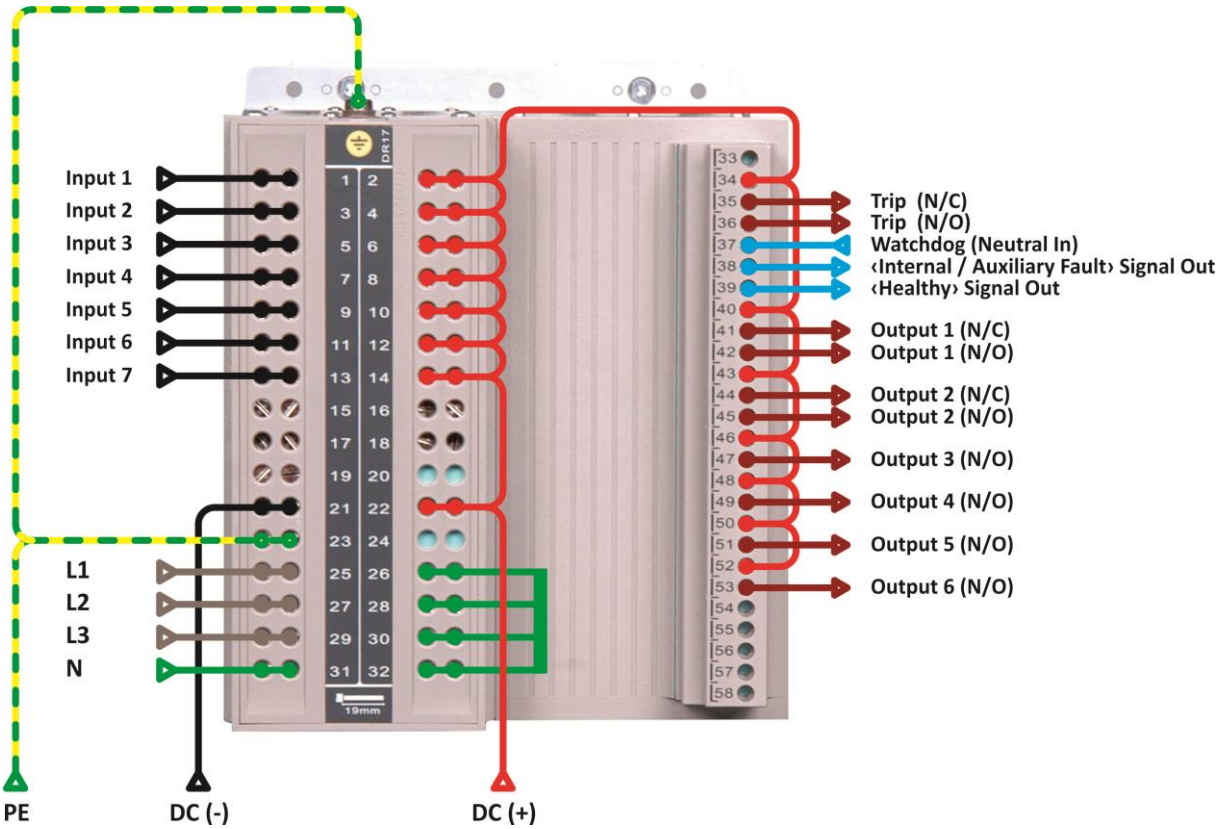
The "Notes" columns on the table suggests a sample application and is not normative. "DC(+)" notes, e.g., are given assuming that the circuit breaker, the power transformer and auxiliary devices are cabled in the way that their common terminals are supplied with DC(-). If an application does not correspond to the case here assumed, do not take the note columns into consideration and create the actual cabling project required to provide the healthy operation of the system. ↺

The diagram below represents the inner circuit design of CPM 310. Sample cabling diagram is given on the following page. ↺



CPM 310 G Circuit Diagram

DEMA CPM 310 Sample cabling diagram is given below. The cabling color codes are given on the top right corner; according to the coding logic, DC (+) cables are in red, DC (-) are in black, AC (L or N) supply cables are in blue, current transformer live secondary signal (L1, L2, L3) cables are in brown, current transformer neutral point (N) cable is in yellow, and protective earthing (PE) cables are in green. Sample diagram is created assuming that neutral point of secondary current lines is to be earthed.



Sample CPM 310 G Cabling Diagram

As explained at the *CPM 310 G Terminal Explanations* list and shown on the diagram above, the common supplies for input and outputs are done as DC (+), excluding Watchdog relay supply. This wiring assumes the following conditions:

- Inputs signals from external sources (e.g. a buchholz signal from a power transformer) would be in DC (-) polarity,
- Output signals to external devices (e.g. the trip coil of a circuit breaker) would be of DC (+) polarity.

If your actual circuit has different polarity requirements, prepare your cabling diagram accordingly.

It is seen on the diagram that the watchdog output is supplied with AC. The logic for this application is, that systems with DC auxiliary supply needs another auxiliary supply source, so that an alarm signal can be taken from the normally closed contact of the watchdog relay. If the circuit diagram given in the former page is examined, it will be determined that the watchdog terminal 39 is closed to 37 in normal service conditions – if any auxiliary supply failure occurs, the relay will release and 38 terminals will be shorted to 37, allowing an alarm signal even when the relay is not functioning. It must be noted that this principle works if the supply source of watchdog differs from the main auxiliary supply of the relay. Similarly, a "System OK" signal can be taken out from the terminal no.39.
↺

CABLING MATERIAL

Cabling material selection is important for all protection systems. The principles listed below are to be paid heed to build a robust system.

- Cabling with thin & multi-wire cables:
  - Never make a connection without applying ferrules to wire ends!
  - Use 18 mm wire end ferrules for all terminals no's 1-32. Using ferrules longer than 18 mm may reduce the dielectric withstand capability of the wiring of these terminals!
  - Use 8 mm wire end ferrules for all terminals no's 34-53. Using ferrules longer than 8 mm may reduce the dielectric withstand capability of the wiring of these terminals!
  - Provide solid earthing with low earth resistance to the relay. Use ring cable connectors for connections to relay earthing bolts. Make the earthing connection directly to earth. Never earth the device indirectly or over high resistances!

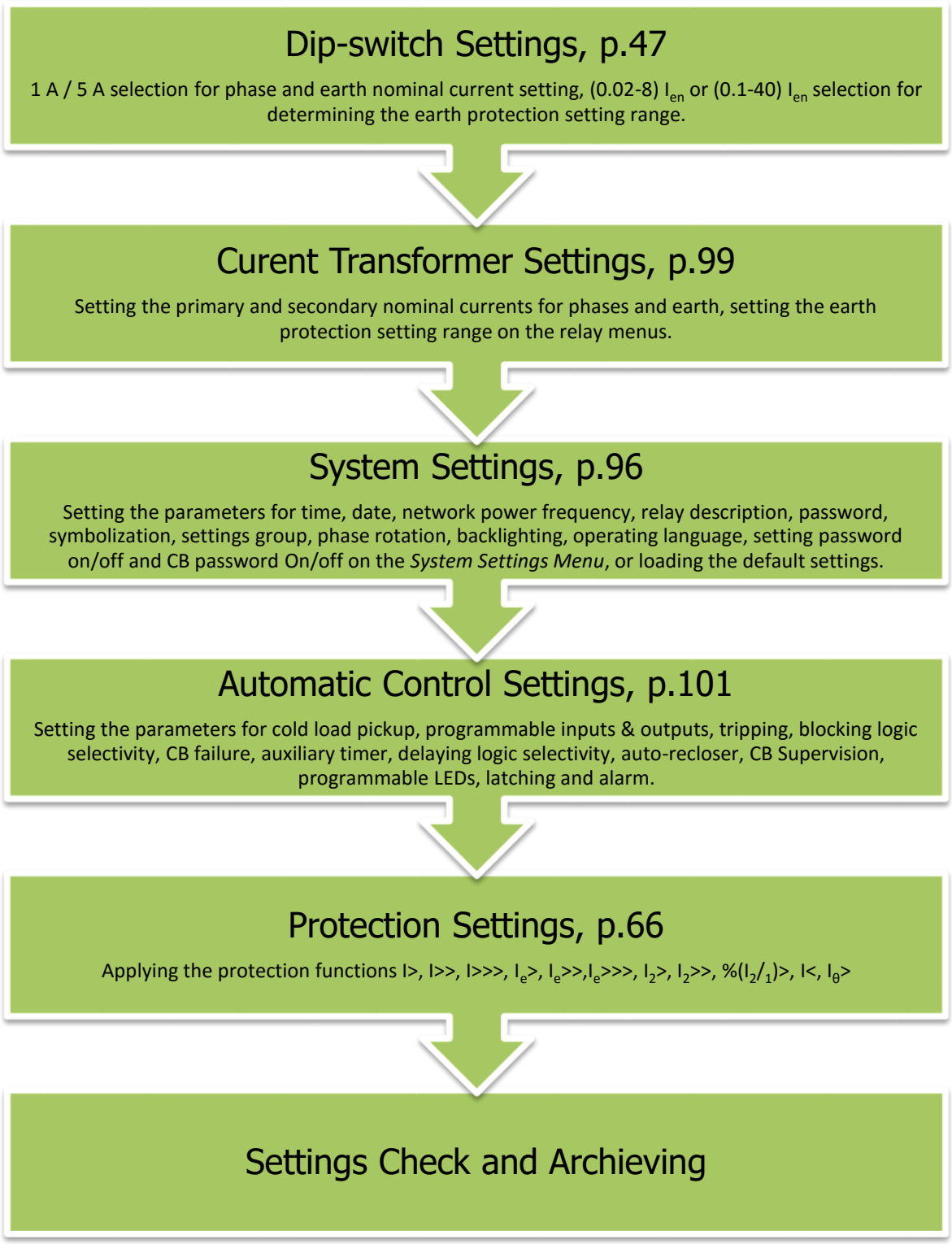
    WARNING!
    Solid earthing is one of the fundamental precautions to provide minimum safety requirements. Before commissioning any electrical system, make sure that earthing process is done correctly according to the relevant standards!

  - Use appropriate tools for crimping the ferrules. Preferably use crimping tools with trapeze cross-section crimping type.
  - Use appropriate tools for stripping the cables. Preferably use stripping tools with adjustable stripping lengths. Apply the instructions of the ferrule manufacturer when stripping.
  - Use appropriate tools for removing the outer coat of multi-core cables, if applicable. Preferably use blades with adjustable cutting depths. Apply the instructions of the cable manufacturer.
  - Use torque screwdrivers to tighten the terminal bolts. Apply (0.56 – 0.69) N·m torque to the bolts – torque application lower than 0.69 N·m may lead to open circuits or high contact resistances, while excessive torque application may damage the terminals!
  - Use non-flammable, standards compliant cables.
  - Determine the wire cross-sections according to relevant standards and engineering guides.

- Cabling with single wire cables is not recommended for protection systems. Mechanical aging risks, increasing contact resistance over time, and poor flexibility are the most important negativities of single wire cables. If cabling with single wire cables is essential, check all connections with great care and apply routine checking procedures to prevent failures. □

Setting

After completing the mounting and cabling phases, relay settings can be done. Follow the procedure explained below. Each step has its own dedicated section to explain setting processes, as stated with page numbers.
To ensure reliable operation, double check and note your settings. ↺



EXAMPLE SETTING AND CALCULATION

Project: It is required that the protection and alarming system of an oil-immersed type power transformer with characteristics 2,500 kV·A, (34.5 / 0.4) kV, 50 Hz is erected, using DEMA CPM 310 G. Protection current transformers are selected as type 60 A / 5 A, 5 V·A 5P10[3]. System must be configured so that the CB control and position indication is achieved via the relay; additionally, it must be alarmed by means of an acoustic alarm system if by any reason the relay is out of service. The power transformer operator should be informed means of an acoustic alarm system, if the power transformer goes through an alarm state or tripped out of service. The neutral current of the upstream power transformer is restricted via resistor banks.

Settings: Relay settings will be done following the steps at p.43.

1. To fulfill the requirements of the project, do the cabling according to the application diagram described at p.190 and given at p.191.

2. Once cabling is done and auxiliary power is supplied to the relay, drive the internal unit of the relay out. Because the nominal secondary current of protection current transformer is 5 A, dip-switch settings must remain as the default ON-ON-ON-ON-ON setting (see p.47); check it. After checking, drive the internal unit inside the case and lock it.

3. The protection current transformer is selected as 60 A / 5 A. Go to the Current Transformer Settings Menu, set Primary Nominal Phase Current and Primary Nominal Earth Current parameters to 60 A and Secondary Nominal Phase Current parameter to 5 A and Secondary Nominal Earth Current parameter to T1-5A (see p.100 – 101).

4. Do the settings below in the Automatic Control Settings Menu:

   Input Settings
   a. Input 1: Buchholz Alarm.
   b. Input 2: Buchholz Trip.
   c. Input 3: Thermometer Alarm.
   d. Input 4: Thermometer Trip.
   e. Input 5: CB Position.

   Output Settings
   a. Output 3: CB Close
   b. Output 6: Trip, Buchholz Alarm, Thermometer Alarm.

   No changes are to be made to default settings in Automatic Control Settings Menu. ↺

[3] The nominal power of current transformers should be determined according to the calculated secondary burden. The burden is calculated by adding up the secondary cable and the protection relay consumption.

5. Thermal protection of the power transformer, and phase and earth protections are to be done. Below calculations and settings are done for this purpose.

Making of Iθ> Thermal Overload Protection Settings

It is assumed that the thermal constant for the power transformer is Te = 20 minutes according to the information supplied by the manufacturer. Take trip threshold translation constant k as 1.10, thermal overload trip heating as %ΘTrip = %100 and thermal overload alarm heating as %ΘAlarm = %80.

Power transformer nominal current is:

$$I_{rTR} = \frac{S_{rTR}}{\sqrt{3} \times U_n} = \frac{2500\ kV \cdot A}{\sqrt{3} \times 34.5\ kV} \cong 41.84\ A$$

Power transformer nominal current / Protection CT primary nominal current ratio:

$$I_{\mathrm{rTR}} = \frac{41.84\ A}{60\ A} \cong 0.70\ I_n$$

Make the setting below so as to activate thermal overload protection at 1.00 I_{rTR}:

Main Screen » Set » I_{Θ}>

Making of I> Phase Overcurrent Protection Settings

a. Around 1.00 I_{rTR}, the PT is protected from overloads. Setting I> threshold at 1.3 I_{rTR} is suitable according to the PT ratings. Threshold set current in terms of I_n of CT:

$$I > = 1.3 \times I_{rTR} \cong 0.91\ I_n$$

b. According to the calculation above, do the following settings: ↺

Main Screen » Set » I>

Notes:

- If there are loads of high inrush pick-up current, fine adjustment of the TMS parameter might be needed.
- If the Thermal Overload Protection is not applied / made passive, set the I> (Phase Overcurrent Protection Threshold) as 1.0 I_{rTR} (0.70 I_n) instead of 1.3 I_{rTR} (0.91 I_n).

Making of I>> Phase Overcurrent Protection Settings

c. To prevent pickup current reach the I>> threshold and cause an unwanted instantaneous trip, I>> can be set to 7 I_{rTR} practically.[4]

$$I \gg = 7 \times I_{rTR} = 4.9\ I_n$$

d. According to the calculation above, do the following settings:

Main Screen » Set » I>>

Making of Ie> Earth Overcurrent Protection Settings

e. It is assumed that earth current up to 0.25 I_{rTR} is considered to be normal. Over this value, the primary circuit will be broken in 1.0 s. Presuming those, I_e> threshold value is calculated as follows:

$$I_e > = (15\ A\ /\ 60\ A) I_{en} = 0.25\ I_{en}$$

f. According to the calculation above, do the following settings:

Main Screen » Set » I_e>

Making of Ie>> Earth Overcurrent Protection Settings

g. Presuming earth current equal to or higher than 0.75 I_{rTR} is considered as earth fault, I_e>> threshold value is calculated as below:

$$I_e \gg = (45\ A\ /\ 60\ A) I_{en} = 0.75\ I_{en}$$

h. According to the calculation above, do the following settings:

Main Screen » Set » I_e>>

6. All needed settings are done by now. Check all the settings and note them. CPM 310 G is ready for commissioning. □

[4] Actual pick-up current values can be checked on *MENU → Measurements → Max RMS Currents* page.

DIP-SWITCH SETTINGS

DEMA CPM Series Overcurrent Protection Relays are equipped with dip-switches to provide compatibility with various kinds of protection current transformers. By employing appropriate dip-switches;

- Acquisition of phase and earth current values from X / 1 A or X / 5 A current transformer,
- Acquisition and processing of phase current within the range of (0.1-40) I_n,
- Acquisition and processing of earth current within the range of (0.1-40) I_{en} or (0.02-5) I_{en},
- Using X / 1 A or X / 5 A CTs,
- evaluation, visualization and taking action for phase current at (0.1-40) I_n range,
- evaluation, visualization and taking action for earth current at (0.1-40) I_{en}, (0.02-5) I_{en} range.

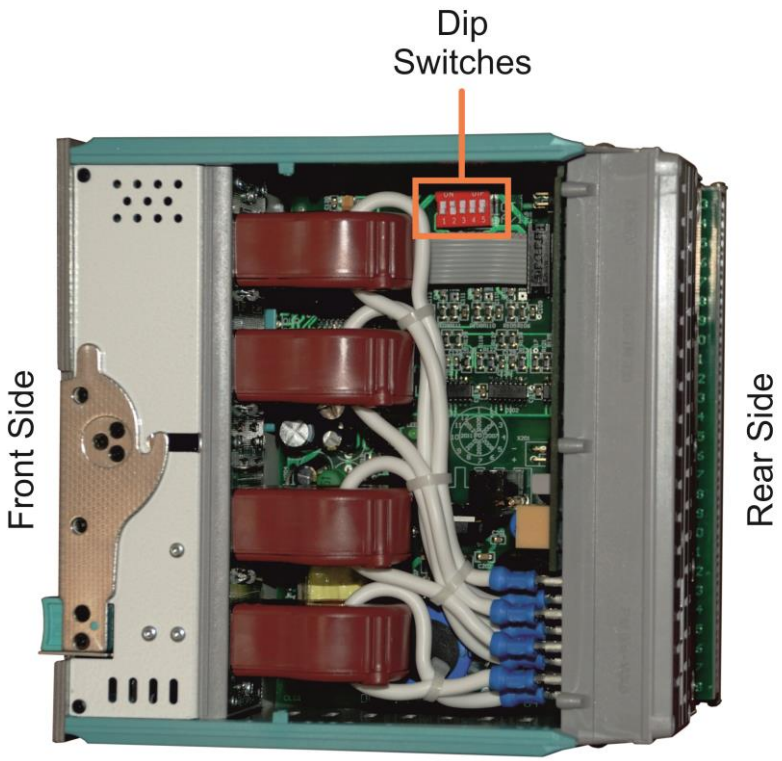
Current transformers play a critical role in secondary protection systems, as they generate the signals essential for the systems. Inappropriate selection and use of current transformers may result in:

- reduced performance of secondary protection systems,
- total loss of protection, or
- loss of primary supply continuity.

To ensure the reliability secondary protection system,

- selection of current transformers must be done considering the engineering principles, and
- use of secondary protection relays with standards compliant characteristics is required.

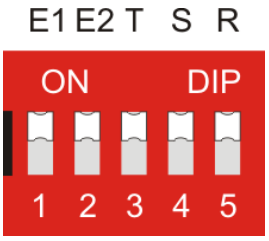
With respect to the principles hereby mentioned, the settings of CPM 310 G dip-switches must be done considering the instructions given in the following pages and with great care.



Localization of Dip Switches on the Internal Unit

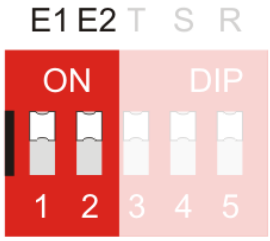
Instructions are given in the following pages and are supported by pictures and figures. Examine them thoroughly. ↺

1. In order to make the settings of the dip-switches, access to the internal unit must be provided. Drive out the internal unit.
2. Dip-switches are located in top right quadrant of the right side of the internal unit, when the unit is viewed from the front (see p.20). Their descriptions are given below.
   If a dip-switch is up, it is in "ON" position, if it is down, it is in "OFF" position. At the figure below, all dip-switches are at "ON" position.



Dip-switches Top View

3. Once the determinations are done for current transformer characteristics and earth protection type needed for the application, settings can be figured out as described below.



Setting Earth Nominal Current and Range

If the current transformer is of X / 5 A type, set as follows;
For T1 type (0.1 - 40) I_{en} range: E1 "ON", E2 "ON"
For T2 type (0.02 - 5) I_{en} range: E1 "OFF", E2 "ON"

If the current transformer is of X / 1 A type, set as follows;
For T1 type (0.1 - 40) I_{en} range: E1 "OFF", E2 "ON"
For T2 type (0.02 - 5) I_{en} range: E1 "OFF", E2 "OFF"

The figure on the right shows a setting example for a current transformer set of X / 5 A and an earth fault protection range of (0.1 - 40) I_{en}.

Setting Phase Nominal Current and Range

If the current transformer is of X / 5 A type, set as follows;
T, S, ve R dip-switches to "ON" position.

If the current transformer is of X / 1 A type, set as follows;
T, S, ve R dip-switches to "OFF" position.

The figure on the right shows a setting example for a current transformer set of X / 5 A.

There are no options for phase overcurrent protection range; the range is available only as (0.1 - 40) I_n.

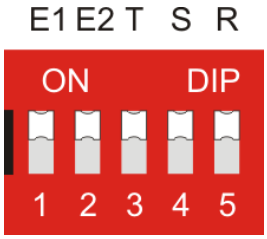
4. After completing the settings of the dip-switches, drive the internal unit into place and go to the *CT Settings* menu on the relay. Set the characteristics on the menu as are done on the dip-switches. Doing this, dip-switch and CT settings are completed. ↺

EXAMPLE DIP-SWITCH SETTINGS

In this example;
1. The sip-switch settings of the relay belonging to a 3 CT feeder.
2. The current transformer ratio is 300 A / 5 A.
3. The phase overcurrent protection range will be (0.1 - 40) I_n.
4. There are no residual current transformers; instead, the secondary circuits of the phase CTs are bridged and earthed over the earth protection current input of the relay, thus, the nominal secondary current of earth protection is the same as phases and it is I_{en} = 5 A.
5. The earth fault protection range is required as (0.1 - 40) I_{en}.

The settings to be done on the dip-switches are as follows:

- As the current transformer ratio is 300 A / 5 A, the secondary nominal current for phases is 5 A. According to that, the T, S and R dip-switches (no. 3, 4, 5) are made to the upper position, so set as "ON".
- The secondary nominal current for earth is 5 A and range is required as (0.1 - 40) I_{en}. According to that, as explained on the page before, the E1 and E2 dip-switches (no. 1 and 2) are made to the upper position, so set as "ON".
- Make the current transformer settings at the relay menu to complete the settings.

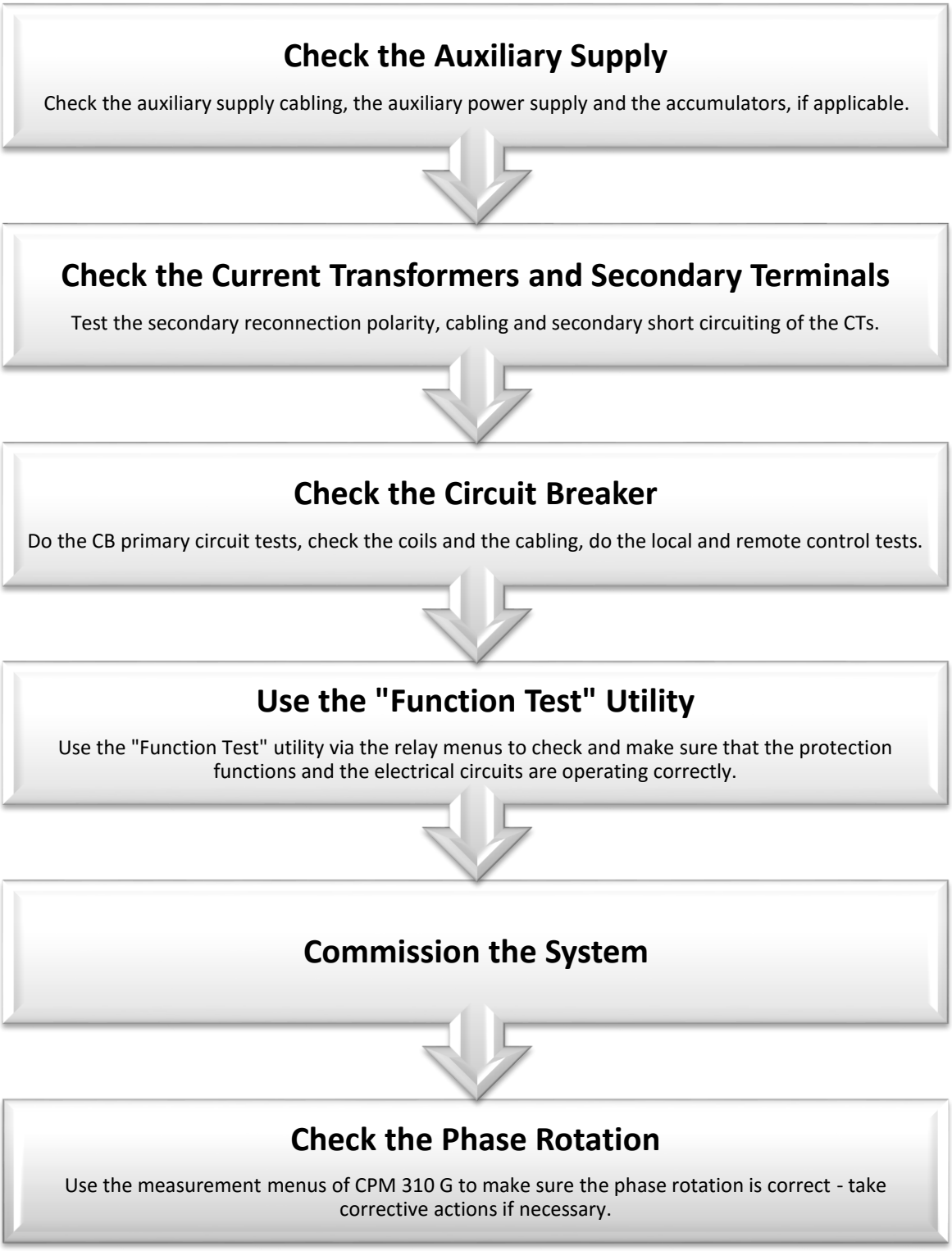


WARNINGS

- DEMA CPM 310 G units are set to "ON – ON –ON – ON – ON" dip-switch settings by default. The default setting presumes that:
  - the nominal current for phases and earth is 5 A
  - the protection range for phases and earth is (0.1 - 40) I_n
- To ensure correct operation of the relay, make sure to check the dip-switch settings physically and current transformer settings on the relay menu before commissioning!
- If the dip-switch settings for the earth protection is changed, the relay resets the protection settings of all earth protection functions (I_e>, I_e>>, I_e>>>) to default. Make sure to set these functions once the dip-switch settings are completed. □

Commissioning

Use the procedure below to commission a CPM 310 G after the mounting, cabling and setting actions are taken. Some of the CPM 310 G relevant steps are examined thoroughly through this manual, as stated with page numbers on diagram below. Other actions (auxiliary supply and CB tests) recommended below are out of this manual's range, take professional help for these steps. Use appropriate devices during the tests to build and provide a healthy protection system! □



Operating

NORMAL OPERATION

After the successful commissioning of CPM 310 G, normal operation conditions are reached; this condition is kept as long as system components operate correctly and load current values are in tolerable limits.

The purposes of electrical protection systems are; protecting the system components from abnormal conditions and minimizing system damage under those conditions, while providing maximum supply continuity and minimum black outs. These functions of protection systems can be obtained by building the system with good engineering practices (which were tried to be described up to here in this manual), but also by applying testing, maintenance, and renewal procedures on a regular basis. Even under conditions where high performance is obtained from secondary protection systems, these procedures must be considered to be highly important to be applied to get the maximum from these systems.

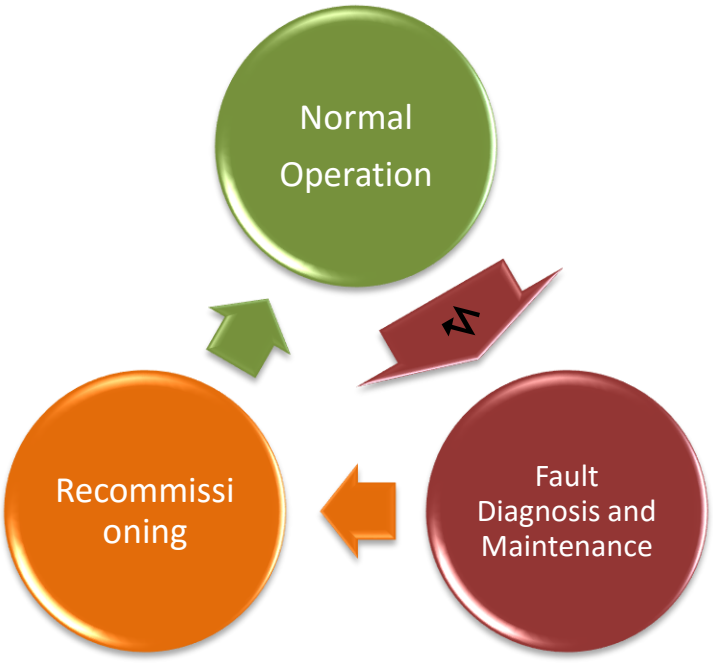
FAULT DIAGNOSIS AND MAINTENANCE

Even under good practices of maintenance and control, electrical systems may go under faults, overcurrent or device failures caused by mechanical, thermal or electrical stresses. When such a condition occurs, the way to handle them is described below.

- Examination of the problem via measurement, alarm, event record and fault record menus of CPM 310 G; and via visual and electrical inspection of the system,
- Determination of the fault source, analyze of possible causes and taking of corrective actions,
- Testing and commissioning of the treated system.

RECOMMISSIONING

Whether initial or post maintenance, commissioning must be done according to the procedure described in the former section. Undesired black-outs must be held as opportunities to test the entire system, which are hardly found under normal service conditions. The preventive actions taken before the commissioning increases the performance of the secondary systems, and maximizes the benefits of well-engineered secondary protection systems. □



Operation Cycle

Testing & Maintenance & Reparation

Under normal service conditions, no testing or maintenance action is required for CPM 310 G. If under a supernormal condition CPM 310 G becomes unstable or out of service, testing, maintenance or reparation of the unit may become essential.

Test Process of CPM 310 G

- Primarily, supply auxiliary power to CPM 310 G to initiate the test process. If the auxiliary power is supplied by local devices, test them to ensure the healthy supply. If CPM 310 G does not start up and there is no "Power" LED signal; possible causes are supply circuit faults or the burn out of CPM 310 G fuse. Analyze those possibilities and take the corrective actions; if the problem is caused by the CPM 310 G fuse, replace it by a new one with specifications Ø5 mm x 20 mm T1A (see p.19). Examine the possible causes of supply overcurrent that made the fuse burn.
- If there is no possibility of employing an appropriate relay test device for testing CPM 310 G, use the *Function Test* option from the relay menus (see p.126). *Function Test* option generates imaginary overcurrent and conditions, and tests the functions in services to find out whether the relay is functioning in the desired way or not. If any protection function is active, function test will result in tripping of the circuit breaker; consider this and set appropriate trip settings to "passive" temporarily (see p.106) to prevent tripping of the primary circuit.
- If detailed tests are required to be carried out, use of a high-sensitivity, low-error relay test device is essential. In this case, trip time delays should be measured independently to confirm the correct operation of the relay. Tests must include the measurements for protection function trip delays, positive and negative sequence current measurements; broken conductor and thermal overload functionalities, input and output configurability.
- In the case a failure is figured out on CPM 310 G, or no specific failures are found while the relay is not operating correctly, get in touch with DEMA Relay Industries technical services. □

RELAY MENUS MANUAL

Introduction

Relay Menus Manual describes DEMA CPM 310 G Digital Overcurrent Protection Relay Manus thoroughly; including the making of protection, control and safety settings; viewing of the measurements, alarms, event & fault records, and access to other options that is embedded within the CPM 310 G firmware. Throughout the manual, pictures and access paths regarding the explored menus are located on the left side of the page. The upcoming screen when entered to a new menu is examined on a graphic showing the front view of CPM 310 G. If any menus that cannot be viewed on a single screen come across, another graphic on a fictional larger screen is added right behind it to demonstrate the full content of the menu.

Description and examination texts are located on the right sides of the pages.

Within the content of this manual, every single menu that the user may come across has been examined and explained. If detailed information about a menu is needed when working on CPM 310 G menus, just read the menu title and refer to the dedicated section of this manual. Use the index on the former page to access the sections quickly.

The purpose of this manual is to explain how menus are accessed and used – project oriented evaluations like selecting and setting functions for specific functionality, calculations needed for settings or engineering issues like selectivity setup are not included within the context of this manual.

Before referring to this manual, examine and learn the physical construction of CPM 310 G on the dedicated sections. Refreshing your secondary protection theory knowledge will also help you figuring out the use of CPM 310 G and combination of the functions of the relay for advanced functionality. Focusing on general secondary protection issues will help you take advantage of enhanced possibilities that CPM 310 G offers.

For any questions that this manual cannot answer, please do not hesitate to request help from our technical service. Your feedback and critics will be most appreciated.

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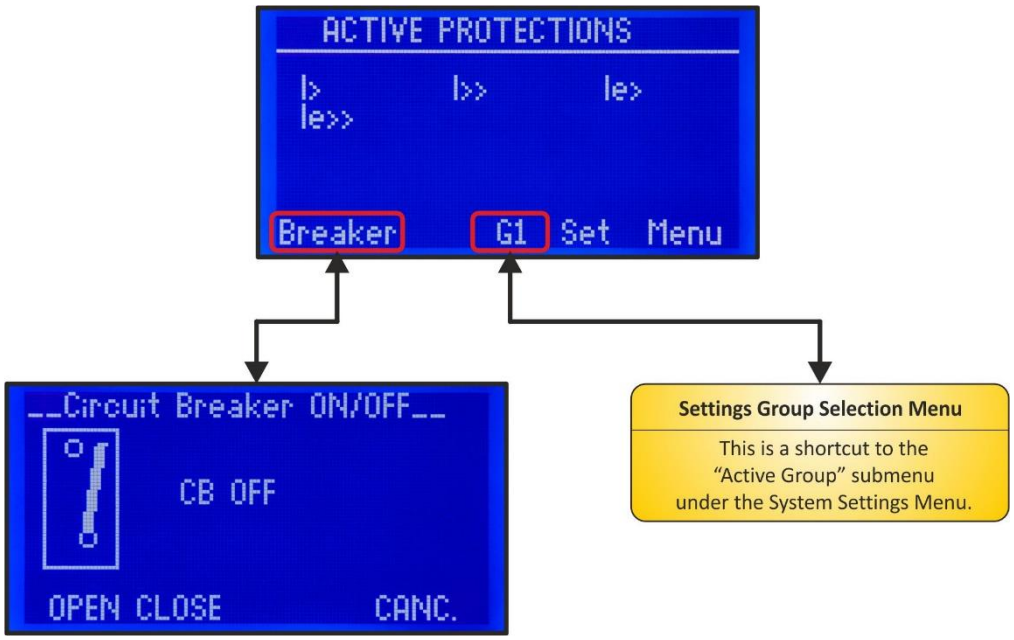
□

The Menu Tree



I>
Phase Overcurrent Protection 1st Threshold Menu

Protection	Active / Passive
I>	(0.10 - 25.00) In
DType	Any of the 11 curves, or DMT
tI> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

I2>
Negative Seq. Overcurrent Pr. 1st Threshold Menu

Protection	Active / Passive
I2>	(0.10 - 40.00) In
DType	Any of the 11 curves, or DMT
tI2> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

I>>
Phase Overcurrent Protection 2nd Threshold Menu

Protection	Active / Passive
I>	(0.50 - 40.00) In
DType	Any of the 11 curves, or DMT
tI> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

I2>>
Negative Seq. Overcurrent Pr. 2nd Threshold Menu

Protection	Active / Passive
I2>>	(0.10 - 40.00) In
DType	Any of the 11 curves, or DMT
tI2>> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

I>>>
Phase Overcurrent Protection 3rd Threshold Menu

Protection	Active / Passive
I>	(0.50 - 40.00) In
DType	Any of the 11 curves, or DMT
tI> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

%(I2/I1)>
Broken Conductor Protection Menu

Protection	Active / Passive
%(I2/I1)>	(20 - 100) %
t%(I2/I1)>	(1 - 14,400) s

Ie>
Earth Overcurrent Protection 1st Threshold Menu

Protection	Active / Passive
Ie>	(0.10 - 25.00) Ien (T1) (0.020 - 5.000) Ien (T2)
DType	Any of the 11 curves, or DMT
tIe> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

I<
Phase Undercurrent Protection Menu

Protection	Active / Passive
I<	(0.02 - 1.00) In
tI<	(0.01 - 150.00) s

Ie>>
Earth Overcurrent Protection 2nd Threshold Menu

Protection	Active / Passive
Ie>>	(0.50 - 40.00) Ien (T1) (0.020 - 5.000) Ien (T2)
DType	Any of the 11 curves, or DMT
tIe>> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

Iϴ>
Thermal Overload Protection Menu

Protection	Active / Passive
Iϴ>	(0.10 - 3.20) In
Te	(1 - 200) minutes
k	1.00 - 1.50
Trip ϴ	(50 - 200) %
Thermal Alarm ϴ	Active / Passive
Thermal Alarm ϴ	(50 - 200) %

Ie>>>
Earth Overcurrent Protection 3rd Threshold Menu

Protection	Active / Passive
Ie>>	(0.50 - 40.00) Ien (T1) (0.020 - 5.000) Ien (T2)
DType	Any of the 11 curves, or DMT
tIe>>> / TMS	(0.01 - 150.00) s / (0.025 - 3.200)
RType	DMT or ANSI
tReset / RTMS	(0.04 - 100.00) s / (0.025 - 3.200)

ARCL
Auto-recloser Settings Menu

Auto-recloser	Active / Passive
tD1 ... tD4	(0.01 - 300.00) s
tR	(0.20 - 600.00) s
tIN	(0.20 - 600.00) s

See the relevant section of the manual for information on programming of the auto-recloser for protection-function-specific reclosing.

MEASUREMENTS
See p.58

COMMUNICATION SETTINGS

EVENT RECORDS

SYSTEM SETTINGS

CT SETTINGS

AUTOMATIC CONTROL SETTINGS
See p.59

FUNCTION TEST

FAULT RECORDS

COMMUNICATION SETTINGS

Type	USB / RS485
Protocol	MODBUS / IEC 60870 / DEMCOM
Baudrate	1200 - 38400
Relay Address	001 - 255

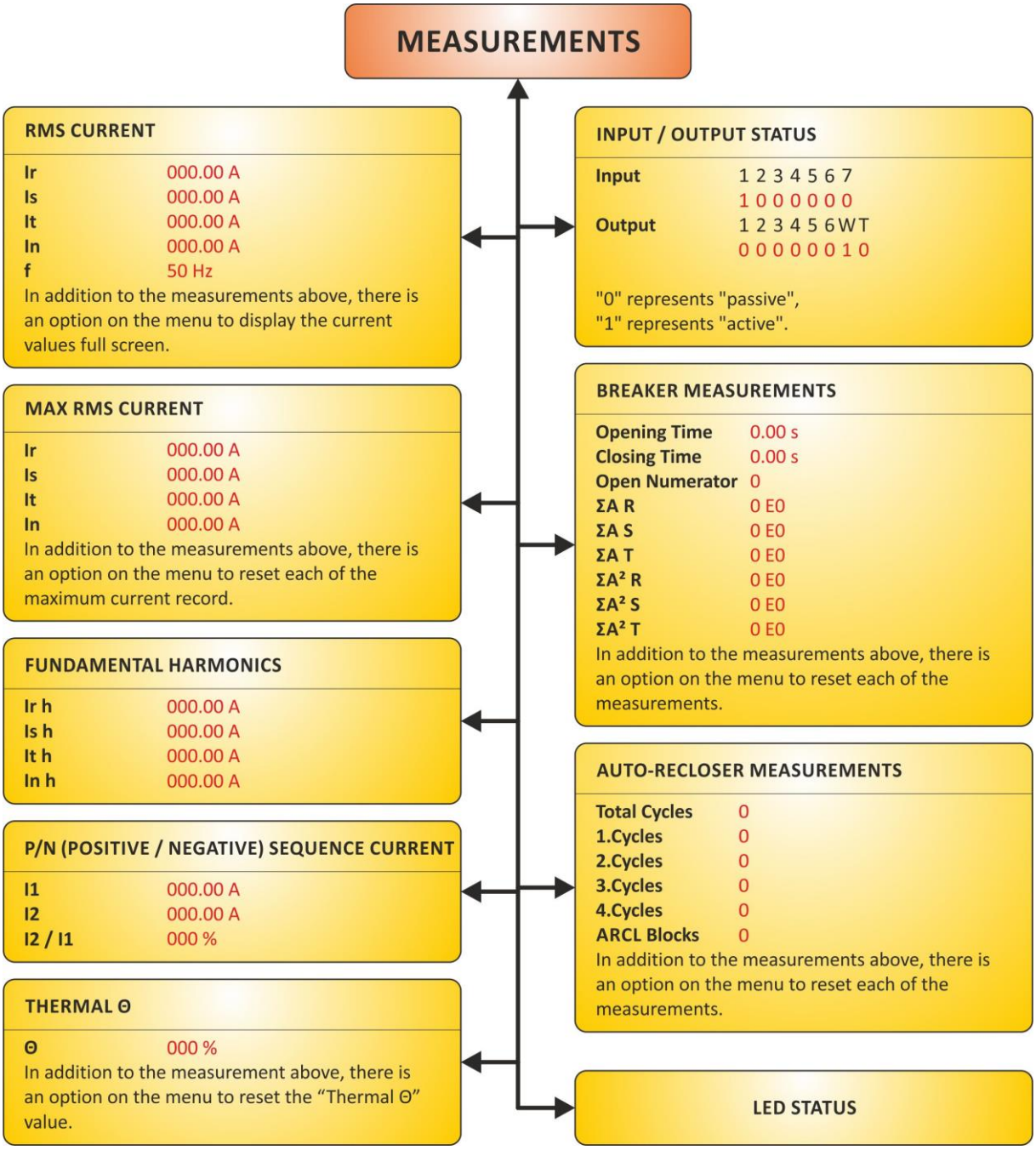
SYSTEM SETTINGS

Hour	08 : 00 : 00 (Hour : Min : Second)
Date	12/03/2016 (Day / Month / Year)
Version	3.11
Frequency	50 Hz / 60 Hz
ID	DEMA123b (8 ANSI characters)
Password	**** (4 digits)
Symbol	rstn / abce
Active Group	Group 1 / Group 2
Phase Rotation	RST / RTS
LCD Backlight	Automatic / ON
Language	Türkçe / English
Settings Password	PASSIVE / ACTIVE
CB Password	PASSIVE / ACTIVE

In addition to the settings above, there is an option in the menu to reload the default settings.

CT SETTINGS

Primary Phase Nom.	(1 - 9999) A
Secondary Phase Nom.	(1 / 5) A
Primary Earth Nom.	(1 - 9999) A
Secondary Earth Nom.	T1-1A / T1-5A / T2-1A / T2-5A


MEASUREMENTS
RMS CURRENT
Ir 000.00 A
Is 000.00 A
It 000.00 A
In 000.00 A
f 50 Hz
In addition to the measurements above, there is an option on the menu to display the current values full screen.
MAX RMS CURRENT
Ir 000.00 A
Is 000.00 A
It 000.00 A
In 000.00 A
In addition to the measurements above, there is an option on the menu to reset each of the maximum current record.
FUNDAMENTAL HARMONICS
Ir h 000.00 A
Is h 000.00 A
It h 000.00 A
In h 000.00 A
P/N (POSITIVE / NEGATIVE) SEQUENCE CURRENT
I1 000.00 A
I2 000.00 A
I2 / I1 000 %
THERMAL Θ
Θ 000 %
In addition to the measurement above, there is an option on the menu to reset the "Thermal Θ" value.
INPUT / OUTPUT STATUS
Input 1 2 3 4 5 6 7
1 0 0 0 0 0 0
Output 1 2 3 4 5 6 WT
0 0 0 0 0 0 1 0
"0" represents "passive",
"1" represents "active".
BREAKER MEASUREMENTS
Opening Time 0.00 s
Closing Time 0.00 s
Open Numerator 0
ΣA R 0 E0
ΣA S 0 E0
ΣA T 0 E0
ΣA² R 0 E0
ΣA² S 0 E0
ΣA² T 0 E0
In addition to the measurements above, there is an option on the menu to reset each of the measurements.
AUTO-RECLOSER MEASUREMENTS
Total Cycles 0
1.Cycles 0
2.Cycles 0
3.Cycles 0
4.Cycles 0
ARCL Blocks 0
In addition to the measurements above, there is an option on the menu to reset each of the measurements.
LED STATUS

AUTOMATIC CONTROL SETTINGS

COLD LOAD PICKUP

Level	(20 - 500) %
Time	(0.1 - 3600.0) s
I>	AKTİF / PASİF
I>>	AKTİF / PASİF
I>>>	AKTİF / PASİF
Ie>	AKTİF / PASİF
Ie>>	AKTİF / PASİF
Ie>>>	AKTİF / PASİF
I2>	AKTİF / PASİF
I2>>	AKTİF / PASİF

OUTPUT RELAY SETTINGS

	1 2 3 4 5 6
Trip	1 0 0 0 0 0
I>	0 0 0 0 0 0
tI>	0 0 0 0 0 0
I>>	0 0 0 0 0 0
tI>>	0 0 0 0 0 0
I>>>	0 0 0 0 0 0
tI>>>	0 0 0 0 0 0
Ie>	0 0 0 0 0 0
tIe>	0 0 0 0 0 0
Ie>>	0 0 0 0 0 0
tIe>>	0 0 0 0 0 0
Ie>>>	0 0 0 0 0 0
tIe>>>	0 0 0 0 0 0
tI<	0 0 0 0 0 0
tI2>	0 0 0 0 0 0
tI2>>	0 0 0 0 0 0
Trip Θ	0 0 0 0 0 0
Thermal Alarm Θ	0 0 0 0 0 0
CB Alarm	0 0 0 0 0 0
52 Failure	0 0 0 0 0 0
Broken Conductor	0 0 0 0 0 0
CB Failure	0 0 0 0 0 0
CB Close	0 0 1 0 0 0
tAux 1	0 0 0 0 0 0
tAux 2	0 0 0 0 0 0
ARCL Running	0 0 0 0 0 0
ARCL Blocked	0 0 0 0 0 0
Buchholz Alarm	0 0 0 0 0 0
Buchholz Trip	0 0 0 0 0 0
Temp. Alarm	0 0 0 0 0 0
Temp. Trip	0 0 0 0 0 0

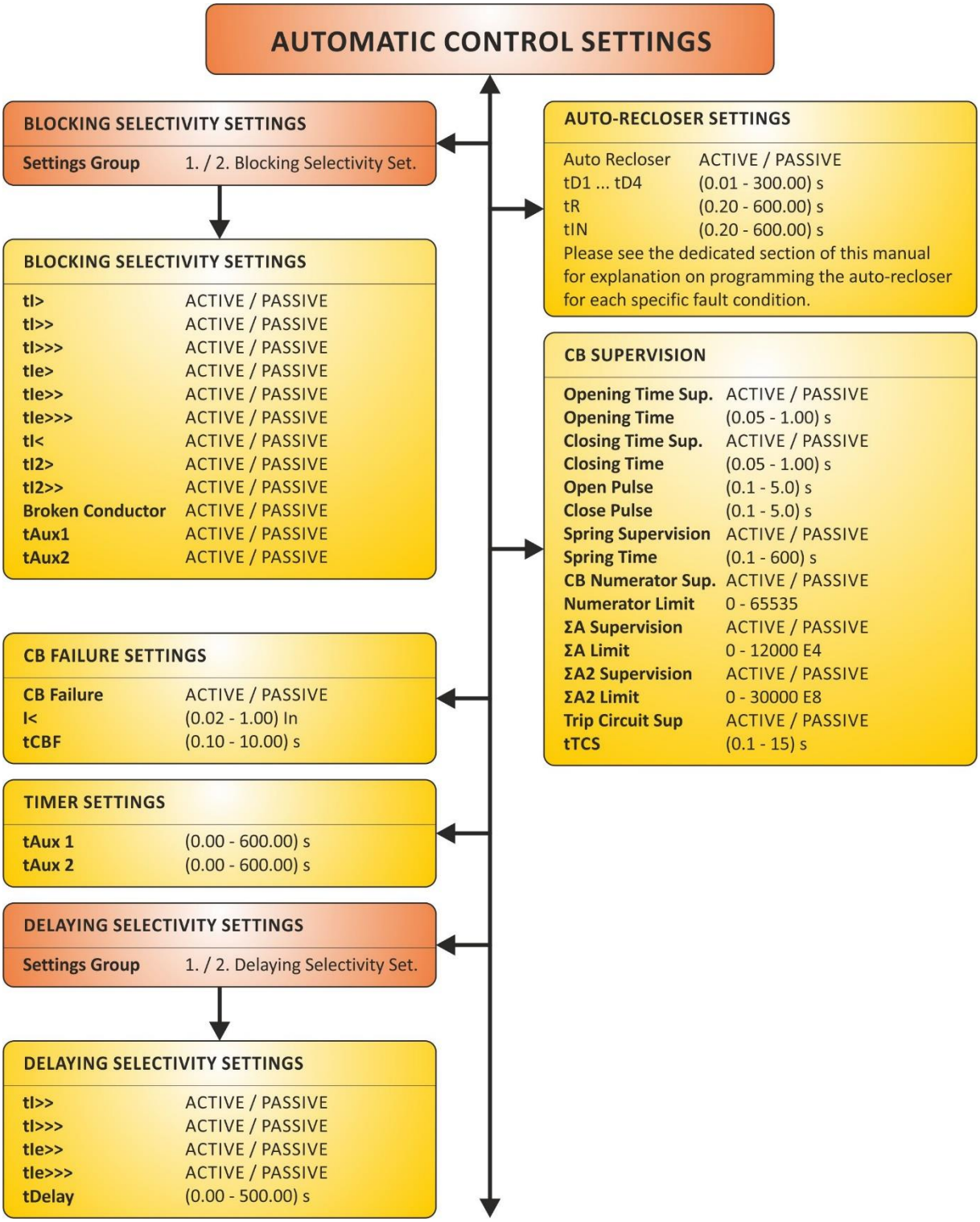
The output relay can be programmed to be triggered by one or more functions by making the relevant parameter “1"; except that “Trip” and “CB Close” functions cannot be programmed to the same output.

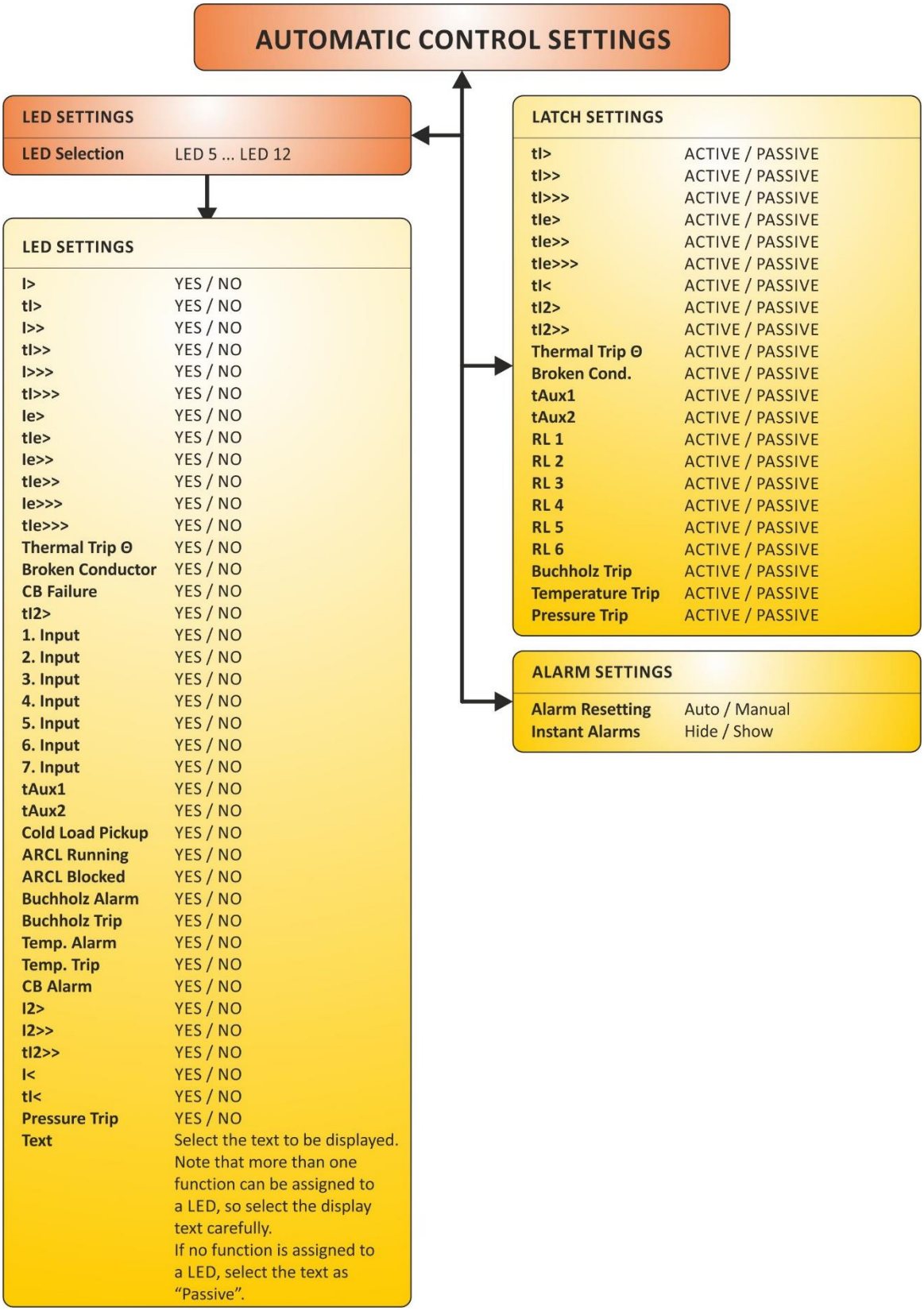
TRIP SETTINGS

tI>	ACTIVE / PASSIVE
tI>>	ACTIVE / PASSIVE
tI>>>	ACTIVE / PASSIVE
tIe>	ACTIVE / PASSIVE
tIe>>	ACTIVE / PASSIVE
tIe>>>	ACTIVE / PASSIVE
tI<	ACTIVE / PASSIVE
tI2>	ACTIVE / PASSIVE
tI2>>	ACTIVE / PASSIVE
Thermal Trip Θ	ACTIVE / PASSIVE
Broken Cond.	ACTIVE / PASSIVE
tAux1	ACTIVE / PASSIVE
tAux2	ACTIVE / PASSIVE
Buchholz	ACTIVE / PASSIVE
Temperature	ACTIVE / PASSIVE
Pressure	ACTIVE / PASSIVE

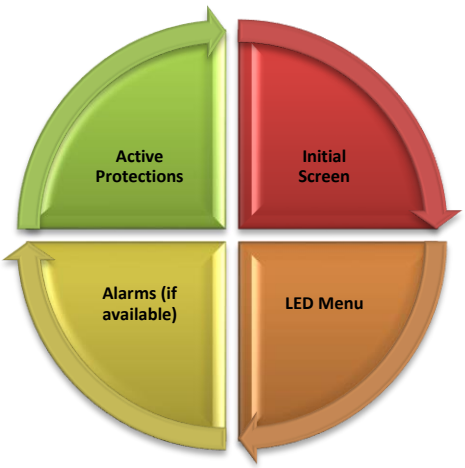
INPUT SETTINGS

1st - 7th Input (One of the functions listed on the right can be assigned to each input)	Passive Unlatch 52a (normally open contact signal) 52b (normally close contact signal) CB Position Start tAux1 (auxiliary timer no.1) Start tAux2 (auxiliary timer no.2) Blocking Sel. 1 Delaying Sel. 1 Start Wave Record Cold Load Pickup Spring Failure Change Settings Group Block ARCL (Auto-recloser) Reset %Θ Trip Circuit Supervision Reset RL1-RL6 Reset LED Pressure Trip Buchholz Alarm Buchholz Trip Temperature Alarm Temperature Trip Blocking Sel. 2 Delaying Sel. 2
Active Position	**1 2 3 4 5 6 7** (Input No) 1 1 1 1 1 1 1 (Setting) If the “Active Position” setting is “1", as by default, the input is triggered when it receives a voltage. If it is “0", the input is triggered as long as it doesn’t receive a voltage.


AUTOMATIC CONTROL SETTINGS
BLOCKING SELECTIVITY SETTINGS
Settings Group 1. / 2. Blocking Selectivity Set.
BLOCKING SELECTIVITY SETTINGS
tI> ACTIVE / PASSIVE
tI>> ACTIVE / PASSIVE
tI>>> ACTIVE / PASSIVE
tIe> ACTIVE / PASSIVE
tIe>> ACTIVE / PASSIVE
tIe>>> ACTIVE / PASSIVE
tI< ACTIVE / PASSIVE
tI2> ACTIVE / PASSIVE
tI2>> ACTIVE / PASSIVE
Broken Conductor ACTIVE / PASSIVE
tAux1 ACTIVE / PASSIVE
tAux2 ACTIVE / PASSIVE
CB FAILURE SETTINGS
CB Failure ACTIVE / PASSIVE
I< (0.02 - 1.00) In
tCBF (0.10 - 10.00) s
TIMER SETTINGS
tAux 1 (0.00 - 600.00) s
tAux 2 (0.00 - 600.00) s
DELAYING SELECTIVITY SETTINGS
Settings Group 1. / 2. Delaying Selectivity Set.
DELAYING SELECTIVITY SETTINGS
tI>> ACTIVE / PASSIVE
tI>>> ACTIVE / PASSIVE
tIe>> ACTIVE / PASSIVE
tIe>>> ACTIVE / PASSIVE
tDelay (0.00 - 500.00) s
AUTO-RECLOSER SETTINGS
Auto Recloser ACTIVE / PASSIVE
tD1 ... tD4 (0.01 - 300.00) s
tR (0.20 - 600.00) s
tIN (0.20 - 600.00) s
Please see the dedicated section of this manual for explanation on programming the auto-recloser for each specific fault condition.
CB SUPERVISION
Opening Time Sup. ACTIVE / PASSIVE
Opening Time (0.05 - 1.00) s
Closing Time Sup. ACTIVE / PASSIVE
Closing Time (0.05 - 1.00) s
Open Pulse (0.1 - 5.0) s
Close Pulse (0.1 - 5.0) s
Spring Supervision ACTIVE / PASSIVE
Spring Time (0.1 - 600) s
CB Numerator Sup. ACTIVE / PASSIVE
Numerator Limit 0 - 65535
ΣA Supervision ACTIVE / PASSIVE
ΣA Limit 0 - 12000 E4
ΣA2 Supervision ACTIVE / PASSIVE
ΣA2 Limit 0 - 30000 E8
Trip Circuit Sup ACTIVE / PASSIVE
tTCS (0.1 - 15) s


AUTOMATIC CONTROL SETTINGS
LED SETTINGS
LED Selection LED 5 ... LED 12
LED SETTINGS
I> YES / NO
tI> YES / NO
I>> YES / NO
tI>> YES / NO
I>>> YES / NO
tI>>> YES / NO
Ie> YES / NO
tIe> YES / NO
Ie>> YES / NO
tIe>> YES / NO
Ie>>> YES / NO
tIe>>> YES / NO
Thermal Trip Θ YES / NO
Broken Conductor YES / NO
CB Failure YES / NO
tI2> YES / NO
1. Input YES / NO
2. Input YES / NO
3. Input YES / NO
4. Input YES / NO
5. Input YES / NO
6. Input YES / NO
7. Input YES / NO
tAux1 YES / NO
tAux2 YES / NO
Cold Load Pickup YES / NO
ARCL Running YES / NO
ARCL Blocked YES / NO
Buchholz Alarm YES / NO
Buchholz Trip YES / NO
Temp. Alarm YES / NO
Temp. Trip YES / NO
CB Alarm YES / NO
I2> YES / NO
I2>> YES / NO
tI2>> YES / NO
I< YES / NO
tI< YES / NO
Pressure Trip YES / NO
Text Select the text to be displayed. Note that more than one function can be assigned to a LED, so select the display text carefully. If no function is assigned to a LED, select the text as "Passive".
LATCH SETTINGS
tI> ACTIVE / PASSIVE
tI>> ACTIVE / PASSIVE
tI>>> ACTIVE / PASSIVE
tIe> ACTIVE / PASSIVE
tIe>> ACTIVE / PASSIVE
tIe>>> ACTIVE / PASSIVE
tI< ACTIVE / PASSIVE
tI2> ACTIVE / PASSIVE
tI2>> ACTIVE / PASSIVE
Thermal Trip Θ ACTIVE / PASSIVE
Broken Cond. ACTIVE / PASSIVE
tAux1 ACTIVE / PASSIVE
tAux2 ACTIVE / PASSIVE
RL 1 ACTIVE / PASSIVE
RL 2 ACTIVE / PASSIVE
RL 3 ACTIVE / PASSIVE
RL 4 ACTIVE / PASSIVE
RL 5 ACTIVE / PASSIVE
RL 6 ACTIVE / PASSIVE
Buchholz Trip ACTIVE / PASSIVE
Temperature Trip ACTIVE / PASSIVE
Pressure Trip ACTIVE / PASSIVE
ALARM SETTINGS
Alarm Resetting Auto / Manual
Instant Alarms Hide / Show

Reset Menu (Reset Cycle)



Reset Button Function Cycle

Reset Menu is reached by pressing the *Reset* button while at any menu. The location of the *Reset* button is pointed in the middle picture. The menu displays any active alarms generated by active protection and supervision functions, and lets the user read and delete these alarms. Exploration, viewing and resetting functions are achieved via Reset button only - the cyclic functionality of Reset button eliminates the need of cover removal to perform Alarm Menu tasks. The reset button cycle is shown on the left.

The schema at the top summarizes the cycle of functionality of the *Reset* button.

- While any screen is being viewed (hereby described as "Initial Screen"), pressing the *Reset* button once will lead to the display of *LED Status* screen, as shown at the bottom picture.

The sample LED status picture shows that there are 4 active programmable LEDs (L5 – L8), that tell the tI>, tI>>, tIe> and tIe>> protection functions have generated a trip signal. Other programmable LEDs (L9 – L12) have no activity. See the LED Status Menu section for more information.

- When the *Reset* button is pressed for the second time, one of the following will happen:

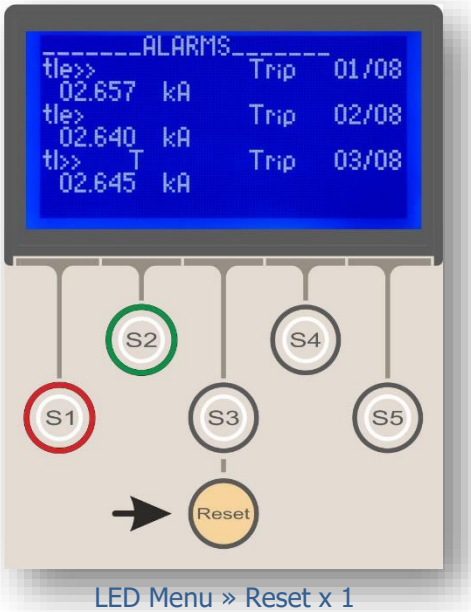
○ If there are any alarm to be viewed, the screen will display the *Alarms* menu (the top picture on the following page). The picture shows a sample situation where there are 8 alarms to be read which are numbered as 01/08, 02/08 … 08/08 on the right side of the screen. Each of the alarms summarizes a trip event and its source (e.g. "tIe>> trip with 2.657 kA tripping current"). Since there are more alarms than can be displayed on a single page, the Alarms Menu will have several pages, of which can be read through by pressing the Reset button several times until the last page is reached.

Pressing the Reset button again after the viewing all of the alarms will lead to the screen given at the middle of the page, displaying this massage:

Press RESET for a long time to delete all alarms.

If the reset button is pressed continuously for 2 seconds when this massage appears, all alarm records will be deleted. If some of the alarms cannot be deleted after this action, this will mean that some of the alarm sources are still active. ↺

○ When the *Reset* button is pressed for the second time and there are no alarms to be viewed, the screen



LED Menu » Reset x 1
(If any alarms are present)

Deleting the Alarms
Reset (2 s)

LED Menu » Reset x 1
(If no alarms are present)

will display the *Active Protection Functions* screen (the bottom picture). This screen simply displays the protection or auto-reclosing functions that are active at that time.

- When the *Reset* button is pressed for another time once the steps above are completed, the display returns to the initial screen.

Note that the external button on the CPM 310 G cover provides IP52 protection and eliminates the need of cover removal to access the *Reset* button. Use the external button to carry out operations up to here explained instead of removing the cover to reach the *Reset* button, to prevent long time exposure of the internal unit to possible ambient effects. □

Circuit Breaker Monitoring and Control Menu

Main Screen » CB

Circuit Breaker Monitoring and Control Menu is represented as "Breaker" on the main screen and is accessed by S1 button, as shown on the picture to the left.

Circuit Breaker Monitoring and Control Menu displays the position of the circuit breaker as "OFF" or "ON" and enables the user to control the circuit breaker remotely.

The position of the circuit breaker is displayed as "OFF" or "ON", and additionally on a mimic diagram, as shown on the picture at the bottom. On this diagram, the CB position is displayed both as text (OFF) and mimic diagram.

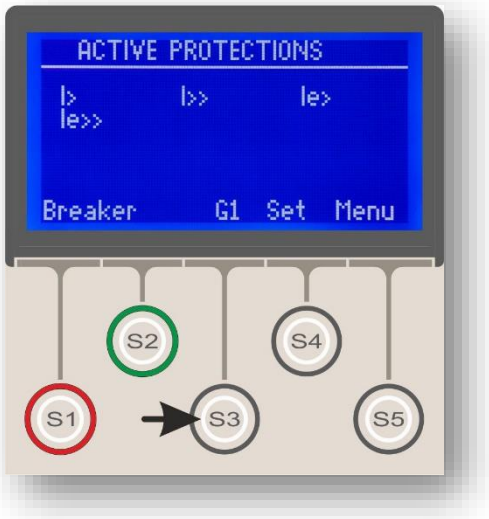
The S1 (OPEN) and S2 (CLOSE) buttons are used for controlling the circuit breaker remotely. As shown on the pictures, the physical OPEN button is colored red and CLOSE button is colored green.

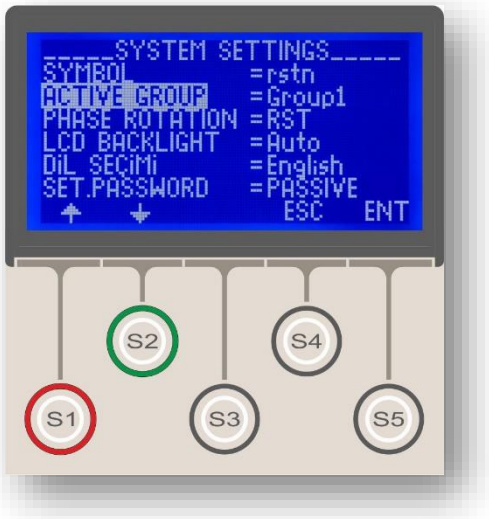
Two topics must be paid attention to ensure the correct operation of the Circuit Breaker Monitoring and Control Menu!

