

3 - Standard additional protections and functions

List of additional protections and functions

The following additional functions and protections are present in Ekip Aware:

Name	Type of protection / Function	Page
Harmonic distortion	Distorted waveforms	110
Trip Unit Temperature Control (TU T)	Abnormal temperatures	110
Hardware Trip	Internal connection errors	110
Thermal Memory	Overheating of the cables	111
L timing above threshold	L protection threshold signalling	111
Zone Selectivity	Management of trip commands in a network of circuit-breakers	111
Startup	Different thresholds on the basis of monitoring thresholds	113
Block functions	Blocking of protection on the basis of programmable events	114
Programmable Commands	Commands programmable with events or states of the protection release	116

Harmonic Distortion Protection

Allows an alarm to be activated in the case of distorted waveforms.

The protection can be enabled via USB-C port, Bluetooth Low Energy and system bus.



IMPORTANT: the protection does not handle the trip, just the signal

Trip Unit Temperature Control (TU T)

Trip Unit Temperature Control (TU T) protection protects against abnormal temperatures measured and transmitted to the sensor inside the unit; temperature verification is always active and includes three operating states:

State	Temperature range [°C]	Ekip Aware actions
Standard	$-25 < t < 70$	Normal operation; display on ⁽¹⁾
Warnings	$-40 < t < -25$ or $70 < t < 85$	Display off; Warning led @ 0,5 Hz
Alarm	$t < -40$ or $t > 85$	Display off; Alarm and Warning leds @ 2 Hz; TRIP if Trip enable is activated

⁽¹⁾ the display remains on within range: $-20\text{ °C} / +70\text{ °C}$

All protections enabled in the unit are active in all operating states.

The Trip Enabling parameter, available via USB-C port, Bluetooth Low Energy and system bus, allows the CB opening command to be transmitted in the event of a temperature Alarm.

Hardware Trip Protection

Hardware Trip protects against connection errors in the protection release.

If enabled, with the CB closed, if one or more of these events are detected:

- current sensors disconnected (phase or external if enabled)
- Trip Coil disconnected
- faults inside the unit

the alarm is signaled and a TRIP command is transmitted.



IMPORTANT:

- the protection trips if the error statuses persist for more than one second
- the alarm due to disconnection activates the Trip coil signal. If Vaux and one of the coils (YO Sense or YO2 Sense) are present, opening is commanded until the CB Open state is detected by the protection release. To activate the option, make sure that YO Sense or YO2 Sense and coil energizing are present.

Thermal Memory Protection

The function, which is available for L and S protections, allows overheating in the cables connected to the circuit-breaker to be prevented: in the case of trips within brief intervals, the unit considers the time between commands and the entity of the faults so as to reduce opening time.



IMPORTANT: for the S protection the function can be activated if the selected curve is time-dependent.



NOTE: besides the various TRIPs, the function reduces trip time also in the case of previous overloads (over 100ms) which did not lead to the open command

L timing above threshold

L protection sets the “L timing above threshold” threshold. A warning signal activates if L protection times and the stored energy exceeds the set threshold. L protection calculates the stored energy on the basis of the protection parameters and fault current.

Presence of the Warning signal means that Trip is imminent.

The threshold can be adjusted from 70 % to 95 %, in 1 % steps.

If the fault current is constant, the threshold can be interpreted as the percentage time reached in relation to the envisaged trip time (e.g. L timing above threshold= 70 %, trip estimated on the basis of fault = 10 s, the warning indicates that timing has exceeded 7 s).

Zone selectivity Protection

The function, which can be activated for S, S2, I, RELT, MCR, G, Gext and MDGF protections (if available and enabled), allows several devices belonging to the same installation (including Ekip Aware) to be interconnected, so as to handle trip commands in the best possible way in the case of S, S2, I, RELT, MCR, G, Gext and MDGF protections.

The function allows the devices to be coordinated so that, if a fault occurs:

- The device nearest to the fault trips
- the other devices are blocked for a programmable time



NOTE: connection can be made between ABB devices that have the zone selectivity function



NOTE: S2 protection is included in an optional package and can therefore only be managed if purchased

Characteristics

Ekip Aware has five selectivity connections, located on the rear connectors of the CB:

Name	Type	Description	Connection
Szi	Input	S, S2, I, RELT and MCR protection selectivity input	From devices on the load side
Szo	Output	S, S2, I, RELT and MCR protection selectivity output	To devices on the supply side
Gzi	Input	G, Gext and MDGF protection selectivity input	From devices on the load side
Gzo	Output	G, Gext and MDGF protection selectivity output	To devices on the supply side
Szc	Common	Common connection of selectivity network	The entire selectivity network

Configuration

To correctly configure the selectivity network of one or more protections:

1. Connect zone selectivity outputs of the same type (example: Szo) of devices belonging to the same zone, to the zone selectivity input of the device immediately upstream (example: Szi).
2. Connect all the Szc of devices in the same network together.
3. Time t2 must be configured at t2 sel + 50 ms or more, with the exclusion of the device further along its network.

Continued on the next page

Logic table

The table includes all cases in which, with zone selectivity enabled in the device, an alarm condition occurs or a zone selectivity signal is received from another device.

**NOTES:**

- the table gives the S protection cases, but is also valid for the other protections: G, S2, I, RELT, MCR, Gext and MDGF, each with its respective connections
- if the selectivities of protections that share the same connections are active at the same time (example: S, S2, I, RELT and MCR), the inputs/outputs are managed with OR logic

Condition	Szi	Szo	Tripping time	Remarks
If < I2	0	0	No TRIP	TRIP II device not in alarm status
If < I2	1	1	No TRIP	The device is not in the alarm status, but sends the selectivity signal received from the device upstream
If > I2	0	1	t2 sel ⁽¹⁾	The device is in the alarm status and is the first to detect the fault: trips within time t2 sel ⁽¹⁾
If > I2	1	1	t2 ⁽²⁾	The device is in the alarm status but is not the first to detect the fault: trips within time t2 ⁽²⁾

⁽¹⁾ the trip time of protection I is that of protection

⁽²⁾ for I protection tripping time is 100ms

Type of selectivity

The zone selectivity inputs and certain of the outputs can be configured via service connector (via Ekip Connect) or via system bus communication for protections S, S2, I, RELT, MCR, G, Gext, MDGF and D (if available and enabled):

- *Standard*: operation as by zone selectivity standard logic (default configuration)
- *Customized*: the event that activates the zone selectivity input or output can be selected in this mode.



CAUTION! in the Customized configuration, the only zone selectivity activation event is the one set and standard selectivity operation is therefore not active (changes should only be made by expert technical personnel)

Startup Protection

The function, which can be activated for protections S, I, G, Gext, MDGF, S2, D and UP (if available and enabled), allow the protection threshold (*StartUp threshold*) to be changed for a period that can be set by the user (Startup time).



NOTE: for UP protection, Startup means the time for which the protection is disabled.

The cycle runs after overcoming a threshold (activation threshold), valid and verified by the protection release for all the phase currents and programmable by the user via all external connection systems.

The Startup condition expires after Startup time or if the current drops below the activation threshold. It re-activates the next time the activation threshold is exceeded.



NOTE: startup does not occur again until at least one current remains above activation threshold level.

Both Startup with activation threshold monitoring and Startup on ProgStatus D can be activated on the protection release; in the latter case, Startup begins if at least one of the conditions is present.

A graphic representation with S protection follows:

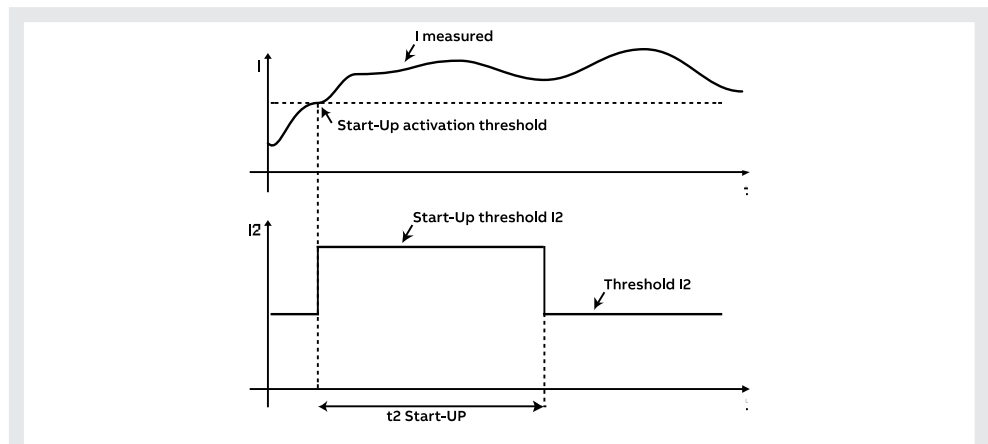


Figure 165

Block functions Six blocks can be configured for certain protections by means of the service connector (via Ekip Connect) or communication via system bus. These blocks are useful for deactivating the protections relating to programmable events:

Block name	Description
BlockOnProgStatusA	Block active if programmable status A is true
BlockOnProgStatusB	Block active if programmable status B is true
BlockOnProgStatusC	Block active if programmable status C is true
BlockOnProgStatusD	Block active if programmable status D is true
BlockOnStartUp	Block active during StartUp time (if StartUp for the specific protection is available and activated)
BlockOnOutOfFrequency	Block active if frequency measured is not within 20 Hz to 110 Hz range

Each block is independent and has its own activation command (Block On). Each protection can be configured with several block conditions by using OR logic.

The protections which have blocks are: S, S2, I, G, Gext, MDGF, Advanced MDGF, D, MCR, VU, UV, UV2, OV, OV2, RV, RP, UF, UF2, OF, OF2, ROCOF, OP, UP, OQ, RQ, SV, SV2, UC



IMPORTANT: the blocks can cause:

- increase of protection trip times (max: + 40 ms), owing to verification of the event itself (example: (frequency check)
- undesired deactivation of the protection, if the block is associated with statuses or signals to modules via local bus and auxiliary power supply is absent. In this case, it may be useful to also consider the status of the auxiliary power supply (Supply from Vaux) when programming the event
- undesired deactivation of the protection, if the block is associated with frequency measurements and the voltage is less than the minimum calculation threshold



IMPORTANT: if the function is activated, the blocks are deactivated during startup (except for BlockOnStartup, which functions during this period)

Set Startup th. on Prog Status

The function can be activated for many of the protections: S, I, G, Gext, MDGF, S2, D, if available and enabled on the protection release.

Similarly to the Startup function, it enables the activation threshold of the protection to be changed with a different threshold (Startup threshold) for a time defined by the user (Startup time).

The cycle starts if programmable state D, which can be programmed by the user via all external connection systems, becomes TRUE (at least 100 ms).

If the sole Startup on ProgStatus D function has been activated for the protection in question. The Startup state concludes if programmable state D becomes FALSE and re-activates if it goes back to being TRUE.

If both the Startup functions (with threshold monitoring and ProgStatus D monitoring) have been activated for the protection in question. The Startup state concludes after Startup time and re-activates upon the successive trigger (status switch from FALSE to TRUE).



NOTE: Startup with threshold monitoring always functions according to its own operating logic.

