- Directional short time dST
- Reverse power protection RP
- Enhanced protective functions EPF

All of the protective functions can be independently enabled “ON” or disabled “OFF”.

2.3.5.2 Long time LT

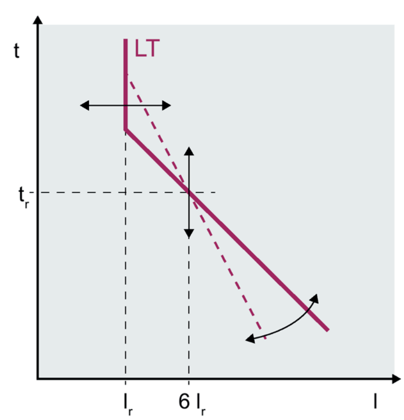
The overload protection is current-dependent and long-time delayed. It is based on the rms value of the current and protects cables, busbars and busway systems in the event of overload.

The overload protection is implemented independently for each phase and is equipped with a thermal memory. This stores the circuit breaker’s thermal state as determined by the operational current and shortens the tripping time when reclosing following a trip.

The overload protection delay is defined at 6 times the current setting I_r. The minimum tripping time is limited to 500 ms.

The overload protection has a two-stage alarm function.

Characteristic



The overload protection is available with the following tripping characteristics:

- I^2t characteristic with dependent long-term delay
- I^4t characteristic with dependent long-term delay for optimum selectivity for upstream and downstream fuses

Phase failure detection

If the current of the phase with the lowest load is 50% less than the current of the phase with the highest load, this is interpreted as a phase failure and the setting I_r is automatically reduced to 80%. If the three phase currents do not differ by more than 50% with respect to each other, the setting I_r applies again.

Phase failure detection can be switched on/off for the ETU600 electronic trip unit.

Thermal memory

The electronic trip unit offers the possibility to continue the internal mathematical simulation of the thermal processes in downstream systems and loads even if the circuit breaker is switched off and no external power supply to the electronics is available. This ensures effective protection against thermal overload, even with frequent closing and opening operations and fluctuating loads. An earlier, completed overload excitation can have a time-shortening effect on a pending overload trip.

Functional principle of the thermal memory:
The thermal memory operates in the overload range. Currents below the tripping threshold are not included in the evaluation. When the operational current exceeds this threshold, a strictly monotonic thermal evaluation is performed according to the characteristic. When the operational current falls below this threshold once again, cooling takes place according to an exponential function with an adjustable time constant.

- Behavior when thermal memory is switched on:
  The thermal history is taken into account. After tripping, the thermal memories of the phases including the neutral conductor are preset with the thermal equivalent of the warmest phase reduced to 90%. This makes it possible to reclose the circuit breaker. Cooling down takes place according to an exponential function with adjustable time constant and is active for a maximum of 30 minutes after overload tripping.
- Behavior when thermal memory is switched off:
  The thermal history is not taken into account.

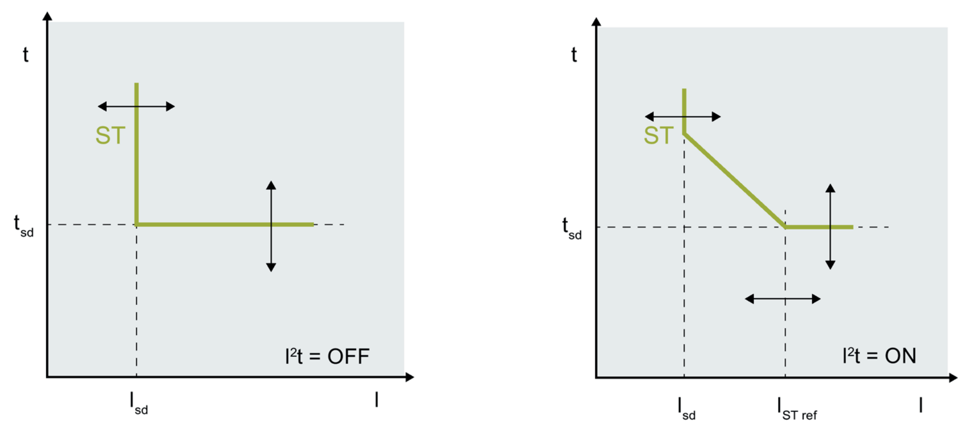
2.3.5.3 Short time ST

With short time ST, the power distribution system is protected against power system faults such as:

- Phase-phase short-circuit
- Phase-neutral conductor short-circuit
- Phase-ground short-circuit

The circuit breaker trips when the rms value of a phase current or the neutral current exceeds the setting of the short-time-delayed tripping current for the duration of the set delay.

Characteristic



The characteristic is determined by the short-time-delayed tripping current I_{sd}, the adjustable tripping time t_{sd}, the characteristic type, and a reference point I_{ref}.

Depending on the setting for I^2t, there are two characteristic curve forms:

- I^2t = OFF (top left figure):
  Tripping takes place independently of the current when the setting I_{sd} is exceeded after the set delay t_{sd}.
- I^2t = ON (top right figure):
  After exceeding the setting I_{sd}, tripping occurs with an inverted time characteristic. When the reference current value I_{ref} is exceeded, the current-dependent short-time delay ends and the circuit breaker trips after the set delay time t_{sd}. This ensures the selectivity for fuses even in the short-circuit current range.

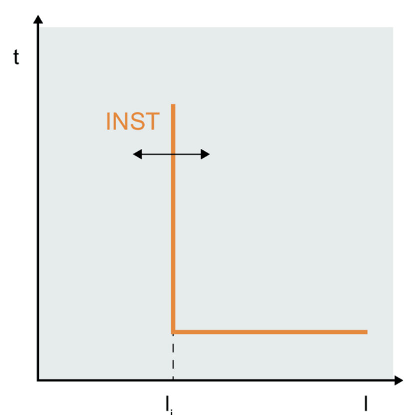
2.3.5.4 Instantaneous short-circuit protection INST

With the instantaneous short-circuit protection, the power distribution system is protected against power system faults such as:

- Phase-phase short-circuit
- Phase-neutral conductor short-circuit
- Phase-ground short-circuit

The circuit breaker trips when the rms value of a phase current or the neutral current exceeds the setting of the instantaneous tripping current I_i.

Characteristic



2.3.5.5 Neutral protection N

The neutral conductor can be protected against overload and short-circuit with the electronic trip unit. The neutral protection consists of a separate overload protection and a common short-circuit protection for the three phases and the neutral conductor.