1. The relay must get the circuit breaker position information correctly to display it correctly. In order to achieve that, a normally open contact of the circuit breaker should be wired to one of the programmable inputs of the relay, and this input should be programmed as "CB Position". The procedure is described in detail at the dedicated section.

2. To control the circuit breaker remotely over CPM 310 G, the trip output of the relay should be wired to the CB trip / release coil terminals, and the CB closing output of the relay should be wired to the CB closing coil terminals. See the dedicated section of this manual for the output programming information. □

Settings Group Selection Menu





Main Screen » G1 or G2

Settings Group Selection Menu is accessed via S3 button on the main screen, which will either be titled as "G1 (Settings Group 1)" or "G2 (Settings Group 2)" depending on the actual configuration.

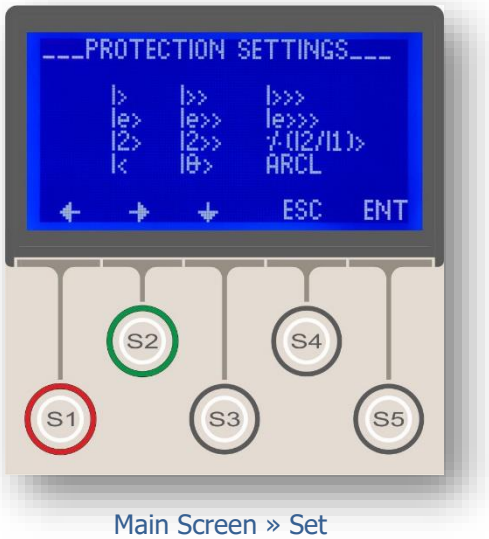
"G1" abbreviation shows that CPM 310 G is operating under no.1 group of settings and "G2" abbreviation shows that CPM 310 G is operating under no.2 group of settings.

Settings Group Selection Menu provides easy and rapid transition possibility between groups of settings. This functionality makes it possible to change the settings of CPM 310 G relays to a preloaded configuration rapidly under critical conditions, e.g. in case of need to alter the supply direction of a ring network because of a permanent failure on one of the sides of the line.

The picture to the left shows the Settings Group Selection Menu. Access to the menu from the main screen is actually achieved via a shortcut; the menu can alternatively be accessed by going through the Main Menu to System Settings Menu, and then to the Active Group option.
Menu » System Settings » Active Group

When the settings group is needed to be changed, simply press S3 button while at the main screen (top picture), and then, at the upcoming menu (bottom picture) press S5 (Enter) to activate selection option, utilize S1 (▲) or S2 (▼) buttons to alternate settings group and finally apply the new settings group by pressing S5 (Apply). □

Protection and Control Settings Menu



Main Screen » Set

Protection and Control Settings Menu is reached from the "Set" command from the main screen by pressing "S4" button, as shown on the picture to the left.

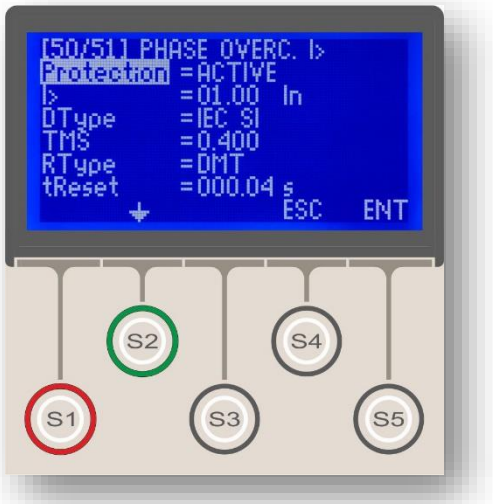
Menu content is shown on the picture below. As shown, the menu provides access to the 12 protection and control functions; and modifications such as function activation, deactivation or setting parameters are done via the controls on this menu. Each of the functions on this menu will be examined thoroughly on the following pages.

On the menu, S1 (←) and S2 (→) buttons let the user to navigate to left and right directions on the menu, while S3(↓) button leads to the next line. By using those buttons, the user can navigate to any of the functions, which will flash when navigated over it. S5 (Enter) button is used to enter the submenus of the function selected, and S4 (Escape) button leads to the main screen.

Abbreviations and descriptions of the functions on the menu are given below.

I> Phase Overcurrent 1st Threshold Protection.
I>> Phase Overcurrent 2nd Threshold Protection.
I>>> Phase Overcurrent 3rd Threshold Protection.
I_e> Earth Overcurrent 1st Threshold Protection.
I_e>> Earth Overcurrent 2nd Threshold Protection.
I_e>>> Earth Overcurrent 3rd Threshold Protection.
I_2> Negative Sequence 1st Threshold Protection.
I_2>> Negative Sequence 2nd Threshold Protection.
%(I2/I1)> Broken Conductor Protection.
I< Phase Undercurrent Protection.
I_θ> Thermal Overload Protection.
ARCL Auto-recloser Settings. □

I> Phase Overcurrent 1st Threshold Protection Menu



Main Screen » Set » I>

Phase overcurrent protection functions are symbolized as I>, I>> and I>>> in IEC Standards, and coded as 50 and 51 in IEEE/ANSI Standards.

Symbol I> indicates that the protection function monitors the phase current and intervenes when current values above the 1st threshold are detected.

The picture on the left shows the Phase Overcurrent 1st Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

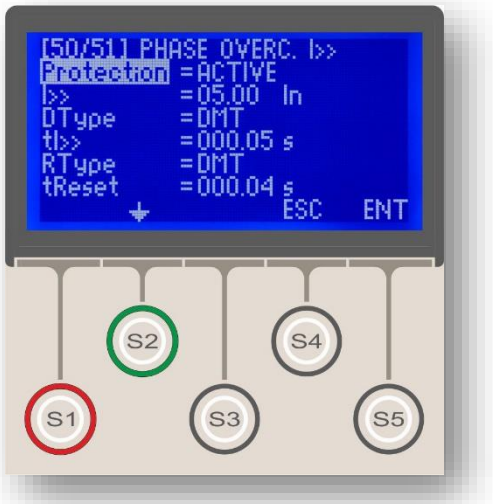
I> (Threshold)
Indicates the threshold value for the protection function. For I>, the set value range is (0.10-25.0) I_n, where I_n is the phase nominal current value of the current transformer.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tI> (Tripping Delay)
TMS (Time Multiplier Setting) or tI> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tI>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tI> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 1.00 I_n would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I>> Phase Overcurrent 2nd Threshold Protection Menu



Main Screen » Set » I>>

Phase overcurrent protection functions are symbolized as I>, I>> and I>>> in IEC Standards, and coded as 50 and 51 in IEEE/ANSI Standards.

Symbol I>> indicates that the protection function monitors the phase current and intervenes when current values above the 2nd threshold are detected.

The picture on the left shows the Phase Overcurrent 2nd Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

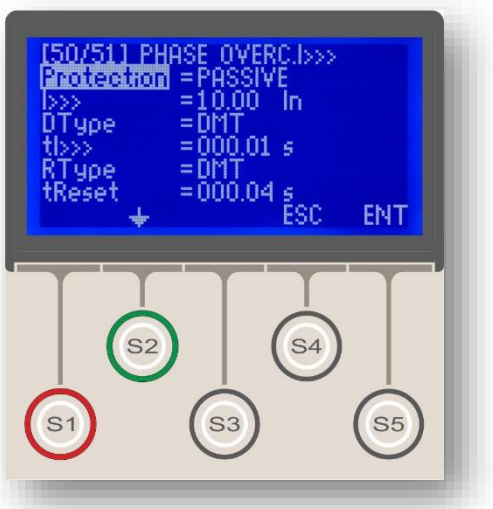
I>> (Threshold)
Indicates the threshold value for the protection function. For I>>, the set value range is (0.50-40.0) I_n, where I_n is the phase nominal current value of the current transformer.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tI>> (Tripping Delay)
TMS (Time Multiplier Setting) or tI>> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tI>>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tI>> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 5.00 I_n would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I>>> Phase Overcurrent 3rd Threshold Protection Menu



Main Screen » Set » I>>>

Phase overcurrent protection functions are symbolized as I>, I>> and I>>> in IEC Standards, and coded as 50 and 51 in IEEE/ANSI Standards.

Symbol I>>> indicates that the protection function monitors the phase current and intervenes when current values above the 3rd threshold are detected.

The picture on the left shows the Phase Overcurrent 3rd Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

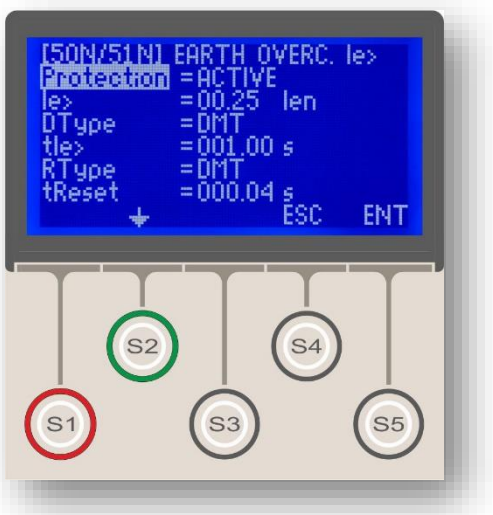
I>>> (Threshold)
Indicates the threshold value for the protection function. For I>>>, the set value range is (0.50-40.0) I_n, where I_n is the phase nominal current value of the current transformer.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tI>>> (Tripping Delay)
TMS (Time Multiplier Setting) or tI>>> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tI>>>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tI>>> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 10.00 I_n would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I_e> Earth Overcurrent 1st Threshold Protection Menu



Main Screen » Set » I_e>

Phase overcurrent protection functions are symbolized as I_e>, I_e>> and I_e>>> in IEC Standards, and coded as 50N and 51N in IEEE/ANSI Standards.

Symbol Ie> indicates that the protection function monitors the earth current and intervenes when current values above the 1st threshold are detected.

The picture on the left shows the Earth Overcurrent 1st Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

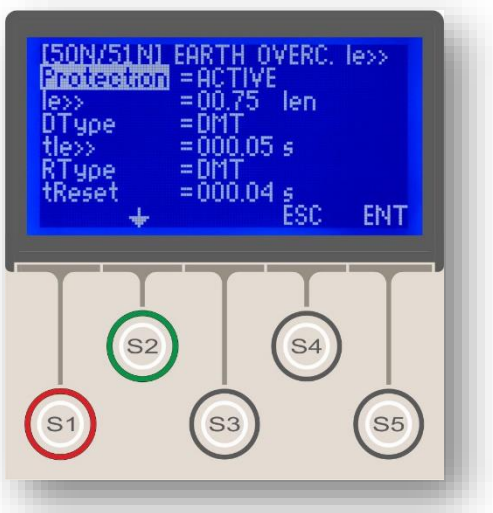
I_e> (Threshold)
Indicates the threshold value for the protection function. For Ie>:
T1 type protection has (0.10 - 25.0) I_{en} range, and
T2 type protection has (0.020 - 5.000) I_{en} range.
I_{en} is the earth nominal current value of the current transformer.
Please see the *Current Transformer Settings Menu* for more info on earth protection types and ranges.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tIe> (Tripping Delay)
TMS (Time Multiplier Setting) or tIe> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tIe>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tIe> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 1.00 I_{en} would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I_e>> Earth Overcurrent 2nd Threshold Protection Menu



Main Screen » Set » I_e>>

Phase overcurrent protection functions are symbolized as Ie>, Ie>> and Ie>>> in IEC Standards, and coded as 50N and 51N in IEEE/ANSI Standards.

Symbol Ie>> indicates that the protection function monitors the earth current and intervenes when current values above the 2nd threshold are detected.

The picture on the left shows the Earth Overcurrent 2nd Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

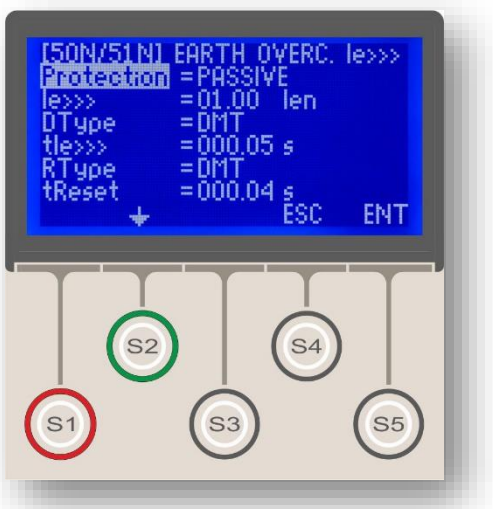
I_e> (Threshold)
Indicates the threshold value for the protection function. For Ie>>:
T1 type protection has (0.50 - 40.0) I_{en} range, and
T2 type protection has (0.020 - 5.000) I_{en} range.
I_{en} is the earth nominal current value of the current transformer.
Please see the *Current Transformer Settings Menu* for more info on earth protection types and ranges.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tIe>> (Tripping Delay)
TMS (Time Multiplier Setting) or tIe>> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tIe>>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tIe>> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 0.75 I_{en} would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I_e>>> Earth Overcurrent 3rd Threshold Protection Menu



Main Screen » Set » I_e>>>

Phase overcurrent protection functions are symbolized as Ie>, Ie>> and Ie>>> in IEC Standards, and coded as 50N and 51N in IEEE/ANSI Standards.

Symbol Ie>>> indicates that the protection function monitors the earth current and intervenes when current values above the 3rd threshold are detected.

The picture on the left shows the Earth Overcurrent 3rd Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

I_e>>> (Threshold)
Indicates the threshold value for the protection function. For Ie>>>:
T1 type protection has (0.50 - 40.0) I_{en} range, and
T2 type protection has (0.020 - 5.000) I_{en} range.
I_{en} is the earth nominal current value of the current transformer.
Please see the *Current Transformer Settings Menu* for more info on earth protection types and ranges.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tIe>>> (Tripping Delay)
TMS (Time Multiplier Setting) or tIe>>> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tIe>>>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tIe>>> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 1.00 I_{en} would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I_2> Negative Sequence Overcurrent 1st Threshold Protection Menu

Main Screen » Set » I_2>

Negative Sequence Overcurrent Protection is symbolized as I_2> in IEC Standards, and coded as 46 in IEEE/ANSI Standards. I_2 describes negative sequence current value.

I_2> symbol indicates that the protection function monitors the negative sequence value of the phase current and intervenes when current values above the 1st threshold are detected.

I_2> negative sequence overcurrent function is applied where load unbalances need to be controlled over the absolute value of the negative sequence.

The picture on the left shows the Negative Sequence Overcurrent 1st Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

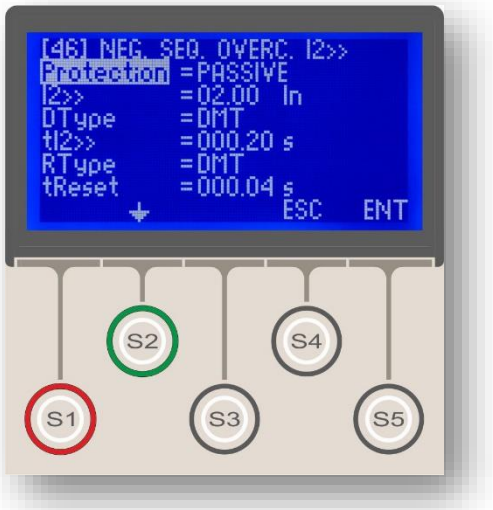
I_2> (Threshold)
Indicates the threshold value for the protection function. For I_2>, the set value range is (0.1-40.0) I_n, where I_n is the phase nominal current value of the current transformer.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tI_2> (Tripping Delay)
TMS (Time Multiplier Setting) or tI_2> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tI_2>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tI_2> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 0.50 I_n would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

I_2>> Negative Sequence Overcurrent 2nd Threshold Protection Menu



Main Screen » Set » I_2>>

Negative Sequence Overcurrent Protection is symbolized as I2> in IEC Standards, and coded as 46 in IEEE/ANSI Standards. I2 describes negative sequence current value.

I_2>> symbol indicates that the protection function monitors the negative sequence value of the phase current and intervenes when current values above the 1st threshold are detected.

I_2>> negative sequence overcurrent function is applied where load unbalances need to be controlled over the absolute value of the negative sequence.

The picture on the left shows the Negative Sequence Overcurrent 2nd Threshold Protection Menu - the menu comprises 6 parameters, as shown in the picture.

Settings and options in the menu are described in the following paragraphs.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

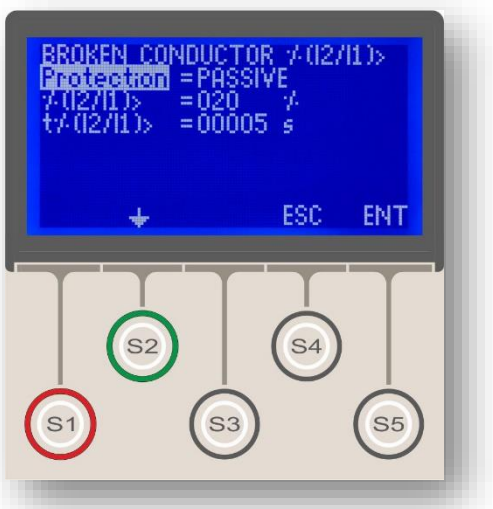
I_2>> (Threshold)
Indicates the threshold value for the protection function. For I_2>>, the set value range is (0.1-40.0) I_n, where I_n is the phase nominal current value of the current transformer.

DType (Delay Type)
Indicates the Delay Type for the protection function. DMT (Definite Minimum Time) or IDMT (Inverse Definite Minimum Time) delay types are available. Delay Type parameter can be set as any curve described in the Introduction section.

TMS or tI_2> (Tripping Delay)
TMS (Time Multiplier Setting) or tI_2>> (definite time delay) determines the character of the protection function along with the Delay Type parameter. If the delay type is selected as "DMT", the delay will be displayed as "tI_2>>" and will have a range of (0.01 – 150) s. If the delay type is selected as one of IDMT curves (e.g. IEC SI), the delay will be displayed as "TMS" and will have a range of (0.025 – 3.2). TMS or tI_2>> value is calculated through an engineering process that takes many parameters into account; such as the network characteristics, protected load characteristics and selectivity schemes.

RType and tReset (Reset Type and Reset Delay)
Reset Type and Reset Time configures the curve type and delay parameter to determine the reset behavior of a function, which takes place when a disturbance (e.g. a current measurement over the threshold value) does not continue enough time to trip. For the above settings, e.g., a current measurement above 0.50 I_n would trigger the trip timer, however, if the current measurement drops below the threshold without having the circuit breaker tripped, the trip timer will be reset after 0.04 seconds. DEMA CPM 310 G has DMT (Definite Minimum Time) and IDMT (Inverse Definite Minimum Time) options as reset characteristics. Please see the *Protection and Reset Curves* section for available Reset Types for each protection function. □

%(I_2/I_1)> Broken Conductor Protection Menu



Main Screen » Set » %(I_2/I_1)>

Broken Conductor Protection is symbolized as %(I_2/I_1)> or I_2/I_1> in the IEC Standards, where I_1 describes the positive sequence current and I_2 describes the negative sequence current.

%(I_2/I_1)> protection is utilized to intervene the primary circuit in cases where one or two primary phase conductors are broken (I = 0 A) but there is no fault current, or one or two secondary wirings are open circuit.

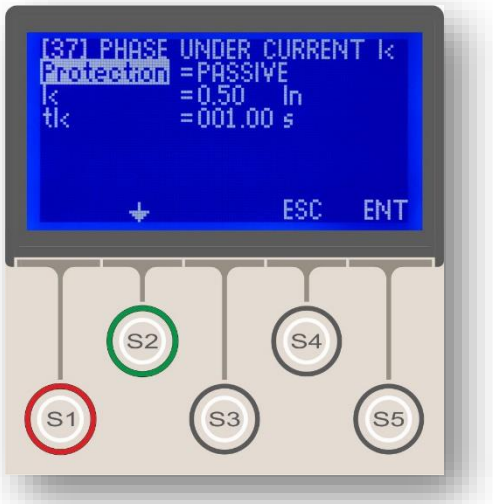
The picture shows the Broken Conductor Protection Menu and the menu comprises 3 parameters.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

%(I_2/I_1)> (Threshold)
Indicates the threshold value for the protection function. The set value range is %(20-100).

t%(I_2/I_1)> (Tripping Delay)
Describes the trip delay time once the %(I_2/I_1) threshold is broken. Delay type for broken conductor protection is DMT and can set within the range of (1 – 14,400) s. □

I< Phase Undercurrent Protection Menu



Main Screen » Set » I<

Phase Undercurrent Protection is symbolized as I< in IEC Standards, and coded as 37 in IEEE/ANSI Standards.

I< symbol indicates that the protection function monitors the phase current and intervenes when current values below the 1st threshold are detected.

Phase undercurrent protection may be needed for some specific applications, such as, breaking of the primary supply line of a water pump when there is no water to be pumped and the consumption of the motor falls below a predefined level close to idle consumption.

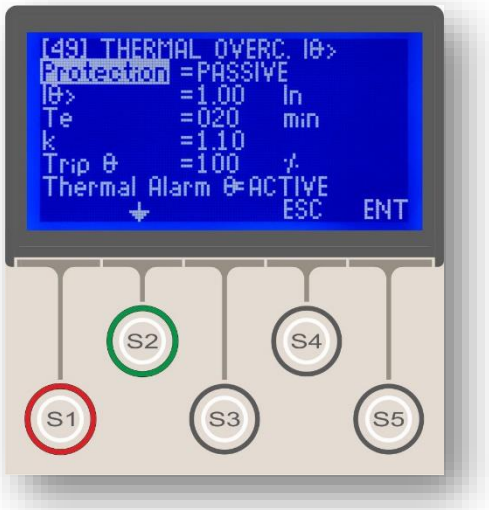
The picture shows the Phase Undercurrent Protection Menu and the menu comprises 3 parameters.

Protection
Can be set as "Active" or "Passive", to have the protection into or out of service.

I< (Threshold)
Indicates the threshold value for the protection function. For I<, the set value range is (0.02-1.00) I_n with steps of 0.01 I_n. I_n is the phase nominal current value of the current transformer.

tI< (Tripping Delay)
The tripping delay of Phase Undercurrent Protection function is DMT. The term "tI<" describes the tripping delay once any of the phase current values fall below the I< threshold. The range is (0.01-150.00) s, and the stepping is 0.01 s. □

I_Θ> Thermal Overload Protection Menu



Main Screen » Set » I_Θ>

Thermal Overload Protection is symbolized as I_Θ> in IEC Standards, and coded as 49 in IEEE/ANSI Standards.

I_Θ> symbol indicates that the protection function measures the phase RMS current and behaves according to the thermal overload protection formula. IEC 60255-8 compliant thermal overload formula is given below.

$$t = T_e \times \log_e \left[\frac{\left| \left(\frac{I}{k \times I_\Theta} \right)^2 - \%\Theta_p \right|}{\left| \left(\frac{I}{k \times I_\Theta} \right)^2 - \%\Theta_{trip} \right|} \right]$$

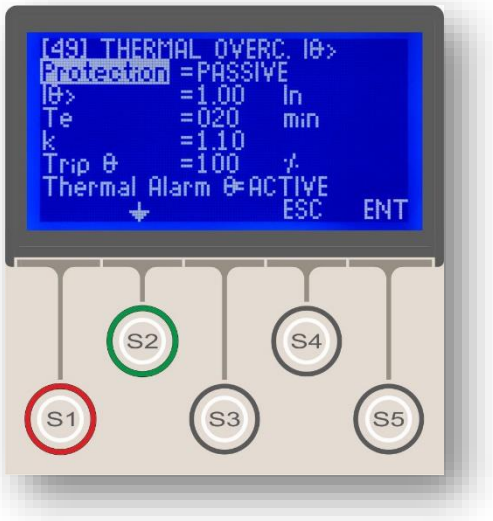
where

t	trip time (minutes),
T_e	thermal constant (minutes),
I	RMS load current (A),
I_Θ	set current (A),
k	trip threshold multiplier (-),
$\%\Theta_p$	overload pre-heating (%),
$\%\Theta_{trip}$	overload trip heating (%).

Thermal overload protection is a unique function of protection which is usually utilized to provide overloading protection for power transformers, power cables, motors and overhead lines at current range of (1.0- 1.5) I_r.

By combining I_Θ> thermal overload protection and I> overcurrent protection functions in appropriate schemes within the boundaries of (1.0- 1.5) I_r, providing the optimum balance between maximum supply continuity and accurate protection for electrical power systems is easier.

Thermal overload protection plays a critical role in modern systems where transient overcurrent and high-order harmonics are observed frequently. Thermal overload protection function provides maximum supply continuity by giving the system sufficient time to recover transient overcurrent, which do not perform a significant stress on components and need not to be cleared instantaneously; while providing a solid protection by monitoring "hidden" effects of high-order harmonics on elements of the system and intervening when necessary. ↺



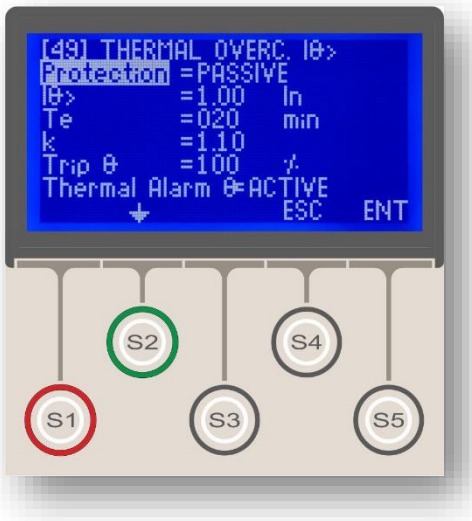
Protection
Can be set as "Active" or "Passive", to have the protection into or out of service

I_{Θ}>
This abbreviation stands for the Thermal Protection Set Current and is calculated by dividing the rated current of the protected equipment to nominal current of the CTs. In practice, the I_{Θ}> value is determined as follows: For a 34.5 kV / 0.4 kV 1,600 kV·A PT with CTs of 30 A / 5 A ratio, The I_r of PT is 26.8 A, which corresponds to 0.89 I_n of CTs (26.8 A / 30 A).
So I_{Θ}> = 0.89 I_n is appropriate.
The setting range for I_{Θ}> is (0.10 – 3.20) I_n.

T_e
This abbreviation represents the heating constant in minutes. T_e value is obtained empirically (usually by the equipment manufacturer)- by measuring the time that the equipment heating reaches %63 of the maximum heating allowed, when loaded with I_{Θ}> = I_r. T_e variable can be set in the range of (1 - 200) minutes.

k
This variable lets the user to multiply the tripping threshold. The actual effect of this variable can be evaluated from the formula to decide what value it should be set in the allowed range of (1.00-1.50).

Trip Θ
Trip Θ value is the maximum heating percentage allowed before tripping. *Trip Θ* is set to typical %100 by default, on the other hand, CPM 310 G provides the user the flexibility to set this value between %50 and %200 to fulfill the requirements of exceptional applications. When the calculated heating percentage reaches the set *Trip Θ* value, the circuit breaker will be tripped to prohibit more heating of and possible damage to the equipment protected.
Trip Θ threshold can be used as an alarming function alternatively, when automatic tripping is not desired. To employ the function in this way, a programmable output with *Trip Θ* function appointed could be cabled so that when the *Trip Θ* function operates, an acoustic, optic or digital signal is generated to warn the supervisor to take appropriate action to intervene the situation. ↺



Thermal Alarm Θ

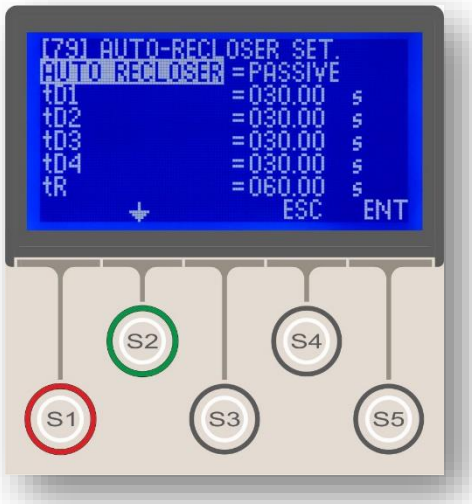
Just like *Trip Θ*, *Alarm Θ* is a heating threshold in percentage; however, *Alarm Θ* function activates LEDs and any possibly configured outputs to inform the administrator to take appropriate precautions, instead of tripping the circuit breaker. *Alarm Θ* setting can be done within the range of %50 - %200, with the limitation that *Alarm Θ* value cannot be set over the *Trip Θ* set value. *Alarm Θ* function can be set as *Active* or *Passive* via the *Alarm Θ* option.

Alarm Θ function can be utilized in two ways.

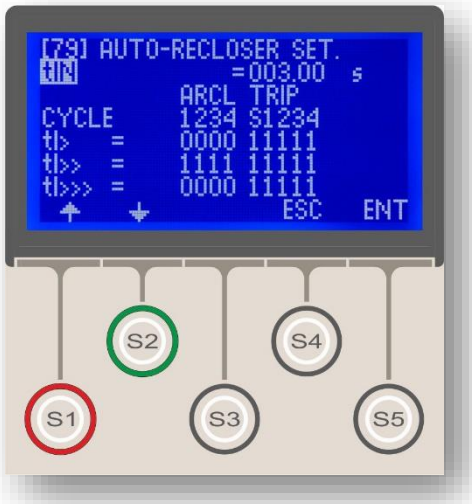
When *Thermal Θ* measurement reaches *Alarm Θ* threshold, the user is notified via the static alarm LED on the frontal face of CPM 310 G, while the alarming situation is declared on the *Alarm Menu*. The use of *Alarm Menus* will be examined thoroughly on the dedicated section in the following pages.

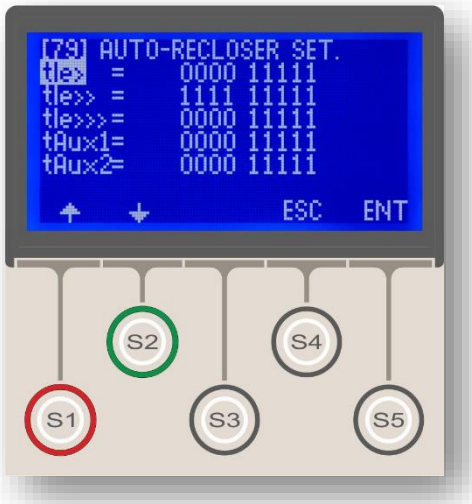
Alarm Θ function can also be utilized to automate cooling systems or to inform the supervisor about the situation remotely. If, e.g., a forced air cooling system is to be driven when the protected power transformer reaches a fixed heating percentage, a programmable output with Alarm Θ function appointed can be employed to generate a start signal to the preconfigured appropriate circuit. If the Alarm Θ notification is to be sent to the supervisor via an auxiliary system, e.g. a GPRS communication system, a programmable output with Alarm Θ function appointed can be employed to provide notification signal to the related device. Doing this, CPM 310 G will inform the configured communications device to take appropriate action when Alarm Θ threshold is reached. □

ARCL Auto-Recloser Settings Menu



Main Screen » Set » ARCL





Auto-reclosing is a widely used control function, which provides rapid pick up of the network when black-outs caused by temporary faults occur and mostly eliminates the need of manual intervention to those types of faults; while blocking itself if the fault is found out to be permanent, any manual intervention occurs or other predefined conditions are present.

The picture on the top of this page shows the initial screen when the Auto-Recloser menu is entered, while the pictures below it shows the full menu content. The menus that provide settings options for specific protection and control functions will be examined in the following pages.

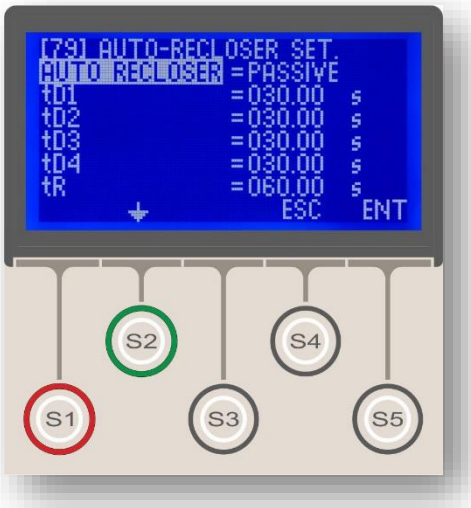
The CPM 310 G auto-recloser function has the following characteristics:

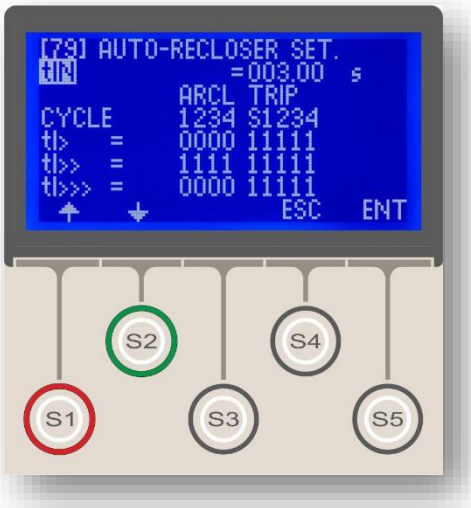
- Auto-reclose shots up to 4 cycles,
- Definite time reset characteristics,
- Definite time inhibition function,
- Independent settings for each individual function of phase overcurrent protection, earth overcurrent protection and auxiliary timers,
- 2 independent auto-reclose settings groups for G1 and G2,
- Self-blocking features to provide maximum service security:
  - Blocking on manual tripping of CB,
  - Blocking on manual closing of CB if any faults occur within the inhibition time interval,
- Auto-reclose cycle measurement, alarm and event recording,
- Visualization of auto-recloser condition via programmable LEDs.

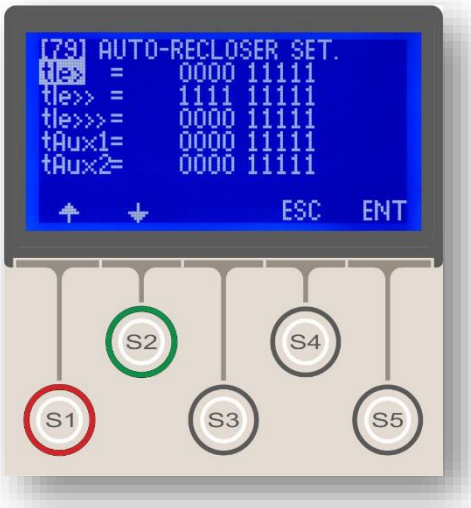
Settings that are shown on the pictures on the left side are explained below.

Auto Recloser
Can be set as "Active" or "Passive", to have the control into or out of service.

tD1, 2, 3, 4
Settings for the dead time intervals between the shots. Setting range is (0.01-300.0) s. ↺







tR

tR abbreviation represents the reset time with definite time characteristics. It determines the time delay to reset the function after the last successful shot. Setting time interval is (0.20 – 600.0) s.

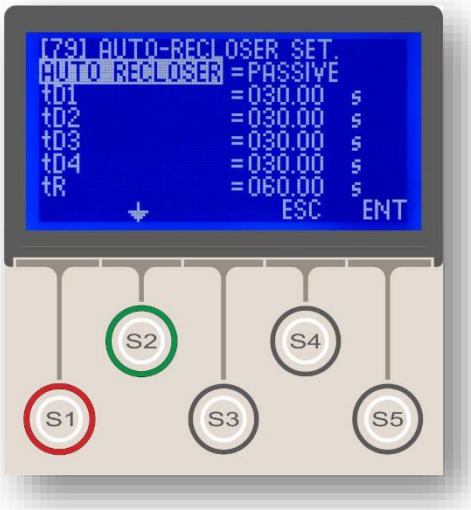
tIN

tIn abbreviation represents the inhibition time of auto-recloser after manual closing of the circuit breaker and has definite time characteristics. If any faults occur within the inhibition time, auto-recloser will be blocked and no shots will be conducted. tIN setting range is (0.20-600.0) s.

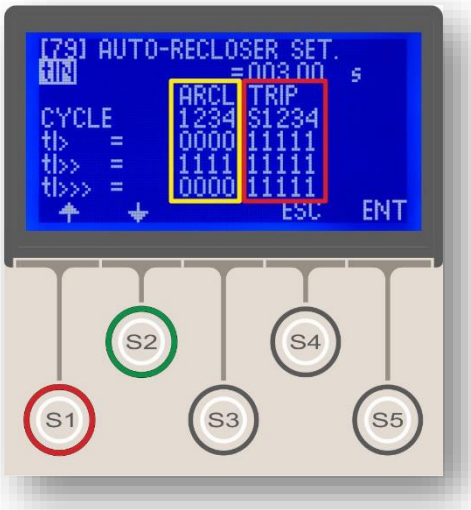
As described before, DEMA CPM 310 G relays are capable of handling independent procedures of auto-reclosing when phase fault, earth faults or auxiliary timer triggers operate. The 2 pictures on the left bottom side show the menus to set auto-reclosing options for each individual function covered. The menus are reached by pressing S2 (🡻) button after navigating to the last line of the main *ARCL Settings* menu.

The list below shows the functions that are covered by the auto-recloser feature of CPM 310 G. Configuring the settings of each function at their dedicated menus, an auto-reclose scheme can be set up to provide any desired automatic response to various types and combinations of faults. E.g., settings can be done so as to provide multiple shots of auto-reclosing if any overcurrent faults by 1st thresholds of phase and earth protections occur, while prohibiting auto-recloser to be triggered by the other faults.

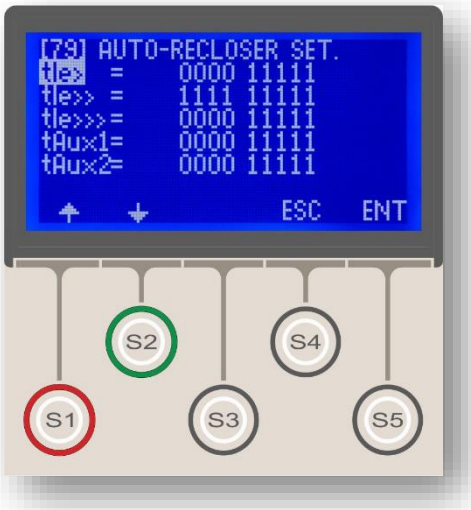
1. tI> Phase Overcurrent 1st Threshold Protection
2. tI>> Phase Overcurrent 2nd Threshold Protection
3. tI>>> Phase Overcurrent 3rd Threshold Protection
4. tI_e> Earth Overcurrent 1st Threshold Protection
5. tI_e>> Earth Overcurrent 2nd Threshold Protection
6. tI_e>>> Earth Overcurrent 3rd Threshold Protection
7. tAux1 Auxiliary Timer No.1
8. tAux2 Auxiliary Timer No.2 ↺



The tripping settings (shown within the red borders on the picture in the middle) determine the tripping behavior of the circuit breaker within the auto-reclosing cycles, if a function (e.g. tI>) generates a trip decision. The line under the title describes cycle numbers and the line at the bottom comprises the settings. If any of the setting values on the bottom lines is set as "1", tripping by the related function at the related cycle will be allowed; but if it is set as "0", tripping will be prohibited. Note that the informative "S" abbreviation stands for the standard tripping action that triggers the auto-recloser and cannot be set as "0". According to the sample settings on the picture, any tripping decision generated by tI> function will result in tripping on any cycles. Note that if a tripping option is set to "0" and no other function clears the related fault when occurred, the "0" option will be ignored at that time to provide clearance of the fault. This algorithm ensures prevention of failures of system protection due to auto-recloser configurations.



To have Auto-Recloser function into service, it is required that,
1. One of the any programmable inputs is cabled to a normally open auxiliary contact of CBs and 52a appointment is done to that input,
2. One of the any programmable outputs is cabled to the closing release terminal of CBs and Close CB appointment is done to that output.



If the ARCL function is tried to be had into service without fulfilling the requirements explained above, the Alarm LED warns the user and the Alarm Menu displays the following message: "Auto-recloser settings error". If no corrective actions are taken, the auto-recloser remains out of service. When the auto-recloser functions are activated, any active latch settings are automatically driven out of service; the reason is that the auto-recloser cannot operate properly when there are active latch functions that need manual resetting. Knowing this, having any active latch settings manually out of service is highly recommended to prevent potential misinterpretations that the output relays that are configured to latch under described conditions will operate as set. It must always be kept in mind that the Auto-Recloser settings overrule the latch settings. □

Main Menu

Main Screen » Menu

DEMA CPM 310 G Main Menu is accessed via the MENU button (S5) on the main screen, as pictured on the left. The middle and bottom pictures show the whole menu content. Explanations on the sub-menus seen on the picture at the bottom will be studied in the following sections.

Below does the summary of the sub-menus and functions exist within the Main Menu.

1. Measurements Menu

Measurements Menu is where the momentary, cumulative and statistical values are accessed which CPM 310 G watches continuously. The menu comprises the measurements of power frequency, RMS current, current fundamental harmonic, positive and negative sequence current, thermal θ, input & output status, CB measurements, and auto-recloser measurements.

2. Communication Settings Menu

This menu allows the viewing and editing of digital communications settings. Setting the communications port, protocol, speed and relay address is available via the menu controls.

3. Event Records Menu

Event Records Menu displays the recorded events which may number up to 151 records. The records include settings & status changes, fault & disturbance records with comprehensible explanations and time/date stamps.

4. System Settings Menu

System Settings Menu allows users to view and change basic settings of DEMA CPM 310 G. The menu allows users to view and change time, date, nominal network frequency, unit description and password, phase and earth notation, settings groups, phase rotation, display lighting and language settings, as well as displaying the firmware version of the device. The menu also contains the control for resetting of the settings to the default values.

5. CT Settings Menu

CT Settings Menu is where nominal primary and secondary current values for phase and earth are set. Type and setting range selection for earth protection is also done on this menu. ↺

6. Automatic Control Settings Menu

Automatic Control Settings Menu has the entire settings options if protection and measurement controls are put aside. These controls are listed below;

- Cold Load Pickup Settings,
- Output Settings,
- Trip Settings,
- Input Settings,
- Blocking Selectivity Settings,
- CB Failure Settings,
- Timer Settings,
- Delaying Selectivity Settings,
- Auto-Recloser Settings,
- CB Supervision,
- LED Settings,
- Latch Settings, and
- Alarm Settings.

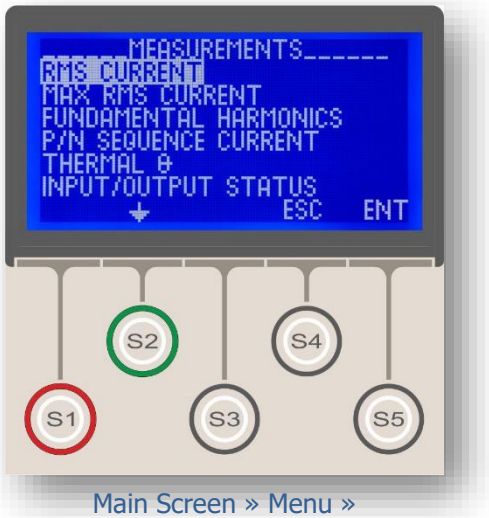
7. Function Test Menu

Function Test Menu enables the testing function that conducts the final tests of the settings, functionality and cabling done before commissioning CPM 310 G. The function basically generates virtual current around 40 I_n to check and supervise the settings, functionality and cabling.

8. Fault Records Menu

This menu displays fault records that are filtered and derived from the event records. The filtering method is based on the elimination of the events not resulting with tripping. The display format is the same with that of event records. □

Measurements Menu



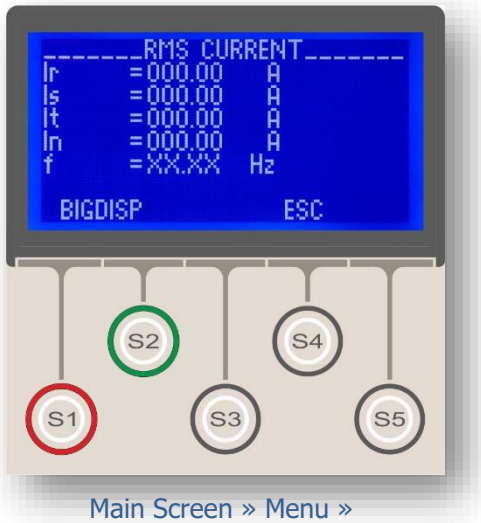
Main Screen » Menu » Measurements

Measurements Menu is where the momentary, cumulative and statistical values are accessed which CPM 310 G watches continuously. As seen on the pictures to the right, the menu comprises

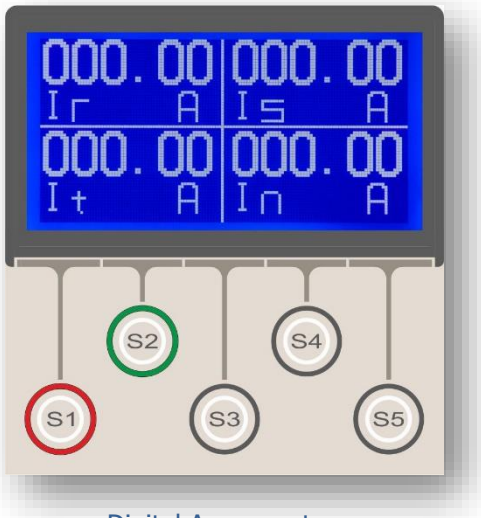
- RMS Current Measurements Menu,
- Max. RMS Current Measurements Menu,
- Fundamental Harmonics Measurements Menu,
- Positive / Negative Sequence Current Measurements Menu,
- Thermal Θ Measurement Menu,
- Input / Output Status Monitoring Menu
- Breaker Measurements Menu,
- Auto Recloser Measurements Menu,
- LED Status Monitoring Menu.

The following sections describe the use of the listed menus. □

RMS Current and Frequency Measurements Menu



Main Screen » Menu » Measurements » RMS Current



Digital Ampermetre

RMS Current Measurements Menu measures amplitudes of current waves of frequencies from 50 Hz / 60 Hz (1st order harmonic) to 500 Hz / 600 Hz (10th order harmonic) to evaluate the root mean square value of the line primary current and displays the momentary and peak results. The menu contains:

- R, S, T line and N RMS current values, and
- Momentary network frequency value.

The values displayed on the menu are the network primary values.

As DEMA CPM 310 G evaluates the primary current values by utilizing the information acquired from the secondary signals and the *CT Settings* menu, the values at the *CT Settings* menu must be set correctly to make sure *RMS Current Measurements Menu* displays correct evaluations.

RMS current values are measured and displayed within the range of (0.1-40.0) I_n and (0.1-40.0) I_{en}. Values lower than the base limit will neither be measured nor be displayed, while values exceeding the upper limit will be evaluated and displayed as 40 I_n or 40 I_{en}.

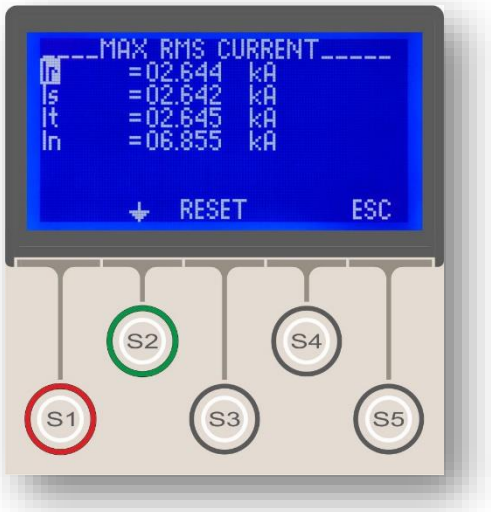
If the S1 (BIGDISP) button is pressed on the menu, the ampermeter interface (shown at the bottom picture) is displayed. This ampermeter shows all the current values in the largest visual format possible, to make it easier for the operator to observe the current readings. Pressing any other button than the Reset button will lead the screen to the *RMS Current Measurements* menu.

Below the I_r, I_s, I_t and I_n values, the momentary frequency measurement is displayed. Note that this measurement will not be able to be done if no current can be measured from the CTs (e.g. when the circuit breaker is in open position) and the *f* value will be displayed as "XX.XX", as on the top picture.

WARNING!
To ensure the correct operation and measurements of DEMA CPM 310 G relays, the *Frequency* parameter at the *System Settings* Menu has to be set correctly! Inappropriate settings may cause in protection faults and incorrect measurements!

The *Frequency* parameter in the *System Settings* Menu is set to 50 Hz by default. If the network nominal power frequency is 50 Hz, no changes are needed to be done on the control; however, if the network nominal power frequency is 60 Hz, the following address is to be followed to set the parameter correctly to ensure safe and expected functionality of the unit:
Main Screen » Menu » System Settings » Frequency » 60 Hz □

Max RMS Current Measurements Menu



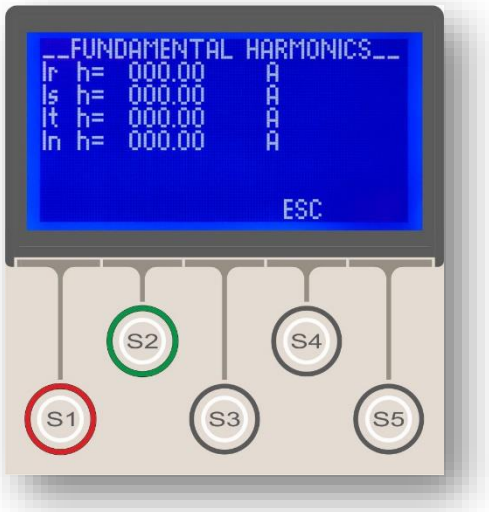
Main Screen » Menu » Measurements » Max. RMS Current

Max. RMS Measurements Menu displays the measured maximum R, S, T and N line RMS current values since the last resetting.

The *Max RMS Current Measurements* menu;
- Makes it possible to check the inrush current of the protected system and fine-tune the protection functions,
- Monitors the peak current values a fault can reach,
- And gives statistical information for archiving,

Maximum RMS current values are measured and displayed within the range of (0.1-40.0) I_n and (0.1-40.0) I_{en}. Values lower than the base limit will neither be measured nor be displayed, while values exceeding the upper limit will be evaluated and displayed as 40 I_n or 40 I_{en}. As seen on the picture on the middle of the page, maximum values of each measurement (R, S, T and N) can be reset; this feature enables the users to collect statistical data by regular basis. □

Fundamental Harmonics Measurements Menu



Main Screen » Menu » Measurements » Fundamental Harmonics

Fundamental Harmonics Measurements Menu displays the measurements of fundamental harmonics (f= 50 Hz / 60 Hz) of the primary R, S, T phases and the primary earth current. The display menu is shown on the left.

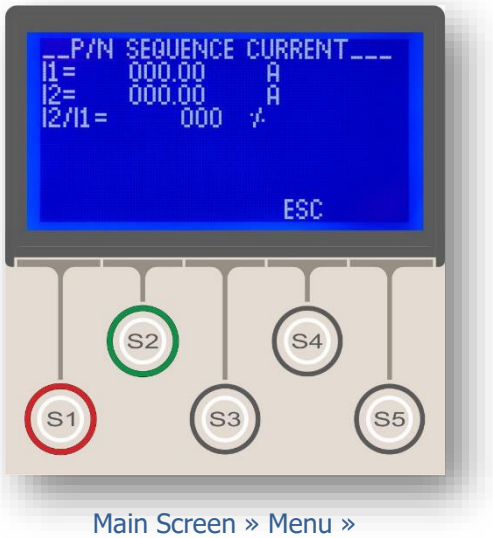
Using *RMS Current Measurements Menu* and *Fundamental Harmonics Measurements Menu* together, administrators can easily evaluate the TDH (Total Harmonic Distortion) on the line.

Note that the values shown on the menu are primary values.

Fundamental harmonics current values are measured and displayed within the range of (0.1-40.0) I_n and (0.1-40.0) I_{en}. Values lower than the base limit will neither be measured nor be displayed, while values exceeding the upper limit will be evaluated and displayed as 40 I_n or 40 I_{en}.

For the fact that DEMA CPM 310 G evaluates the primary current values by utilizing the information acquired from the secondary signals and the *CT Settings* menu, the values at the *CT Settings* menu must be set correctly to make sure *RMS Current Measurements Menu* displays correct evaluations. □

Positive & Negative Sequence (P/N) Current Measurements Menu



Main Screen » Menu » Measurements » P/N Sequence Current

Positive and Negative Sequence Current Measurements Menu screen is shown on the left picture.

The menu monitors the following measurements.

I1 (Positive Sequence Measurement)
Positive sequence component of the phase current values is formulated as follows.

$$I_r(t) = I_p \times \sin[\omega t - \phi] \quad [1]$$
$$I_s(t) = I_p \times \sin[\omega t - (\phi + 120°)] \quad [2]$$
$$I_t(t) = I_p \times \sin[\omega t - (\phi + 240°)] \quad [3]$$
$$3\underline{I_1} = \underline{I_r} + a\underline{I_s} + a^2\underline{I_t} \quad [4]$$

Where,
$I_{r,s,t}(t)$ the momentary values of phases' current,
I_p current peak value,
$\underline{I}_1$ positive sequence current vector,
$\underline{I}_r$, $\underline{I}_s$ ve $\underline{I}_t$ phase current vectors,
a an operator that rotates a vector by 120°,
a^2 an operator that rotates a vector by 240°.

I_1 gets the same value with the phases when the phase current values get the same value; while having the average value of the phases' when load imbalance takes place.

I2 (Negative Sequence Measurement)
Negative sequence component of the phase current values is formulated as follows.

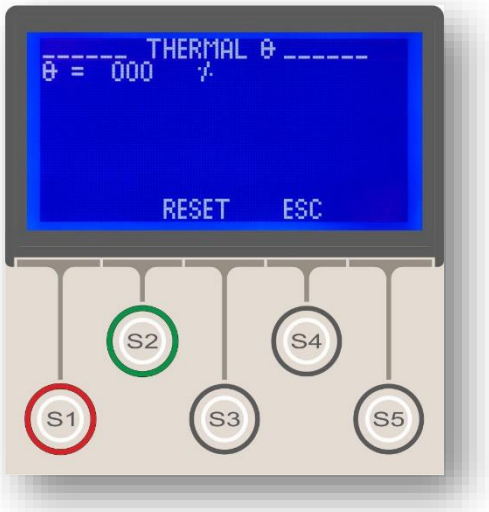
$$3\underline{I_2} = \underline{I_r} + a^2\underline{I_s} + a\underline{I_t} \quad [5]$$

Where,
$\underline{I}_2$: represents the negative sequence current vector.

I_2 gets zero value when the phase current values the same value; while having values greater than 0 when load imbalance takes place.

I2/I1 (Negative Sequence / Positive Sequence)
I_2 / I_1 (Negative Sequence / Positive Sequence) value is monitored on this row. The momentary value is displayed in percentages. □

Thermal Θ Measurements Menu



Main Screen » Menu » Measurements » Thermal Θ

Thermal Θ Measurements Menu displays the heating percentage of the system being watched in percentages.

Thermal Θ is evaluated according to the IEC formulations; the actual formula is given below.

$$t = T_e \times \log_e \left[\frac{\left| \left(\frac{I}{k \times I_\Theta} \right)^2 - \%\Theta_p \right|}{\left| \left(\frac{I}{k \times I_\Theta} \right)^2 - \%\Theta_{trip} \right|} \right]$$

Where,

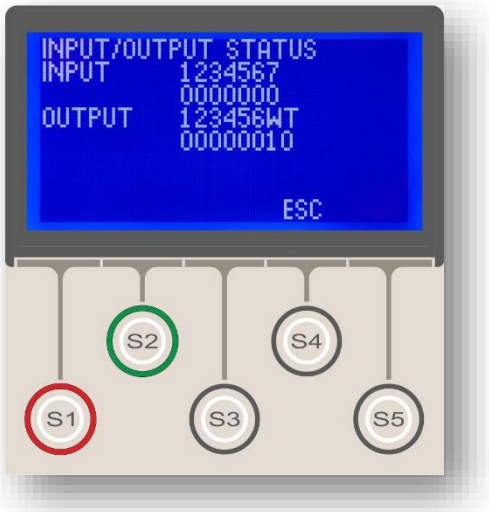
t	trip delay (minutes),
T_e	thermal constant (minutes),
I	load current (A),
I_Θ	set current (A),
k	trip threshold translation constant (-),
$\%\Theta_P$	preheating percentage (%),
$\%\Theta_{trip}$	heating trip percentage (%).

Thermal Θ measurement, alarming and protection are important functions for machines and systems where the actual conductor heating cannot be partially or entirely measured by direct means, or where overcurrent protection cannot provide the sensitive protection characteristics needed around lower current value limits.

Thermal Θ measurement, alarming and protection are the essential functions of modern electrical protection systems and have unique functionalities, therefor cannot be replaced by other functions.

Note that the percentages refer to the allowed maximum thermal loading, which is determined by the manufacturer or characteristics of the machines/conductors being protected. □

Inputs & Outputs Status Monitoring Menu



Main Screen » Menu » Measurements » Input Output Status

Input & Output Status Monitoring Menu displays the momentary status of the following contacts:

- 7 programmable inputs (top picture),
- 6 programmable outputs (bottom picture),
- Watchdog (W) relay (bottom picture), and
- Trip (T) relay (bottom picture).

The menu comprises two sub-menus, which are studied below.

Input Status

When Input & Output Status Monitoring Menu is accessed, the first two lines below the title display the input status. The first line shows the input no. while the second line gives the status of the inputs as "1"s and "0"s. When an input is inactive, the related monitoring cell on the status line displays "0", or, vice versa, when the input is active, "1" is displayed to show the status of the related input. E.g., the sample input status monitoring screen on the picture to the top displays that all inputs are inactive.

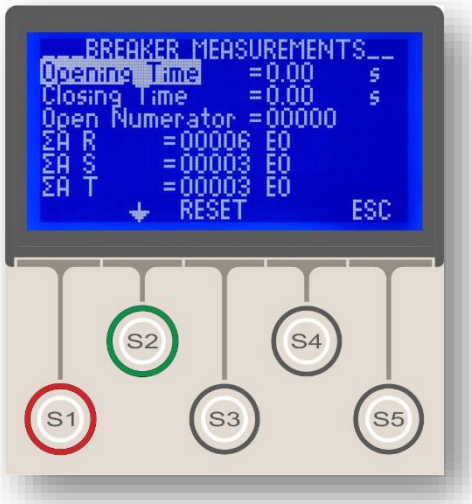
Outputs Status

Outputs status examination is done the same way done for inputs. As seen on the picture, 3rd line of the screen displays the titles for the monitored outputs; 6 programmable outputs, the watchdog relay and the trip relay. The 4th line on the screen displays the status of the outputs as "1"s and "0"s, identical to inputs screen. When the outputs are passive, relevant monitoring cells on the status line displays "0", while "1" is displayed for outputs that are active. This rule counts also for SPDT (single pole / double throw) relays, which are: programmable relays 1&2, the trip relay and the watchdog relay.

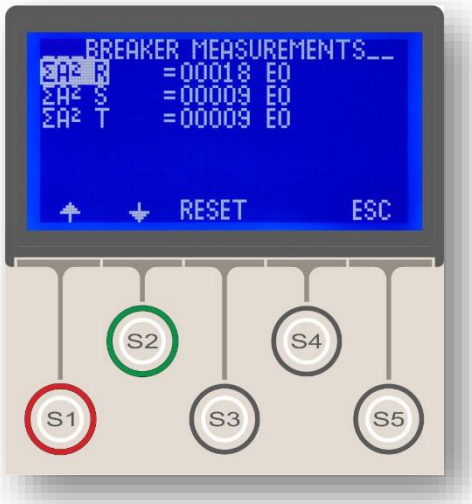
NOTE

Note that the watchdog relay has a unique activation behavior. Unlike the other outputs, the watchdog relay closes by default when CPM 310 G is in service. This results from the nature of the relay - the watchdog relay opens contacts only when there is an auxiliary supply shortage or internal error. Because of the mentioned functionality characteristics, the watchdog relay (W) is always monitored as "1". □

Circuit Breaker Measurements Menu



Main Screen » Menu » Measurements » CB Measurements



As shown on the image above, the ∑A and ∑A^2 values on the measurement menu is shown in scientific notation. E.g., 12745 E4 means 12745 x 10^4.

Circuit Breaker Measurements Menu is intended to be used by statistical and diagnostic means; therefor all values displayed on the menu can be reset when needed. Values that are shown on the menu are listed and explained in the following paragraphs.

Opening Time
Monitors the latest tripping time of the circuit breaker. In order to use this feature, the following are required:
- Cabling a programmable input to a normally open auxiliary contacts of the CB,
- Assigning "52a" to the programmable input.

Supervising the tripping time of the CB is of high importance to make sure that the CB mechanism is in good condition and the CB works within the expected trip time delay interval and would not jeopardize the selectivity scheme. Note that the measurement is effective only when the opening / tripping command is carried out over the relay.

Closing Time
Monitors the latest closing time of the circuit breaker. In order to facilitate this feature, the following are required:
- Cabling a programmable input to a normally open auxiliary contacts of the CB,
- Assigning "52a" to the programmable input,
- Assigning "Close CB" function to any of the programmable outputs.

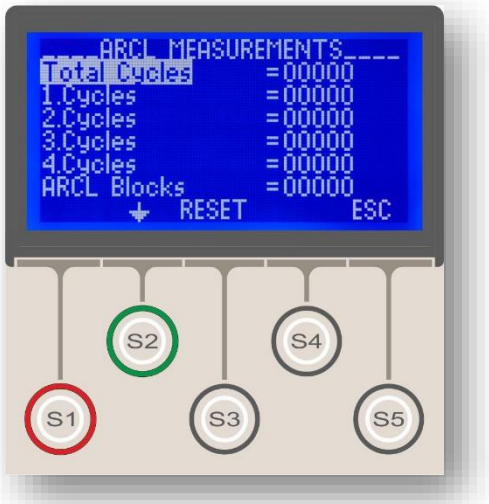
Supervising the closing time of the CB is of high importance to make sure that the CB mechanism is in good condition. Note that the measurement is effective only when the closing command is carried out over the relay.

Open Numerator
Trip operations conducted via CPM 310 G is counted and displayed on this field.

∑A (R, S, T)
These measurements are the summation of the RMS current values at tripping moment. ∑A measurements should be compared to the ∑A limit value characteristics supplied by the manufacturer for CBs with I_r > 52 kV.

∑A^2 (R, S, T)
These measurements are the summation of the RMS current-square values at the tripping moment. ∑A^2 measurements should be compared to the ∑A^2 limit value characteristics supplied by the manufacturer for CBs with $I_r \leq 52$ kV. □

Auto-Recloser (ARCL) Measurements Menu



Main Screen » Menu » Measurements » ARCL Measurements

Auto-Recloser (ARCL) *Measurements Menu* is intended to be used by statistical and diagnostic means; therefor all values displayed on the menu can be reset when needed. E.g., pressing S3 (Reset) button while at the menu shown on the top picture will reset the *Total Cycle*s measurement value. This action is applicable for all measurements on the menu.

The measurements available on the menu are described below.

Total Cycles Measurement
This measurement is the summation of the values of 1st, 2nd, 3rd and 4th cycle measurements and represents the total number of CB closing commands generated by the auto-recloser function.

1st, 2nd, 3rd and 4th Cycle Measurements
These values give the total CB closing commands generated by the auto-reclose function for each of the cycles.

ARCL Blocks Measurement
This measurement displays the total number of the instances that auto-recloser is blocked.

Having examined the explanations above, the following example tries to figure the behavior of the ARCL *(Auto-Recloser) Measurements Menu* when an auto-recloser session is completed. The example below is given presuming that the CPM 310 G unit is configured to make two auto-reclose shots when the CB is tripped by I>> function.[5]

1. When the CB is tripped by the I>> function, the auto-recloser would conduct a reclose shot.
2. If the failure is detected again, the CB will be tripped by the I>> function again, and the auto-recloser will conduct a second reclose shot.
3. If the failure is detected for the third time, the CB will be tripped and the auto-recloser will be blocked.

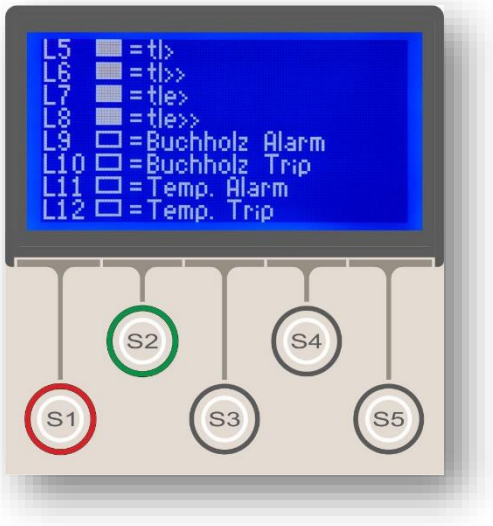
For a scenario as above, formerly reset measurements will read as following:

Total Cycles	00002
1st Cycle	00001
2nd Cycle	00001
3rd Cycle	00000
4th Cycle	00000
ARCL Blocks	00001

□

[5] For detailed information on the configuration of auto-recloser, please refer to the *Auto-recloser Settings Menu* Section on this Manual.

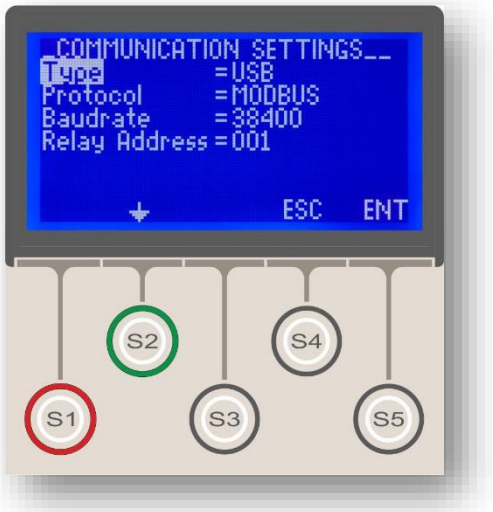
LED Status Menu



The *LED Status Menu* displays the status of all programmable virtual LEDs, which are programmed through the *LED Settings Menu* under the *Automatic Control Functions Menu*.

The sample LED status picture on the left shows that there are 4 active programmable LEDs (L5 – L8), that tell the tI>, tI>>, tI_e> and tI_e>> protection functions have generated a trip signal. Other programmable LEDs (L9 – L12) have no activity. □

Communication Settings Menu



Main Screen » Menu » Communication Settings

Communication Settings Menu allows the users to view and change digital communication settings. The menu controls provide the available options of communication ports, communication protocols, communication speed and relay addressing to be accessed and changed.

The welcome menu and the full content are shown on the pictures in order.

The options on the menu are described below.

Type
This field enables the port setting alter between USB and RS485. The USB port is located on the front face of the unit, and is usually utilized to provide CPM 310 G – *DigiConnect PC Program* communication. Most of the other communication systems need and use the RS485 port, of which terminals are located on the backside terminal blocks of the unit. The default setting is *USB*.

Protocol
DEMA CPM 310 G allows the activation and use of three communications protocols. These protocols are listed below.