A graphic representation with S protection is illustrated below (in the two states described):

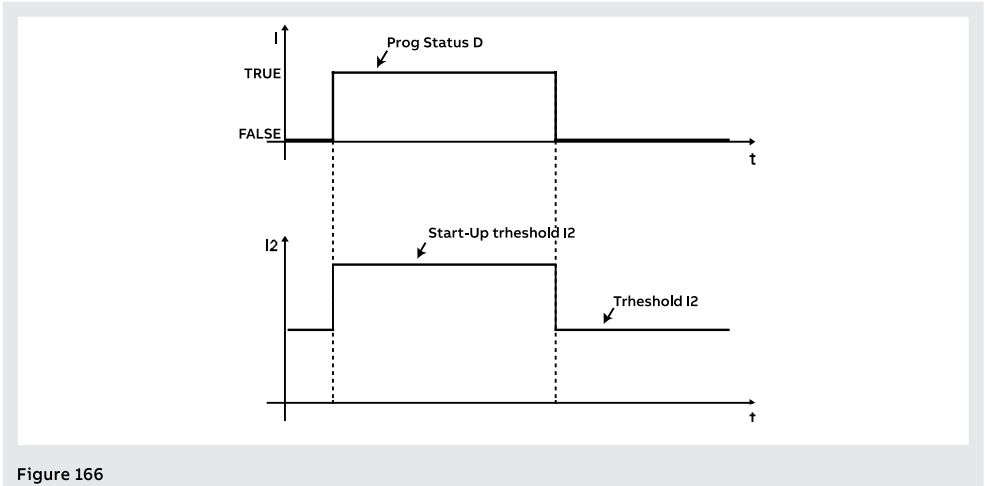


Figure 166

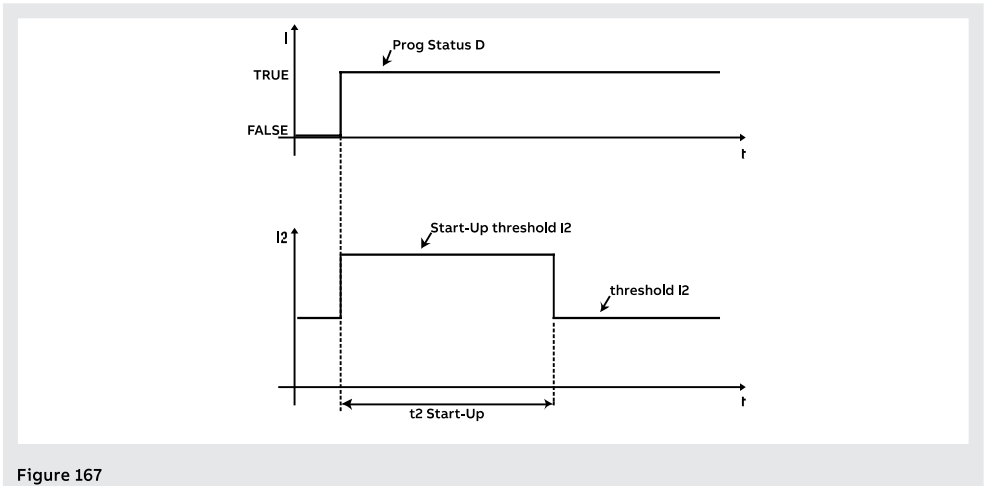


Figure 167

Programmable Functions and Commands

Numerous commands are available, with activation that can be programmed on the basis of signals or events. Configuration with every external communication System is possible.

Name	Description
External Trip	Sends a TRIP command
Internal Trip	Send a Trip command; programming with the activation alarm of the YO and YU sense coils is recommended, so as to use it as backup command.
Trip RESET	Reset of the trip signal
Turn on SET B	Change protection set to Set B i NOTE: Command available and configurable if the Double or Triple Protection Set is available
Power up SET C	Change protection set to Set C i NOTE: Command available and configurable if the Triple Protection Set is activated
RESET Energy	Resets the energy meters
YO Command	Sends an open command ⁽¹⁾
YO2 Command	Sends an open command ⁽¹⁾
YC Command	Sends a close command ⁽¹⁾
YC2 Command	Sends a close command ⁽¹⁾
Release YU	Send a release command to coil YU, with consequent opening of the CB ⁽¹⁾
Release YU2	Send a release command to coil YU2, with consequent opening of the CB ⁽¹⁾
LOCAL Switch On	Changes the configuration, from Remote to Local
Signaling RESET	Reset the contacts of the signalling modules
Restart DLog1	Restart Datalogger 1 recording
Restart DLog2	Restart Datalogger 2 recording

⁽¹⁾ the presence of Sense coils is required

Parameters

Each command provides two programming parameters:

Parameter	Description	Default
Function	Event or several command activation events (up to eight, in AND or OR logic configuration). The Custom configuration can be programmed via Ekip Connect.	Deactivated
Delay	This is the minimum time the expected event must be present in order to activate the command; the value is given in seconds and can be set within a range: 0 s to 100 s, in 0.1 s steps	0 s



IMPORTANT: the commands are sent if all the operating conditions expected by the unit are present (connections, power supplies, alarms, etc..).

4 - Zone Selectivity

Description Zone Selectivity is an evolution of time selectivity (see chapter "5 - Selectivity between ABB SACE circuit-breakers"), in which a dialog is created between the trip units through input and output blocking signals: an active input blocking signal means that the circuit-breaker must remain closed.

The protection release activates the blocking signal on the output when it detects a higher fault current than the threshold set for the protection with function enabled. Before opening, the release checks the corresponding blocking signal on the input.

- if the input is not active, the trip unit opens with a delay equal to the selectivity time set for the protection (which must be lower than the protection tripping time);
- if the input is active, it opens only if the fault persists and with a delay equal to the tripping time of the protection.

With certain ABB SACE circuit-breakers, Zone Selectivity can be activated via cabling (**Hardware Selectivity**).

Besides Hardware Selectivity, SACE Emax 3 circuit-breakers enable **Logic Selectivity** to be configured using communication via Link Bus between releases equipped with Ekip Supply Evo Modbus TCP module. Further details are given in the next paragraph.

Logic Selectivity is also supported by ABB SACE Emax 2 circuit-breakers, which can be installed in the same Link Bus network to which Emax 3 is connected.

For details about Emax 2 consult document [1SDH001330R1002](#).

Zone Selectivity with ABB SACE circuit-breakers

The following general considerations apply to ABB SACE circuit-breakers with Hardware Zone Selectivity:

- Zone selectivity can be implemented only for protections S I G and D (Directional).
- If the function is available, the circuit-breaker is equipped with two blocking outputs and two blocking inputs that is, one output and one input for each S, I and G protection), or as an alternative two outputs and two inputs for protection D (one output and one input per direction).
- Since only two blocking outputs and two blocking inputs are available, Zone Selectivity for protections S, I and G and Directional Zone Selectivity are mutually excluding (to implement Directional Zone Selectivity, the S, I and G protections must be disabled, and vice versa).
- To actuate Zone Selectivity, the releases must be equipped with auxiliary voltage to activate the outputs.
- Zone selectivity for S and I protection share the same restrain signal
- Each S G and D protection has two selectivity parameters: the function enabling parameter and selectivity time. The selectivity time indicates the opening time of the circuit-breaker when the selectivity input is not activated.
- For I protection the selectivity time is fixed (without possibility to modify the value).
- The blocking outputs and inputs are considered active if the level is high (equal to the auxiliary voltage).
- For protection D, the selectivity time to be set is the same for both directions.

For Zone Selectivity, enter the protection settings and wire the blocking inputs and outputs. The settings must enable the opening only of circuit-breakers that isolate the overload or fault without de-energizing the rest of the installation.

For clarification:

- Technical application paper QT1 [1SDC007100G0205](#) "Low voltage selectivity with ABB circuit-breakers" provides information about definitions, operating principles, areas of application, advantages and disadvantages of every type of selectivity. It also includes requirements, indications about protection settings and application examples.
- for Directional Selectivity, application examples are available in the White Paper [1SDC007401G0201](#) "Directional protection and directional zone selectivity".

Zone Selectivity with SACE Emax 2 and Emax 3 circuit-breakers

ABB SACE Emax 3 circuit-breakers configured with Ekip Aware enable zone Selectivity to be extended to several protections: S, I, G, D, RELT, MCR, S2, Gext, MDGF (availability depends on the model of protection release and the optional packages present).

Hardware Selectivity operation is the same as that described in the previous section for SACE circuit-breakers other than Emax 3, except for the addition of S2, Gext and MDGF in the list of protections supported.



IMPORTANT: S2, Gext and MDGF share the same selectivity inputs/outputs of S (S2) and G (Gext and MDGF), respectively. If several protections are active with the same channels (e.g.: S and S2) the trip unit controls the inputs and outputs with OR logic: configure the parameters with care to avoid undesired signals or actions.

Emax 2 also enables zone selectivity to be activated for many more protections; for more details see the document [1SDH001330R1002](#).

5 - Logic selectivity

Presentation Logic Selectivity can be activated for numerous protections (S, I, G, D, RELT, MCR, S2, Gext, MDGF) when Ekip Supply Evo Modbus TCP is present; compared to Hardware Selectivity, Logic Selectivity provides several advantages:

- each protection is independent and there are no cases of shared or exclusive channels/bits (example: selectivity D can be actuated without disabling protections S and G).
- each device connected to Link Bus can be customized with many propagation, mask, diagnosis parameters.

Selectivity parameters and states are available with all remote connection systems (the next descriptions refer to Ekip Connect).

Consult the next paragraph for details about how to pair together releases connected to the same Link Bus.

Parameters

The function must be enabled, the selectivity time configured and the operating mode selected (Logic or Logic+Hardware) in the parameters menu of every protection for which Logic selectivity must be activated.

All the other parameters required to make Logic selectivity function are distributed among the pages of the Ekip Supply Evo Modbus TCP module (Supply Pro - Link pages) described below.



NOTE: all the following parameters and configurations are available when Ekip Supply Evo Modbus TCP is connected and on

Setting Logic selectivity can be implemented for 12 to 15 actors (protection releases) paired to the protection release via Link Bus:

- select hardware only selectivity or mixed selectivity (hardware and logic) in the “Supply PRO - Link Enhanced Selectivity” page
- enter the IP address of each actor present in the “Supply Pro - Link Configuration” page; entry of the address enables the configuration parameters and state indicators to be displayed in the various pages (see chapter Power Controller).
- the function must be enabled for each actor paired to the protection release via Link Bus and for which Logic selectivity must be actuated (the “True” value must be assigned to the the Actor Selectivity parameter).
- the selectivity masks described below are available in the “Supply PRO - Link Enhanced Selectivity” page for each actor present.

The **selectivity masks** allow you to select the protections of the actors (S, I, RELT, MCR, G, D-Forward, D-Backward, S2, Gext, MDGF) that activate the selectivity input of Ekip Aware (example: actor 1, protection mask S= S2: selectivity S of Ekip Aware will be active in the presence of signals S2 of actor 1).

In this configuration, activation of the function for S protection and its alarm state trips the S/D Forward hardware blocking signal and the S logic selectivity bit on the output. Based on the blocking signals:

- If, on the input, the S/D-Forward hardware blocking signal and the S2 logic selectivity bit of actor 1 are not activated, the system sends the opening command in accordance with the selectivity time set for S protection
- If, on the input, the S/D-Forward hardware blocking signal is activated or if mixed selectivity has been selected and the S2 logic selectivity bit of actor 1 is activated, the system waits for a time equal to the trip time of S protection. Once this time has elapsed, the system only sends the open command if S protection is still in the alarm state.

Continued on the next page

**IMPORTANT:**

- the logic selectivity bits on the output and on the input are those in the data packages shared by the releases via Link Bus;
- the S/D-Forward (G/D-Backward) hardware output is only activated if the S or D-Forward (G or D-Backward) protections are in the alarm status, and the S/DForward (G/D-Backward) hardware input only acts as a block for the S and D-Forward (G and D-Backward) protections, regardless of whether solely hardware or mixed selectivity has been selected.



IMPORTANT: if solely hardware selectivity has been selected, the logic selectivity bits are ignored on the input, but are still activated on the output

Selectivity masks

Remote Programmable States A and B are also included in the **selectivity masks**: these 2 parameters, which are available in the *Ekip Link configuration* page, enable the event (or combination of several events) and reference actor that activates the selectivity input to be selected.

2 additional states are available, C and D, but they cannot be configured for Zone Selectivity; all 4 programmable states are used for the Programmable Logic function (see *Ekip Supply Modbus TCP* module on page 287).



NOTE: the Programmable Logic function is independent from that of Zone Selectivity

Repetition

The **Supply PRO - Link Enhanced Selectivity** parameter is available in the *Ekip Link advanced selectivity* page. It enables the selection of protections whose logic selectivity bit, if present on the input, must be propagated regardless of the status of the protection on the current unit.



NOTE: the parameter only acts on the selectivity bits. It does not involve the outputs

Errors and inconsistencies

Regardless of the diagnosis, if a hardware input is active and none of the logic selectivity bits of the associated actors is active, a line inconsistency for this input is reported in the *Supply PRO - Link Status* page.



NOTE: line inconsistency is ascertained by checking all the actors associated with the unit, even those for which the function has not been enabled (the Selectivity Actor parameter has not been assigned value: True)

A line inconsistency (independent of diagnosis) is indicative of a possible configuration error (example: a hardware input of the release is connected to the hardware output of a device not associated via Link Bus, or of an actor for which the function has not been enabled).

To avoid a line incongruity signal, the system must connect to the Link Bus and pair Ekip Aware to devices with hardware outputs connected to the hardware inputs of Ekip Aware itself. There is no need to enable the function for these devices or to assign the *True* value to the Selectivity Actor parameter.

6 - Performance table of standard protections

- General notes:**
- the performance values given in the next table are valid with ≥ 100 ms trip time, temperature and signals within the operating limits; failure to comply with these limitations could lead to an increase in the tolerances;
 - Ekip Aware sends the TRIP command if the signal read exceeds the threshold for longer than the set time (or the time resulting from the calculation formula)
 - with an inverse time-delay trip curve, the calculation refers to a signal with a constant value throughout the timing: variation of the alarm signal causes a different trip time;
 - the additional notes are given after all the tables.