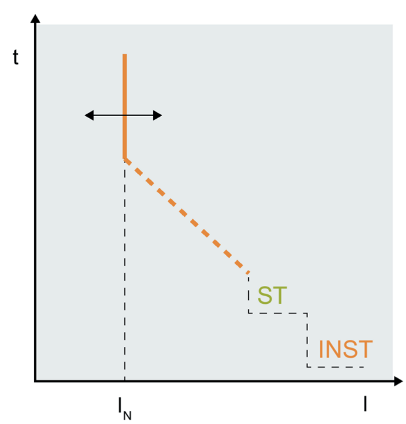
The overload protection has the setting I_N. The delay, the overload characteristic, and the thermal memory correspond to the settings of the overload protection of the three phases. For four-pole circuit breakers, the setting I_N of the overload protection is limited by the maximum rated current $I_{n\,max}$ of the circuit breaker.

For the short-circuit protection of the N-conductor, the settings of the short time ST and the instantaneous short-circuit protection INST are adopted.

Note

For a 3-pole circuit breaker, an external current sensor (N-CT) is required to protect the neutral conductor, see Chapter External current sensor for neutral pole (Page 313).

Characteristic

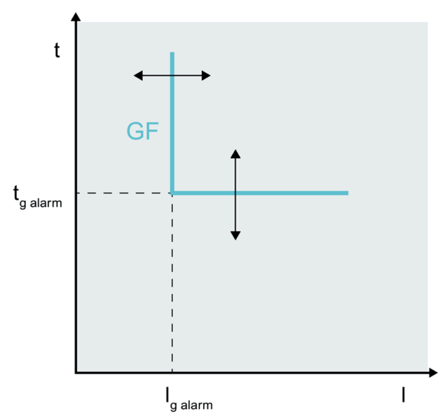


2.3.5.6 Ground-fault alarm

A ground fault can occur due to aging and the resulting deterioration of an insulating component in a power distribution system or due to a foreign body in the system. If the fault resistance is so high that the ground-fault current is below the settings of the ground-fault protection, the electronic trip unit will not trip. With the ground-fault alarm, a high-resistance ground fault can be detected without switching off the system. Then the elimination of the fault must be initiated.

The ground-fault alarm detects fault currents between the conductors and grounded parts of the power distribution system. It responds when the rms value of the ground-fault current exceeds the set alarm threshold $I_{g\ alarm}$ for the duration of the set delay $t_{g\ alarm}$.

Characteristic



2.3.5.7 Ground-fault protection GF

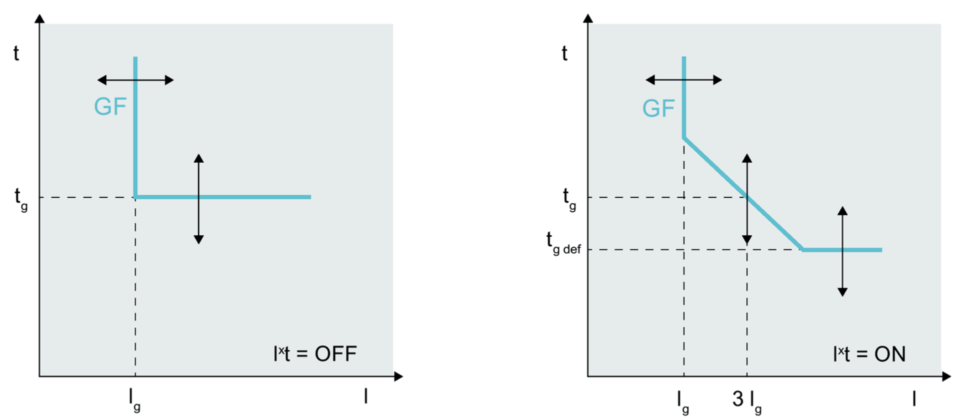
The ground-fault protection detects residual currents between the conductors and grounded parts of the power distribution system. The ground-fault protection function responds when the ground-fault current exceeds the set tripping current I_g for the set delay time t_g.

Ground-fault protection can be implemented either as a current-independent or a current-dependent function.
The ETU600 electronic trip unit with the option plug LSIG GFx has a current-independent or current-dependent characteristic curve with the following characteristics for ground-fault protection:

- I^2t
- I^4t
- I^6t

In the case of a current-independent characteristic curve, the circuit breaker trips when the tripping current is exceeded after the set delay t_g. In the case of a current-dependent characteristic, the circuit breaker trips according to the inverse-time characteristic.

Characteristic



Implementation on the circuit breaker

For direct measurement of the ground-fault current, an external current sensor (GF-CT) can be connected to terminals X8-11 and X8-12 of the secondary disconnect terminal of the circuit breaker.

The current sensor must have the following properties:

- Primary rated current I_{pr} = 150 A to 2000 A
- Secondary rated current I_{sr} = 1 A
- Accuracy class 1

NOTICE
Damage to electronic trip unit (ETU) due to incorrectly dimensioned current sensor
The measuring input of the electronic trip unit is designed for a maximum ground fault sensor secondary rated current of 4 A for 500 ms. This value must not be exceeded.
The selection of the current sensor must take into account the internal circuit breaker load of 0.11 Ω.

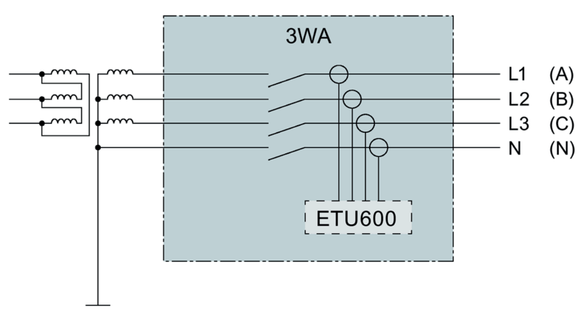
The transformation ratio of the current sensor must be set on the ETU600 electronic trip unit. This can be done on the display of the ETU600 electronic trip unit in menu item 5.3.6 Ground-fault current or with the SENTRON powerconfig configuration software.

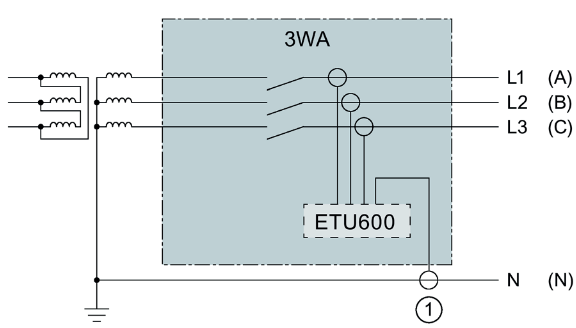
GF mode

A ground-fault current can be calculated mathematically or measured directly. The three GF modes available on the ETU600 electronic trip unit are described below.

GF Residual

The ground current is formed by the vectorial sum of the currents measured with the internal current sensors and the external N-conductor sensor (N-CT). All four-pole circuit breakers have an internal N-conductor sensor.