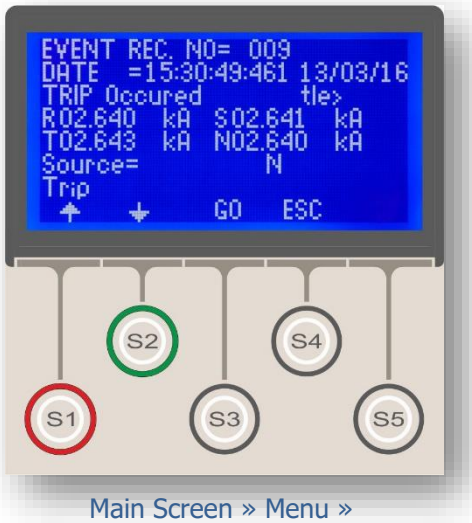
1. DEMCOM (DEMA Communications Protocol),
2. MODBUS,
3. IEC 60870-5-103.

The default setting for this field is *DEMCOM*.

Baudrate
Options for this field are 1,200 – 2,400 – 4,800 – 9,600 -19,200 and 38,400 bauds. The default setting is 38,400 bauds.

Relay Address
When more than one units of CPM 310 G are to be watched and/or controlled remotely, relay addressing becomes essential. DEMA CPM 310 G Relays allow addressing in integers from 1 to 255. The default address is "001". □

Event Records Menu



Main Screen » Menu » Event Records

Event Records Menu contains the records of CPM 310 G actions that are related with settings changes, detected disturbances, detected faults, input & output status changes an alarms. Up to 151 records can be viewed on the menu.

The upper picture displays a sample event record. The following paragraphs explain how to read the content of the record.

The record number is displayed on the top. The event record number grows as more events are recorded, until the record number reaches 150 and the memory is full. The next record after that will be numbered as 0, and the menu will start to overwrite the oldest records to provide an infinite loop of recording. Note that the number displayed here when the menu is accessed also shows the latest record number.

The second line of the screen gives the event record time stamp in hour : minute : second : millisecond format.

The third line displays the summary of the record.

The bottom line contains the controls to browse backward (▲) or forward (▼) in the menu, to jump to a specific record (*GO*), to exit the menu (*ESC*) or to explore the details of the displayed record (*ENT*: Enter).

The picture placed on the left shows the screen that comes up when the *GO* command is used. This sub-menu asks for the record number to jump; once the number is decided, *ENT* (S4) command is utilized to go to the record with the given record number.

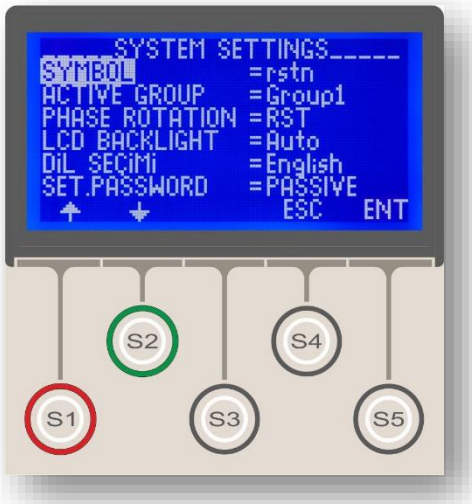
The record on the top picture is read as follows:

At date 13.03.2016 at hour 15:30:49:461, the following event has occurred, and recorded as Event 9:
An earth fault is detected (Source= N), the CB is tripped as the delay time is reached (tIe>).
At the tripping moment, the primary circuit current values were detected to be:

R 2.640 kA
S 2.641 kA
T 2.643 kA
N 2.640 kA
□

System Settings Menu

Main Screen » Menu » System Settings



System Settings Menu allows users to view and change fundamental settings of DEMA CPM 310 G. The menu allows users to view and change time, date, nominal network frequency, unit description and password, phase and earth notation, settings groups, phase rotation, display lighting, language, setting & CB password activation settings as well as displaying the firmware version of the device. The menu also contains the control for resetting of the settings to the default values.

The explanations of the settings and options available on the menu are given below.

Time
Time setting is accessed and used by CPM 310 G for time stamping in recording functions such as waveform, event and fault recording. This field allows the time setting to be done in hour : minute : second format.

Date
Date setting is accessed and used by CPM 310 G for date stamping in recording functions such as waveform, event and fault recording. This field allows the time setting to be done in day / month / year format.

Version
This field is read-only and displays the loaded firmware version of the unit.

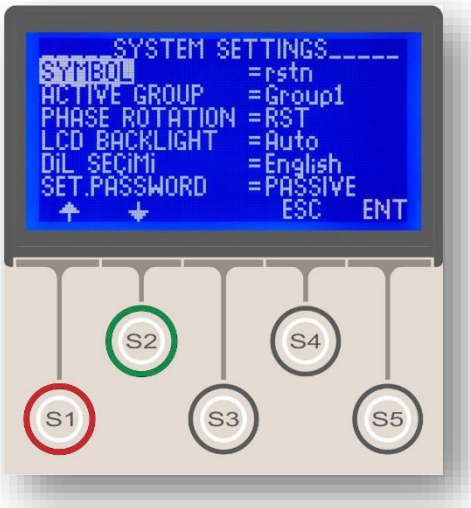
Frequency
The power frequency of the network which CPM 310 G will be used in is selected on this field. The default setting is 50 Hz, however, it must be altered where the power frequency is 60 Hz.

WARNING!
Setting the Frequency option to the wrong value may result in protection and measurement failures!

ID
The ID field allows an 8-character description of the CPM 310 G unit. The ID to be entered hereby is recommended to descriptive to provide the intended advantages for maintenance actions that require the removal of several units at a time, and for SCADA applications where unit descriptions are read from the unit memory. ↺

Password
CPM 310 G password feature is a security application that prohibits unauthorized operation on the device, including settings changes, function testing and circuit breaker control. The password is a 4-digit word of which default value is "0000". If no need for password security is evaluated, the password can be left as the default value; by doing this, all functions that require password confirmation will be accesses by simply confirming the appearing password on the password screen. If the password is changed to provide enhanced security, the edited password has to be entered each time the confirmation screen appears, otherwise, the operation will not be validated by CPM 310 G.

WARNING!
If a password is lost or forgotten, there is no way to recover the password via CPM 310 G! In such a case, the password reset process can only be done via PC program. Remember that when passwords other than "0000" is used and take appropriate precautions!



Symbol
System symbolization determines the notation style of line & earth current. The options are "rstn" and "abce".

Active Group
Active Group setting allows users to switch between the two existing settings groups. The subject is examined thoroughly in the *Settings Group Selection Menu* section earlier in this manual.

Phase Rotation
Phase rotation selection feature of CPM 310 G enables the action of changing the secondary line cabling order without re-cabling once the system is commissioned. In the case of cabling the CT secondaries in wrong order to CPM 310 G, problems like negative sequence or broken conductor tripping even for healthy systems are likely to occur. If this kind of cabling problem is detected and intervention to the live cabling is not possible, *Phase Rotation* feature can fix the problem: changing the default setting "RST" to "RTS" will resolve the problem.
Operators can check the phase order using the *P/N Measurements Menu*; if the I_2 value is higher than the I_1 value, there is a phase order problem. ↺

LCD Backlight
LCD backlighting options are *Automatic* and *Always On*.
• The default setting *Automatic* provides backlighting when the user's hands are on, and switches off backlighting 5 minutes later from the most recent operation.
• If the field is set to *Always On*, the backlighting will be always on, regardless from user activity. For the cases that the secondary system is supplied from the auxiliary supply system, when the primary source is off, it must be kept in mind that *Always On* setting increases power consumption of the units by a factor of approximately 4:3, when compared to the *Automatic* setting.

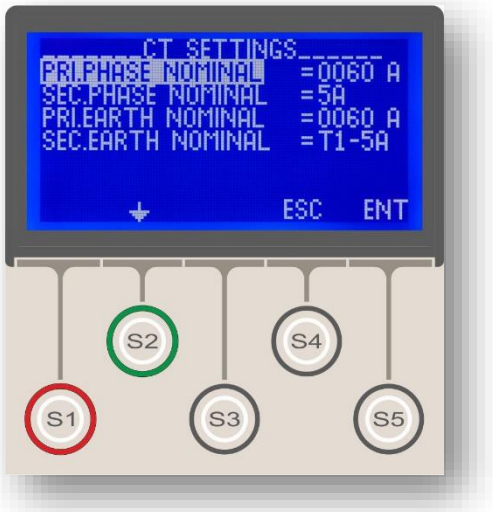
Language (on TR Menus) / Dil (on EN Menus)
DEMA CPM 310 G relays currently provide Turkish and English menu language options. One of these options can be selected on this field. Note that the name of the field is given in the alternative language to help monolingual users locate and change the language to their native.

Settings Password
This control enables or disables password protection of protection and automatic control settings. If this parameter is made "Active", password validation will be required to modify protection and automatic control functions. Default setting is "Passive".

CB Password
This control enables or disables password protection of the CB control menu. If this parameter is made "Active", password validation will be required to access the CB Control Menu. Default setting is "Passive".

Load Default Settings
If by any reason, the CPM 310 G unit settings are to be reset to the default settings, *Load Default Settings* command should be utilized. When the control is intended to be used; first a password validation is required, and then the menu on the middle picture appears. While on that screen; if Y (Yes, S1) button is pressed, the unit will restart its operating system with the default settings, while pressing N (No, S2) or CNC (Cancel, S5) buttons will stop the procedure and lead back to the *System Settings Menu*. The default settings of CPM 310 G are given in the *Technical Data* section of this manual. □

Current Transformer Settings Menu



Main Screen » Menu » CT Settings

Current Transformer Settings Menu is a declarative menu of high importance for the correct operation of CPM 310 G, where the primary and secondary nominal current values of the phases and the earth are declared to CPM 310 G, as well as earth protection range setting is done.

DEMA CPM 310 G is designed to comply with various types of current transformers – keeping only one type of overcurrent protection relay in inventory is made possible thanks to this feature of CPM 310 G.

See the below explanations for detailed information on the options in the menu.

Primary Phase Nominal Current
This declarative field is where the primary phase nominal current is set in amperes. The setting range is (1 – 9,999) A. DEMA CPM 310 G evaluates the primary phase current values using the secondary signals and the declaration on this field; therefor, entering inappropriate values to this field will result in wrong calculations to be displayed on the alarm and records menus.

Secondary Phase Nominal Current
This informative field is where the secondary phase nominal current is set in amperes. The options are 1 A and 5 A. While DEMA CPM 310 G handles and evaluates the secondary signals not according to this field but the dip-switch settings, however, selecting the wrong option on this field may misinform the users. Please see the *Dip-Switch Settings* section for detailed information on the secondary signal processing principles of CPM 310 G, at p.47 of this manual.

Primary Earth Nominal Current
This declarative field is where the primary earth nominal current is set in amperes. The setting range is (1 – 9,999) A. DEMA CPM 310 G evaluates the primary earth current values using the secondary signals and the declaration on this field, therefor, entering inappropriate values to this field will result in wrong calculations to be displayed on the alarm and records menus. The setting must be done in the same value with the set *Primary Phase Nominal Current* value, if a distinct residual current transformer is not used. ↺

Secondary Earth Nominal Current
This field enables the declaration of the secondary earth nominal current and earth protection range. The options available for the field are listed below.[6]

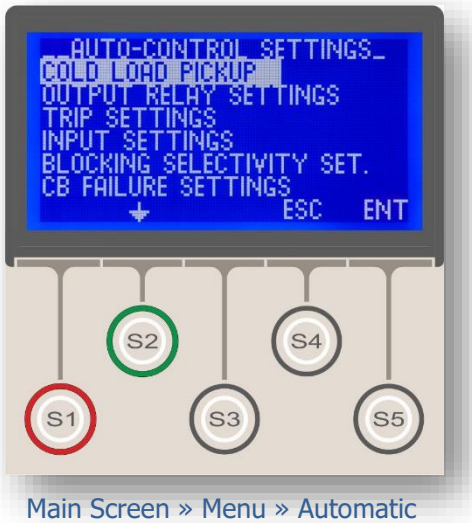
Option	Earth Protection Type	Range	I_{en}
T1-1A	T1 (Type 1)	(0.1 - 40) I_{en}	1 A
T1-5A	T1 (Type 1)	(0.1 - 40) I_{en}	5 A
T2-1A	T2 (Type 2)	(0.02 - 5) I_{en}	1 A
T2-5A	T2 (Type 2)	(0.02 - 5) I_{en}	5 A

WARNING!
Setting current transformers characteristics on the Current Transformers Menu does not provide the correct operation of CPM 310 G by itself; but also, the dip-switch settings must also be done! Incomplete and inappropriate settings on the menus and dip-switches may result in secondary protection, selectivity and supply continuity failures, performance drops and misinterpretations!

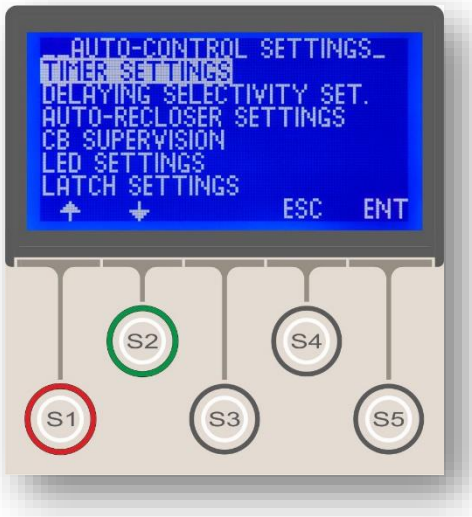
Please see the *Dip-Switch Settings* section for detailed information on the secondary signal processing principles of CPM 310 G, at p.47 of this manual. □

[6] Please read the warnings on this page!

Automatic Control Settings Menu



Main Screen » Menu » Automatic Control Settings



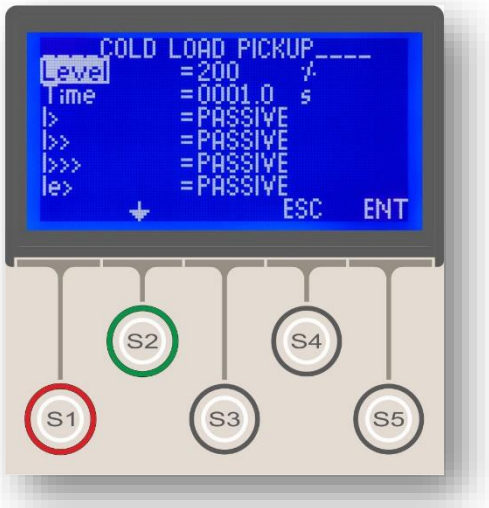
Automatic Control Settings Menu has the entire settings options other than protection and measurement controls. The controls in this menu are listed below;

- Cold Load Pickup Settings,
- Output Relay Settings,
- Trip Settings,
- Input Settings,
- Blocking (Logic) Selectivity Settings,
- CB (Pole) Failure Settings,
- Timer Settings,
- Delaying (Logic) Selectivity Settings,
- Auto–reclose Settings,
- CB Supervision Settings,
- LED Settings,
- Latch Settings, and
- Alarm Settings.

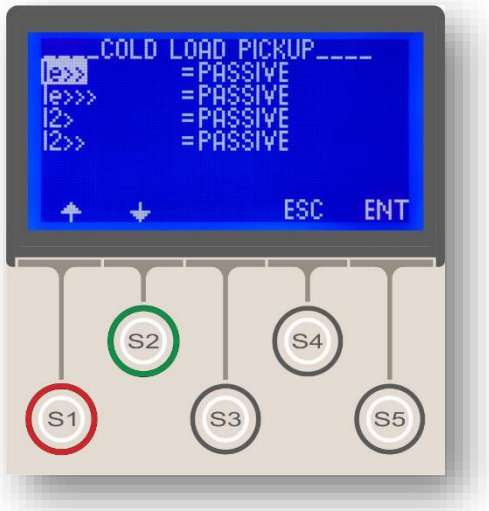
The welcome screen and the full menu content are shown on the pictures on the left side.

All of the controls existing on the Automatic Control Settings Menu will be covered in the following sections.
□

Cold Load Pickup Settings Menu



Main Screen » Menu » Automatic Control Settings » Cold Load Pickup



Cold Load Pickup (CLP) feature of CPM 310 G provides the option to pull up delay times of desired protection functions to enable easy pickup of machines and systems with high pickup / inrush current without protection relay intervention.

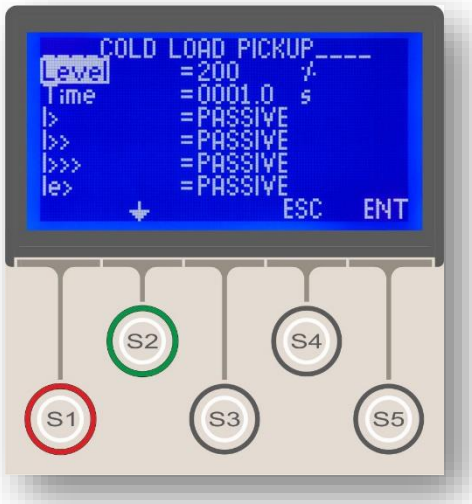
The cold load pickup operation starts when a programmable input with *Start CLP* appointment receives a signal. Once the CLP function is active, delay times for the configured functions are multiplied by the *Level* parameter for the time determined by the *Time* parameter. Initialization by the *Start CLP* appointed input can be achieved by cabling the input terminals to a normally open auxiliary contact terminals of the circuit breaker. See *Application Diagram 1* at p.194 of this manual on the subject.

In order to utilize the cold load pickup function, one of any programmable inputs should be programmed as "Start CLP" and one of the normally open contacts of the circuit breaker should be wired to that input. Once these arrangements are complete, *Cold Load Pickup* function will start to operate to modify the protection levels ONLY at the moment the circuit breaker is closed, but not for disturbances that occur during stable operating conditions.

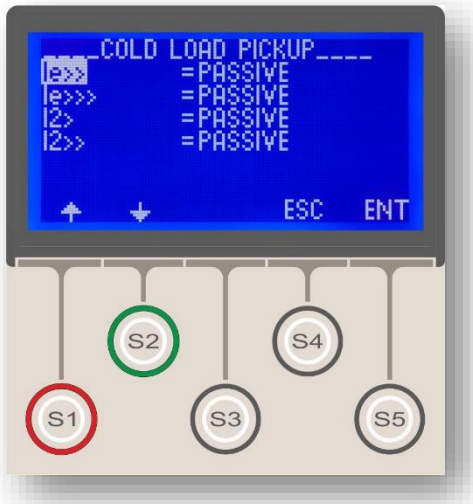
The following scenario examines CPM 310 G's cold load pickup behavior:

- Let the relay be set to I>> = 1.00 I_n, DType = IEC SI and TMS = 1.00.
- Cold Load Pickup function is set as "Active", Level = %200, Time = 1.00 s and I>> = Active.
- At the moment the circuit breaker is closed ("Start CLP" input is activated) the I>> threshold will be temporarily set to 2.00 I_n instead of 1.00 I_n.

Please pay attention to the following characteristics of the function:
- If any of the protection functions that is controlled by the Cold Load Pickup function has DMT delay characteristics, CLP will only modify the threshold value, but not the trip delay time.
- If any of the protection functions that is controlled by the Cold Load Pickup function has IDMT delay characteristics, CLP will modify both the threshold value and the trip curve characteristics. For the scenario above, if a current of 3 I_n is measured within the active CLP time; the ratio of (I/I_s) will be treated as 1.5 instead of 3.0, as the *Level* parameter is set to %200. Consequently, trip delay will be longer than normal. ↺



Main Screen » Menu » Automatic Control Settings » Cold Load Pickup



Below are the descriptions of the controls existing in the menu.

Level
Level parameter sets the multiplication factor of delay times for the selected functions. The setting range is from %20 to %500; in other words, delay times can be multiplied in a range of 0.2 to 5.0. When the setting value is declared below %100, the CLP function will behave in inverse characteristics it is intended for. This kind of application is made available for specific applications. When the setting value is declared above %100, the CLP function will behave as described in the previous paragraphs.

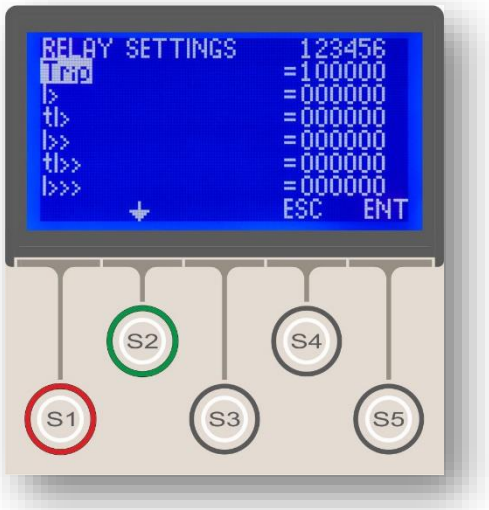
Time
The *Time* parameter determines the duration of CLP functionality, starting at the moment that the dedicated input receives the *Start CLP* signal. This duration determines, at the same time, the moment that the protection functions will start to behave as they originally set to.

Covered Functions (Active / Passive)
The entire control lines other than those described in the previous page are used for declaring CPM 310 G which protection functions are to be covered by the CLP functionality. By setting each of the listed functions as *Active* or *Passive*, the functions that are covered and excluded are decided. The functions being mentioned here is listed as follows:

- Phase Overcurrent Protection Functions: I>, I>>, I>>>.
- Earth Overcurrent Protection Functions: I_e>, I_e>>, I_e>>>.
- Negative Sequence Overcurrent Functions: I_2>, I_2>>.

CLP configuration methods vary by numerous applications. To decide to use CLP, or which functions are to be included or excluded, examinations with a number of parameters must be studied. It is recommended to seek professional help for these processes. □

Output Relay Settings Menu



Main Screen » Menu » Automatic Control Settings » Output Settings

The configuration of the 6 programmable outputs of CPM 310 G is done via the *Output Relay Settings Menu*. As shown on the picture, the first line of the menu displays the output addresses (1, 2, 3, 4, 5, 6) and the following lines display the assignable functions (e.g. *Trip*). At the bottom line, navigation options are displayed as usual. (▲, ▼, ESC (Escape) and ENT (Enter)).

Multiple functions can be set to trigger an output; e.g., if tI> and tI>> functions are assigned to Output 1, then trips from I> and I>> functions will trigger the operation of output relay no. 1.

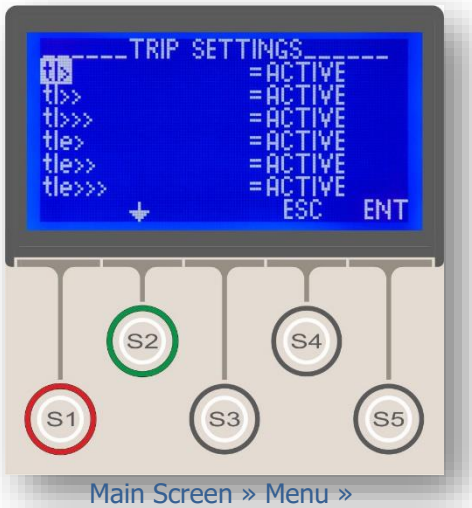
To assign a function to an output, simply navigate to that function using the S1 (▲) and S2 (▼) buttons and use the S5 (ENT) button to enter that function control. Use the S3 (➔) button to navigate to the appropriate output parameter, then use S1 (▲) or S2 (▼) buttons to set the parameter as "1" (assigned) or "0" (not assigned). Use S5 (ENT) button to complete the setting for that function.

Each programmable output is capable of handling numerous functions at the same time; functions that conflicts are exceptions. The *Trip* and *Close CB* functions pair is an example of conflicting functions. When two conflicting functions are tried to be appointed on the same programmable output, for instance, the older appointment is canceled automatically and the most recent appointment is accepted by CPM 310 G.

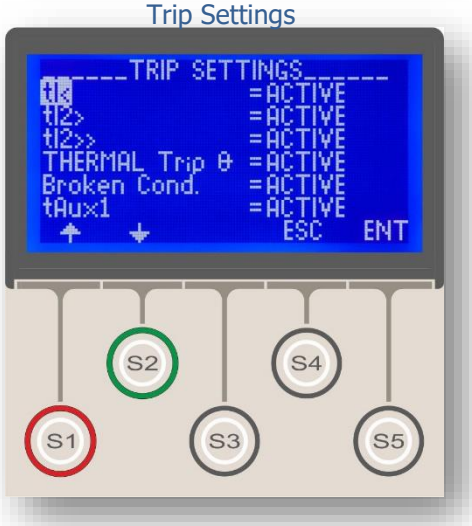
Available function appointments to the outputs are:

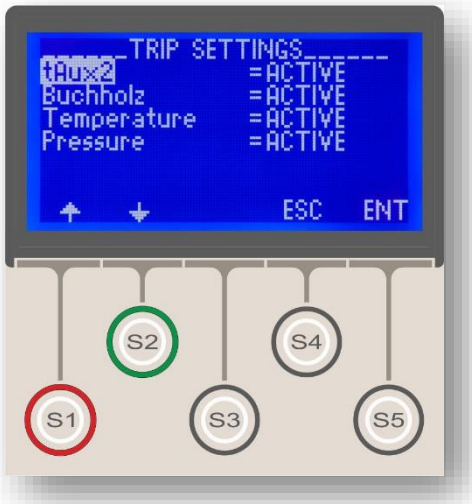
Trip, I>, tI>, I>>, tI>>, I>>>, tI>>>, I_e>, tI_e>, I_e>>, tI_e>>, I_e>>>, tI_e>>>, tI<, tI_2>, tI_2>>, Trip Θ, Thermal Alarm Θ, CB Alarm, 52 Failure, Broken Conductor, CB Failure, CB Close, tAux1, tAux2, ARCL Running, ARCL Blocked, Buchholz Alarm, Buchholz Trip, Temperature Alarm, Temperature Trip. □

Trip Settings Menu



Main Screen » Menu » Automatic Control Settings » Trip Settings





Trip Settings Menu is a control menu where certain protection and auxiliary timer functions, which are normally expected to give tripping signal to the circuit breaker, are set to trip the CB or not.

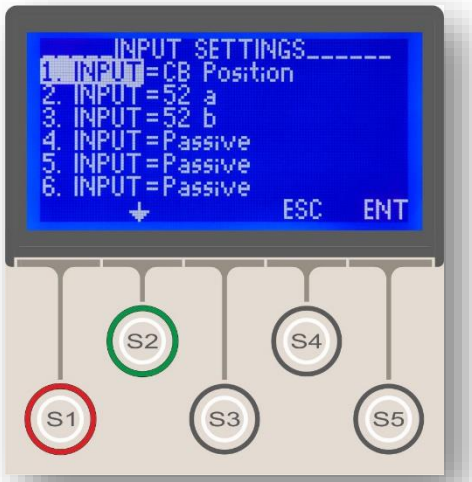
Setting trip functions to *Active* (let CPM 310 G to trip the CB by that function) or *Passive* (prevent CPM 310 G to trip the CB by that function) may be needed in many types of applications, e.g.,

- I>>> and I_e>>> functions can be set active to monitor the pick-up current, while their tripping settings are set to Passive, therefor are not let to trip the CB. By utilizing this method, it is possible to acquire information without tripping the CB, whether a device's (e.g. an asynchronous motor) pick-up current exceeds a specified limit,
- A function test of CPM 310 G may be needed to be conducted online – in this case, setting all parameters in Trip Settings Menu will do the trick.

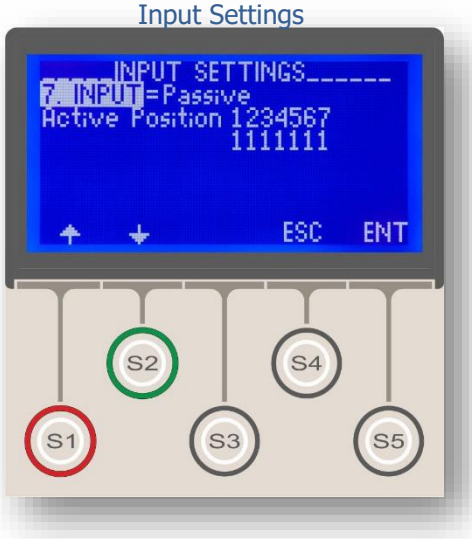
As seen on the pictures to the left, all functions that normally lead to the tripping of the CB can be controlled from the menu. The sample picture shows the default values; with which all protection and auxiliary timer functions will trip the CB when triggered.

WARNING!
Trip settings are to be modified only by the authorized personnel; since changes on those settings can prevent the relay to interrupt faults!
If the settings on the Trip Settings Menu are done inappropriately, the resulting behavior of the relay may cause system stresses, failure of fault interrupting, facility damages, selectivity failures and supply discontinuity! □

Input Settings Menu



Main Screen » Menu » Automatic Control Settings » Input Settings



Input Settings Menu is a control menu where the existing 7 programmable inputs of DEMA CPM 310 G relays are programmed and decided how to behave.

The picture at the top displays the welcome screen and the picture beneath shows the rest of the contents of the *Input Settings Menu*.

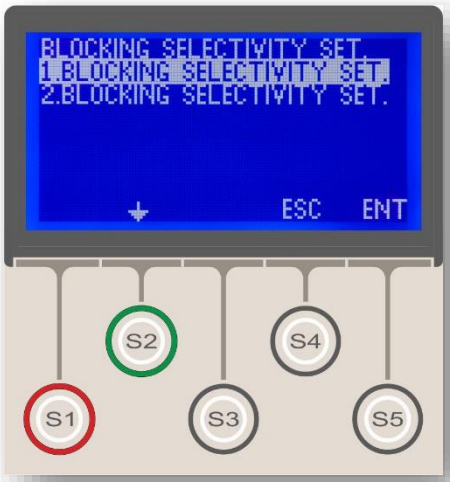
Programmable inputs are identical and independent of each other. Each input accepts one of any of the 25 functions listed below:

- Passive,
- Unlatch,
- 52a (normally open auxiliary contact signal),
- 52b (normally closed auxiliary contact signal),
- CB Positi. (CB Position),
- Start tAux1 (auxiliary timer no.1),
- Start tAux2 (auxiliary timer no.2),
- Blocking 1 (Blocking selectivity input no.1),
- Delay Sel1 (Delaying selectivity input no.1),
- Start Wave (Start Waveform Recording),
- Cold L. Pi. (Cold Load Pickup),
- Spr. Fail (CB Charging Spring Failure),
- Group Sel. (Settings Group Altering),
- ARC Block. (Block Auto-recloser),
- %Θ Reset (Reset Thermal Monitor),
- TripCirSup (Trip Circuit Supervision),
- Start CBF (Start CB Failure Alarm),
- Reset LED,
- Press.Trip (Pressure Trip),
- Buch.Alarm (Buchholz Alarm),
- Buch.Trip (Buchholz Trip),
- Temp.Alarm (Temperature/Thermometer Alarm),
- Temp.Trip (Temperature/Thermometer Trip),
- Blocking 2 (Blocking selectivity input no.2), and
- Delay Sel2 (Delaying selectivity input no.2).

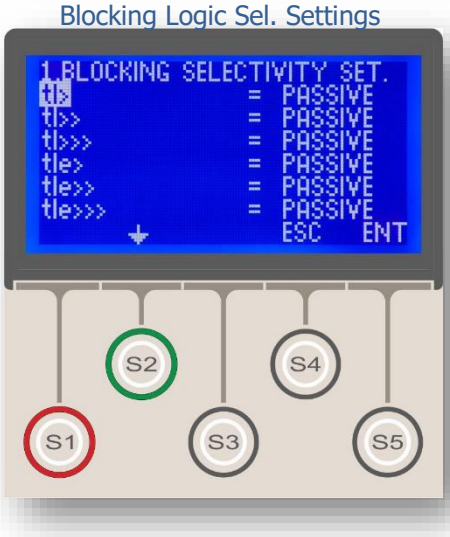
The last two line on the picture to the left controls and displays the activation options of the inputs. The sample picture shows that all 7 inputs are set to activate when a voltage is applied to their terminals ("1"). If any of the inputs are set to activate in the absence of a signal ("0"), the activating behavior of that input will change in the opposite manner, activating with the loss of voltage across its terminals.

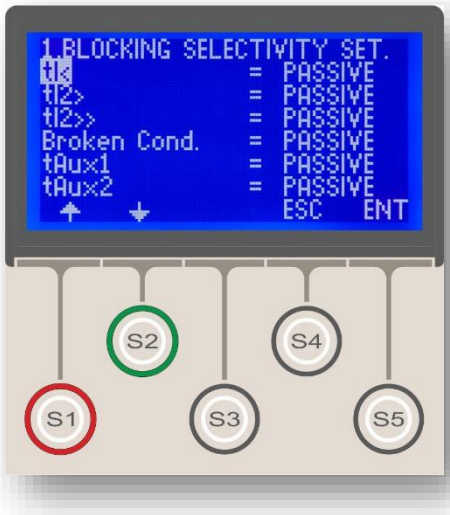
Note that the default settings for the input activation controls are 1111111; resulting in the activation of each of the inputs when a voltage is applied to its terminals. □

Blocking Logic Selectivity Settings Menu



Main Screen » Menu » Automatic Control Settings » Blocking Logic Sel. Settings



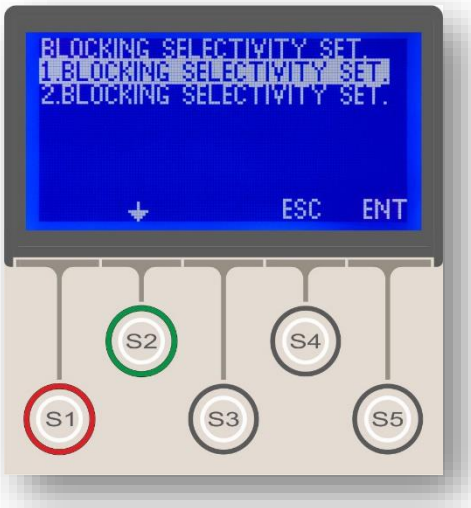


Blocking Logic Selectivity Settings Menu (Displayed briefly as *Blocking Settings* on the relay menus) is a control menu that enables the users to utilize the *Blocking Logic Selectivity* scheme on a number of relays that are protecting the same circuit, and are installed back-to-back. Applying the *Blocking Logic Selectivity* scheme on systems eliminates the need for time grading selectivity schemes, which, by their nature, prolong the clearance times of faults and can be applied with relatively small number of steps of selectivity.

The principle of the *Blocking Logic Selectivity* scheme is a follows: when a fault current flows through the current transformers of two or more relays which are located in series regarding to the primary circuit, the upstream relay is blocked by the downstream relay by means of a dedicated input. That is achieved utilizing a pilot line, which conducts an AC or DC signal from the downstream relay to the input of the upstream relay. Regardless of the number of the relays on the system that sense the fault, each relay is blocked by the nearest downstream relay instantly and independently; that results the only relay that is not blocked to trip – which is automatically the nearest relay to the fault location. Note that the relay that is nearest to the fault location is not blocked, for that the next downstream relay does not read any current.

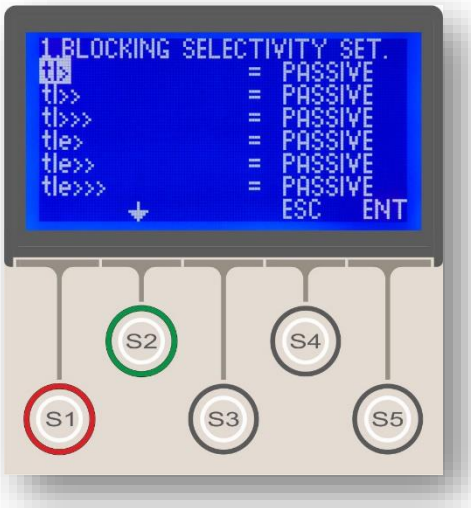
The signal conduction needed for the utilization of blocking logic selectivity can be achieved by conducting DC or AC signals directly between relays that are located relatively close; when the distances grow, an optical communication interface application may be needed.

It is determined by the options on the menu (shown in the middle and lower pictures) if a relay will be blocked against generating trip signals when it receives a signal on its blocking input. If the current reading of a relay is exceeding the threshold current value of a protection function at the instant it receives the blocking signal, the relay checks the blocking settings and decides whether to intervene or behave neutral. If the blocking setting of that protection function is set as Active, then the relay will not generate any tripping signal; otherwise, it will start the pre-adjusted protection procedure. ↺



When the *Blocking Selectivity Settings* menu is entered (top picture), the user is asked to select the settings group. Once the selection is made by the *S5* button (*ENT*), the submenu shown on the middle and bottom pictures appear. Note that the title of the submenu includes the settings group name, e.g. "1. Blocking Selectivity Set.", as seen on the middle picture.

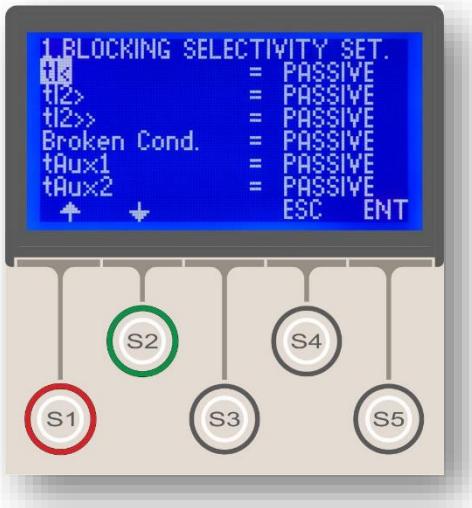
On the submenu, it is decided whether the protection functions should intervene related faults or not when receive a blocking signal, as described recently. The sample picture on the bottom of the previous page shows the default settings, which will not allow any blockings to be done by inputs. If any of the protection functions (e.g. tI>>) are needed to be blocked by an input signal, the parameter of that function must be set as *Active*.

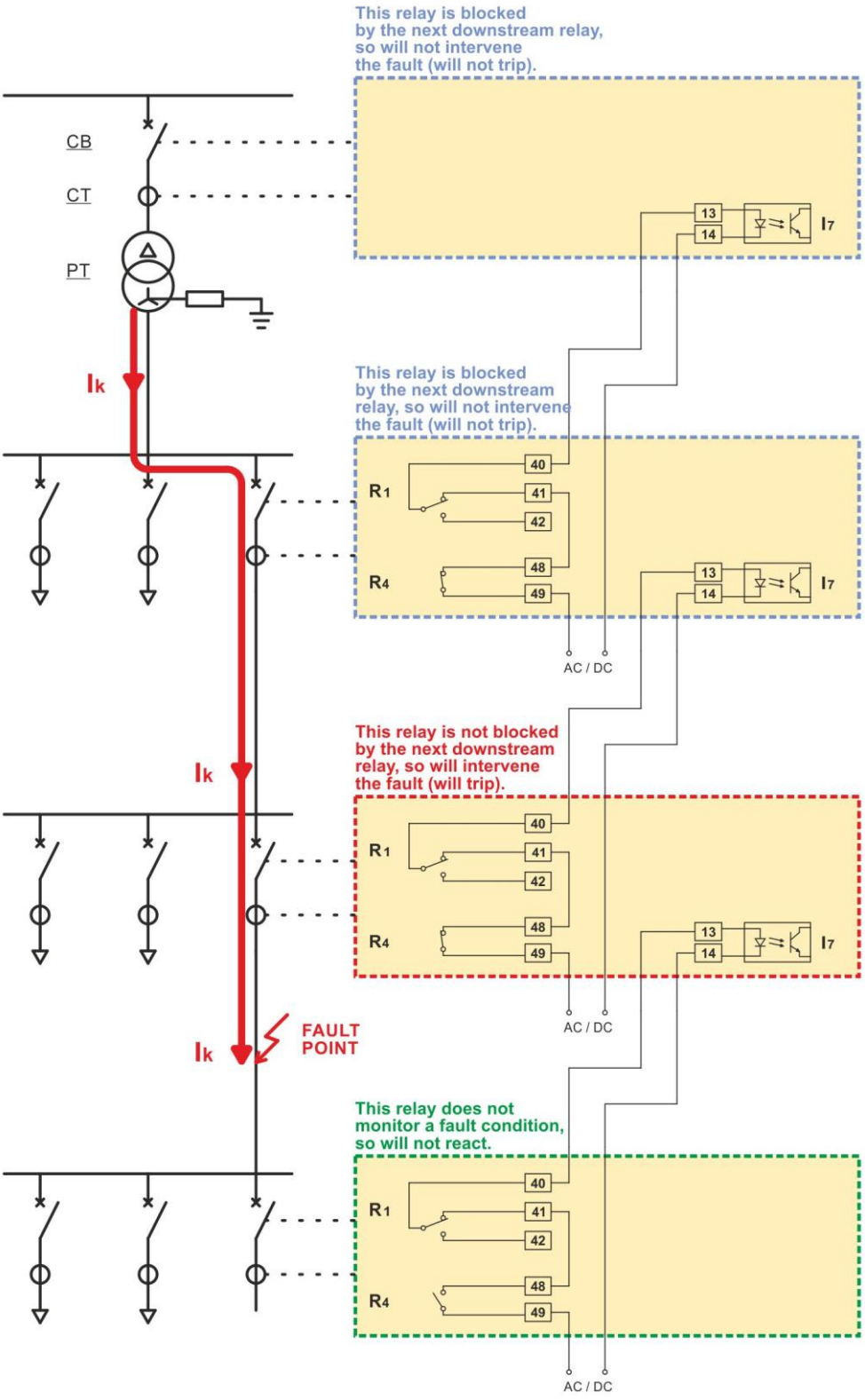


It must be kept in mind that the setting the parameters on the *Blocking Logic Selectivity Settings Menu* is not enough to utilize the blocking logic selectivity system; additional settings and applications must be done for commissioning, which are:

- Programming of the input and output relays,
- Pilot wiring between the relays.

□

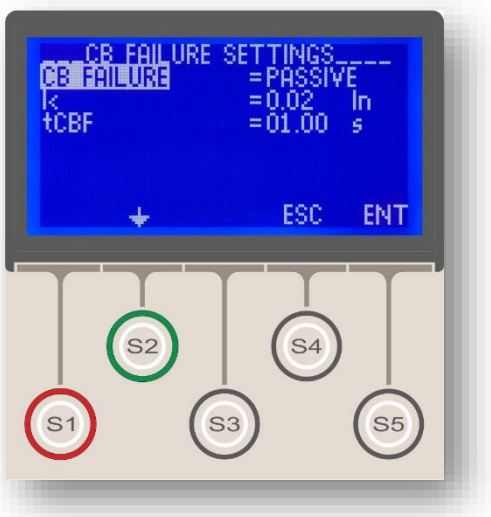




Obtaining selectivity using the Blocking Logic Selectivity function (Application Diagram 8, p.201).

Settings Made:
R1: CB Failure, R4: I>>, I>>>, I_e>>, I_e>>>, I_7: Blocking Sel.1.

CB Failure Settings Menu



Main Screen » Menu » Automatic Control Settings » CB Failure Settings

CB Pole Failure Settings Menu controls a supervision function that monitors the primary current value for a set time after the tripping signal is generated, and triggers an alarm if the primary current has not dropped below a set value; which will mean that the circuit breaker has failed to break the primary circuit as expected. The alarm signal is displayed on the Alarm LED and Alarm Menu; an optical or acoustic alarm signal can be triggered via a programmable output that the *CB Pole Failure* option is assigned.

CB pole failure supervision function can be utilized for the following functionalities:

- Warning the operator that one or more poles of the circuit breaker does not operate normally / fail,
- When applicable, blocking the auto-reclosing sessions if the CB does not break the circuit normally,
- When applicable, eliminating the risk of selectivity failure on systems where blocking logic selectivity scheme is utilized. To prevent the situation described on the latter topic, the normally closed contacts of an SPDT output that is programmed as *CB Failure* must be connected in series with the output that generates the blocking signals; this will prevent the blocking of the next upstream relay, letting it to clear the fault. This preventive cabling scheme is given on the previous page.

CB Pole Failure Settings Menu controls the parameters of the function and it is seen on the picture above. Settings to be done on the menu are described below.

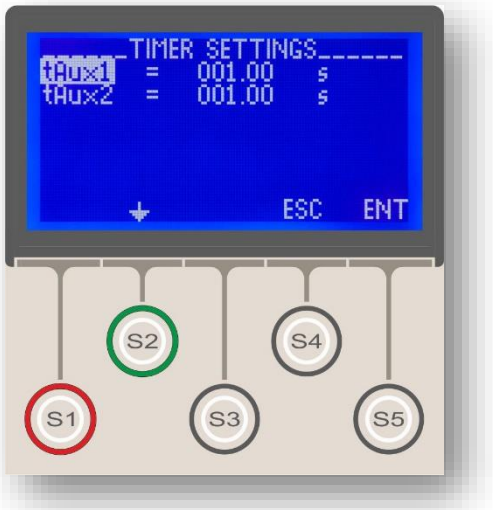
CB Failure
This parameter can be set as *Passive* or *Active*. To utilize the function, the parameter must be set to *Active*. If the parameter is set to *Passive*, the function will not monitor the primary current in means of expected CB behavior.

I< (CB Pole Failure Threshold)
This setting is done in I_n (current transformer primary nominal current) and can be set within the interval of (0.02 – 1.00) I_n. The default value of 0.02 I_n, which is limited by the lowest current reading capability of CPM 310 G, is not recommended to be changed for normal application. Special cases need further study which will not be discussed here. ↺

tCBF (CB Pole Failure Delay Time)
tCBF is the delay time counter limit value before alarming, which is triggered at the instant that the trip signal is generated, and terminated if the primary circuit current drops below the threshold current. The setting zone for the counter is (0.01 – 10) s in 10 ms steps. The default value for tCBF is 1.0 s, however, tCBF value is not recommended to exceed 100 ms if the function is to be used in blocking logic selectivity schemes.

WARNING!
CB pole failure supervision function is to be used as a preventive function to inform the users of a possible CB failure. The absence of failure alarm from this supervision function is not to be considered as guaranteed successful operation of the circuit breaker! General safety rules and live working principles apply! □

Auxiliary Timer Settings Menu



Main Screen » Menu » Automatic Control Settings » Auxiliary Timer Settings

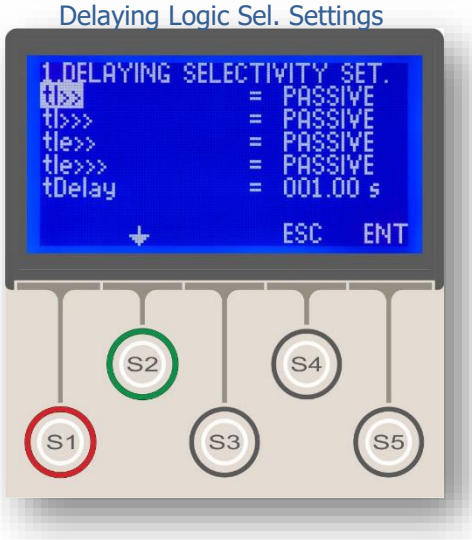
DEMA CPM 310 G Overcurrent Protection Relays are equipped with 2 independent auxiliary timers. These timers are set to trip the circuit breaker by default, but can be utilized for wide range of applications.

Auxiliary timers can be triggered via inputs that are programmed as *Start tAux1* or *Start tAux2*, and can trigger outputs programmed as *tAux1* or *tAux2*. Note that the auxiliary timers can be triggered only externally via dedicated inputs; e.g. by a button that energizes an input, to which *StartAux1* function is assigned; or, by a programmable output relay.

The setting range for auxiliary timers is (0.0 - 600.0) s.
□

Delaying Logic Selectivity Settings Menu

Main Screen » Menu » Automatic Control Settings » Delaying Logic Sel. Settings



Delaying Logic Selectivity Settings Menu (Displayed briefly as *Delaying Settings* on the relay menus) is a control menu that enables the users to utilize the *Delaying Logic Selectivity* scheme on a number of relays that are protecting the same circuit, and are installed back-to-back. Applying the *Delaying Logic Selectivity* scheme on systems eliminates the need for time grading selectivity schemes, which, by their nature, prolong the clearance times of faults and can be applied with relatively small number of steps of selectivity.

Delaying Logic Selectivity function operates with principles similar to those of *Blocking Logic Selectivity*. When a fault current flows through the current transformers of two or more relays which are located in series regarding to the primary circuit, the upstream relay tripping is delayed by the downstream relay by means of a dedicated input. That is achieved utilizing a pilot line, which conducts an AC or DC signal from the downstream relay to the input of the upstream relay. Regardless of the number of the relays on the system that sense the fault, the tripping of each relay is delayed by the nearest downstream relay instantly and independently; that results the tripping of the only relay of whose tripping is not delayed – which is naturally the nearest relay to the fault location. Note that the tripping of the relay that is nearest to the fault location is not delayed, for that the next downstream relay reads no current.

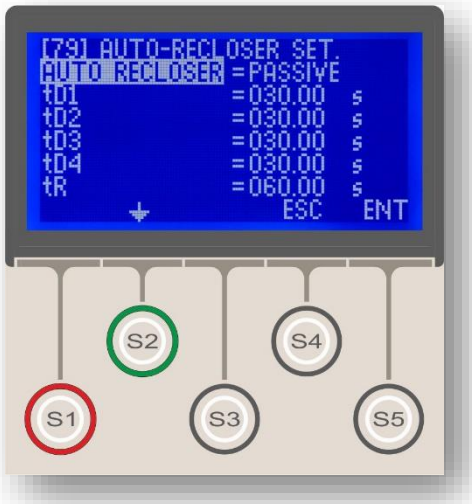
When the *Delaying Logic Selectivity Settings Menu* is entered (top picture), the user is asked to select the settings group. Once the selection is made by the *S5* button (*ENT*), the submenu shown on the bottom pictures appear.

On the submenu, it is decided whether the protection function tripping times are to be translated or not when CPM 310 G unit receives a delaying signal, as described recently. The sample picture on the bottom of the previous page shows the default settings, which will not allow any delaying actions to be trigger by inputs. If any of the protection functions (e.g. tI>>) are needed to be delayed by an input signal, the parameter of that function must be set as *Active*.

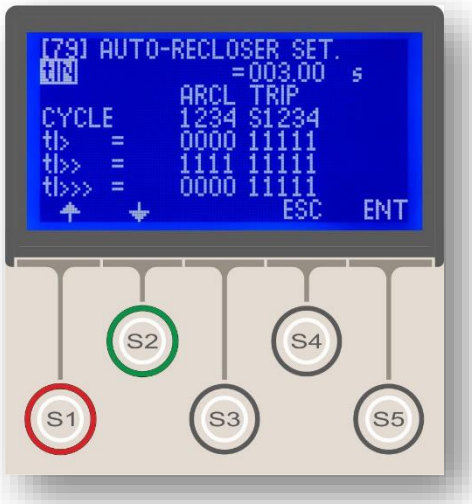
It must be kept in mind that the setting the parameters on the Delaying Logic Selectivity Settings Menu is not enough to utilize the delaying logic selectivity system; additional settings and applications must be done for commissioning, which are:

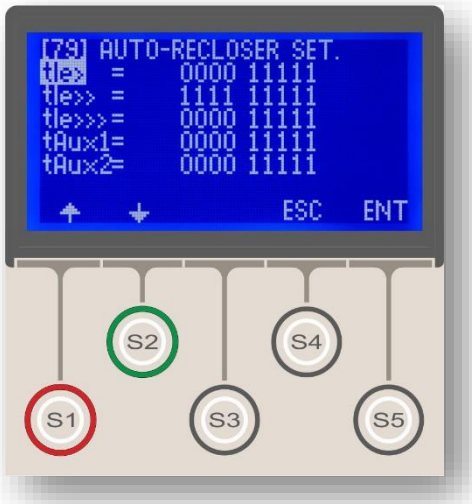
- Programming of the input and output relays,
- Pilot wiring between the relays. □

ARCL Auto-Recloser Settings Menu



Main Screen » Set » ARCL





Auto-reclosing is a widely used control function, which provides rapid pick up of the network when black-outs caused by temporary faults occur and mostly eliminates the need of manual intervention to those types of faults; while blocking itself if the fault is found out to be permanent, any manual intervention occurs or other predefined conditions are present.

The picture on the top of this page shows the initial screen when the Auto-Recloser menu is entered, while the pictures below it shows the full menu content. The menus that provide settings options for specific protection and control functions will be examined in the following pages.

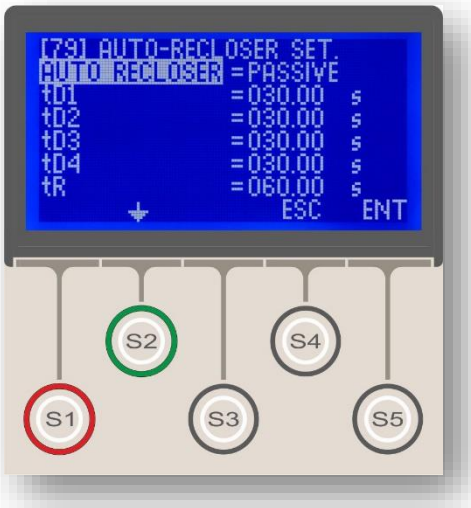
The CPM 310 G auto-recloser function has the following characteristics:

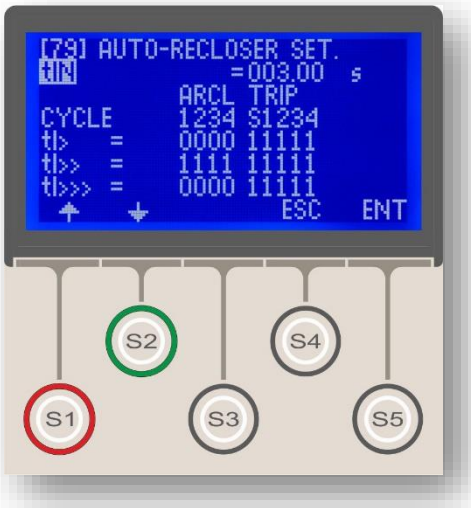
- Auto-reclose shots up to 4 cycles,
- Definite time reset characteristics,
- Definite time inhibition function,
- Independent settings for each individual function of phase overcurrent protection, earth overcurrent protection and auxiliary timers,
- 2 independent auto-reclose settings groups for G1 and G2,
- Self-blocking features to provide maximum service security:
  - Blocking on manual tripping of CB,
  - Blocking on manual closing of CB if any faults occur within the inhibition time interval,
- Auto-reclose cycle measurement, alarm and event recording,
- Visualization of auto-recloser condition via programmable LEDs.

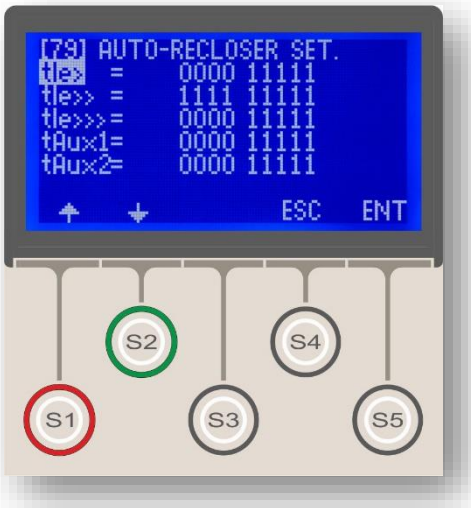
Settings that are shown on the pictures on the left side are explained below.

Auto Recloser
Can be set as "Active" or "Passive", to have the control into or out of service.

tD1, 2, 3, 4
Settings for the dead time intervals between the shots. Setting range is (0.01-300.0) s. ↺







tR

tR abbreviation represents the reset time with definite time characteristics. It determines the time delay to reset the function after the last successful shot. Setting time interval is (0.20 – 600.0) s.

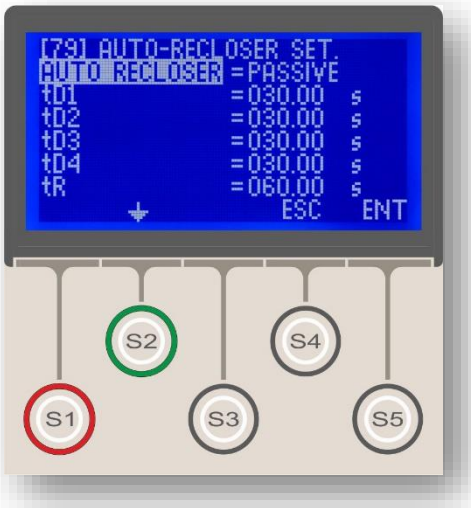
tIN

tIn abbreviation represents the inhibition time of auto-recloser after manual closing of the circuit breaker and has definite time characteristics. If any faults occur within the inhibition time, auto-recloser will be blocked and no shots will be conducted. tIN setting range is (0.20-600.0) s.

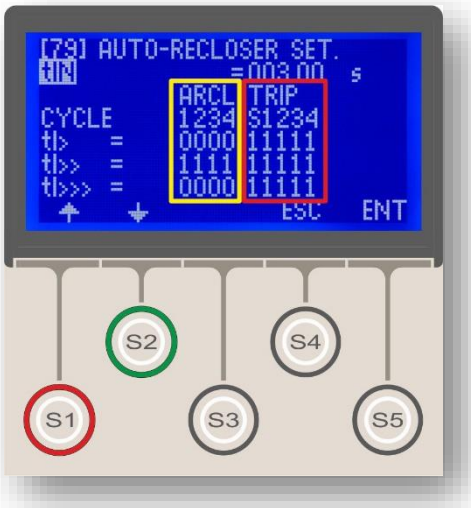
As described before, DEMA CPM 310 G relays are capable of handling independent procedures of auto-reclosing when phase fault, earth faults or auxiliary timer triggers operate. The 2 pictures on the left bottom side show the menus to set auto-reclosing options for each individual function covered. The menus are reached by pressing S2 (🡻) button after navigating to the last line of the main *ARCL Settings* menu.

The list below shows the functions that are covered by the auto-recloser feature of CPM 310 G. Configuring the settings of each function at their dedicated menus, an auto-reclose scheme can be set up to provide any desired automatic response to various types and combinations of faults. E.g., settings can be done so as to provide multiple shots of auto-reclosing if any overcurrent faults by 1st thresholds of phase and earth protections occur, while prohibiting auto-recloser to be triggered by the other faults.

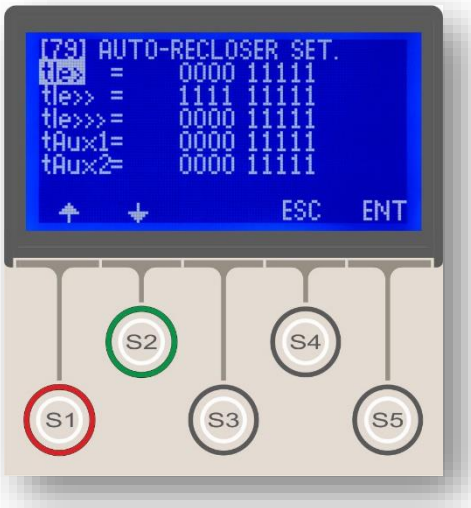
1. tI> Phase Overcurrent 1st Threshold Protection
2. tI>> Phase Overcurrent 2nd Threshold Protection
3. tI>>> Phase Overcurrent 3rd Threshold Protection
4. $tI_e>$ Earth Overcurrent 1st Threshold Protection
5. $tI_e>>$ Earth Overcurrent 2nd Threshold Protection
6. $tI_e>>>$ Earth Overcurrent 3rd Threshold Protection
7. tAux1 Auxiliary Timer No.1
8. tAux2 Auxiliary Timer No.2 ↺



The tripping settings (shown within the red borders on the picture in the middle) determine the tripping behavior of the circuit breaker within the auto-reclosing cycles, if a function (e.g. tI>) generates a trip decision. The line under the title describes cycle numbers and the line at the bottom comprises the settings. If any of the setting values on the bottom lines is set as "1", tripping by the related function at the related cycle will be allowed; but if it is set as "0", tripping will be prohibited. Note that the informative "S" abbreviation stands for the standard tripping action that triggers the auto-recloser and cannot be set as "0". According to the sample settings on the picture, any tripping decision generated by tI> function will result in tripping on any cycles. Note that if a tripping option is set to "0" and no other function clears the related fault when occurred, the "0" option will be ignored at that time to provide clearance of the fault. This algorithm ensures prevention of failures of system protection due to auto-recloser configurations.

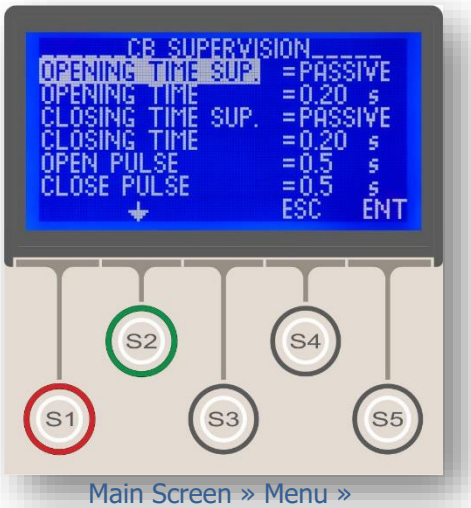


To have Auto-Recloser function into service, it is required that,
3. One of the any programmable inputs is cabled to a normally open auxiliary contact of CBs and 52a appointment is done to that input,
4. One of the any programmable outputs is cabled to the closing release terminal of CBs and Close CB appointment is done to that output.

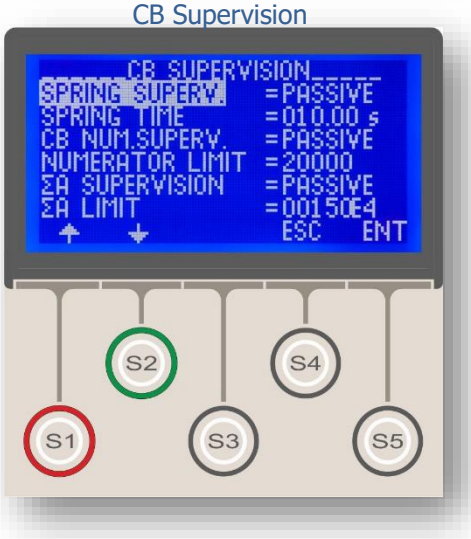


If the ARCL function is tried to be had into service without fulfilling the requirements explained above, the Alarm LED warns the user and the Alarm Menu displays the following message: "Auto-recloser settings error". If no corrective actions are taken, the auto-recloser remains out of service. When the auto-recloser functions are activated, any active latch settings are automatically driven out of service; the reason is that the auto-recloser cannot operate properly when there are active latch functions that need manual resetting. Knowing this, having any active latch settings manually out of service is highly recommended to prevent potential misinterpretations that the output relays that are configured to latch under described conditions will operate as set. It must always be kept in mind that the Auto-Recloser settings overrule the latch settings. □

CB Supervision Settings Menu



Main Screen » Menu » Automatic Control Settings » CB Supervision



CB Supervision Settings Menu monitors and configures the following 9 functions that are effective on the CB.

1. Opening Time Supervision

This function measures and supervises the time interval between the generation of tripping impulse and the disappearance of 52a signal from the CB. If the measured value is evaluated greater than the set value, the Alarm LED is activated; "CB Alarm" and "CB Open Failure" texts are displayed on the *Alarm Menu*.

Note that, the tripping time of the CB declared by the manufacturer and the maximum tripping delay time taken into account while the selectivity evaluations are made must be considered when determining the *Opening Time* value.

To utilize *Opening Time Supervision* function, the function must be set as *Active* and a programmable input with *52a* assignment must be wired to a normally open auxiliary contact of the CB. The measured tripping time for the latest operation of the CB can be viewed and reset at this address:
MENU » Measurements»> CB Meas. > (Opening Time).

2. Closing Time Supervision

This function measures and supervises the time interval between the generation of closing impulse and the appearance of 52a signal from the CB. If the measured value is evaluated greater than the set value, the Alarm LED is activated; "CB Alarm" and "CB Close Failure" texts are displayed on the *Alarm Menu*.

Note that the closing time of the CB declared by the manufacturer must be considered when determining the *Closing Time* value.

To utilize *Closing Time Supervision* function, the function must be set as *Active* and a programmable input with *52a* assignment must be wired to a normally open auxiliary contact of the CB. The measured closing time for the latest operation of the CB can be viewed and reset at this address:
MENU » Measurements » CB Meas. » (Closing Time).

3. Open Pulse

This value is set in seconds and determines the duration of the tripping impulse generated by the relay.

4. Close Pulse

This value is set in seconds and determines the duration of the closing impulse generated by the relay.
↺

5. Spring Supervision

This function monitors and supervises the CB spring charging time. When the charging spring is discharged, the "end of charging" auxiliary contact of the CB is closed. If this contact is wired to an input that is assigned as *Spring Failure*, and the excitation duration of that input exceeds the time determined by the (*CB Charging) Spring Time*, the Alarm LED is activated; *CB Alarm* and *CB Spring Failure* alarms are displayed on the *Alarm Menu*.

Note that the spring charging time of the CB declared by the manufacturer must be considered when determining the (*CB Charging) Spring Time* value; and a positive tolerance for charging time is recommended to be added on.

To utilize (*CB Charging) Spring Supervision* function, the function must be set as *Active* and a programmable input with *Spring Failure* assignment must be wired to the "end of charging" auxiliary contact of the CB.

6. CB Numerator Supervision

This function counts and supervises the tripping operation of the CB triggered by the tripping relay of CPM 310 G; if the count exceeds the set value *Numerator Limit*, the function triggers the Alarm LED, displays *CB Alarm* and *CB Numerator Alarm* texts on the *Alarm Menu*. Note that the *CB Numerator Supervision* function does not count the manual tripping operations of the CB.

Maximum guaranteed tripping operations of the CB declared by the manufacturer must be considered when determining the *Numerator Limit* value. This value can be set between 1 and 65535.

The tripping operation numerator can be monitored and reset via the following address:
MENU » Measurements » CB Measurements » (Open Numerator).

7. ΣA Supervision

ΣA (Total Amperes) Supervision measures and processes the RMS value of the phases at the tripping instant. ∑A values are monitored and evaluated in means of supervision and determination of maintenance periods of CBs with U_r > 52 kV.

Note that the allowed ΣA for the CB poles declared by the manufacturer must be considered when determining the *ΣA Limit* value.

ΣA values for each pole of the CB can be viewed and reset via the following address:
MENU » Measurements » CB Measurements » (ΣA R), (ΣA S), (ΣA T).

8. ΣA^2 Supervision

ΣA^2 (Total Square-Amperes) Supervision measures and processes the RMS value of the phases at the tripping instant. $\sum A^2$ values are monitored and evaluated in means of supervision and determination of maintenance periods of CBs with $U_r \leq 52$ kV.

Note that the allowed ΣA^2 for the CB poles declared by the manufacturer must be considered when determining the *ΣA^2 Limit* value.

