

2 - Main settings of the Measuring digital upgrade

Foreword The Measuring digital upgrade adds new configuration parameters to the Settings menu.
The new 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

Power flow Power flow, required for D protection, is available in the Configuration menu.

2 settings are available:

- High → Low: power flows from high terminals to low terminals (load connected low)
- Low → High, power flows from low terminals to high terminals (load connected high)

Voltage transformer Enables the presence or absence of the external transformer to be selected.

The parameter is available on the display in the *Configuration* menu.

Primary Voltage Defines rated voltage U_n , which acts as a reference both in the presence and absence of the voltage transformer.

The value is given in absolute value (Volts) and can be set in a range from 100 V to 1200 V (with VT absent), 100 V to 1380 V (with VT present); 1V steps.

The parameter is available on the display in the *Configuration* menu.

Secondary Voltage Available in the presence of a transformer; defines the secondary voltage of the transformer.

The value can be set within the 100 V to 230 V range.

The parameter is available on the display in the *Configuration* menu.

3 - 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, Unit Configuration page.

A description of the different functions is given below.

Filters Measuring filters can be activated on channel V0:

- V0 filter available with neutral connection activated.

If the filter is activated, V0 measurement is dealt with differently: Ekip Aware applies a pass-band filter to the signal so as to measure the fundamental component only (50 or 60 Hz).

Neutral connection Available with 3P CB; allows the presence of the external Neutral to be enabled.



NOTE: presence of the neutral activates phase voltage measurement.

Class 0,5 and Class 1 Power and Energy metering

1 - Class 0,5 and Class 1 Power and Energy metering

Foreword Emax 3 measuring performance can be expanded by two additional functions: Class 0.5 and Class 1.

Class 1% performance and list Presence of the *Class 0,5 Power & Energy Metering* function allows higher measuring accuracy to be obtained for the following quantities:

Measurement	Measurement interval (min-max)	Normal operating range	Accuracy of read value
Phase currents ⁽⁶⁾⁽⁸⁾	0,004 ÷ 64 In	Standard IEC 61557-12, tables 20-22	0,5% ⁽¹⁾
Internal earth fault current ⁽²⁾	0,08 ÷ 64 In	Standard IEC 61557-12, table 20	0,5% ⁽¹⁾
Line frequency	30 ÷ 80 Hz ⁽³⁾	$f_n \pm 10\%$ ⁽⁴⁾	$\pm 0,1$ Hz
Total active and apparent power ⁽⁷⁾	$ P_{min} \div P_{max} $ ⁽⁵⁾	Standard IEC 61557-12, tables 8-11-14	1% ⁽¹⁾
Active and apparent phase power	$ P_{min} \div P_{max} $ ⁽⁵⁾	Standard IEC 61557-12, tables 8-11-14	1% ⁽¹⁾
Total active and apparent energy	1 kWh ÷ 2 TWh; 1 kVARh ÷ 2 TVARh; 1 kVAh ÷ 2 TVAh	Standard IEC 61557-12, tables 8-11-14	1% ⁽¹⁾
Power factor	0,5 ÷ 1	Standard IEC 61557-12, table 27	1% ⁽¹⁾

⁽¹⁾ the accuracy values refer to the normal operating intervals and conditions established by IEC 61557-12, for each quantity and class declared

⁽²⁾ available with LSIG versions

⁽³⁾ available for voltage values of over 30 V (with $U_n < 277$ V) or 60 V (with $U_n \geq 277$ V)

⁽⁴⁾ 47 ÷ 55 Hz with $f_n = 50$ Hz; 54 ÷ 66 Hz with $f_n = 60$ Hz

⁽⁵⁾ $P_{min} = 0,0625 I_n \times 5$ V; $P_{max} = 3 \times 16 I_n \times 900$ V

⁽⁶⁾ the higher phase currents are also available in the Histograms, Measuring instruments and Measurement summary pages

⁽⁷⁾ the higher total powers are also available in the Measuring instruments and Measurement summary pages

⁽⁸⁾ internal phase current; in the presence of an external Neutral, the accuracy of current I_n is 1%

Class 0.5% list and performance

Presence of the *Class 0.5 Power and Energy Measuring* function allows higher measuring accuracy to be obtained for the following quantities:

Measurement	Measurement interval (min-max)	Normal operating range	Accuracy of read value
Phase currents ⁽⁶⁾⁽⁸⁾	0,004 ÷ 64 In	Standard IEC 61557-12, tables 20-22	0,5% ⁽¹⁾
Internal earth fault current ⁽²⁾	0,08 ÷ 64 In	Standard IEC 61557-12, table 20	0,5% ⁽¹⁾
Line frequency	30 ÷ 80 Hz ⁽³⁾	$f_n \pm 10\%$ ⁽⁴⁾	$\pm 0,01$ Hz
Total active and apparent power ⁽⁷⁾	$ P_{min} \div P_{max} $ ⁽⁵⁾	Standard IEC 61557-12, tables 8-11-14	0,5% ⁽¹⁾
Active and apparent phase power	$ P_{min} \div P_{max} $ ⁽⁵⁾	Standard IEC 61557-12, tables 8-11-14	0,5% ⁽¹⁾
Total active and apparent energy	1 kWh ÷ 2 TWh; 1 kVARh ÷ 2 TVARh; 1 kVAh ÷ 2 TVAh	Standard IEC 61557-12, tables 8-11-14	0,5% ⁽¹⁾
Power factor	0,5 ÷ 1	Standard IEC 61557-12, table 27	0,5% ⁽¹⁾

⁽¹⁾ the accuracy values refer to the normal operating intervals and conditions established by IEC 61557-12, for each quantity and class declared

⁽²⁾ available with LSIG versions

⁽³⁾ available for voltage values of over 30 V (with $U_n < 277$ V) or 60 V (with $U_n \geq 277$ V)

⁽⁴⁾ 47 ÷ 55 Hz with $f_n = 50$ Hz; 54 ÷ 66 Hz with $f_n = 60$ Hz

⁽⁵⁾ $P_{min} = 0,0625 I_n \times 5$ V; $P_{max} = 3 \times 16 I_n \times 900$ V

⁽⁶⁾ the higher phase currents are also available in the Histograms, Measuring instruments and Measurement summary pages

⁽⁷⁾ the higher total powers are also available in the Measuring instruments and Measurement summary pages

⁽⁸⁾ internal phase current; in the presence of an external Neutral, the accuracy of current I_n is 1%

Functional characteristics The measuring performance of the *0.5 Class and Class 1 Power & Energy Metering* functions is guaranteed in the following conditions (from table 43 of standard 61557-12):

Characteristic	Value
Power supply	Vaux auxiliary power supply
Classification of performance measuring and monitoring device (PMD) in accordance with chapter 4.3 of the standard	PMD-DD
Temperature	Operating: T = -25°C to +70°C; Storage: T = -30°C to +70°C; Class: K70
humidity and altitude	Up to 90% relative humidity without condensation; From 0 to 2000 meters
Performance class for active energy and power	1

Information page Presence of the *Class 0.5 and Class 1 Power & Energy Metering* functions activates the IEC 61557-12 information page, which can be consulted in the *About* menu

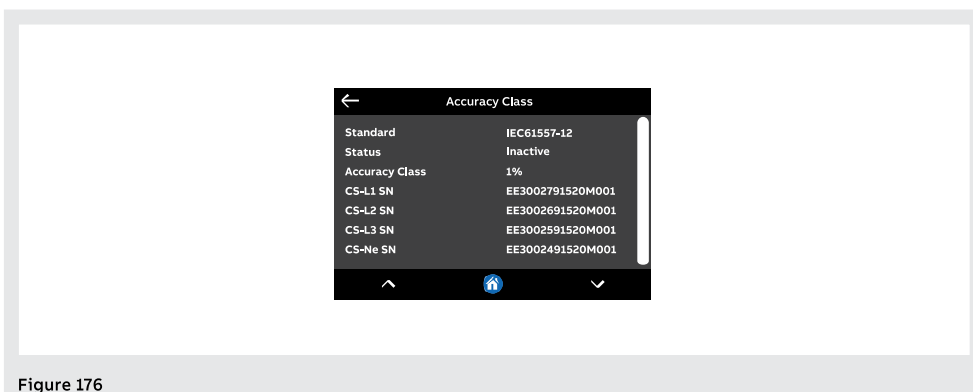


Figure 176

The page gives the activation state of at least one of the **Class 0,5 and Class 1 Power & Energy Metering** (Activated/Deactivated) functions, the reference class (to distinguish which function is present) and the serial numbers of the current sensors inside the CB, specifically installed to comply with the characteristics of the Class 0,5 and Class 1 functions.

Datalogger Pro

1 - Datalogger Pro

Overview The Datalogger Pro digital update activates the function of the same name, which represents the evolved version of Datalogger. The function enables data paired to one or more trigger events to be recorded on an external medium (SD-CARD) to obtain a more extensive time window.

Datalogger Pro has two recording modes. The Single mode includes one single Trigger event and a single recording block. The Multiple mode enables multiple Trigger events to be managed by continuous recording.

The data recorded are:

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

The function can be programmed from all remote connection systems; the Ekip Connect application also allows you to read the recordings.

Single mode recordings Single mode recording is similar to that of Datalogger:

1. When Datalogger is enabled and activated (START), Ekip Aware continuously acquires data, thereby filling and emptying the memory of the SD-CARD (B).
2. If a trigger event (A) occurs, Ekip Aware interrupts data acquisition (STOP) immediately or after a time that can be set by the user (C) and stores all the data in the window (D), which can then be downloaded to a PC (by connecting Ekip Aware directly or just the SD-CARD) for reading and analysis.