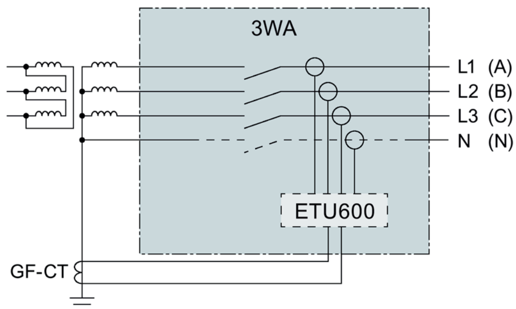


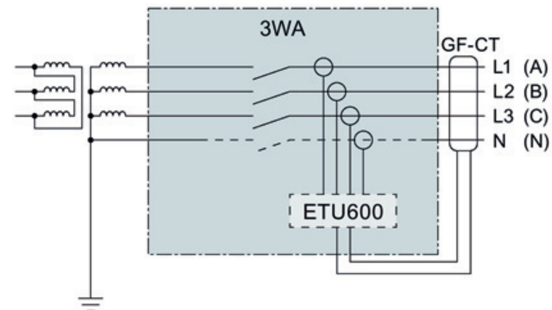


(1) External N-conductor sensor (N-CT)

GF Direct

The ground-fault current is measured directly, e.g. in the cable of the transformer neutral point, with a current transformer. Commercially available measuring transformers with primary rated current I_{pr} = 150 A to 2000 A and secondary rated current I_{sr} = 1 A can be used for this purpose.

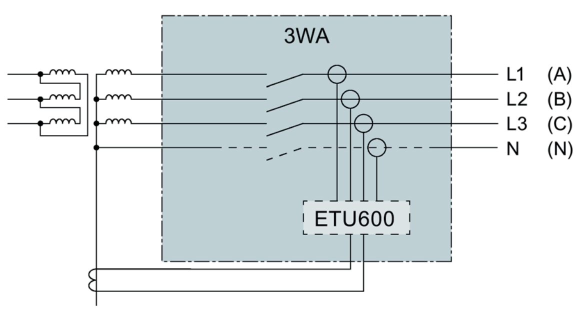




GF Dual

With the setting GF Dual, the acquisition methods GF Residual (calculation of the vectorial sum of the currents) and GF Direct (direct measurement of the ground-fault current with an external current transformer) can be used simultaneously. This provides the user with two independent characteristics for ground-fault protection.

In this GF mode, the ETU600 LSIG electronic trip unit is able to distinguish an infeed-side ground fault from an outgoing-side ground fault. The ground fault on the outgoing side can be interrupted with the circuit breaker. When a ground fault is detected on the infeed side, the ETU600 LSIG electronic trip unit can issue a signal to open the upstream medium-voltage circuit breaker.



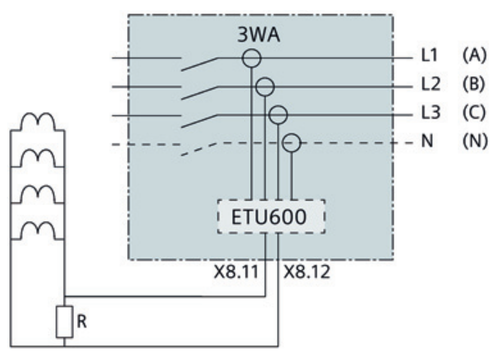
2.3.5.8 Ground-fault protection GF Hi-Z

In addition to the GF modes mentioned in the Chapter "Ground-fault protection GF", the 3WA circuit breaker with the ETU600 LSIG Hi-Z electronic trip unit offers the possibility of connecting a current transformer combination for ground-fault protection Hi-Z between the transformer and the circuit breaker. The current transformer combination consists of several current transformers.

The GF Hi-Z ground-fault protection is only available with the ETU600 LSIG Hi-Z electronic trip unit. This was specially developed for the detection of ground-fault currents on the infeed side of the circuit breaker. The ETU600 LSIG Hi-Z provides the necessary inputs for connecting the voltage transformers required for this application. This makes it possible to dispense with the protection relay which would otherwise be required for protection between the transformer and the circuit breaker. The ETU600 LSIG Hi-Z takes over this task completely.

Two independently operating ground-fault protection functions are available to the user.

For this purpose, commercially available Class TPS current sensors, which are interconnected in a group and connected in parallel via a high-resistance load resistor, are connected to terminals X8-11 and X8-12 of the secondary disconnect terminal of the circuit breaker.

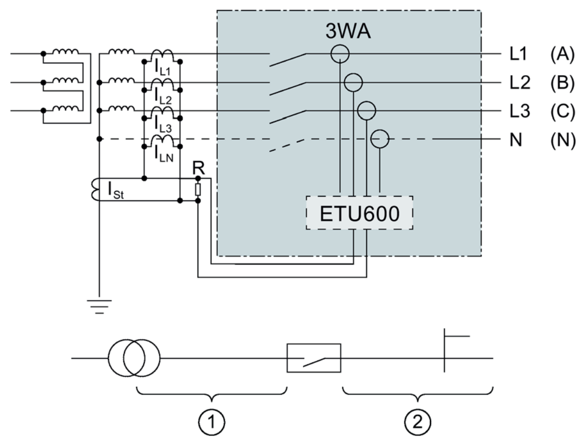


Note

The maximum voltage at the measuring input of the electronic trip unit is 150 V rms. This must not be exceeded. A varistor or other suitable voltage limitation device must be connected in parallel to the load for this reason.

The ETU600 LSIG Hi-Z electronic trip unit can differentiate between an infeed-side ground fault and an outgoing-side ground fault. In countries where British standards are used, the areas before and after the circuit breaker are referred to as the "restricted zone" and "unrestricted zone" respectively. Derived from this, this type of ground-fault protection is called "Restricted Earth Fault (REF)" and "Unrestricted Earth Fault (UREF)".

Please note that ground-fault protection with ETU600 LSIG Hi-Z differs from high-resistance neutral point grounding and must not be confused with it.



(1) Restricted zone of protection

(2) Unrestricted zone of protection

Current transformer configurations

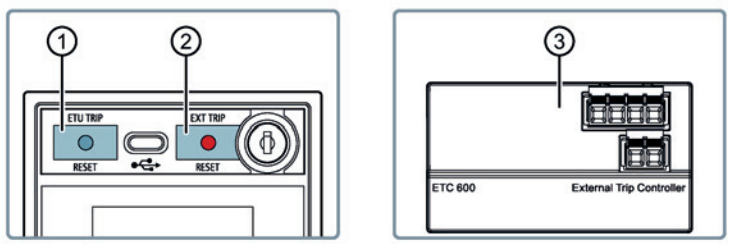
Depending on the network topology of the power distribution system, several current transformers are required for the detection of ground-fault currents on the infeed side. In practice, current transformers of class TPS (former designation class X) according to IEC 60044-6 are used in a transformer combination. If only one current transformer is used in the neutral point of the transformer, the ground-fault currents of the outgoing feeders are also acquired via this transformer.

