DEMA

CPM 310 G
Digital Overcurrent Protection Relay

Brochure

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Withdrawable & Modular Construction

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General Specifications and 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 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 designed to protect electrical facilities against phase and earth faults. These relays provide phase & earth overcurrent and thermal overload protection for overhead lines, underground cables, power transformers, generators and high-power motors; while providing selectivity with various methods. These features of DEMA CPM 310 G provide highest degree of protection while ensuring maximum availability.

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.

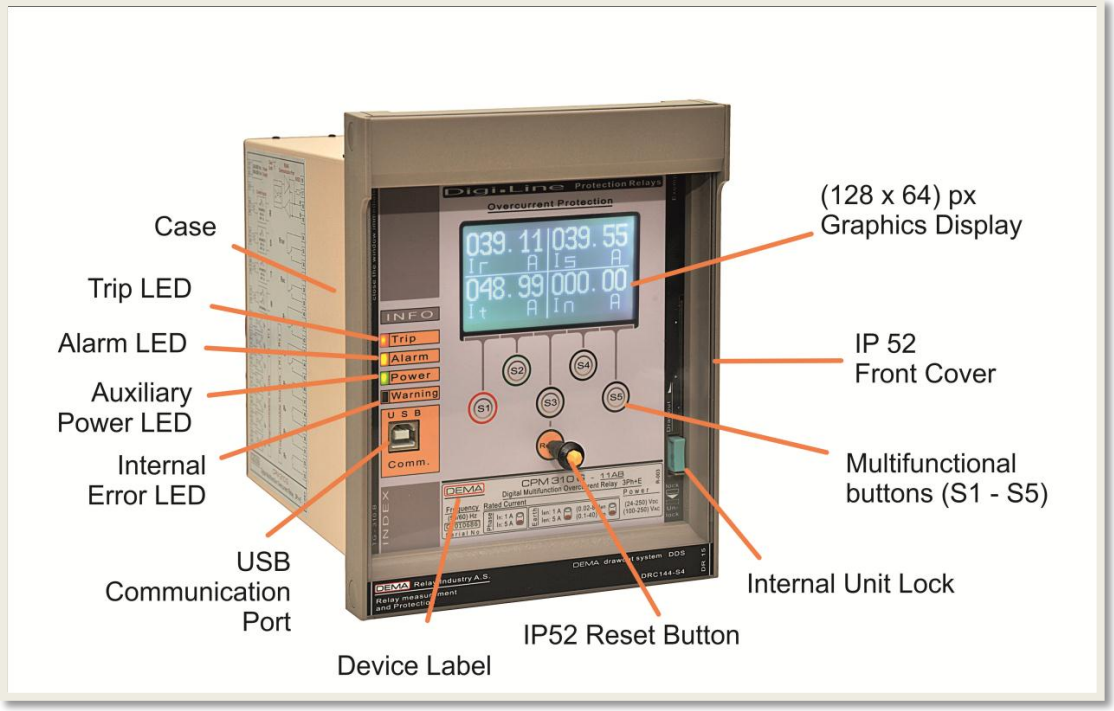
The general specifications of CPM 310 G are listed below to create a common sense for the product. □

Function	ANSI Code	CPM 310 G
Phase Overcurrent Protection – Instantaneous	50	3 thresholds
Phase Overcurrent Protection – Delayed	51	3 thresholds
Earth Overcurrent Protection – Instantaneous	50N	3 thresholds
Earth Overcurrent Protection – Delayed	51N	3 thresholds
Thermal Overload Protection	49	2 thresholds
Phase Undercurrent Protection	37	1 thresholds
Negative Sequence Overcurrent Protection	46	2 thresholds
Output Latching	86	✓
Circuit Breaker Failure Detection	50BF	✓
Auto – Reclosing	79	4 shots
Thermometer – Buchholz Protection	26 / 63	✓
Broken Conductor Protection		✓
Cold Load Pickup		✓
Protection and Settings Groups		2 groups
Circuit Breaker Trip Circuit Supervision	TCM	✓
Circuit Breaker Monitoring and Control		✓
Blocking Logic Selectivity	68	✓
Delaying Logic Selectivity		✓
Circuit Breaker Remote Control	94	✓
7 inputs and 8 outputs		✓
Disturbance Waveform Recording		3 x 5 s
Event & Fault Recording	SER	150 records
USB & RS485 Communication Ports		✓
X/1 A & X/5 A CT Compatibility		✓
Frequency, Current and Thermal Imaging Measurements		✓
Positive & Negative Sequence Current Measurements		✓
Phase Rotation Monitoring		✓
Auto-reclosing Measurements		✓
Self-check		✓
Protection Functions Testing		✓

General Specifications and Advantages

- Wide IEC, ANSI and custom delay curve support, enabling selectivity setup with all types of protection relays including electromechanical relays,
- DMT and IDMT delay curve support for all overcurrent protection functions,
- Remote control and monitoring of the circuit breaker via dedicated menu with mimic diagram,
- 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),
- Buchholz & thermometer alarm & trip functions and pressure trip functions that can be appointed to programmable inputs & outputs & LEDs,
- 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,
- 1 independent threshold for 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,
- Main menu that displays the activated protection functions so as to provide quick overview by the user,
- 2 level password system to provide access security to settings menus and remote CB control menu,
- Quick alarm menu access and enhanced alarm explanations with manual and automatic alarm resetting option,
- 8 programmable alarm LEDs,
- Event and fault records up to 150 instances,
- 5 waveform records with 3 seconds duration each,
- Electro-magnetic compatibility tested to satisfy related IEC directives,
- Draw-out system that enables under-load unit displacement / replacement,
- Protection function testing feature for checking the fundamental cabling and settings without need to use external testing devices,
- 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} = (21 – 250) V_{DC} / (100 – 250) 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,
- Free-of-charge PC software and accessories,
- Fast and low cost repairs thanks to the modular electronics,
- Matchless customer support, a variety of application schemas 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.

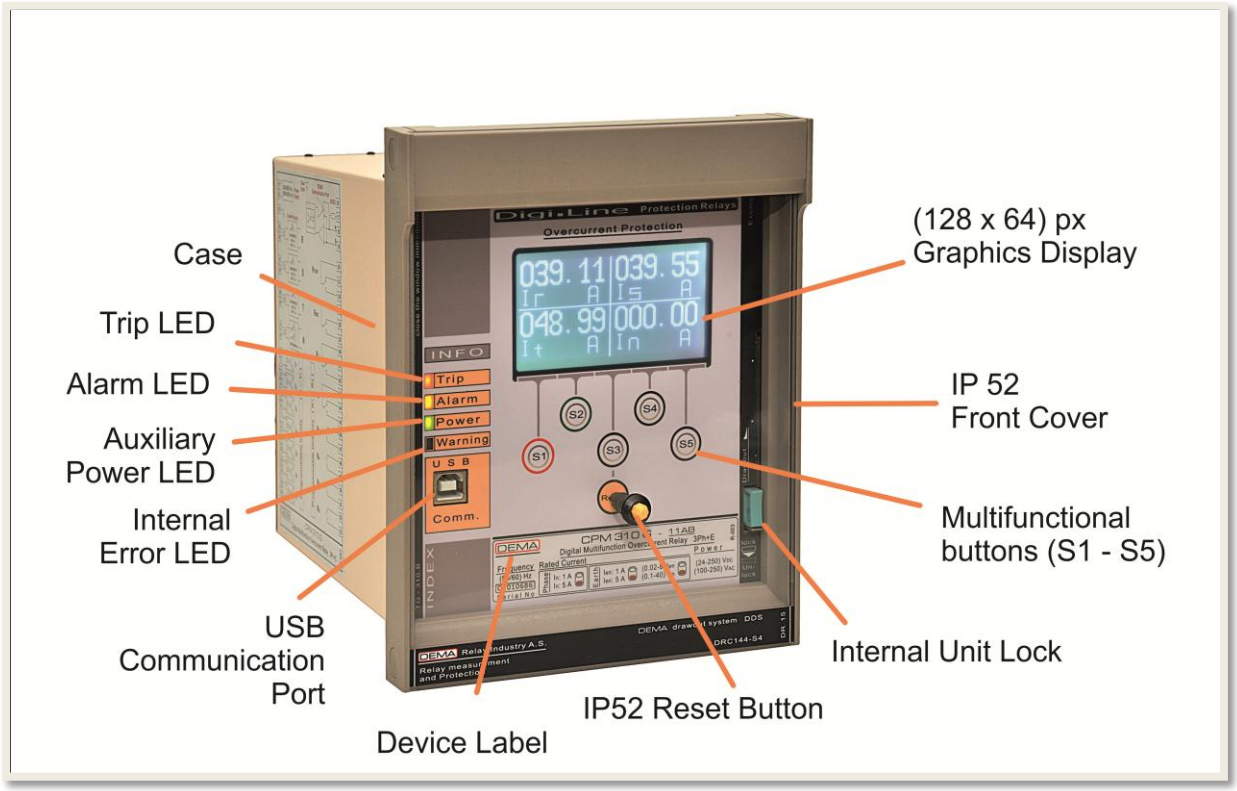
- **Alarm LED**
  Indicated with "Alarm" label on the front panel of CPM 310 G. LED light is in yellow color and runs according to configuration.