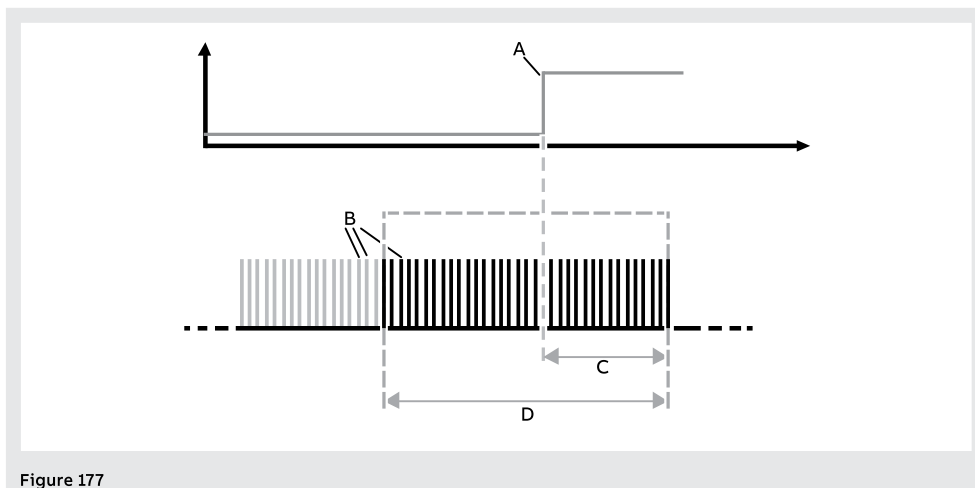


Figure 177

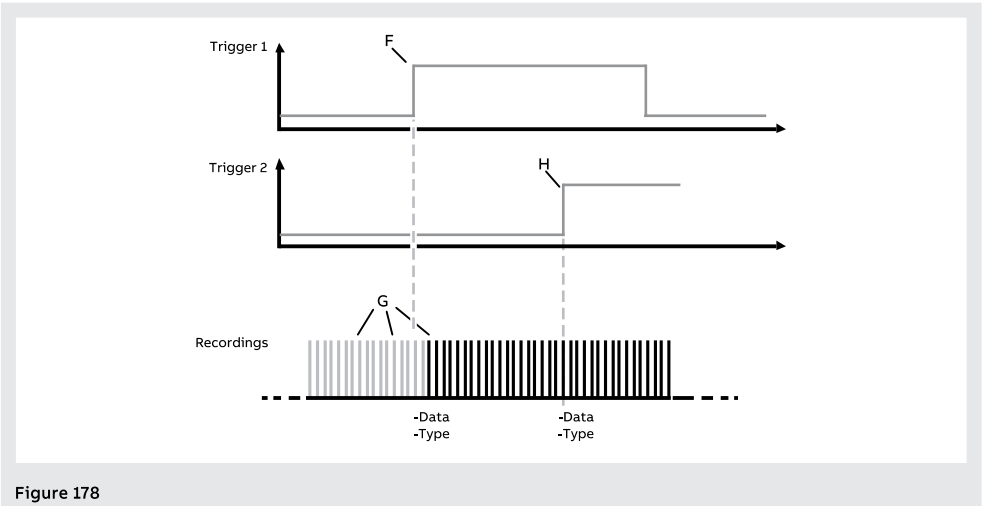


NOTE: if the SD-CARD memory fills completely, recording will not stop but will resume without interruptions and overwrite the oldest data.

Multiple mode recordings

Recording in the Multiple mode expands the trigger modes:

- 1. The user can program from one to three trigger events.
- 2. When Datalogger is enabled and activated (START), Ekip Aware continuously acquires data, thereby filling and emptying the memory of the SD-CARD (G).
- 3. If one of the programmed trigger events (F) occurs, Ekip Aware saves the recording and the data of this first trigger (among which Date and Type of trigger), but recording does not stop.
- 4. Other saves are performed if further triggers (H) occur.
- 5. Recording stops if the user activates the stop command (STOP) or when the entire memory of the SD-CARD has been filled, if there has been at least one recording trigger.
- 6. As in the Single mode, the data can then be downloaded to a PC (by connecting Ekip Aware directly or just the SD-CARD) for reading and analysis.



NOTES:

- if the SD-CARD memory reaches its maximum capacity and trigger events do not occur, the system will start recording again by overwriting the oldest data without interruptions.
- if the SD-CARD memory fills completely and there has been at least one trigger, the system will stop recording as soon as the point relating to the first trigger recorded has been reached.

Parameters

Taking Ekip Connect as a reference, the parameters and commands of the function can be accessed in the "Datalogger Pro" page.

Parameter	Description	Default
Enable	Activates/deactivates the function	OFF
Trigger Modality	Enables you to select between the Single and Multiple modes and enable the respective parameters.	Single
Datalogger frequency	Establishes the number of samples acquired per second and the recording window. Four options are available: 1200 Hz, 2400 Hz, 4800 Hz, 9600 Hz. i NOTE: a high frequency allows the data to be analyzed more accurately	9600 Hz
Registers in Sample	Allows you to select the number of measurements to be saved for each recording, 8 (only currents), 16 (currents and voltages), 32 (currents, voltages and power factors) and 64 (currents, voltages and power factors) i NOTE: the programmable Datalogger Mode parameter described below is available in the configuration with 64 Registers in Sample	32

Continued on the next page

Parameter	Description	Default
Trigger type	In the "Single" mode, the trigger event interrupts the recording. In the "Multiple" mode, one of the three programmable triggers starts the recording. The system proposes the main protection options, such as openings, timings and alarms, as well as the actuator state (open/closed) and the Custom configuration to customize the event.	None
Stop delay	Available in the "Single" mode, it is the recording interruption delay calculated starting from the trigger. The value is given in seconds and can be set within the 0 s to 10 s range, in 0.01 steps:	0,01 s
Second Trigger type	Available in the "Multiple" mode, it is one of the three programmable triggers at which recording is executed. The same programming options as the other Triggers are available.	None
Third Trigger type	Available in the "Multiple" mode, it is one of the three programmable triggers at which recording is executed. The same programming options as the other Triggers are available.	None
Start DTLG	Recording start command	
Stop DTLG	Recording stop manual command	
Download DTLG	Recording save command	

The maximum duration of the recording depends on the size of the SD-CARD and the *Datalogger Frequency* and *Registers in Sample* parameters.

By way of example, with a 512 Gb SD-CARD, *Datalogger Frequency* = 9600 Hz and *Registers in Sample* = 32, the maximum duration is approximately 9 consecutive days.

Downloadable recording time window *Treg* depends on the *Datalogger Frequency* and *Registers in Sample* parameters, according to the table below:

	F = 1200 Hz	F = 2400 Hz	F = 4800 Hz	F = 9600 Hz
Reg = 8	Treg = 218 s	Treg = 109 s	Treg = 54 s	Treg = 27 s
Reg = 16	Treg = 109 s	Treg = 54 s	Treg = 27 s	Treg = 13 s
Reg = 32	Treg = 54 s	Treg = 27 s	Treg = 13 s	Treg = 6 s
Reg = 64	Treg = 27 s	Treg = 13 s	Treg = 6 s	Treg = 3 s



NOTE: The values in the table are valid if the SD-CARD remains inserted in the protection release; the time window will be different if it is removed and connected to an external reader.

Datalogger Mode

In the 64 Registers in Sample configuration, the recordings can be customized by selecting from among four pre-defined options, using the commands available to Ekip Connect in the Datalogger Pro page:

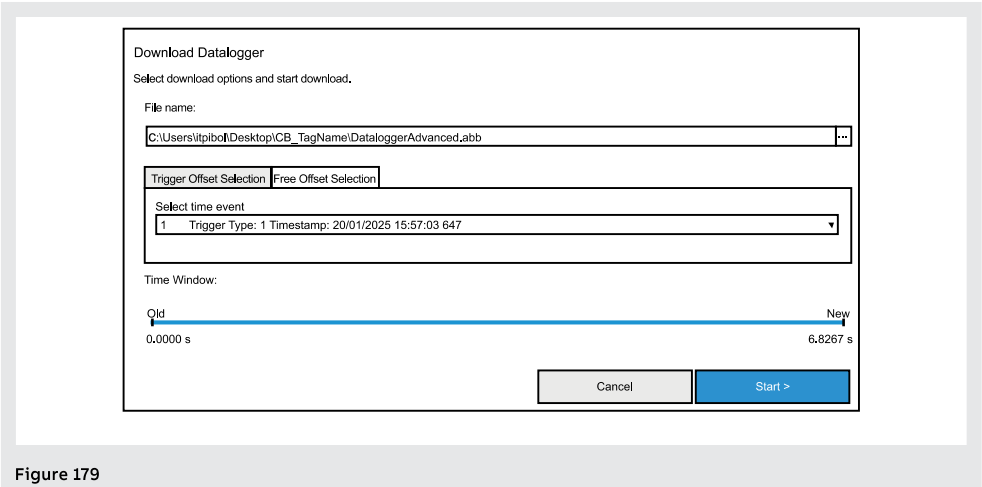
Normal Mode: records the Neutral, Internal earth fault, External earth fault currents, in RMS value and Offset values.

Smart Sensor Temperatures: records the temperatures of the Smart Sensor modules (1 and 2)

Sign 4T Temperatures: records the temperatures of the Ekip Signalling 4T modules (-1 and -2)

SmartSensor-1 + Sign 4T-1 Temperatures: records the temperatures of the Smart Sensor 1 and Ekip Signalling 4T-1 modules.

Download recording The window also depends on the “Datalogger Frequency” parameter when there are very long recordings. The download command has certain save options that facilitate the operation and enable optimal window selection to suit analysis requirements.



Option	Description
Time Window	Time-based window for selecting Download start and end; the window you want to save can be reduced or enlarged by scrolling the two cursors.
Trigger Offset Selection	Allows you to select the single trigger event in the “Single” mode or one from the available list in the “Multiple” mode on which the available Time window can be centered. This enables up to half the time before and after the trigger event to be viewed.
Free Offset Selection	Allows the download window to be centered on an absolute time

About Taking Ekip Connect as a reference, certain information is available in the “Datalogger Pro” page:

- State and Trigger type
- Connection state and SD-CARD details
- In the “Multiple” mode, log data of all the triggers (Date and type)

Display Datalogger activated but not triggered illuminates the relevant white icon on the display, at the top right. If there is a recording present, Ekip Aware provides the information on the diagnostic bar (DLog1 available).