Standard Protections

Protection [ANSI code]	Trip time $t_t^{(1)}$	Trip threshold tolerance ⁽³⁾	Trip time tolerance ⁽³⁾
L [49]	$t_t = \frac{r_1 \times 10}{\left(\frac{I_f}{I_1}\right)^2}$ (with curve $t = k / I^2$)	Activation for I_f within range: $(1.05 \text{ to } 1.2) \times I_1$	with $I_f \leq 6 I_n$: $\pm 10 \%$ / with $I_f > 6 I_n$: $\pm 20 \%$
	$t_t = \frac{11 \times 10 \times 10}{\left(\left(\frac{I_f}{I_1}\right)^2 - 1\right)}$ (with curves 60255-151)		
I [50]	$t_t \leq 30$ ms	$\pm 10 \%$	--
MCR	$t_t \leq 30$ ms	$\pm 10 \%$	--
RELT ⁽¹⁾⁽⁴⁾	- with $I_f \geq 18$ kA, $t_t \leq 3$ ms - with $I_f < 18$ kA and $I_f \geq I_{31}$, $t_t \leq 7$ ms (If three-phase) or $t_t \leq 9$ ms (If single-phase) - with $I_f < 18$ kA and $I_f < I_{31} \times 3$, $t_t \leq 15$ ms	$\pm 10 \%$	--
S [50TD / 51]	$t_t = t_2$ (with curve $t = k$)	with $I_f \leq 6 I_n$: $\pm 7 \%$ / with $I_f > 6 I_n$: $\pm 10 \%$	The best between $\pm 10\%$ and 40 ms
	$t_t = \frac{12 \times 100}{I_f^2}$ (with curve $t = k / I^2$)		with $I_f \leq 6 I_n$: $\pm 15 \%$ / with $I_f > 6 I_n$: $\pm 20 \%$
G [50N TD / 51N]	$t_t = t_4$ (with curve $t = k$)	$\pm 7 \%$	The best between $\pm 10\%$ and 40 ms ⁽²⁾
	$t_t = \frac{214}{\left(\frac{I_f}{I_1}\right)^2}$ (with curve $t = k / I^2$)		$\pm 15 \%$
Gext [50GTD / 51G]	$t_t = t_{41}$ (with curve $t = k$)	$\pm 7 \%$	The best between $\pm 10\%$ and 40 ms ⁽²⁾
	$t_t = \frac{2}{\left(\frac{I_f}{I_1}\right)^2}$ (with curve $t = k / I^2$)		$\pm 15 \%$
MDGF	$t_t = t_{41}$ (with curve $t = k$)	$\pm 7 \%$	The best between $\pm 10\%$ and 40 ms ⁽²⁾
	$t_t = \frac{2}{\left(\frac{I_f}{I_1}\right)^2}$ (with curve $t = k / I^2$)		$\pm 15 \%$

Continued on the next page

Startup

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance ⁽³⁾	Trip time tolerance
I StartUp	$t_t \leq 30$ ms	± 10 %	--
S StartUp	$t_t = t_2$ startup	with $I_f \leq 6 I_n$: ± 7 % / with $I_f > 6 I_n$: ± 10 %	The best between ± 10 % and 40 ms
G StartUp	$t_t = t_4$ startup	± 7 %	The best between ± 10 % and 40 ms
Gext StartUp	$t_t = t_{41}$ startup	± 7 %	The best between ± 10 % and 40 ms
MDGF	$t_t = t_{41}$ startup	± 7 %	The best between ± 10 % and 40 ms

Notes ⁽¹⁾ use trip and threshold current values expressed in I_n for calculating t_t (example: $I_f = 0.8 I_n$, $I_1 = 0.6 I_n$)

⁽²⁾ with $t_4 =$ instantaneous, the maximum tolerance is 50 ms

⁽³⁾ tolerance values valid with Trip unit at steady state or on with auxiliary power supply, trip time ≥ 100 ms, temperature and signals within operating limits; the tolerances in the table after the notes are applicable if the conditions are not guaranteed

⁽⁴⁾ operating parameters guaranteed with auxiliary energizing via Ekip Supply module (Lite or Evo Modbus TCP)

Performance guaranteed in all operating conditions

Protection	Trip threshold tolerance	Trip time tolerance
L	Activation within range: $(1.05 \text{ to } 1.2) \times I_1$	± 20 %
I	± 15 %	≤ 60 ms
RELT	≤ 60 ms	± 10 %
S	± 10 %	± 20 %
G	± 15 %	± 20 % (60 ms with $t_4 =$ instantaneous)
Gext	± 15 %	± 20 %
MDGF	± 15 %	± 20 %

7 - Curves of standard protections

Introduction This chapter includes the trip curves of the protections, which are shown in different graphs:

- the curves are represented considering the maximum and minimum values of the parameters of each protection, including the TRIP functions provided (current, time);
- protections with several curves (example: S protection), are shown in several graphs;
- the curves do not take account of the effects of special parameters, such as thermal memory and startups.

i **NOTE:** it is advisable to always use the mathematical function in the summary table of the protections to calculate the trip time (page 121).

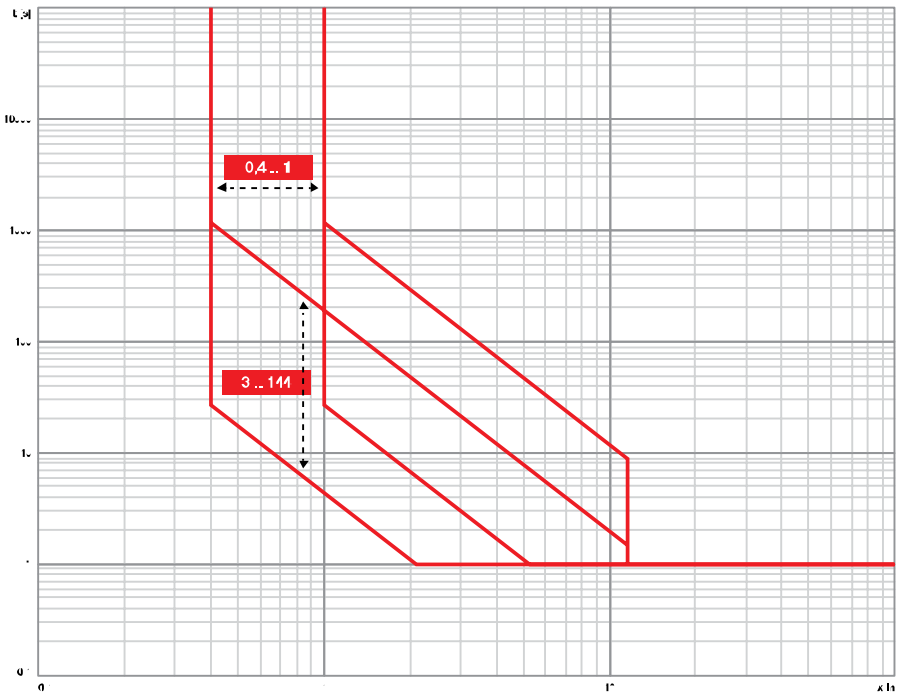
This chapter illustrates the electronic trip curves of the available protections with all the protection trip units for SACE Emax 3 circuit-breakers, represented in various dot diagrams. Some notes for reading the diagrams:

- The curves are illustrated considering the minimum and maximum values and of the parameters of each protection.
- The curves do not take account of the effects of special parameters such as thermal memory, startup, etc.

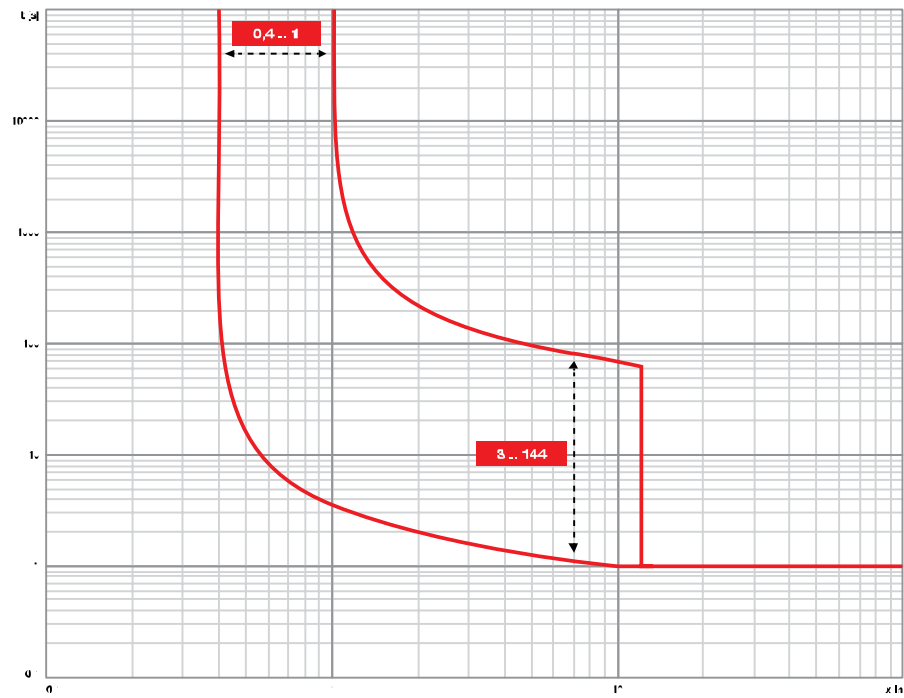
i **NOTE:** trip curve modeling software should be consulted when conducting a coordination or arc flash study as these are simplified representations of the protection curves.

Protections	Page
L Protection	123
I and MCR protection	126
RELT protection	126
S Protection	127
G and Gext protection	128
MDGF Protection	129

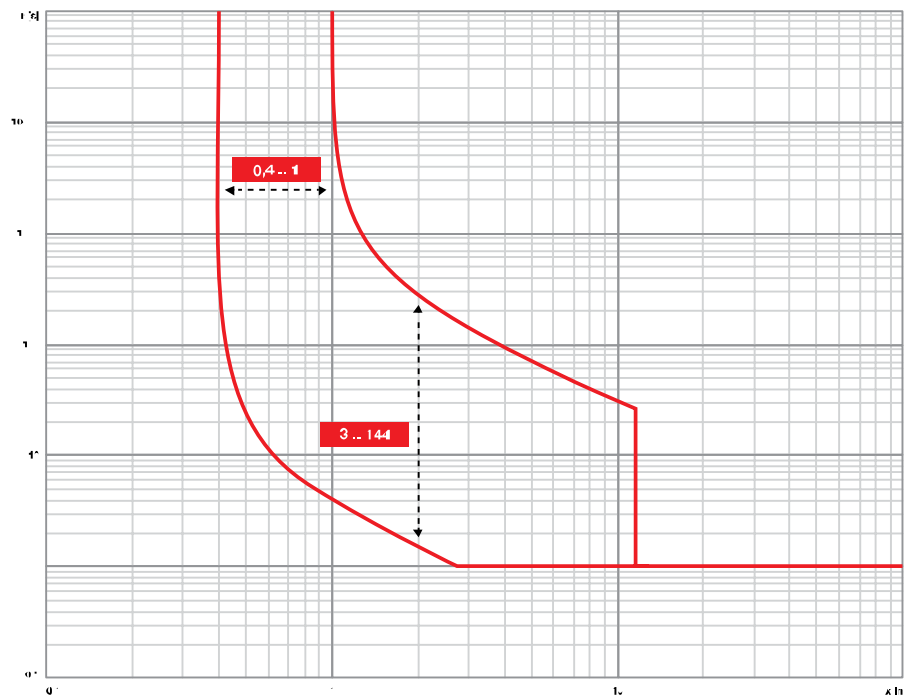
Function L ($t = k/I^2$)



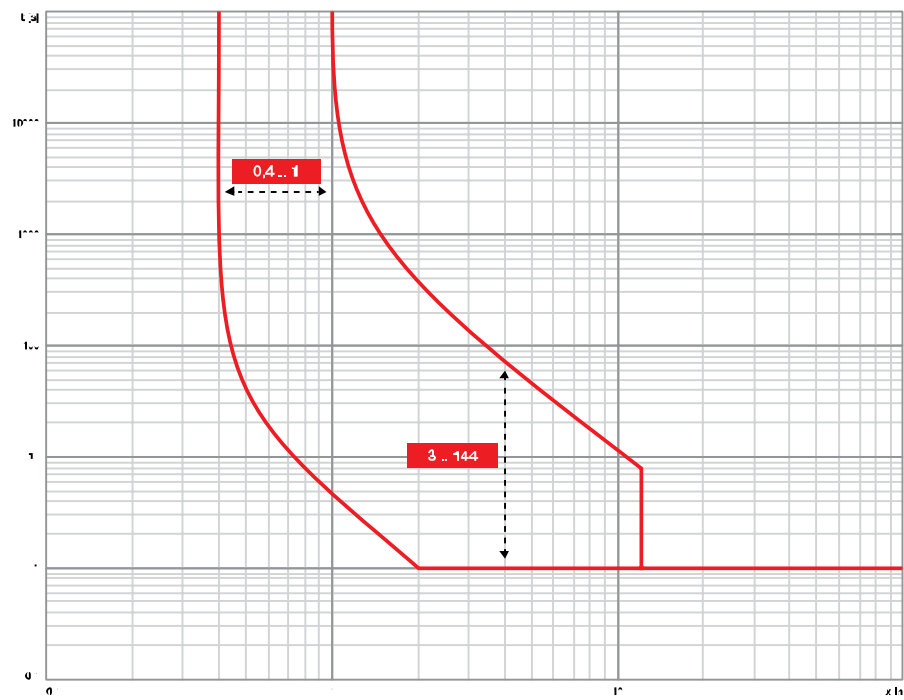
Function L (IEC 60255-151 SI)