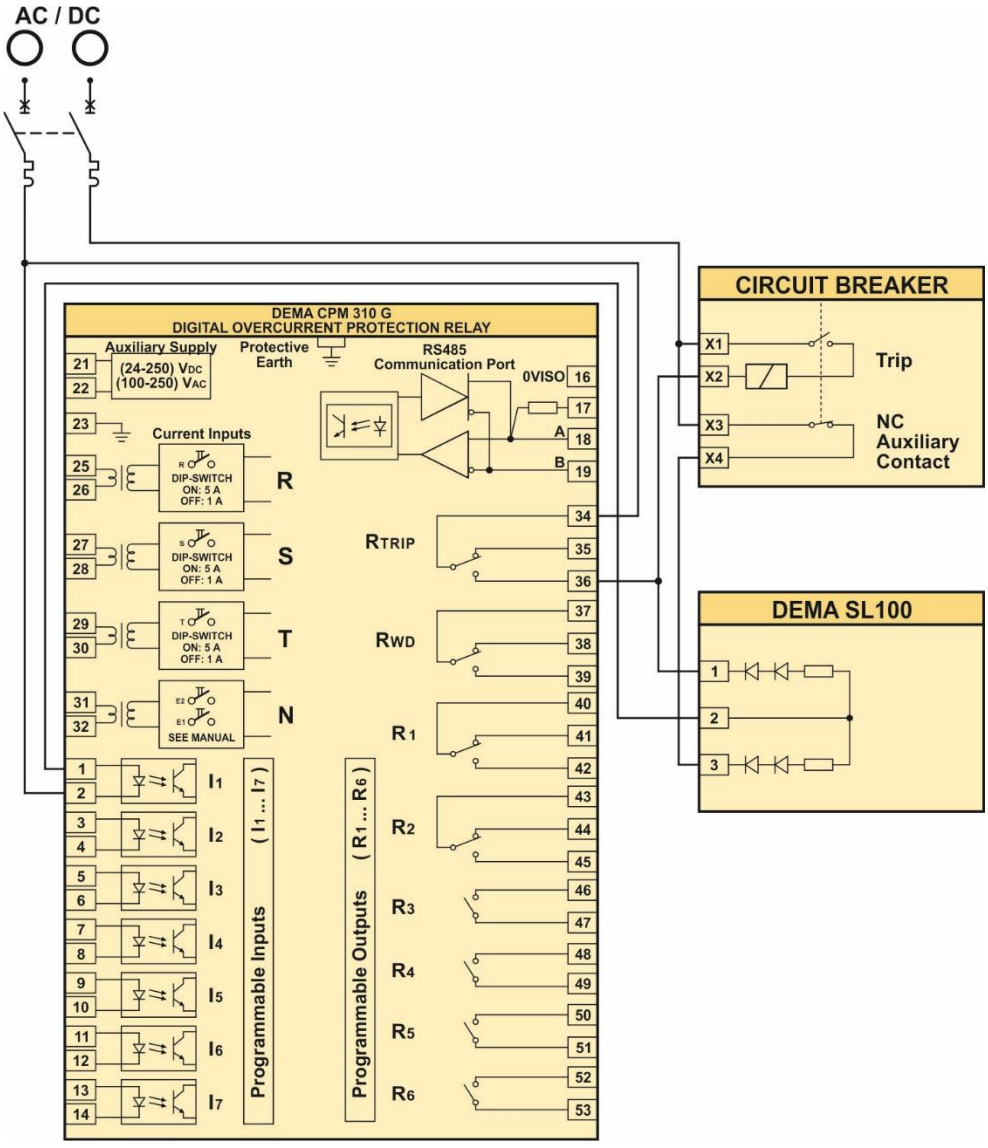
ΣA^2 values for each pole of the CB can be viewed and reset via the following address:
MENU » Measurements » CB Measurements » (ΣA2 R), (ΣA2 S), (ΣA2 T). ↺

9. Trip Circuit Supervision

CPM 310 G relays are capable of checking the electrical continuity of the trip circuit (the circuit that connects the *Trip Relay* (RL_{TRIP}) of CPM 310 G and the release coil of the CB); by utilizing the Trip Circuit Supervision function.

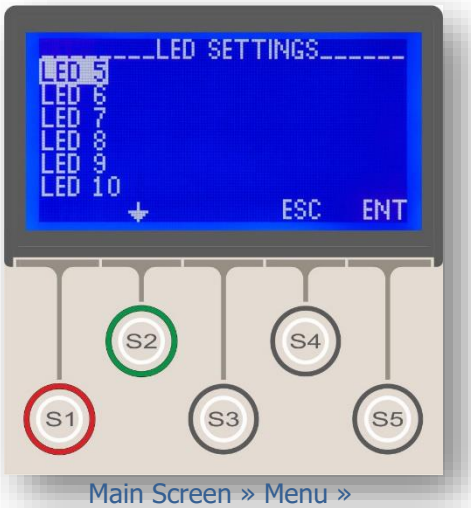
To utilize the function, the diagram below must be applied and an available programmable input (e.g. I1 on the diagram below) must be programmed as "TripCirSup".

If electrical discontinuity is detected after the commissioning of the function, the function counts for the time determined by the tTCS before the Alarm LED is activated and *CB Alarm* and *TripCirSup* messages are displayed on the *Alarm Menu*. □



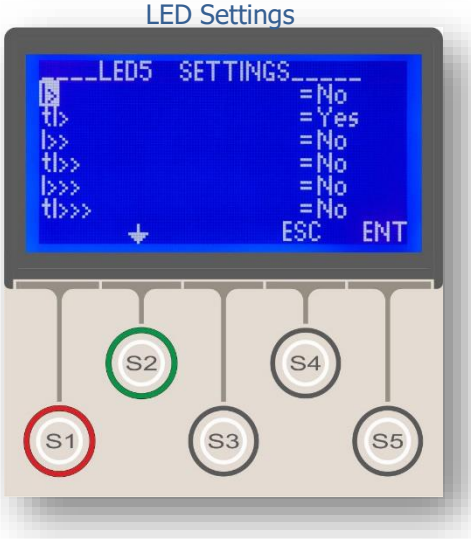
Trip Circuit Supervision Application Diagram

LED Settings Menu



Main Screen » Menu » Automatic Control Settings » LED Settings

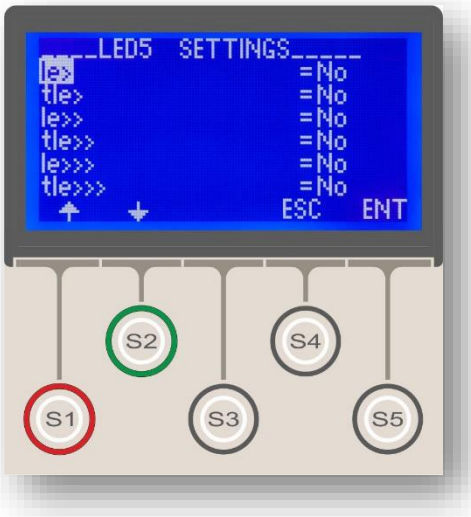
LED Settings Menu is the menu where the programmable LEDs are configured. Note that the programmable LEDs are viewed on the LED Menu, which is accessed simply by pressing the Reset button once while on any menu of CPM 310 G.

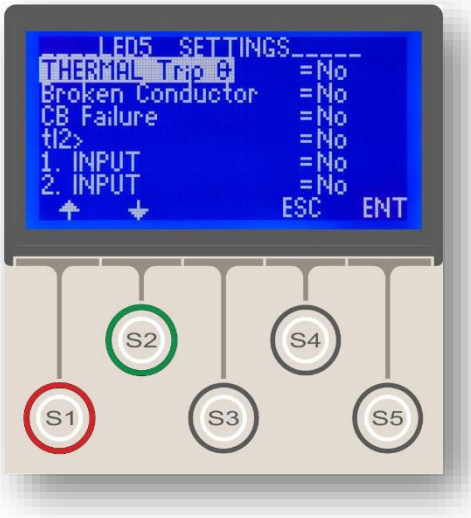


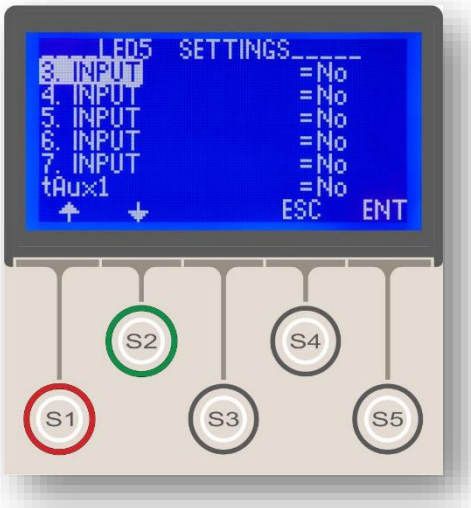
The picture to the middle of the page displays the LED Settings Menu welcome screen. As seen on the pictures, each programmable LED is configured from its independent sub-menu.

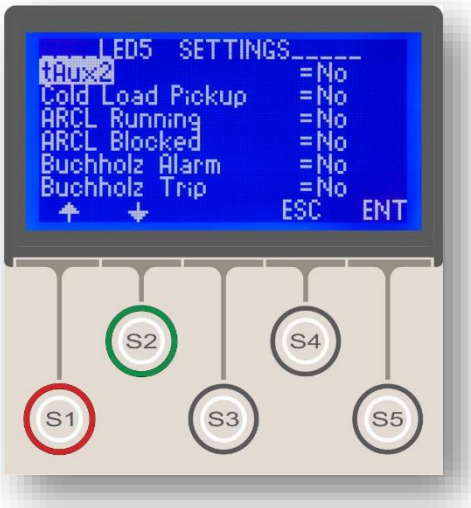
The sub-menus contain the following controls:

- Functions to activate each programmable LED,
- Display text of each programmable LED. ↺









The setting procedure is described below.

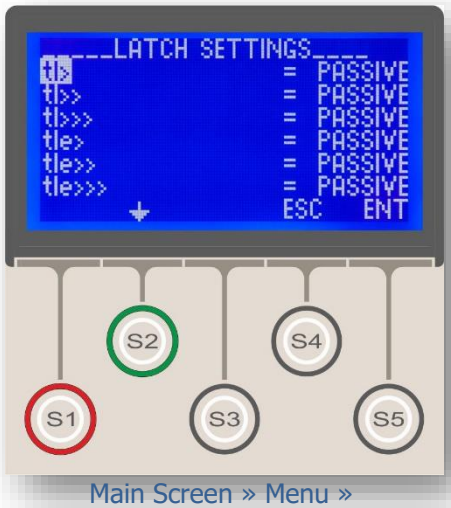
1. Select the programmable LED to be set on the LED Settings Menu by navigating on the menu and press S5 (ENT) button to proceed to the sub-menu,

2. The sub-menu contains the list of functions that can activate the LED that the sub-menu belongs to. Select and set the parameter of any function desired to trigger the LED to *Yes*. Note that a LED accepts multiple functions, e.g. *tI>* and *Thermal Trip*. When multiple functions are appointed to a LED, the LED is triggered in OR logic, in other words, the LED can be triggered independently by any of the functions appointed.

3. As shown on the picture to the left, the last line that the sub-menu contains is titled as *Text*. This setting controls the display text of the programmable LED.
- For programmable LEDs that has only one function appointed, the *Text* variable is recommended to be set as the same name of that of the appointed function's (as seen on the bottom middle picture),
- For programmable LEDs that have more than one function appointed, the *Text* variable should be decided to be set as the name of one of the appointed functions'. E.g., if a programmable LED is set to be activated by the functions *tI>* and *Thermal Trip*, the *Text* variable can be set as *tI>*. For the reason that a programmable LED is named as only one of the appointed functions' name, it is recommended that functions with similar functionalities are grouped under each programmable LED to prevent misinterpretations.

□

Latch Settings Menu



Main Screen » Menu » Automatic Control Settings » Latch Settings

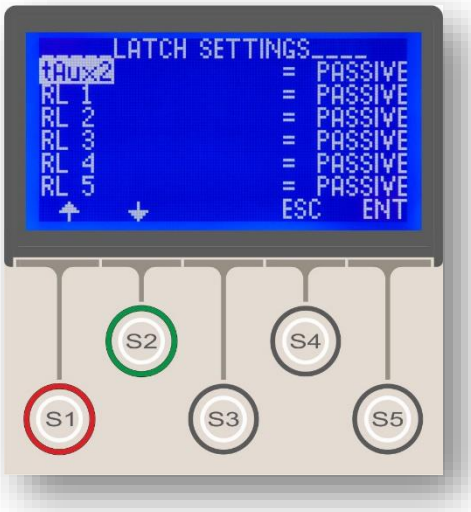
Latch Settings Menu contains the controls that determine the latching behavior of functions and programmable outputs.

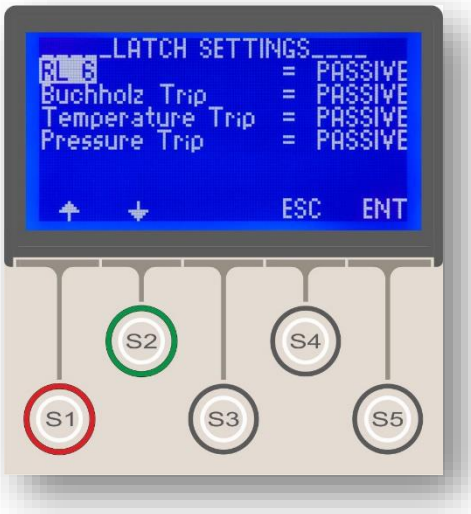
By default, the protection and auxiliary timer functions do not latch the Trip Relay or the other relays that they are appointed to; similarly, programmable outputs do not latch when activated by any functions. When a function is needed to latch the Trip Relay, or the programmable relays that they are appointed to; or a programmable output relay is needed to be latched regardless of the function that triggers it, the related option on the Latch Settings Menu must be set as *Active*. As seen on the pictures on the left, all latch options are set as *Passive* by default.

Functions that can latch Trip Relay, or the programmable relays that they are appointed to, are listed below:

tI> Time delay trip due to phase overcurrent I>.
tI>> Time delay trip due to phase overcurrent I>>.
tI>>> Time delay trip due to phase overcurrent I>>>.
$tI_e>$ Time delay trip due to earth overcurrent $I_e>$.
$tI_e>>$ Time delay trip due to earth overcurrent $I_e>>$.
$tI_e>>>$ Time delay trip due to earth overcurrent $I_e>>>$.
tI< Time delay trip due to undercurrent I<.
$tI_2>$ Time delay trip due to negative sequence $I_2>$.
$tI_2>>$ Time delay trip due to negative sequence $I_2>>$.
Thermal Trip Θ Trip due to thermal protection.
Broken Conductor Trip due to broken conductor.
tAux1 Trip due to auxiliary timer no.1.
tAux2 Trip due to auxiliary timer no.2.
Buchholz Trip Trip due to power transformer buchholz signal.
Temperature Trip Trip due to power transformer temperature signal.
Pressure Trip Trip due to power transformer pressure signal.

Note that deleting the alarms on the Alarm Menu via the DigiConnect PC program would also result in the release of the latched relays. ↺





Outputs that can be latched are listed below:

1. TRIP CB Trip Output; via settings of the 13 protection functions above.
2. RL1 Programmable Output 1.
3. RL2 Programmable Output 2.
4. RL3 Programmable Output 3.
5. RL4 Programmable Output 4.
6. RL5 Programmable Output 5.
7. RL6 Programmable Output 6.

When configuring the latch settings, the following point must be considered.

A. If a programmable output is appointed to the Trip Relay, the latching of the programmable output will result also in the latching of the Trip Relay.
B. If the tripping function is appointed to any of the programmable output relays, a Trip Relay latching action will result also in the latching of those programmable outputs.

WARNINGS & NOTES:
- If the auto-recloser function is activated on a unit with active latch settings, all latch settings will be set out of service (set to Passive) instantly.
- When the *Trip Relay* is set to latch when activated, the circuit breaker will not be able to close successfully neither by remote nor by manual commands before resetting the latched *Trip Relay*, if such a case is confronted, keep in mind that the *Trip Relay* latch MUST BE RESET before closing the CB.
- The latched programmable output relays (RL1 – RL6) can be reset by triggering a "RL1 – RL6 Reset" programmed input. □

Alarm Settings Menu

Main Screen » Menu » Automatic Control Settings » Alarm Settings

Alarm Settings Menu controls the behavior of the Alarm Menu, which is accessed simply by pressing the Reset button twice regardless of what CPM 310 G menu is being displayed at that time.

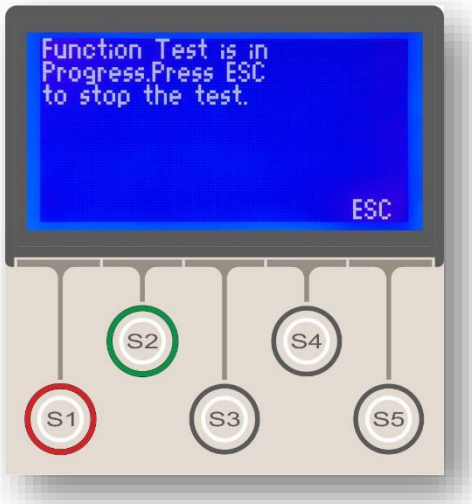
The *Alarm Resetting* control in the menu lets the user choose whether or not to delete older alarms when a new alarm is generated, while the *Instant Alarms* control decides whether or not to monitor current threshold violations.

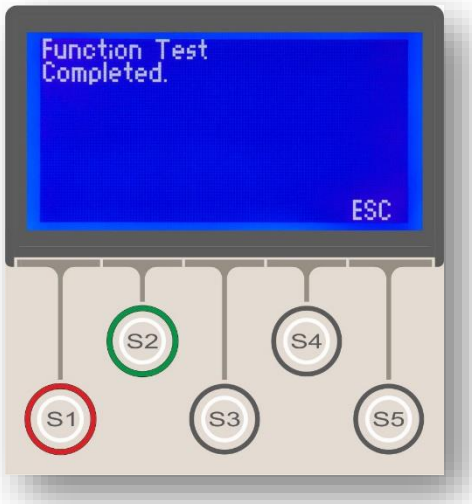
When the *Alarm Resetting* control is set as *Auto*, alarms that belong to a later event deletes the older ones; while the *Manual* option keeps all alarms displayed until they are manually deleted. Note that all but one of the several analogous alarms (e.g. *tI> R Phase*) will be deleted regardless of the *Alarm Clear* setting.

When the *Instant Alarms* parameter is set as *Hide*, current threshold violations / disturbances will not be displayed on the *Alarm Menu*, while the *Show* option will record all of the disturbances on the Alarm Menu. □

Function Test Menu

Main Screen » Menu » Function Test





Function Test Menu is a test triggering menu, via which a test is launched to check the functionality of the CPM 310 G unit and the trip circuit.

When the Function Test Menu is accessed, the user is asked to enter the password. Password requirement is important; as running the function test will result in the tripping of the CB and breaking of the primary supply, if special precautions are not taken, thus, the test should only be initiated by authorized personnel.

Once the password is entered, the Function Test Menu is reached (the top picture). The menu asks for confirmation to run the test; pressing S2 (N) or S5 (CNC) button will cancel the test, leading back to the Automatic Control Settings Menu; while pressing S1 (Y) button will start the function test.

As the test is started, the text that tells that the test is in progress until the test is over (the middle picture). If it is needed to terminate the test at this phase, pressing S5 (ESC) button will do the job.

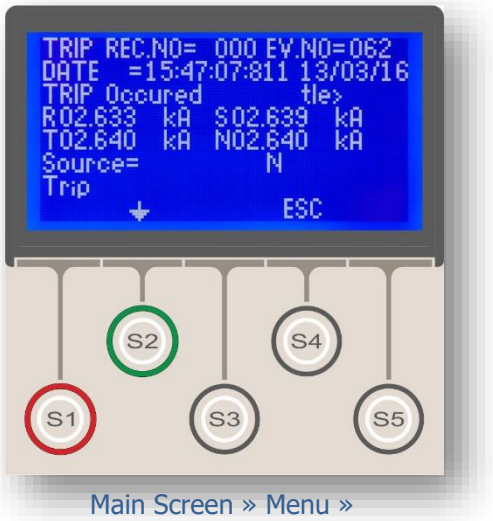
If the test is not interrupted, the test completes after a time that depends on the settings of the protective functions. The user is noticed when the test is over (the bottom picture).

During the function test, the relay processor creates virtual current readings around 40 I_n and runs the active protection settings under these virtual conditions. When these virtual conditions occur, e.g. on a relay that is configured to have active I> and Ie> functions, the test will result in tripping of the CB at the set time characteristics of the active protective functions and tI> and tIe> alarms for each phase will be generated.

If it is observed that some of the protective functions do not generate alarms as expected, it is concluded that those functions do not operate correctly and corrective actions must be taken. Similarly, if the CB does not trip during a function test while the relay has active protective functions, the trip circuit and the CB must be checked for errors and failures.

After the assembly of any CPM units or CBs, or during regular system checks, function tests are recommended to be performed, to ensure the reliability of the system after commissioning. □

Fault Records Menu



Main Screen » Menu » Fault Records

Fault Records Menu displays fault records that are filtered and derived from the event records. The filtering method is based on the elimination of the events not resulting with tripping. The display characteristics are same with that of event records. The design of the menu focuses on rapid access to the first and brief information about the faults when occurred. The detailed information obtained just before and just after the tripping is displayed on the Event Records Menu but not here.

Fault Records Menu filters and displays the events that are related to the following tripping functions, which are also listed in Trip Settings Menu:

- tI>
- tI>>
- tI>>>
- tI_e>
- tI_e>>
- tI_e>>>
- tI<
- t%(I_2/I_1)>
- tI_2>
- tI_2>>
- trip Θ
- tAux1
- tAux2
- Buchholz Trip
- Thermometer Trip
- Pressure Trip

Fault records count is the actual count of events that resulted in tripping of the CB and that currently exist in the list of Event Records Menu; thus is dependent on the actual content of event records at that time. It can be concluded that; in case that the Event Records Menu records 151 events that does not contain tripping, the Fault Records Menu will contain no records.

Fault Records Menu displays the latest record in the first order, thus, the latest tripping event always gets the label 000, which is displayed automatically when the menu is entered.

The fault record display format is almost identical to the event records', with the exception that the fault record screen displays the relevant event record number at the top right. □

DIGICONNECT PC PROGRAM MANUAL

Operating System & Hardware Requirements

DEMA DigiConnect Software operation system and hardware requirements to provide a successful setup and runtime are listed below.

DigiConnect – Operating System Compatibility

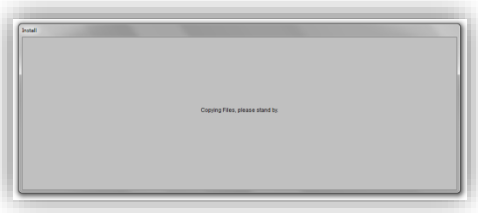
- Microsoft Windows 98SE
- Microsoft Windows 2000
- Microsoft Windows XP 32-bit / 64-bit
- Microsoft Windows Vista 32-bit / 64-bit
- Microsoft Windows 7 32-bit / 64-bit
- Microsoft Windows 8/8.1 32-bit / 64-bit
- Microsoft Windows 10 32-bit / 64-bit

DigiConnect Hardware Requirements

- Processor — Intel Pentium-II 266 MHz / equivalent or higher.
- RAM — 128 MB RAM or higher.
- Hard Disc — 50 MB or higher free space.
- Optical Drive — CD / DVD / Blu-Ray drive, 12x/1x/1x or higher.
- Communications Ports — RS485 or USB 1.1 / 2.0 / 3.0.

□

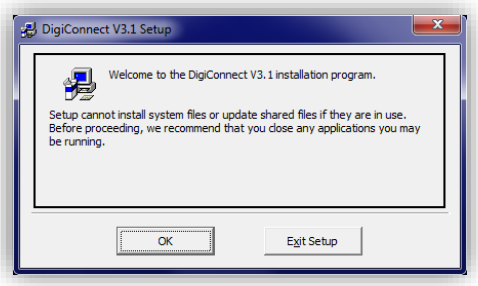
Program Setup



Setup Dialogue 1

DEMA DigiConnect program setup may be launched by the following ways.

1. For operating systems where CD-ROM or DVD-ROM is set as to enable auto-start, the setup process will launch automatically when the DigiConnect CD is inserted into the optical disc drive.
2. If by any reason the setup does not start automatically, follow one of the methods described below:
    a. Go to the optical drive address (e.g. D:\) and double-click the Setup.exe file; that will launch the setup process,
    b. alternatively, launch the *Run* tool located under the *Start* menu, and type the following command:
    D:\setup.exe
    Note that the command line above is given as an example assuming that the optical drive address is D:\. The drive address may vary by the hardware and software configuration of your PC. On such a case, replace the "D:\" address by, e.g., E:\ or whatever the drive address is. The address of your optical drive may be found out by exploring *My Computer* window, usually located on and launched from the *Desktop*.



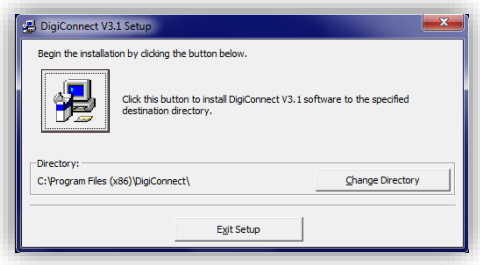
Setup Dialogue 2

Once the program setup is launched the screen shown on the *Setup Dialogue 1* pops up and is monitored for a while. During the time, the operating system copies the needed files for the setup to the PC memory and hard drive. After the process is completed, the screen disappears and replaces with the menu shown on the picture *Setup Dialogue 2*.

This menu contains the text below:

Welcome to the DigiConnect v3.1 installation program. Setup cannot install system files or update shared files if they are in use. Before proceeding, we recommend that you close any applications you may be running.

Following the instructions by the setup, please close all other application that may be running and continue with the setup by clicking the button *OK*. If you want the setup process to be terminated at this step, you may use the *Exit Setup* button. ↘



Setup Dialogue 3

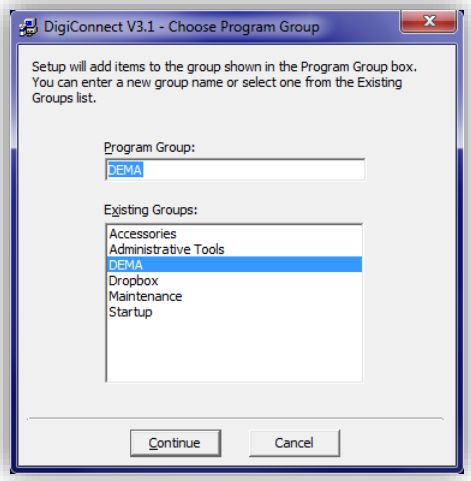
After pressing *OK* button to continue with the setup, the menu shown by the *Setup Dialogue 3* picture on the left pops up. The menu contains the following text:

Begin the installation by clicking the button below.
Click this button to install DigiConnect vX.XX software to the specified destination directory.
Directory:
C:\Program Files (x86)\DigiConnect

On this menu;

- The *Install* button located on the upper left side of the menu starts the installation process,
- The *Change Directory* button changes the destination directory that the program files will be copied to,
- And the *Exit Setup* button terminates the setup process.

↘

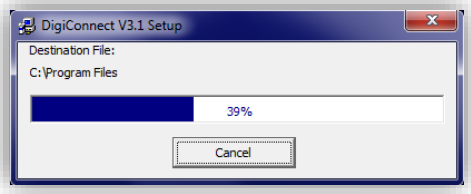


Setup Dialogue 4

If the *Install* button is clicked under the menu shown by the *Setup Dialogue 3*, the menu shown by the *Setup Dialogue 4* picture will appear. On this menu, the following information will be displayed:

Setup will add items to the group shown in the Program Group box. You can enter a new group name or select from the Existing Groups list.
Program Group: Dema
Existing Groups: Dema

The program group name may be left as the default title *Dema*, or be changed to another descriptive title the user decides suitable. Once the group name is decided, press the *Continue* button to install the program. The *Cancel* button on this menu provides the last option to exit the setup without installing the program.

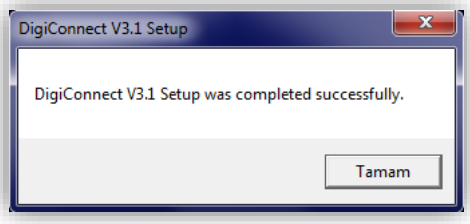


Setup Dialogue 5

After the *Continue* button on *Setup Dialogue 4* is clicked, the installation of the program starts and processes instantly. *Setup Dialogue 5* announces that the program is installed successfully by the following text.

DigiConnect v3.1 Setup was completed successfully.

Press *OK* button to finalize the setup.

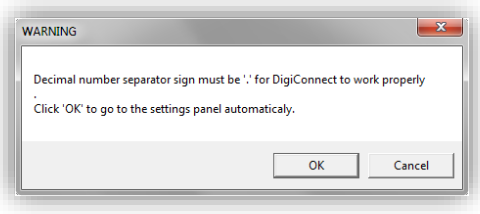


Setup Dialogue 6

DigiConnect program setup typically takes 1 minute. The setup duration may change slightly by the performance and configuration of your PC.

If any difficulties are experienced during the setup process, please contact our technical service. □

Program Startup

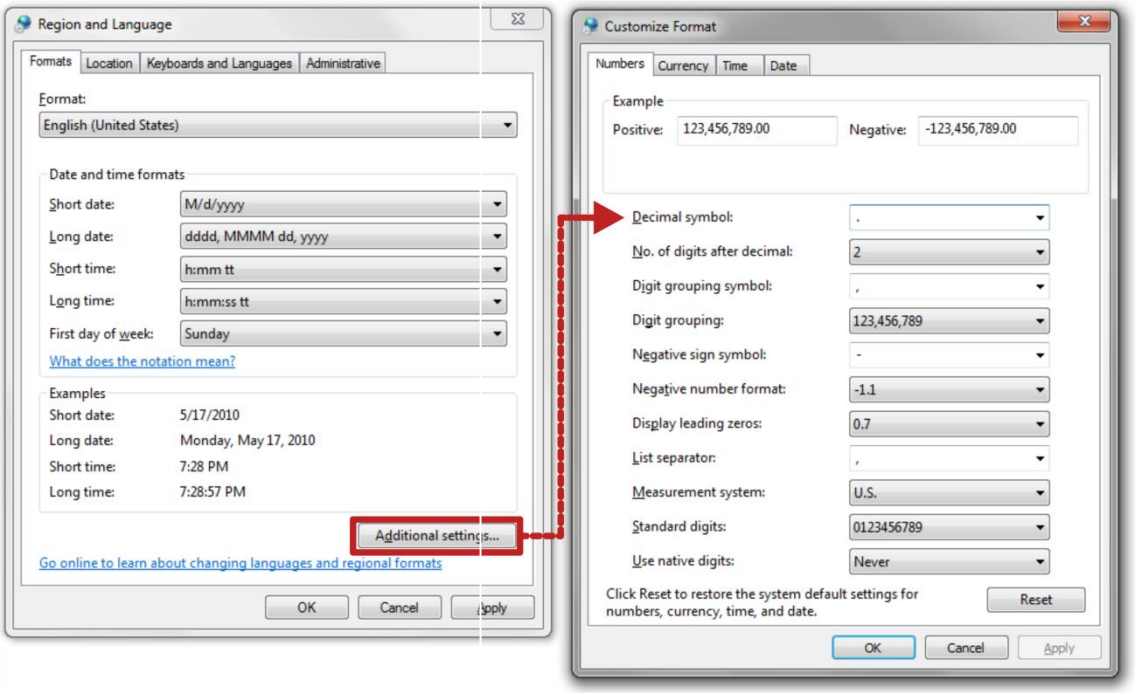


Startup Dialogue 1

Starting Up The Program

After the setup of the DigiConnect program is completed, it can be launched utilizing one of the methods described below. The program can be launched;

1. via the *Start Menu* by accessing: *Start » Programs » Dema » DigiConnect*.
2. by double clicking the *DigiConnect* shortcut automatically created by setup.
3. via command prompt or *Windows Explorer* at the address; *C:\Program Files (x86)\DigiConnect\digiconnect.exe*



Startup Dialogue 2a

Startup Dialogue 2b

Establishing Communication with CPM 310 G via DigiConnect

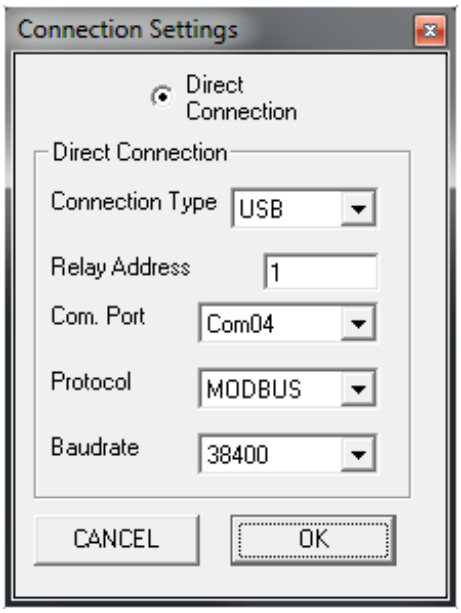
1. Once the program is launched, the screen shown on the picture *Startup Dialogue 1* pops up. The menu reads as below:

For the correct operation of DigiConnect software, the number format of your operating system must be set as "." To proceed to the related options menu of your operating system, press the "OK" button. As the DigiConnect software uses the parameter format of 123,456,789.00, system settings must be set to allow this format as keyboard input.

- If you want to edit or check the systems settings, *OK* button is clicked on this screen; the resulting screen is shown on *Startup Dialogue 2a*. On this menu, check or change the system settings as the format described before, by clicking the *Customize* button and having the *Decimal Symbol* parameter as "." (Point). Once it is assured that the setting is correct, press the *OK* button to save the settings and discard.
- If you are sure that the system settings are correctly done, press the *Cancel* button while at *Startup Dialogue 1*, to jump to next screen, shown on picture *Startup Dialogue 2b*. Press the *Continue* button to access to the next step. ↘

Startup Dialogue 3

2. After the steps explained on the previous page have been completed, the menu shown on the picture *Startup Screen 3* is reached. The menu shows and lets the user select the relay types to be connected via DigiConnect program. Since DigiConnect v3.1 program is designed to communicate with CPM 310 G only, there are no options on this screen. Press the *Select* button to continue or hit *Cancel* button to exit startup.



Startup Dialogue 4

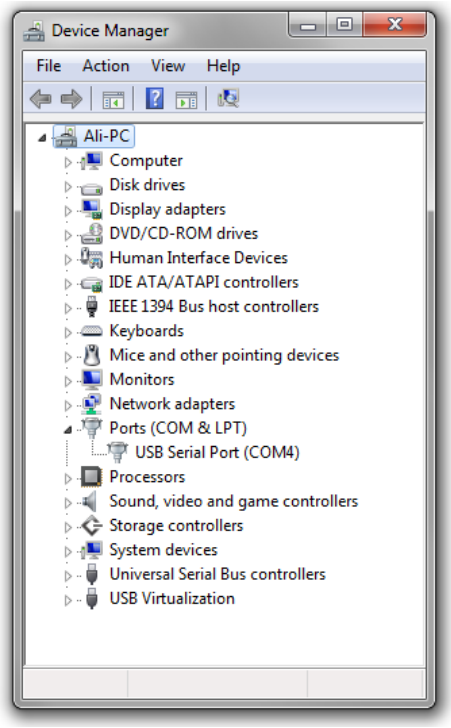
3. If the startup is continued by pressing the *Select* button as described above, *Connection Settings* menu as shown in *Startup Dialogue 4* is reached. Setting the parameters correctly on this menu is essential for the establishment of healthy communication with the relay.

- Connection Type: This option must be selected as *USB* if the physical connection is done from the USB port located at the front face of CPM 310 G, or must be set to *RS485* if the connection is made via the RS485 port from the terminal blocks located at the backside of CPM 310 G.
- Relay Address: CPM 310 G relays can be addressed with numbers 1≤n≤255. To read the actual address of the relay to be connected to, read the value at the address on the CPM 310 G menus:
  MENU » Communication Settings » (Relay Address)
  For further information on addressing a CPM 310 G unit, please refer to *Communications Settings Menu* section of *Relay Menus Manual*.

- Communications Port: To obtain the address of the PC port that is physically connected to CPM 310 G, go to the following address on the PC.

  Start » Settings » Control Panel » System » Hardware » Device Manager.

  At the menu with the given address (shown as *Device Manager Menu* picture on the next page), find the port that is to be used under the submenu: *Ports*. On the picture in the next page, the USB connection port of PC to CPM 310 G has been located. Notice that, according to the picture, the communication port address is COM4. Once the port address is obtained as described, set the *Communication Port* parameter to the obtained address. ↘



Device Manager Dialogue

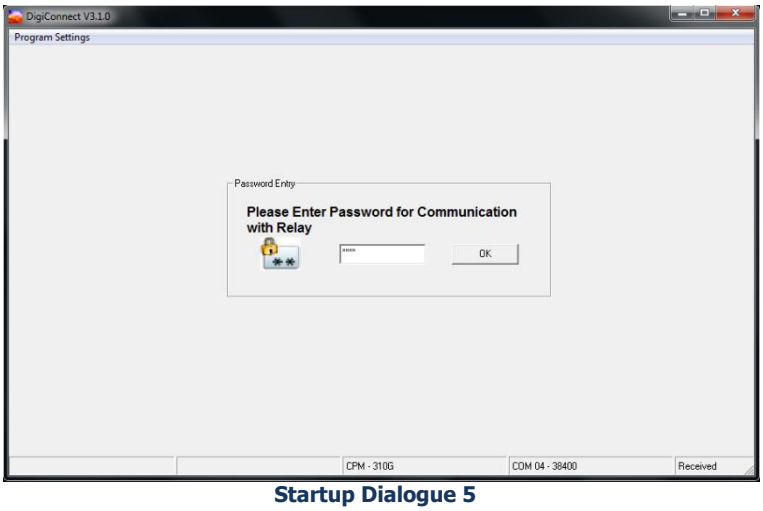
- Protocol: CPM 310 G relays can communicate using MODBUS, IEC60870-5-103 and DEMCOM protocols. When communicating with CPM 310 G via a PC, following points must be considered.
  - When communication is to be established via the USB port located on the front face of CPM 310 G; MODBUS or DEMCOM protocol may be selected.
  - When communication is to be established via the RS485 serial port located on the backside terminals of CPM 310 G; MODBUS, IEC60870-5-103 or DEMCOM protocol may be selected.

- Baud rate: Baud rate (communications speed) may be set to 1,200, 2,400, 4,800, 9,600, 19,200 or 38,400 bauds. On SCADA applications, communications speed may vary by the hardware and software used and any of the listed speed options may be required. When direct communication to CPM 310 G via a PC is intended, setting the baud rate to 38,400 will be most favorable.

Remark

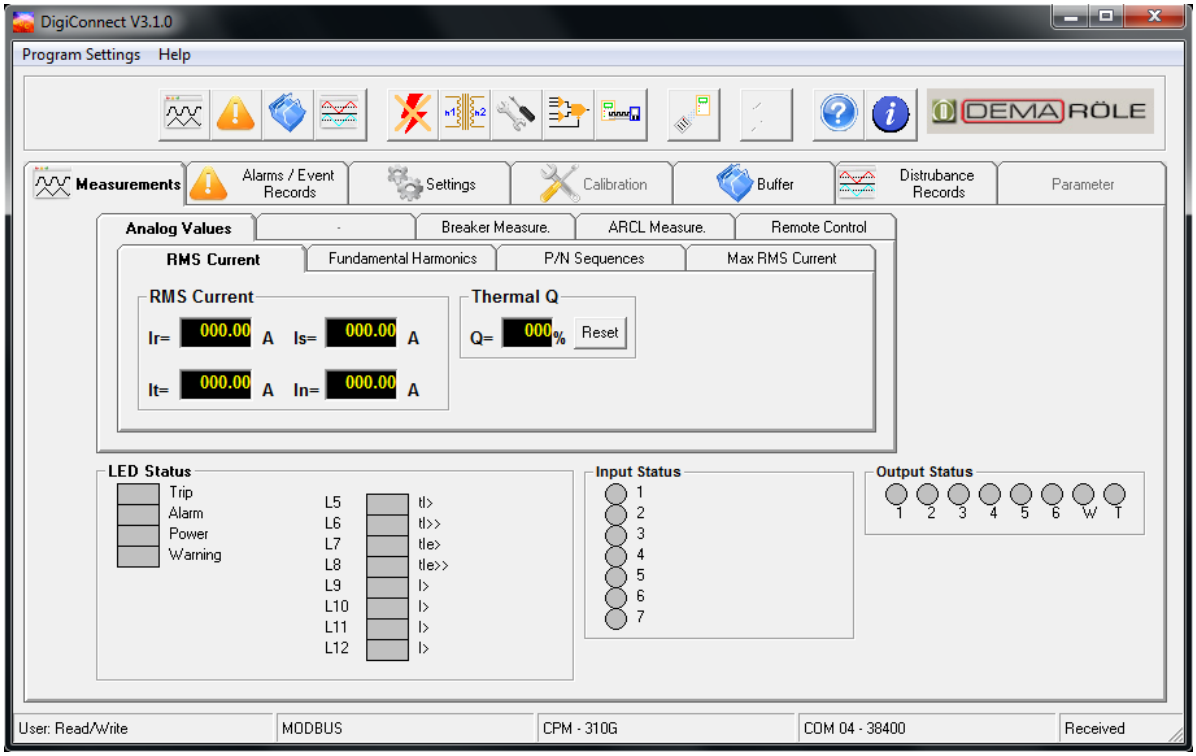
When direct communication to CPM 310 G via a PC is intended, the communications settings of CPM 310 G must be analogous to the settings shown on *Startup Dialogue 4*. For detailed information on these settings, please refer to *Communications Settings Menu* section of *Relay Menus Manual*.

4. Once the settings are completed, click the *OK* button *Connection Settings* menu (Startup Dialogue 4) to establish the connection. At this point, the password screen is monitored, as shown in the picture *Startup Dialogue 5* below. If the password is entered correctly and *OK* button is hit, the DigiConnect program will be started successfully. □



Startup Dialogue 5

Software Introduction and Guide



Sample Screenshot

DigiConnect software is developed and released for Microsoft Windows based systems, and utilizes standard Windows forms. General Windows knowledge is sufficient to work comfortably with DigiConnect software.

On the following pages of *DigiConnect PC Program Manual*, the menu being explored is shown with a screenshot, similar to the sample above. Some zones are marked with numbers to make it easier to follow the instructions. Additionally, each menu screenshot has the access address just below it.

This manual explores and explains all the menus and screens of DigiConnect, to have the reader handle the full functionality of the program.

For any support requests or feed-backs on DigiConnect software or manual, please contact our technical service.

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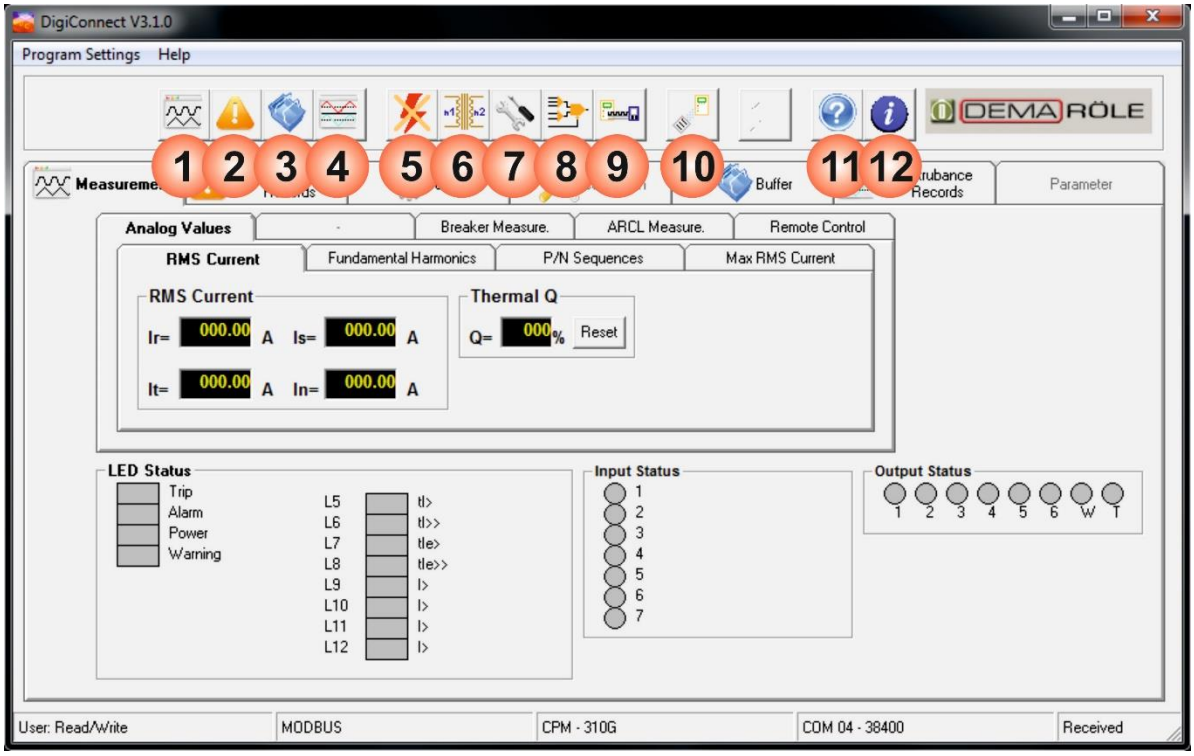
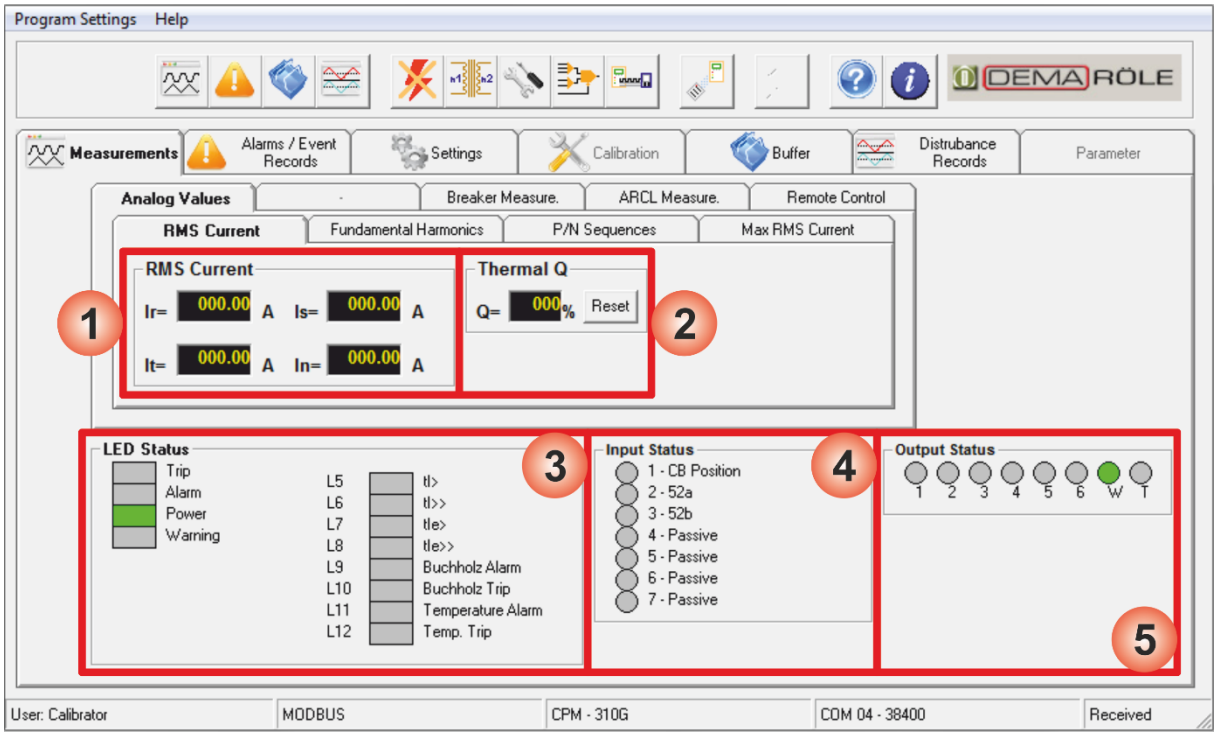
□



Welcome Screen

On the upper side of *Welcome Screen*, shortcuts to the menus listed below are located. It is also possible to reach the same menus by exploring the tabs below the shortcuts.

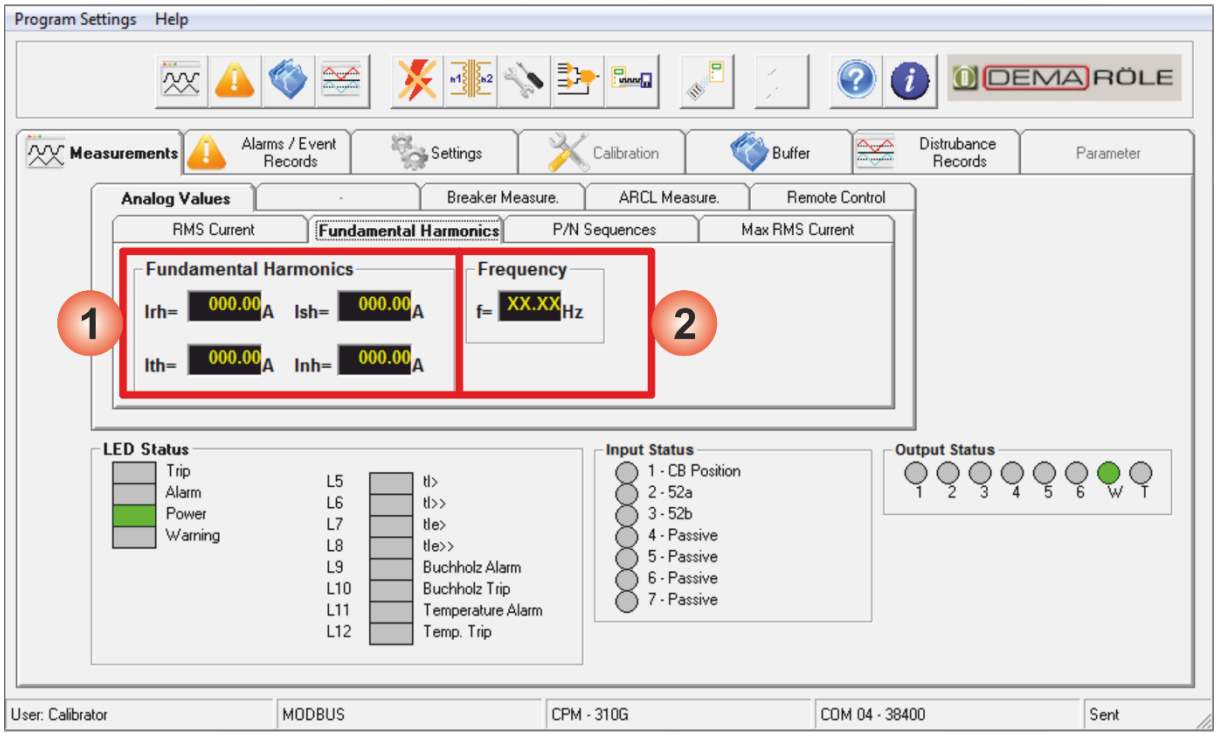
1. *Measurements* shortcut leads to the measurement menus;
2. *Alarms / Event Records* shortcut leads to the submenus where alarms, event records and fault records can be viewed;
3. *Buffer* shortcut leads to the menu where setting changes recorded to the buffer are sent to the relay, and where the template and password files are managed;
4. *Waveform Records* shortcut leads to the menu where recorded waveforms are explored;
5. *Protection Settings* shortcut leads to the protection settings menu;
6. *CT Settings* shortcut leads to the menu where current transformer settings are done;
7. *System Settings* shortcut leads to the menu where system settings are made;
8. *Automatic Control Settings* shortcut leads to the leads to the automatic control settings menu;
9. *Communication Settings* shortcut leads to the menu where communication settings are done;
10. *Remote Control* shortcut leads to the menu where the circuit breaker and programmable outputs are controlled remotely;
11. *Help* shortcut launches the help file in PDF format;
12. *About* shortcut pops up the window where software version is monitored, as shown on the screenshot below. □



Measurements » Analog Values » RMS Current

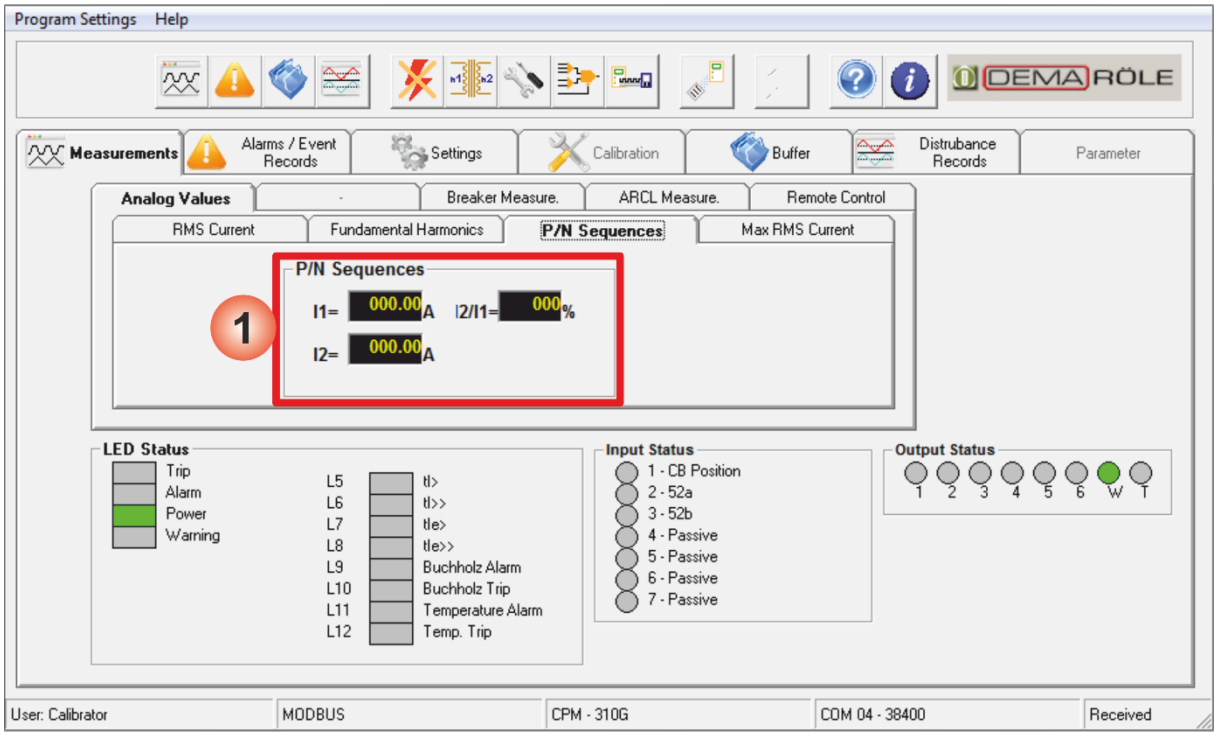
1. Phase and earth current RMS momentary values are monitored in this region. Values are given in amperes.
2. Thermal Θ (heating percentage) values are monitored in this region. The thermal heating percentage shown here is the cumulative evaluation made by using the set parameters and RMS current measurements. Thermal Θ can be reset by clicking the *Reset* button; but it must be kept in mind that resetting the Thermal Θ under normal service conditions may result in protection errors.
3. *LED Status* window monitors both the positions of the fixed physical LEDs, placed at the front face of CPM 310 G; and the programmable virtual LEDs, which can be accessed by pressing the Reset button once while at any menu. The window enables users to see the explanations of the LEDs hereby being monitored and the position of these LEDs via color graphics. The *LED Conditions* window on the sample picture above represents that the relay is being supplied by the auxiliary source healthily; while there are no tripping, alarming or failure detections.
4. *Input Status* window displays the actual assignments made to the 7 programmable inputs, and the activity on the inputs at that time. If any of the inputs are activated, the activation is announced to the user via red color on the virtual LEDs of the related inputs. Similarly, if no inputs are active, there will be no active LEDs of inputs monitored. The *Input Status* window on the sample picture above states that; *CB Position* function is assigned to the first input, *52a* and *52b* functions are assigned to the second and third inputs respectively, and the other inputs are left passive. The window also tells that none of the inputs (1-7) are active.
5. *Output Status* window displays the actual assignments made to the 6 programmable outputs plus trip and watchdog outputs and the activity of those at that time. The activity display method of outputs are similar to input status'; the active output is indicated by a red color virtual LED. The Out*put Status* window on the sample picture above states that; the programmable outputs (1-6) and trip relay (T) are inactive, and the watchdog relay (W) is closed – as expected when there are no internal errors or auxiliary supply shortages.

   LED, input and output conditions windows appear on any submenus of *Measurements* tab; thus, the explanations hereby given will not be repeated on the other pages. □



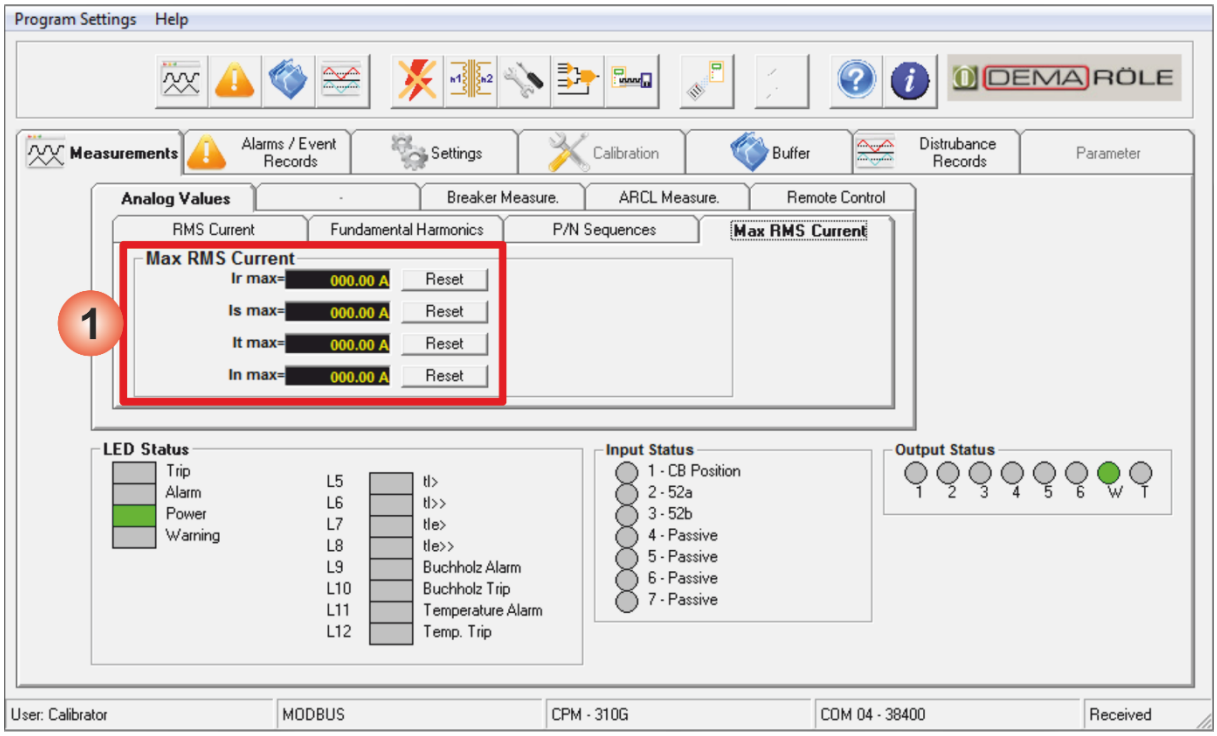
Measurements » Analog Values » Fundamental Harmonics

1. *Fundamental Harmonics* window displays the fundamental harmonic component (f = 50 Hz / 60 Hz) of the phase and earth current filtered of higher order harmonics.
2. *Frequency* window displays the actual network power frequency measured on the secondary circuit. □



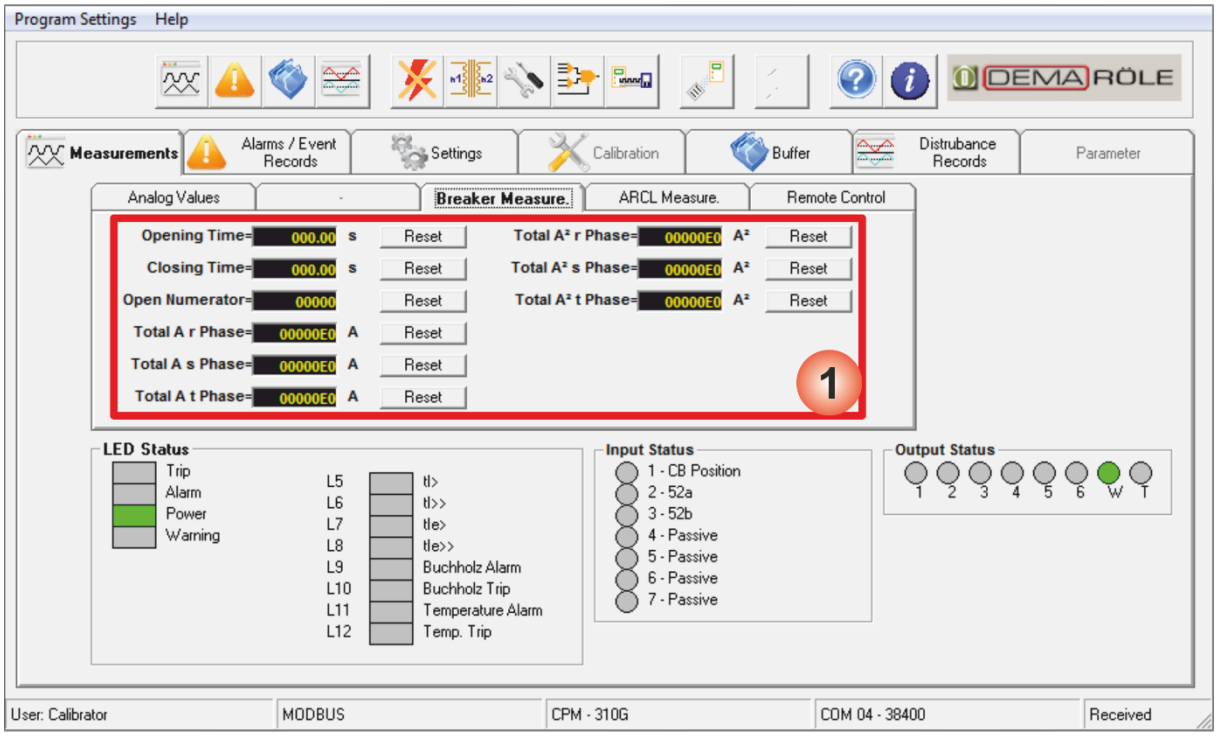
Measurements » Analog Values » P/N Sequences

1. *P/N (Positive / Negative) Sequences* window displays the positive and negative sequence components of the measured fundamental component of the secondary current; as absolute values in amperes and as proportion in percentage. □



Measurements » Analog Values » Max. RMS Current

1. *Max RMS Current* window displays the maximum value of the phase & earth RMS current since the last reset, in amperes or kiloamperes. Max RMS current values can be reset for each phase and earth individually by using the *Reset* buttons next to each of them. □



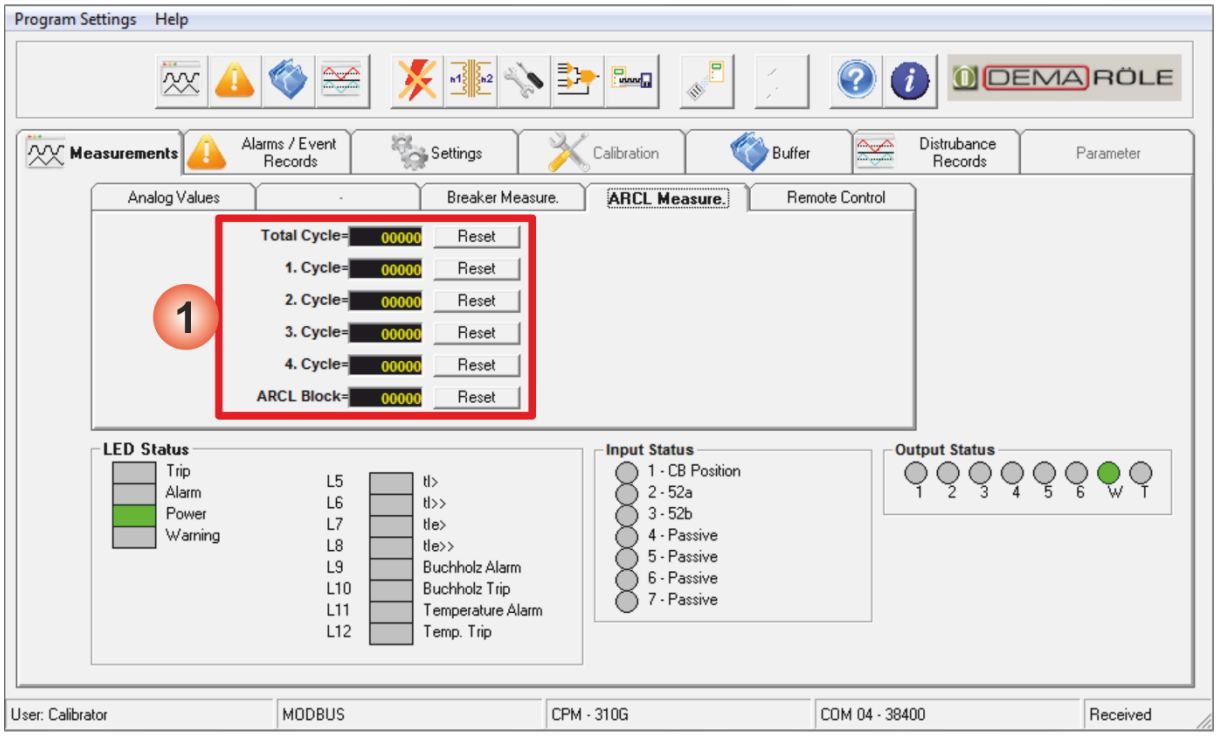
Measurements » Breaker Measurements

1. *CB Measurements* window monitors and records all of the circuit breaker activity. The window displays:

   - Durations of the last closing and tripping operations, in seconds;
   - Total tripping numerator;
   - Cumulative total tripping current for each of R, S and T phases, in amperes (A);
   - Cumulative total tripping current-square for each of R, S and T phases, in amperes-square (A^2).

   Trip and *Closing Time* values are of great importance for administrators to supervise the circuit breaker mechanism condition. During evaluations, it must be kept in mind that the values shown are the measured delays between the excitation of trip / closing release coils and loss / receive of signals from the normally open auxiliary contact of the CB. Note that, assigning *52a* to any of the programmable inputs and cabling a normally open auxiliary contact of the CB to that input is essential for the functionality of *Trip* and *Closing Time* monitors.