Ground fault interruption

The ground fault on the outgoing side can be interrupted with the circuit breaker.

When a ground fault is detected on the infeed side, the ETU600 LSIG Hi-Z electronic trip unit issues a signal to open the medium-voltage circuit breaker. In this case, the ETC600 external trip controller can be integrated in the intertripping circuit of the medium-voltage circuit breaker and can also open the low-voltage 3WA circuit breaker by means of the second tripping solenoid F6.

The tripping solenoid F6 operates independently of the ETU600 electronic trip unit and prevents reclosing after the circuit breaker has been opened. The circuit breaker can only be closed after resetting the reclosing lockout locally, marked EXT TRIP in the figure below. The 3WA is the only circuit breaker capable of this functionality.



(1) ETU TRIP, reclosing lockout not active

(2) EXT TRIP, reclosing lockout active

(3) ETC600 external trip controller

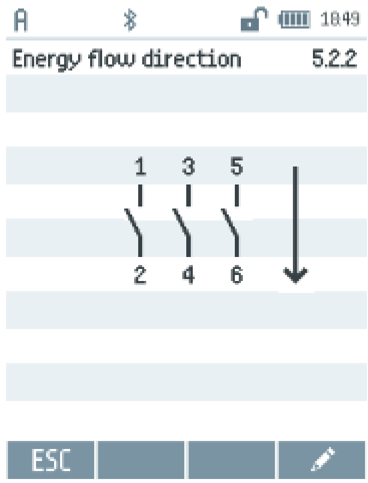
2.3.5.9 Directional short time dST

With the directional short time dST, the power distribution system is protected against power system faults such as:

- Phase-phase short-circuit
- Phase-neutral conductor short-circuit
- Phase-ground short-circuit

The circuit breaker trips when the rms value of a phase current exceeds the set directional short-time-delayed tripping current for the duration of the set directional delay.

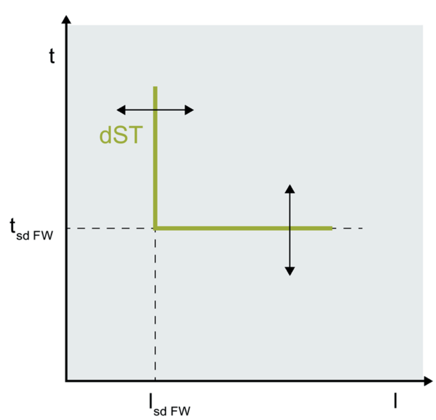
This function requires an internal voltage tap or external voltage transformers and a voltage tap module VTM. For this protective function, the direction of energy flow must also be defined and parameterized on the ETU600 electronic trip unit:

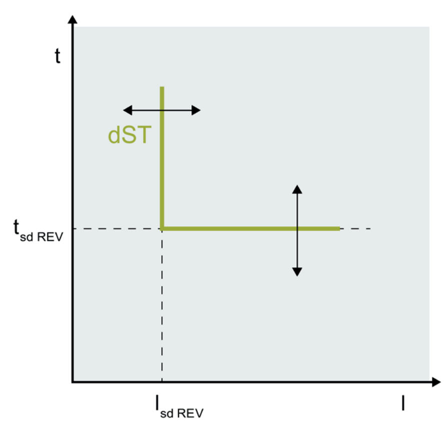


Characteristic

The characteristic is determined by the short-time-delayed tripping currents $I_{sd\ FW}$ (forward direction) and $I_{sd\ REV}$ (reverse direction) and the adjustable tripping time $t_{sd\ FW}$ and $t_{sd\ REV}$.

Forward **Reverse**





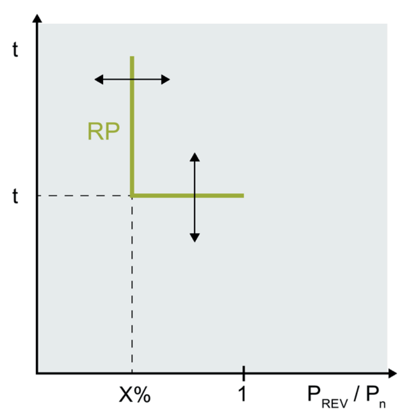
2.3.5.10 Reverse power protection RP

The reverse power protection trips the circuit breaker if the power flow through the device reverses against the direction of flow defined as normal and exceeds the set delay time. The setting is referred to the rated active power P_n as a percentage. This is dependent on the rated current I_n of the circuit breaker and the rated voltage U_n parameterized on the electronic trip unit.

For reverse power protection, the current and voltage signals are evaluated and the active and apparent power are put into relation. A reversing power flow is identified by the phase offset between current and voltage signal.

This function also requires internal voltage taps or external voltage transformers and the voltage metering module VTM.

Characteristic



2.3.5.11 Enhanced protective functions EPF

Enhanced protective functions can be added to the function scope of the ETU600 electronic trip unit. On the basis of the measured currents, voltages and frequency, overshooting or undershooting of the resulting metering values can cause tripping of the circuit breaker.

The following enhanced protective functions can be used:

- Phase unbalance current (device number 46)
- Phase unbalance voltage (device number 47)
- Total harmonic distortion for current (device number THDC) and voltage (device number 81THDV)
- Undervoltage (device number 27), overvoltage (device number 59)
- Forward power (ANSI 32F), reverse power (ANSI 32R)
- Underfrequency (device number 81U), overfrequency (device number 81O)
- Reverse-phase sequence protection (device number 46)

Note

Two different calculation methods are used for the calculation of phase unbalance.

- ANSI definition:
  Ratio of the greatest difference of the phases from the arithmetic mean value of the phases.
- IEC definition:
  Ratio of the greatest difference of the phase from the phase with the highest load.

The method to be used can be parameterized on the electronic trip unit.

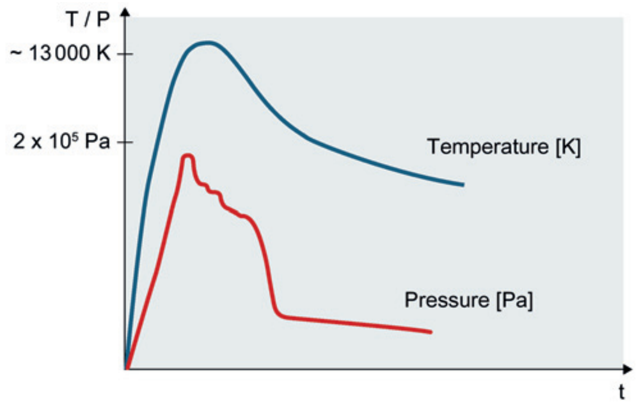
One of the enhanced protective functions trips the circuit breaker when the corresponding measured value exceeds or falls below the set delay time.