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

- Datalogger-Datalogger Pro tools; provide for the same options and commands as the Datalogger page for configuring the recording parameters in a simplified graphic layout and for downloading the recordings
- Data Viewer tools; for opening and consulting the recordings

Limitations Datalogger Pro needs auxiliary voltage and the SD-CARD to be present. Up to a maximum of 30 recordings are available in the “Multiple” mode.

**NOTE:** The *START* recordings command is inhibited without the SD-CARD

**IMPORTANT:** Standard Capacity SD-CARDS are not supported; choose High Capacity SD-CARDS for optimum use of the Datalogger Pro function; it is advisable to use SD-CARDS with over 48 Gb capacity.

Network Analyzer

1 - Network Analyzer

Presentation The Network Analyzer digital upgrade allows you to set long-term voltage and current controls so you can analyze how your installation operates.

To this purpose, voltages and currents are monitored, so as to find:

- voltage sequences (Over, Under, Pos and neg)
- unbalance between voltages (Unbalance)
- short voltage drops (Interruption) and slow sags (Sag)
- short voltage increases (Spikes) and slow swells (Swell)

Each monitoring is associated with control parameters set by the user and updated each time the set control conditions occur.

The parameters and measurements are available via all remote connection systems. Ekip Connect is used as a reference in the next chapters.



NOTE: The Network Analyzer function of Emax3 complies with the IEC61000-4-30 Class S standard for calculating voltage unbalances, overshoots and dips. Aggregation of metering data every 10 min can be obtained by setting the "Monitor Time" parameter to 10 min (default parameter setting). The reference channel is managed dynamically and is always the one with the highest line-to-line voltage. 1.5% fixed hysteresis is applied for each voltage threshold.

Parameters The configuration parameters of the counters are available in the *Network Analyzer - Parameters* page. The "Monitored time" parameter, which defines the period of each monitoring session, is also available in the *Unit configuration* page of Ekip Connect.



NOTE: the parameter is the one used for measuring the maximum currents and voltages

Main Menu

Parameter	Description	Default
Enable	Activates/deactivates the function	Off
Spikes and Interrupts History Enable	Enables the type of logs recorded to be customized and is available on the Ekip Connect Network Analyzer History page: • Disabled = available in Sags and Swells log • Enabled = available in Sags, Swells, Spikes and Interruptions log	-
Low voltage threshold	Control threshold of the <i>Under V Th</i> counter The value is given as a percentage of rated voltage U_n and can be set within the range: 75% to 95%, in 5% steps.	85 % U_n
High voltage threshold	Control threshold of the <i>Over V Th</i> counter The value is given as a percentage of rated voltage U_n and can be set within the range: 105, 110, 115 % U_n	110 % U_n
Voltage Imbalance Threshold	Alarm threshold for the <i>Unbalance</i> counter. The value is given as a percentage of rated voltage U_n and can be set within the range: 2% to 10% U_n , in 1% steps. NOTE: 0% = symmetrical and balanced system	3 % U_n
Spikes and Swells	List of parameters for monitoring voltage sags, described after this table	
Interruptions and Sags	List of parameters for monitoring voltage swells, described after this table	
Harmonics	List of parameters for monitoring harmonics, described after this table	

Continued on the next page

Interruptions and Sags

All the thresholds are given as a percentage of rated voltage U_n and can be set from 10% to 95% U_n , in 5% steps.

All the times are given in seconds and can be set within the range: 0.04 s to 60 s, in variable steps

Parameter	Description	Default
Micro voltage outage threshold	Monitoring threshold of V micro-outage counter. The value is given as a percentage of the rated voltage U_n and can be set within the range: 10% to 95% U_n , in 5% steps.	95 % U_n
Voltage Sag Threshold (short type)	Control threshold of <i>Sags Short</i> counter	10 % U_n
Voltage Sag Duration (short type)	Minimum duration of sag below the Short threshold to validate the count of the <i>Sags Short</i> counter	0,8 s
Voltage Sag Threshold (middle type)	Control threshold of <i>Sags Middle</i> counter	45 % U_n
Voltage Sag Duration (middle type)	Minimum duration of sag below the <i>Middle</i> threshold to validate the count of the <i>Sags Middle</i> counter	0,8 s
Voltage Sag Threshold (long type)	Control threshold of <i>Sags Long</i> counter	95 % U_n
Voltage Sag Duration (long type)	Minimum duration of sag below the Long threshold to validate the count of the <i>Sags Long</i> counter	0,8 s



NOTE: Ekip Aware accepts changes to the parameters subject to compliance with the following limitations: Voltage Sag Duration (long type) $\geq$ Voltage Sag Duration (middle type) $\geq$ Voltage Sag Duration (short type)

Spikes and Swells

All the thresholds are given as a percentage of rated voltage U_n and can be set from 105% to 125% U_n , in 5% steps.

All the times are given in seconds and can be set within the range: 0.04 s to 60 s, in variable steps

Parameter	Description	Default
Voltage Spike Threshold	Monitoring threshold of Spike counter. The value is given as a percentage of U_n and can be set within the range: 105% to 125% U_n , in 5% steps.	105 % U_n
Voltage Swell Threshold (short type)	Control threshold of the <i>Swell Short</i> counter	125 % U_n
Voltage Swell Duration (short type)	Minimum duration of swell above the <i>Short</i> threshold to validate the count of the <i>Swell Short</i> counter	0,8 s
Voltage Swell Threshold (long type)	Control threshold of the <i>Swells Long</i> counter	105 % U_n
Voltage Swell Duration (long type)	Minimum duration of swell above the Long threshold to validate the count of the <i>Swells Long</i> counter	0,8 s



NOTE: Ekip Aware accepts changes to the parameters subject to compliance with the following limitations: Voltage Swell Duration (long type) $\geq$ Voltage Swell Duration (short type)

Counters The Ekip Connect *Network Analyzer - Statistics* page contains all the measurements and meters recorded while Network Analyzer was activated, divided into fourteen groups.

Counter	Description
Last Sequences Related Values	Measurements relating to the voltage sequence in progress
Statistics Voltage Unbalance	Counters relating to voltage unbalances
Statistics Over Voltages	Counters relating to swells in the mean value of the voltage sequences
Statistics Under Voltages	Counters relating to sags in the mean value of the voltage sequences
Statistics Spikes (less than 20 ms)	Counters relating to short time voltage swells
Statistics Interruptions (less than 20 ms)	Counters relating to short time voltage sags
Statistics Sags (short type)	Counters relating to voltage sags
Statistics Sags (middle type)	Counters relating to voltage sags
Statistics Sags (long type)	Counters relating to voltage sags
Statistics Swells (short type)	Counters relating to voltage swells
Statistics Swells (long type)	Counters relating to voltage swells

Last Sequence Related Values The Last Sequences Related values group includes the following measurements and counters:

Counters (Sequences)	Description
last sequences related time stamp	Date and time of last recording of the sequences
last positive sequence value	Positive sequence of period preceding the one in progress [V]
last negative sequence value	Negative sequence of period preceding the one in progress [V]
last unbalance value	Voltage unbalance relating to the period in progress [%]
actual positive sequence value	Positive sequence of period in progress [V]
actual negative sequence value	Negative sequence of period in progress [V]
actual unbalanced value	Voltage unbalance relating to the period preceding the one in progress [%]
actual 3 secs positive sequence value	Positive sequence calculated during the last three seconds [V]
actual 3 secs negative sequence value	Negative sequence calculated during the last three seconds [V]
actual 3 secs unbalance value	Voltage unbalance calculated during the last three seconds [%]



NOTE: all measurements of unbalances (Not balanced and Unbalance value) saturate when 200% is reached

Statistics Voltage Unbalance

The Statistics Voltage Unbalance group includes the following measurements and counters:

Counters (Sequences)	Description
last Voltage Unbalance time stamp	Date and time of last recording of the unbalances
Last Unbalance Value	Voltage unbalance relating to the period preceding the one in progress [%]
actual number of voltage unbalances	Counts the number of times the mean value of the ratio between positive sequence and negative sequence, considering 3-2-1 rotation, exceeds the V Th Unbalance threshold. The count provides the number of events relating to the actual day
actual day - [1..7] number of voltage unbalances	Calculates the number of unbalances detected in the seven days prior to the activity. Calculate the data using the internal clock of the protection release
cumulative number of voltage unbalances	Cumulative counter of all the unbalances detected by the protection release



NOTE: all measurements of unbalances (Not balanced and Unbalance value) saturate when 200% is reached

Statistics Over Voltages

The Statistics Over Voltages group includes the following measurements and counters:

Counters	Description
last Over Voltage time stamp	Date and time of last recording of Over V Th counter
Last OverVoltage Value	Value of the last exceedance of the Over V Th [V] threshold
actual number of voltage over thresholds	Over V Th count of the actual day
actual day - [1..7] number of voltage over thresholds	Over V Th count of the last seven days of activity, calculated using the internal clock of the protection release
cumulative number of voltage over thresholds	Cumulative counter of all the over V Th [V] counts detected by the protection release

Statistics Under Voltages

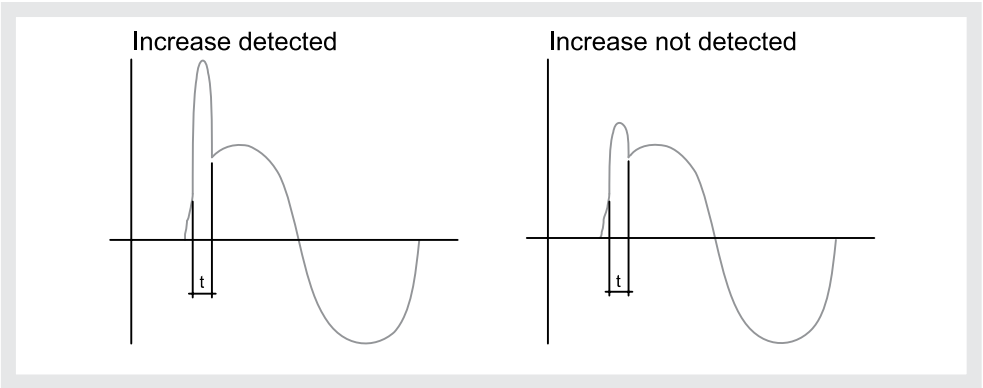
The Statistics Under Voltages group includes the following measurements and counters:

Counters	Description
last Under Voltage time stamp	Date and time of last recording of the Under V Th counter
Last UnderVoltage Value	Value of the last exceedance of the Under V Th [V] threshold
actual number of voltage under thresholds	Under V Th count of the actual day
actual day - [1..7] number of voltage under thresholds	Under V Th count of the last seven days of activity, calculated using the internal clock of the protection release
cumulative number of voltage under thresholds	Cumulative counter of all the over V Th [V] counts detected by the protection release

Statistics Spikes (less than 20 ms)

The *Statistics Spikes (less than 20 ms)* counter should be intended as the increase of the RMS value of the line-to-line voltage above the set *V Spike Threshold* threshold for less than 20 ms (short time voltage spike).