   Total Trips, *Total A* and *Total* A^2 measurements are the values that the administrator can use to evaluate mechanical and electrical maintenance periods. *Total* A^2 values are usually utilized for CBs with rated voltage 36 kV or lower, while *Total A* values are evaluated for determination of maintenance periods of CBs with rated voltage 52k V or higher. Documentation of the CB's manufacturer must be examined to decide whether to supervise *Total A* or *Total* A^2 values for a given CB. □

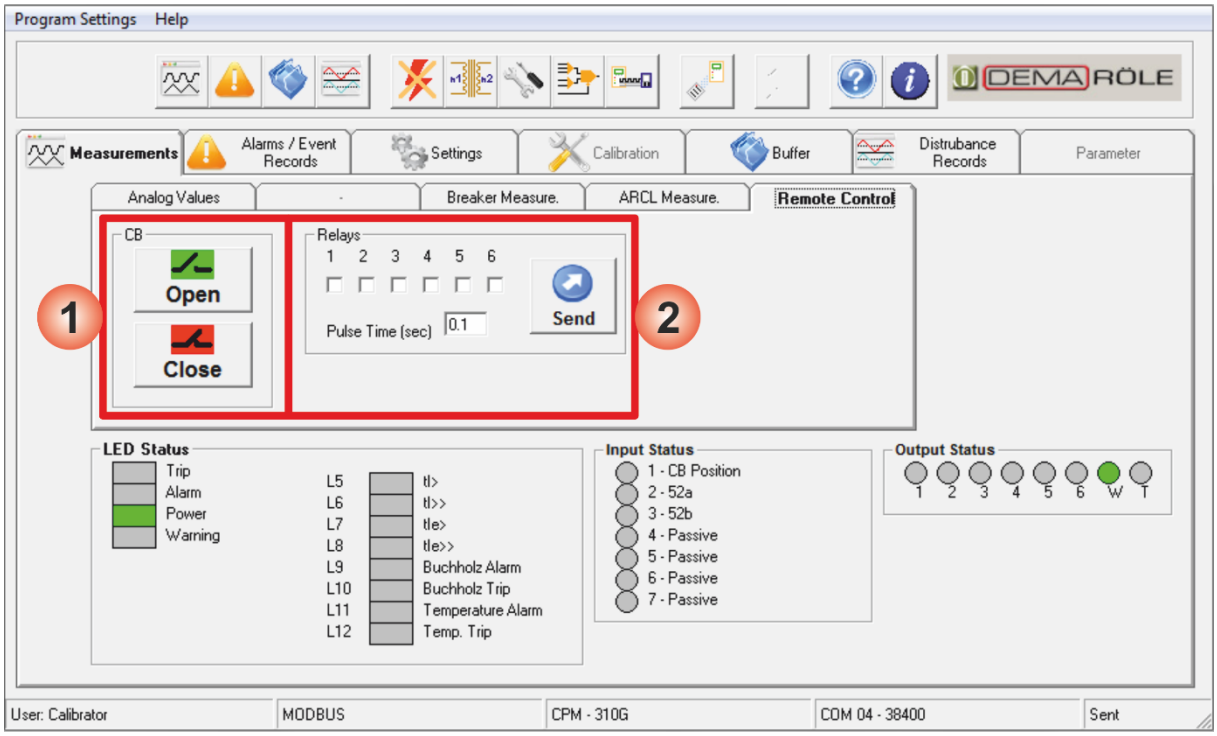


Measurements » ARCL Measurements

1. *ARCL (Auto-recloser) Measurements* window displays the cumulative and individual values of reclosing cycles, and the total number of auto-recloser blockings. As seen on the picture above; the left column gives the explanations of the monitors to their right (e.g. *Total cycle*), the middle column comprises of the 5-digit monitors, and the column at the far right contains the buttons to reset each of the monitors.

   - Total Cycles: Total ARCL cycles numerator sums and displays the values of 1st to 4th cycles.
   - Individual Cycle Numerators (1st, 2nd, 3rd and 4th Cycles): These numerators watch and display the number of each successful cycle.
   - ARCL Block: Auto-recloser is subject to be blocking under some predefined conditions, e.g., permanent failures, user intervention, CB charging spring failure, CB pole failure and CB trip / closing time errors. After each of the auto-recloser blockings, the *ARCL Block* numerator records it onto its history to create a cumulative statistic. □

   NOTES
   - ARCL Cycle: An ARCL cycle comprises of 1 closing command. Tripping is not evaluated at ARCL Measurements.
   - For the initiation of ARCL cycles, the ARCL settings must have been done so that an ARCL session is triggered by the tripping function. The subject is explained in detail at the dedicated section *ARCL Settings*.

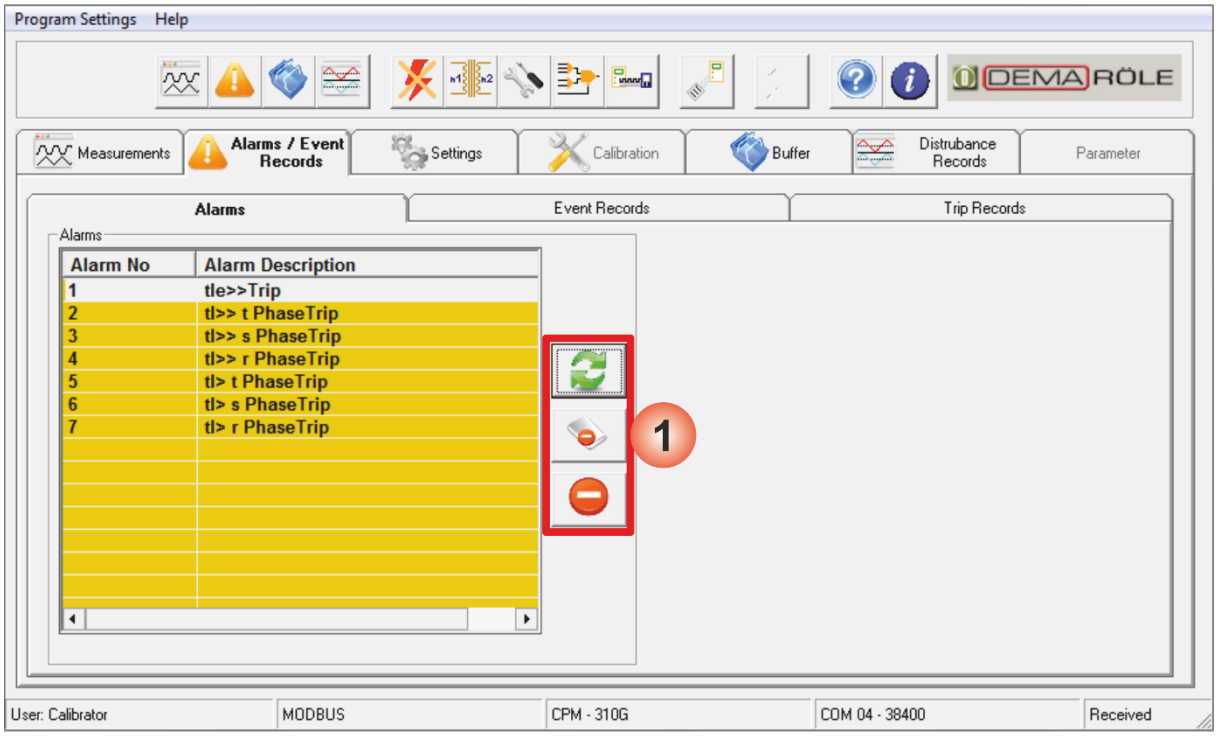


Measurements » Remote Control

Remote Control tab comprises controls that enable the user to take remote control the CB and the programmable outputs.

1. *CB (Circuit Breaker)* window is used for controlling the circuit breaker via the *Open* and *Close* buttons.
2. *Relays* window is used for controlling the programmable outputs by utilizing the check boxes and the *Send* button. When a check box is checked and the *Send* button is hit, the related output relay changes position for the time determined by the *Pulse Time* parameter on the window. It must be noted that, if the output being controlled is set to latch via the related menu *Latch Settings*, the output relay will be latched and stay closed even after the pulse time has expired.

   Pulse time parameter can be set within the range of (0.1 - 5.0) s. □



Alarms / Event Records » Alarms

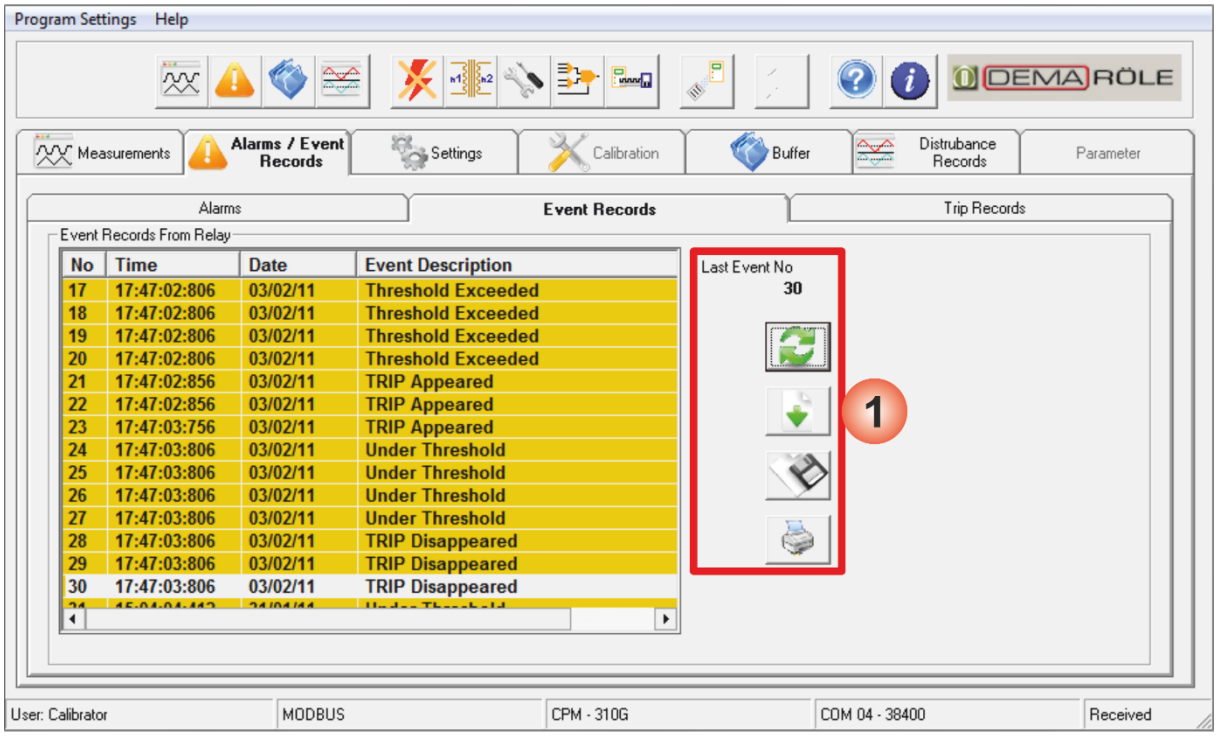
Alarms window lets the user;

- Download alarm records from CPM 310 G memory,
- Display alarms,
- Delete individual records, or
- Delete entire set of records.

As seen on the image above, *Alarms* window has an alarm display area on the left side of the screen which displays the number of the alarms and the alarm information.

1. There are a number of buttons to the right of the alarms display. The *Refresh* button (top) downloads the alarm records to the display list, if any exist. *Delete All* button (middle) deletes all alarm records from both the display and the device memory, while *Delete Selected* button does the same job for a selected record.

   NOTE
   When DigiConnect program is launched, no records exist or displayed at the *Alarms* window. To download and display alarms from CPM 310 G, use the *Refresh* (1) button. □



Alarms / Event Records » *Event Records*

Event Records window lets the user;

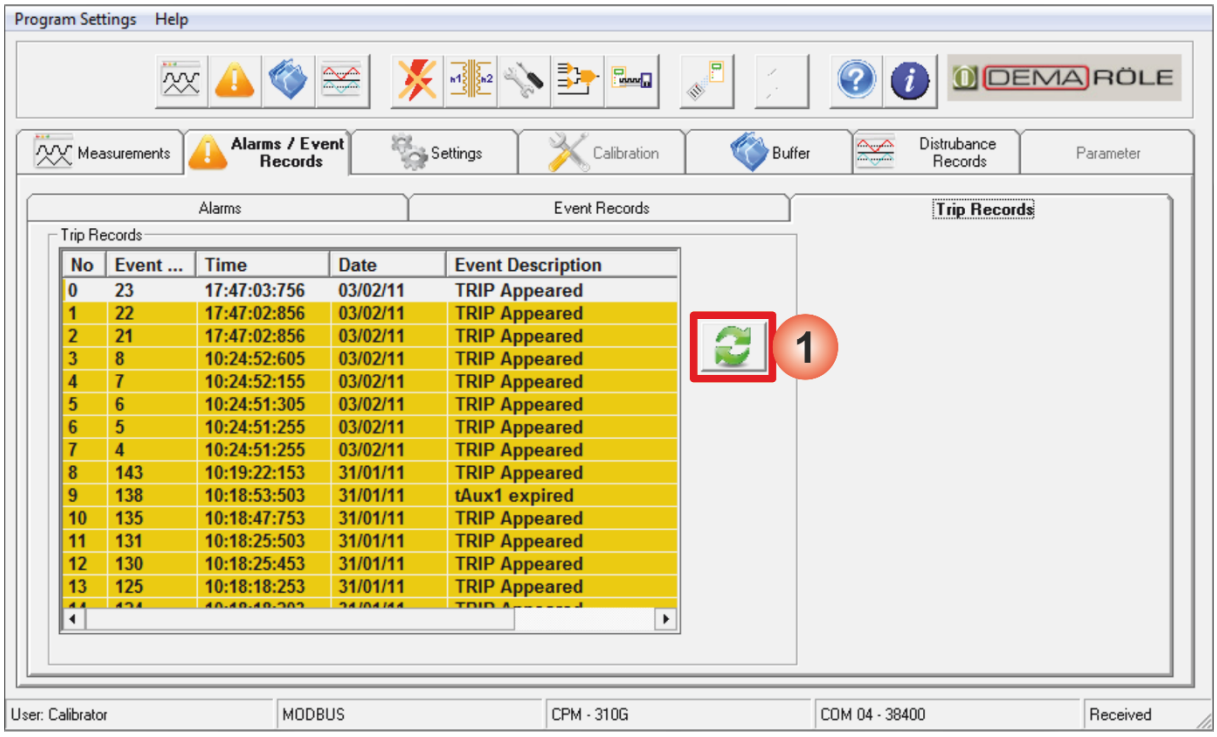
- Download event records from CPM 310 G memory,
- Print selected records,
- Save event records to a file on the local disc, and
- Download and display archived event records from a file on local disc.

As seen on the picture below, *Event Records* window has an alarm display area on the left side of the screen which displays the alarm stamps and the alarm information.

1. On the right side of the records display area, there is an indication field that displays the order of the last recorded event, and 4 buttons that enable following actions:

- *Refresh* button downloads the event records to the display list. The latest record is noted on the field just above the refresh button (e.g. on the picture: 17), so that the latest events can be followed both from DigiConnect and CPM 310 G menus.
- *Download from File* button pops up a dialog window to locate and open an existing records archive file and gives access to older records. Archiving functionality of DigiConnect lets users to create a library of events that a certain establishment faces. When locating an existing file, note that the archiving data file extension will be ".erf".
- *Save to File* button saves the downloaded event records to an archive file with the ".erf" extension on the local disc. Utilizing a systematic folder and naming scheme when saving events records archive files will help users to use the records libraries efficiently.
- *Print* button pops up a dialog box that asks the user to determine the printing range of records between 1 and 150 (e.g. 32-49); once this step is done, the standard Windows printing interface opens to print the demanded reports. All details of the event records printed will be available on the document.

NOTE
When DigiConnect program is launched, no records exist or displayed at the *Event Records* window. To download and display even records from CPM 310 G, use the *Refresh* (1) button. □

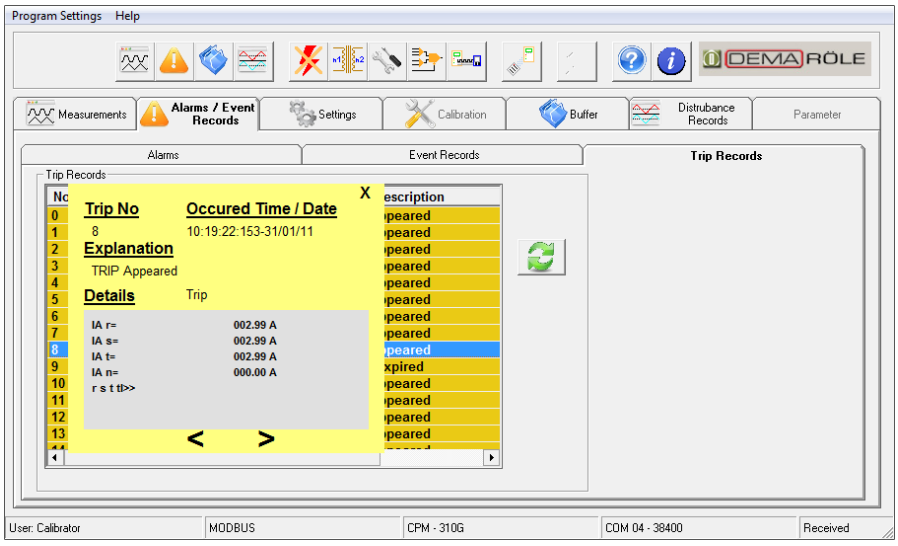


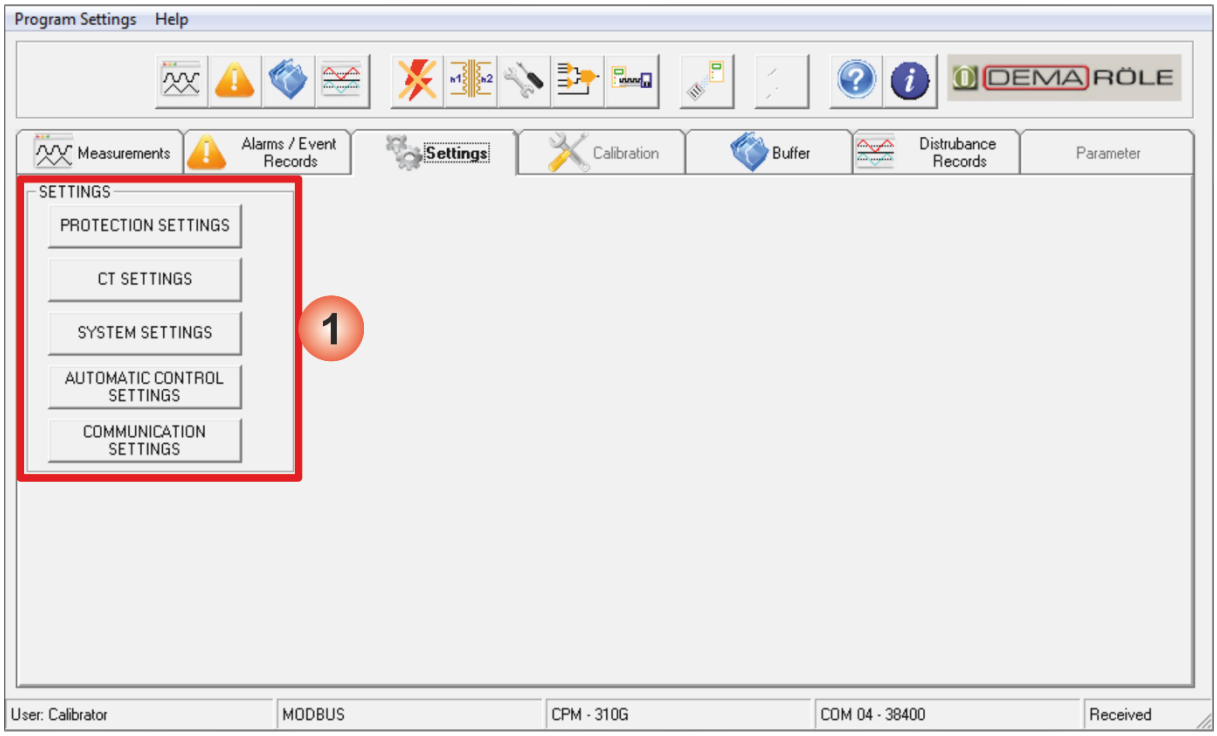
Alarms / Event Records » *Trip Records*

Trip Records window acquires data from the CPM 310 G memory to display fault records.

Trip records are filtered and derived from the event records. The filtering method is based on the elimination of the events not resulting with tripping. The acquisition, display and evaluation principles are same with those of event records.

NOTE
When DigiConnect program is launched, no records exist or displayed at the *Trip Records* window. To download and display fault records from CPM 310 G, use the *Refresh* (1) button. □

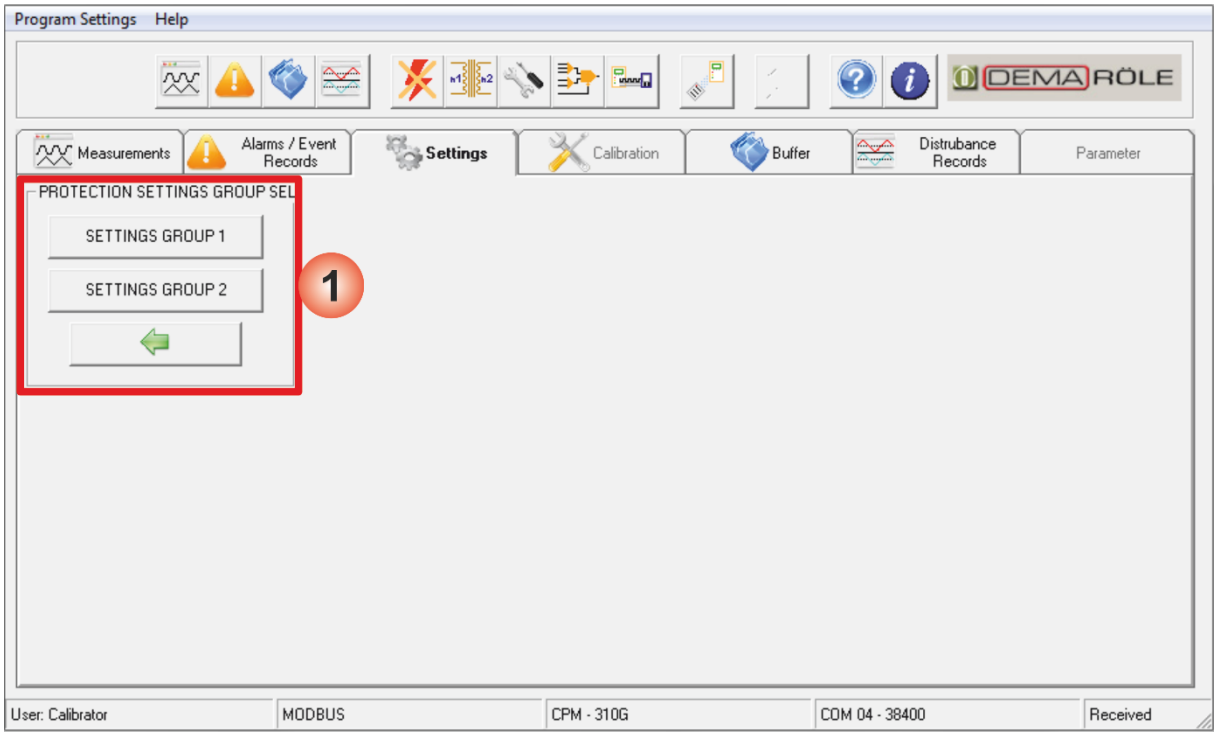




Settings

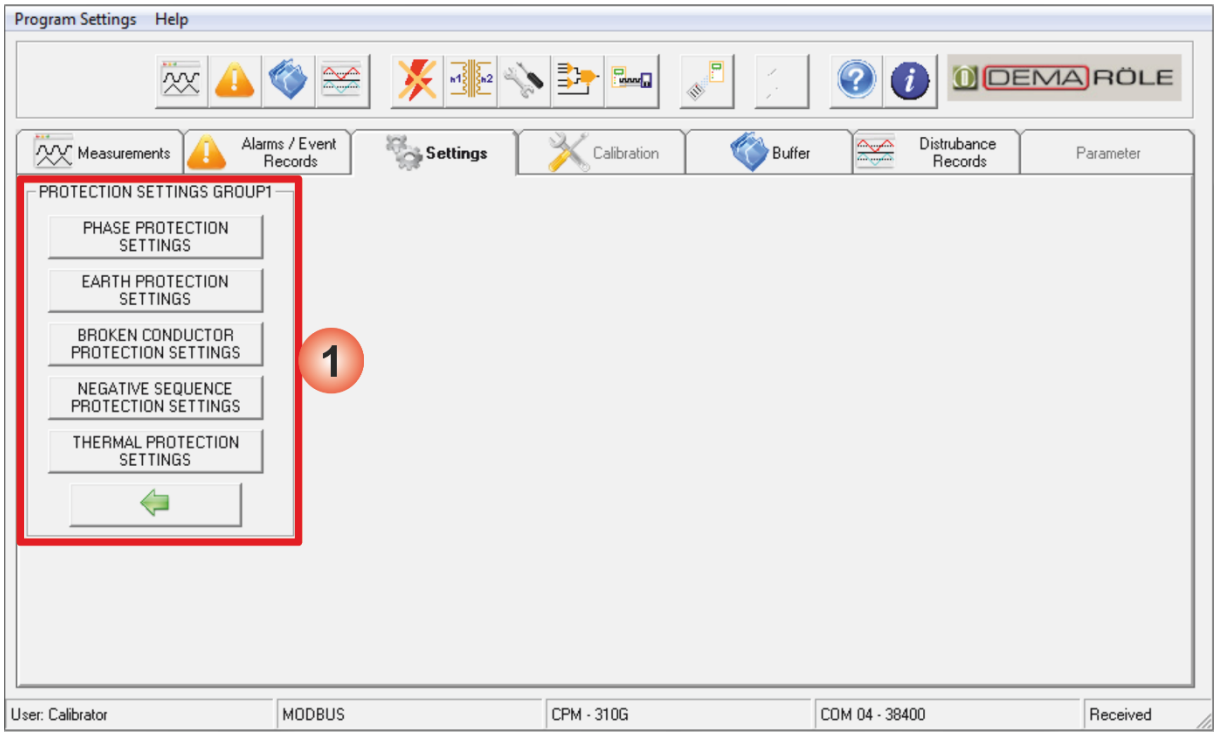
1. *Settings* tab is displayed on the above picture. Via this tab, it is possible to access;
    a. Protection Settings window,
    b. CT Settings window,
    c. System Settings window,
    d. Automatic Control Settings window, and
    e. Communication Settings window.

    The introductions to the mentioned windows are given in the following pages. □



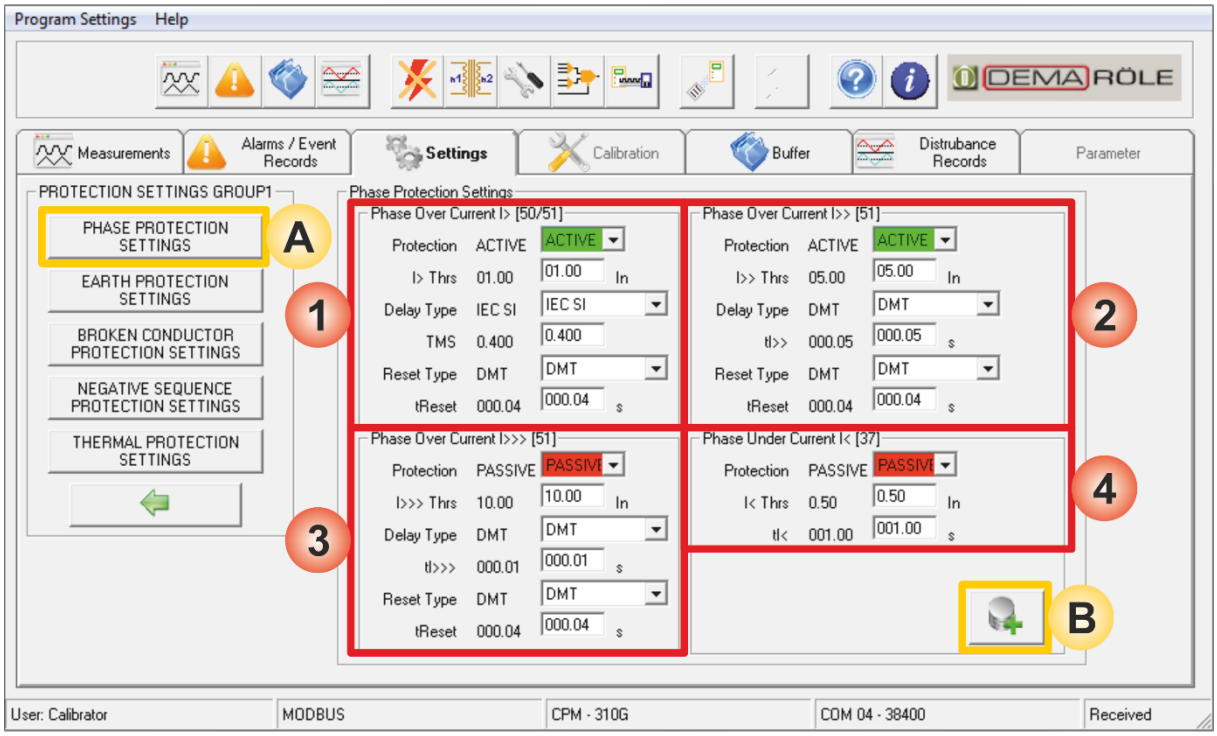
Settings » Protection Settings

1. When *Protection Settings* button is clicked under the *Settings* tab, the window titled *Protection Settings Group Selection* is displayed. On this window, the group that the settings will be in effect must be selected to proceed further. The *Back* button below the settings group buttons leads back to the main menu of settings. □



Settings » Protection Settings » Protection Settings Group 1/2

1. Once the protection settings group selection is done, the protection settings menu is reached. This menu comprises the setting menus of following functions:
    a. Phase Protection Settings,
    b. Earth Protection Settings,
    c. Broken Conductor Protection Settings,
    d. Negative Sequence Protection Settings,
    e. Thermal Protection Settings. □

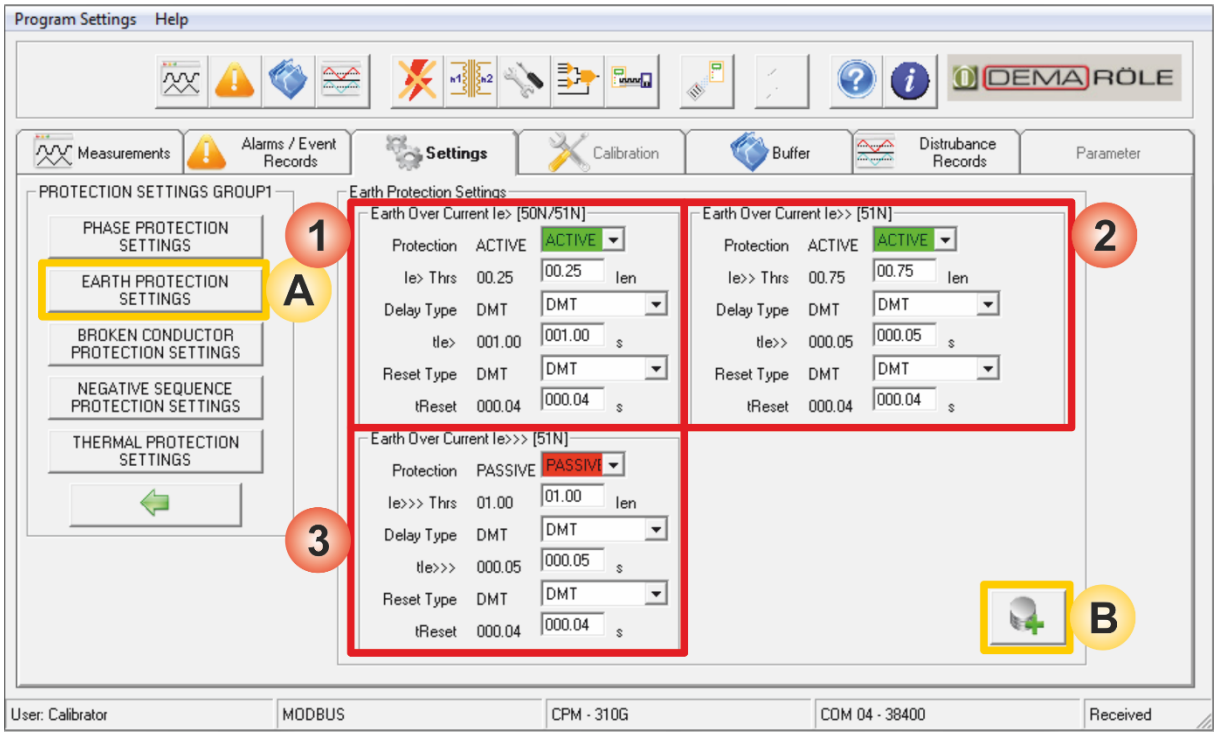


Settings » Protection Settings » Protection Settings Group 1/2 » Phase Protection Settings

A. *Phase Protection Settings* button leads to the menu where phase overcurrent and phase undercurrent protection parameters are set.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Phase overcurrent 1st threshold protection (I>) (ANSI 50/51) parameters and settings area,
2. Phase overcurrent 2nd threshold protection (I>>) (ANSI 51) parameters and settings area,
3. Phase overcurrent 3rd threshold protection (I>>>) (ANSI 51) parameters and settings area,
4. Phase undercurrent protection (I<) (ANSI 37) parameters and settings area.

NOTE
The determination processes of parameter set values are beyond the content of this guide. See the relevant section of the *Relay Menus Manual* for assistance on the protection functions and their parameters. Consider providing professional help on the evaluation of parameters. □

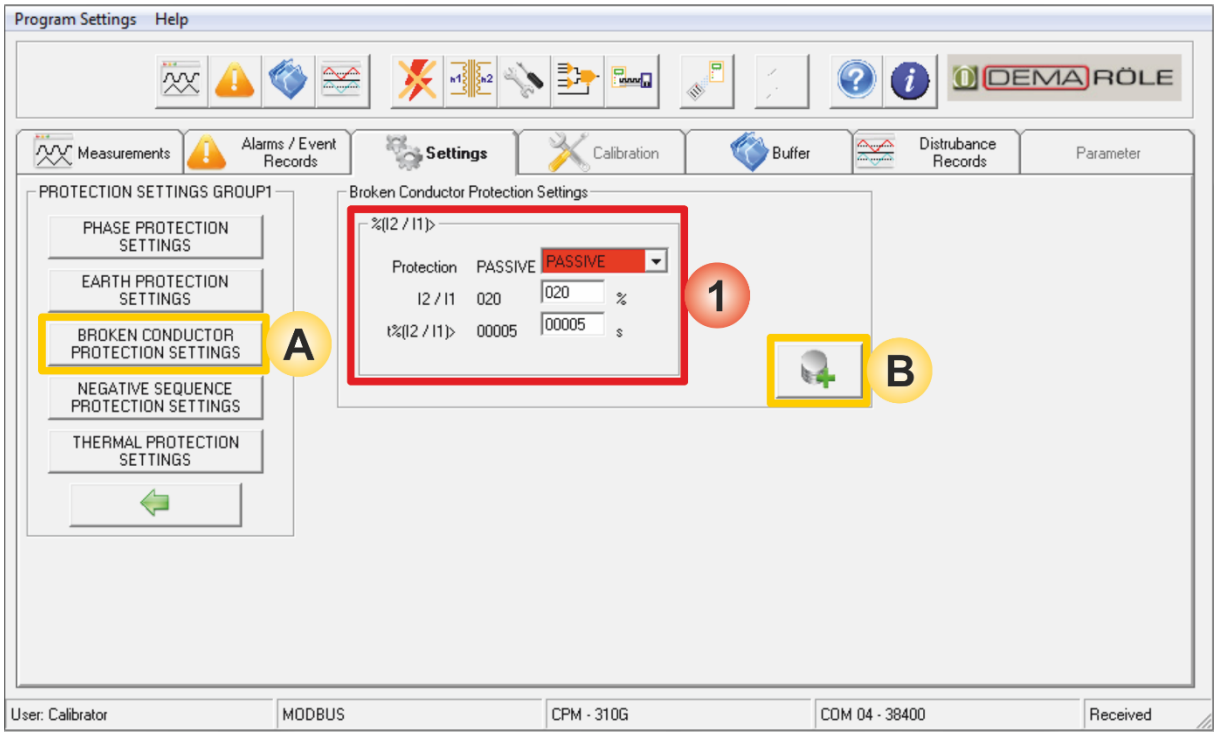


Settings » Protection Settings » Protection Settings Group 1/2 » Earth Protection Settings

A. *Earth Protection Settings* button leads to the menu where earth overcurrent protection parameters are set.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Earth overcurrent 1st threshold protection (I_e>) (ANSI 50N/51N) parameters and settings area,
2. Earth overcurrent 2nd threshold protection (I_e>>) (ANSI 51N) parameters and settings area,
3. Earth overcurrent 3rd threshold protection (I_e>>>) (ANSI 51N) parameters and settings area.

NOTE
The determination processes of parameter set values are beyond the content of this guide. See the relevant section of the *Relay Menus Manual* for assistance on the protection functions and their parameters. Consider providing professional help on the evaluation of parameters. □

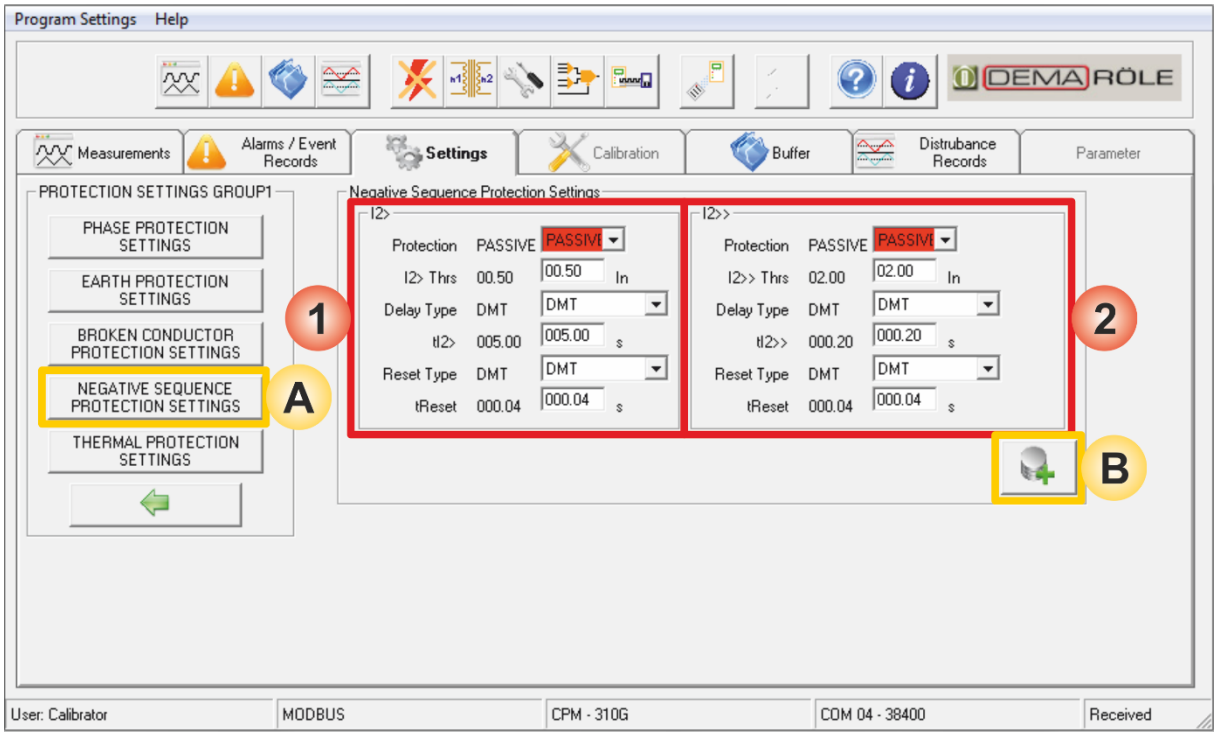


Settings » Protection Settings » Protection Settings Group 1/2 » Broken Conductor Protection Settings

A. *Broken Conductor Protection Settings* button leads to the menu where broken conductor protection parameters are set.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Broken conductor protection parameters and settings area.

NOTE
The determination processes of parameter set values are beyond the content of this guide. See the relevant section of the *Relay Menus Manual* for assistance on the protection functions and their parameters. Consider providing professional help on the evaluation of parameters. □

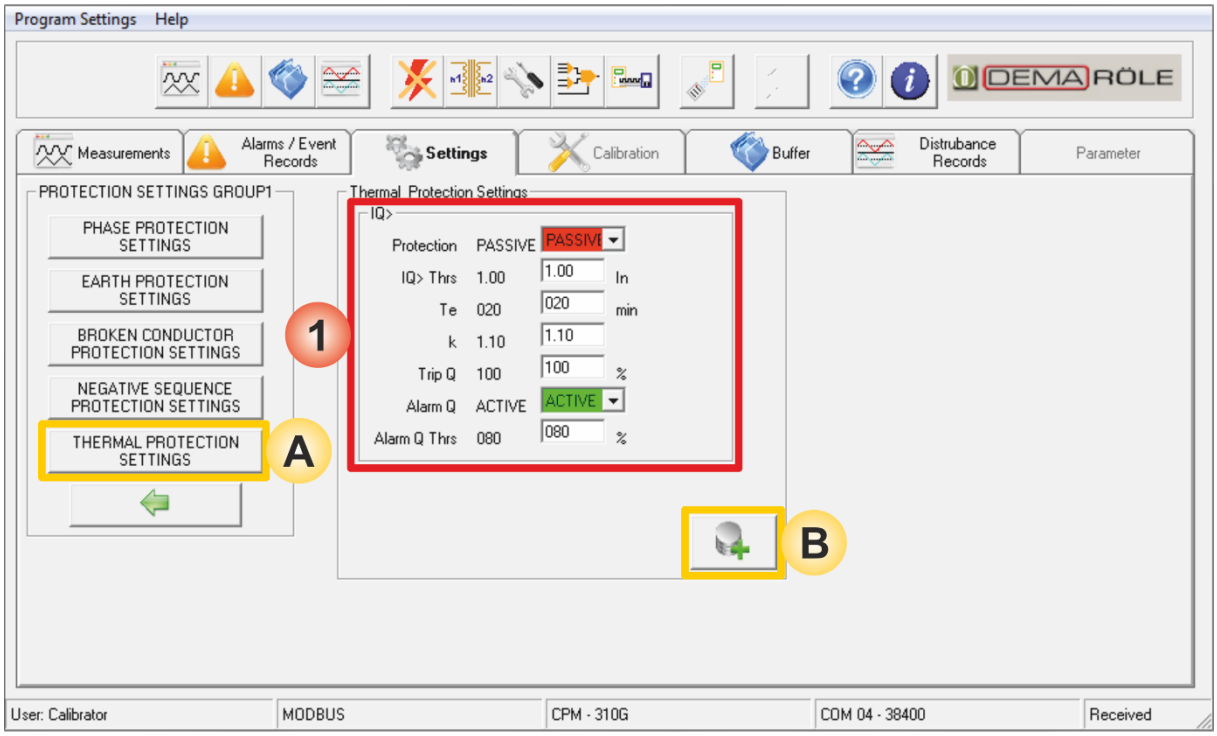


Settings » Protection Settings » Protection Settings Group 1/2 » Negative Sequence Protection Settings

A. *Negative Sequence Protection Settings* button leads to the menu where negative sequence overcurrent protection parameters are set.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Negative sequence overcurrent 1st threshold protection (I_2>) (ANSI 46) parameters and settings area,
2. Negative sequence overcurrent 2nd threshold protection (I_2>>) (ANSI 46) parameters and settings area.

NOTE
The determination processes of parameter set values are beyond the content of this guide. See the relevant section of the *Relay Menus Manual* for assistance on the protection functions and their parameters. Consider providing professional help on the evaluation of parameters. □

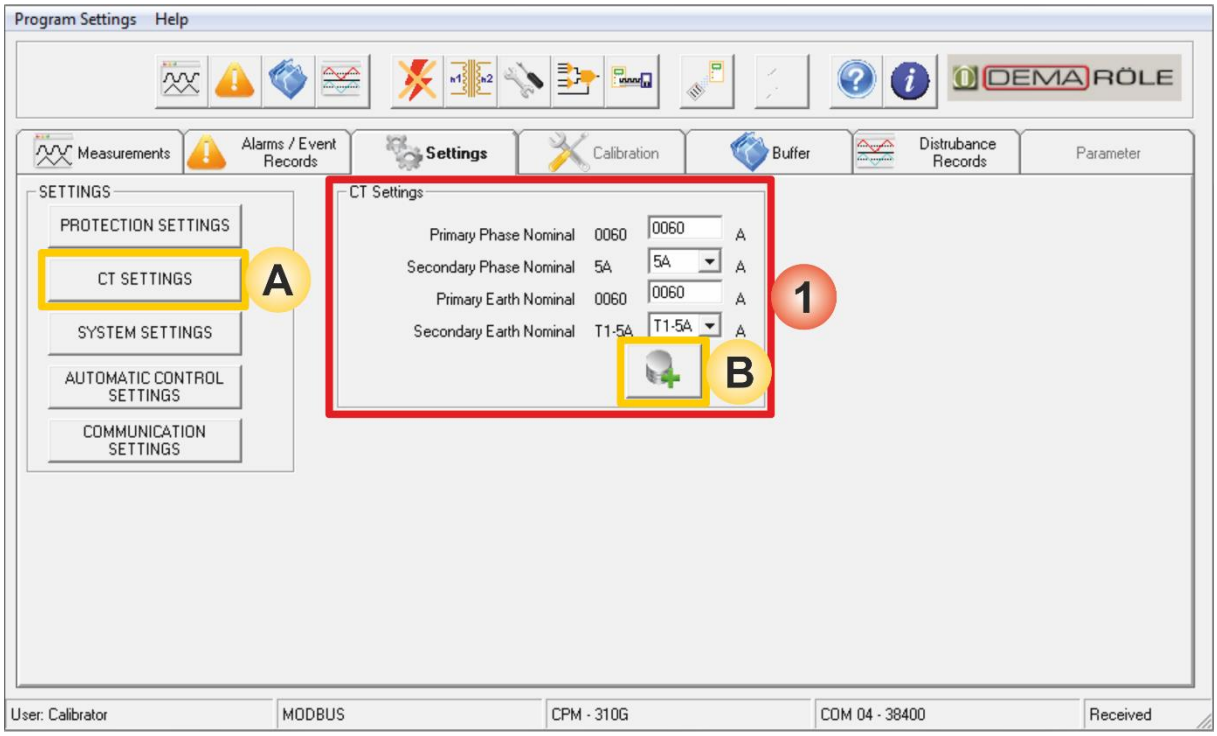


Settings » Protection Settings » Protection Settings Group 1/2 » Thermal Protection Settings

A. *Thermal Protection Settings* button leads to the menu where thermal overload protection parameters are set.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Thermal overload protection (I_Θ>) (ANSI 49) parameters and settings area.

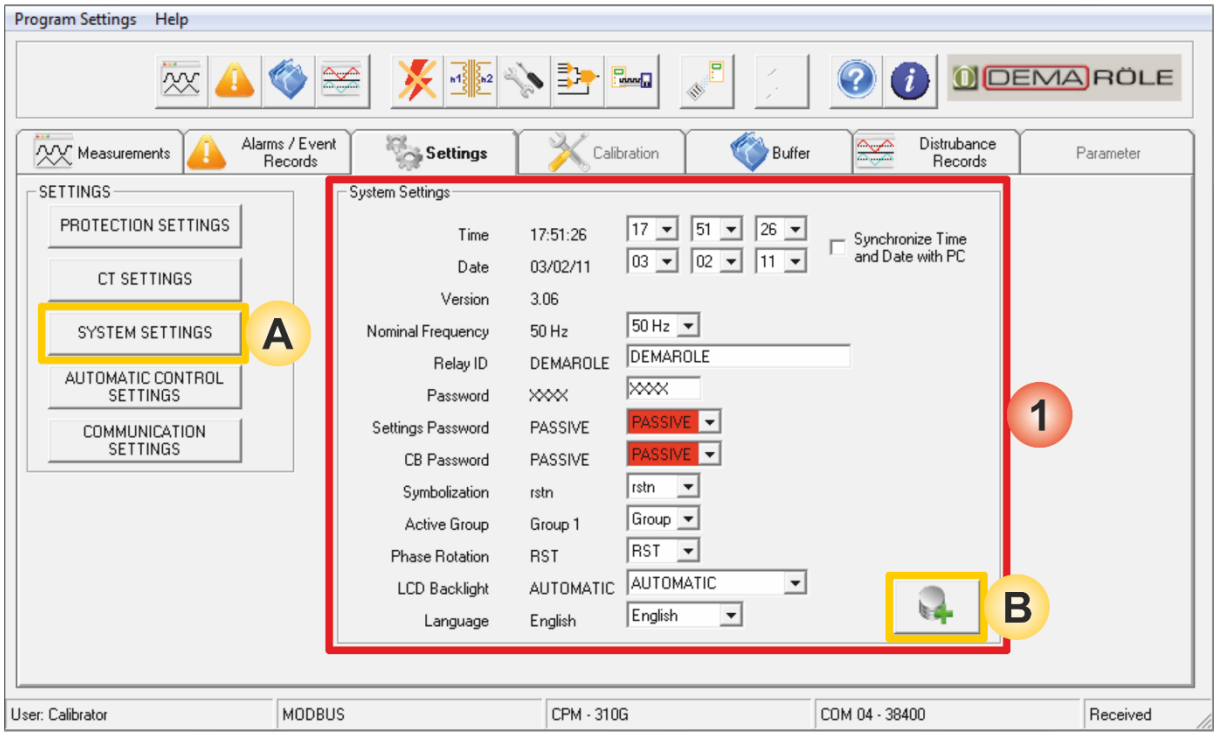
NOTE
The determination processes of parameter set values are beyond the content of this guide. See the relevant section of the *Relay Menus Manual* for assistance on the protection functions and their parameters. Consider providing professional help on the evaluation of parameters. □



Settings » CT Settings

A. *CT Settings* window is reached when *CT Settings* button under the *Settings* tab is clicked.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *CT Settings* window embeds the settings options for primary and secondary nominal current for phases and earth. It must be noted that, with the selection of earth secondary nominal current, type of earth protection and set ranges are also determined. See the dedicated subsection *Current Transformer Settings Menu* within the *Relay Menus Manual* section of this book for detailed information. □



Settings » System Settings

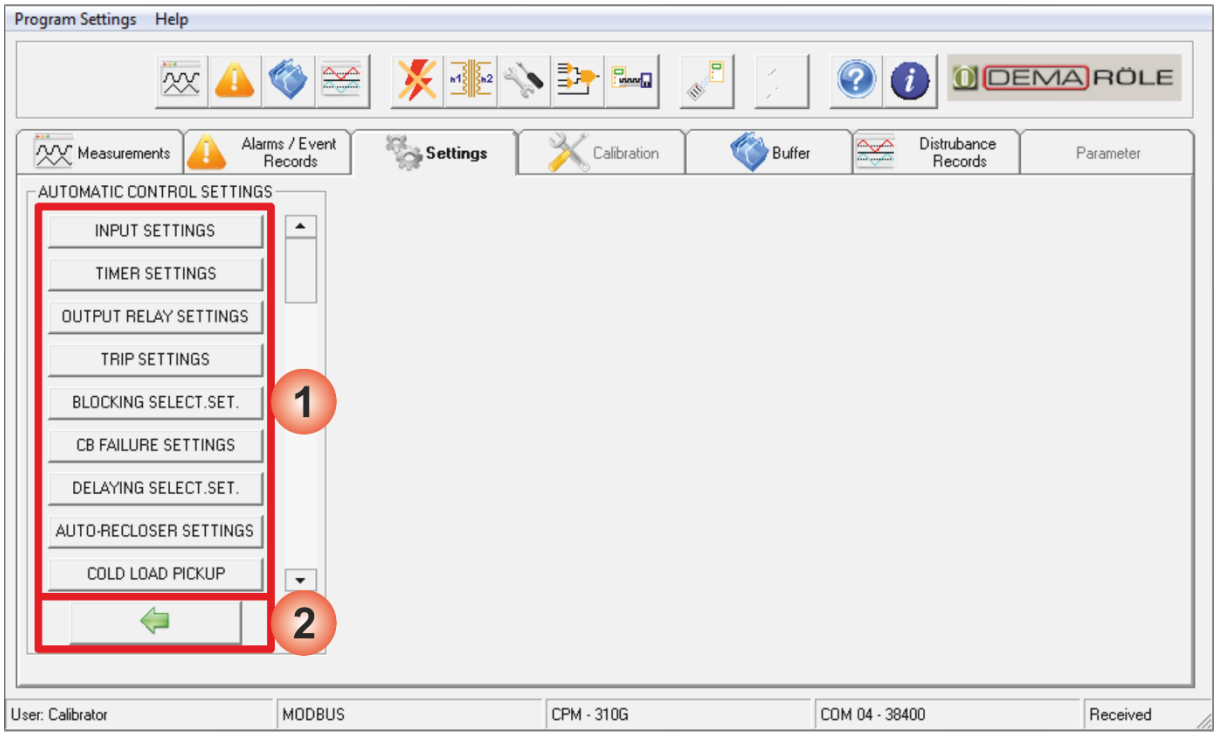
A. *System Settings* window is accessed by clicking the *System Settings* button under the *Settings* tab of DigiConnect.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. CPM 310 G basic settings are made via the *System Settings* window under the *Settings* tab. The menu monitors the system firmware version; and lets the user view and set time, date, nominal network power frequency, relay ID, system password, password application settings (Setting Password Control and CB Password Control), phase and earth symbolization, active settings group, phase rotation, LCD backlighting and language parameters or options.

   As seen on the picture above, the left side of the window includes the descriptions and current values of the parameters, while the right side embeds combo and text boxes to edit parameters and options.

   System settings parameters are studied at the *System Settings* subsection of the *Relay Menus Manual* in the previous pages, thus, will not be gone over here again. The only exception to that is the *Automatic Time and Date* option, located to the right side of time and date settings combo boxes.

   When the *Synchronize Time and Date with PC* option is enabled, DigiConnect synchronizes the time and date values with the PC operating system; and if these settings are uploaded to CPM 310 G, the system time and date configurations of the relay will be synchronized to those of PC's. Note that manual setting of the time and date fields is not allowed when the *Synchronize Time and Date with PC* option is enabled; so the option must be disabled to perform a manual setting. □

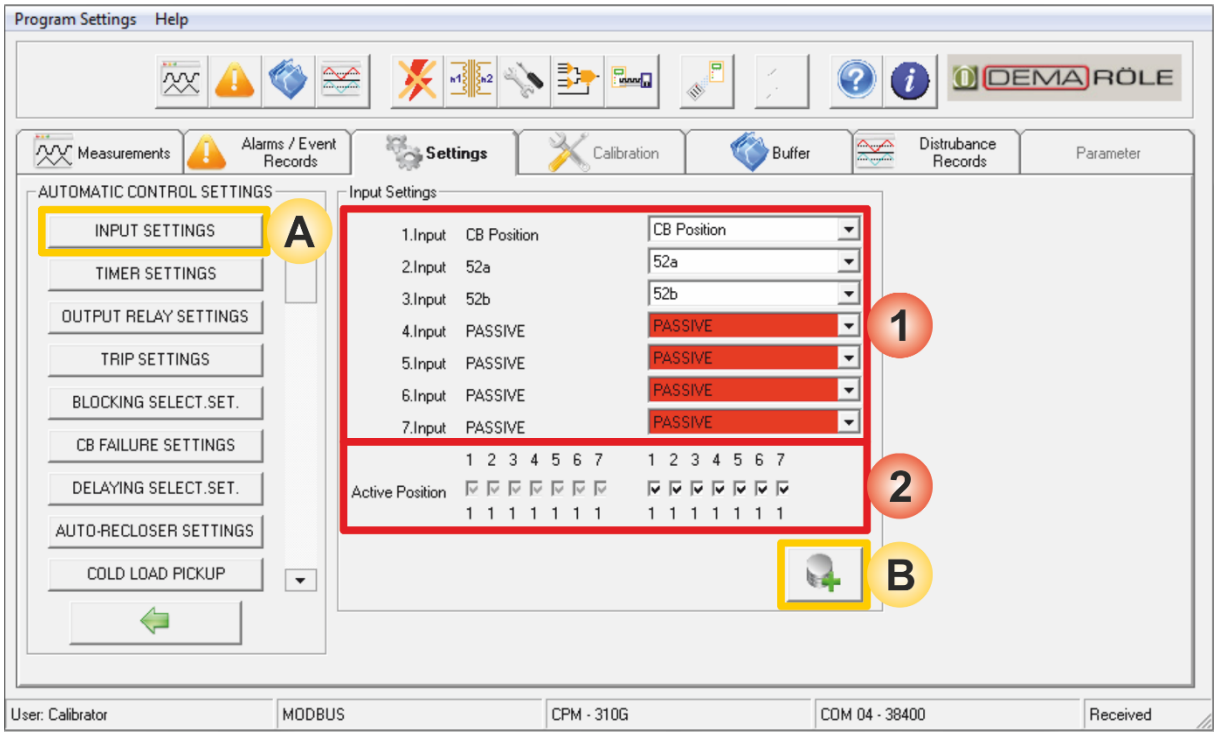


Settings » Automatic Control Settings

1. *Automatic Control Settings* window layout enables full scale access to the automatic control functions of CPM 310 G via DigiConnect program. Menus of automatic control functions that CPM 310 G can utilize are listed below.

    a. Input Settings,
    b. Timer Settings,
    c. Output Relay Settings,
    d. Trip Settings,
    e. Blocking (Logic Selectivity) Settings,
    f. CB Failure Settings,
    g. Delaying Selectivity Settings,
    h. Auto-reclose Settings,
    i. Cold Load Pickup Settings,
    j. CB Supervision Settings,
    k. LED Settings,
    l. Latch Settings,
    m. Alarm Settings.

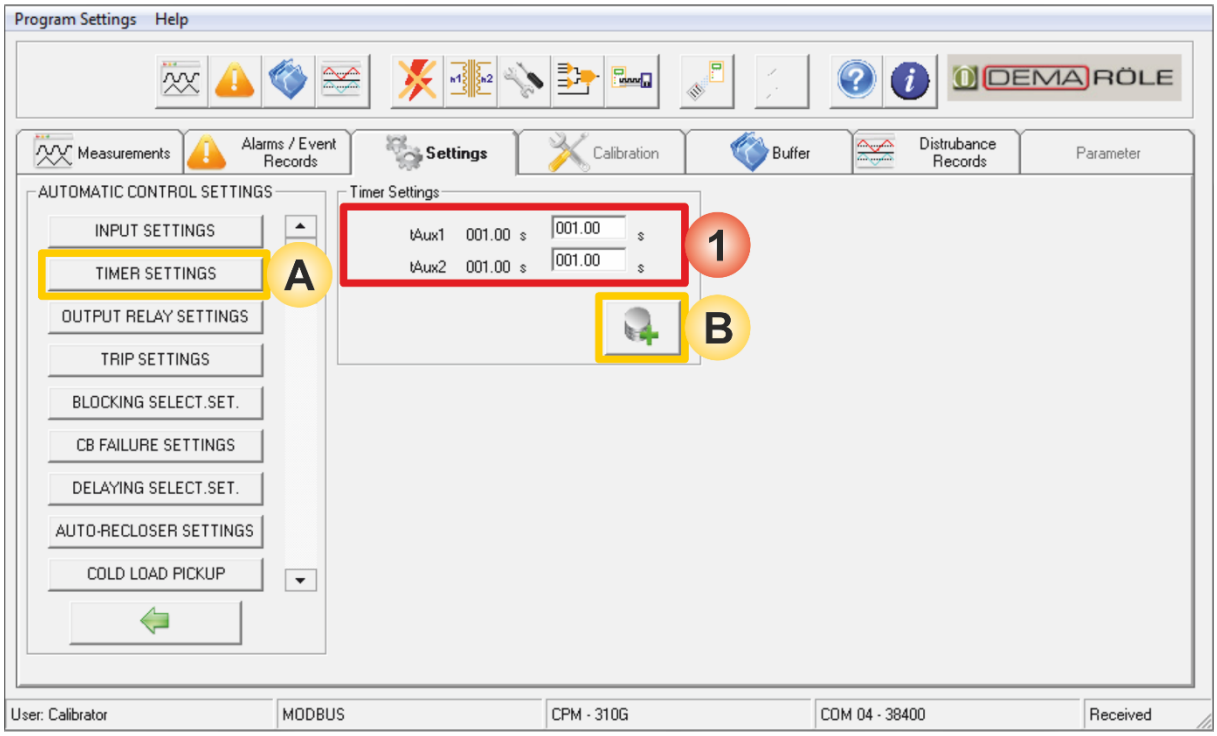
2. *Back* button leads to the *Settings* root menu. □



Settings » Automatic Control Settings » Input Settings

A. *Input Settings* window is accessed by clicking the *Input Settings* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

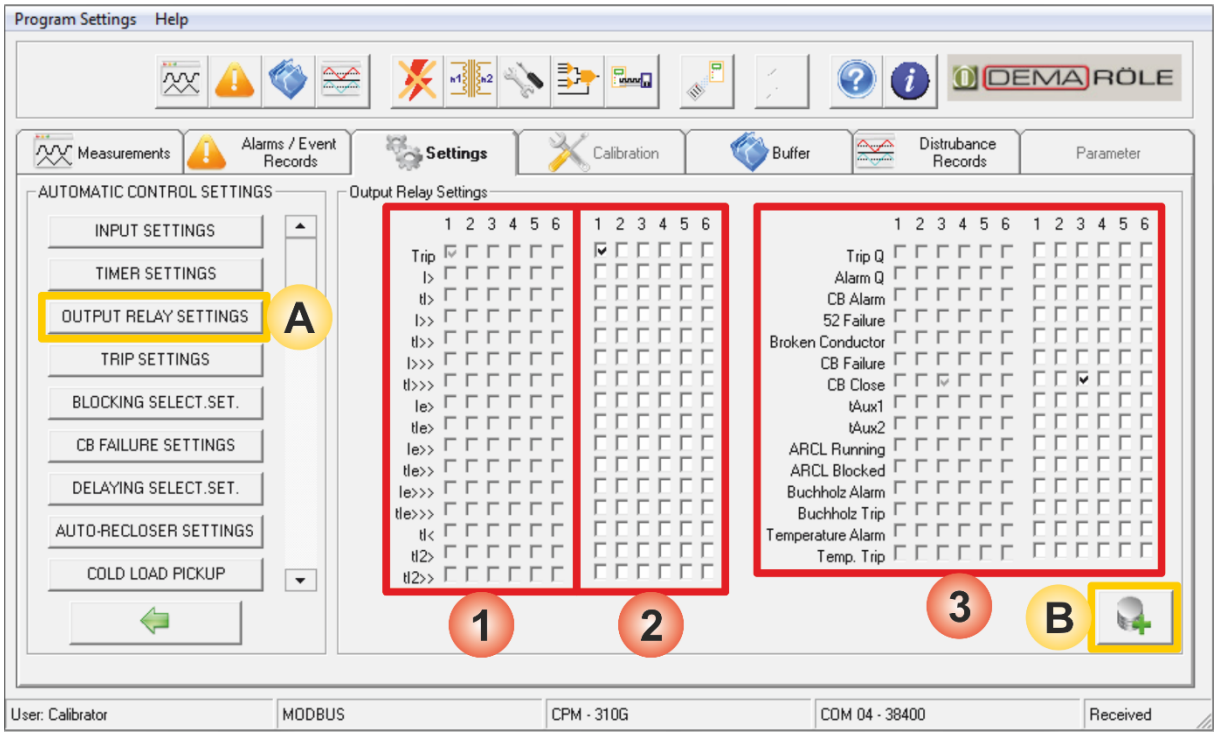
1. As seen on the picture above, functions can be appointed to the 7 programmable inputs of CPM 310 G via *Input Settings* window. The left side of the window shows the input names and current appointments; while combo boxes of available function appointments take place on the right side of the window.
The *Active Positions* window is composed by check boxes that determine the way CPM 310 G evaluates the input signals on the right side of the area, and current settings display on the left side of the area. For the case shown above, CPM 310 G does evaluate the input to be passive as long as there are no signals at the inputs. If any boxes are unchecked and these settings are applied to CPM 310 G; inputs with the changed active position settings will be set to “0”, and will be evaluated as active as long as there are no signals at their terminals. □



Settings » Automatic Control Settings » Timer Settings

A. *Timer Settings* window is accessed by clicking the button with the same title on the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

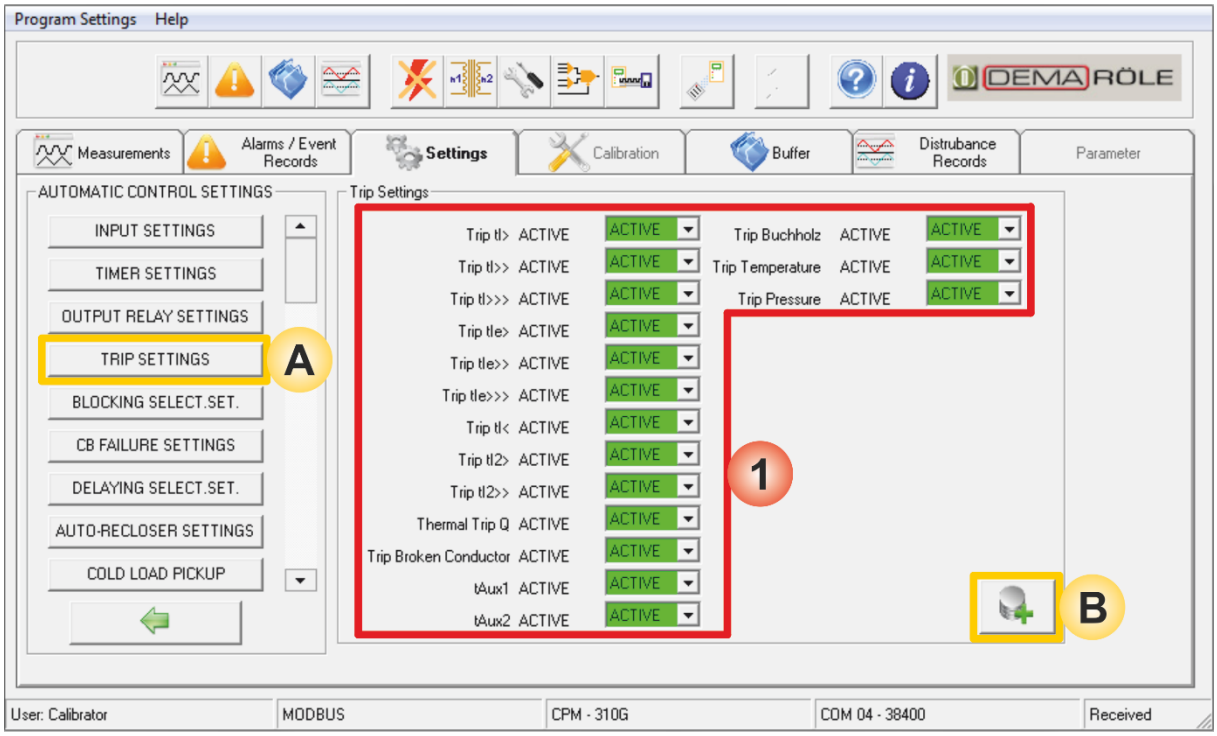
1. *Timer Settings* window houses the existing value indication and parameter editing fields for the 2 independent auxiliary timers embedded within DEMA CPM 310 G. Setting possibilities for both of the timers are (0 – 600) s in 0.01 s steps. □



Settings » Automatic Control Settings » Output Relay Settings

A. *Output Relay Settings* window is accessed by clicking the *Output Relay Settings* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. On the very left of these columns; thresholds (e.g. I> and I_e>), time delay protection functions (e.g. tI> and tI_e>), function status (e.g. *ARCL running*) and CB control functions (e.g. *trip* and *close*) are listed; to the right of this list, current appointments are indicated in columns of boxes, each aligned to the related output numbers. According to the sample picture above, *trip* function is appointed to 1st programmable output.
2. These boxes let the user to assign or cancel assignment of functions to each of the programmable outputs. Note that it is possible both to assign more than one function to a single output, and to assign a single function to more than one outputs.
3. This area is the continuation of the first and second areas, which were just studied on the previous paragraphs. On the above sample window, it is observed that *CB Close* function is appointed to output no.3. □

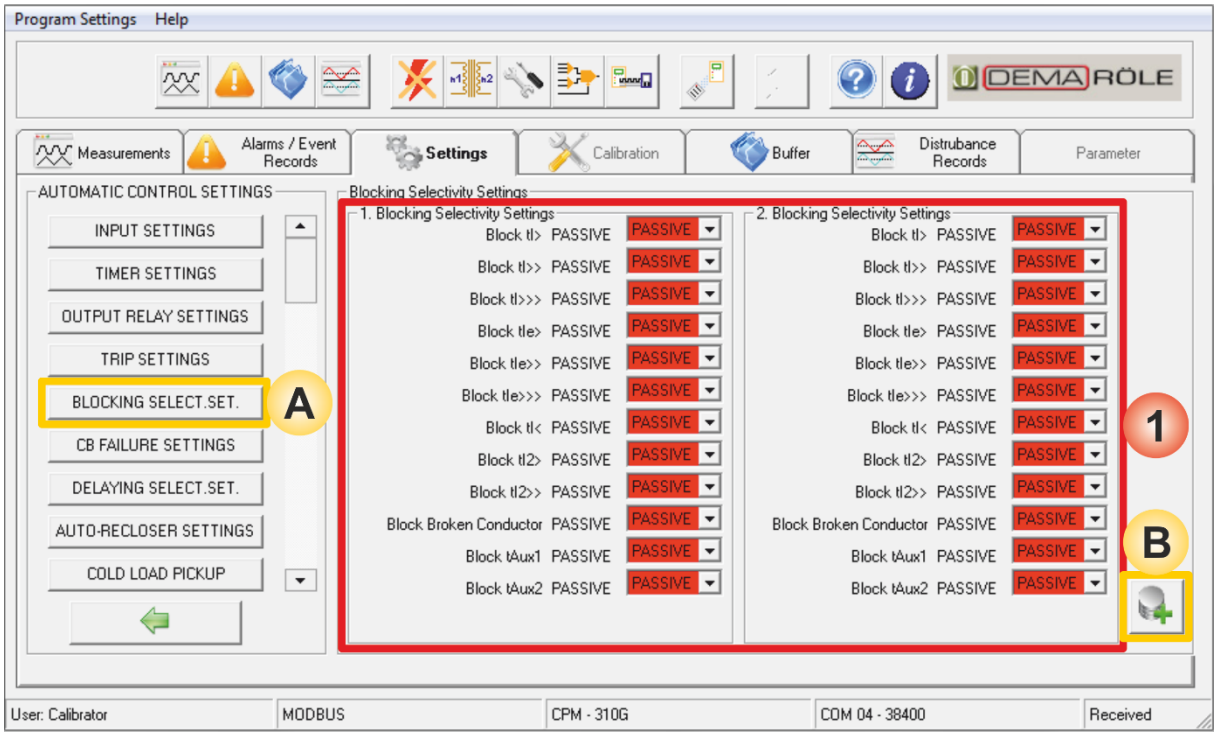


Settings » Automatic Control Settings » Trip Settings

A. This window is accessed by clicking the *Trip Settings* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. Alternatives in the *Trip Settings* window provide the user to choose whether the defined protection functions can trigger a trip process or not. As seen on the picture above, the window gives the protection function titles, the current settings, and *Active* / *Passive* options for the functions to trigger a trip. By default, the settings are made as *Active* so as to provide all functions to trip the CB; if any of the settings are changed the *Passive*, the related functions will still run and generate alarms if predefined conditions occur, but tripping by these functions will be prohibited.