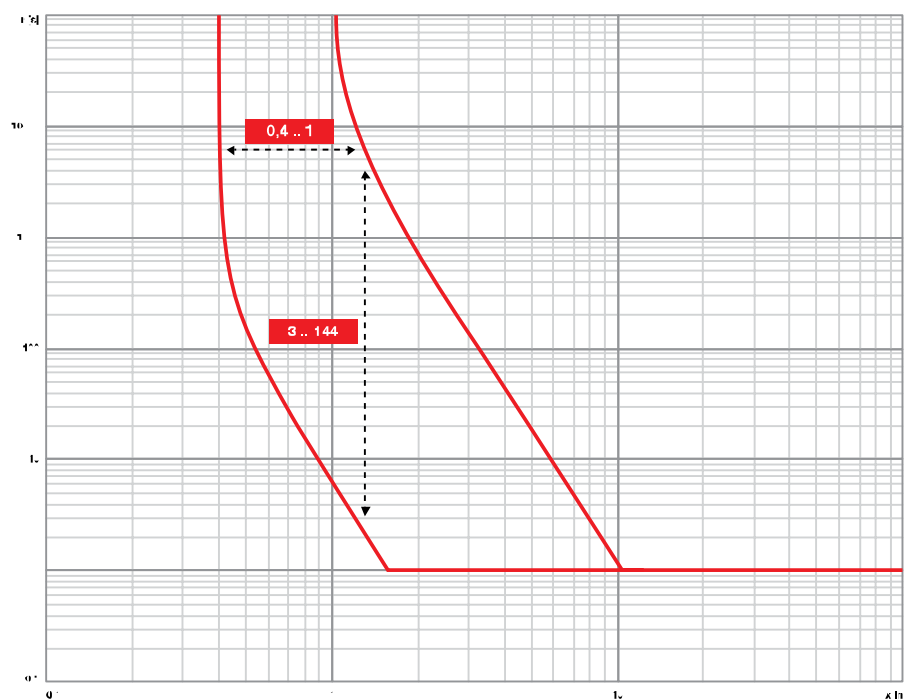
Function L (IEC 60255-151 VI)



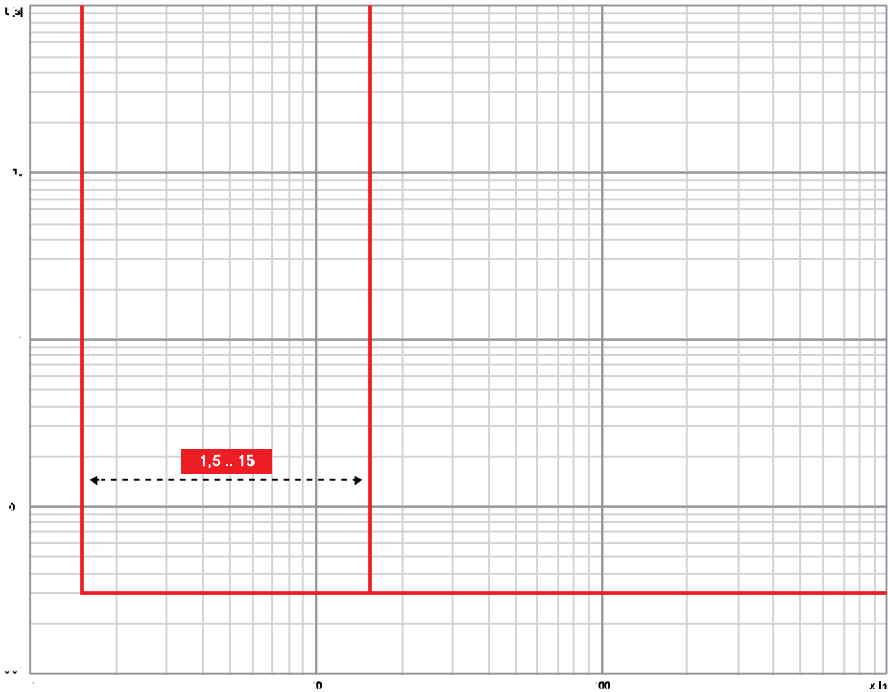
Function L (IEC 60255-151 EI)



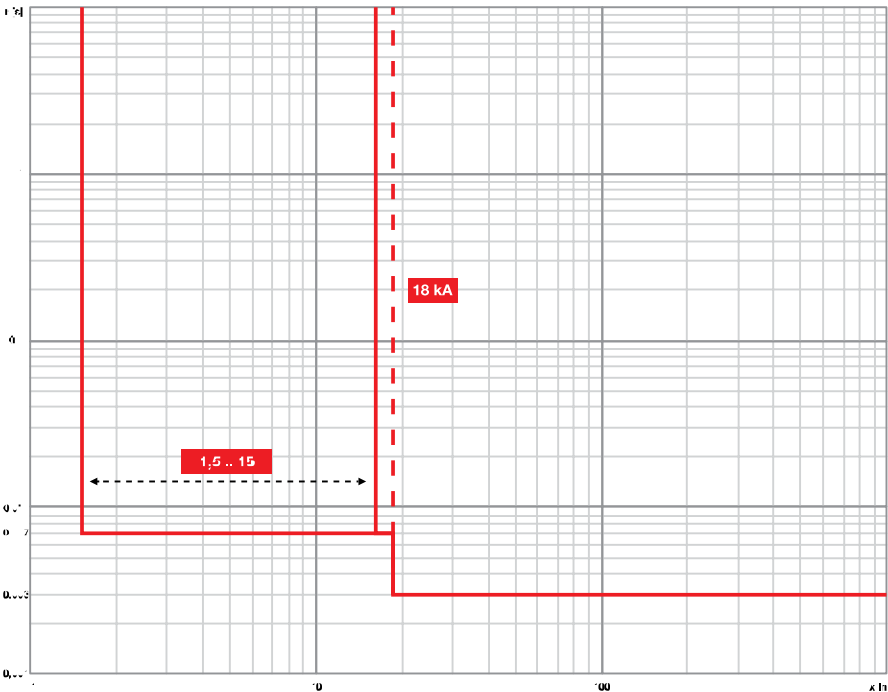
Function L ($t = k/I^4$)



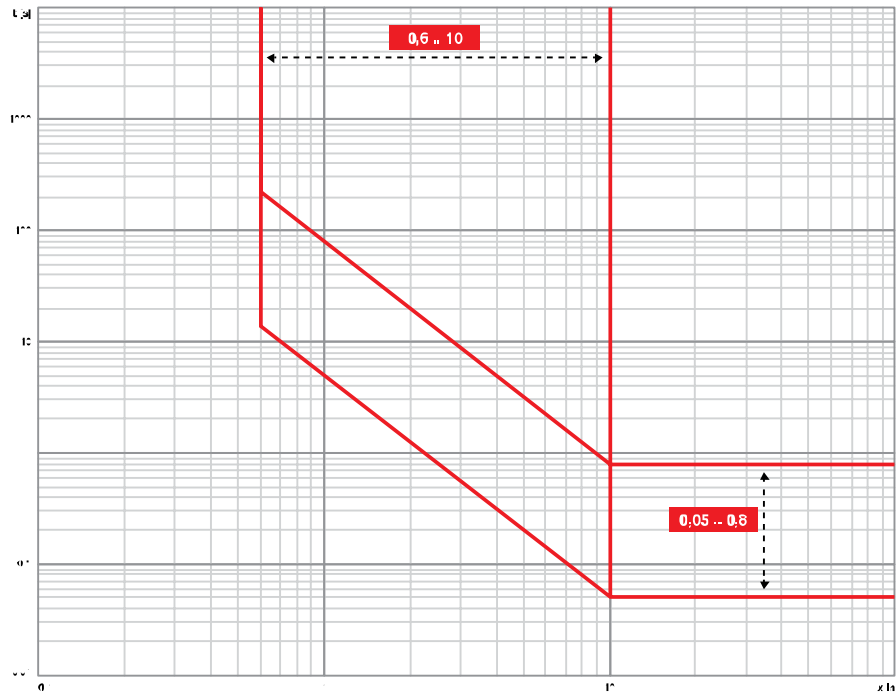
Function I \ Function MCR



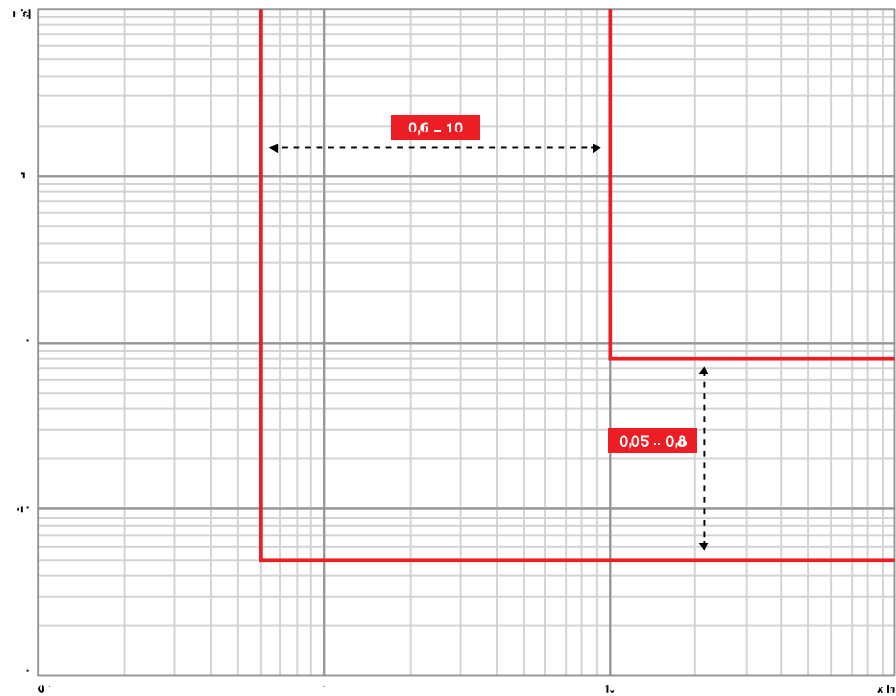
RELT curve



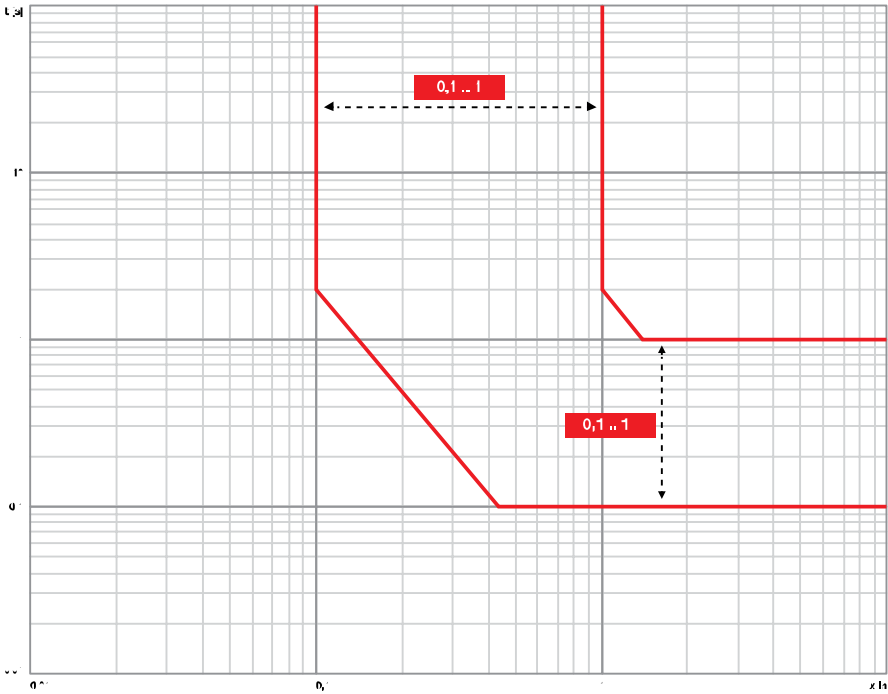
Function S ($t = k/I^2$)