The required voltage tap module is a component of the ETU600 electronic trip unit from metering function type PMF-I on. The enhanced protective functions are part of the standard scope of a circuit breaker with metering function from type PMF-II. For more information, see Chapter Metering function (power metering function) (Page 103).

No external auxiliary voltage is required for the enhanced protective functions.

2.3.6 DAS+ maintenance mode

An arcing fault can be described as a gas discharge with plasma formation and temperatures up to 50,000 K, in which the electric current flows through unintended dynamic paths. In addition to the extreme temperatures, very high pressures are also generated.



Arcing events typically result from:

- Human error,
 such as accidental contact with voltages above ground potential, tools or debris inadvertently left behind after maintenance, or improper assembly
- Lack of adequate maintenance for the operating or ambient conditions
- Insulation failure due to aging, environmentally-related degradation, animals in the system (e.g. snakes or rodents), or operation not in accordance with the product ratings

After ignition, the arc transforms its surroundings by ionizing the air and converting metallic materials into conductive plasma and expands with explosive force under extreme heat. The more material is vaporized, the stronger the arc.

DAS+ maintenance mode

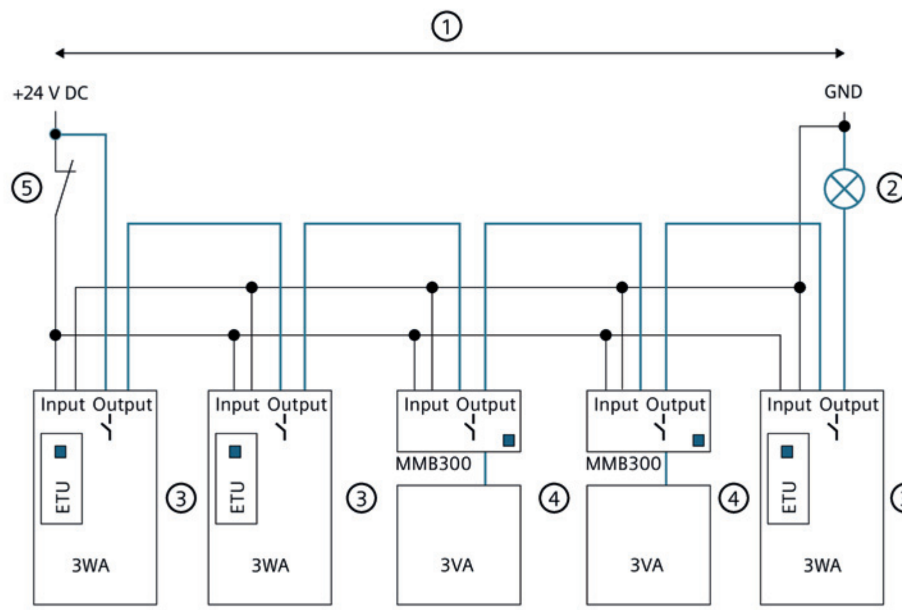
Fast tripping of circuit breakers and extinction of the arc are extremely important in order to protect employees working in the immediate vicinity of live parts. To this end, the DAS+ maintenance mode operates with its own set of protection parameters to reduce the trip threshold, thus ensuring that the circuit breaker trips at a lower threshold than would be necessary for normal operation and without delay times.

The DAS+ maintenance mode is an energy-reducing function with local status indication, which is used to comply with the following norms/standards:

- National Electrical Code (NEC) Section 240.87 (B)(3) Arc-Flash energy reduction (energy-reducing maintenance switching with local status indicator)
- NFPA 70E Standard for Electrical Safety in the Workplace
- DIN EN 50110-1 Operation of electrical installations/B.6 Arc hazard

DAS+ system

The following shows how to integrate several circuit breakers in the DAS+ maintenance mode. The activation is done via a switch. The activated maintenance mode on all the circuit breakers is signaled by a "DAS+ active" light.



(1) To ensure proper performance, the total cable length of the system must not exceed 50 m (165 ft).

(2) The "DAS+ active" light should be installed in such a way that it is clearly visible to maintenance personnel.
It is only active when all circuit breakers are in the DAS+ maintenance mode. The maximum switching and continuous current of the digital output ETU-OUT is 0.1 A at 24 V DC. A coupling relay must be used for higher loads or other voltages.

(3) 3WA air circuit breaker

(4) 3VA6 molded case circuit breaker with external maintenance module MMB300

(5) On/off switch for activating the DAS+ maintenance mode
The switch should be installed in a suitable position outside the arc-flash zone.

The DAS+ system is compatible with the 3WL circuit breaker with COM35. For more information, refer to the "3WL air circuit breakers via COM35 - PROFINET IO, Modbus TCP" communication manual; see Chapter Reference documents (Page 16).

DAS+ is not compatible with 3WL10 and 3VA27 circuit breakers.

Activation

The DAS+ maintenance mode can be activated in various ways.

Activation options:

- Digital ETU input of the circuit breaker, secondary disconnect terminals X8-5 and X8-6. Depending on the selected signal state (LOW/HIGH), the input can be controlled via an NC contact or an NO contact.
- Button on the display of the ETU600 electronic trip unit
- Input of a digital input/output module
- Via the fieldbus interfaces of a communication module, see Chapter Communication and system connection (Page 106).

The activated DAS+ maintenance mode is indicated by the blue LED on the electronic trip unit and on the display.

A message can also be sent via the following signals:

- Digital ETU output of the circuit breaker, secondary disconnect terminals X8-7 and X8-8
- Via an output of a digital input/output module
- Via fieldbus communication

Note

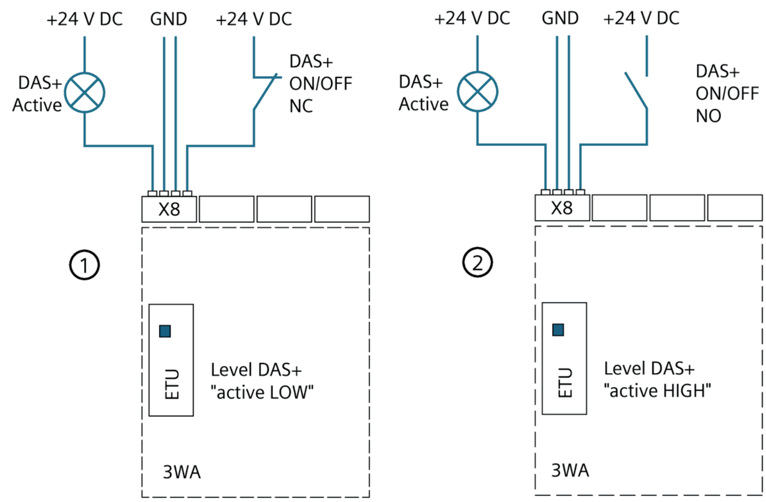
For security reasons, the DAS+ maintenance mode can only be deactivated using the same method by which it was activated.