WARNING!
Settings changes made on this menu will directly affect the way CPM 310 G controls the circuit breaker. It is strongly recommended that settings changes are evaluated and made by only authorized personnel! □



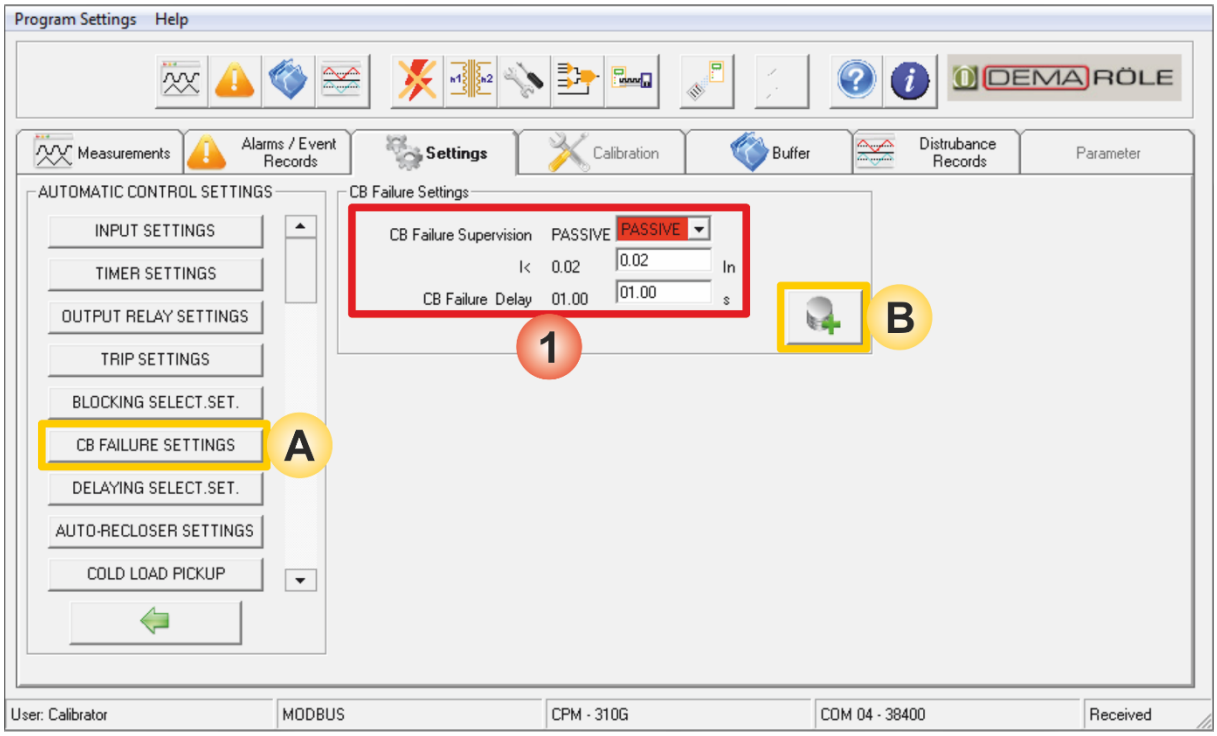
Settings » Automatic Control Settings » Blocking (Logic) Selectivity Settings

A. *Blocking Settings* menu is accessed by clicking the *Blocking Settings* button in the *Automatic Control Settings* window.

B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Blocking (Logic) Selectivity Settings* menu comprises settings of functions to involve in blocking logic selectivity activities. Please see the section named *Blocking Logic Selectivity Settings Menu* in the *Relay Menus Manual* earlier in this book for application and details of the function. Settings on this menu are done the same way on CPM 310 G menus.

   NOTE
   Blocking Logic Selectivity and Delaying Logic Selectivity functions cannot be used together within the same settings group. If for any settings group (e.g. G1) these two functions are both intended to be activated, the earlier function to be set into service will be pushed out of service automatically. □



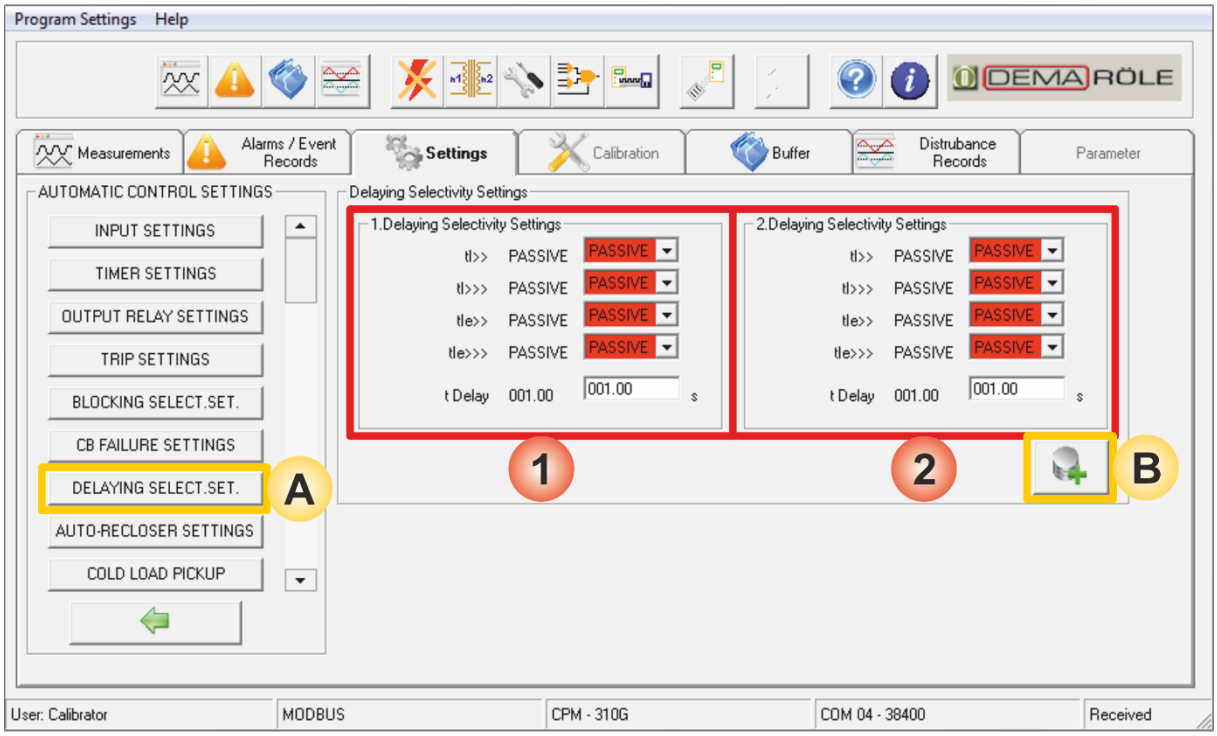
Settings » Automatic Control Settings » CB Failure Settings

A. *CB Failure Settings* window is accessed by clicking the *CB Failure Settings* button in the *Automatic Control Settings* window.

B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *CB Failure Settings* window comprises the control for having the CB protection function into or out of service, as well as parameter setting fields.
   - *CB Failure Supervision*
     This parameter can be set as Active or Passive to have the function into or out of service.
   - *I<: CB Failure Threshold Current*
     I< is the upper limit of the circuit breaker pole current to decide that one or more poles of the circuit breaker has failed to operate normally as the delay time expires. The function watches the *52a* (normally open auxiliary contact of the circuit breaker) input; once the 52a signal is lost, CB failure delay time is counted until the pole current goes below the limit. If the current does not fall down below the threshold value,
     - The function generates an alarm on the *Alarm Menu* and triggers the *Alarm LED* to inform the user, and tells that a *Circuit Breaker Failure* condition is detected, or,
     - If applicable, triggers a dedicated output to start the configured alarming actions.

     I< can be set as low as the current measurement lower limit, which is 0.02 I_n, and is recommended to be set to this value under normal conditions.
   - *CB Failure Delay*
     CB failure delay time decides how long to wait before the measured current above the threshold value is evaluated as a fault. Circuit breaker mechanical operation and arc extinguishing time values differ for various brands and models, however, these values are below a certain value not exceeding 0.1s for modern circuit breakers. Setting this value in the range of (0.05 – 0.1) s would be appropriate for most of the applications. On the other hand, the set value may have to be determined beyond these values for atypical cases.
     It must be noted that, some requirements must be fulfilled for correct operation of this function;
   - A programmable input must be dedicated to this function with *CB Failure Protection* appointment, and The dedicated input must be cabled to a normally open auxiliary contact of the circuit breaker. □

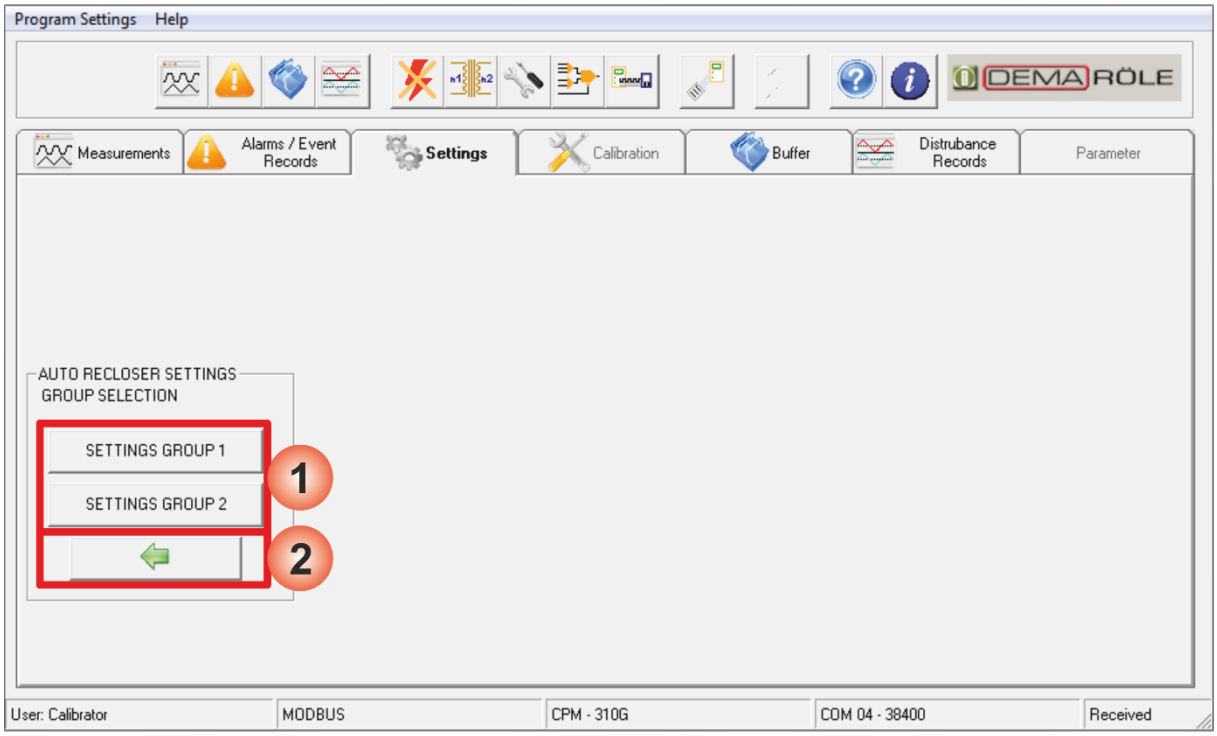


Settings » Automatic Control Settings » Delaying (Logic) Selectivity Settings

A. *Delaying Selectivity Settings* window is accessed by clicking the *Delay Select. Settings* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Delay Selectivity Settings* menu includes settings of functions to involve in delaying logic selectivity actions. Please see the section named *Delaying Logic Selectivity Settings Menu* in the *Relay Menus Manual* earlier in this book for application and details of the function. Settings on this menu are done the same way on CPM 310 G menus.

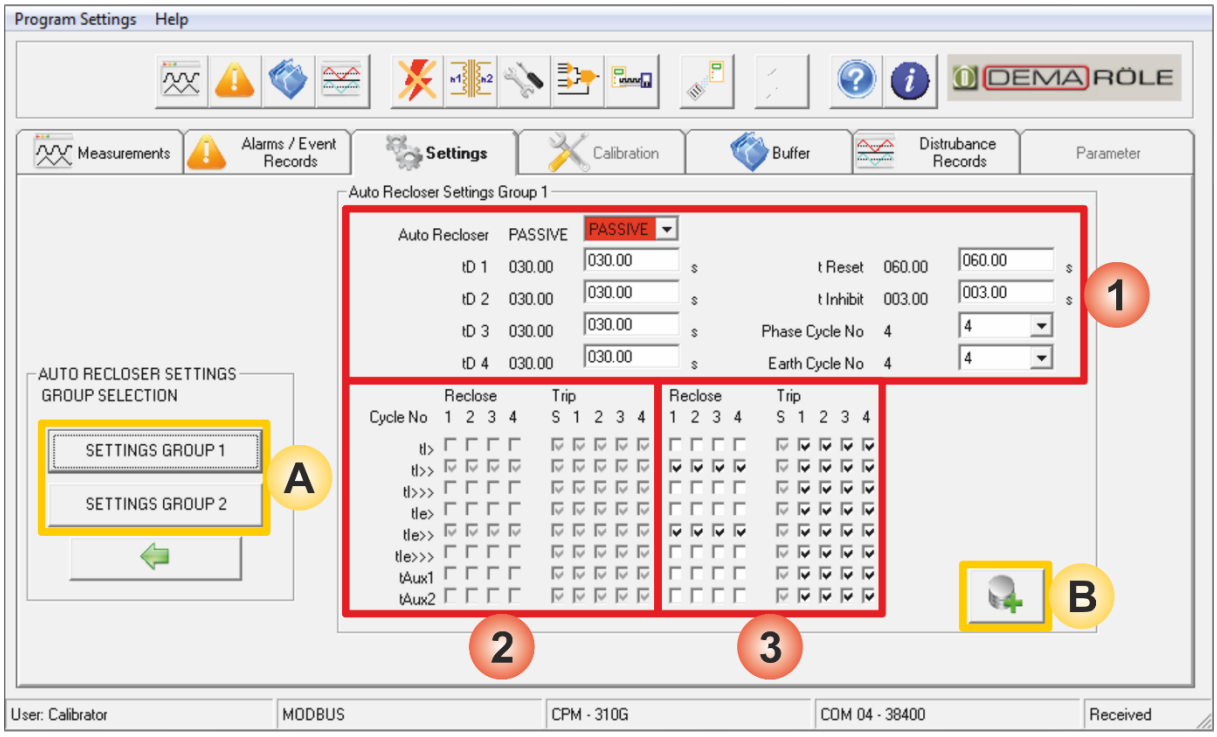
   NOTE
   Delaying Logic Selectivity and Blocking Logic Selectivity functions cannot be used together within the same settings group. If for any settings group (e.g. G1) these two functions are both intended to be activated, the earlier function to be set into service will be pushed out of service automatically. □



Settings » Automatic Control Settings » Auto-recloser Settings

Auto-reclose Settings Group Selection menu is reached when *Auto-reclose Settings* button is hit under the *Automatic Control Settings* window.

1. Auto-reclose settings are done for two independent settings groups, as in the case for protection settings. To access to the *Auto-reclose Settings* menu, a settings group must be selected first at the screen shown above.
2. *Back* button leads back to *Automatic Control Settings.* ↘



Settings » Automatic Control Settings » Auto-recloser Settings » Settings Group 1/2

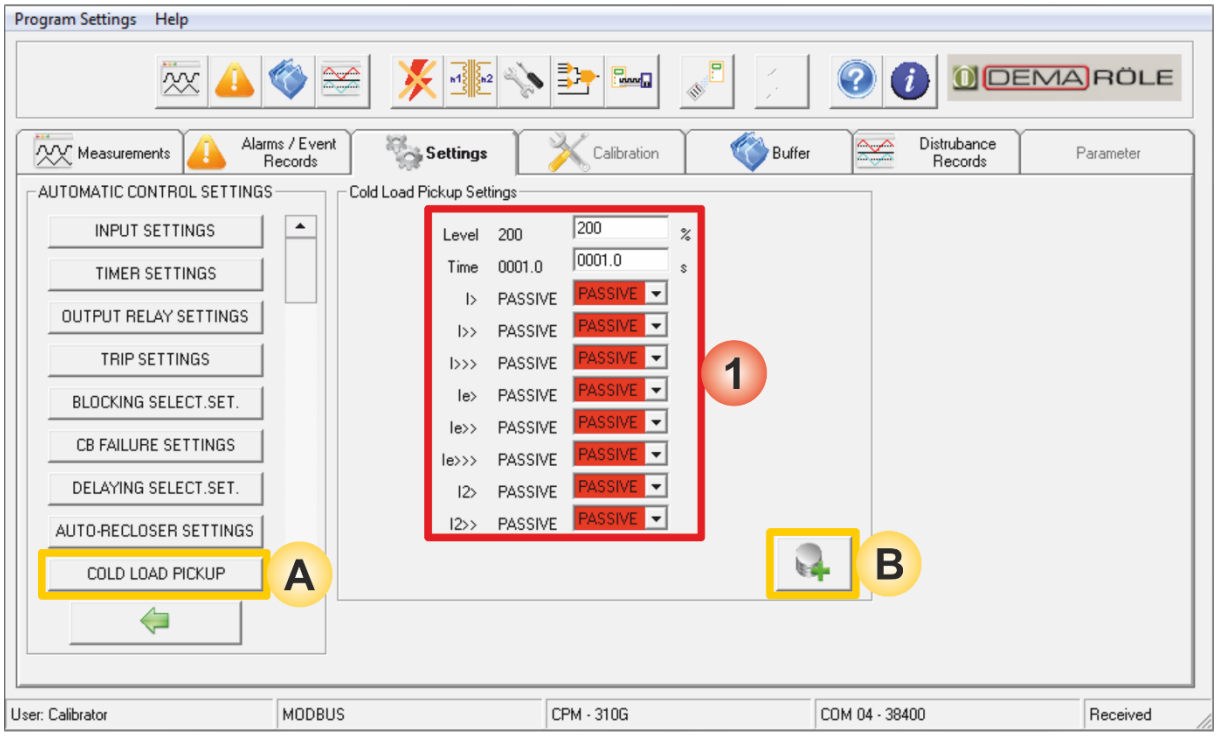
A. Once the group selection is made on the menu appeared by clicking *Auto-reclose Settings* button under the *Automatic Control Settings* window, *Auto-reclose Settings* main menu comes up.

B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. This area comprises functionality and characteristics monitoring and modifying fields for the AR function.
   - *Auto-reclose* parameter is to be set *Active* or *Passive* to have the function into or out of service.
   - *tD1-tD4* parameters are to be set within the range of (0.01-300) s by 0.01s stepping to determine the dead time durations between the auto-reclosing cycles.
   - *tReset* parameter is set within the range of (0.2-600) s in steps of 0.01s to determine when the auto-recloser decides that the network has reached to the normal service conditions after the last successful shot.
   - *tInhibit* parameter is set within the range of (0.2-600) s in steps of 0.01s to determine how long to prohibit triggering of an auto-reclose session after the circuit breaker is closed manually.
   - *Cycle Limits* parameters can be set between 1 and 4 to determine the limits of maximum cycles.
2. This area shows the active settings of auto-reclosing algorithm. The algorithm can be modified via the controls in area 3, as marked on the picture above. See the paragraph below.
3. There are two groups of control check boxes in this area.
   - The first group titled *Reclose* allows the user to decide on which cycles and for which functions an auto-reclosing shot is to be triggered. Note that each box in the matrix is aligned to a protection function on the abscissa and an AR cycle number on the ordinate. The sample settings on the picture above provide 4 cycles of auto-reclosing if tI>> or tI_e>> protection functions trigger a trip.
   - The second group titled *Trip* allows the user to decide on which cycles and for which functions tripping is allowed. Note that there is an extra column of locked check boxes with *S* title, which shows that the initiating trips by protection functions are allowed by default. Prohibition of initial tripping of protection functions are not allowed here.[7] The sample settings on the picture above allow tripping by any active protection functions at all 4 cycles

   Looking at the picture above, it can be concluded that these sample settings allow tripping for any protection functions at any cycles, however, if tripping is triggered by a function other than tI>> or tI_e>> on any of the cycles, the auto-reclose session will be stopped and the auto-recloser will be blocked. □

[7] If anyway tripping by certain active protective functions are needed to be prohibited, utilize the *Trip Settings* menu under the *Automatic Control Settings* menu.

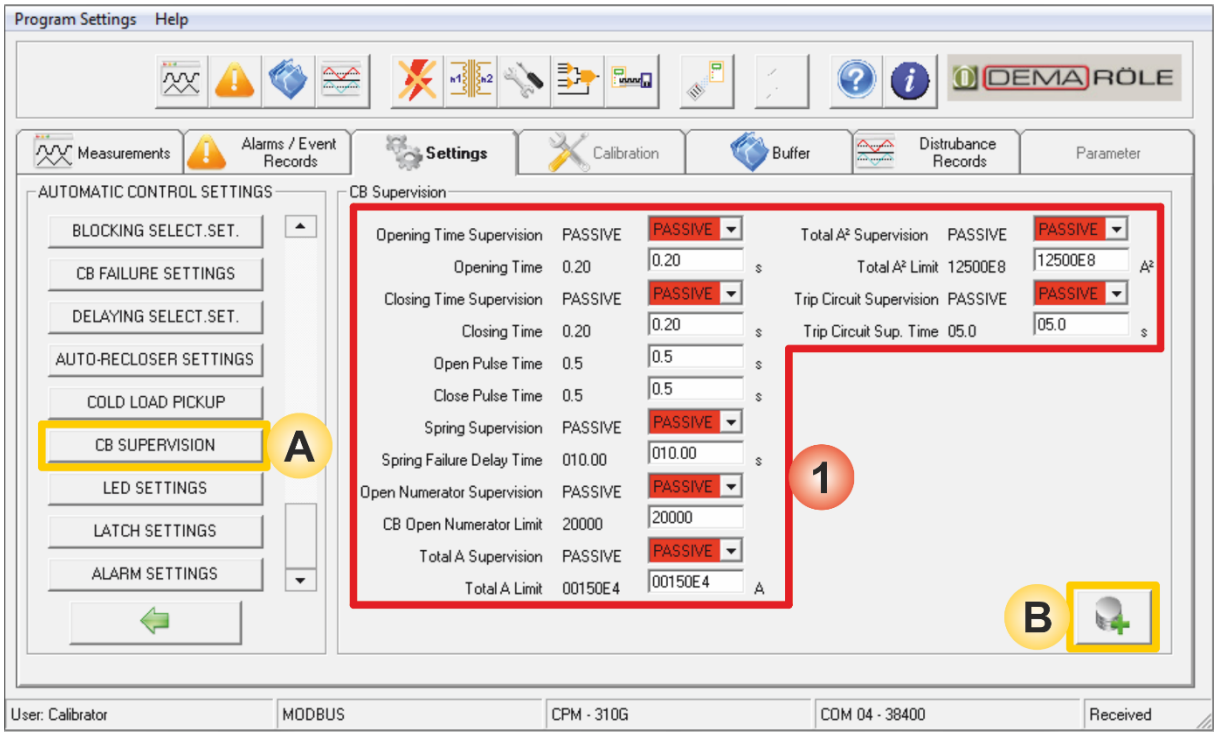


Settings » Automatic Control Settings » Cold Load Pickup

A. *Cold Load Pickup Settings* window is accessed by clicking the *Cold Load Pickup* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Cold Load Pickup Settings* window allows the users to set the functionality and parameter variables via the DigiConnect program. Parameters set on this screen includes:
   - Universal pickup percentage for thresholds,
   - Pickup duration in seconds, and
   - Selection of protection functions to be involved in the pickup functionality.

   For detailed information on the function, see dedicated section *Cold Load Pickup Settings Menu* in the *Relay Menus Manual* earlier in this book. □



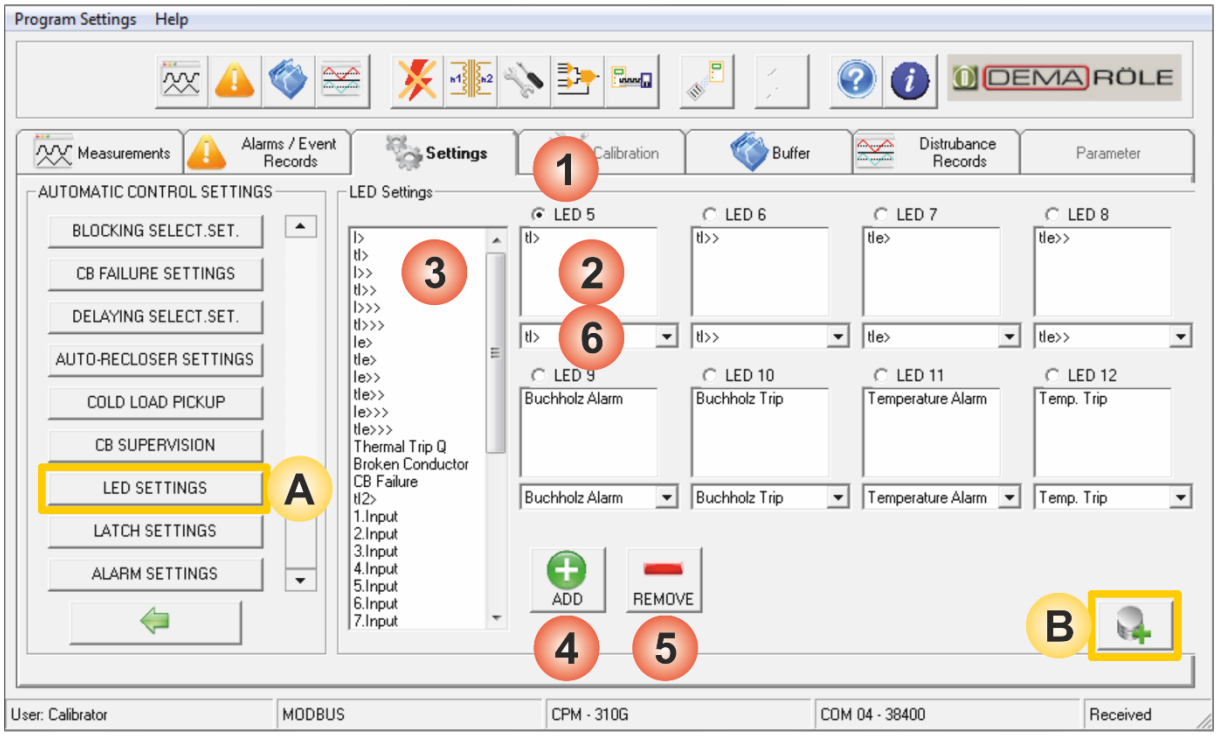
Settings » Automatic Control Settings » CB Supervision

A. *CB Supervision Settings* window is accessed by clicking the *CB Supervision* button in the *Automatic Control Settings* window.

B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *CB Supervision* window allows the users to have the various types of circuit breaker supervision functions into or out of service and set the needed parameters for them. Functions on this menu include:
   - CB tripping time supervision,
   - CB closing time supervision,
   - Trip pulse duration control,
   - Close pulse duration control,
   - CB charging spring supervision,
   - CB trip numerator supervision,
   - Total trip amperes supervision,
   - Total trip amperes-square supervision,
   - CB trip circuit supervision.

2. Please see the section named *CB Supervision Settings Menu* in the *Relay Menus Manual* earlier in this book for applications and details of the function. Settings on this menu are done the same way on CPM 310 G menus. □



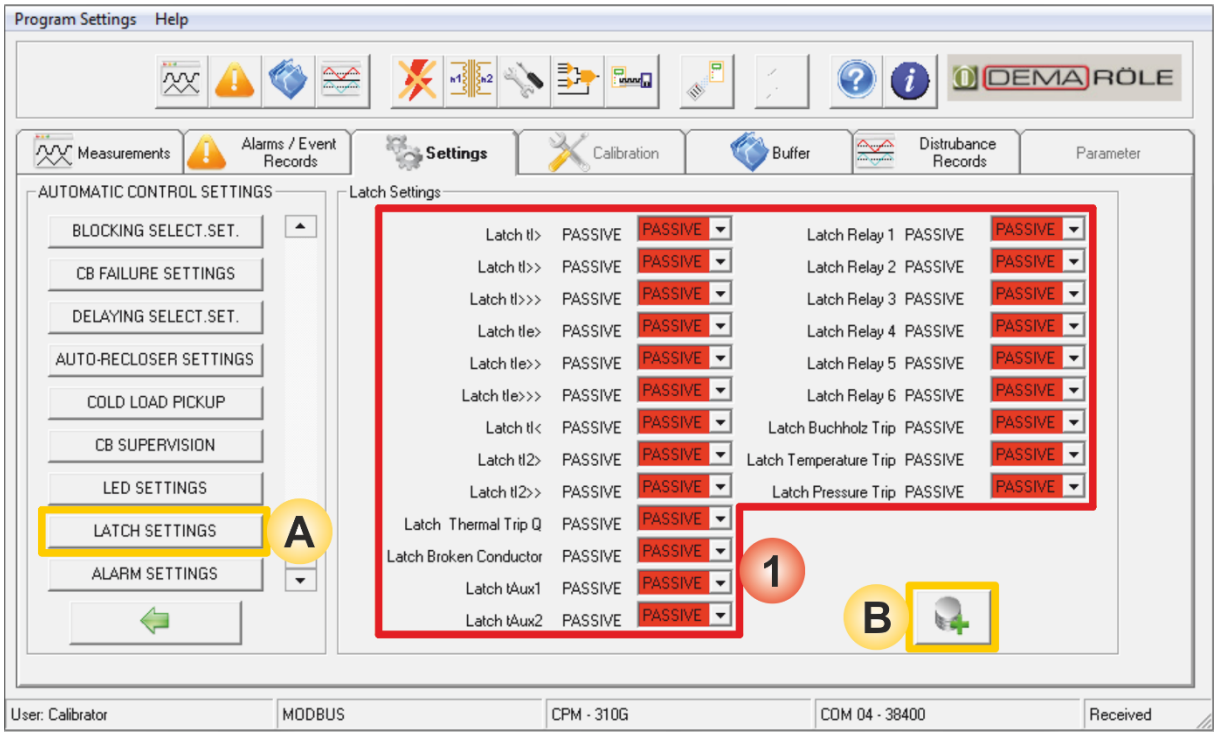
Settings » Automatic Control Settings » (Programmable) LED Settings

A. *LED Settings* window is accessed by clicking the *LED Settings* button in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

LED setting principles have been examined thoroughly back at the dedicated section in the *Relay Menus Manual*. The *LED Settings* window of the DigiConnect program utilizes the same principles, however, the organization of action differ from the CPM 310 G menus. The organization is explained below.

- Programmable LED addresses (1) are given on the top of “appointed functions” list (2).
- To add a function to appointed functions list, any functions are selected from the available functions list (3), and *Add* button (4) is clicked.
- To remove the appointment of a function from a certain programmable LED, the function is selected from the related “appointed functions” list and *Remove* button (5) is hit.
- To modify the displayed title of a programmable LED, a title is selected from the combo box (6) just below the appointed functions list. Note that more than one function can be appointed to trigger a programmable LED, so determining the displayed title of a LED must be done with care to prevent misinterpretations.

It must be kept in mind that the LEDs hereby involved in the explanations are the programmable LEDS on the LEDs Menu, which is accessed by pressing *Reset* button on the front face/cover of CPM 310 G once. □



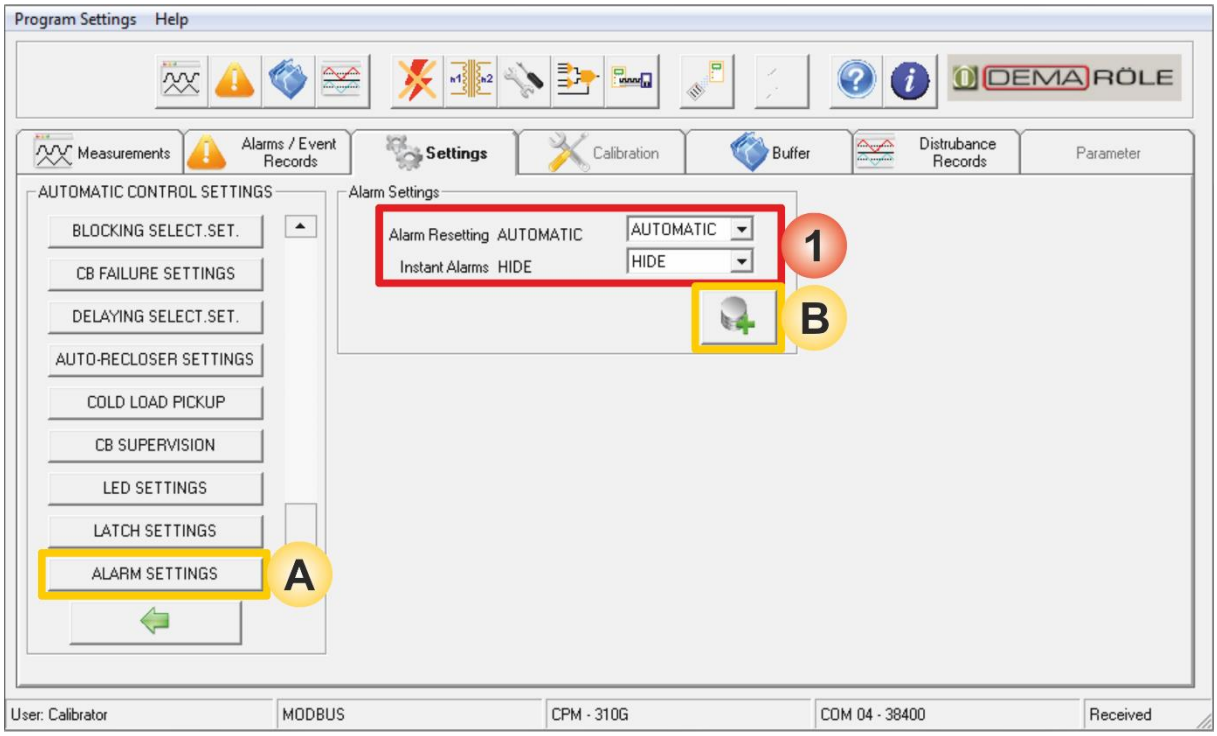
Settings » Automatic Control Settings » Latch Settings

A. *Latch Settings* window is accessed by clicking the button with the same title in the *Automatic Control Settings* window.
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Latch Settings* window gives the users the option to latch:
   - Any of the programmable relays directly, or
   - The trip or programmable relays indirectly via appointed functions with latch option enabled.

   By default, the trip relay and the programmable relays are set to remain closed only for the pulse duration.
   - To leave this condition as it is, the latch settings must be left as already set by default, as shown on the picture above.
   - If the trip relay or any programmable relays are desired to be latched, the appropriate functions must be set to *Active*.

   Note that, if any latch settings are done, latching of the related relays will be active until CPM 310 G is reset. □

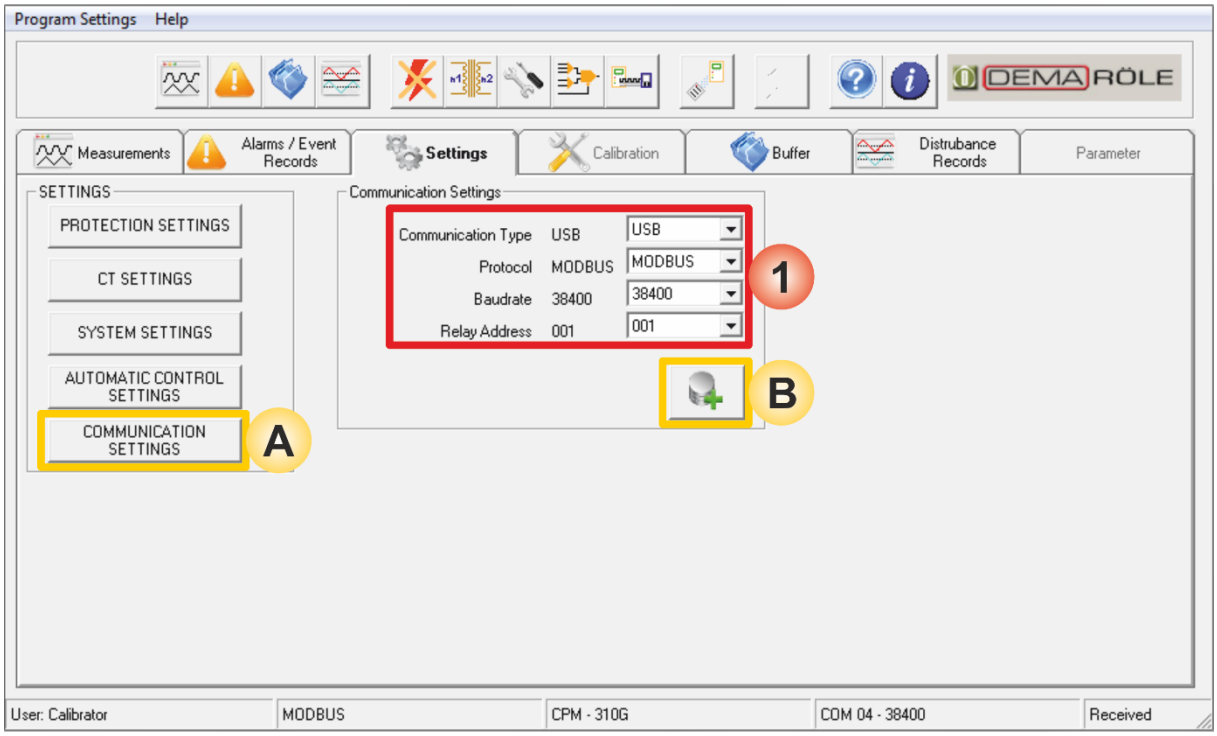


Settings » Automatic Control Settings » Alarm Settings

A. *Alarm Settings* window is accessed by clicking the *Alarm Settings* button in the *Automatic Control Settings* window.

B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Alarm Settings* window provides monitoring of the active settings and editing the following parameters:
   - *Clear Alarm* parameter can be set as *Automatic,* to make the latest alarms delete the old ones automatically, or as *Manual* to leave alarms on the *Alarm Menu* until they are reset manually.
   - *Instant Alarm* parameter can be set as *Hide,* to have the disturbance alarms out of alarming conditions, or *Show* to record and display any irregular events. □



Settings » Communication Settings

A. *Communication Settings* menu is accessed by clicking *Communication Settings* button under the *Settings* tab.

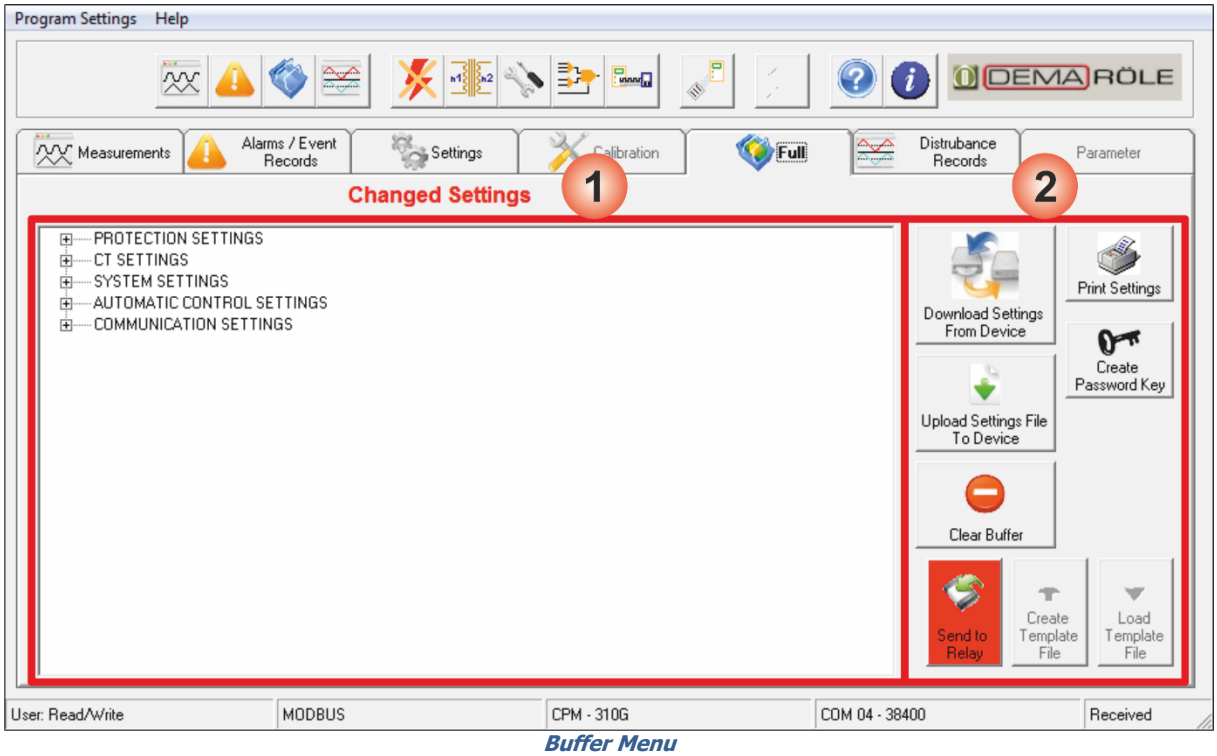
B. *Save to Buffer* button sends the parameter changes to the DigiConnect buffer. When changes are to be applied to CPM 310 G unit, *Save to Device* button must be utilized, which is located under the *Buffer* tab.

1. *Communications Settings* window allows users to view and modify CPM 310 G communications options. The options and available settings are listed below.

- Communication Mode [USB / RS485]
- Protocol [DEMCOM / MODBUS / IEC 60870-5-103]
- Baudrate (Communications Speed) [1,200 / 2,400 / 4,800 / 9,600 / 19,200 / 38,400]
- Relay Address Between 001 and 255.

WARNING!

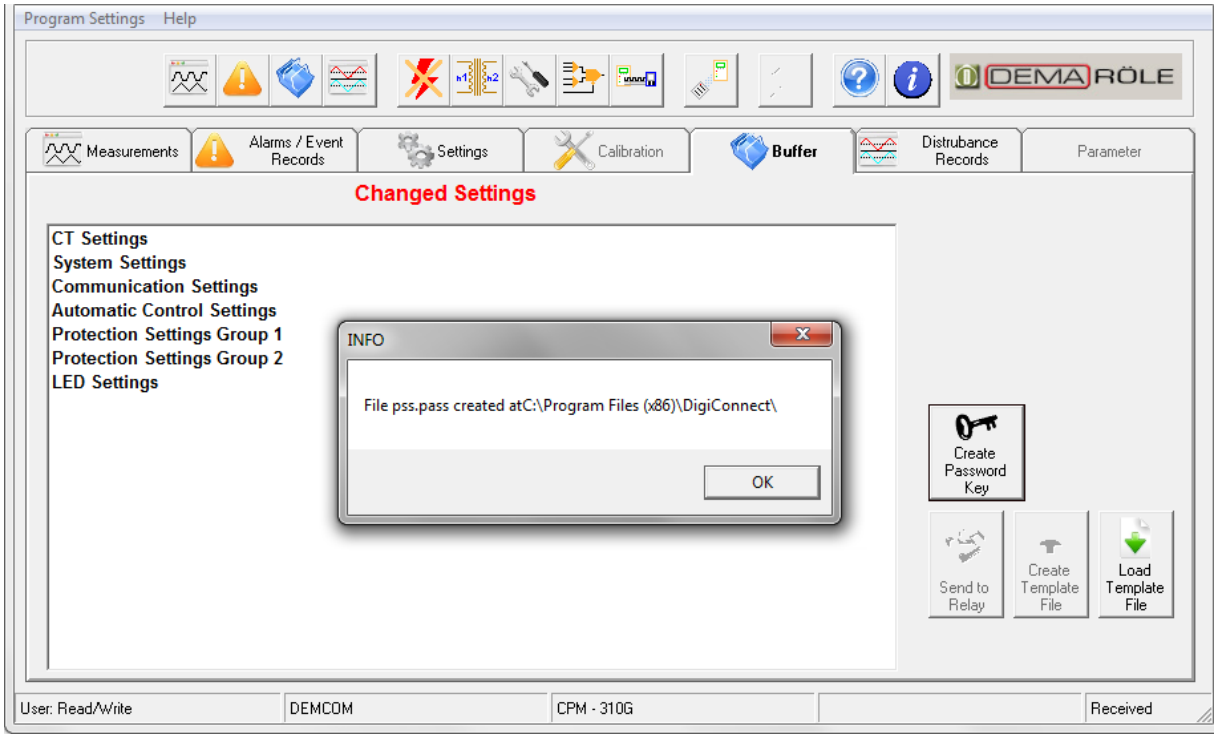
- If communication settings are changed via DigiConnect program, the communication between CPM 310 G and PC will be reset and lost. Restart of the program and reconnection to the CPM 310 G unit with the updated communication settings will be needed to carry on working! □



Buffer Menu

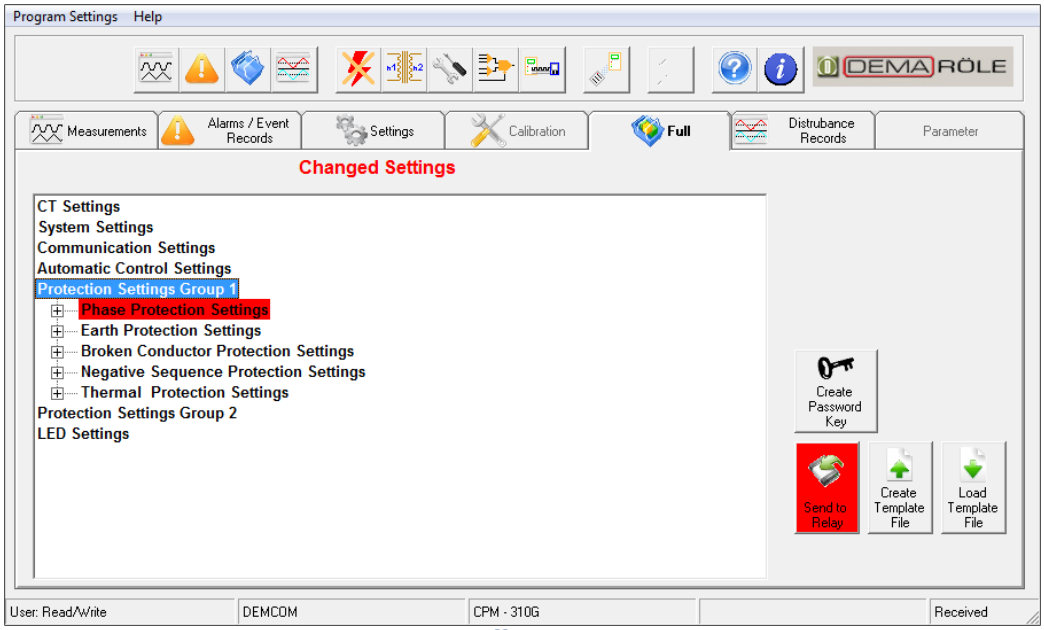
Buffer menu under the tab with same title is unique to DigiConnect program and does not exist on CPM 310 G menus. The reason for that is DigiConnect utilizes a temporary memory field to save the settings changes before loading the settings to CPM 310 G until the changes are confirmed by the user on the *Buffer* menu. *Buffer* menu comprises the following windows and controls.

1. *Changed Settings* window displays the settings changes that are made on the DigiConnect menus and sent to the buffer, but not loaded to CPM 310 G yet. As seen on the picture above, changes or main titles that contain changes are highlighted in red, until they are applied to CPM 310 G utilizing the *Send to Device* control. If the highlighted title is clicked, the title expands to show the specific function that contains the changes. The picture showing the expanded title menu can be found on the next page.
2. The buttons on the bottom right side of the window are used for the following duties:
    a. *Create Password Key* button is used when the password of a CPM 310 G unit is lost. In such a case, the DigiConnect program is launched and connected to the relay with the secure password "1234". When connected to the unit with the secure password, DigiConnect allows no modifications on the relay settings but to create a password key file. When *Create Password Key* button is hit, DigiConnect program creates a password recovery file and saves it to the local disc. When this file is send to DEMA, the password will be recovered and notified to you.
    b. *Send to Relay* button applies the changes made since the last settings update from DigiConnect program. If there are any changes in the DigiConnect buffer to be sent to CPM 310 G, the button is highlighted with red color flashing, while the button remains in passive condition in dim color if there are no modifications to be sent from the buffer.
    c. *Create Template File* button saves the changes made since the last settings update from DigiConnect program to create a file that can manipulate any CPM 310 G units with the same changes in settings. Like the *Send to Relay* button, the *Create Template File* button remains in passive condition in dim color if there is nothing to be saved at the buffer. Note that the template file does not contain all of the relay settings but only the recent settings changes, so as to provide manipulation of certain variables on differently set relays.
    The template file extension is ".tpl".
    d. *Load Template File* button triggers a process to locate and load a previously created changes template file to DigiConnect buffer. In order to apply the content of the file to CPM 310 G, the buffer content must be send to the relay unit using *Send to Relay* button.
    e. While locating a previously created changes file, look for the ".tpl" extension. ↺



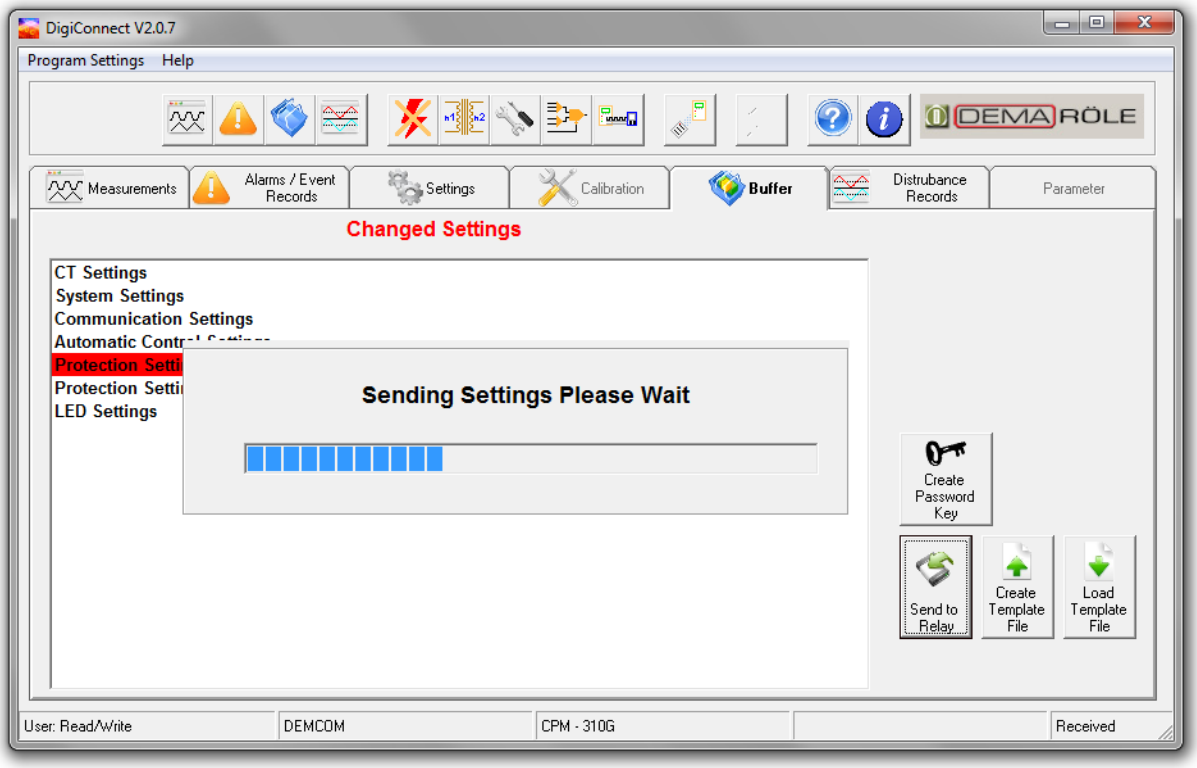
Buffer Menu

The picture above displays the pop-up window when the *Create Password Key* button is clicked. When the button is hit, DigiConnect automatically creates a password recovery file named *pss.pass* and save it in the DigiConnect setup directory.



Buffer Menu

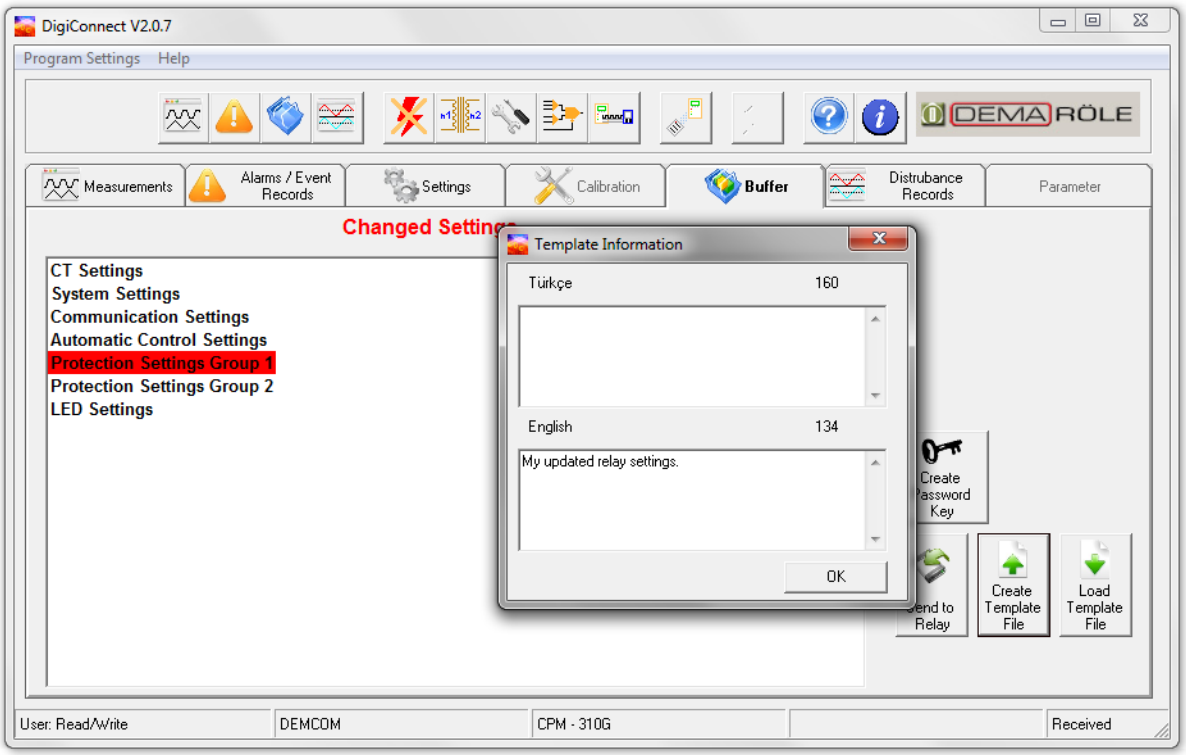
The picture above shows that a setting change (at Phase Protection Settings of Protection Settings Group 1) is done on the PC program, but not has been sent to the device yet. ↺



Buffer Menu

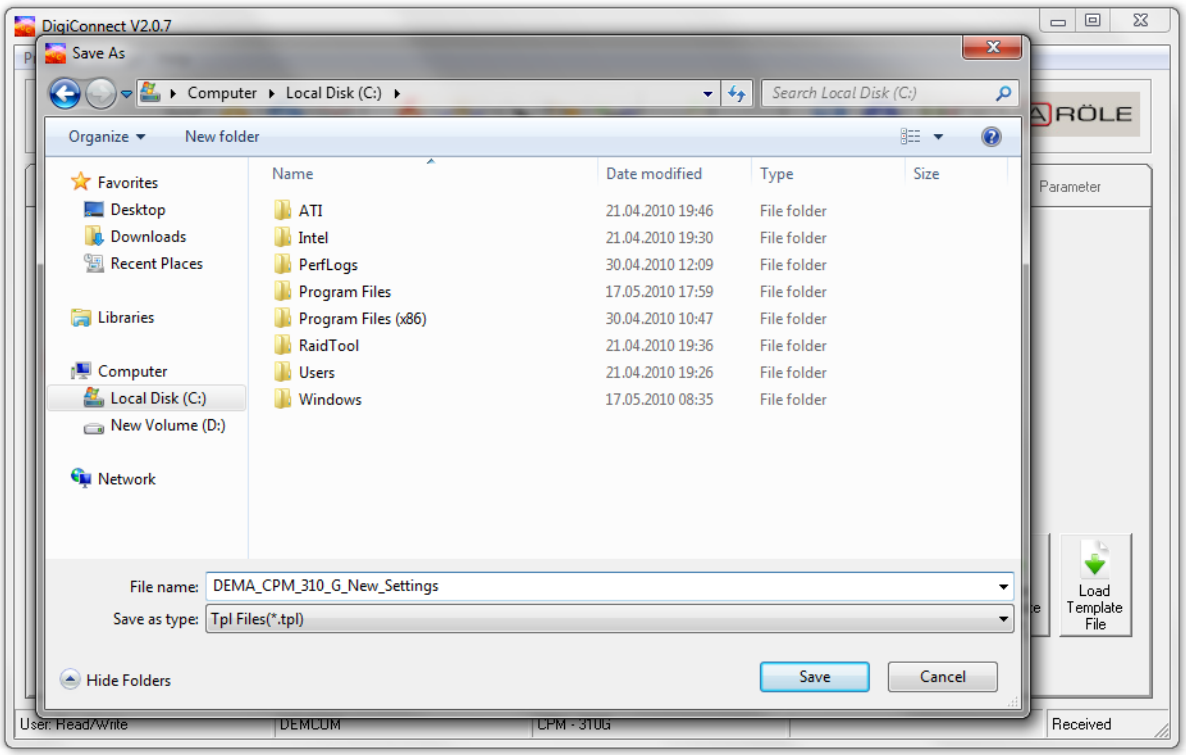
The picture above describes a case that a change on protection settings is made and sent to the buffer. Clicking *Send to Relay* button at this stage will load the changes to CPM 310 G unit, removing the highlights on the *Changed Settings* window and the *Send to Relay* button. *Create Template File* button will also go dim and creating templates will not be possible if done so.

The image above displays the progress interface while the buffer content is being loaded to CPM 310 G. ↺



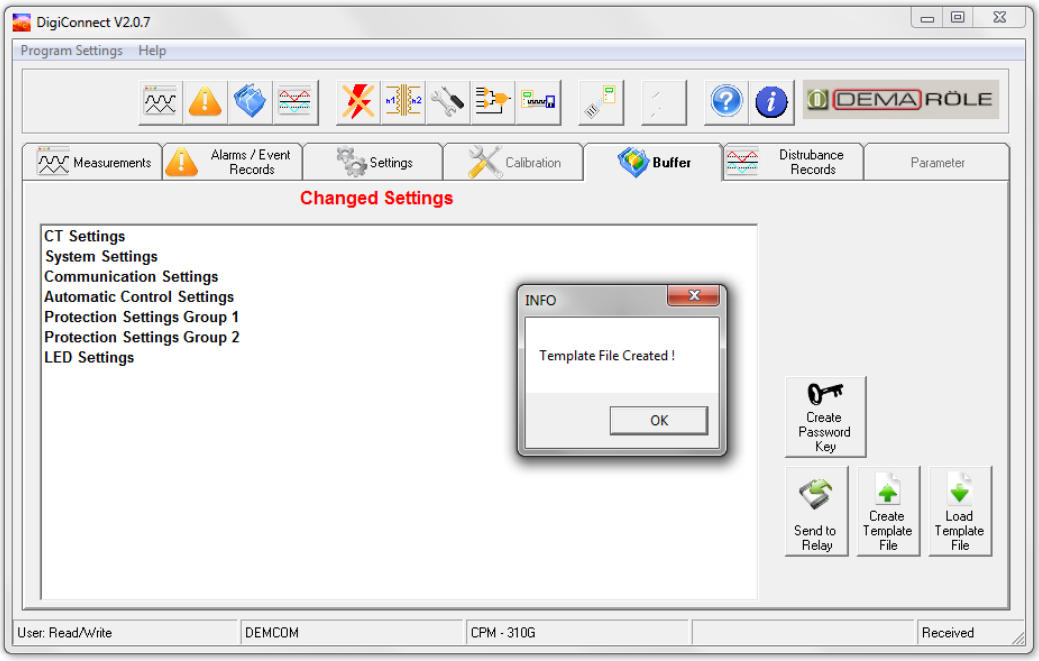
Buffer Menu

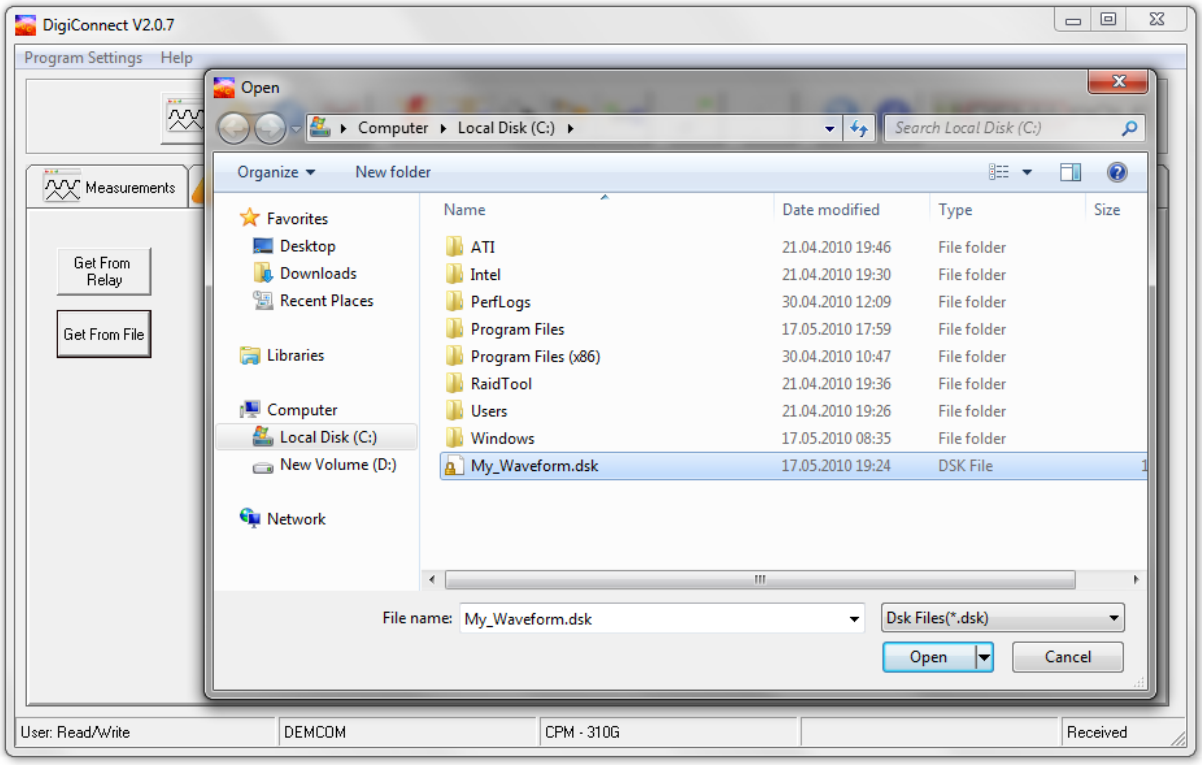
Create Template File button saves the changes made since the last settings update from DigiConnect program to create a file that can manipulate any CPM 310 G units with the same changes in settings. Like the *Send to Relay* button, the *Create Template File* button remains in passive condition and in dim color if there is nothing to be saved at the buffer. Note that the template file does not contain all of the relay settings but only the recent settings changes, so as to provide manipulation of certain variables on differently set relays.
When *Create Template File* button is clicked, the *Template Information* window pops up, as shown on the picture above. Description texts that explain the content of the template file are to be entered here. ↺



Buffer Menu

When the actions on the *Template Information* window are done, OK button is pressed to advance to the next step. The next window is a standard Windows *Save As* dialog box, asking for the file saving name and location. Once the file name and location is decided and OK button is clicked, the template file creation process is completed (see the picture below). If *Cancel* button is pressed at this last stage, the whole process will be cancelled without creating a template file. ↺

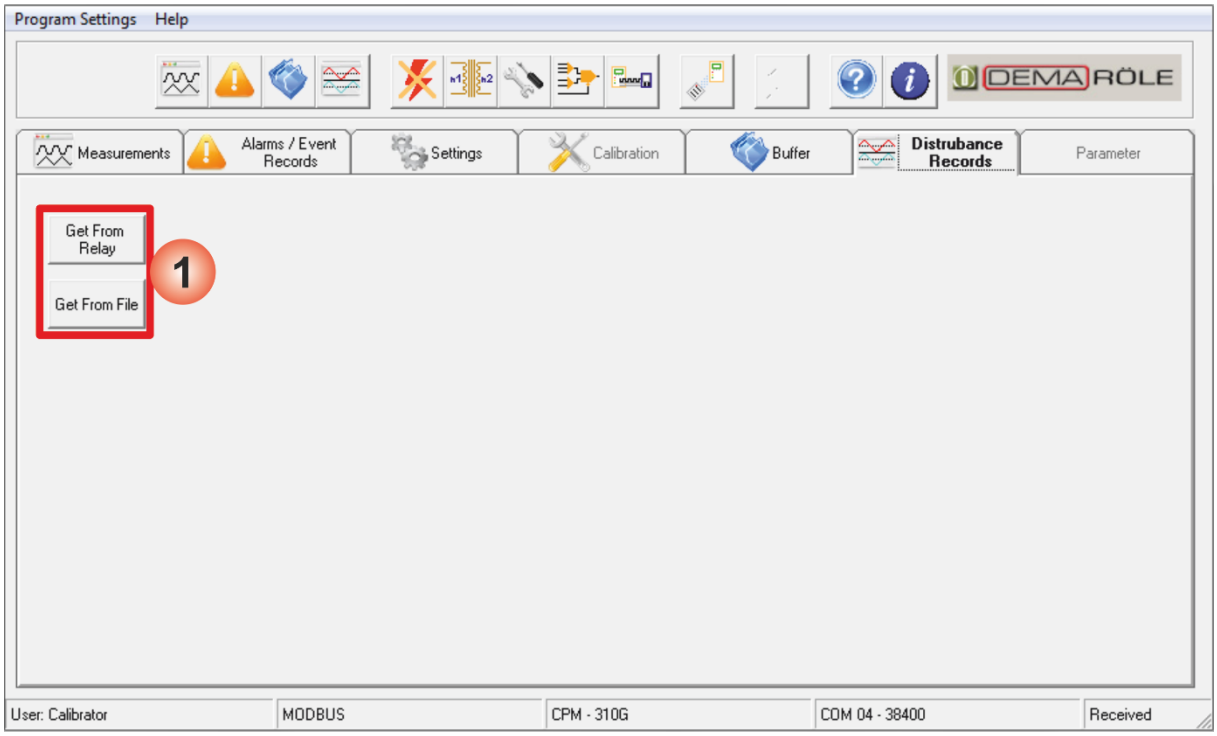




Buffer Menu

Another control button, named *Load Template File*, enables the user to load existing template files to the buffer. Once this is done, the setting changing orders within the file can be sent and applied to CPM 310 G by hitting the *Send to Relay* button.