! **IMPORTANT:** since the counter is based on the RMS value calculation, two rapid voltage spikes of equal duration may be evaluated differently, depending on their amplitude



The Statistics Spikes group (less than 40 ms) includes the following measurements and counters:

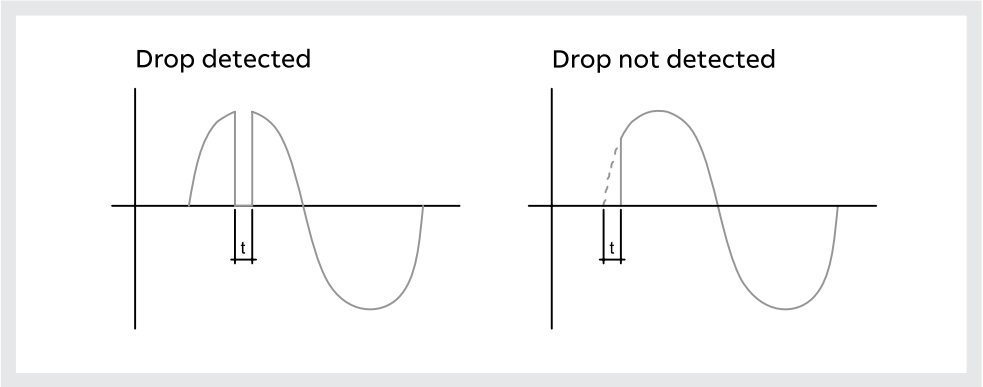
Counters	Description
Last Spike time stamp	Date and time of last recording of the <i>Spikes</i> counter
Last Spike Value	Value of last swell above <i>Spikes</i> [V] threshold
Last Spike Duration	Duration of last swell above <i>Spikes</i> [ms] threshold
Actual day number of spikes	<i>Spikes</i> count for the current day
Actual day -[1..7] number of spikes	<i>Spikes</i> count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of spikes	Cumulative counter of all the <i>Spikes</i> detected by the protection release

Statistics Interruptions (less than 20 ms)

The *Statistics interruptions (less than 20 ms)* counter should be intended as reduction of the RMS value of the line-to-line voltage below the *V microinterr. Th* set threshold for less than 20 ms (short time voltage sag).

The counter is available in the two submenus *Counters - Day -1* and *Counters - Cumulative* (previous day or cumulative)

! **IMPORTANT:** since the counter is based on the RMS value calculation, two rapid voltage sags of equal duration may be evaluated differently, depending on when they occur



Continued on the next page

The Statistics Interruptions (less than 20 ms) group includes the following measurements and counters:

Counters (Interruptions)	Description
Last interruption instant	Date and time of last recording of the V microinterr counter
Last interruption value	Value of last sag below the V microinterr [V] threshold
Last interruption duration	Duration of last sag below the V microinterr [ms] threshold
actual day number of interruptions	V microinterr count of the actual day
Actual day - [1..7] number of interruptions	V incrointerr count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of interruptions	Cumulative counter of all interruptions detected by the protection release

Statistics Sags (short type) The count refers to the reference menu interval (previous day or cumulative)



NOTE: since an event may fall under more than one category, only the counter of the main type (Long > Middle > Short) is increased

The Statistics Sags (short type) group includes the following measurements and counters:

Counters	Description
Last Sag time stamp	Date and time of last recording of the Short Sags counter
Last Sag Value	Value of last sag below the Short Sags [V] threshold
Last Sag Duration	Duration of last sag below the Short Sags [ms] threshold
Actual day number of sags	Short Sags count for the current day
Actual day - [1..7] number of sags	Short Sags count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of Sags	Cumulative counter of all the Sags detected by the protection release

Statistics Sags (middle type) The count refers to the reference menu interval (previous day or cumulative)



NOTE: since an event may fall under more than one category, only the counter of the main type (Long > Middle > Short) is increased

The Statistics Sags (middle type) group includes the following measurements and counters:

Counters	Description
last Sag time stamp	Date and time of last recording of the Middle Sags counter
Last Sag Value	Value of last sag below the Middle Sags [V] threshold
Last Sag Duration	Duration of last sag below the Middle Sags [ms] threshold
Actual day number of sags	Middle Sags count for the current day
Actual day - [1..7] number of sags	Middle Sags count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of Sags	Cumulative counter of all the Sags detected by the protection release

Statistics Sags (long type)

The count refers to the reference menu interval (previous day or cumulative)



NOTE: since an event may fall under more than one category, only the counter of the main type (Long > Middle > Short) is increased

The Statistics Sags (long type) group includes the following measurements and counters:

Counters	Description
Last Sag time stamp	Date and time of last recording of Long Sags counter
Last Sag Value	Value of last sag below Long Sags [V] threshold
Last Sag Duration	Duration of last sag below Long Sags [ms] threshold
Actual day number of sags	Long Sags count of the actual day
Actual day - [1..7] number of sags	Long Sags count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of Sags	Cumulative counter of all the Sags detected by the protection release

Statistics Swells (short type)

The count refers to the reference menu interval (previous day or cumulative)



NOTE: since an event may fall under more than one category, only the counter of the main type (long > short) is increased

The Statistics Swells (short type) group includes the following measurements and counters:

Counters	Description
Last Swell time stamp	Date and time of last recording of Short Swells counter
Last Swell Value	Value of last swell above Short Swells [V] threshold
Last Swell Duration	Duration of last swell above Short Swells [ms] threshold
Actual day number of Swell	Short Swells count of actual day
Actual day - [1..7] number of Swell	Short Swells count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of Swells	Cumulative counter of all Swells detected by the protection release

Statistics Swells (long type)

The count refers to the reference menu interval (previous day or cumulative)



NOTE: since an event may fall under more than one category, only the counter of the main type (long > short) is increased

The Statistics Swells (long type) group includes the following measurements and counters:

Counters	Description
Last Swell time stamp	Date and time of last recording of Long Swells counter
Last Swell Value	Value of last swell above Long Swells [V] threshold
Last Swell Duration	Duration of last swell above Long Swells [ms] threshold
Actual day number of Swell	Long Swells count of the actual day
Actual day - [1..7] number of Swell	Long Swells count of the last seven days of activity, calculated using the internal clock of the protection release
Cumulative number of Swells	Cumulative counter of all Swells detected by the protection release

**Network Analyzer
Measurements log**

Ekip Aware can record the measurements relating to Network Analyzer at regular intervals: Sags, Swells, Spikes and Interruptions.

Different parameters that characterize these recordings:

- The recording interval between one measurement and the next is defined by the monitored Time parameter, available on the *Unit configuration* page.
- The type of measurements recorded depends on the *Spikes and Interrupts History Enable* parameter available in the *Network Analyzer - Parameters* page and described on page 157.
- All the measurements and a command to reset them are available in the *Network Analyzer - Network Analyzer History* page.

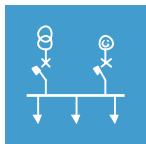
Power Controller

1 - Power Controller

Description

The *Power Controller* function allows the loads of an installation to be managed according to power consumption, for the purpose of reducing consumption and optimizing energy efficiency.

All the parameters and measurements of the function are available via Ekip Connect.



IMPORTANT: consult the Technical catalog or White paper of the function for full details (page 8).

Adaptive Load Shedding

1 - Adaptive Load Shedding

Description The *Adaptive Load Shedding* function allows faults to be managed in installations which are able to function thanks to the energy produced by renewable and local energy sources, especially the absence of power supply caused, for example, by a fault on the MV voltage side.

All the parameters and measurements of the function are available via Ekip Connect.



IMPORTANT: consult the Technical catalog or White paper of the function for full details (page 8).

RC protection

1 - RC protection

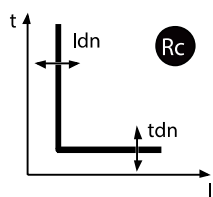
Foreword The Rc Protection package allows you to activate Rc protection, which provides protection against differential ground faults by detecting the fault current using a purpose-made external toroid of the Rc type.

Settings Configuration of the toroid and protection parameters is available from all external configuration systems; presence of the RC type sensor is also available via display.

The Type of External Toroid parameter is available in the Ekip Connect “Unit configuration” page and on the display in the “Settings, Configuration” menu; if the parameter is configured like Rc:

- The protection activates automatically
- presence control of the Rc toroid on terminal box activates; if the trip unit fails to detect the sensor, an alarm signal appears (on both the diagnostic bar and in Alarm areas with external communication)
- the test command is available in the display area of the same name

RC Protection



The protection sends a TRIP command if the current from toroid Rc exceeds threshold I_{dn} for longer than T_{dn} .

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 168)
- the graph with trip curve (page 169)

Parameters

The protection parameters are available in the Ekip Connect *Parameters of protections - Other parameters A* page.



IMPORTANT: the protection can also be configured in the Other parameters B and Other parameters C pages if the Dual or Triple setting digital upgrade are present

Parameter	Description	Default
Threshold I_{dn}	Defines the value that activates the protection; the value is given in amperes and can be set within a range of values from 3 A to 30 A	3 A
Time T_{dn}	This is the trip time of the protection; the value is given in seconds and can be set within a range of values from 0.05 s to 0.8 s	0,06 s

Limitations and additional functions

In order to function correctly, the protection needs the presence of either Vaux (Ekip Supply Lite or Ekip Supply Evo Modbus TCP) or power supply via busbar (Ekip Supply Busbar).