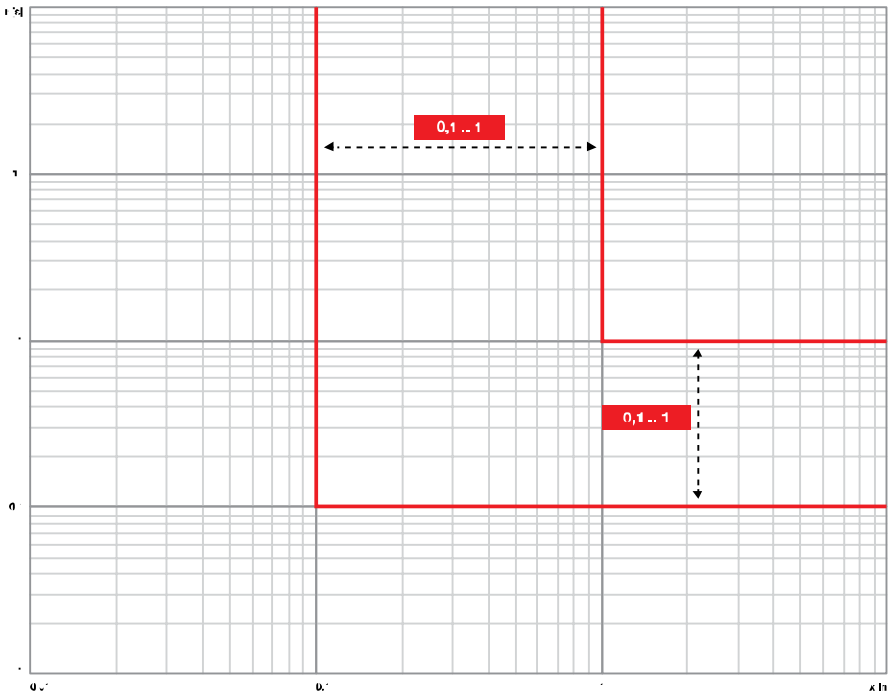
Function S ($t = k$)



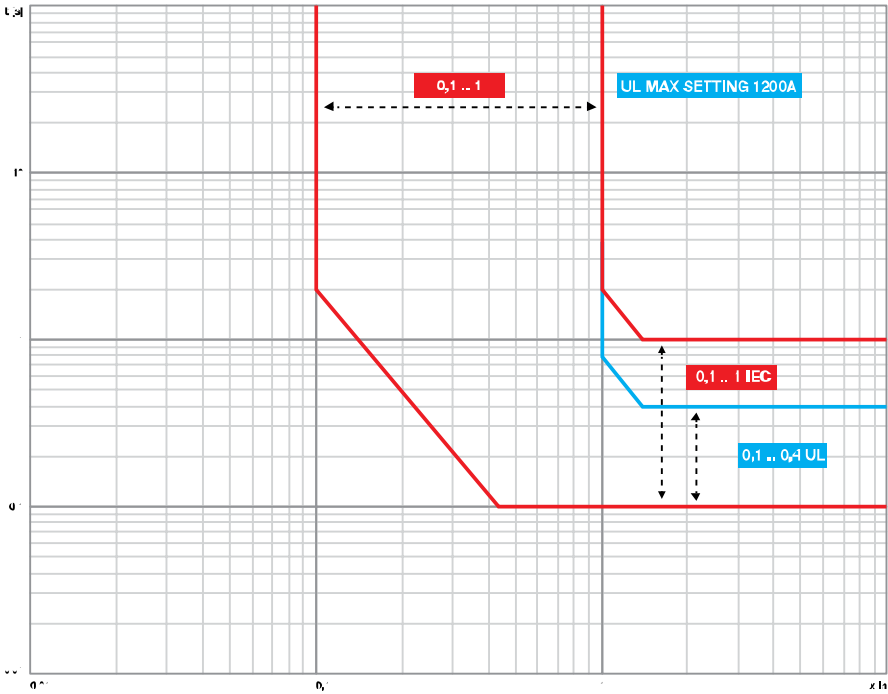
Function G ($t = k/l^2$) \ Function
Gext ($t = k/l^2$)



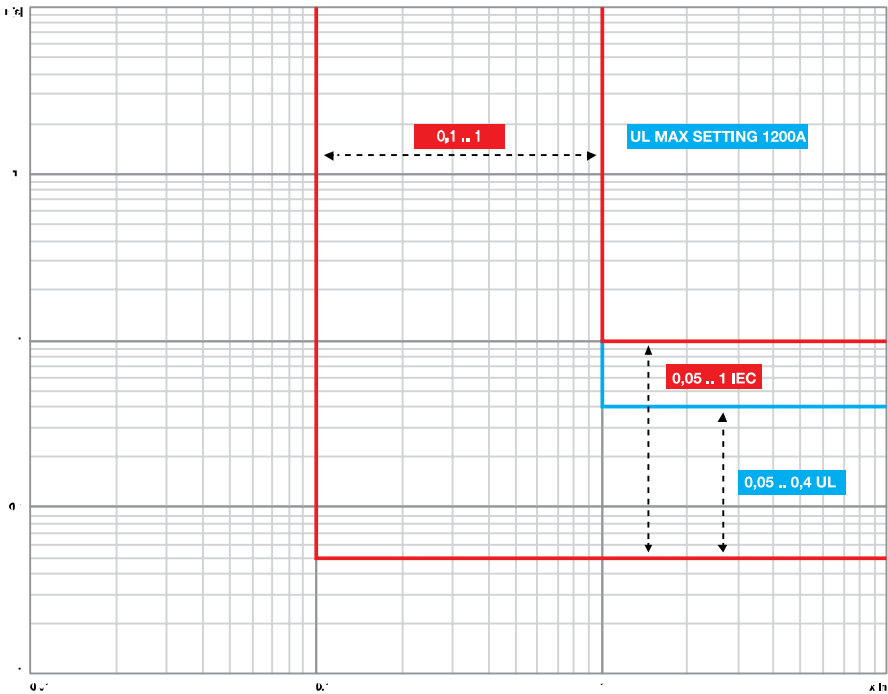
Function G ($t = k$) \ Function
Gext ($t = k$)



Function MDGF ($t = k/I^2$)



Function MDGF ($t = k$)



8 - Standard Measurements

List All Ekip Aware versions provide for measurements and recordings, some directly from the Home page, others in the screen display menus:

Parameter	Description	Page
<i>Instantaneous currents</i>	Phase and earth fault current measurements in real time ⁽¹⁾	130
<i>Events</i>	List of events, status changes, alarms, recorded by the Trip unit	131
<i>Trip</i>	List of current protection trips (TRIP)	131
<i>Load Profiles</i>	Meters paired to instant currents	132
<i>Maintenance</i>	CB status: contact wear and last maintenance	132
<i>CB Statistic</i>	Number of mechanical and electrical operations	132
<i>State</i>	General state of circuit-breaker	132

⁽¹⁾ Earth fault currents available with LSIG version of Ekip Aware

All the measurements listed above and other additional measurements can be accessed from all the remote connection systems.

Parameter	Description	Page
<i>Min-Max measurements</i>	Minimum and maximum current values recorded by the protection release	133
<i>measurements log</i>	Phase current measurements recorded at programmable intervals	
<i>Peak factor</i>	Real time measurement of peak factor of phase currents	
<i>THD current</i>	Measurement of THD of currents	
<i>Currents TDD</i>	Measurements of TDD of currents	

Instantaneous currents The phase and earth faults currents, given in root mean square value and measured in real time, are available in Home and in the Measuring menus.

The number of currents and how they are displayed depends on the menu/page selected:

- Barchart and Virtual cockpit give the larger phase current in both absolute value (Amperes) and in relation to the nominal size (% In)
- Panel gives all phase and earth fault current measurements in Amperes

The measuring range, representation and performance depend on the rated current defined by the Digital Rating Plug (In):

Measurement	Measurement interval (min-max)	Normal operating range	Accuracy of value read ⁽¹⁾
<i>Phase currents</i>	0,004 ÷ 64 In	0,2 ÷ 1,2 In	2% ⁽³⁾
<i>Internal earth fault current⁽²⁾</i>	0,08 ÷ 64 In	0,2 ÷ 1,2 In	2 % ⁽³⁾

⁽¹⁾ the accuracies refer to normal operating ranges, as established by IEC 61557-12

⁽²⁾ available with LSIG versions

⁽³⁾ accuracy values relate to Ekip Aware without Class 0.5 or Class 1 optional functions; if one of these two functions is present, check performance values given from page 150.

Special representations

Type of measurement	Measurement < min value	Measurement > max value	"_ _ _" displayed: (not available) due to
Internal earth fault and phase currents		[64 In] ⁽¹⁾	Sensors disconnected

⁽¹⁾ gives the value nearest to the theoretic maximum threshold considering the measurement resolution; example: if In=1000 A the value given is 63999 A

Events Ekip Aware can record the last 200 events, mainly concerning variations in the status and operation of the unit; in particular:

- configuration status of the bus, operating mode, active set, auxiliary supply
- connection statuses or alarms: current sensors, *Trip Coil*
- protections: delay in action or alarm
- trip: status of open command, signaling of trips due to protection



NOTE: the first event available in the list is the most recent one; having reached the 200-events threshold, the oldest events will be progressively overwritten.



NOTE: if a numerical alarm is displayed (e.g.: 30002), consult the *Events* page of the *System Interface* to identify the error. Contact ABB if the code is not included in the list.

The complete list is available in the *Diagnostic - Events* menu, where a set of information is given for each event: icon of the type of event, name of event, date and time of recording.

There are 4 icons that identify the type of event:

Icon	Description
	Event reported for information purposes
	Timing of a protection in progress, trip expected
	Alarm referring to a non-dangerous condition
	Alarm concerning operation, a fault or connection failure

Trip Ekip Aware is able to record the last 30 TRIPs.

The complete list is available in the *Diagnostic - Trip* menu; each TRIP is provided with useful information:

- the protection that caused the trip;
- the consecutive number of the trip;
- the date and time of the trip (with reference to the internal clock);
- the measurements associated with the tripped protection.



NOTE: once the 30-TRIP threshold has been exceeded, the oldest trips are progressively overwritten.

Correlated measurements

The type of protection involved determines the measurements recorded at the moment of tripping:

Protection	Measurements recorded	Notes
Current	L1, L2, L3, Ne, Ig Currents	Ne is available with CBs type 4P and 3P + N; Ig is available in the case of trips due to G protection
Temperature	L1, L2, L3, Ne Currents	The temperature cannot be displayed

Access to most recent trips

Besides being available in the *Historicals* menu, information about the most recent trips can be accessed in three different ways, depending on the conditions of Ekip Aware:

Condition	Access
Trips that have just occurred with Ekip Aware on	The main page is temporarily replaced by a trip information page; press the iTEST button to reset and go back to the normal screen page
Trips that have just occurred with Ekip Aware off	Hold your smartphone near to the protection release to view the TRIP details NOTE: this option is available if the protection release has an NFC and the BLE has been previously activated in the <i>Settings</i> - <i>Connectivity</i> menu.
Rapid consultation in all the other conditions	Press the iTEST button four times from any page other than a menu, or a page accessed via a menu

Load Profile SACE Emax 3 has 4 meters which display how long the maximum current measured by the trip unit has remained in each percentage band.
The meter values are given in seconds and the bands are: 0-49 % In, 50-79 % In, 80-89 % In, >90 % In
The meters are available in the *Diagnostic - Meters* menu.

Maintenance The *Diagnostic - Maintenance* menu provides information about the operations and type of maintenance regarding the circuit-breaker: date of last maintenance, type of maintenance provided for the circuit-breaker in question (basic version = TimeBased), date of last operation recorded.

CB Statistic Contact wear and CB operations are available in the *Diagnostic - Meters* menu. The CB operations (total manual operations and TRIPs) are recorded by the Trip unit in the presence of auxiliary power supply and are available in the *About - Circuit breaker* menu.

The following counters are also available when communication with the Trip unit is activated:

- total number of operations
- number of mechanical operations
- number of openings due to protection trips (Trip)
- number of trip tests performed

Contact Wear

Contact wear provides an estimation of the state of wear of the main contacts of the circuit-breaker. The value is given in percentage form and is 0% if there is no wear and 100% if the contacts are completely worn.

It is calculated automatically by the Trip unit whenever a trip is caused by a protection or, in the presence of auxiliary power supply, whenever the circuit-breaker is opened in the manual mode.



NOTES:

- the percentage is no longer increased once 100% has been reached;
- 80% wear is signaled by a prealarm, while 100% is signaled by an alarm.