When the *Load Template File* is clicked, the dialog box shown above pops up asks the user to locate the template file that is intended to be loaded to the buffer. To load the file, user must locate and select the template file, and then press the *OK* button at the right bottom corner of the dialog box. The template loading process can be terminated by pressing the *Cancel* button on the dialog box. □



Disturbance Records

Waveform records provide network administrators important information where supply problems or protection errors occur frequently, protection settings convenience needs to be checked or fault characteristics are to be evaluated in detail. DEMA CPM 310 G presents the users this powerful tool with the following characteristics.

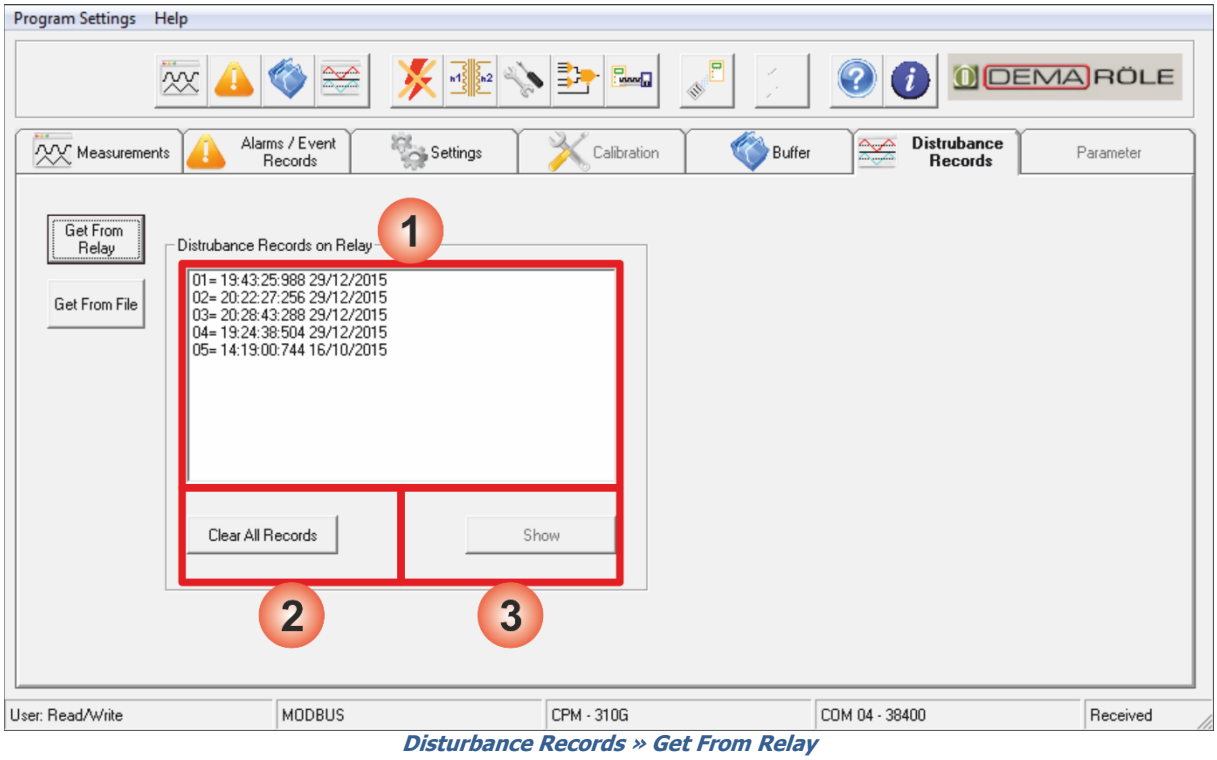
Max. Waveform Records Quantity	5 records
Waveform Record Duration	3 s
Waveform Record Time Structure	0.4 s before trigger 2.6 s after trigger
Measurement Method	RMS current
Monitoring	DigiConnect PC program
Recording Triggers	Recording triggered either automatically by threshold triggers or manually/semi-automatically via an input with *Start Waveform Recording* appointed.

Waveform records are presented as long duration and high resolution graphics therefore cannot be visualized on the graphics display, DigiConnect PC program needs to be utilized instead.

As seen on the picture above, the initial window of waveform record controls brings up two options.

- The first option is to download and display waveform records from CPM 310 G memory, using the *Download from Device* button.

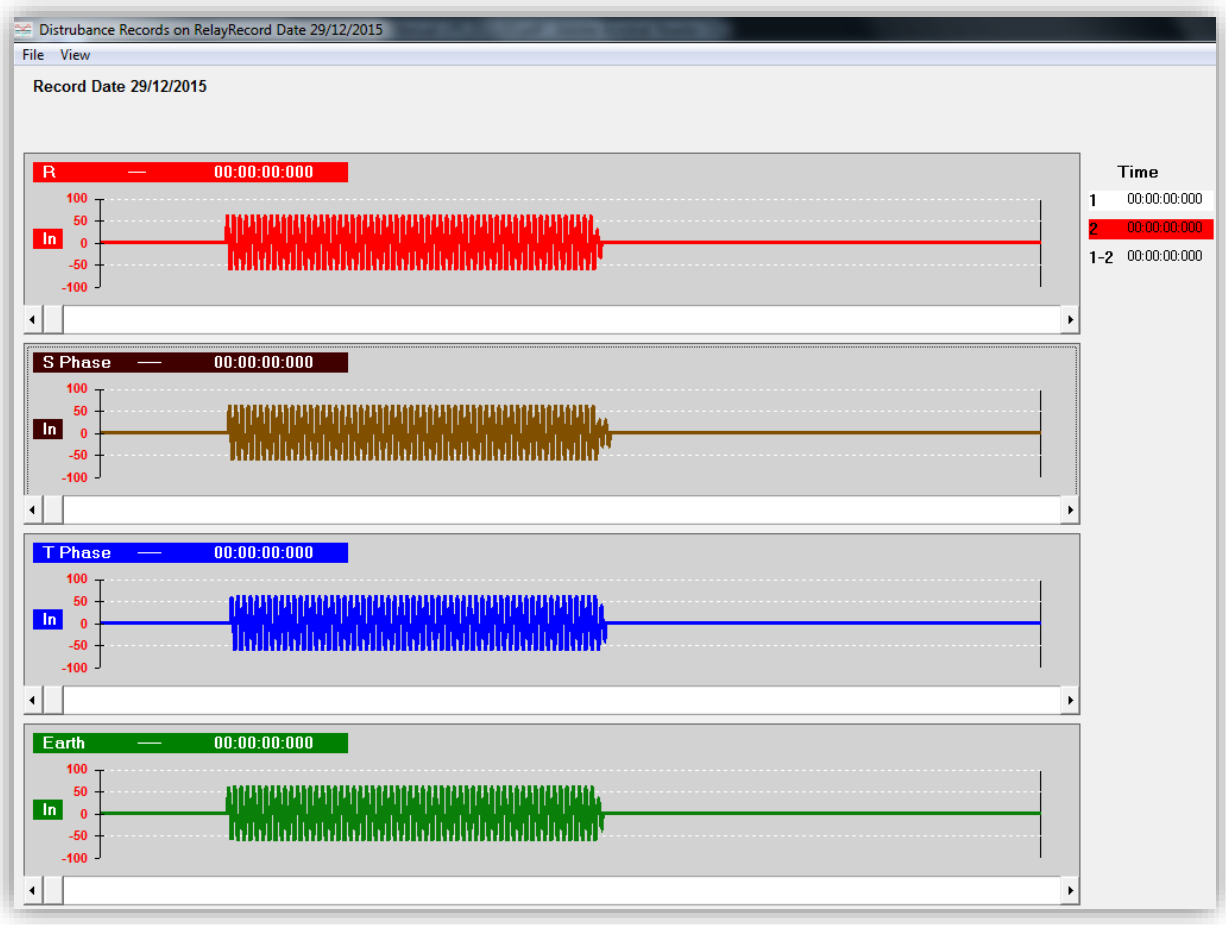
The alternative option is to locate and download saved waveform record archive files from the local disc. Waveform records can be saved to and reloaded from the local PC hard drives as .dsk format archive files. ↺



Disturbance Records » Get From Relay

The first option to view the waveform records is to download and display waveform records from CPM 310 G memory, using the *Get from Relay* button. The picture above displays a sample screen that *Get from Relay* button leads to.

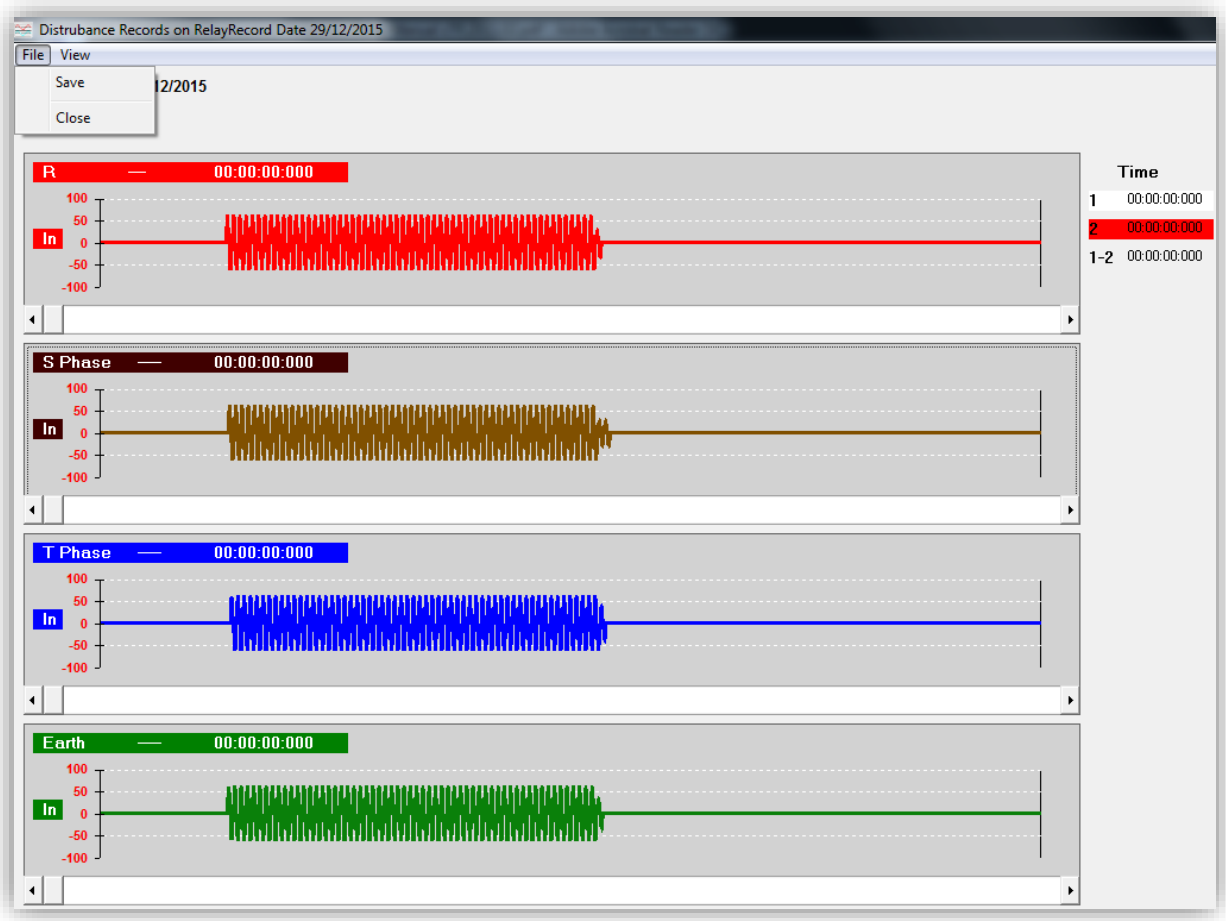
1. *Disturbance Records on Relay* window displays the waveform records on CPM 310 G memory, stamped with recording time information in *hour : minute : second : millisecond, day / month / year* format.
2. *Clear All Records* button deletes all the records existing on CPM 310 G memory. Before taking this action, it must be understood that this process is irreversible and all records that are not archived will be permanently lost. Note that CPM 310 G automatically overwrites old records when the dedicated memory is full, so manual memory cleanup is not necessary under normal conditions.
3. *Show* button downloads the data of selected record and launches a new window to display the contents of the waveform record. The download process takes up to 2 minutes for each record via RS232 communication. ↺



Disturbance Records

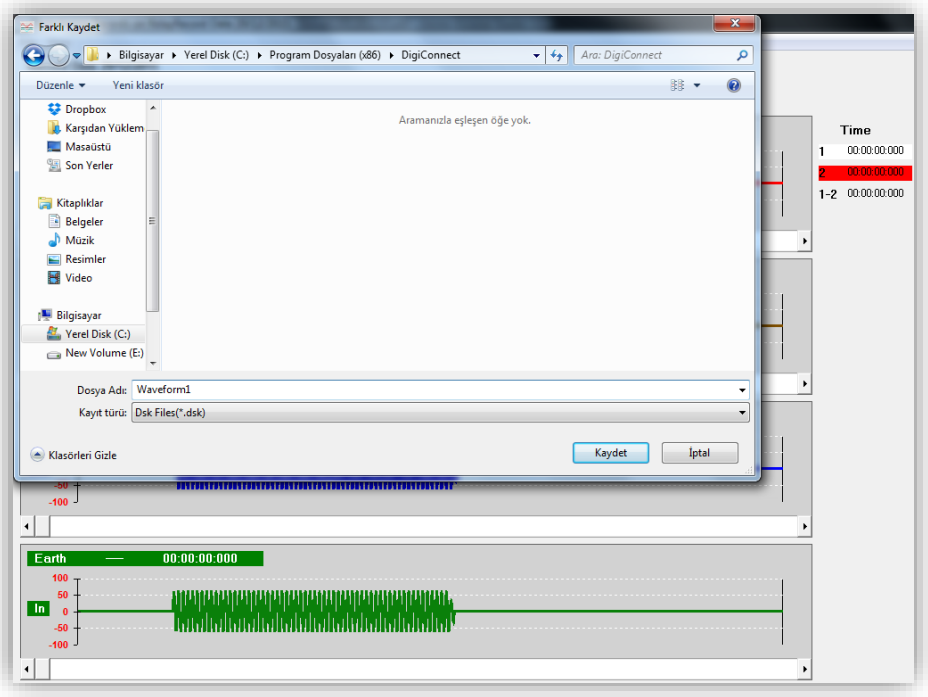
Once one of the existing records is selected and *Show* command is given, DigiConnect downloads the requested data from CPM 310 G to its temporary memory field. Then the downloaded data is processed to form the user interface *Disturbance Records on Relay*, where waveforms and viewing commands are displayed. On the top left side of this new pane *File* and *View* menus are located. Just below these menus, the record time stamp is displayed, and below the stamp, 4 current-time graphics take place which belong to the R, S, T phases and earth in order. Time monitors which are to be used with time-sticks are located on the right side of the pane.

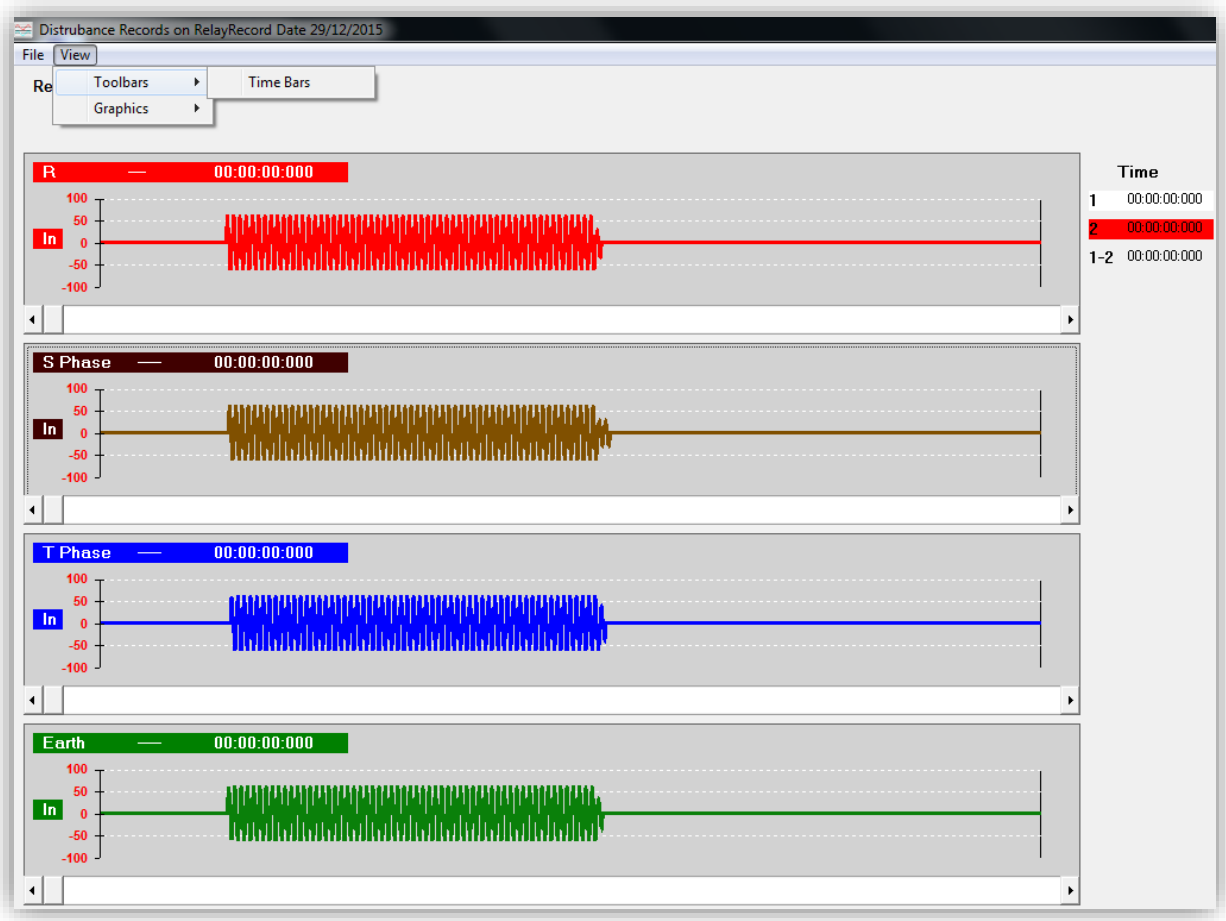
The *Disturbance Records on Relay* is introduced on the paragraph above and will be examined thoroughly in the following pages. ↺



Disturbance Records

The *File* menu on the top left side of the pane embeds the *Save* and *Close* commands. *Save* command launches the archiving process of the loaded waveform record (shown below), while *Close* command terminates the *Disturbance Records on Relay*. ↺



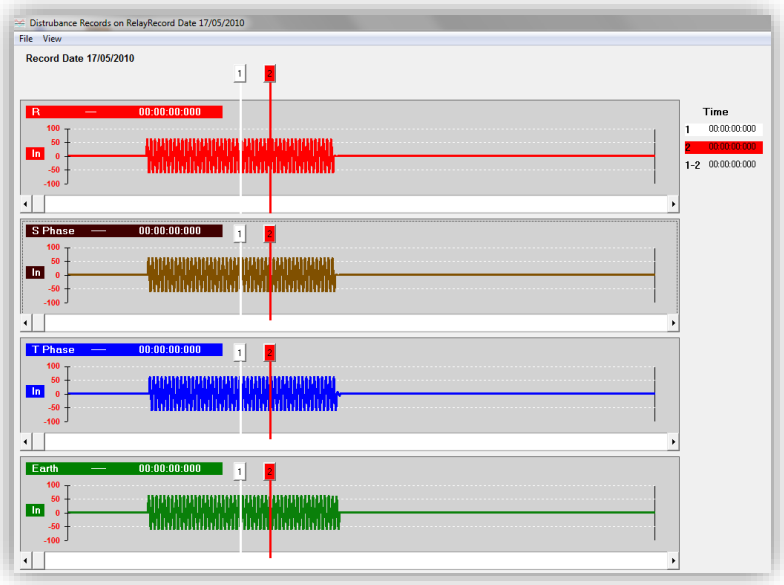


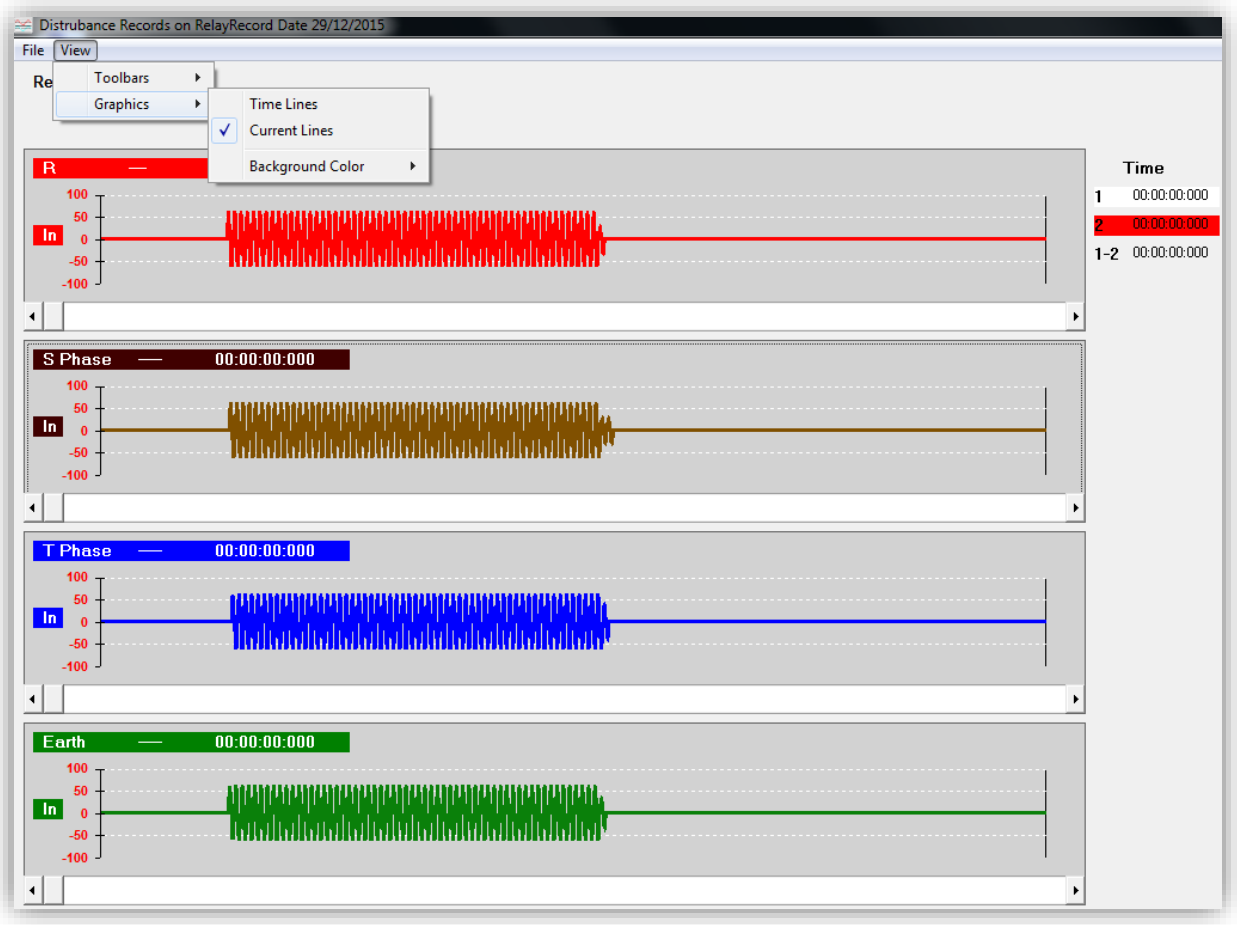
Disturbance Records

The *View* menu on the top left side of the pane embeds two sub-menus:

1. Toolbars,
2. Graphics.

Toolbars submenu contains the *Time Bars* command, which activates two time sticks for each current-time graphics. Time bars allow the user to measure time between any two desired points (shown below). ↺





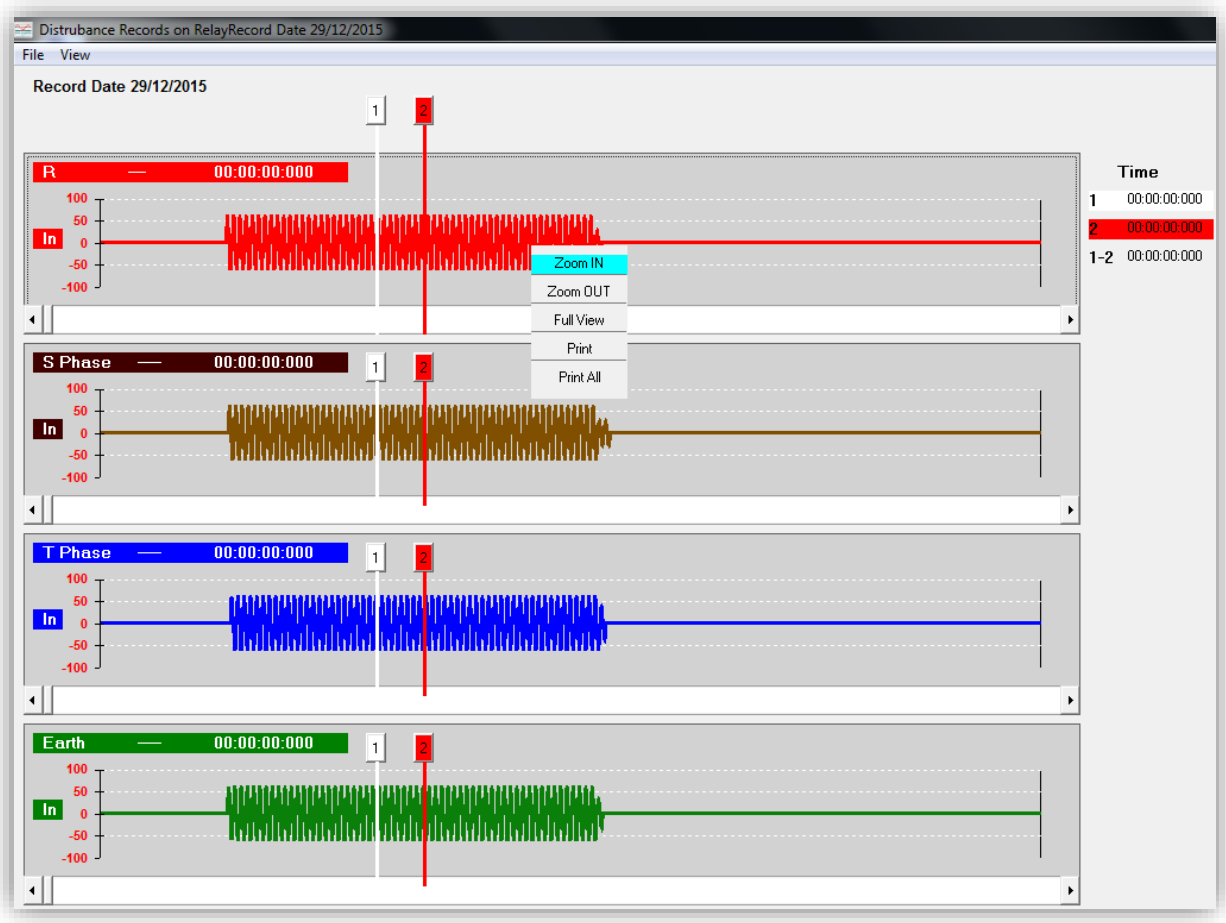
Disturbance Records

Time bars behave independent on all current-time graphics. The bars are titled as “1” and “2”, and are positioned freely by clicking on the title and then clicking on an alternative point on the graphic. When the bars are moved, the time monitors on the right side of the screen display:

- The actual time abscissa where the sticks are moved to, and
- The time interval between the bars.

By utilizing these time bars, any time measurements can be achieved; e.g. system reaction time to a fault current.

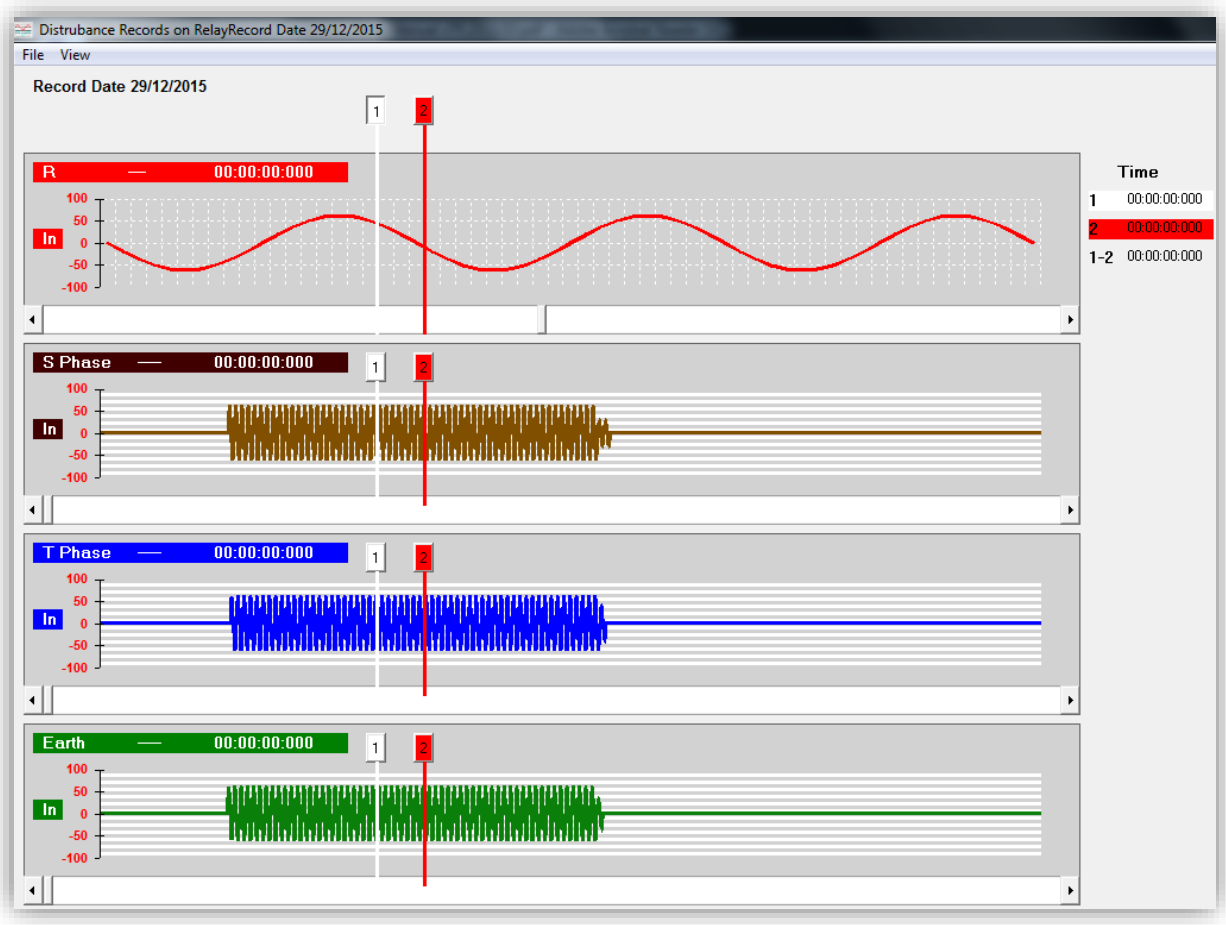
The other sub-menu of the *Layout* menu is the *Graphics* sub-menu. *Graphics* sub-menu comprises commands to display or hide 1 ms time lines and current lines, or switch the background color between white, grey and black. ↺



Disturbance Records

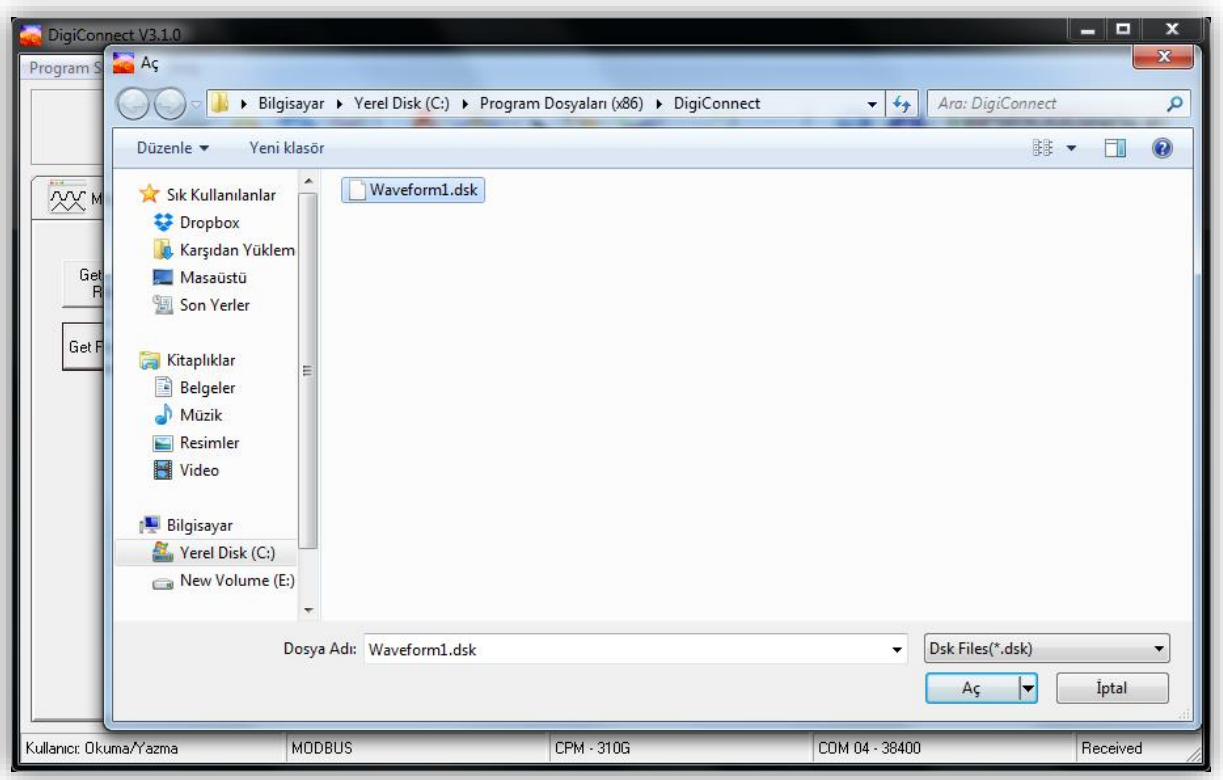
When right-clicked on any point of one of the waveform graphics, a menu with 5 commands appears, as seen on the picture above. The commands and their duties are explained below:

- **Zoom In** Activates the zoom in tool. When the tool is activated, each right click on the graphic will zoom in to display a narrower range of the waveform.
- **Zoom Out** Activates the zoom out tool. When the tool is activated, each right click on the graphic will zoom out to display a wider range of the waveform.
- **Full View** This command is used for displaying the whole 3 seconds of the waveform record on the current-time coordinate system.
- **Print** Prints the active waveform graphic.
- **Print All** Prints all 4 of the waveform graphics. ↺



Disturbance Records

On the picture above, it is observed that phase R waveform graphics is zoomed in to display approximately 3 cycles of the current wave. Note that the 1ms time lines are activated via *Layout » Graphics » Time Lines* command. ↺



Disturbance Records » Get From File

The second option to view the waveform records is to download and display waveform records from the local PC drives, utilizing the *Get From File* button. The picture above displays a sample screen that *Get From File* button leads to.

To download and display waveform records from a local drive:

- Waveform archive files with ".dsk" extension must exist and be located on the drive,
- The file must be selected and opened from the *Open* dialog box that appears when the *Get From File* command is given.

Once the file is loaded to DigiConnect temporary memory field, the pop-up pane is managed the same way as described for *Get from Relay* procedure. □

APPLICATION DIAGRAMS

ON THE USE OF APPLICATION DIAGRAMS

The cabling of CPM 310 G varies by the application. All applications need the *Fundamental Cabling Diagram,* given at p.193; however, protection applications on power transformers, motors or overhead lines requiring different schemes and functions will need numerous types of additional application diagrams.

Application diagrams that may be required to realize these various protection applications are given on the following pages. Appropriate diagrams can be selected and merged to form a master diagram; by using this modular method, it should be easier to derive any desired diagrams suitable for a given application. Utilize the *Use of Application Diagrams With Respect to Functions* table given at p.192 to form your own master diagram.

SAMPLE APPLICATION

It is required that, the protection and alarming system of an oil-immersed type power transformer with characteristics 2,500 kV·A, 34.5 kV / 0.4 kV, 50 Hz is to be done, using DEMA CPM 310 G. Protection current transformers are selected as type 5 V·A, 5P20, (60/5)A [8]. System must be configured so that the CB control can be done via relay menus, CB position indication is monitored on the relay; additionally, it must be alarmed by means of an acoustic announcing system if by any reason the relay is out of service or auxiliary supply failure occurs.

To create a master diagram that fulfills these requirements, *Use of Application Diagrams With Respect to Functions* table has been utilized and the following information has been acquired:

- Like for any application, *Fundamental Cabling Diagram* must be used.
- To provide CB control and position monitoring via CPM 310, *Application Diagram No.3* is needed.
- Protection and alarm contacts existing on a 2500 kV·A, 34.5 kV / 0.4 kV power transformer is listed below.
    - Buchholz Alarm,
    - Buchholz Trip,
    - Thermometer Alarm,
    - Thermometer Trip,

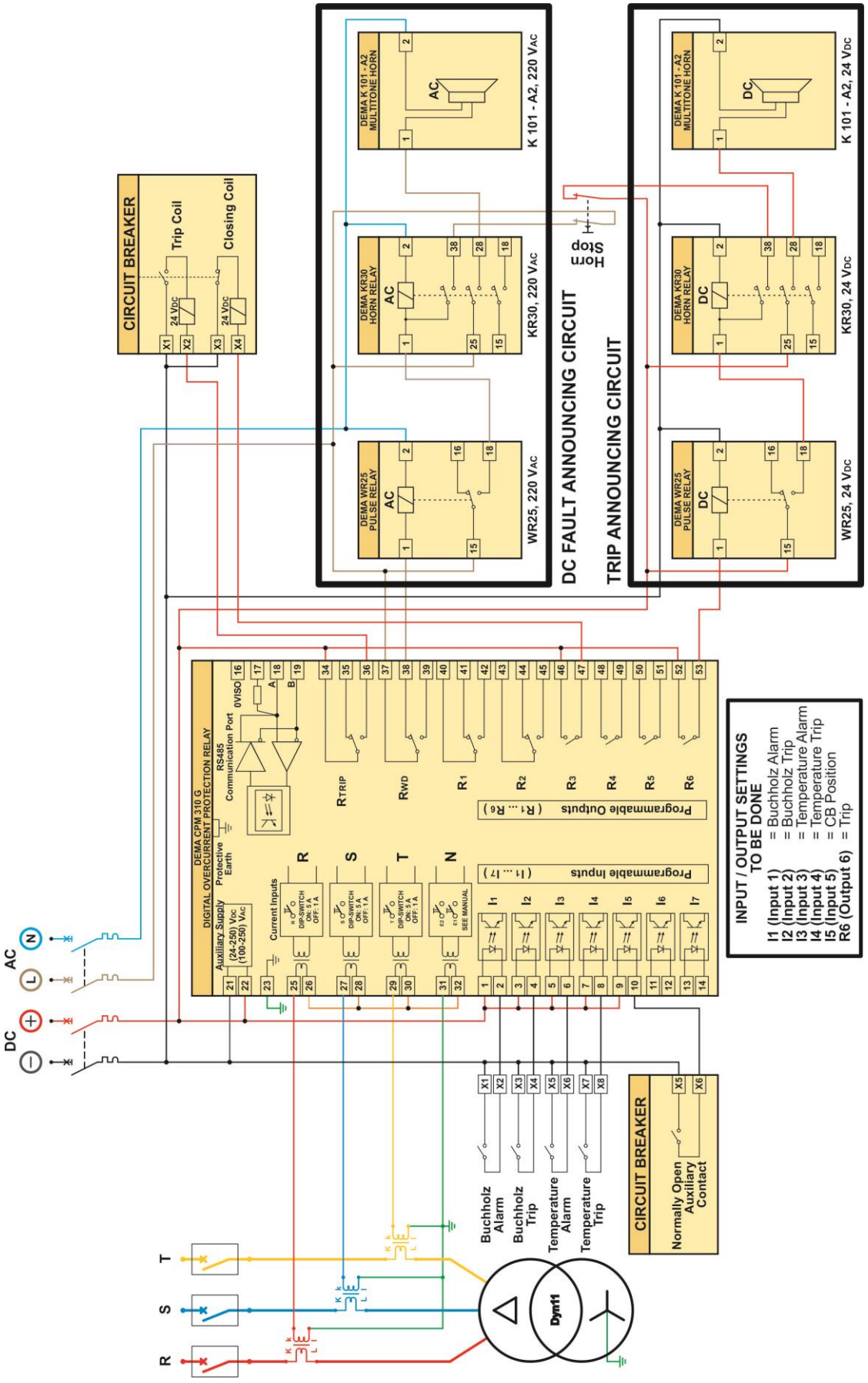
  To monitor and evaluate signals from these contacts, *Application Diagram No.5* will be used.
- To notify the operator by means of an acoustic announcing system if the protection system generates an alarm signal or trip, *Application Diagram No.7* should be applied. For the alarm / trip announcing circuit on this example, DEMA WR25 Pulse Relay, KR30 Horn Relay and K 101 – A2 Horn with U_{aux} = 24 V_{DC} are used.
- To notify the operator by means of an acoustic announcing system if by any reason the relay is out of service or auxiliary supply failure occurs, *Application Diagram No.2* should be applied. For the DC Fault announcing circuit on this example, DEMA WR25 Pulse Relay, KR30 Horn Relay and K 101 – A2 Horn with U_{aux} = 220 V_{AC} are used.

The master diagram will be formed by merging:

- *Fundamental Cabling Diagram,*
- *Application Diagram No*.2,
- *Application Diagram No*.5,
- *Application Diagram No*.6,
- *Application Diagram No*.7.

Master diagram that fulfills the requirements of the project is formed and given at p.191. □

[8] The rated secondary complex power of CTs are evaluated taking actual secondary burden into consideration. Please note that secondary burden consists of secondary cabling and devices.



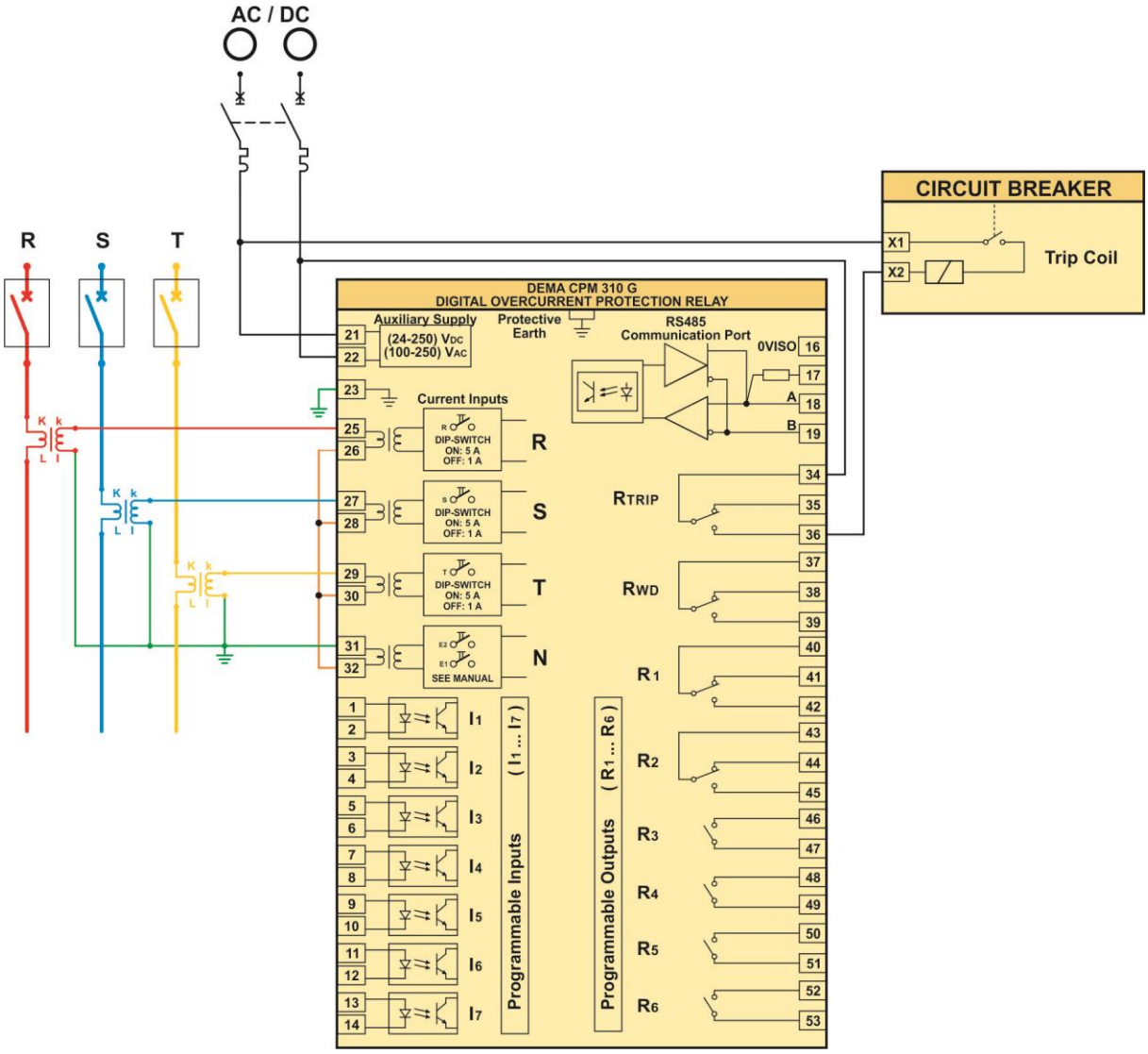
Sample Power Transformer Protection Application Diagram

	Symbol	Description	Application Diagram No.
Protection Functions	I>	Phase Overcurrent 1st Threshold Protection	-
	I>>	Phase Overcurrent 2nd Threshold Protection	-
	I>>>	Phase Overcurrent 3rd Threshold Protection	-
	Ie>	Earth Overcurrent 1st Threshold Protection	-
	Ie>>	Earth Overcurrent 2nd Threshold Protection	-
	Ie>>>	Earth Overcurrent 3rd Threshold Protection	-
	%(I2/I1)>	Broken Conductor Protection	-
	I2>	Negative Sequence Overcurrent 1st Threshold Protection	-
	I2>>	Negative Sequence Overcurrent 2nd Threshold Protection	-
	I<	Phase Undercurrent Protection	-
	IΘ>	Thermal Overcurrent Protection	-
Measurement Functions	-	Frequency Measurement	-
	-	RMS Current Measurement	-
	-	Fundamental Component Measurement	-
	-	Positive & Negative Sequence Measurement	-
	-	Thermal Θ Measurement	-
	-	Inputs & Outputs Measurement	-
	-	Circuit Breaker Measurements - Trip Time	3
	-	Circuit Breaker Measurements - Close Time	3
	-	Circuit Breaker Measurements - Trip Numerator	-
	-	Circuit Breaker Measurements - ∑A	-
	-	Circuit Breaker Measurements - ∑A²	-
	-	Auto-recloser Measurements	3
Automatic Control Functions	-	Cold Load Pickup	1
	-	Blocking Logic Selectivity	8
	-	Circuit Breaker Pole Failure Supervision	-
	tAux	Auxiliary Timer	4
	-	Delaying Logic Selectivity	8
	ARCL	Auto-recloser	3
	-	Auto-recloser blockage - Manual	4
	-	Reset R1 - R6	4
	-	Circuit Breaker Supervision - Trip Time	3
	-	Circuit Breaker Supervision - Close Time	3
	-	Circuit Breaker Supervision - Charging Spring Failure	6
	-	Circuit Breaker Supervision - Trip Numerator	-
	-	Circuit Breaker Supervision - ∑A	-
	-	Circuit Breaker Supervision - ∑A²	-
	-	Circuit Breaker Supervision - Trip Circuit Supervision	9
Other Functions	-	Circuit Breaker Position Indication and Control	1
	-	Settings Group Selection	(4)
	Watchdog	Inner Circuit Error / Auxiliary Supply Failure Supervision	2
	-	Manual Latch Reset for Trip and Programmable Output Relays	(4)
	Reset LED	Manual Reset for Alarms and LEDs	(4)
	-	Buchholz Alarm for Power Transformer Protection	5
	-	Buchholz Trip for Power Transformer Protection	5
	-	Thermometer Trip for Power Transformer Protection	5
	-	Thermometer Alarm for Power Transformer Protection	5
	-	Pressure Trip for Power Transformer Protection	5
	-	Alarming over Output Relays	7
	-	Manual Starting of Waveform Recording	4
	-	RS485 Cabling	10

Use of Application Diagrams With Respect to Functions

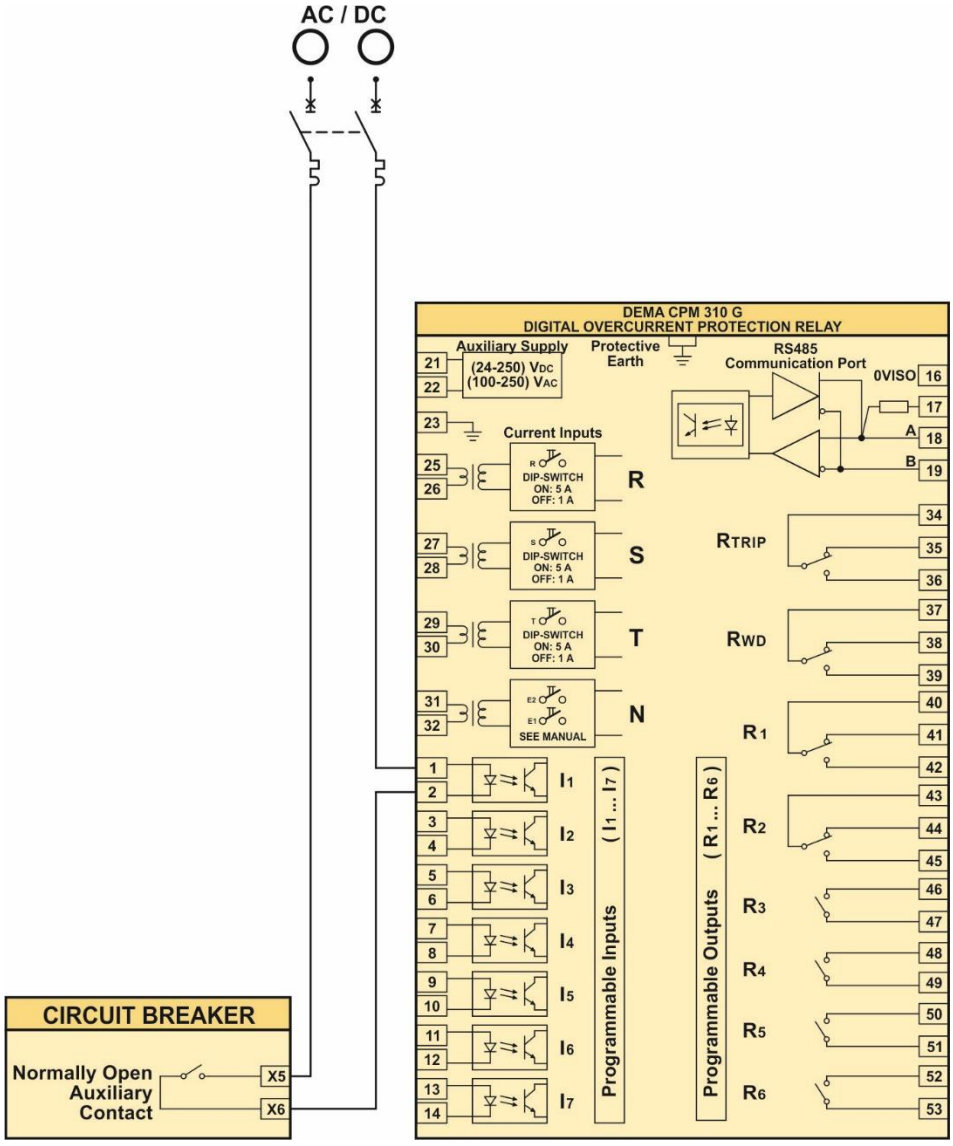
Note 1: If a diagram number is shown in brackets, it means that the related function can be triggered externally by the triggering method shown on the diagram or internally by using relay menus.
Note 2: The table is valid after Fundamental Cabling Diagram is applied.

FUNDAMENTAL CABLING DIAGRAM



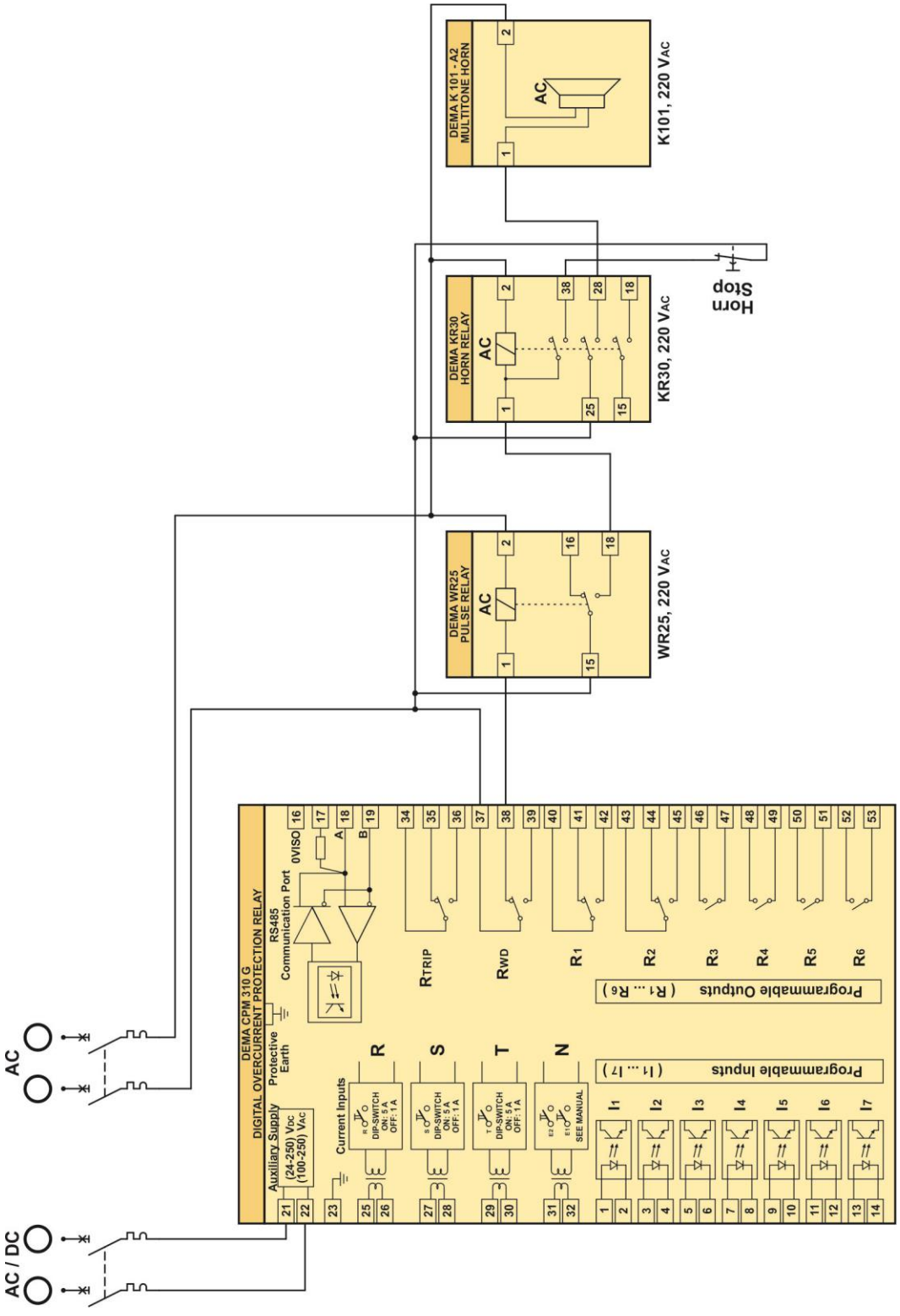
APPLICATION DIAGRAM NO. 1

Function	Function Activation Address	Settings
CB Position Indication	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » CB Position
Cold Load Pickup	MENU » Auto. Control Settings » Cold Load Pickup Settings	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Cold Load Pickup



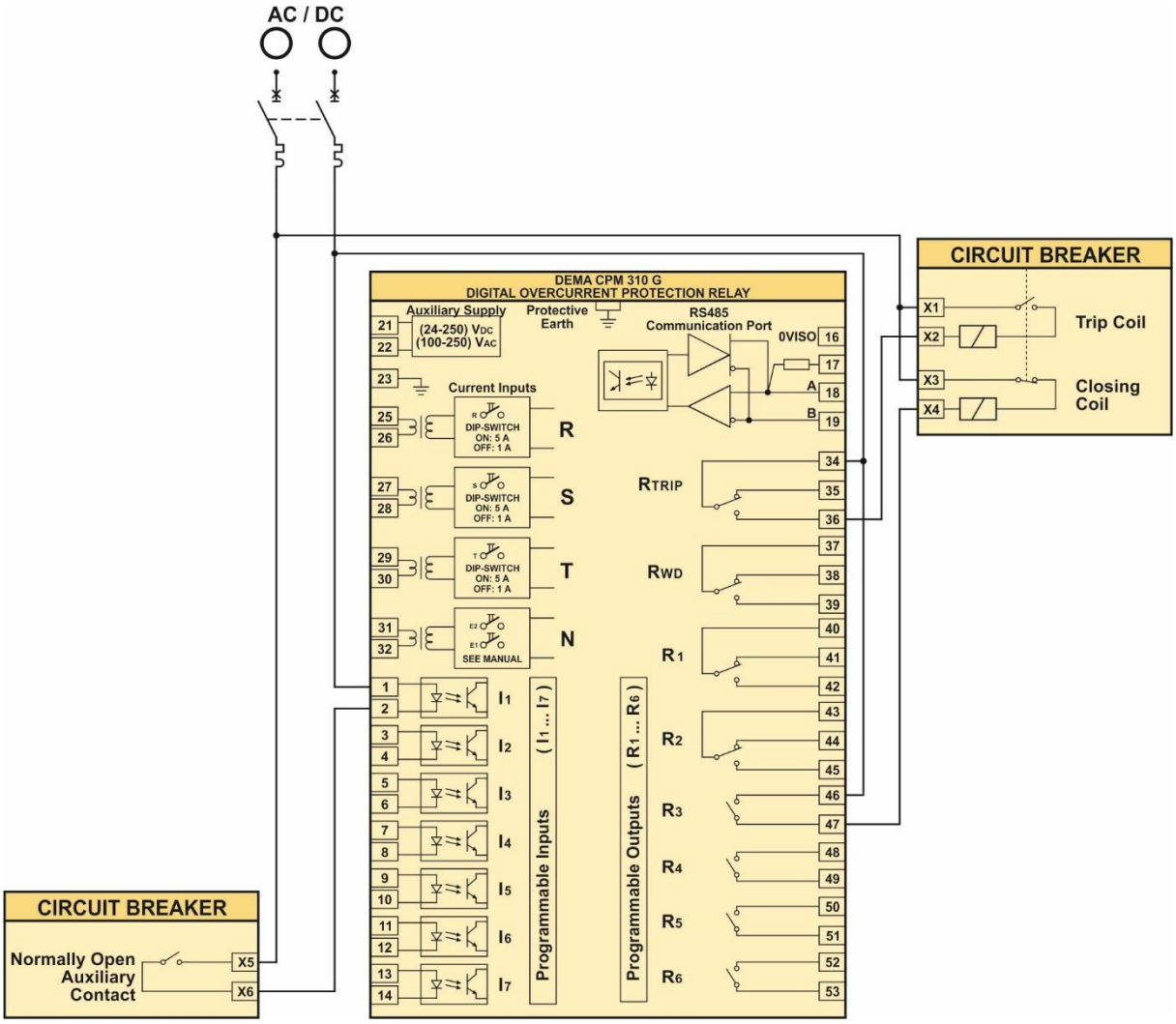
APPLICATION DIAGRAM NO. 2

Function	Function Activation Address	Settings
Internal Error Alarm	Automatic	Output
		-



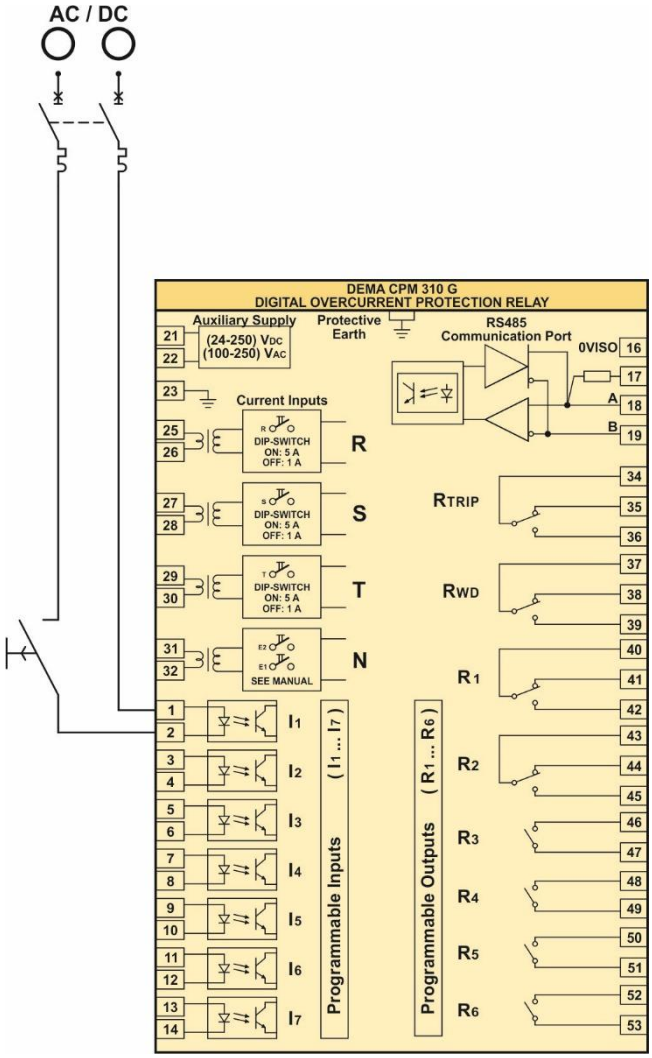
APPLICATION DIAGRAM NO. 3

Function	Function Activation Address	Settings
Auto-recloser	Add » ARCL	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » 52a
		Output
		MENU » Automatic Control Settings » Output Settings » 1-6.Output » CB Close
CB Trip Time Supervision, CB Closing Time Supervision.	MENU » Automatic Control Settings » CB Supervision Settings	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » 52a
		Output
		MENU » Automatic Control Settings » Output Settings » 1-6.Output » CB Close



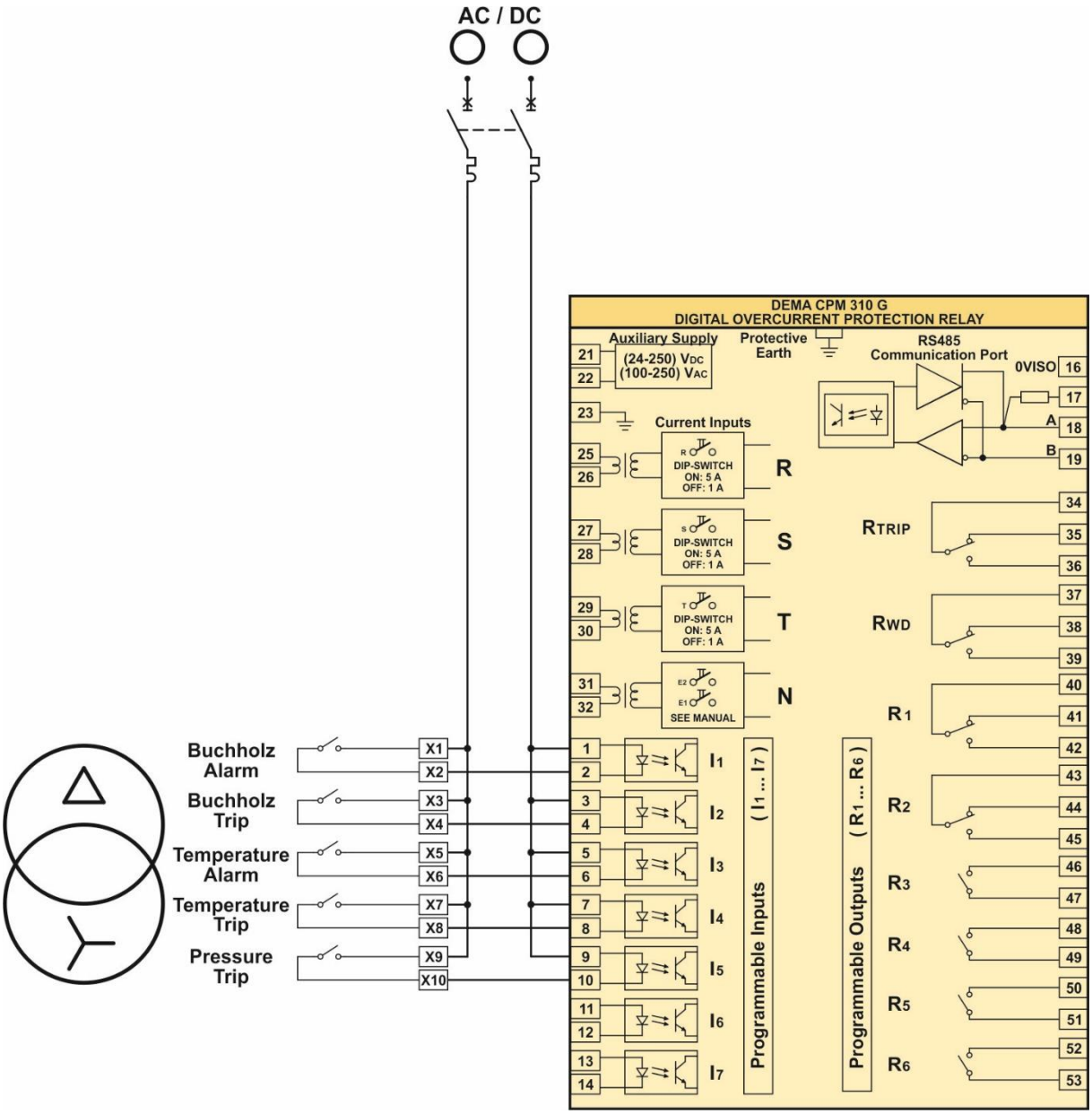
APPLICATION DIAGRAM NO. 4

Function	Function Activation Address	Settings
Reset Latch	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Reset Latch
tAux1	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Start tAux1
tAux2	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Start tAux2
Setting Group Selection	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Group Selection
Auto-recloser blocking	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Block ARCL
Reset LED	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Reset LED
Start Waveform Record	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Start Waveform Rec.