2 - RC Protection performance table

- 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.

Protection [ANSI code]	Trip time $t_t^{(1)}$	Trip threshold tolerance ⁽²⁾	Trip time tolerance
RC [64 50N TD 87N]	$t_t = t_{dn}$	-20 % ÷ 0	140 ms @ 0,06 s ⁽³⁾ 950 ms @ 0,8 s ⁽³⁾

⁽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⁾ tolerance values valid with protection release 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

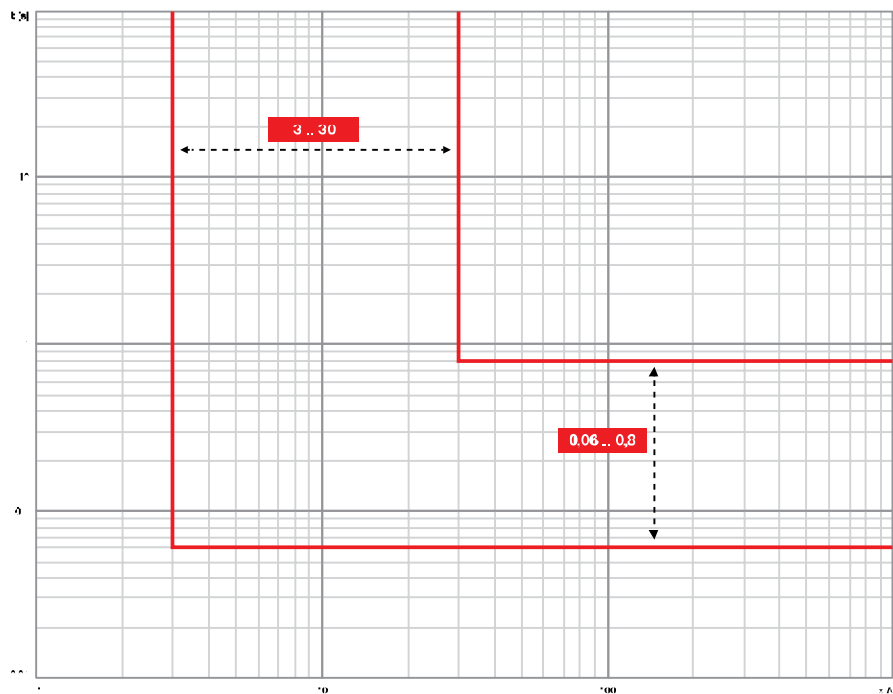
⁽³⁾ maximum trip time

Performance guaranteed in all operating conditions

Protection	Trip threshold tolerance	Trip time tolerance
RC	--	± 20 %

3 - RC protection curve

Function RC



4 - RC Protection test

Description	The command can be accessed via display in the Test, CB Test menu. Selection of the command accesses a window containing the protection settings: 1. press the iTEST button to send a test signal to the toroid. 2. the toroid sends a signal to the trip unit as though it had measured an alarm current. 3. The protection release sends the 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 (of the toroid and power supplies of the unit) are correct and that TRIP is accomplished.
--------------------	--

5 - RC Protection default

Description	If the Rc protection package is installed, the External Toroid Type parameter and, thus, the protection will be off.
--------------------	---

L OFF Protection

1 - L OFF Protection

Description



If the “L Protection OFF” digital upgrade is present, L protection, which normally cannot be disabled and is always activated, can be enabled/disabled by the State parameter, remotely available in the menu dedicated to L protection. !da duplicazione!

The absence of L protection is signalled on the display of the HOME page by the dedicated L icon crossed-out.

No protection parameter is available on the display or from the remote connection systems.

Flexible Digital Rating Plug

1 - Flexible Digital Rating Plug

Description

Digital Flexible Rating Plug digital update allows you to change the value of rated current I_n , defined by the Digital Rating Plug. You can change the current value via Ekip Connect or EPiC, from the USB-C port or via BLE.

When using Ekip Connect, and the function is active, the Rating Plug item appears in the Configure Unit menu, with a drop-down menu showing the selectable I_n current values.

The I_n value set must be compatible with the information provided in the Digital Rating Plug chapter on page 278.

Non Defeatable I Protection

1 - Non Defeatable I Protection function

Description

The non-excludable Protection I function prevents protection I, present by default in all Ekip Aware versions, from being deactivated.

The function, which must be ordered at the time the circuit-breaker is purchased, can only be installed at ABB.

Current Protections

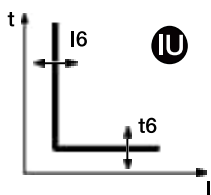
1 - Current Protections

Overview The following protections are available when the Current Protections digital upgrade is installed.

Name	Type of protection	Page
IU	Current unbalance	172
Current thresholds	Current control with programmable thresholds	173
S2	Short-circuit with adjustable delay	174

The parameters of every protection can be checked and configured via all remote connection systems. In addition, the display includes the main parameters of certain protections in the Protections menu, such as S2 and current thresholds. The presence of all the available protections can be checked in the Info menu.

IU Protection Function



The protection trips if the current readings are unbalanced; the protection sends a TRIP command if the detected unbalance exceeds threshold I_6 for longer than t_6 .

The protection is automatically self-excluding in two cases:

- the measurement of at least one current exceeds $6 I_n$
- the maximum current value between all the phases is less than $0.25 I_n$ (in I Avg configuration) or $0.3 I_n$ (in I Max configuration)

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 176)
- the graph with trip curve (page 177)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Algorithm	Allows the unbalance calculation mode to be selected: - With respect to I_{max}: $\% Sb_{il} = 100 \times (I_{max} - I_{min}) / I_{max}$ - With respect to I_{Avg}: $\% Sb_{il} = 100 \times (\max I_{Avg}) / I_{Avg}$ i NOTE: $\max I_{Avg}$: maximum deviation among the measured currents, calculated by comparing each current with the mean value; I_{Avg} : mean value of the current readings	With respect to I_{max}
Threshold I_6	Establishes the unbalance value that trips the protection. Unbalance is given in percentage value within the range: 2% to 90% with 1% steps.	50 %
Time t_6	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 60 s, in 0.5 s steps	5 s

Configuration

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

Current thresholds **Function**

The Current thresholds allow checks to included set along the current lines, to be associated with the programmable contacts of the *Ekip Signalling* modules.

Two pairs of programmable contacts are available:

- Threshold 1 I1 and Threshold 2 I1, with control relating to I1;
- Threshold Iw1 and Threshold Iw2, with control referring to In.

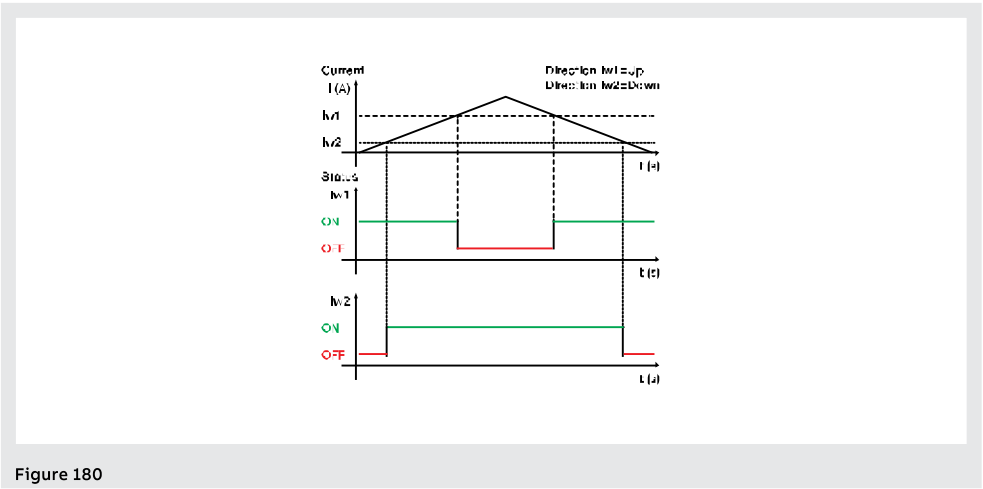


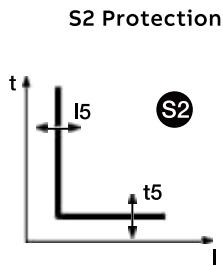
IMPORTANT:

- **monitoring is performed by using the highest of the phase currents as a reference;**
- **the current thresholds do not handle the trip just the signal;**
- **the function is activated if the trip unit is powered by auxiliary voltage.**

Parameters

Threshold	Available parameters	Default
Threshold 1 I1	<i>Enable:</i> Activates the protection and availability of the threshold in the menu	OFF
	<i>Threshold:</i> The value is given in percentage of threshold I1 and can be set within the range: 50% I1 to 100% I1, in 1% steps.	50 % I1
Threshold 2 I1	<i>Enable:</i> Activates the protection and availability of the threshold in the menu	OFF
	<i>Threshold:</i> The value is given in percentage of threshold I1 and can be set within the range: 50% I1 to 100% I1, in 1% steps.	75 % I1
Threshold Iw1	<i>Enable:</i> Activates the protection and availability of the threshold in the menu	OFF
	<i>Direction:</i> allows the user to choose whether to have the signal when the current is higher (Up) or lower (Down) than the threshold.	Down
	<i>Threshold:</i> The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.1 In to 10 In, in 0.01 In steps	3 In
Threshold Iw2	<i>Enable:</i> Activates the protection and availability of the threshold in the menu	OFF
	<i>Direction:</i> allows the user to choose whether to have the signal when the current is higher (Up) or lower (Down) than the threshold.	Up
	<i>Threshold:</i> The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.1 In to 10 In, in 0.01 In steps	3 In





Function

S2 protection functions in the same way as S protection: if the current of one or more phases exceeds threshold I_5 for longer than time t_5 , the protection activates and sends a TRIP command.



IMPORTANT: unlike S protection, S2 protection only has one fixed time trip curve and has no thermal memory

It is independent of S protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with S and open command with S2 or vice versa, or both S and S2 for signaling or tripping).

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 176);
- the graph with trip curve (page 177).