- **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 (Warning) 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

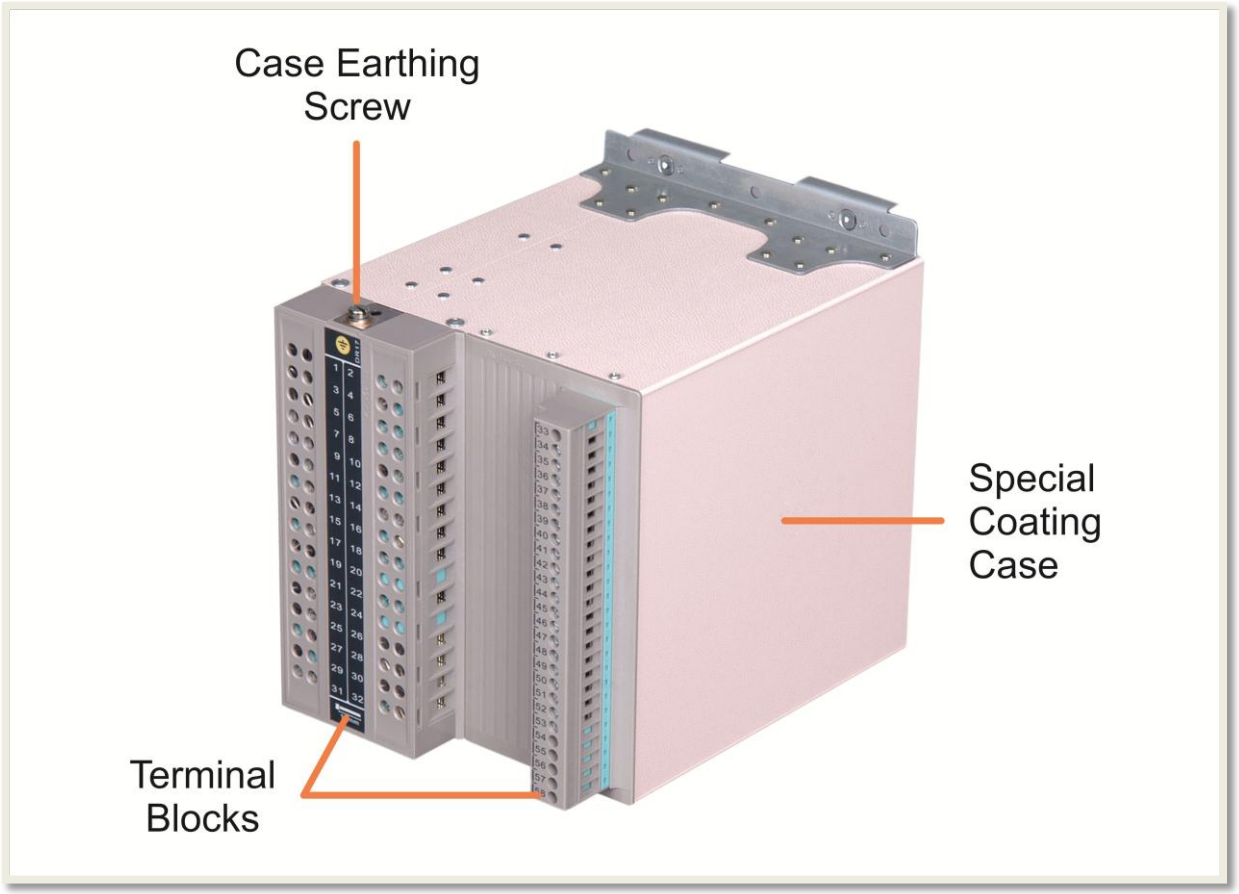
- **Graphics Display**
  128 px x 64 px backlit graphics display provides a large viewing area that ensures easy operation and readability.

- **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

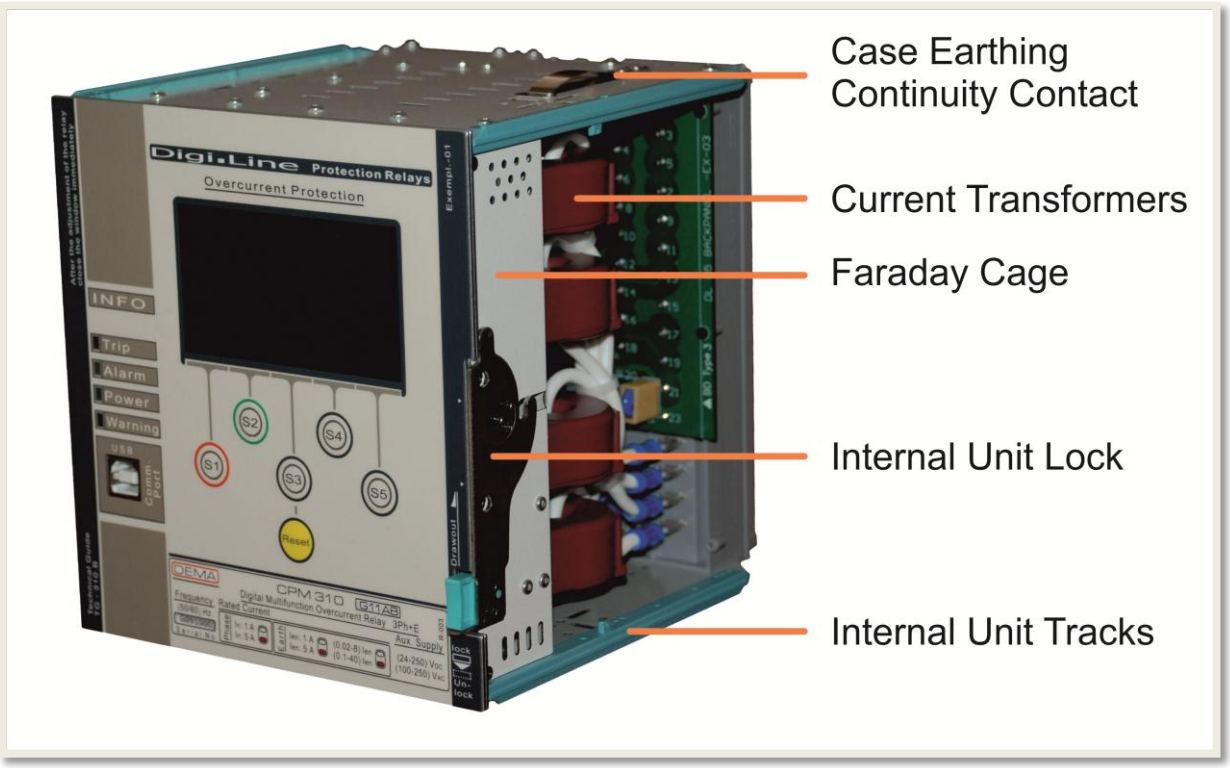
- **Circuit Diagram**
  CPM 310 G Circuit diagram is fixed on the relay case. Users do not need to keep documents for basic cabling duties on the field thanks to this inerasable diagram.

- **Case**
  The 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 circuit continuity of the internal unit to the casing. The low-resistance spring contact is rated for prospective 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

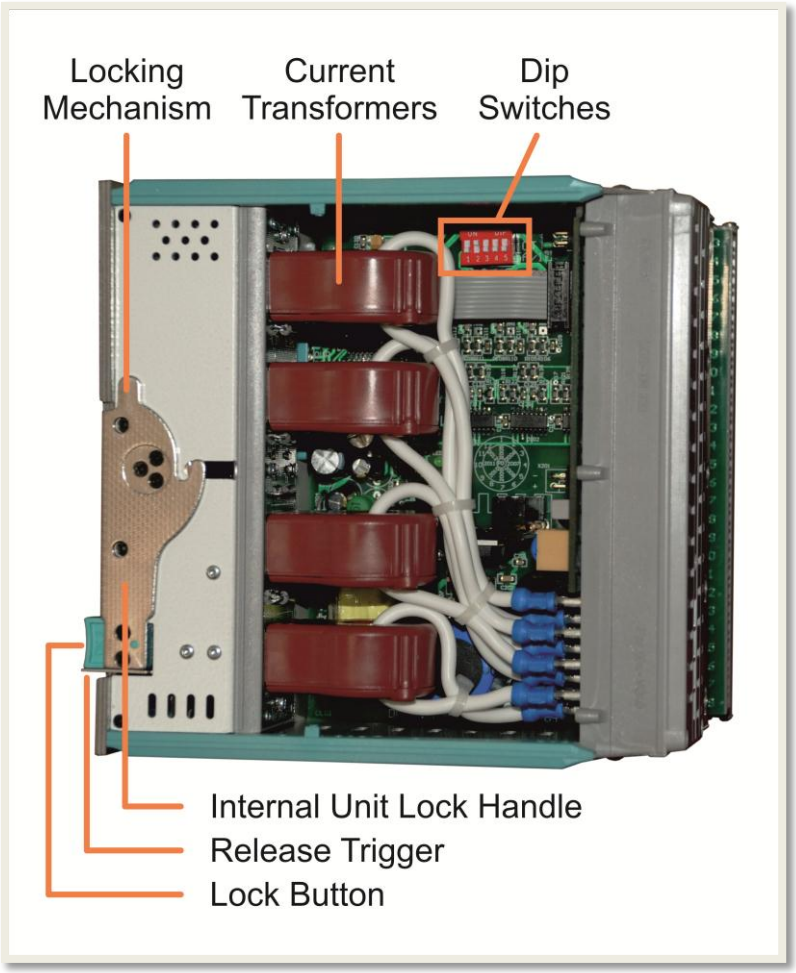
- **Internal Unit Terminal Sockets**
  Sockets make the electrical connection by locking to the plugs when the internal unit is drawn into the case. All sockets are made of inflammable material.