Application examples

The following figure shows the activation of the DAS+ maintenance mode by the digital ETU input with a normally-closed contact (NC) and a normally-open contact (NO).

- LOW signal (NC):
  The DAS+ maintenance mode is active when there is no signal present at the secondary disconnect terminals X8-5 and X8-6 (example ①)
- HIGH signal (NO):
  The DAS+ maintenance mode is active when there is a signal present at the secondary disconnect terminals X8-5 and X8-6 (example ②)

The digital ETU output, secondary disconnect terminals X8-7 and X8-8, is used for signaling "DAS+ ON".



Terminal assignment for DAS+ maintenance mode:

X8													
14	13	12	11	10	9	8	7	6	5	4	3	2	1
						ETU-OUT	ETU-OUT	ETU-IN	ETU-IN				

2.3.7 Activation limits and power supply

The electronic trip unit does not require auxiliary power. The electronic trip unit is powered by the circuit breaker's internal current sensors. Depending on the operational current, the electronic trip unit of the circuit breaker is activated from:

	Size 1 / 2	Size 3	ACT LED (Active)		Description
1-pole/2-pole load	80 A	90 A		Flashing (frequency: 1 Hz)	Electronic trip unit active, display off
	100 A	110 A		On	Electronic trip unit active, display on
3-pole load	70 A	80 A		Flashing (frequency: 1 Hz)	Electronic trip unit active, display off
	100 A	110 A		On	Electronic trip unit active, display on

Alternatively, for a circuit breaker with integrated voltage tap, the ETU600 electronic trip unit can be supplied via the VTM680 voltage tap module.

If functions with data exchange via CubicleBUS² are to be used with the ETU600 electronic trip unit, an external 24 V DC power supply must be connected to the secondary disconnect terminals X8-3 and X8-4. This means that the ETU600 is active even when the circuit breaker is open or when the operational current is below the activation limit.

WARNING

Loss of direct-acting circuit breaker functionality with option code Z = K60

When the circuit breaker is equipped with current sensors without energy cores, the electronic trip unit is not self-powered.
For these applications, an undervoltage release and an external 24 V DC power supply are required to power the electronic trip unit.
The auxiliary power supplying the electronic trip unit is internally coupled to the undervoltage release of the circuit breaker.

2.4 Electronic trip unit ETU600

2.4.1 Overview of variants

All the circuit breakers with integrated ETU600 electronic trip units have two independently operating microprocessors - one for protective functionality and one for metering and accessory functionality.

Function packages can be added to the ETU600 electronic trip unit to add protective functions and additional measurement capabilities. This makes the ETU600 a future-proof protection and measuring device in the age of digitalization.

The protective functions of the ETU600 comply with the regulations for electrical installations and protect them against overcurrent and short circuit.

The optionally integrated metering function supplies the metering values for energy management and can be referred to as a "power metering function" in a circuit breaker as defined in IEC 61557-12. The functionality is equivalent to a power metering and monitoring device.

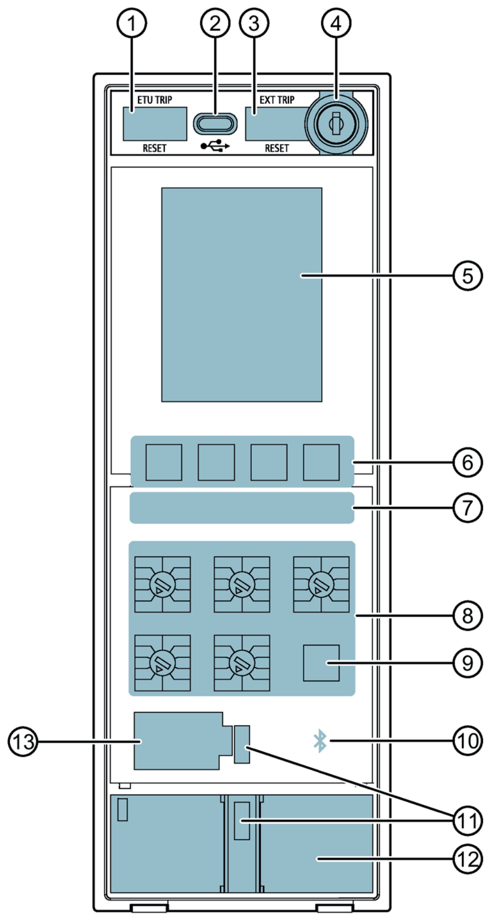
The ETU600 electronic trip unit is available in the following versions:

- ETU600 LSI
  This version has overload protection, short-time and instantaneous short-circuit protection as basic protective functions. The basic protective functions do not require an auxiliary power supply; they are supplied by the current flowing through the circuit breaker.
- ETU600 LSIG
  In addition to the basic protective functions of the ETU LSI, this version offers ground-fault protection, see Chapter Ground-fault protection GF (Page 55).
- ETU600 LSIG Hi-Z
  Compared to the ETU LSIG, this version offers enhanced ground-fault protection, see Chapter Ground-fault protection GF Hi-Z (Page 58).

The function scope of all versions can be extended by directional or enhanced protective functions.

2.4.2 Operator controls, displays and voltage tap module

2.4.2.1 Overview



(1) ETU TRIP: Trip indication and mechanical RESET of the reclosing lockout after a trip by the ETU600 electronic trip unit

(2) USB connection (USB-C)

(3) EXT TRIP: Trip indication and mechanical RESET of the reclosing lockout after an external switch-off

(4) Safety lock, prevents a RESET of the reclosing lockout (option)

(5) Display

(6) Operating keys F1 to F4

(7) LED displays

(8) Rotary switch

(9) Query button

(10) Marking to indicate internal Bluetooth interface

(11) Sealing eye for sealable and lockable cover (option)

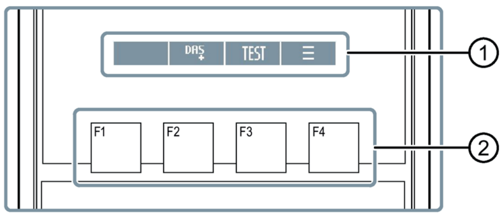
(12) Voltage tap module VTM (optional)

(13) Option plug

2.4.2.2 Display and operating keys F1 to F4

The ETU600 electronic trip unit has an integrated color display. This can be used to display metering values, set parameters, and report events.

The four operating keys F1 to F4 are assigned menu-dependent actions. One to four operating keys can be active.