Certain parameters can be configured and consulted in the Protections menu.

Parameters

Parameter	Description	Default
<i>Enable</i>	Activates/deactivates the protection and its availability in the parameters menu.	OFF
<i>Trip Enable</i>	Activates/deactivates transmission of the open command. If disabled, the alarm and exceedance of protection time are only managed as information.	ON
<i>Threshold I_5</i>	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (A) and relative value (In) and can be set within the range: $0.6 I_n$ to $10 I_n$, in $0.1 I_n$ steps	$2 I_n$
<i>Time t_5</i>	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 0.4 s, in 0.01 s steps	0,05 s
<i>Time t_5</i>	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 0.8 s, in 0.01 s steps	0,05 s
<i>ZoneSelectivity</i>	Activates/deactivates the function and selectivity time availability on the display (page 111)  IMPORTANT: if at least two of the selectivity S, S2, I, 2I and MCR are enabled, the input and output are shared with the OR function; it is sufficient that even a selectivity is activated to stimulate inputs and outputs	OFF
<i>Selectivity time</i>	This is the trip time of the protection with the zone selectivity function activated and selectivity input not present (page 111) The value is given in seconds and can be set within the range: 0.04 s to 0.2 s, in 0.01 s steps	0,04 s
<i>StartUp enable</i>	Activates/deactivates the function and availability of the associated parameters on the display (page 113)	OFF
<i>StartUp Threshold</i>	Protection threshold valid during Startup time, in the conditions in which the function is activated (page 113) The value is given as both absolute value (A) and relative value (In) and can be set within the range: $0.6 I_n$ to $10 I_n$, in $0.1 I_n$ steps	$2 I_n$
<i>StartUp Time</i>	This is the time for which the StartUp threshold remains activated, as calculated from the moment the activation Threshold is exceeded (page 113) The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

Continued on the next page

Limitations and additional functions

- threshold I5 must be higher than threshold I1 (if S2 protection is activated)
 - all the parameters described above are available via USB-C port, Bluetooth Low Energy and system bus, as are certain further ones:
 - block functions
 - type of selectivity
 - Startup th. on Prog Status D
- The description is available in section List of additional protections and functions on page 110.
- Information about S2 zone selectivity is available on page 197.
-

2 - Performance table of Current 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.

Performance

Protection [ANSI code]	Trip time $t_t^{(1)}$	Trip threshold tolerance ⁽²⁾	Trip time tolerance ⁽²⁾
S2 [50TD]	$t_t = t_5$	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
IU [46]	$t_t = t_6$	$\pm 10\%$	with $t_6 \geq 5$ s: ± 100 ms / with $t_6 < 5$ s the best between $\pm 10\%$ and ± 40 ms

Startup

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance ⁽²⁾	Trip time tolerance
S2 StartUp	$t_t = t_5$ startup	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

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

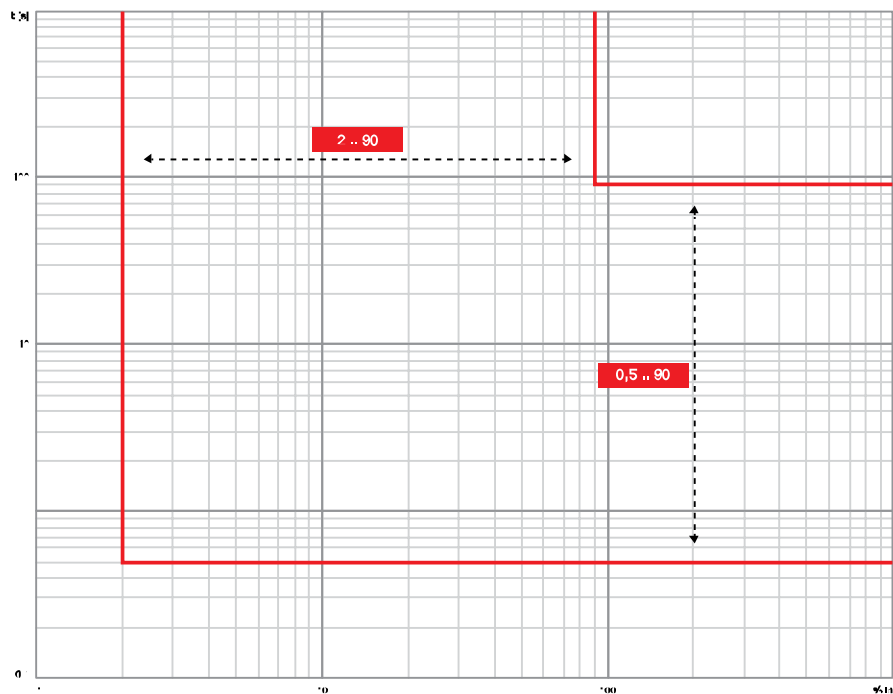
⁽²⁾ tolerance values valid with protection release at steady state or on with auxiliary power supply, trip time ≥ 100 ms, temperature and signals within operating limits; the tolerances in the table after the notes are applicable if the conditions are not guaranteed

Performance guaranteed in all operating conditions

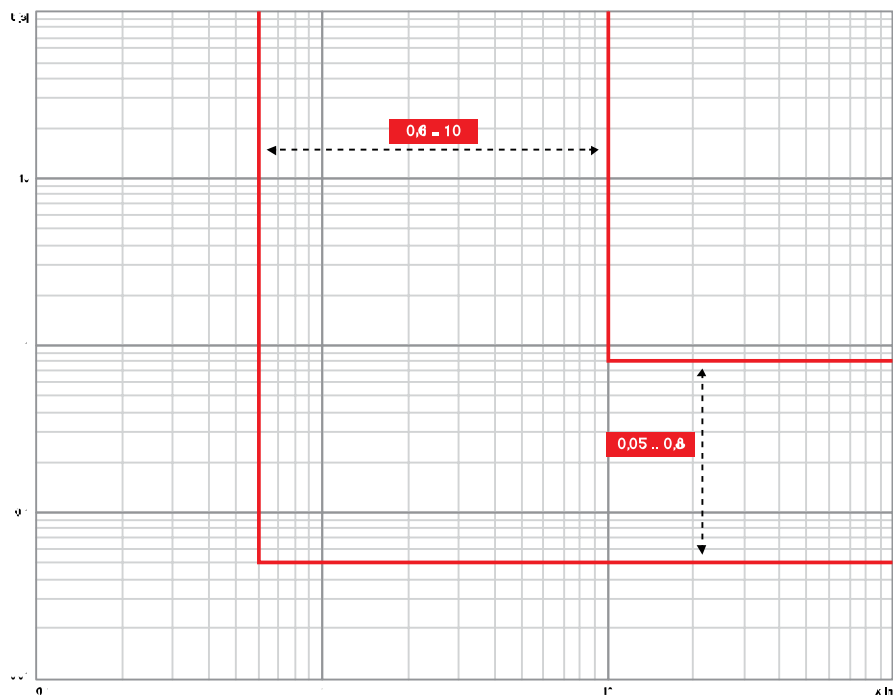
Protection	Trip threshold tolerance	Trip time tolerance
S2	--	$\pm 20\%$
IU	--	$\pm 20\%$

3 - Current Protections Curves

Function IU



Function S2



4 - Settings of Current Protections

Settings	The Current Protections digital upgrade does not enable any additional parameter in the Settings menu on the display. The available parameters are all described and available in the Protections chapter.
-----------------	---

5 - Current Protections test

Test	The Current Protections digital upgrade does not enable any additional test command in the Test menu on the display. Ekip Connect has a Test Protections section where the presence of current or voltage alarm signals can be simulated and the times and trips of certain protections in the package can be checked.
-------------	---

6 - Default of Current Protections

Default	All the protections in the package are supplied in the OFF configuration by default.
----------------	--

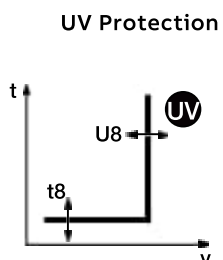
Voltage Protections

1 - Voltage Protections

Overview The following protections are available when the Voltage Protections digital upgrade is present:

Name	Type of protection	Page
UV	Minimum voltage	179
OV	Maximum voltage	180
Phase Sequence	Phase sequence error	180
VU	Voltage unbalance	180
S(V)	Short-circuit with voltammetric control	187
Voltage Stability	Voltage threshold check	182

The parameters of every protection can be checked and configured via all remote connection systems. In addition, Phase sequence can also be activated via display in the Protections menu and the presence of all can be checked in the Info menu.



Function

The protection sends a TRIP command if one or more line-to-line voltages detected by the unit drop below threshold U_8 for longer than t_8 .

To check and simulate the trip times in relation to all the parameters, please consult:

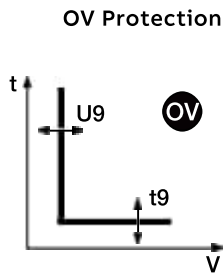
- summary table of the protections with the operating characteristics (page 183)
- the graph with trip curve (page 184)

Parameters

Parameter	Description	Default
<i>Enable</i>	Activates/deactivates the protection and its availability in the parameters menu	OFF
<i>Trip Enable</i>	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
<i>Threshold U_8</i>	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (U_n) and can be set within the range: $0.05 U_n$ to $1 U_n$ in $0.001 U_n$ steps	$0.9 U_n$
<i>Time t_8</i>	This is the trip time of the protection; the value is given in seconds and can be set within a range: $0.05 s$ to $120 s$, in $0.01 s$ steps	$5 s$

Limitations and additional functions

All the parameters described and the block functions are available via USB-C port, Bluetooth Low Energy and system bus (List of additional protections and functions on page 110).

**Function**

The unit sends a TRIP command when one or more of the phase-to-phase voltages exceeds threshold U_9 for longer than t_9 .