- **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

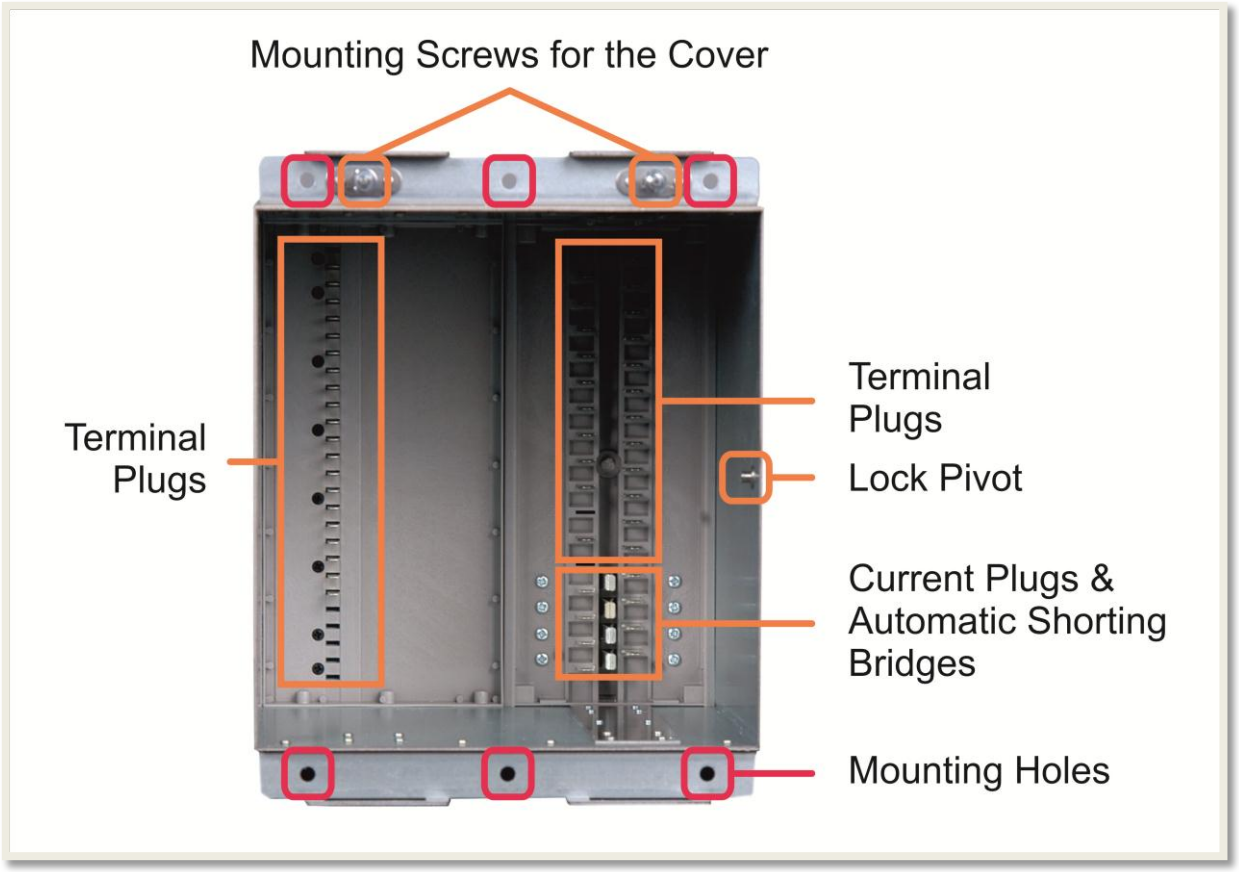
- **Locking Mechanism**
  As a subsystem of the patented DDS (DEMA Draw out System) technology, internal unit locking mechanism provides locking and drawing out of the internal unit with ease. Locking ensures safe electrical contacts.

- **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/1 A or X/5 A 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. □

CPM 310 G Features & Functions

X/1 A & X/5 A CT Compatibility
CPM series relays are suitable for use with conventional X/1 A and X/5 A current transformers. By making appropriate settings on the dip-switch group on the internal unit, the secondary nominal current can be changed as I_n = 1 A or I_n = 5 A within seconds.

Phase & Earth Fault Instantaneous Protection (ANSI 50 / 50N)
There are 3 thresholds for instantaneous phase & earth fault protection. The setting zones are given below.

For phase protection:
I> = (0.1 - 25) I_n
I>> = (0.5 - 40) I_n
I>>> = (0.5 - 40) I_n

There are two setting zones for earth fault protection. These are available via appropriate dip-switch settings on the internal unit, and have the following setting zones:

For T1 earth fault protection:
I_e> = (0.1 - 25) I_{en}
I_e>> = (0.5 - 40) I_{en}
I_e>>> = (0.5 - 40) I_{en}

For T2 earth fault protection:
I_e> = (0.02 - 5) I_{en}
I_e>> = (0.02 - 5) I_{en}
I_e>>> = (0.02 - 5) I_{en}

Phase & Earth Fault Delayed Protection (ANSI 51 / 51N)
DEMA CPM 310 G provides a large variety of protection curves for delayed phase & earth fault protection. These curves consist of standard IEC/ANSI curves, definite time delay (DMT) as well as custom curves that are compatible with electromechanical relays. To help the users apply flexible and precise settings, these curves feature a large setting zone with relatively small steps. The resetting delay setting zones are likewise flexible and precise.

Thermal Overload Protection (ANSI 49)
Best protection for power transformers, overhead lines and underground cables at loads around (100 – 150) % is provided by thermal overload protection schemes. Unlike the overcurrent curves, the thermal overload protection curve delivers relatively longer delays to provide maximum power availability, while preventing excessive thermal stresses on the protected equipment by utilizing thermal imaging technology. By applying appropriate combination of thermal overload and phase overcurrent functions, it is possible to achieve the optimal protection, selectivity and power availability solutions. In addition to the automatic protection function, the thermal stress on the equipment is monitored in real time for checking on demand. It should be noted that the thermal overload protection function fulfills the requirements of the IEC 60255-8 standard.

Phase Undercurrent Protection (ANSI 37)
This function is used in applications where undercurrent monitoring is required (e.g. tripping of a contactor controlling a water pump when the water source is exhausted). The function requires a 52a (normally open contact) signal for reliable operation. Setting zone is I< = (0.02 - 1.0) I_n.

Negative Sequence Overcurrent Protection (ANSI 46):
Unbalanced phase current conditions without earth faults on the primary circuit of a distribution line or unbalanced current conditions with or without earth faults on the secondary circuit of a power transformer can be detected and intervened by this function. The delaying options are the same with phase overcurrent protection function.

Output Latching (ANSI 86)
CPM 310 G allows users to latch the trip output relay and the 6 programmable output relays on demand. The latching settings menu on the relay allows independent latching control for the mentioned 7 outputs. Unlatching of the outputs is available via the reset button or an external signal to an appropriately programmed input.

Circuit Breaker Failure Detection (ANSI 50BF)
This function checks to see if any poles of a circuit breaker fails to interrupt the primary circuit current when tripped. If such case is detected, the alarm menu notices the user about the fault and the logic signal to an upstream relay is removed, if applicable. The process starts with the opening of the CB; if the current measurements from one or more poles of the CB do not fall below the defined level of detection, then the fault is diagnosed. After a defined delay, the alarm is given and an output reacts, if programmed so. In applications where blocking or delaying logic selectivity schemes are utilized, the logic signal to the upstream relay is removed by means of this programmed output.

Auto-reclosing (ANSI 79)
The auto-reclosing function that CPM series relays feature allows the users to auto-reclose the CB up to 4 shots. The auto-reclosing behavior of CPM 310 G can be customized for all phase and earth protection functions and auxiliary timers, independently of each other. The inhibit time, the dead time and the delays between the auto-reclosing shots can be independently set. The advanced auto-reclosing algorithm of CPM 310 G ensures the safety of the system by blocking the auto-reclosing function in certain cases, such as the manual operation of the CB, detection of a fault current within the inhibit time, and detection a CB failure. ↺

Broken Conductor Detection

The current faults in a distribution system are easily detected and cleared by protection relays. However, faults without overcurrent such as:

- breaking of an overhead line jumper,
- single phase fuse blow,
- closing failure of one of the poles of a CB,
- conducting problems of a primary power equipment,
- or open circuit on one of the current transformer secondary circuits introduce dangerous and intolerable conditions where different methods of protection should be utilized. The broken conductor detection function on CPM 310 G calculates the ratio between the negative sequence current and positive sequence current to sense and intervene these kinds of problems reliably, even at relatively low current signal levels from the healthy phases. The function behavior can be modified by setting the critical ratio threshold and the delay.

Cold Load Pickup

The cold load pickup function provides the chance to shift the threshold values of the phase & earth & negative sequence overcurrent protection functions temporarily when the circuit breaker closes to drive cold loads such as high power motors, capacitor banks and power transformers. The shifting ratio can be set within the zone (20-500) % by 1 % steps, while the duration of this temporary state can be determined between 0.1 s and 3,600 s by 0.1 s steps. The function resolves the pickup problems by shifting any independent thresholds desired and leaving others unchanged, while blocking none. The cold load pickup function is triggered by means of activation of a programmed input over one of the auxiliary contacts of the CB / contactor, or by a signal from an external device; thus, the risks of triggering by primary events which some other algorithms suffer are removed.

Settings Groups

In open ring distribution systems, the setting values of a protection relay are closely related to the power flow direction at the point the relay is operated. Meanwhile, the time to change these settings when the power flow direction is to be altered under a force major is scarce. Taking these into account, the CPM 310 G relay features 2 settings groups that can handle 2 completely independent sets of values of protection and automatic control functions, that would save valuable time for the user while switching to the suitable settings in a new condition. Altering between the settings groups can be done manually on the control panel, via remote control over communication systems or by means of triggering of a programmed input.