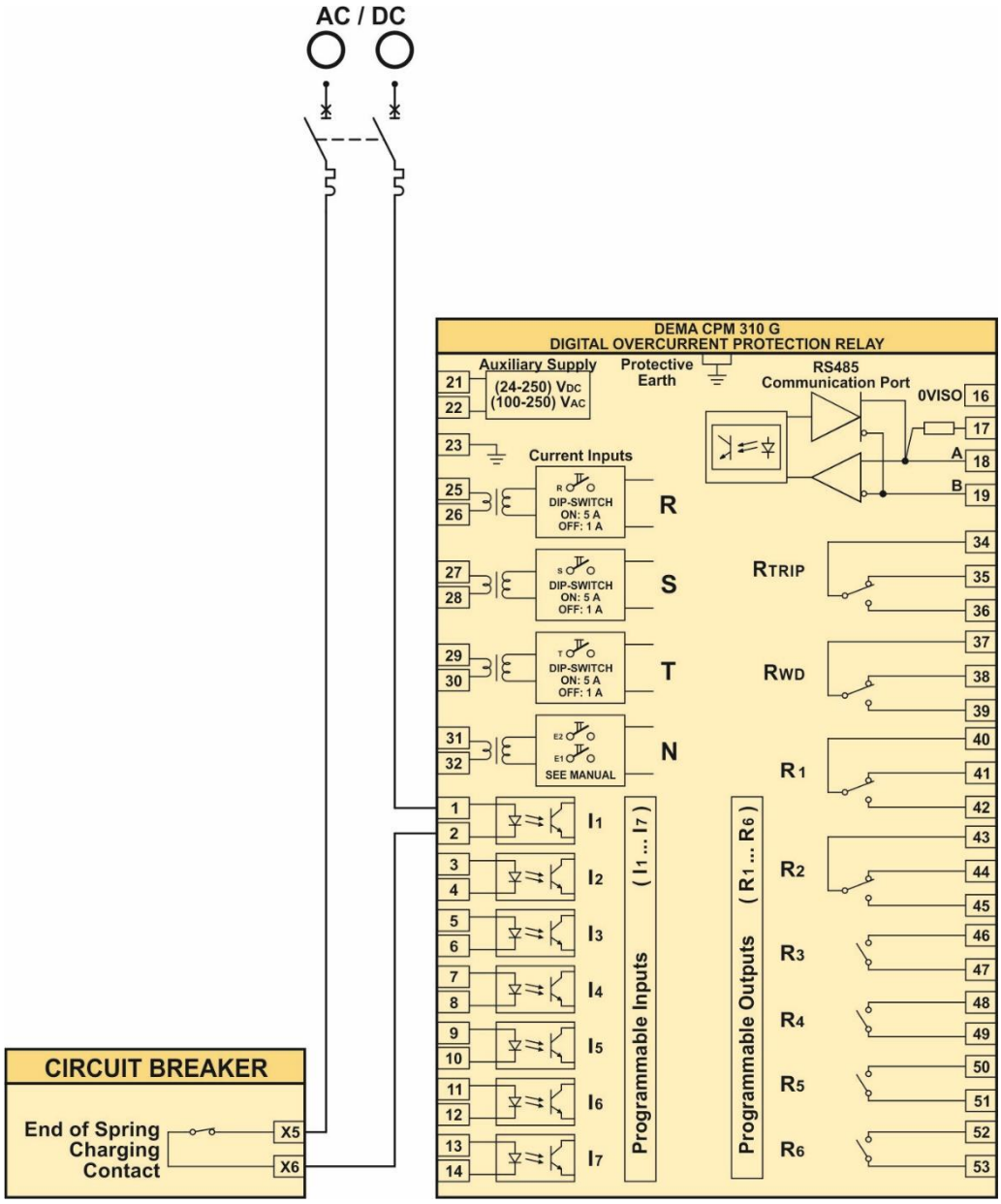
APPLICATION DIAGRAM NO. 5

Function	Function Activation Address	Settings
Buchholz Alarm	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7. Input » Buchholz Alarm
Buchholz Trip	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7. Input » Buchholz Trip
Thermometer Alarm	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7. Input » Thermometer Alarm
Thermometer Trip	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7. Input » Thermometer Trip
Pressure Trip	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7. Input » Pressure Trip



APPLICATION DIAGRAM NO. 6

Function	Function Activation Address	Settings
CB Charging Spring Supervision	Automatic	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » CB Spring Failure

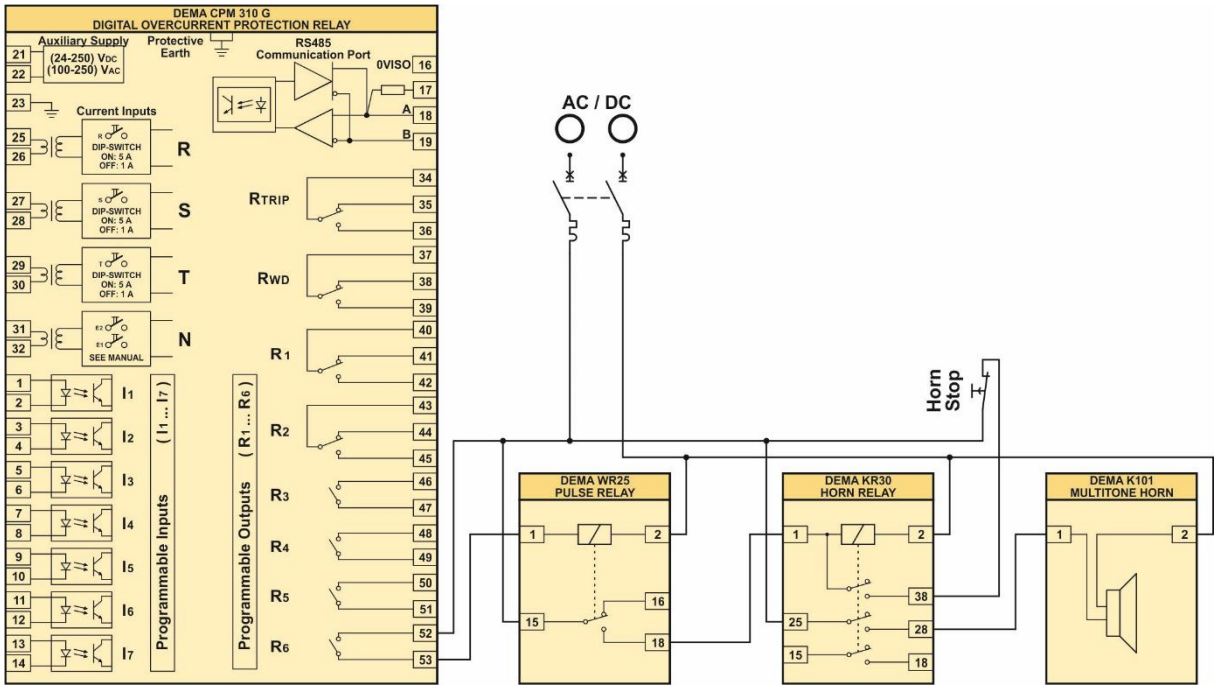


APPLICATION DIAGRAM NO. 7

Function	Function Activation Address	Settings
Control and Alarming via Outputs	Automatic	Output
		MENU » Automatic Control Settings » Output Settings » 1-6.Output » (Any function)

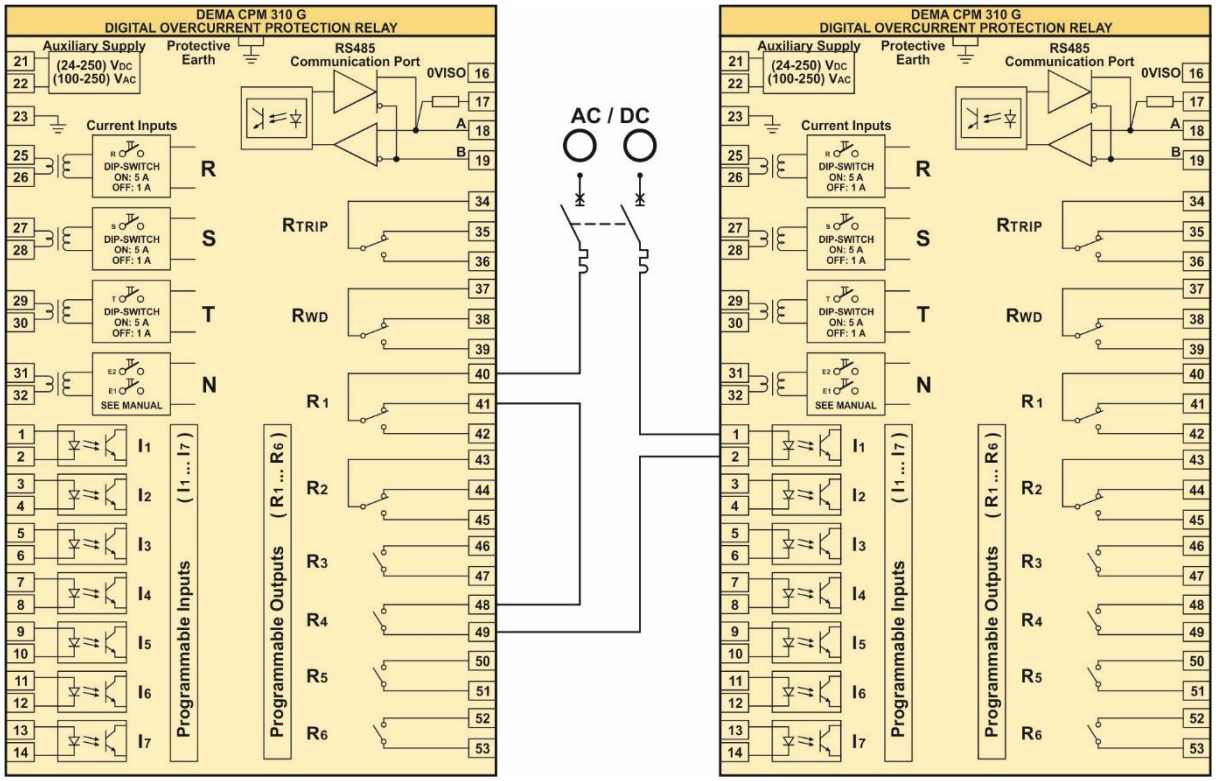
The diagram below can be applied to any settings of programmable outputs to setup any desired system providing alarming, control or logic combinations functionality.

When a function is appointed to an output, it is essential that the function itself is active for the output to work. E.g., if “I>>>” function is appointed to an output, that output will not work unless I>>> is activated. Likewise, an output programmed as “Buchholz Trip” will never work until an input is set as “Buchholz Trip”. □



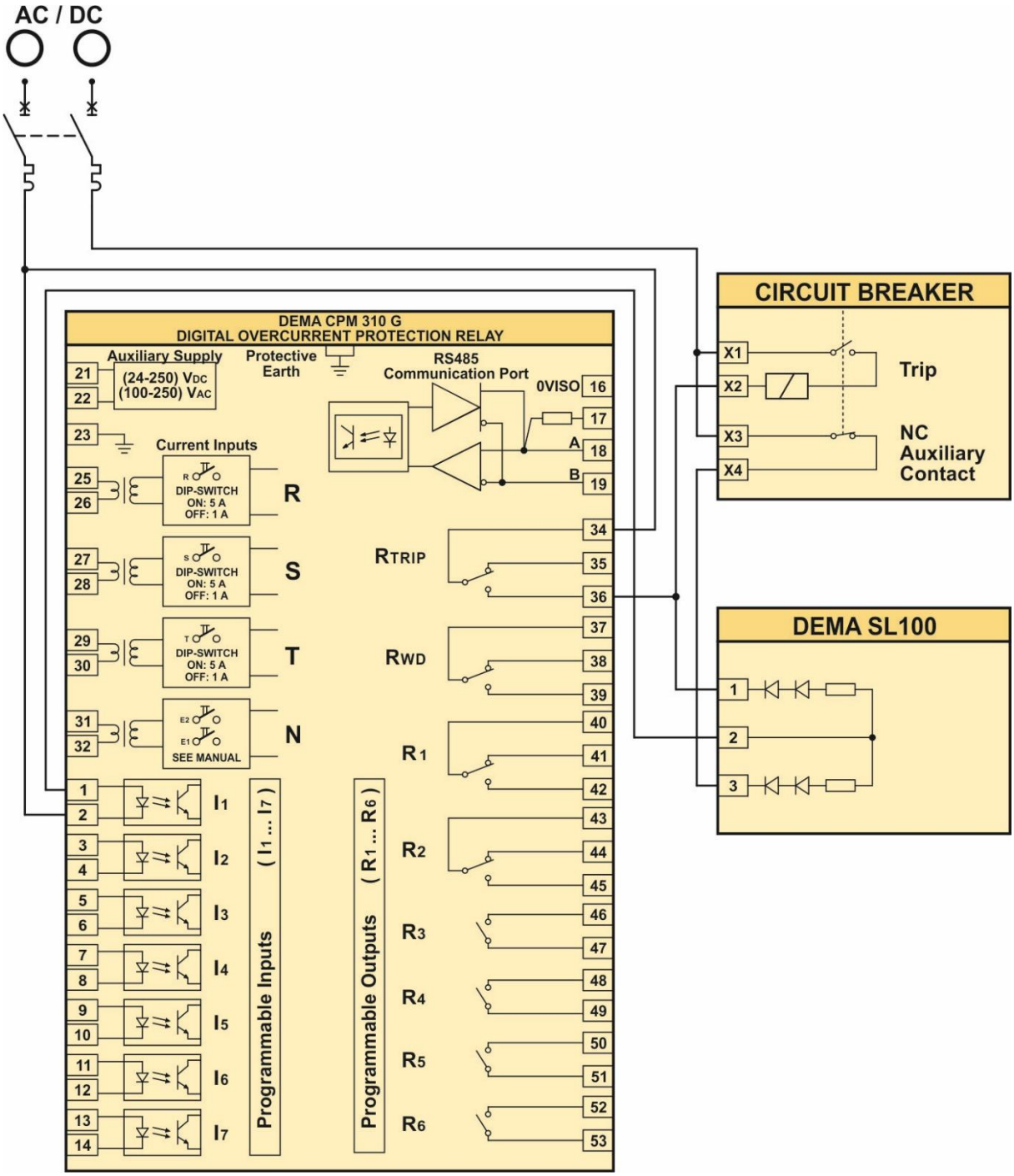
APPLICATION DIAGRAM NO. 8

Function	Function Activation Address	Settings
Blocking Logic Selectivity	MENU » Automatic Control Settings » Blocking Logic Selectivity Settings	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Blocking L.S. 1/2
		Output
		MENU » Automatic Control Settings » Output Settings » 1-2.Output » CB Pole Failure
		MENU » Automatic Control Settings » Output Settings » 3-6.Output » I>>, I>>>, Ie>>, Ie>>>
Delaying Logic Selectivity	MENU » Automatic Control Settings » Delaying Logic Selectivity Settings	Input
		MENU » Automatic Control Settings » Input Settings » 1-7.Input » Delaying L.S. 1/2
		Output
		MENU » Automatic Control Settings » Output Settings » 1-6.Output » CB Pole Failure
		MENU » Automatic Control Settings » Output Settings » 3-6.Output » I>>, I>>>, Ie>>, Ie>>>

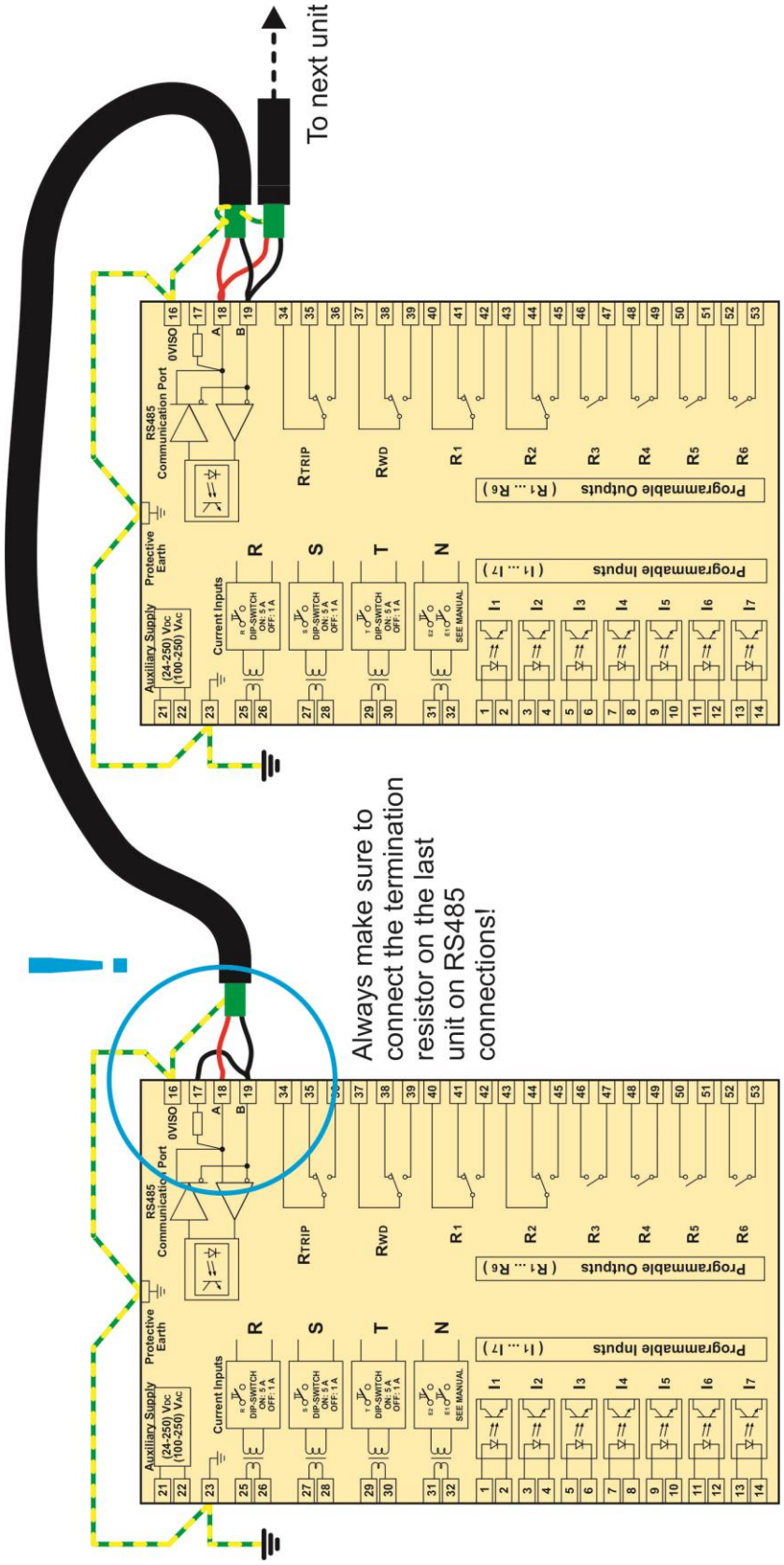


APPLICATION DIAGRAM NO. 9

Function	Function Activation Address	Settings
CB Trip Circuit Supervision	MENU » Auto. Control Settings » CB Supervision Settings	Input MENU » Automatic Control Settings » Input Settings » 1-7.Input » Trip Circuit Superv.



APPLICATION DIAGRAM NO. 10
RS485 Cabling



TECHNICAL DATA

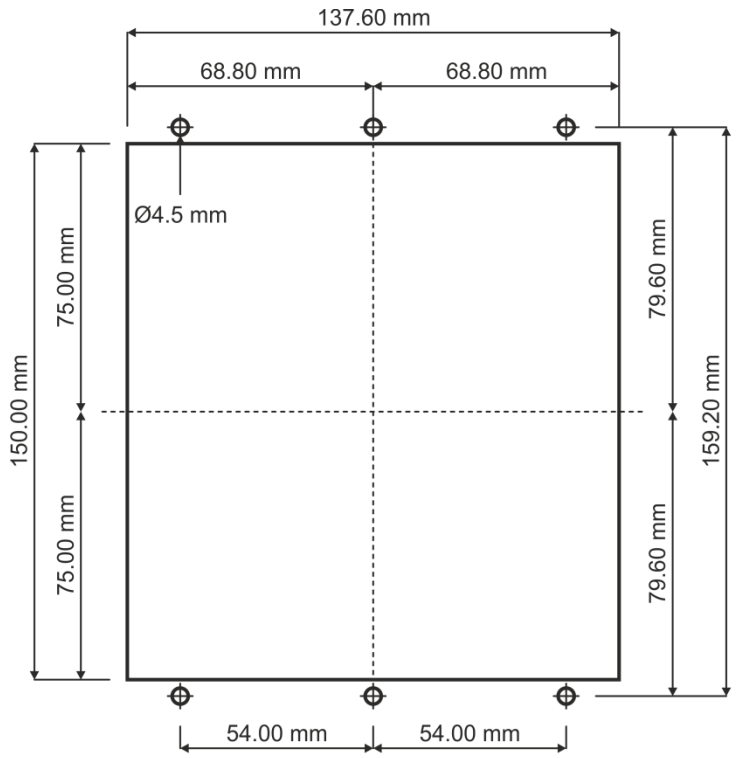
USB Connection Cable

The cable used for establishing communications between CPM 310 G and PCs is a standard USB cable with terminations Type A on one side and Type B on the other side. This cable is widely preferred for PC – printer connections. The cable comes within the CPM 310 G case.

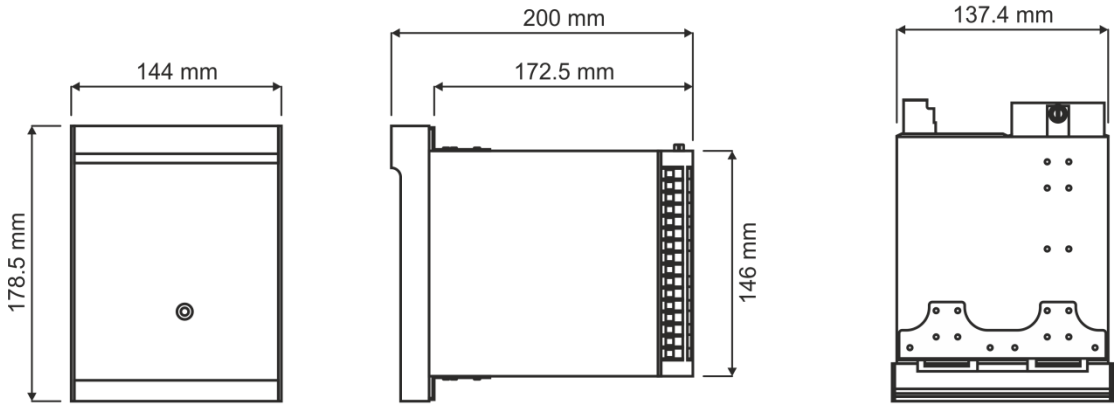
□

Technical Drawings

The drawing below specifies the overall dimensions of CPM 310 G and the cutout dimensions for flush mounting. □



DRC 144 - S4 Cutout Drawing



DEMA CPM 310 G General Dimensions

Technical Specifications

Technical Characteristics	
1 - Input and Output Characteristics	
1.1 - Measuring Units	
Nominal Current (I_n)	1 A / 5 A (via dip-switch settings).
Nominal Frequency (f_n)	50 Hz / 60 Hz (via menu settings).
Secondary Circuit Loads	
Phase Current Inputs	for 1 A : 0.01 V·A for 5 A : 0.2 V·A
Earth Current Inputs	for 1 A : 0.01 V·A for 5 A : 0.2 V·A
Current Circuit Thermal Withstand	100 I_n / 1 s 4 I_n (20 A) / continuous
Current Circuit Dynamic Withstand	250 I_n /10 ms
Current Transformer Recommendation	In = 1 A : 1 V·A, 5P10 or 5P20 (Additional secondary loads should be taken into consideration.) In = 5 A : 1 V·A, 5P10 or 5P20 (Additional secondary loads should be taken into consideration.)
1.2 Auxiliary Supply Voltage (Uaux)	
Supply Voltage Range (Nominal)	(24-240) V_{DC} / V_{AC}
Supply Voltage Range (Limits)	(21-264) V_{DC} / V_{AC}
DC Consumption	$P_{aux\ min}$: 4.5 W $P_{aux\ max}$: 8.0 W
AC Consumption	$S_{aux\ min}$: 9.0 V·A $S_{aux\ max}$: 15.0 V·A
1.3 Output Relays and Relay Contact Characteristics	
Trip Relay	SPDT (N/C + N/O), 1 relay.
Internal Fault & Auxiliary Failure Relay	SPDT (N/C + N/O), 1 relay.
Programmable Relays	SPDT (N/C + N/O), 2 relay. SPST (N/O), 4 relay.
Relay Contact Characteristics	
Rated Values	8 A / 250 V_{AC} ohmic, 8 A / 24 V_{DC} ohmic.
Short Time Withstand Current	16 A / 3 s, 30 A / 0.5 s
Max. Switching Voltage	440 V_{AC}
Max. Switching Current	16 A
Max. Switching Power	On making: 2.2 kW / 2.2 kV·A On breaking: 50 W / 2.2 kV·A
1.4 Programmable Inputs	
Programmable Input Quantity	7 inputs with optic-coupling.
Rated Excitation Voltage	(24-240) V_{DC} / V_{AC}
Extended Excitation Voltage Interval	(21-264) V_{DC} / V_{AC}
Input Activation Delay	≤ 15 ms
Max. current per input	3 mA
Programmable Input Setting Options	
Passive	Input is passive.
Unlatch	Latched relays are reset and released.
52a	Watches the normally open auxiliary contact of circuit breaker.
52b	Watches the normally closed auxiliary contact of circuit breaker.
CB Position	Used for displaying the circuit breaker position on the relevant menu.
Start tAux1	Triggers the first auxiliary timer.
Start tAux2	Triggers the second auxiliary timer.
Blocking Sel.1	Used for blocking selected protection functions while the protection group is set to "1".

Technical Characteristics	
Programmable Input Setting Options (Continued)	
Delaying Sel.1	Used for increasing trip delays for the selected protection functions while the protection group is set to "1".
Start Wave Record	Used for triggering a 3 second record of the current waveform.
Cold Load Pickup	Used for increasing the threshold settings of the selected protection function for a given time.
Spring Failure	Supervises the CB charging spring via auxiliary contacts.
Change Set.Group	Used for altering between protection settings groups 1 and 2.
Block ARCL	Used for disabling auto-reclose cycles.
Reset %Θ	Used for resetting the thermal image.
Trip Circuit Sup.	Supervises the trip circuit of circuit breaker.
Reset RL1-RL6	Resets all programmable outputs.
Reset LED	Used for resetting programmable LEDs and alarm records.
Pressure Trip	Evaluates the pressure trip auxiliary contact information.
Buchholz Alarm	Evaluates the Buchholz alarm auxiliary contact information.
Buchholz Trip	Evaluates the Buchholz trip auxiliary contact information.
Temp.Alarm	Evaluates the thermometer alarm auxiliary contact information.
Temp.Trip	Evaluates the thermometer trip auxiliary contact information.
Blocking Sel.2	Used for blocking selected protection functions while the protection group is set to "2".
Delaying Sel.2	Used for increasing trip delays for the selected protection functions while the protection group is set to "2".
1.5 RS485 Serial Communications Port	
Connection Cable	2-wire screened communications cable.
Connection Point	4 terminals at the rear side of the device: reference, sending, receiving and termination resistance terminals.
Communications Protocols	DEMCOM (DEMA communications protocol), MODBUS and IEC60870-5-103.
Communications Speed	min. 1,200 baud, max. 38,400 baud.
Insulation Level	2000 V / 1 min.
1.6 USB Serial Communications Port	
Connection Type	Between CPM 310 G and PC.
Connection Usage	USB serial port is used for establishing communications between CPM 310 G and a PC for using DEMA DigiConnect software.
Connection Point	On the front side of the relay, USB B-type connector under the cover.
Communications Protocols	DEMCOM (DEMA communications protocol) and MODBUS.
Communications Speed	min. 1,200 baud, max. 38,400 baud.
1.7 Command Interface Buttons	
S1, S2, S3, S4, S5 Buttons	Multifunctional buttons, functioning as described on the screen for each menu.
Reset Button	Reset button has cyclic duty over LED, Alarm and Ampermeter menus. While at any menu; first hit heads to the "Programmable LEDs" menu, second hit heads to the "Alarm Menu" if any alarms are available, or to the "Ampermeters" menu if there are no alarms to display. Hitting further returns to the initial menu. The reset button is reachable either the cover is closed or open.

Technical Characteristics	
2 Protection Functions	
2.1 Phase Overcurrent Protection [ANSI 50/51]	
Measurement Technique	Fundamental harmonic.
Current Measurement Range	(0.1-40) I_n Important Note: It must be kept in mind that CPM 310 measures currents up to 40 In, and no precise evaluations can be done for current values higher than this.
Current Threshold Setting Range	3 independent thresholds, set as multipliers of In. 1.threshold and set interval : (0.1-25) I_n, in 0.01 I_n steps. 2.threshold and set interval : (0.5-40) I_n, in 0.01 I_n steps. 3.threshold and set interval : (0.5-40) I_n, in 0.01 I_n steps.
Pick-up Current	For all threshold values: over 1.05 times the set value.
Current Reset Ratio (Hysteresis)	~%95
Instantaneous Trip Time	~35 ms
Drop-out Time	~40 ms
Trip Time Delays for Phase Thresholds	Below descriptions are valid for tI>, tI>>, tI>>>. DMT, Definite Minimum Time. Setting Range: (0.01-150) s, step: 0.01 s. IDMT, Inverse Definite Minimum Time. Setting Range: TMS (Time Multiplier Setting): (0.025-3.2), step: 0.001.
Inverse Protection Curves available	IEC STI, IEC Short Time Inverse IEC SI, IEC Standard Inverse IEC VI, IEC Very Inverse IEC EI, IEC Extreme Inverse IEC LTI, IEC Long Time Inverse SA, Semiconductor Protection SB, Definite Inverse SC (CO2), Short Time Inverse SD (CO8), Long Time Inverse SE (CO-C3H), Normal Inverse IEEE MI, IEEE Moderately Inverse IEEE VI, IEEE Very Inverse IEEE EI, IEEE Extremely Inverse
Reset Time Delays for Phase Thresholds	Below descriptions are valid for tI>, tI>>, tI>>>. DMT, Definite Minimum Time. Setting Range: (0.01-150) s, step: 0.01 s. IDMT, Inverse Definite Minimum Time. Setting Range: TMS (Time Multiplier Setting): (0.025-3.2), step: 0.001.
2.2 Earth Overcurrent Protection [ANSI 50N/51N]	
Measurement Technique	Fundamental harmonic.
Current Measurement Range	For Type T1 Protection: (0.1-40) I_{en}, in 0.01 I_{en} steps. For Type T2 Protection: (0.02-5) I_{en}, in 0.001 I_{en} steps.
Current Threshold Setting Range	3 independent thresholds, set as multipliers of Ien. Setting range for type T1: (0.1 - 40) Ien. For T1 Ie> : (0.1 - 25) Ien, in 0.01 Ien steps. For T1 Ie>> : (0.5 - 40) Ien, 0.01 Ien steps. For T1 Ie>>> : (0.5 - 40) Ien, 0.01 Ien steps. Setting range for type T2: (0.02 - 5) Ien. For T2 Ie> : (0.02 - 5) Ien, 0.001 Ien steps. For T2 Ie>> : (0.02 - 5) Ien, 0.001 Ien steps. For T2 Ie>>> : (0.02 - 5) Ien, 0.001 Ien steps.

Technical Characteristics	
2.2 Earth Overcurrent Protection [ANSI 50N/51N] (Continued)	
Pick-up Current	For all threshold values: over 1.05 times the set value.
Current Reset Ratio (Hysteresis)	~%95
Instantaneous Trip Time	~35 ms
Drop-out Time	~40 ms
Trip Time Delays for Earth Thresholds	Tripping delay ranges for earth fault protection is the same with those for phase fault protection. DMT and IDMT characteristics available.
Reset Time Delays for Earth Thresholds	Reset delay ranges for earth fault protection is the same with those for phase fault protection. DMT and IDMT characteristics available.
2.3 Thermal Overload Protection [ANSI 49]	
Measurement Technique	RMS current.
Threshold Setting Range	IΘ> = (0.1-3.2) I_n, in steps of 0.01 I_n.
Thermal Constant Setting Range	T_e : (1-200) min, in steps of 1 min.
Thermal Trip Level Multiplier (k) Setting Range	k : 1-1.5, in steps of 0.01.
Thermal Trip Level Setting Range	Trip Θ : %(50-200), in steps of: %1.
Thermal Alarm Level Setting Range	Alarm Θ : %(50-200), in steps of: %1.
2.4 Broken Conductor Detection [%(I2/I1)>]	
Measurement Technique	%(I_2/I_1)> where I_1 is fundamental harmonics of positive sequence and I_2 is fundamental harmonics of negative sequence current.
%(I_2/I_1)> Setting Range	%(20-100), in steps of %1.
Tripping Delay Setting Range	(1-14,400) s, in steps of 1 s.
2.5 Negative Sequence Overcurrent Protection (I2>) [ANSI 46]	
Measurement Technique	Fundamental harmonic.
Threshold Setting Range	(0.1-40) I_n
Thresholds and Setting Ranges	There are 2 independent thresholds available for negative sequence overcurrent protection function. I_2> = (0.1-40) I_n, in steps of 0.01 I_n. I_2>> = (0.1-40) I_n, in steps of 0.01 I_n.
Pick-up Current	~1.05 I_s
Current Reset Ratio (Hysteresis)	~%95
Tripping Delay Setting Range	The range is the same with phase overcurrent protections'.
Resetting Delay Setting Range	The range is the same with phase overcurrent protections'.
2.6 Undercurrent Protection (I<) [ANSI 37]	
Measurement Technique	Fundamental harmonic.
Threshold Setting Range	I< = (0.02-1.0) I_n, in steps of 0.01 I_n.
Tripping Delay Setting Range	tI< = (0.01-150) s, in steps of 0.01 s.
Triggering Condition	Current measurement below the set level while 52a input is active.
Current Reset Ratio (Hysteresis)	~ %105
Pick-up Current	~ I<

Technical Characteristics	
2.7 Multi-shot Auto-reclose Function (ARCL) [ANSI 79]	
Shots	1≤n≤4
Auto-reclose Triggers	Below thresholds can be set independently for each shot. Phase Thresholds: tI>, tI>>, tI>>> Earth Thresholds: tIe>, tIe>>, tIe>>> Auxiliary Timers: tAux1, tAux2.
Auto-reclose Blocking Conditions	Below conditions blocks auto-reclose cycles automatically: * Manual blocking, * Activation of a "Block ARCL" assigned input, * CB Charging Spring Failure, CB Trip Time Error, CB Close Time Error, * CB Pole Failure, * Activation of a protection function during Inhibit Time, * Manual closing of circuit breaker.
Dead Time and Setting Ranges	4 programmable dead time setting, abbreviated as tD1, tD2, tD3 and tD4. Setting range: (0.01-300) s, step: 0.01 s
Reset Delay Setting	tR: (0.2-600) s, step: 0.01 s
Inhibit Time Delay	tIN: (0.2-600) s, step: 0.01 s
2.8 Automatic Control Functions	
2.8.1 Cold Load Pickup	
Thresholds used with Cold Load Pickup	I>, I>>, I>>>, I_e>, I_e>>, I_e>>>, I_2>, I_2>>.
Threshold Setting Range	%(20-500), in steps of %1
Delay Setting Range	(0.1-3600) s, in steps of 0.1 s
2.8.2 Programmable Outputs Settings	
Programmable Output Assignment Options	Trip, I>, I>>, I>>>, tI>, tI>>, tI>>>, Ie>, Ie>>, Ie>>>, tIe>, tIe>>, tIe>>>, tI<, tI2>, tI2>>, Trip Θ, Thermal Alarm Θ, CB Alarm, 52 Failure, Broken Conductor, CB Failure, CB Close, tAux1, tAux2, ARCL Running, ARCL Blocked, Buchholz Alarm, Buchholz Trip, Temp. Alarm, Temp. Trip.
2.8.3 Trip Settings	
Functions available to assign to Trip Relay	tI>, tI>>, tI>>>, tI_e>, tI_e>>, tI_e>>>, tI<, tI_2>, tI_2>>, Thermal Trip Θ, Broken Conductor, tAux1, tAux2, Buchholz, Temperature, Pressure.
2.8.4 Programmable Input Settings	
Functions available to assign to Programmable Inputs	Passive, Unlatch, 52 a, 52 b, CB Position, Start Aux1, Start tAux2, Blocking Sel.1, Delaying Sel.1, Start Wave Record, Cold Load Pickup, Spring Failure, Change Settings Group, Block ARCL, Reset %Θ, Trip Circuit Supervision, Reset RL1-RL6, Reset LED, Pressure Trip, Buchholz Alarm, Buchholz Trip, Temperature Alarm, Temperature Trip, Blocking Sel.2, Delaying Sel.2.
2.8.5 Blocking Logic Settings	
Blocking Logic Selectivity Groups	2 groups, 1 setting for each group.
Trigger Options	tI>, tI>>, tI>>>, tI_e>, tI_e>>, tI_e>>>, tI<, tI_2>, tI_2>>, broken conductor, tAux1, tAux2.
2.8.6 Circuit Breaker Pole Failure Settings [ANSI 50BF]	
Current Sensing Threshold Range	I< : (0.02-1) I_n, in steps of 0.01 I_n.
Delay Setting Range	tCBF : (0.1-10) s, in steps of 0.01 s.
2.8.7 Auxiliary Timer Settings	
Quantity of timers	2 independent auxiliary timers.
Trigger Options	Via programmed input.
Setting Range	tAux1 & tAux2 : (0-600) s, in steps of 0.01 s

Technical Characteristics	
2.8.8 Delaying Logic Selectivity Settings	
Delaying Logic Selectivity Groups	2 groups, 1 setting for each group.
Trigger Options	tI>>, tI>>>, tI_e>>, tI_e>>>
Delaying Range	(0-500) s, in steps of (0-01) s.
2.8.9 Circuit Breaker Supervision Settings	
CB Opening Time Supervision	Setting range: (0.05-1) s, in steps of 0.01 s.
CB Closing Time Supervision	Setting range: (0.05-1) s, in steps of 0.01 s.
CB Open Pulse	Setting range: (0.1-5) s, in steps of 0.1 s.
CB Close Pulse	Setting range: (0.1-5) s, in steps of 0.1 s.
CB Spring Supervision	Setting range: (0.1-600) s, in steps of 0.01 s.
CB Numerator Supervision	Setting range: 0-65355, in steps of 1.
Σ (Total Amperes) Supervision	Setting range: (0-12,000x104) A, in steps of 1 A.
Σ² (Total Amperes-square)Supervision	Setting range: (0-30,000x108) A², in steps of 1 A².
Trip Circuit Supervision	Triggers when the signal is lost on a programmed input. tTCS : (0.1-15) s, in steps of 0.1 s.
2.8.10 Programmable LED Settings	
Programmable LEDs	There are 8 programmable LEDs displayed as L5, L6, ..., L12 symbols on the display. The LED Menu is accessed by hitting the Reset button once while on any menu. Any activated LEDs will flash on the menu automatically.
Functions available to assign to Programmable LEDs	One or more of the functions listed below are available for assigning to any of the programmable LEDs. The label for the LED is set independently, as a LED may represent several functions. I>, I>>, I>>>, I_e>, I_e>>, I_e>>>, tI>, tI>>, tI>>>, tI_e>, tI_e>>, tI_e>>>, Thermal Trip Θ, Broken Conductor, CB Failure, Programmable Inputs (#1, #2, #3, #4, #5, #6, #7), tAux1, tAux2, Cold Load Pickup, ARCL Running, ARCL Blocked, Buchholz Alarm, Buchholz Trip, Temp. Alarm, Temp. Trip, CB Alarm, I_2>, I_2>>, tI_2>, tI_2>>, I<, tI<, Pressure Trip.
Labels available to assign to Programmable LEDs	The label for each LED is set to only one of the functions listed above.
2.8.11 Latching Settings [ANSI 86]	
Latchable Outputs	Trip Relay and programmable outputs from RL1 to RL6.
Functions available to force trip relay latching.	tI>, tI>>, tI>>>, tI_e>, tI_e>>, tI_e>>>, tI<, tI_2>, tI_2>>, Thermal Trip Θ, Broken Conductor, tAux1, tAux2, RL1-RL6, Buchholz Trip, Temperature Trip, Pressure Trip.
Functions available to force programmable outputs latching.	Any function that is assigned to an output may be set to latch the output.
2.8.12 Alarm Settings	
Auto-reset Option for Alarm Menu	Automatic (new alarms are overwritten to the old ones) or Manual (new alarms are recorded to the front lines, olds are kept below).
Threshold Alarm Hiding Option	Disturbances are shown or hidden by the option.
2.8.13 Loading Default Settings	
Loading Default Settings option is available at "MENU » System Settings" address. Password is required to carry out the task.	

Technical Characteristics	
2.9 Event Records	
Record Details	Setting changes, trip records, disturbance records, alarms and other records are saved with time & date stamps.
Stamp Information	Time Information: day / month / year, hour / minute / second / millisecond.
Distinguishing Time	1 ms
Recordings Quantity	151 records.
Record Structure	Record title and time stamp; amplitude, source and input & output status is applicable.
Records Viewing	On the relay menus or over DigiConnect PC program.
2.10 Waveform Records	
Waveform Records Quantity	5 records.
Waveform Record Time	3 s each.
Record Time Structure	0.4 s record before trigger. 2.6 s record after trigger.
Record Form	Current oscillogram.
Records Viewing	PC program.
Trigger	Via an input or automatically by protection function pick-up.
2.11 Error Ratings	
Pick-up Current and Error	1.05 of threshold (1.6 of threshold for SA Semiconductor curve), error: ±0.1 I_s
Protection Threshold Error	±% 2
DMT and IDMT Delaying Error	±% 5 or ± 40 ms (One of the criteria will be fulfilled). Valid in the range (2 - 20) I_s. Measured current is max. 40 I_n.
Thermal Trip Delaying Error	±% 5 or ± 200 ms (One of the criteria will be fulfilled). Valid in the range (1.5 - 8) I_s.
Measuring Error	±%1 at I = I_n.
2.12 Current Transformer Compatibility	
Primary Phase Nominal Current	Setting range: (1-9999) A, in steps of 1 A.
Secondary Phase Nominal Current	1 A or 5 A. Settings should be done along with dip-switch adjustment.
Primary Earth Nominal Current	Setting range: (1-9999) A, in steps of 1 A.
Secondary Earth Nominal Current	T1-1A, T1-5A, T2-1A or T2-5A. Settings should be done along with dip-switch adjustment.
2.13 General Information	
Dielectric Withstand	2,000 V / 50 Hz / 1 min and 2,200 V / 50 Hz / 1 s.
Mounting Options	Flush / rack mounting.
Case Construction	Socket and draw out construction, automatic secondary circuit bridging function.
Case Dimensions	144 mm x 179 mm x 200 mm (width x height x depth).
Case Level of Protection	Front side IP52, rear side and terminals IP20.
Storage & Operation Ambient Temp.	min. -25°C, max +70°C
Net Weight	3.5 kg

Default Settings

Default Settings	
Protection Settings, Group 1	
Phase Overcurrent, I> (ANSI 50/51)	
Protection	Active
I> (Threshold)	1.00 In
Delay Type	IEC SI
tI>	0.4
Reset Type	DMT
tReset	0.04 s
Phase Overcurrent, I>> (ANSI 50/51)	
Protection	Active
I>> (Threshold)	5.00 In
Delay Type	DMT
tI>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Phase Overcurrent, I>>> (ANSI 50/51)	
Protection	Passive
I>>> (Threshold)	10.00 In
Delay Type	DMT
tI>>>	0.01 s
Reset Type	DMT
tReset	0.04 s
Phase Undercurrent, I<	
Protection	Passive
I< (Threshold)	0.5 In
tI<	1.0 s
Earth Overcurrent, Ie> (ANSI 50N/51N)	
Protection	Active
Ie> (Threshold)	0.25 Ien
Delay Type	DMT
tIe>	1.00 s
Reset Type	DMT
tReset	0.04 s
Earth Overcurrent, Ie>> (ANSI 50N/51N)	
Protection	Active
Ie>> (Threshold)	0.75 Ien
Delay Type	DMT
tIe>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Earth Overcurrent, Ie>>> (ANSI 50N/51N)	
Protection	Passive
Ie>>> (Threshold)	1.00 Ien
Delay Type	DMT
tIe>>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Broken Conductor, %(I2/I1)>	
Protection	Passive
%(I2/I1)> (Threshold)	20%
t%(I2/I1)>	5.0 s

Default Settings	
Protection Settings, Group 1 (Continued)	
Negative Sequence Overcurrent, I2> (ANSI 46)	
Protection	Passive
I2> (Threshold)	0.5 In
Delay Type	DMT
tI2>	5.0 s
Reset Type	DMT
tReset	0.04 s
Negative Sequence Overcurrent, I2>> (ANSI 46)	
Protection	Passive
I2> (Threshold)	2.0 In
Delay Type	DMT
tI2>	0.2 s
Reset Type	DMT
tReset	0.04 s
Thermal Overload, Iθ> (ANSI 49)	
Protection	Passive
Iθ> (Threshold)	1.0 In
Te	20 min
k	1.1
Trip θ	100%
Alarm θ	Active
Alarm θ Threshold	80%
Protection Settings, Group 2 (Settings are the same with Group 1)	
Phase Overcurrent, I> (ANSI 50/51)	
Protection	Active
I> (Threshold)	1.00 In
Delay Type	IEC SI
tI>	0.4
Reset Type	DMT
tReset	0.04 s
Phase Overcurrent, I>> (ANSI 50/51)	
Protection	Active
I>> (Threshold)	5.00 In
Delay Type	DMT
tI>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Phase Overcurrent, I>>> (ANSI 50/51)	
Protection	Passive
I>>> (Threshold)	10.00 In
Delay Type	DMT
tI>>>	0.01s
Reset Type	DMT
tReset	0.04 s
Phase Undercurrent, I<	
Protection	Passive
I< (Threshold)	0.5 In
tI<	1.0 s

Default Settings	
Protection Settings, Group 2 (Continued)	
Earth Overcurrent, Ie> (ANSI 50N/51N)	
Protection	Active
Ie> (Threshold)	0.25 Ien
Delay Type	DMT
tIe>	1.00 s
Reset Type	DMT
tReset	0.04 s
Earth Overcurrent, Ie>> (ANSI 50N/51N)	
Protection	Active
Ie>> (Threshold)	0.75 Ien
Delay Type	DMT
tIe>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Earth Overcurrent, Ie>>> (ANSI 50N/51N)	
Protection	Passive
Ie>>> (Threshold)	1.00 Ien
Delay Type	DMT
tIe>>>	0.05 s
Reset Type	DMT
tReset	0.04 s
Broken Conductor, %(I2/I1)>	
Protection	Passive
%(I2/I1)> (Threshold)	20%
t%(I2/I1)>	5.0 s
Negative Sequence Overcurrent, I2> (ANSI 46)	
Protection	Passive
I2> (Threshold)	0.5 In
Delay Type	DMT
tI2>	5.0 s
Reset Type	DMT
tReset	0.04 s
Negative Sequence Overcurrent, I2>> (ANSI 46)	
Protection	Passive
I2> (Threshold)	2.0 In
Delay Type	DMT
tI2>	0.2 s
Reset Type	DMT
tReset	0.04 s
Thermal Overload, Iθ> (ANSI 49)	
Protection	Passive
Iθ> (Threshold)	1.0 In
Te	20 minutes
k	1.1
Trip θ	100%
Alarm θ	Active
Alarm θ Threshold	80%

Default Settings	
Communication Settings	
Communications Mode	USB
Protocol	DEMCOM
Baud rate	38,400
Relay Address	001
System Settings	
Hour	GMT+02:00
Date	GMT+02:00
System Frequency	50 Hz
Relay Description	DEMAROLE
Password	0000
Symbolization	rstn
Active Group	G1
Phase Rotation	RST
Backlight	Automatic
Language	English
Setting Password	Passive
CB Password	Passive
Current Transformer Settings	
Primary Phase Nominal	60 A
Secondary Phase Nominal	5 A
Primary Earth Nominal	60 A
Secondary Earth Nominal	T1-5A
Automatic Control Settings	
Cold Load Pickup	
Level Percentage	200%
Time	1.0 s
Pickup tI>	Passive
Pickup tI>>	Passive
Pickup tI>>>	Passive
Pickup tIe>	Passive
Pickup tIe>>	Passive
Pickup tIe>>>	Passive
Pickup tI2>	Passive
Pickup tI2>>	Passive
Output Settings	
Output No.:	123456
Trip	100000
I>	000000
tI>	000000
I>>	000000
tI>>	000000
I>>>	000000
tI>>>	000000
I_e>	000000
tI_e>	000000
I_e>>	000000
tI_e>>	000000
I_e>>>	000000
tI_e>>>	000000
tI<	000000

Default Settings	
Output Settings (Continued)	
$tI_2>$	000000
$tI_2>>$	000000
Trip θ	000000
Alarm θ	000000
CB Alarm	000000
52 Failure	000000
Broken Conductor	000000
CB Pole Failure	000000
CB Close	001000
tZR1	000000
tZR2	000000
ARCL Run	000000
79 Trip	000000
Buchholz Alarm	000000
Buchholz Trip	000000
Thermometer Alarm	000000
Thermometer Trip	000000
Pressure Trip	000000
Trip Settings	
Trip tI>	Active
Trip tI>>	Active
Trip tI>>>	Active
Trip $tI_e>$	Active
Trip $tI_e>>$	Active
Trip $tI_e>>>$	Active
Trip tI<	Active
Trip $tI_2>$	Active
Trip $tI_2>>$	Active
Trip θ	Active
Trip Broken Conductor	Active
Trip tZR1	Active
Trip tZR2	Active
Trip Buchholz	Active
Trip Temperature	Active
Trip Pressure	Active
Input Settings	
1.Input	CB Position
2.Input	52a
3.Input	52b
4.Input	Passive
5.Input	Passive
6.Input	Passive
7.Input	Passive
Active Position	1111111
Blocking Logic Selectivity Settings, Group 1	
Block tI>	Passive
Block tI>>	Passive
Block tI>>>	Passive
Block tIe>	Passive
Block tIe>>	Passive

Default Settings	
Blocking Logic Selectivity Settings, Group 1 (Continued)	
Block tIe>>>	Passive
Block tI<	Passive
Block tI2>	Passive
Block tI2>>	Passive
Block Broken Conductor	Passive
Block tAux1	Passive
Block tAux2	Passive
Blocking Logic Selectivity Settings, Group 2	
Block tI>	Passive
Block tI>>	Passive
Block tI>>>	Passive
Block tIe>	Passive
Block tIe>>	Passive
Block tIe>>>	Passive
Block tI<	Passive
Block tI2>	Passive
Block tI2>>	Passive
Block Broken Conductor	Passive
Block tZR1	Passive
Block tZR2	Passive
Circuit Breaker Failure Settings	
CB Pole Failure Supervision	Passive
I<	0.02 I_n
Failure Time	1.0 s
Timer Settings	
tAux1	1.0 s
tAux2	1.0 s
Delaying Logic Selectivity Settings, Group 1	
Logic Selectivity tI>>	Passive
Logic Selectivity tI>>>	Passive
Logic Selectivity tIe>>	Passive
Logic Selectivity tIe>>>	Passive
Logic Selectivity Delay	1.0 s
Delaying Logic Selectivity Settings, Group 2	
Logic Selectivity tI>>	Passive
Logic Selectivity tI>>>	Passive
Logic Selectivity tIe>>	Passive
Logic Selectivity tIe>>>	Passive
Logic Selectivity Delay	1.0 s
Auto-recloser Settings, Group 1	
Auto-reclose	Passive
tDelay1	30 s
tDelay2	30 s
tDelay3	30 s
tDelay4	30 s
tReset	60 s
tInhibit	3 s
tI>	0000 11111
tI>>	1111 11111
tI>>>	0000 11111

Default Settings	
Auto-recloser Settings, Group 1 (Continued)	
$tI_e>$	0000 11111
$tI_e>>$	1111 11111
$tI_e>>>$	0000 11111
tAux1	0000 11111
tAux2	0000 11111
Auto-recloser Settings, Group 2	
Auto-reclose	Passive
tDelay1	30 s
tDelay2	30 s
tDelay3	30 s
tDelay4	30 s
tReset	60 s
tInhibit	3 s
tI>	0000 11111
tI>>	1111 11111
tI>>>	0000 11111
$tI_e>$	0000 11111
$tI_e>>$	1111 11111
$tI_e>>>$	0000 11111
tAux1	0000 11111
tAux2	0000 11111
Circuit Breaker Supervision	
CB Trip Supervision	Passive
Trip Time	0.2 s
CB Close Supervision	Passive
Closing Time	0.2 s
Trip Pulse Duration	0.5 s
Close Pulse Duration	0.5 s
Charging Spring Supervision	Passive
Charging Duration	10 s
Trip Numerator Supervision	Passive
Trip Numerator Limit	20000
∑A Supervision	Passive
∑A Limit	150 E4
$\sum A^2$ Supervision	Passive
$\sum A^2$ Limit	12,500 E8
CB Trip Circuit Supervision	Passive
CB Trip Circuit Failure Delay	5.0 s

Default Settings	
LED Settings	
LED 5	tI>
LED 6	tI>>
LED 7	$tI_e>$
LED 8	$tI_e>>$
LED 9	Buchholz Alarm
LED 10	Buchholz Trip
LED 11	Temp. Alarm
LED 12	Temp. Trip
Latch Settings	
tI>	Passive
tI>>	Passive
tI>>>	Passive
tIe>	Passive
tIe>>	Passive
tIe>>>	Passive
tI<	Passive
tI2>	Passive
tI2>>	Passive
Thermal Trip θ	Passive
Latch Broken Conductor	Passive
Latch tZR1	Passive
Latch tZR2	Passive
Latch Output 1	Passive
Latch Output 2	Passive
Latch Output 3	Passive
Latch Output 4	Passive
Latch Output 5	Passive
Latch Output 6	Passive
Buchholz Trip	Passive
Temp. Trip	Passive
Pressure Trip	Passive
Alarm Settings	
Alarm Reset	Automatic
Threshold Alarm	Hide

Type Tests

Type Tests
Tests carried out at Turkak accredited TUBITAK/UME and TSE Electrics and Electronics Laboratories.
A - Dielectrics Tests
EN 60255-5 Dielectric Withstand Test : 2 kV / 50 Hz / 1 min.
EN 60255-5 Dielectric Resistance Test : >100 MΩ / 500 VDC.
EN 60255-5 Voltage Impulse Test : Class 3: 5 kV @ (1.2 µs / 50 µs - 0.5 J), 3 negative pulses.
B - EMC Immunity Tests
EN60255-22-1 High Frequency Test : Class 3: 2.5 kV, 1 MHz.
EN60255-22-2 Electrostatic Discharge Test : Class 3: 6 kV / 8 kV contact and air discharge.
EN60255-22-3 Fields Affect Immunity Test : Class 3; Amplitude Modulation 10 V/m, (80-1000) MHz; Point Frequency App. 10 V/m, (80/160/450/900) MHz; Pulse Frequency App. 10 V/m, 900 MHz.
EN60255-22-4 Fast Transient Regime Change (Burst) : 4 kV / 2.5 kHz.
EN60255-22-5 Instantaneous Rise Wave Voltage (Surge) : 2 kV.
EN60255-11 DC Auxiliary Supply Failure and AC Wave Affect Test - Failure : 400 ms @ 220 VAC/VDC; wave rate: %12.
C - EN60255-25 EM Emission Test : (0.15 - 30) MHz
D - Mechanical Withstand Tests
EN60255-21-1 Sinusoidal Vibration Reaction Test : Class 1: Vibration Reaction: f = (10-150) Hz; Transition = 60 Hz, Amplitude = 0.035 mm; Peak Acceleration = 1 G, 3 dimensional.
EN60255-21-2 Mechanical Impact and Crash Tests : Class 1.
EN60255-21-3 Sinusoidal Seismic Test : Class 1: f = (2-35) Hz, Transition = 8 Hz; Horizontal Amplitude = 3.5 mm, Acceleration = 1 G; Vertical Amplitude = 1.5 mm, Acceleration =0.5 G.
EN60529 External Case Level of Protection : Front Cover IP52: protection against dust and dripping water when tilted up to 15º; Terminals IP20: protection against objects equal to or bigger than 12.5 mm.
EN60695-2-12 Plastic Withstand Class against Fire : inflammability test of plastic parts tested with 900 °C incandescent
E - Climatic Tests
EN60068-2-1 Dry Cold Air Withstand Test : -25 °C, 72 hours : for operating/storage/transport.
EN60068-2-2 Dry Hot Air Withstand Test: +70 °C, 72 hours : for operating/storage/transport.
EN60068-2-3 or HD323.2.3 S2 : +400 °C, %93 relative humidity, 56 day duration : for operating/storage/transport. Hot Humidity Withstand Test.
F - Overload Capacity Tests
EN60255-6 Continuous Current Test : Continuous 4 In (20 A) loading.
EN60255-6 Thermal Withstand Current Test : 100 In (500 A) / 1 s.
EN60255-6 Dynamic Withstand Current Test : 250 In (1.25 kA) / 10 ms.

Ordering Codes

Model codes to be supplied to DEMA when ordering CPM 310 G is given on the table below.

		C	**P**	**M**	**3**	**1**	**0**	**G**				
Standard Product Code	CPM 310 G	C	P	M	3	1	0	G				
Earth Protection Setting Zones	Type T1 (0.1 - 40) I_{en}								1			
	Type T2 (0.02 - 5) I_{en}								1			
Communication Protocols	MODBUS / IEC 60870-5-103 / DEMCOM									1		
Default Language	Turkish										A	
	English										B	
Alternative Language	Turkish											A
	English											B
	French											C
	German											D
	Italian											E

Sample Model and Ordering Code

- *CPM 310 G11BA:*
  CPM 310 G Digital Overcurrent Protection Relay,
  T1 and T2 type earth protection functions,
  Communication support for MODBUS, IEC 60870-5-103 and DEMCOM protocols.
  Menu Languages - Default Language: English, Alternative Language: Turkish. □

GLOSSARY

1...9

52 Error Trip circuit supervision alarm.
79 Run “Auto-recloser running.”
79 Trip “Auto-recloser blocked.”

A

Alarm θ Alarm related to thermal overload protection.
ARCL Auto-recloser.
ANSI American National Standards Institute, U.S.A.
ANSI 37 Phase undercurrent protection.
ANSI 46 Negative sequence current protection.
ANSI 46 BC Broken conductor protection.
ANSI 49 Thermal overload protection.[9]
ANSI 50 Instantaneous tripping related to phase overcurrent protection.
ANSI 50BF Circuit breaker pole failure supervision.
ANSI 50N Instantaneous tripping related to earth overcurrent protection.
ANSI 51 Time delay tripping related to phase overcurrent protection.
ANSI 51N Time delay tripping related to earth overcurrent protection.
ANSI 64N Restricted earth fault protection.
ANSI 79 Auto-reclose function.
ANSI 86 Output relay latch function.

B

-

C

CB Circuit breaker.
CLP Cold Load Pick-up / Cold Load Pick-up function.
CT Current transformer.

D

DDS DEMA® Draw-out System.
DType Delay type.
DEMCOM DEMA® communications protocol.
DMT Definite Minimum Time.
Dropout Time Minimum reset time of an activated protection function.

E

-

F

f_n Nominal frequency.
f_r Rated frequency.

G

G1 Settings group no.1.
G2 Settings group no.2.
GMT Greenwich Mean Time.

[9] Thermal overload protection function of CPM 310 utilizes IEC 60255-8 compliant thermal memory.

H

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I

%(I_2/I_1)> Broken conductor protection function. / Instantaneous tripping due to broken conductor protection. / Broken conductor protection threshold value.

I< Undercurrent protection function. / Instantaneous tripping due to undercurrent protection. / Undercurrent protection threshold value.

I> Phase overcurrent 1st threshold protection function. / Instantaneous tripping due to phase overcurrent 1st threshold protection. / Phase overcurrent protection 1st threshold value.

I>> Phase overcurrent 2nd threshold protection function. / Instantaneous tripping due to phase overcurrent 2nd threshold protection. / Phase overcurrent protection 2nd threshold value.

I>>> Phase overcurrent 3rd threshold protection function. / Instantaneous tripping due to phase overcurrent 3rd threshold protection. / Phase overcurrent protection 3rd threshold value.

I_e> Earth overcurrent 1st threshold protection function. / Instantaneous tripping due to earth overcurrent 1st threshold protection. / Earth overcurrent protection 1st threshold value.

I_e>> Earth overcurrent 2nd threshold protection function. / Instantaneous tripping due to earth overcurrent 2nd threshold protection. / Earth overcurrent protection 2nd threshold value.

I_e>>> Earth overcurrent 3rd threshold protection function. / Instantaneous tripping due to earth overcurrent 3rd threshold protection. / Earth overcurrent protection 3rd threshold value.

I_n Nominal current.

I_r Rated current.

I_s Set / threshold current.

I_θ> Thermal overload protection.

I_2> Negative sequence overcurrent 1st threshold protection function. / Instantaneous tripping due to negative sequence overcurrent 1st threshold protection. / Negative sequence overcurrent protection 1st threshold value.

I_2>> Negative sequence overcurrent 2nd threshold protection function. / Instantaneous tripping due to negative sequence overcurrent 2nd threshold protection. / Negative sequence overcurrent protection 2nd threshold value.

IDMT Inverse Definite Minimum Time.

IEC International Electro-technical Commission.

IEEE Institute of Electrical and Electronics Engineers, U.S.A.

IP International Protection Rating according to IEC 60529 Standard.

IP20 Protection against objects with size >12.5mm.

IP52 Protection against dust and dripping water when tilted up 15°.

ISO International Organization for Standardization.

J

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K

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L

L5 Programmable LED no.5.

L6 Programmable LED no.6.

L7 Programmable LED no.7.

L8 Programmable LED no.8.

L9 Programmable LED no.9.

L10 Programmable LED no.10.

L11 Programmable LED no.11.

L12 Programmable LED no.12.

Latch Relay locking.

M

MCB Miniature Circuit Breaker.
MODBUS Modicon® Communications Protocol.

N

-

O

-

P

P Active power (W).
PT Power Transformer.

Q

Q Reactive power (V·Ar).

R

RMS Root Mean Square.
RS485 2 wired, half-duplex, multi point serial communications connection.
RType Reset type

S

S Visual Power (VA).
SPST Single pole, single throw.
SPDT Single pole, double throw.
$S_{r\,PT}$ Power transformer rated complex power (kV·A).
$S_{n2\,CT}$ Current transformer secondary nominal complex power (V·A).

T

T1 Type 1 earth protection.
T2 Type 2 earth protection.
tCBF Circuit Breaker Failure delay time (s).
TCS Trip Circuit Supervision.
TS Sensitive type earth protection.
$t\%(I_2/I_1)>$ Time delay trip due to broken conductor protection.
t_{TCS} Trip Circuit Supervision delay time (s).
tI> Time delay trip due to phase overcurrent 1st threshold protection.
tI>> Time delay trip due to phase overcurrent 2nd threshold protection.
tI>>> Time delay trip due to phase overcurrent 3rd threshold protection.
$tI_e>$ Time delay trip due to earth overcurrent 1st threshold protection.
$tI_e>>$ Time delay trip due to earth overcurrent 2nd threshold protection.
$tI_e>>>$ Time delay trip due to earth overcurrent 3rd threshold protection.
tI< Time delay trip due to undercurrent protection.

U

USB Universal Serial Bus.
U_n Nominal voltage (kV).

V

VDE Verband der Elektrotechnik Elektronik Informationstechnik: Electrotechnics, Electronics and Communications Technologies Association (Germany).

W

Watchdog Alarm relay for reporting internal failures and auxiliary supply shortage.

X

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Y

-

Z

-

Σ (Sigma)

∑A Cumulative trip ampere-meter / value.
$\sum A^2$ Cumulative trip ampere-square-meter / value.

Θ (Theta)

%θ Thermal heating percentage.

%

$\%\Theta_p$ Thermal overload pre-heating percentage.
$\%\Theta_{trip}$ Thermal overload trip heating percentage.

CPM 310 G Digital Overcurrent Protection Relay User Manual EN (TG - 310.B)

Version: EN 2016.03
225 pages
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CPM 310 G Firmware version: v3.11
DigiConnect PC Program version: v3.1.0

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