CAUTION! 100% wear does not impose any functional limit; however, the state of the circuit-breaker must be checked as soon as possible

State Information about the health of the circuit-breaker is available in the *Diagnostic - State* menu: warnings or alarms present, date of last trip, date of last operation recorded.

There is also a command that can have two values and that enables the details of the individual parts of the circuit-breaker to be checked: "View Status (in green), when there is no warning or alarm; "System Check" (in red), when alarms or warnings are present.

Use the arrows to scroll and view the state of each alarm category (green= ok, red= alarm or warning present; grey= not available/applicable).



NOTE: Alarms and warnings concern the system, not timed protections.

Additional measures Further, additional measurements can be accessed from all remote connection systems (the reference system in the next descriptions is Ekip Connect).

Min-Max measurements

Ekip Aware records the minimum and maximum absolute values of the currents, voltages, powers and power factors measured.

The data and a command for resetting them are available in the “List of measurements - Other measurements” page of Ekip Connect.

Measurements history

Ekip Aware can record the values of the currents, voltages, powers and power factors at regular intervals.

The recording interval between one measurement and the next is defined by the monitored Time parameter, available on the “Unit configuration” page of Ekip Connect.

The measurements and a command for resetting them are available in the “Measurements log” page of Ekip Connect.

Peak factor

The peak factors are real time measurements of the ratio between the peak and RMS values of the phase current; the measurement is supported by the *Harmonic distortion* protection function (page 110).

Measurement	Monitor time	Accuracy	Notes
Peak factor	$0,3 \div 6I_n$	1,5%	“---” (not available) is indicated for currents outside the range and disconnected sensors

THD current

Harmonic analysis of the currents can be activated in the “THD-Harmonics, Harmonics Parameters” page of Ekip Connect.

Enabling allows access to the Harmonics THD page where the actual values of the THD of all phase currents are available (can also be viewed on the dedicated page of Ekip Aware).

The “Harmonics Parameters” page allows you to program a monitoring threshold for total THD (within range: 5% to 20% in 1% steps) and the individual harmonics (in a 3% to 10% range in 1% steps), which activates an alarm signal if the thresholds are exceeded.

Currents TDD

Besides the currents THD measurements, the “Harmonics THD” page of Ekip Connect also contains the instantaneous values of total THD and of all the phase currents, neutral excluded (can also be viewed on the dedicated page of Ekip Aware).

TDD indicates the harmonic distortion of a load configurable from 0.2 I_n to 1 I_n (in 0.01 I_n steps) available in the “Harmonics Parameters” page; total TDD considers the root-mean-square value of the individual phase TDD.

9 - Datalogger

Presentation



Function

The Datalogger is a function which allows data associated with a trigger event to be recorded. The following data are recorded:

- Analog measurements: line-to-line voltages and phase currents
- Digital events: protection events or alarms, circuit-breaker status signals, protection trips.

The function can be configured and the recordings downloaded from Ekip Connect.

When the Datalogger is enabled and activated, Ekip Aware continuously acquires data by filling and emptying an internal buffer (**B**).

If a trigger event (**A**) occurs, Ekip Aware interrupts acquisition (**STOP**) immediately or after a time that can be set by the user (**C**) and stores all the data of the window (**D**), which can then be downloaded to a PC for reading and analysis.



IMPORTANT: the function requires an auxiliary voltage supply.

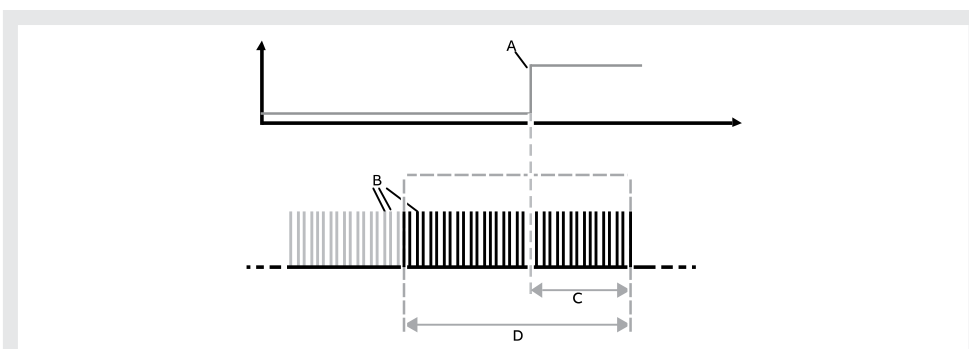


Figure 168

Parameters 1

The “Datalogger” page of Ekip Connect contains the parameters and commands of the function.

Parameter	Description	Default
Enable	Activates/deactivates the function	Off
Sampling frequency	Establishes the number of samples acquired per second and the recording window. Four options are available: 1200 Hz (window= 13.6 s), 2400 Hz (6.8 s), 4800 Hz (3.4 s), 9600 Hz (1.7 s) i NOTE: a high frequency allows the data to be analyzed more accurately	9600 Hz
Registers in Sample	Allows you to store the number of measurements saved for each recording, 8 (only currents), 16 (currents, voltages, state and trips), 32 (currents, voltages, state, trips, times, alarms and currents Icw)	
Trigger Type	Trigger event at which the recording is to be interrupted; the main protection options (openings, timings, alarms), the actuator state (open/closed) and the Custom configuration to customize the event are proposed.	None
Stop delay	Recording interruption delay, calculated from the trigger; the value is given in seconds and can be set within a range: 0 s to 10 s, in 0.01 s steps	0.01 s
Restart	Recording start command	
Stop	Manual recording stop command	

Signallings If there is a recording present, Ekip Aware provides the information on the diagnosis bar (DLog1 available).

Instruments Two areas can be accessed in the Tools area of Ekip Connect:

- **Datalogger** same options and commands as the Datalogger Basic page in a simplified visual form to configure the parameters in a simplified visual form and download the recordings
- **Data Viewer** for opening and consulting the recordings

10 - Main settings of Ekip Aware

Foreword There are three configuration areas in the Settings menu:

- Connectivity, to define the external connections
- Configuration, for the circuit-breaker and system settings
- Device, for the parameters of the protection release

All the parameters and other additional ones are available via external connection systems.



WARNING! changes to the settings must be made in the absence of protection alarms.

Bluetooth Low Energy - Connection security

The BLE function in the protection release can be activated in the *Bluetooth Low Energy* menu. This is useful for launching a communication with an external device (tablet, smartphone) according to the Bluetooth Low Energy protocol, via the *EPiC APP* (page 8).

To activate Bluetooth Low Energy communication, the release must be pre-engineered for a wireless connection. The ABB EPiC application and the pairing configuration described in the table of the next paragraph ensure that the data and Bluetooth Low Energy connection between the protective release and device are secure.



IMPORTANT: BEFORE CONFIGURING THE BLUETOOTH CONNECTION consult chapter Cybersecurity guidelines on page 80.

Connectivity

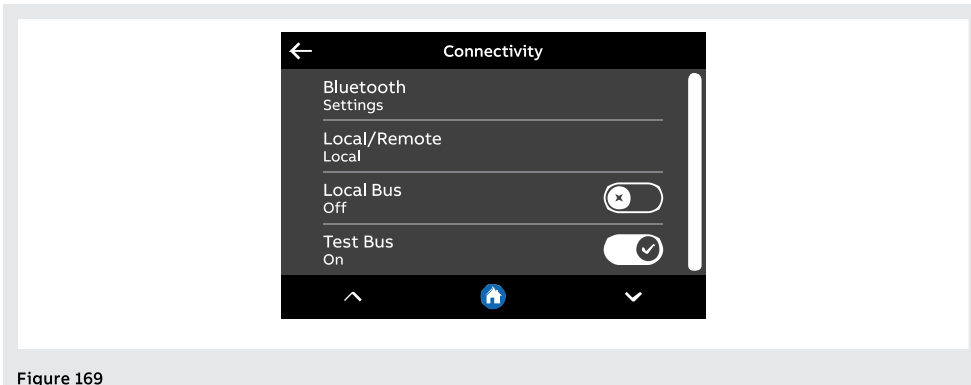


Figure 169

The following parameters are available in the Connectivity menu:

Continued on the next page

Bluetooth Low Energy

BLE and NFC can be accessed and configured in this menu:

Parameter	Description	Default
<i>Enable</i>	Enables/disables activation of the BLE function and availability of the other parameters in the menu: • if <i>On</i>, BLE comes on • if <i>Off</i>, BLE and NFC are off	Off
<i>Start Pairing</i>	Command which activates the pairing window, where communication between Ekip Aware and an external device can be activated via BLE. The window lasts two minutes, after which you need to press the command again	---
<i>Decouple devices</i>	Command that deletes the list of devices coupled to the Trip unit i NOTE: the command is not available if communication with a device is activated	---
<i>Version</i>	FW version of the Bluetooth Low Energy module installed on board	---
<i>Name Connected Device</i> command must be pressed again	Name of the last device connected to Ekip Aware via BLE, both in the case of communication activated (current device) and communication not activated (last device connected)	---

The connection procedure between protection release and external BLE device is described in paragraph 3 - BLE.



IMPORTANT: if Bluetooth is disabled during the order (with the extracode) or disabled by a Service L3 authorized person, the dedicated menu will neither be present, nor visible nor usable. The icons will not be shown on the screen if Bluetooth is disabled

Local/Remote

The parameter defines the mode in which the parameters are written in the unit:

- Local: parameter editing only via display, via USB connector and via BLE
- Remote : parameter editing only via Ekip Com modules

**NOTES:**

- the Remote mode requires the presence of auxiliary power supply and Ekip Com modules, otherwise it disables automatically
- However, the Local/Remote parameter can still be edited in the Remote mode

Local bus

The parameter enables communication between the protection release and modules installed on terminal box or outside the unit to be activated.

Correct communication between unit and modules is confirmed by:

- presence of the Info-Modules menu on the display, with the information pages of all the modules detected
- Power LEDs of the modules on and synchronized like the power LED of Ekip Aware
- absence of Local Bus alarm in diagnostic bar

Test Bus

The parameter allows parameter editing via USB connector and via BLE to be enabled/disabled.

If disabled, configuration of all the options is limited to solely HMI menus (in the Local mode) or Ekip Com modules (in the Remote mode).



NOTE: if Test Bus is disabled, communication via USB connector is still guaranteed (reading enabled). Ekip Aware is supplied with the Test Bus enabled.

Configuration

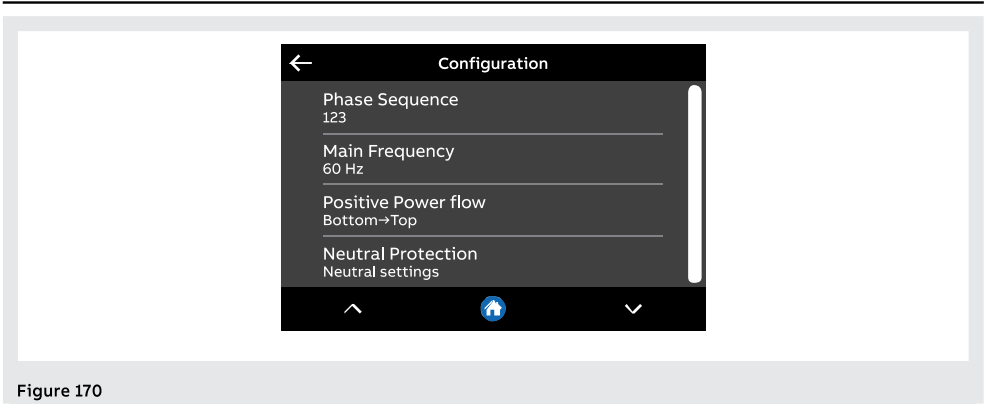


Figure 170

The following parameters are available in the Configuration menu:

Configuration

The parameter, present with three-pole circuit-breakers, enables the presence of the external Neutral sensor to be enabled.

Activation of the configuration with External neutral (3P + N) enables:

- histograms of phase Ne in the *Histograms* page
- neutral current measurements
- submenu for configuring the Neutral protection (*Neutral Protection*)
- neutral current recording in the case of TRIP

With 3P CB, the parameter is set by default as: 3P.

Main frequency

Frequency adjustment is performed to set the installation frequency; the choice is between 50 Hz and 60 Hz.



NOTE: the measurements are taken on the basis of the set grid frequency: incorrect configuration of the parameter may lead to abnormal measurements and protection

Ekip Aware is supplied with the parameter setting that suits the ordered configuration.