Circuit Breaker Trip Circuit Supervision (ANSI TCM)

The trip circuit of a circuit breaker comprises the trip coil, the trip output of a relay and the cabling between them. An open circuit on one of these components would prevent the correct operation of the CB when needed. CPM series relays are capable of supervising the condition of the trip circuit continuously by one of the programmable inputs. In the case an open circuit is detected, the user is noticed about the situation by the alarm signal on the control panel, and if desired, remotely by means of a programmed output.

Circuit Breaker Supervision and Control

CPM series relays have built-in CB supervision and control functions that manage the essential values and statistics to keep track of the CB condition.

- The last opening and closing times of the CB,
- The total opening number of the CB,
- And the ΣA and ΣA^2 values (pole condition)

are continuously supervised by the function to notice the user in abnormal or critical conditions by means of local and / or remote alarming.

Blocking Logic Selectivity (ANSI 68)

CPM 310 G supports the blocking logic selectivity scheme. This scheme is to be applied on networks where power flow is unidirectional. When this scheme is applied, each of the relays on a series primary line blocks the next upstream relay by means of sending a blocking signal to their programmed input, blocking and preventing the latter to react. This circuit design leads to the blocking of all relays but the one closest to the fault point, enabling total selectivity without applying time stepping settings. Time delayed phase & earth & negative sequence overcurrent protection functions and the broken conductor detection function can be blocked this way.

Delaying Logic Selectivity

CPM 310 G supports the delaying logic selectivity scheme. This scheme is to be applied on networks where power flow is unidirectional. When this scheme is applied, each of the relays on a series primary line shifts the trip delays of the next upstream relay by means of sending a delaying signal to their programmed input, delaying the latter to react. This circuit design leads to the delaying of all relays but the one closest to the fault point, enabling total selectivity without applying time stepping settings. The tripping delays of the 2^{nd} and 3^{rd} thresholds of the phase & earth overcurrent protection functions can be prolonged this way.

Circuit Breaker Remote Control (ANSI 94)

CPM series relays can remotely control circuit breakers by means of their trip relays and programmable outputs. The CB control can be done from the control panel of the relay and over the DigiConnect PC software. ↺

Inputs and Outputs (Including ANSI 26 & 63)

CPM 310 G is equipped with 7 optically isolated & programmable inputs and 8 output relays to fulfill demanding requirements of modern applications. The inputs accept any signals within the range (24 - 250 V_{DC}) and (100 - 250 V_{AC}). The outputs feature 4 SPDT and 4 SPST relays, each operating below 10 ms delays and rated 8 A / 250 V_{AC}. Two of the outputs are predefined as trip and watchdog relays, and the rest are programmable.

Disturbance Waveform Recording

CPM series relays can digitally save the disturbance waveforms they measure, and the saved files can be downloaded and viewed over the DigiConnect software. CPM 310 G can hold up to 5 instances of disturbance recordings, each totaling 3 seconds of sampling with 0.4 s predisturbance recording. Being able to observe the disturbance waveforms allows users to analyze faults, confirm the convenience of the parameter settings, and understand the network behavior better.

Event and Fault Recording (ANSI SER)

CPM series relays store up to 150 events and fault records. The event and fault records are time-stamped with the information from a real-time clock which is supplied by a built-in extra long-life lithium-ion battery. The records comprise the precise timing, type and details of the events / faults. The records can be viewed on the device screen as well as on a PC utilizing the DigiConnect software.

Communications Features

CPM series relays make use of two serial communication ports.

- One of the ports is the hi-speed USB port located on the front panel of the device. The USB port is suitable for establishing a direct communication link between the device and a PC over a standard USB cable, which is already supplied within the product box. Note that communication over USB port does not require the utilization of an adaptor, thus is the recommended and easier method of using DigiConnect.
- The other port is a RS485 serial communications port, which is accessible from the terminals at the rear side of the device.

CPM series relays are compatible with MODBUS RTU and IEC 60870-5-103 communication protocols at rates between 1,200 bauds and 38,400 bauds.

Measurement Functions

CPM series relays feature the following measurement functions:

- Frequency measurements: The primary circuit power frequency once the secondary current exceeds 0.1 I_n.
- Current measurements: The momentary & maximum RMS current values and fundamental harmonic value of the phases and the earth circuits.
- Positive / negative sequence measurements: The absolute values of positive and negative sequence current, and the ratio of these in percentage.
- Thermal Θ measurements: Thermal stress in percentage.
- Input & Output measurements: The states of programmable inputs and outputs as well as the trip and the watchdog relays.
- CB measurements: The last opening and closing times, total opening number, and ΣA & ΣA^2 (pole condition) for each of the circuit breaker poles.
- Auto-reclosing measurements: All statistics and measurements of the auto-reclosing activity, including number of successful auto-reclosing cycles, and auto-reclosing blockings.
- LED states: The momentary states of all 8 programmable LEDs.

Self-check & Watchdog

CPM series relays utilize a circuit to watch over the condition of the internal circuits and the power supply continuity to the device. At an instance of internal failure or power supply shortage, the watchdog relay reacts to close the normally closed contact, which is fixed at the open state in healthy operation conditions.
The positive operation characteristic of the watchdog relay therefor allows the users to monitor the healthiness of the protection system remotely, using appropriate circuitry evaluating the information from the N/O and N/C contacts of the watchdog relay.

Function Test

CPM series relays feature a built-in functional test. The test is launched manually from the control panel. Once the test is initiated, the digital signal processor within the relay produces virtual overcurrent signals to run the protection functions activated by the user, leading to tripping of the circuit breaker and termination of the test. This test allows the users to check the basic condition and behavior of the protection system elements (such as the trip circuit cabling, the circuit breaker and the auxiliary supply system) without having to use an external testing device. □

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

Curve Type		Overcurrent Curve Parameters				Reset Curve Parameters					Applied Standard
Definition	Abbreviation	A	α (Trip Factor)	B	Setting Interval	Treshhold	α (Reset Factor)	C	Setting Zone	Reset Type	
Short Time Inverse	IEC STI	0.05s	0.04	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEC
Standard Inverse	IEC SI	0.14s	0.02	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEC
Very Inverse	IEC VI	13.5s	1	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEC
Extremely Inverse	IEC EI	80s	2	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEC
Long Time Inverse	IEC LTI	120s	1	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEC
Semiconductor Protection	SA Semic	35,500s	6	0	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	Special Curve SA
Definite Inverse (DI)	SB DI	2.96875s	2.3	1.96875s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	Special Curve SB
Short Time Inverse (CO2)	SC CO2	0.0092s	0.02	0.008s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	Special Curve SC
						6.9s	2	0	RTMS 0.025-3.2	IDMT	
Long Time Inverse (SD CO8)	SD CO8	21s	2	0.72s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	Special Curve SD
						39.6s	2	0	RTMS 0.025-3.2	IDMT	
Standard Inverse (CO-C3H)	SE CO-C3H	1.81s	1.05	0.68s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	Special Curve SE
						2.2s	2	0	RTMS 0.025-3.2	IDMT	
Moderately Inverse	IEEE MI	0.0515s	0.02	0.114s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEEE / ANSI
						4.85s	2	0	RTMS 0.025-3.2	IDMT	
Very Inverse	IEEE VI	19.61s	2	0.491s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEEE / ANSI
						21.6s	2	0	RTMS 0.025-3.2	IDMT	
Extremely Inverse	IEEE EI	28.2s	2	0.1217s	TMS 0.025-3.2	-	-	-	DMT 0.04-100s	DMT	IEEE / ANSI
						29.1s	2	0	RTMS 0.025-3.2	IDMT	
Definite Minimum Time	DMT	-	-	-	DMT 0.01-150s	-	-	-	DMT 0.04-100s	DMT	-
Thermal Overload	Parameters are studied in the *IEC Protection Curves* Section										IEC

Table of CPM 310 G Protection and Reset Curves Parameters

IEC Inverse Time Protection Curves

The "IEC (International Electrotechnical Commission) *60255-3, Electrical relays - Part 3: Single input energizing quantity measuring relays with dependent or independent time"* standard defines the following protection curves.