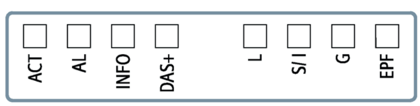
(1) Action that is executed by the assigned operating key

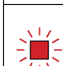
(2) Operating keys

The display is also used for detailed representation of events. A description of selected events is given in Chapter Display and menu structure (Page 76).

2.4.2.3 LED displays

Status information of the ETU600 electronic trip unit and the last trip cause are indicated by LEDs.



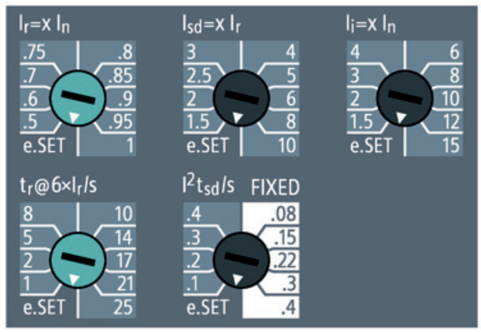
LED	Meaning	Description
ACT (active) Activation of the ETU		
	Off	ETU not activated
	Flashing (frequency: 1 Hz)	ETU activated
AL (alarm) Two-stage overload alarm		
	Off	Current is less than the set alarm threshold AL1
	On	Current in a phase exceeds the alarm threshold 1
	On	Current in a phase is greater than or equal to the setting I_r of the overload protection

<table>
<tr><th>LED</th><th>Meaning</th><th colspan="2">Description</th></tr>
<tr><td colspan="4">INFO
Display of status information</td></tr>
<tr><td>□</td><td>Off</td><td colspan="2">Normal operating status (no unacknowledged trip)</td></tr>
<tr><td></td><td>On</td><td colspan="2">Warning is present</td></tr>
<tr><td></td><td>On</td><td colspan="2">Error is present</td></tr>
<tr><td colspan="4">DAS+
DAS+ maintenance mode</td></tr>
<tr><td>□</td><td>Off</td><td colspan="2">DAS+ not activated</td></tr>
<tr><td></td><td>On</td><td colspan="2">DAS+ activated</td></tr>
<tr><td colspan="4">L, S/I, G, EPF
Last trip cause</td></tr>
<tr><td>□</td><td>Off</td><td colspan="2">Normal operating state</td></tr>
<tr><td rowspan="5"></td><td rowspan="5">On</td><td colspan="2">Tripping due to:</td></tr>
<tr><td>L</td><td>Long time LT</td></tr>
<tr><td>S/I</td><td>Short circuit ST, dST or INST</td></tr>
<tr><td>G</td><td>Ground fault GF</td></tr>
<tr><td>EPF</td><td>Enhanced protective function</td></tr>
<tr><td colspan="4">Details on tripping are shown on the display and stored in the trip log of the ETU600. If the ETU600 is not activated, the trip cause can be displayed by pressing the Query button.</td></tr>
</table>

Additional information on the display of error messages can be found in Chapter Error display (Page 133).

2.4.2.4 Rotary switch

The electronic trip unit has five rotary switches for parameterizing the basic protective functions.



Nine fixed values can be set mechanically for each rotary switch. The tenth position is marked with “e.SET”. In this position, the parameter can be set via the display or with the help of the SENTRON powerconfig configuration software via Bluetooth or communication.
The basic settings for the “e.SET” position are set as follows at the factory:

- I_r: 0.4 x I_n
- t_r: 0.5 s
- I_{sd}: 0.6 x I_n
- t_{sd}: 0.1 s FIXED
- I_i 1.5 x I_n

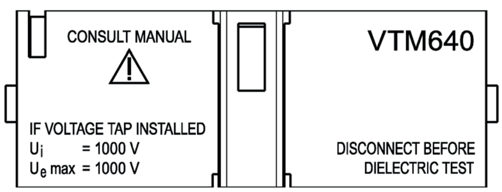
2.4.2.5 Voltage tap module

A voltage tap module VTM is required for measuring the voltage and calculating further metering values. It is available as an option for 3WA circuit breakers with rated voltage up to 1000 V and ETU600.

The voltage tap module is available in two versions:

- VTM680 voltage tap module
  For 3WA circuit breakers with breaking capacity N, S, M, H, C and maximum rated voltage 690 V AC
  Provides power to the ETU600 via the voltage applied in the power distribution system
- VTM640 voltage tap module
  For 3WA circuit breakers with breaking capacity E and max. rated voltage 1000 V AC

  No power supply for ETU600



The voltage tap module requires an internal voltage tap on the upper or lower main circuits in the circuit breaker.

For rated voltages greater than 1000 V, external voltage transformers must be used to measure the system voltage.

Metering values

If a voltage tap module is added to the circuit breaker, the following metering values are available:

- Phase-to-phase voltage U_{LL}
- Phase voltage U_{LN}
- Active energy E_a

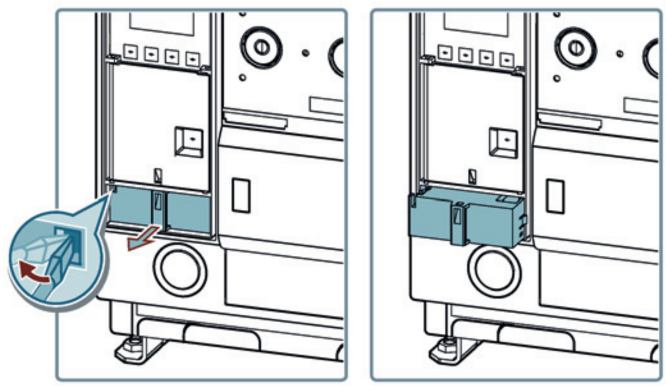
This makes the 3WA circuit breaker a PMF-I type measuring device in accordance with IEC 61557-12.

Test position

Before performing the insulation test of the power distribution equipment, the voltage tap module must be pulled out into the test position. This provides galvanic isolation between the electronics and the primary circuit.

Note

Performing an insulation test without pulling the voltage tap module into the test position may result in a failed insulation test. This will not affect the circuit breaker functionality.

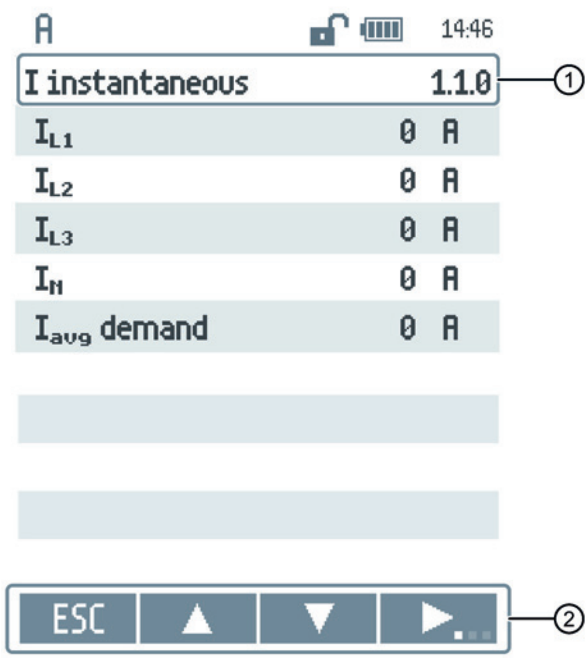


2.4.3 Display and menu structure

2.4.3.1 Operating philosophy

For a simple and intuitive operation of the ETU600 electronic trip unit, the following two properties are important:

- In each menu, the menu name and the corresponding menu number are displayed in the top line.
- The operating keys F1 to F4 have a menu-dependent assignment.