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 183)
- the graph with trip curve (page 184)

Parameters

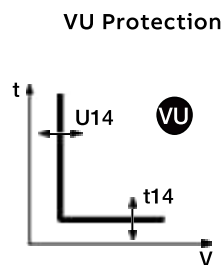
Parameter	Description	Default
<i>Enable</i>	Activates/deactivates the protection and its availability in the parameters menu	OFF
<i>Trip Enable</i>	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
<i>Threshold U_9</i>	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (U_n) and can be set within the range: $1 U_n$ to $1.5 U_n$ in $0.001 U_n$ steps	$1,05 U_n$
<i>Time t_9</i>	This is the trip time of the protection; the value is given in seconds and can be set within a range: $0.05 s$ to $120 s$, in $0.01 s$ steps	$5 s$

Limitations and additional functions

All the parameters described and the block functions are available via USB-C port, Bluetooth Low Energy and system bus (List of additional protections and functions on page 110).

Phase sequence protection

The *Phase Sequence* protection enables an alarm to be activated when the sequence of line-to-line voltages is not aligned with the sequence set by the user.

**Function**

The protection trips if the line-to-line voltages read by the unit are unbalanced; the protection sends a TRIP command if the detected unbalance exceeds threshold U_{14} for longer than t_{14} .

The protection excludes itself if the maximum value of the line-to-line voltage is less than $0.3 U_n$

To check and simulate the trip times in relation to all the parameters, please consult:

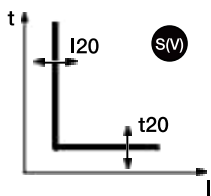
- summary table of the protections with the operating characteristics (page 183)
- the graph with trip curve (page 185)

Parameters

Parameter	Description	Default
<i>Enable</i>	Activates/deactivates the protection and its availability in the parameters menu	OFF
<i>Trip Enable</i>	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
<i>Threshold U_{14}</i>	Establishes the unbalance value that trips the protection. Unbalance is expressed in percentage value and is calculated in the following way: $\% \text{ Unba} = 100 \times (\Delta \max U_{mi}) / U_{mi}$ in range: 2% to 90% in 1% steps. i NOTE: $\Delta \max U_{mi}$: maximum deviation among the three voltages calculated by comparing each line-to-line voltage with the mean value; U_{mi} : mean value of the line-to-line voltages	50 %
<i>Time t_{14}</i>	This is the trip time of the protection; the value is given in seconds and can be set within a range: $0.5 s$ to $60 s$, in $0.5 s$ steps	$5 s$

Limitations and additional functions

All the parameters described and the block functions are available via USB-C port, Bluetooth Low Energy and system bus (List of additional protections and functions on page 110).

S(V) Protection Function

S(V) protection protects against short circuits, with a threshold sensitive to the value of the voltage.

If the current of one or more phases exceeds threshold I_{20} for longer than time t_{20} , the protection activates and sends a TRIP command.

Following a voltage drop, the I_{20} threshold varies according to two different modes:

- **Step** provides for a stepped variation, depending on parameters U_I and K_s ;
- **Lin** (linear) provides for a dynamic variation, depending on parameters U_I , U_h and K_s .

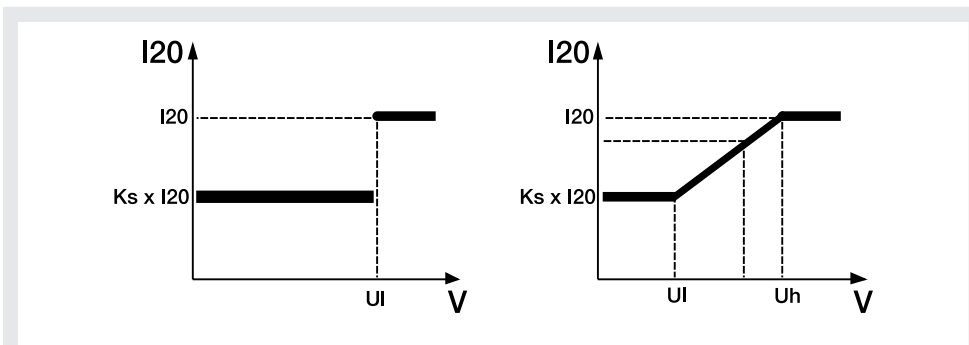


Figure 181

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 183);
- the graph with trip curve (page 185).

Parameters

Parameter	Description	Default
<i>Enable</i>	Activates/deactivates the protection and its availability in the parameters menu	OFF
<i>Trip Enable</i>	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
<i>Curve</i>	Allows the operating mode, Step or Lin, to be selected	Scal
<i>Threshold I20</i>	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (amperes) and relative value (I_n) and can be set within the range: $0.6 I_n$ to $10 I_n$, in $0.1 I_n$ steps	$1 I_n$
<i>Threshold UI</i>	This is the voltage that determines the change in trip threshold I_{20} ; the behavior differs, depending on the mode selected ⁽¹⁾ The value is given as both absolute value (V) and relative value (U_n) and can be set within the range: $0.2 U_n$ to $1 U_n$ in $0.01 U_n$ steps	$1 U_n$
<i>Threshold Uh</i>	The parameter is shown by the Lin curve and contributes towards I_{20} trip threshold calculation: • with voltage reading $< U_h$ (and $\geq U_I$), the threshold changes gradually ⁽¹⁾ ; • with voltage reading $\geq U_h$, the threshold is I_{20} . The value is given as both absolute value (V) and relative value (U_n) and can be set within the range: $0.2 U_n$ to $1 U_n$ in $0.01 U_n$ steps	$1 U_n$
<i>Threshold Ks</i>	I_{20} threshold calculation constant. The value is given as percentage of threshold I_{20} and can be set within the range: $0.1 I_{20}$ to $1 I_{20}$, in 0.01 steps	$0,6 I_{20}$
<i>Time t20</i>	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 30 s, in 0.01 s steps	0.1 s

⁽¹⁾ Trip threshold (depending on the operating curve)

Continued on the next page

Mode	Voltage reading	Trip threshold
ScaI	< U _I	K _s x I ₂₀
	≥ U _I	I ₂₀
Lin	< U _I	K _s x I ₂₀
	≥ U _I (e < U _h)	$((I_{20} \times (1 - K_s) \times (U_{mis} - U_h)) / (U_h - U_I)) + I_{20}$

Limitations and additional functions

All the parameters described and the block functions are available via USB-C port, Bluetooth Low Energy and system bus (List of additional protections and functions on page 110).

Voltage Stability

If all three of the phase-to-phase voltages measured by the protection release are beyond the window defined by the monitoring thresholds for the set time, the “Voltage Stability OK” signal is activated on the diagnosis bar.

Parameter	Description	Default
<i>Enable</i>	Activates/deactivates monitoring of the parameters and their availability in the menu	OFF
<i>Signal source</i>	Defines whether the line-to-line voltages to be checked are those from the internal sockets (Measurement) or from <i>Ekip Synchrocheck</i> , if present. i Note: if <i>Ekip Synchrocheck</i> is set, checking will refer to one single voltage	Meas.
<i>Threshold DOWN</i>	Establishes the lower value of the control band, given as both absolute value (V) and relative value (Un), which can be set within the range: 0.5 Un to 1 Un in 0.001 Un steps	0,9 Un
<i>Threshold UP</i>	Establishes the upper value of the control band, given as both absolute value (V) and relative value (Un), which can be set within the range: 1 Un to 1.5 Un in 0.001 Un steps	1,1 Un
<i>Time</i>	This is the monitoring time that activates the signal; the value is given in seconds and can be set within a range: 0.1 s to 900 s, in 0.1 s steps	30 s

2 - Performance table of Voltage 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.

Performance

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance ⁽¹⁾	Trip time tolerance
UV [27]	$t_t = t_8$	$\pm 2\%$ ⁽²⁾	with $t_8 \geq 5$ s: ± 100 ms / with $t_8 < 5$ s: the best between $\pm 10\%$ and ± 40 ms
OV [59]	$t_t = t_9$	$\pm 2\%$ ⁽²⁾	with $t_9 \geq 5$ s: ± 100 ms / with $t_9 < 5$ s: the best between $\pm 10\%$ and ± 40 ms
VU [47]	$t_t = t_{14}$	$\pm 5\%$ ⁽³⁾	with $t_{14} \geq 5$ s: ± 100 ms / with $t_{14} < 5$ s: the best between $\pm 10\%$ and ± 40 ms
S(V) [51V]	$t_t = t_{20}$	$\pm 10\%$	with $t_{20} \geq 5$ s: ± 100 ms / with $t_{20} < 5$ s: the best between $\pm 10\%$ and ± 40 ms

⁽¹⁾ 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

⁽²⁾ the protection release considers 3% hysteresis for quitting alarm condition

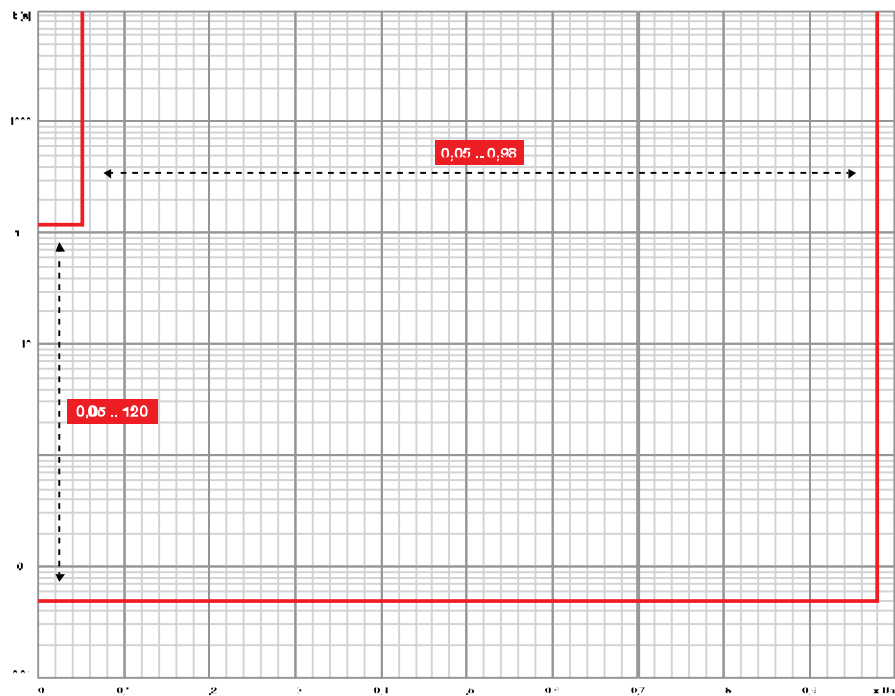
⁽³⁾ tolerance valid with threshold $U_{14} > 10\%$; with $U_{14} \leq 10\%$ (and $> 6\%$), the tolerance is 10%; with $U_{14} < 5\%$, the tolerance is 15%