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

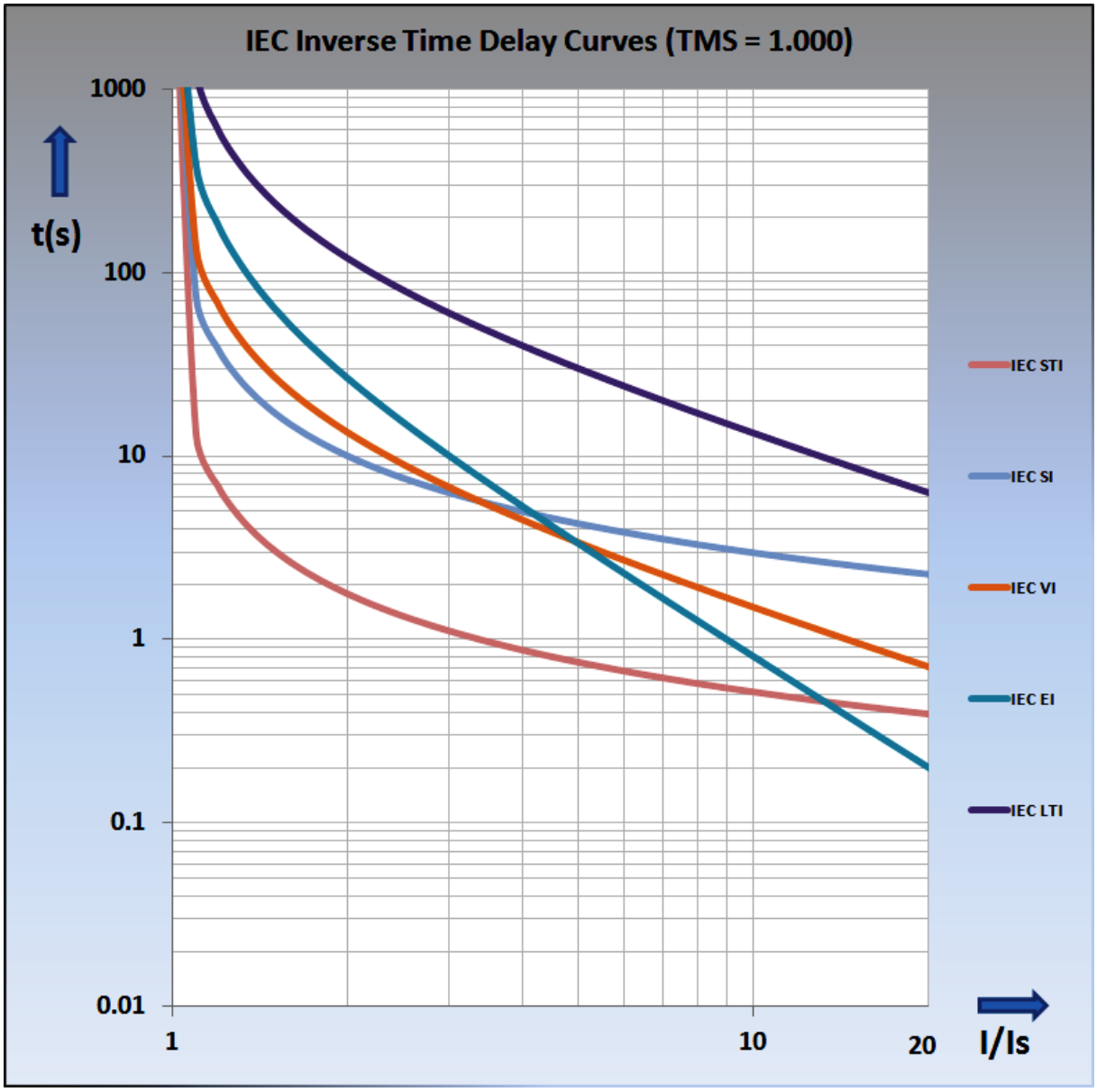
$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

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 Zone
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 within the range of (0.025 - 3.2) for any protection function.

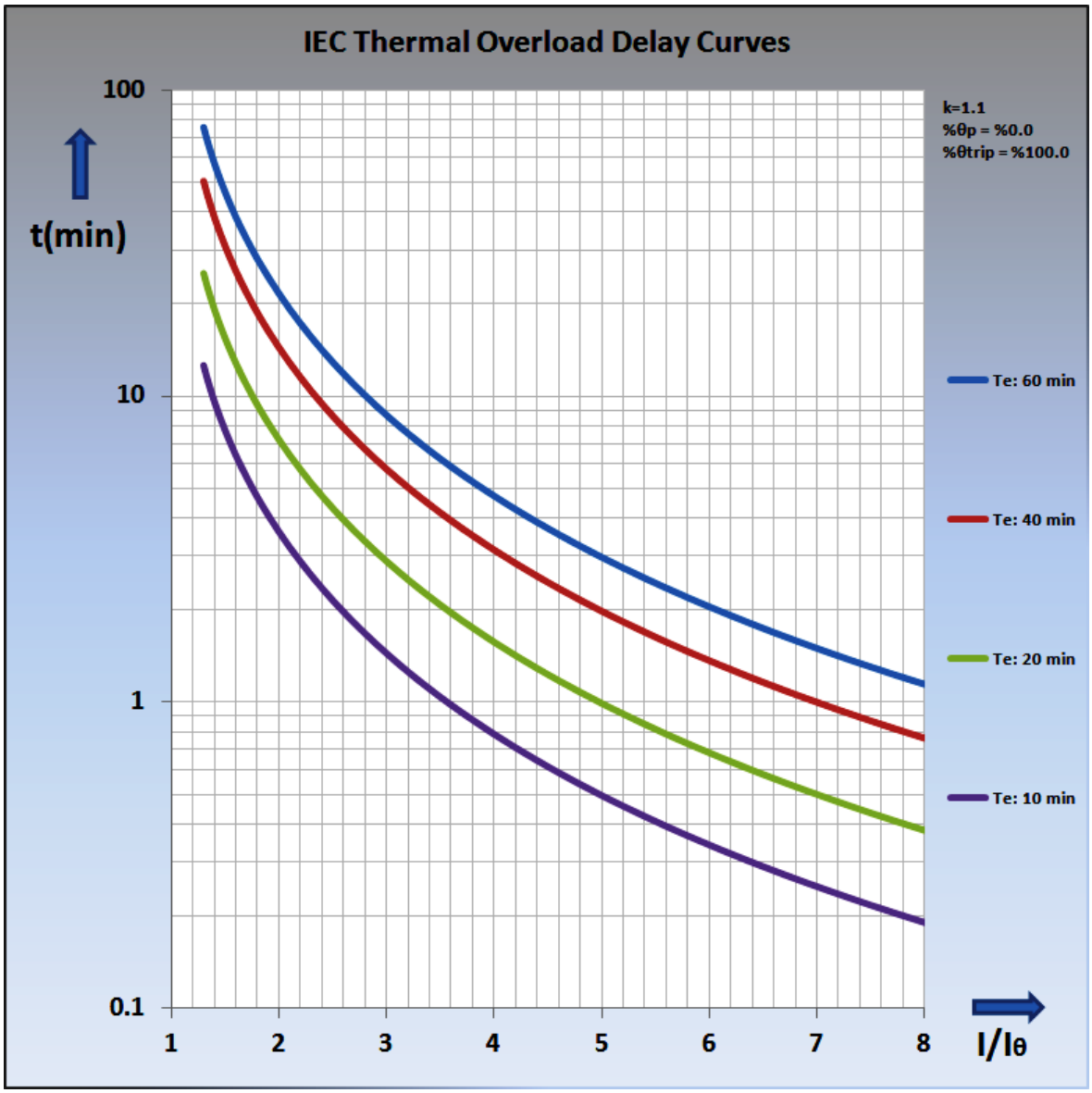


IEC Thermal Overload Protection Curves

IEC Thermal Overload Protection formula and sample curves according to this formula are given below. Formula characteristic is determined by the T_e, k, Iθ, $\%\theta_p$ 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) min, in 1 min 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) I_n, in 0.01 I_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 Inverse Time 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.

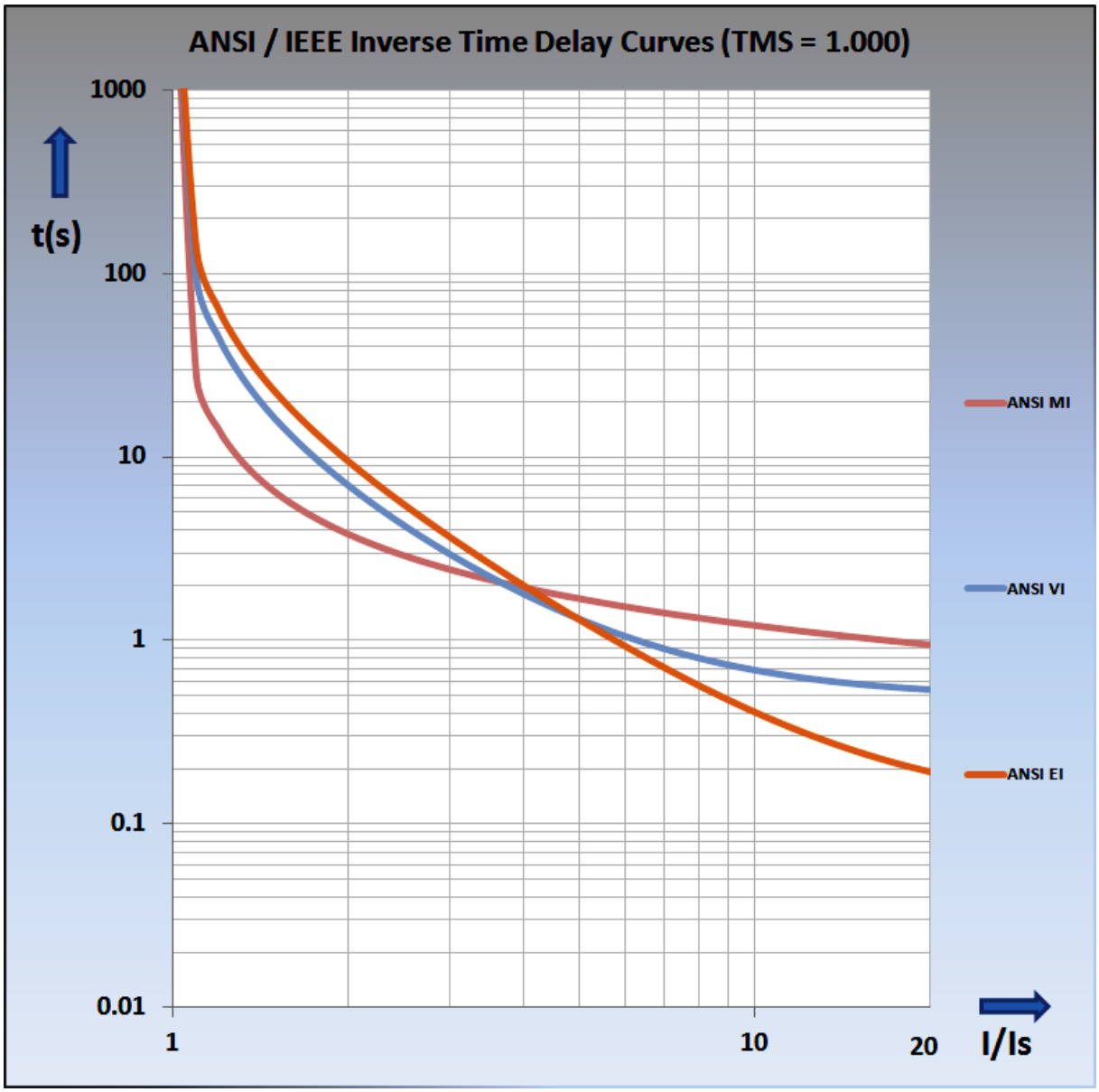
$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

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 Zone
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 = 1.00. 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.