Device The following parameters are available in the Device menu:

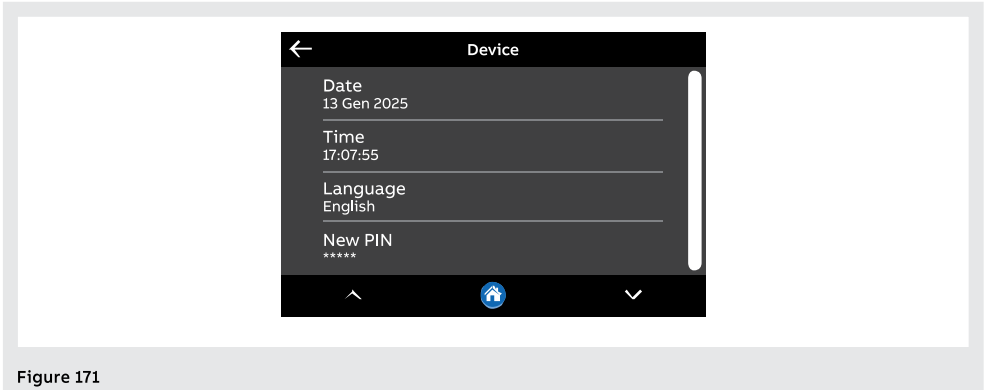


Figure 171

Parameter	Description	Default
Date	Setting the current date	
Time	Setting the current time	
Language	Setting the language in display menus	English
PIN	PIN setting (page 78)	000001



IMPORTANT: setting and checking Date and Time is important for all the recording functions (trips or measurements); in the event of date and time glitches, reset and if necessary replace the battery inside Ekip Aware (page 365).

11 - Additional settings via remote

Presentation The parameters described above and further additional parameters can be accessed from all the remote connection systems.
The reference system in the next descriptions is Ekip Connect.

Programmable States The “Programmable state and outputs page” of Ekip Connect provides sixteen independent programmable states identified by letters A, B, C, D, E, F, G, H, I, L, M, N, O, P, Q, R, allowing different event control solutions to be obtained.

Each programmable status can have two values: True or False. There are also various configuration parameters available:

- *Trigger*, event or combination of several status activation events (up to 24, in AND or OR logic configuration);
- *On Delay*, status activation delay calculated from trigger presence onwards;
- *Off Delay*, status de-activation delay calculated from trigger absence onwards.



NOTE: the status activates if the trigger is present for longer than the On delay setting and de-activates if the trigger is absent for longer than the Off delay setting.

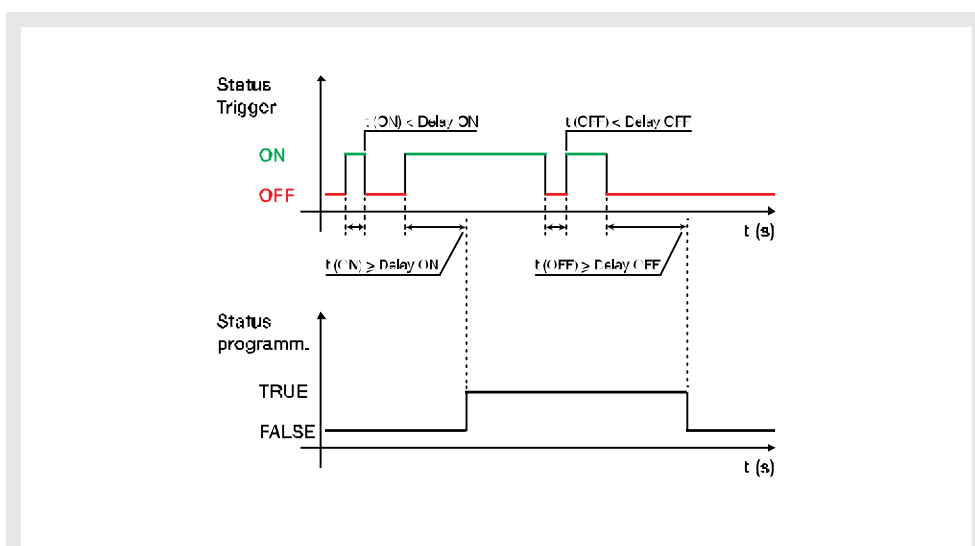


Figure 172

The statuses can be used with external module *Ekip Signalling 10K Link*, on Link Bus or with the programmable functions, so as to convey the required signaling combination to the contacts.

TAG Name, User data Tags that can be programmed by the user to facilitate remote identification of units.



NOTE: the Name TAG and communication address form the identification used by Ekip Connect for the connected devices.

Customizable information Allows you to activate an additional information page, which can be accessed by pressing the iTEST button once or twice from the main menu. Off by default

Maintenance	The function allows the user to be alerted by a Warning that: • one year has elapsed since maintenance was last performed • contact wear has increased by over 10% with respect to the last maintenance value The reference date is that of the internal clock of the protection release and the time elapsed is calculated with the unit both on and off (so long as the internal battery functions).  NOTE: manual modification of the date can cause variations in the calculation of the time elapsed, and therefore in the date of the next maintenance.  NOTE: the maintenance signal due to increased contact wear is active for values higher than 20 %.
Installation	Date of installation of unit.
LED Alive	The parameter enables the behavior of the Power led of the Trip unit and of all the connected modules to be modified; if activated (<i>Alive Mode on</i>), the Power leds act in the following way: • <i>Ekip Aware</i>: flashes at 0.5 Hz frequency • <i>Modules</i>: if there are no communication errors, they synchronize with the led of Ekip Aware If deactivated, the Power leds on the respective devices come on with a steady light.
Wink	The command enables the power LED of the protection release to flash at 2 Hz frequency. This helps to physically identify a protection release that cannot be identified in other ways. The <i>Wink</i> command is available in the <i>State</i> page from all remote connection systems.
Open/Close Remote Direct Command	The parameter controls 2 different command packages for remote opening and closing: • <i>Enabled</i>: command 7 and 8 valid (direct Open and Close commands). • <i>Disabled</i>: commands 7 and 8 not valid: in this case, remote opening and closing can still be obtained using the programmable YC COMMAND and YO COMMAND functions and the <i>Request circuit-breaker opening</i> and <i>Request circuit-breaker closing</i> commands
Repeat zone selectivity S/G HW	If Enabled, zone selectivity HW signals propagation logic applies in accordance with the table in the QT1 technical application notes. 1SDC007100G0205. If Disabled, the HW selectivity signal is not propagated by Ekip Aware.
Zone selectivity input functions	The zone selectivity inputs and certain of the outputs can be configured in this section: • <i>Standard</i>: input or output operation as per standard zone selectivity logic; all selectivity functions are set as Standard. (1SDC007100G0205 or 1SDC007401G0201) • <i>Customized</i>: the event that activates the zone selectivity input or output can be selected.  CAUTION! in the Customized configuration, the only zone selectivity activation event is the one set and standard selectivity operation is therefore not active (changes should only be made by expert technical personnel).
Glitch Commands	Available in the <i>State</i> page of Ekip Connect, the commands of Glitches 16 to 23 activate the respective glitch registers, which can be used for customizing programmable functions or output contacts.
Wizard Reset	Reset Wizard: the Wizard window appears on Ekip Aware when powered-up the next time and allows some of the parameters of the unit to be entered.

Start Paring	The Start Pairing command, which enables BLE to be paired to new devices for 2 minutes. The command is available in HMI in the BLE enable menu or via Ekip Connect on the “Configure unit” page.
Modules network settings retention	Defines whether, upon first connection between the protection release and the new module, The protection release transfers the parameters to the module (Override) or the module transfers its data to the protection release (Retain Module data).
Low PW visualization	The parameter defines whether data below the minimum display threshold are to be represented on the display by 0 or NA.

12 - Test

Presentation The test area can be accessed on the display; the commands available in this area allow certain functions of the Trip unit to be checked; details of all the commands available in the Test menu are given below (page 74).

Ekip Connect has a *Test Protections* section where the presence of current or voltage alarm signals can be simulated and times and trips can be checked.

Trip Test Selection of the *Trip test* command accesses the dedicated page where the operator is asked to press the **iTEST** key to confirm the test operation.

An open command is transmitted to the Trip Coil of the CB when the key is released.

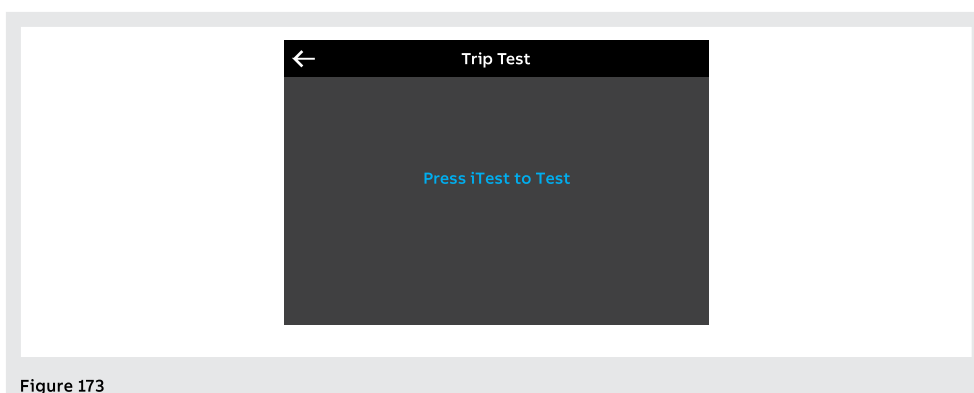


Figure 173



CAUTION!

- the open command is sent with the circuit-breaker closed and in the absence of current;
- following a command, the user is responsible for checking the effective change in status of the actuator and the information displayed, make sure that there are no alarms on the diagnosis bar before performing the test.



NOTE: to reset the TRIP signal, go back to the HOME page and press the **iTEST** key or transmit a TRIP RESET command (via Ekip Connect or remotely).

Test CB

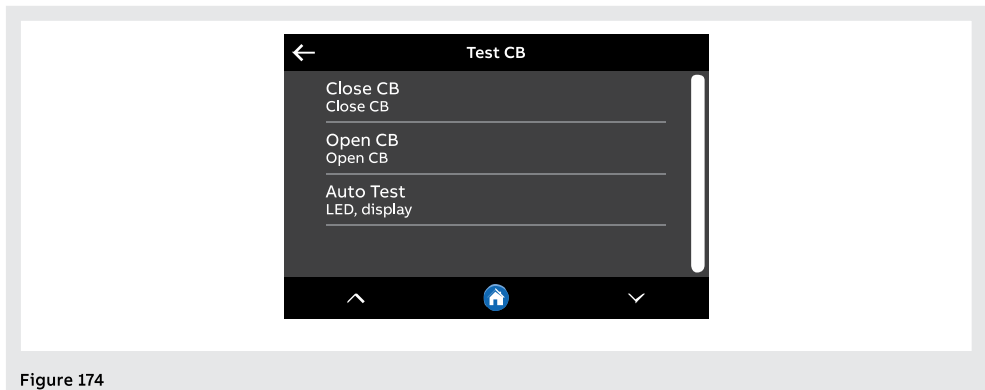


Figure 174

Selection of the *Test CB* command accesses a submenu with the *Open CB* and *Close CB* commands. The commands activate opening coil YO-Sense and closing coil YC-Sense, respectively: "Test Executed" appears in the window to confirm that the command has been transmitted correctly.

**IMPORTANT:**

- the open and close commands only function when the Trip unit is on and powered by an auxiliary supply;
- Make sure that the coils are connected to the power source and that the protection release acknowledges their presence (either via remote connection systems or, using HMI, by checking that the state of health of the tested coil is present in the *Diagnostic-Health Index* menu);
- the commands check protection release operation, possible faults in the coils are not detected

Ekip Signalling 4K

The menu activates in the presence of module *Ekip Signalling 2K* and auxiliary power supply.

The *Autotest* command is available in the menu; it activates the automatic output test sequence (contacts and leds) and provides for the following operations:

- Opening of the output contacts and switching off of output leds
- Closing in sequence of the four output contacts and switching on of the relative leds
- Reset initial conditions



CAUTION! the Autotest command closes the contacts regardless of the configuration set by the user: the user is responsible for making the devices connected to the modules secure, checking that the contacts have closed properly and that the leds have come on

Ekip Signalling 2K

The menu activates in the presence of module *Ekip Signalling 2K*, auxiliary power supply and local bus enabled.



NOTE: a menu is available for each *Ekip Signalling 2K* module present, up to a maximum of two

The *Autotest* command is available in each submenu; it activates the automatic output test (Contacts and leds), input test (leds) and provides for the following operations:

1. Resetting of output contacts (= open) and leds (= off).
2. Lighting up of all leds in sequence (output and input)
3. Closing and switch-off in sequence of the two output contacts while the relative leds come on.
4. Re-establishment of initial conditions.



CAUTION! the Autotest command closes the contacts regardless of the configuration set by the user: the user is responsible for making the devices connected to the Ekip Signalling 2K modules secure, checking that the contacts have closed properly and that the leds have come on

- Ekip RELT
- The menu activates in the presence of the Ekip RELT module, auxiliary power supply and local bus enabled. The Autotest command is available in each submenu; it activates the automatic output test (Contacts and LEDs) and input test (LEDs) and provides for the following operations:
1.