Performance guaranteed in all operating conditions

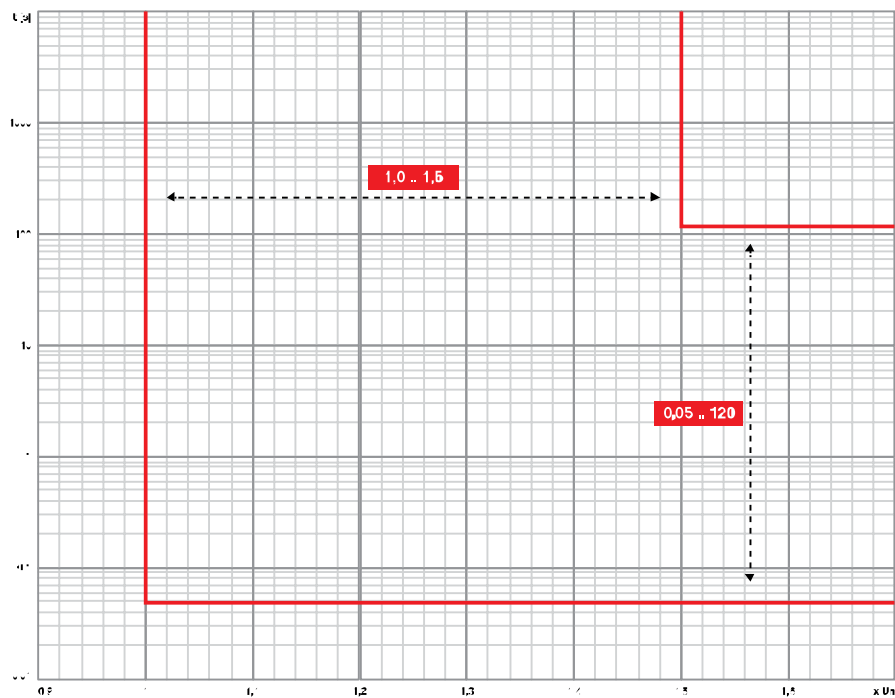
Protection	Trip threshold tolerance	Trip time tolerance
UV	--	$\pm 20\%$
OV	--	$\pm 20\%$
VU	--	$\pm 20\%$
S(V)	--	$\pm 20\%$

3 - Voltage Protection curves

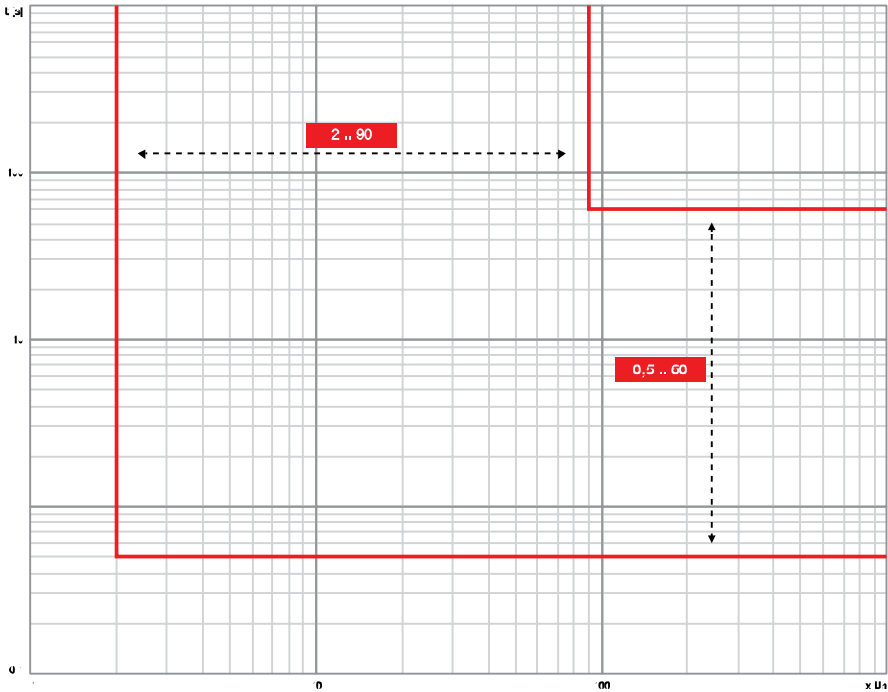
Function UV



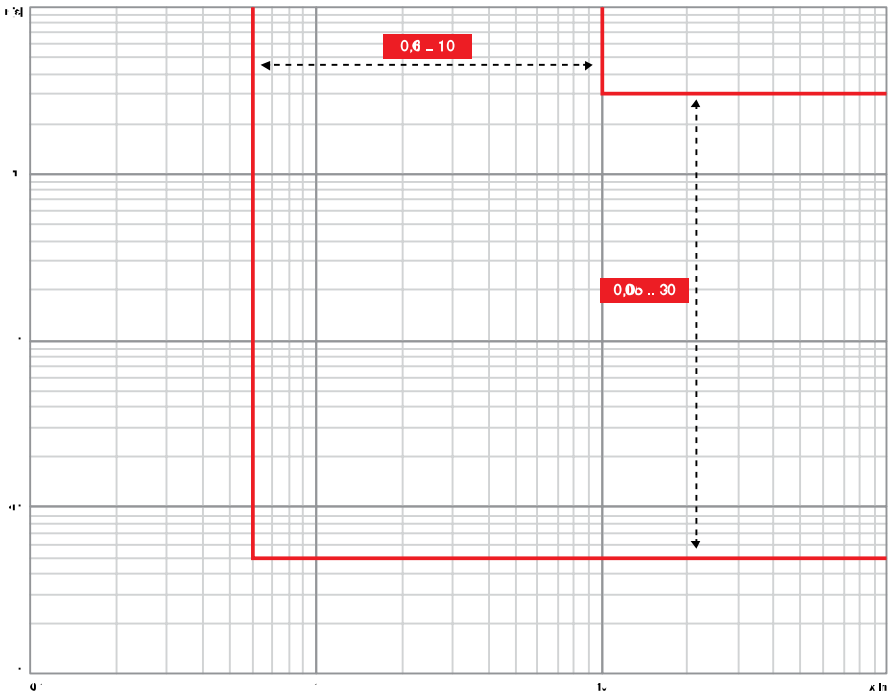
Function OV



Function VU



Function S(V)



4 - Voltage Protection settings

Settings	The Voltage Protections digital upgrade enables the Phase Sequence parameter to be present in the Configuration settings menu on the display. The parameter enables you to define the sequence of the phases between 123 and 321, useful for the protection of the same name and for checking the direction of the signals, for D protection.
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5 - Voltage Protection test

Test	The Voltage Protections digital upgrade does not enable the presence of any additional test command in the Test menu on display. Ekip Connect has a Test Protections section where the presence of voltage alarm signals can be simulated and the times and trips of certain protections in the package can be checked.
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6 - Voltage Protection default

Default	All the protections in the package are supplied by default in the OFF configuration and phase sequence 123.
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Advanced Voltage Protections

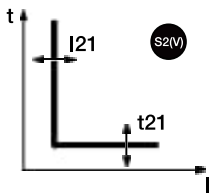
1 - Advanced Voltage Protections

Overview The following protections are available when the Advanced Voltage Protections digital upgrade is present:

Name	Type of protection	Page
S2(V)	Short-circuit with voltammetric control	187
RV	Residual voltage	188
UV2	Minimum voltage	189
OV2	Maximum voltage	190
Voltage Stability 2	Voltage threshold check	190

The remote connection systems enable the parameters of each protection to be checked and configured. In addition, the presence of all the protections can be checked in the Info menu on the display.

S(V) Protection Function



S2(V) protection functions in the same way as S(V) protection and protects against short-circuits, using a threshold sensitive to the voltage value.

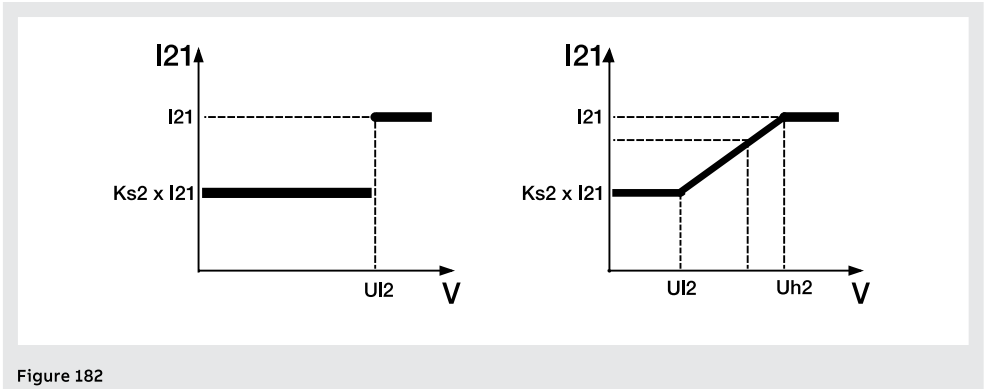
It is independent of the S(V) protection, enabling the thresholds and functions of both protections to be programmed so that different plant solutions can be adopted.

Example: signalling can be configured with S(V) and the opening command with S2(V) or vice versa, or both protections can be set for signalling or for trips.

The protection activates and sends the TRIP command when the current of one or more of the phases exceeds threshold I21 for longer than t21.

Following a voltage drop, the I21 threshold varies according to two different modes:

- **Step** provides for a stepped variation, depending on parameters UI2 and Ks2;
- **Lin** (linear) provides for a dynamic variation, depending on parameters UI2, Uh2 and Ks2.



To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 191);
- the graph with trip curve (page 185).

Continued on the next page