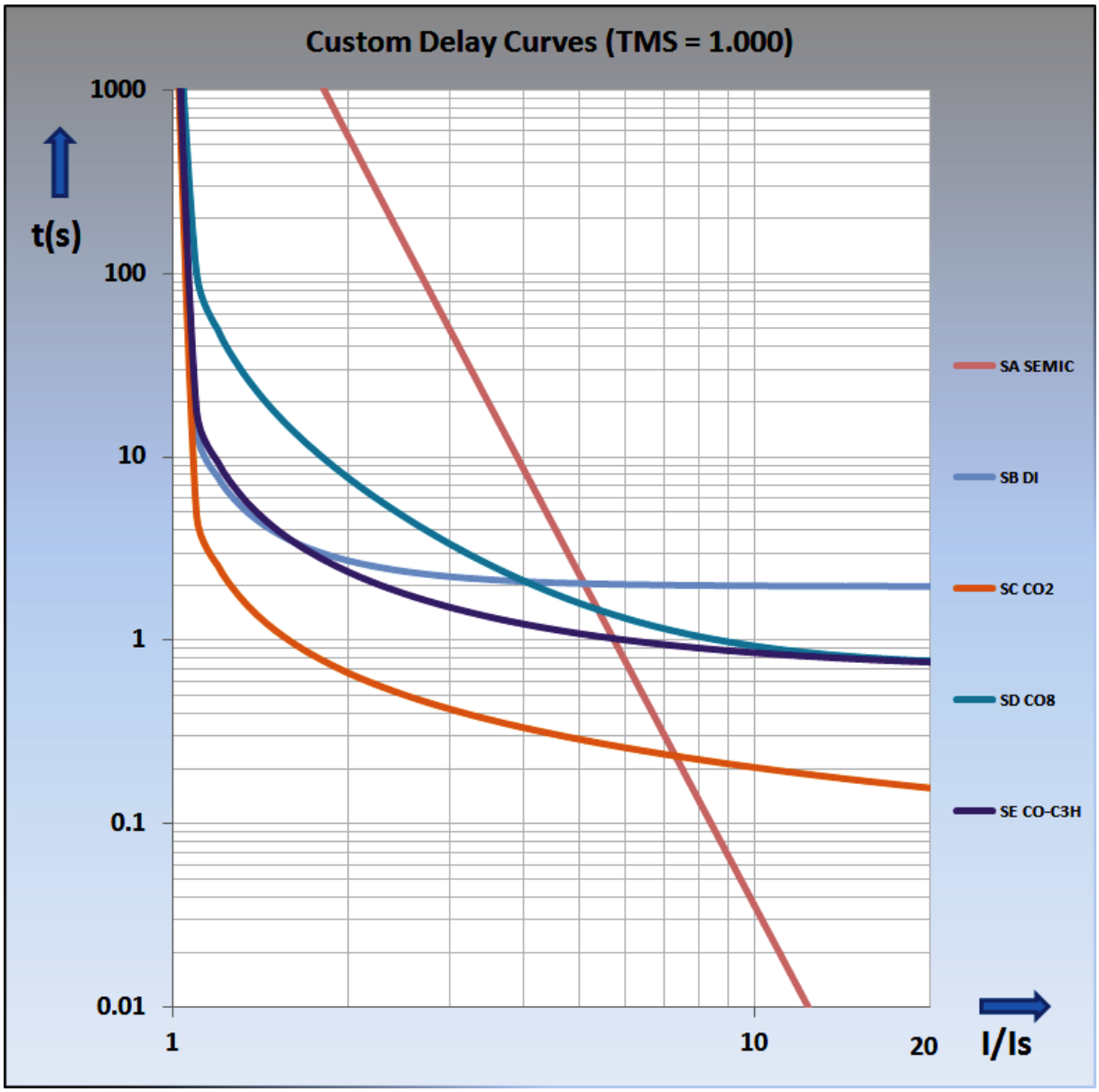
$$t = \left[\frac{A}{\left(\frac{I}{I_S}\right)^{\alpha} - 1} + B\right] \times TMS$$

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 Zone
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* $RTMS\ (0.025 - 3.2)$

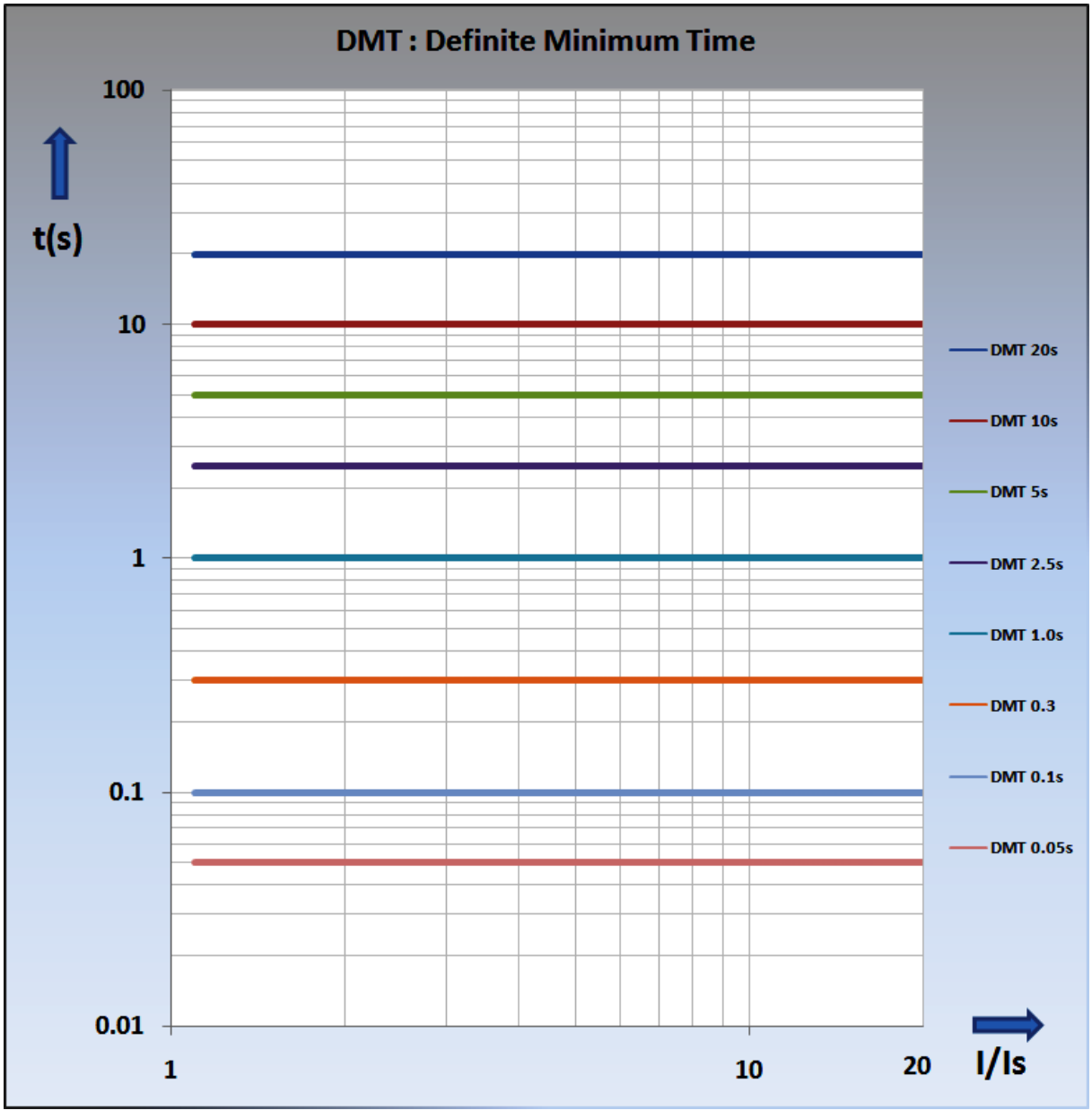
The image below shows the custom trip delay curves with TMS = 1.00. TMS can be set in the range (0.025 - 3.2) for any protection function. □