Resetting of output contacts (= open) and leds (= off).

2.

Lighting up of all leds in sequence (output and input)

3.

Closing and switch-off in sequence of the two output contacts while the relative leds come on.

4.

Reset initial conditions



CAUTION! the Autotest command closes the contacts regardless of the configuration set by the user: the user is responsible for ensuring that the devices connected to the Ekip RELT modules are secure, for checking that the contacts have closed properly and that the LEDs have come on

ZoneSelectivity

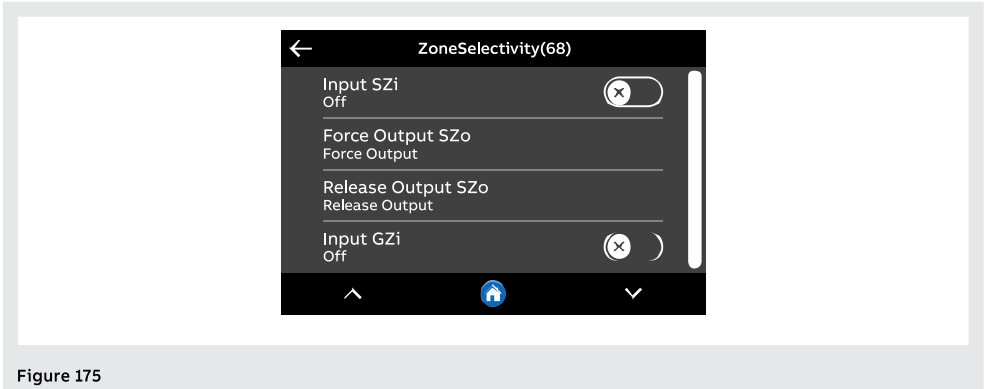


Figure 175

The menu has one or two sections, visibility of which depends on the protections available and enabled:

Submenus	Reference selectivity	Outputs/Inputs managed
S Selectivity	S, S2, D (Forward)	SZi (DFi), SZo (DFo)
G Selectivity	G, Gext, MDGF, D (Backward)	GZi (DBi), GZo (DBo)

Each submenu has three fields for checking selectivity inputs and outputs:

Field	Description
Input	Provides the status of the selectivity input (On/Off)
Force output	Selectivity output activated
Force Output	Selectivity output deactivated

Consult the description of the commissioning procedure when checking the selectivity contacts.

- RC test
- The command is available in the presence of the Rc protection package of the Rc toroid. Selection of the command accesses a window containing the protection settings and test instructions:
1.

Press the **iTEST** button to send a test signal to the toroid.
2.

The toroid sends Ekip Aware a signal as though it had measured an alarm current.
3.

Ekip Aware sends a TRIP command.



CAUTION! the command sends a signal to the Rc toroid and concludes with a TRIP command: the user is responsible for checking that the initial connections are correct (of the toroid and power supplies of the unit) and that TRIP is accomplished

13 - Ekip Aware default parameters

Foreword Given the number of parameters available with Ekip Aware, each chapter describing their characteristics also includes their default value settings.
The configurations of the main parameters are given below.

Protections All Ekip Aware versions are supplied with the protections (and relative correlated functions) off, with the exception of the protections listed below:

Protection	Configuration
L	I _l = 1 I _n ; t _l = 144 s; curve= t= k/I ² ; prealarm: 90% I _l
I	I ₃ = 4 I _n ; startup= OFF
Harmonic distortion	On

Parameters Unless different specifications are requested when ordering, all Ekip Aware versions are supplied with the following configurations:

Parameters	Configuration
Frequency	50 Hz (IEC)
Configuration	3P (3P circuit-breaker) / 4P (4P circuit-breaker)
Neutral	Off (3P circuit-breaker) / 50% (4P circuit-breaker)
Local bus	Off
Mode	Local
Language	English
Bluetooth Low Energy	Off
Pin	000001
Home page	Histograms
LED Alive	Disabled
View	Horizontal
Maintenance	On
Test Bus	On

Measuring

1 - Measuring

List The Measuring digital upgrade allows you to access the following measurements and recordings, some directly from the Home page, others in the screen display menus:

Condition	Access	Page
<i>Instantaneous voltages</i>	Phase and line-to-line voltage measurements in real time	146
<i>Instantaneous powers</i>	Real time measurements of the active, reactive, apparent phase and total powers	146
<i>Trip</i>	List of trips (TRIP) due to voltage, frequency, power protections	147
<i>Power factor</i>	Real time measurement of the power factor	147
<i>Energy counters</i>	Measurement of active, reactive, apparent energy	147

All the measurements listed above and other additional measurements can be accessed from all the remote connection systems:

Condition	Access	Page
<i>Instantaneous frequency</i>	Measurement of the line frequency	148
<i>Min-Max Absolute measurements</i>	Minimum and maximum voltage, power and $\cos\phi$ values recorded by the protection release	
<i>measurements log</i>	Line-to-line voltage measurements, recorded at programmable intervals	
<i>THD Voltages</i>	THD measurements of line-to-line and phase voltage	
<i>Harmonics</i>	Measurements up to the 50th harmonic of currents, line-to-line voltages, phase voltage	

Instantaneous measurements Instant voltages (line-to-line and phase) and instant powers (active, reactive and apparent, of each phase and total), expressed in in root mean square value and measured in real time are available in the Measuring menu.

Line-to-line voltages are also available in Home (Barchart).

The number of measurements and how they are displayed depends on the menu/page selected:

- Virtual cockpit displays the larger measurements of each type and gives them both in absolute value (Volt, Watt, VA, VAR) and with reference to the nominal size (% Un, % Pn, % Sn)
- Panel displays all the measurements of every type, both phase and total, expressed in absolute value (Volt, Watt, VA, VAR)

Measuring range and performance depend on the nominal size set (Un,) or calculated size (Pn, Sn):

- S_n for total powers ($S_n = I_n \cdot U_n \cdot \sqrt{3}$).
- P_n for phase powers ($P_n = I_n \cdot U_n / \sqrt{3}$).



NOTE: the phase powers and voltages are available with 4P and 3P + N CBs

Measurement	Measurement interval (min-max)	Normal operating range	Accuracy of value read ⁽¹⁾
Line-to-line voltages	5 V ÷ 900 V	100 ÷ 690 V	0.5 % ⁽⁴⁾
Phase voltages	5 V ÷ 900 V	50 ÷ 400 V	0.5 % ⁽⁴⁾
Total active, reactive and apparent power	$P_{min} \div P_{max}^{(3)}$	0,3 ÷ 1,2 S_n	2 % ⁽²⁾
Active, reactive and apparent phase power	$P_{min} \div P_{max}^{(3)}$	0,3 ÷ 1,2 P_n	2 % ⁽²⁾

⁽¹⁾ the accuracies refer to normal operating ranges, as established by IEC 61557-12

⁽²⁾ accuracy values relate to Ekip Aware without Class 0.5 or Class 1 optional functions; if one of these two functions is present, check performance values given from page 150

⁽³⁾ $P_{min} = 0,5 I_n \times 5 V$; $P_{max} = 3 \times 16 I_n \times 900 V$

⁽⁴⁾ without transformers; 0.7 % with class 0.2 external transformers

Continued on the next page

Special representations

Type of measurement	Measurement < min value	Measurement > max value	"_ _ _" displayed: (not available) due to
Line-to-line and phase voltages		899,97 V ⁽¹⁾	Measurement module not detected
Active, reactive and apparent total and phase power		> [Pn x 1,25]	Sensors disconnected, Measurement module not present, V < 5 V, I < 0.03 In
Voltage U0		> [Un x 1,25]	

⁽¹⁾ value valid without transformer; when transformer is enabled, gives the value nearest to the maximum threshold (calculated as $900 \cdot \text{primary voltage} / \text{secondary voltage}$) considering the measurement resolution; example: when $V_{\text{prim}}=400 \text{ V}$ and $V_{\text{sec}}=200 \text{ V}$, the theoretic maximum threshold is 1800 V and the value given is 1799.9 V

Trip The *Measurements* digital upgrade adds to the range of TRIPs that Ekip Aware is able to record (page 147).

The voltage, frequency or power protection that trips determines the measurements recorded the moment the trip occurs

Protection	Measurements recorded	Notes
Voltage	Currents L1, L2, L3, Ne, voltages U12, U23, U31, U0	Ne is available with CBs type 4P and 3P + N; U0 is available in the case of trips due to RV protection
Frequency	Currents L1, L2, L3, Ne and grid frequency	Ne is available with CBs type 4P and 3P + N
Power	Currents L1, L2, L3, Ne and total power	Ne is available with CBs type 4P and 3P + N; Active or apparent total power depending on which protection tripped

Power factor The power factor is the real time measurement of the ratio of total active power and total apparent power, expressed as $\cos\phi$.

Measure-ment	Monitor time	Accuracy	Notes
Power factor	0,5 ÷ 1	2,5% ⁽¹⁾	"_ _ _" (not available) is indicated for: active and/or reactive power not available or outside the admissible ranges

⁽¹⁾ accuracy values relate to Ekip Aware without Class 0.5 or Class 1 optional functions; if one of these two functions is present, check performance values given from page 150

Energy counters The energy counters are the measurements of the total reactive and apparent active energy, updated every minute.

Measurement	Monitor time	Accuracy
Total active, reactive and apparent energy	1 kWh ÷ 2 TWh; 1 kVARh ÷ 2 TVARh; 1 kVAh ÷ 2 TVAh	2 % ⁽¹⁾

⁽¹⁾ accuracy values relate to Ekip Aware without Class 0.5 or Class 1 optional functions; if one of these two functions is present, check performance values given from page 150

Reset measurements

The *Energy RESET* command is available in all remote connection systems for the purpose of resetting the energy meters (page 116).

Additional measures All the aforementioned measurements and further, additional measurements can be accessed from all remote connection systems (the reference system in the next descriptions is Ekip Connect).

Frequency

Frequency measurement is obtained from measurement of the line-to-line voltages:

Measurement	Monitor time	Accuracy	Notes
Line frequency	30 ÷ 80 Hz ⁽¹⁾	0,1 % ⁽¹⁾	Reported “_ _ _” (not available) for: Measurement module not present, V < 5 V

⁽¹⁾ available for voltage values of over 30 V (with $U_n < 277$ V) or 60 V (with $U_n > 277$ V)

⁽²⁾ accuracy values relate to Ekip Aware without Class 0.5 or Class 1 optional functions; if one of these two functions is present, check performance values given from page 150

Absolute Measurements Min Max

Ekip Aware records the minimum and maximum absolute values of the different quantities it has measured: line-to-line and phase voltages, total and phase active, reactive and apparent powers, cosφ.

The data and a command for resetting them are available in the “List of measurements, Other measurements” page of Ekip Connect.

Measurements history

Ekip Aware records the following values at regular intervals:

- minimum phase-to-phase voltage;
- maximum phase-to-phase voltage;
- mean and total total active power;
- mean and total total reactive power;
- mean and total total apparent power.

The recording interval between one measurement and the next is defined by the Monitor Time parameter, available on the “Unit configuration” page of Ekip Connect.

The “Measurements log” page of Ekip Connect displays the measurements and includes a command for resetting them.

THD voltages

Two parameters with which harmonic analysis of the line-to-line and phase voltages can be activated are available in the Ekip Connect “THD Harmonics, Harmonics Parameters” page.

Activation enables access to the Harmonics THD page where the actual values of the THD of all line-to-line and phase voltages are available.

The “Harmonics Parameters” page enables you to program a monitoring threshold of the total THD (within the 5% to 20% range in 1% steps) and the individual harmonics (within the 3% to 10% range in 1% steps), which activates an alarm signal if the thresholds are exceeded.

Measurements and counters relating to the voltages THD are available in the “THD Statistics” page:



NOTE: the counters saturate at 65535 minutes (45 days); they can be reset by a service connector command (via Ekip Connect) or by communication via the system bus.

Counters	Description
actual day minutes of Voltage THD	THD Voltages count of the actual day [min]
actual day - [1..7] minutes of Voltage THD	THD Voltages count of the last seven days of activity, calculated using the internal clock of the protection release
cumulative minutes of Voltage THD	Cumulative counter of all events detected by the protection release

Harmonics

Besides the THD, the Measurements package enables the measurements of the individual harmonics through to the fiftieth per quantity, including phase currents, phase-to-phase voltages and phase voltages, in the “THD Harmonics, Harmonics Parameters” page of Ekip Connect.

Each quantity has its own dedicated page.



NOTE: maximum frequency measured: 2.5KHz (with 50Hz frequency setting) / 3kHz (with 60Hz frequency setting)