DMT: Definite Time Protection and Reset Delays

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

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

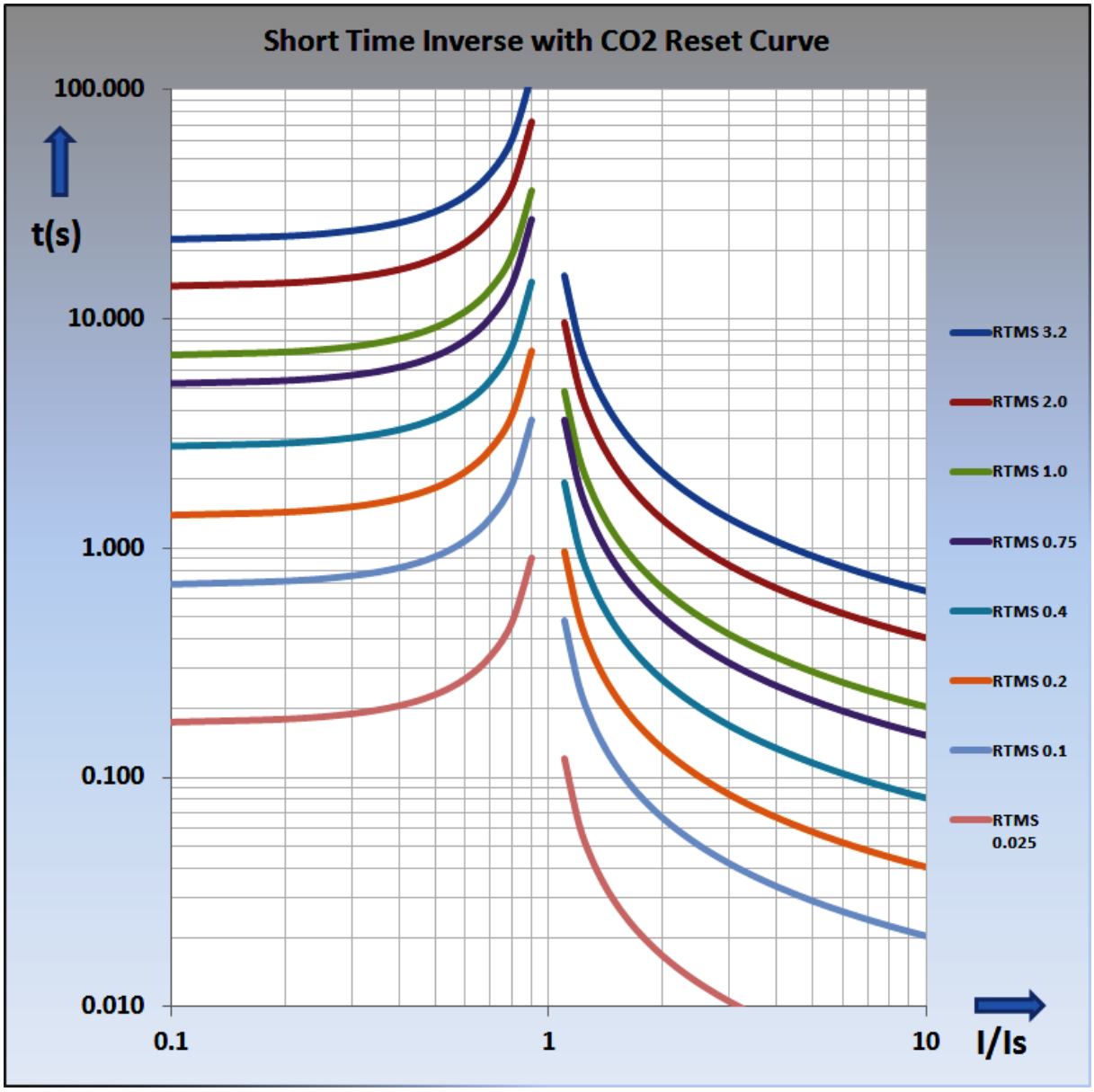


RIDMT: Inverse Definite Time Reset Curves

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 they are based on. The table *CPM 310 G Protection and Reset Curves Parameters* on page 16 shows these parameters. The sample image below shows the CO2 short time inverse trip characteristic and its RIDMT curve. The formula given below explains the calculation method of the reset delay for CO2 RIDMT curve. □

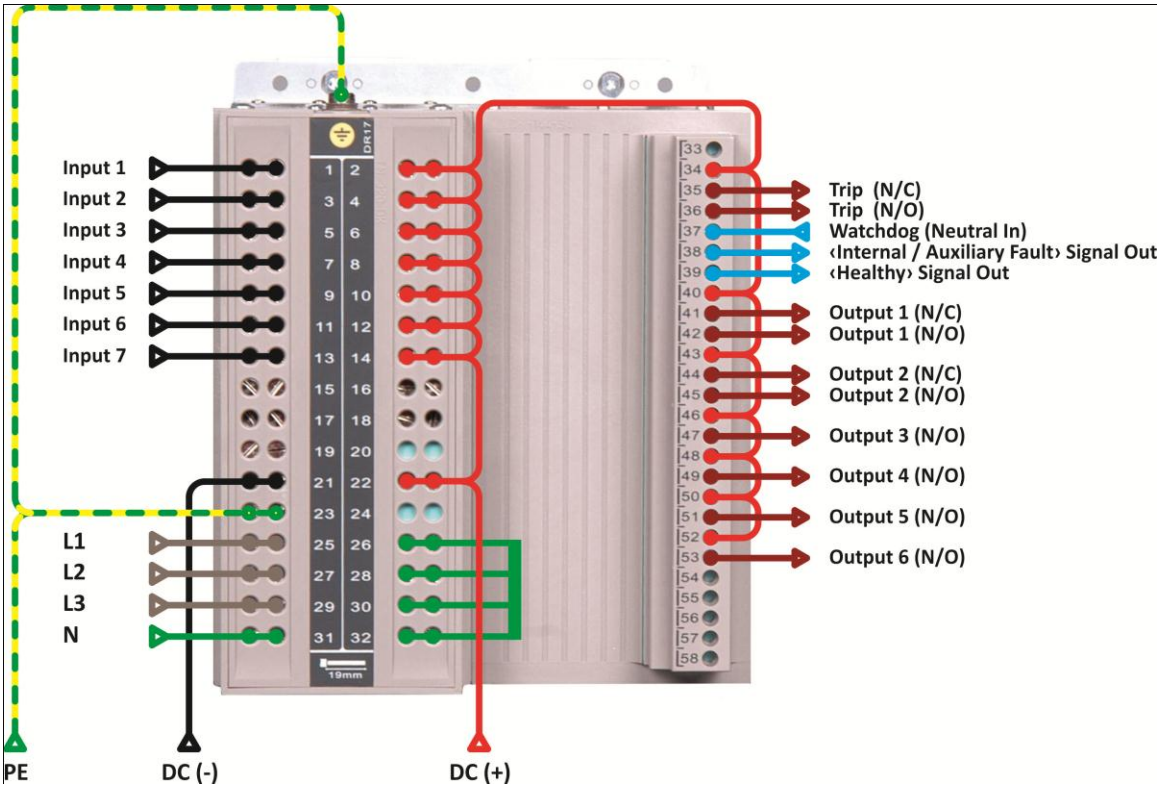
$$t = \left[\frac{6.9\ s}{1 - \left(\frac{I}{I_S}\right)^2}\right] \times RTMS$$

Sample IDMT formula: CO2 IDMT Reset Curve Formula
Please check the table on page 16 for other IDMT formulas.



Terminals Overview

DEMA CPM 310 G terminals and a sample cabling diagram is shown on the image below. The cable color code for the cabling is: red for DC (+), black for DC (-), blue for AC neutral, brown for CT secondary cables (L1, L2, L3), green for CT secondary star point (N) and yellow – green for protective earth conductor (PE). Default cabling diagram assumes that the star point of CT secondary circuit is grounded.



CPM 310 G Sample Cabling Diagram

As shown on the diagram above, one of the terminals of the inputs and outputs are supplied with DC (+) as common supply (The watchdog terminal are excluded). This common supply cabling is decided according to the following assumptions:

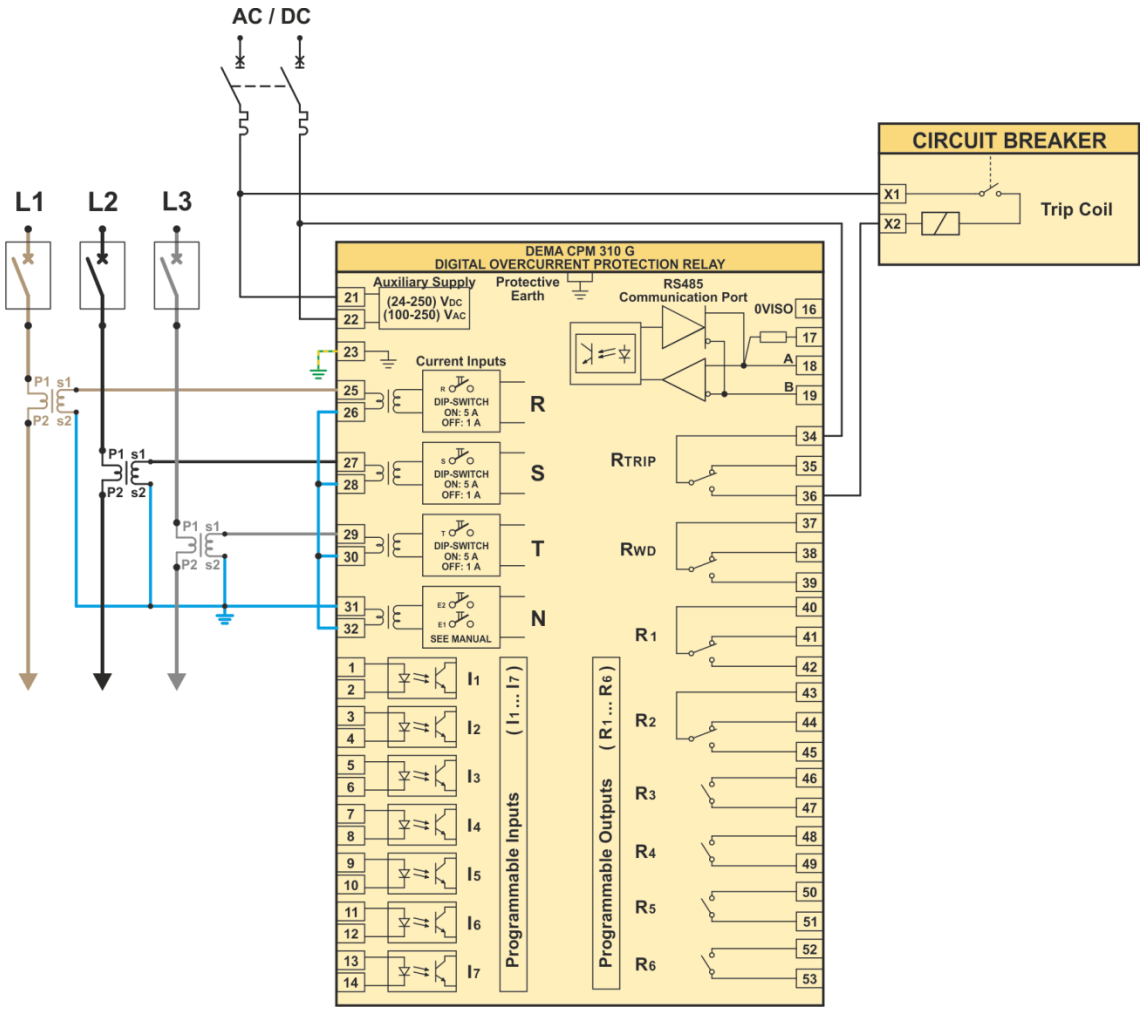
- The input signals from external devices (e.g. the circuit breaker and the power transformer) are in DC (-) polarity,
- The output signals to external devices (e.g. to the circuit breaker or a remote terminal unit) are in DC (+) polarity.

If the actual circuit design does not meet these assumptions, common supply cabling should be arranged accordingly.

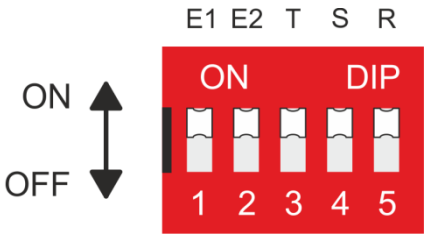
As shown on the diagram above, the watchdog relay is supplied from an AC source. Thanks to this application, a possible DC fault or protection relay failure can be reported to a remote device independently from the DC supply, enabling the best possibility to notice the operator about the situation.

Vice versa; if the auxiliary supply source to the protection relay is based on an AC system, the watchdog relay should be cabled to supply the remote alarm unit from a DC source. □

Fundamental Cabling Schema and 1 A / 5 A Dip-switch Settings



Fundamental Cabling Schema



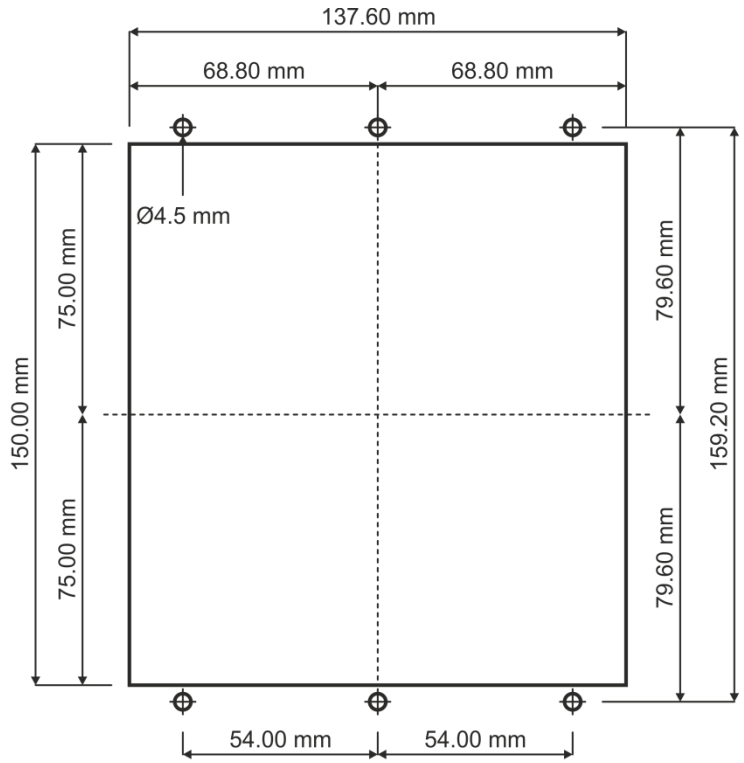
		E1	E2	T	S	R
IR	1 A					OFF
	5 A					ON
IS	1 A				OFF	
	5 A				ON	
IT	1 A			OFF		
	5 A			ON		
T1	1 A	OFF	ON			
	5 A	ON	ON			
T2	1 A	OFF	OFF			
	5 A	OFF	ON			

1 A / 5 A Dip-switch Settings

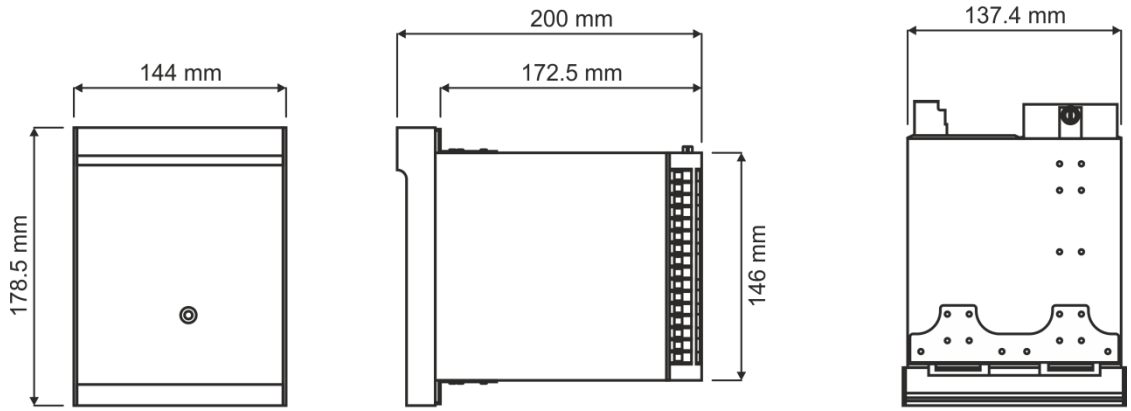
- On the table to the right; I_R / I_S / I_T shows the nominal phase secondary current,
  T1 shows Type 1 earth setting zone (0.1 I_{en} – 40 I_{en}),
  T2 shows Type 2 earth setting zone (0.02 I_{en} – 5 I_{en})
- Important notice: The CT settings should be done on the relay menus once the dip-switch settings are completed!

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 Specification Tables

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)	(24-250) V_{DC}, (100-250) V_{AC}
Supply Voltage Range (Limits)	(21-275) V_{DC}, (80-275) 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	(24-250) V_{DC}, (110-250) V_{AC}
Extended Excitation Voltage Interval	(21-275) V_{DC}, (80-275) 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	2,000 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.
∑ (Total Amperes) Supervision	Setting range: (0-12,000x104) A, in steps of 1 A.
∑² (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	150 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	2000 V / 50 Hz / 1 min and 2200 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

Type Tests

Type Tests
Tests carried out at Turkak accredited TUBITAK/UME and TSE Electrics and Electronics Laboratories.
A - Dielectrics Tests
IEC 60255-5 Dielectric Withstand Test : 2 kV / 50 Hz / 1 min.
IEC 60255-5 Dielectric Resistance Test : >100 MΩ / 500 V_{DC}.
IEC 60255-5 Voltage Impulse Test : Class 3: 5 kV @ (1.2 µs / 50 µs - 0.5 J), 3 negative pulses.
B - EMC Immunity Tests
IEC 60255-22-1 High Frequency Test : Class 3: 2.5 kV, 1 MHz.
IEC 60255-22-2 Electrostatic Discharge Test : Class 3: 6 kV / 8 kV contact and air discharge.
IEC 60255-22-3 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.
IEC 60255-22-4 Fast Transient Regime Change (Burst) : 4 kV / 2.5 kHz.
IEC 60255-22-5 Instantaneous Rise Wave Voltage (Surge) : 2 kV.
IEC 60255-11 DC Auxiliary Supply Failure and AC Wave Affect Test - Failure : 400 ms @ 220 V_{AC}/V_{DC}; wave rate: %12.
C - IEC 60255-25 EM Emission Test : (0.15 - 30) MHz
D - Mechanical Withstand Tests
IEC 60255-21-1 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.
IEC 60255-21-2 Mechanical Impact and Crash Tests : Class 1.
IEC 60255-21-3 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.
IEC 60529 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 mm.
EN60695-2-12 Plastic Withstand Class against Fire : inflammability test of plastic parts tested with 900 °C incandescent
E - Climatic Tests
IEC 60068-2-1 Dry Cold Air Withstand Test : -25 °C, 72 hours : for operating/storage/transport.
IEC 60068-2-2 Dry Hot Air Withstand Test: +70 °C, 72 hours : for operating/storage/transport.
IEC 60068-2-3 +400 °C, %93 relative humidity, 56 day duration : for operating/storage/transport.
Hot Humidity Withstand Test.
F - Overload Capacity Tests
IEC 60255-6 Continuous Current Test : Continuous 4 I_n (20 A) loading.
IEC 60255-6 Thermal Withstand Current Test : 100 I_n (500 A) / 1 s.
IEC 60255-6 Dynamic Withstand Current Test : 250 I_n (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. □

CPM 310 G Digital Overcurrent Protection Relay Brochure TR
CPM 310 G Digital Overcurrent Protection Relay Brochure EN

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