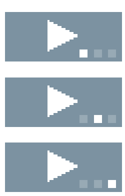


(1) Menu name and menu number

(2) Assignment of the operating keys (menu bar)

Icons of the functions

The assignment of the operating keys F1 to F4 is indicated by the following icons in the menu bar:

Icon	Function
	Navigation in the menu - up
	Navigation in the menu - down
	Confirmation
	Edit settings
	Escape / back If the operating key is pressed for more than > 3 s: Main menu
	Main menu
	Test menu
	Selection of a “Shadow” menu
	Activating the DAS+ maintenance mode
	Generation of a QR code

Additional symbols

If a menu has to be displayed across several pages, this can be recognized by the following symbols on the right-hand side:

Icon	Meaning
	Scroll menu - further menu commands are located above the displayed menu commands
	Scroll menu - there are further menu commands below the displayed menu commands

The following symbols are used to represent a state:

Icon	Meaning
	Status: OK
	Status: Error

2.4.3.2 Menu structure

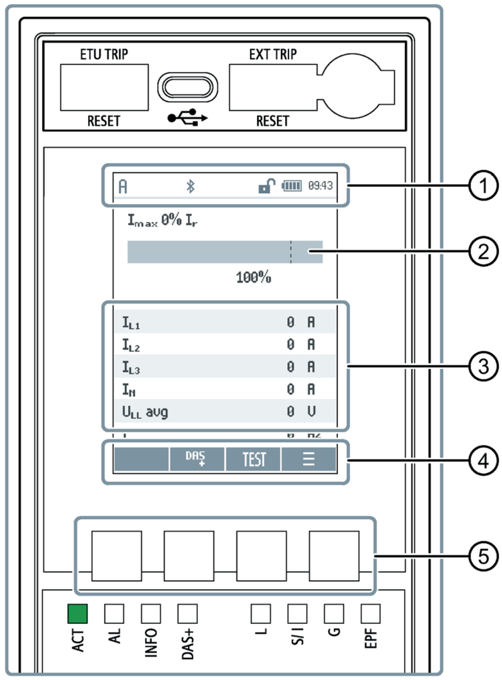
The menu commands are shown in the display of the ETU600 electronic trip unit depending on the version and the available options.

The main menu comprises the following menu commands:

Name	Menu number
Main menu	0.0
Metering values	1.0
Active protection parameters	2.0
Change protection parameters	3.0
Status and maintenance	4.0
Device configuration	5.0
Test	6.0
System configuration	7.0

You will find the entire menu structure in the Appendix, see Chapter ETU600 menu structure (Page 501).

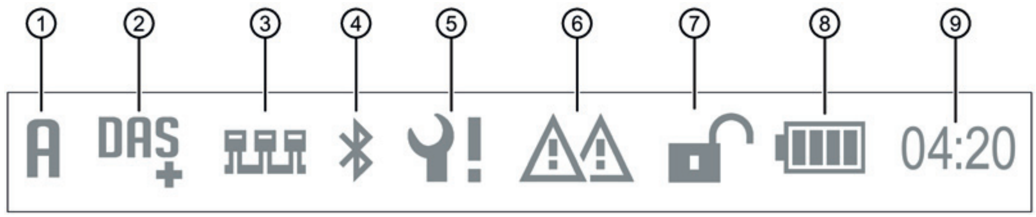
2.4.3.3 Start screen

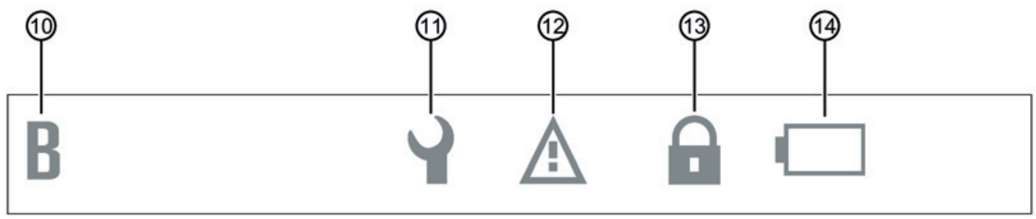


(1) Status bar
(2) Maximum instantaneous value of phase current with respect to overload protection
(3) Metering values
(4) Menu bar
(5) Operating keys

Status bar

In the status bar, the statuses of the circuit breaker are represented by symbols.

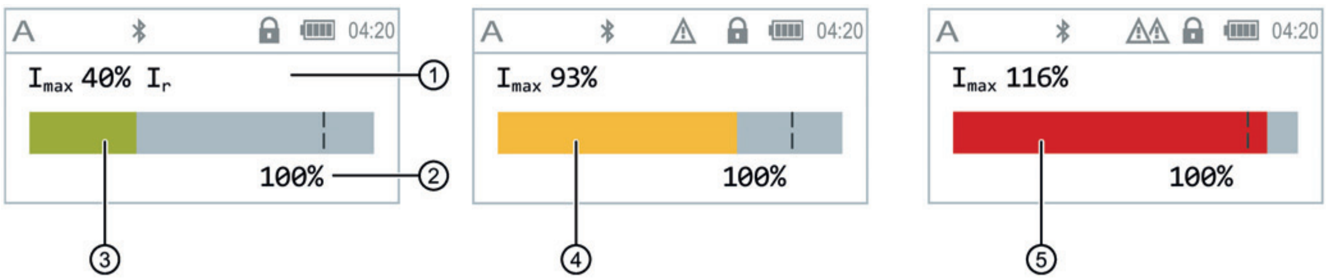




(1) Parameter set A of the protective functions active
(2) DAS+ maintenance mode
(3) CubicleBUS[2] stations available
(4) Existing Bluetooth connection
(5) Maintenance required
(6) Overload alarm AL2
(7) Password protection not set
(8) Battery charge level good
(9) System time
(10) Alternatively to (1): Parameter set B active
(11) Inspection required
(12) Overload alarm AL1
(13) Alternatively to (7): Password protection set
(14) Alternatively to (8): Battery charge level bad

Maximum instantaneous value of the phase current

The maximum phase current as a percentage of the overload protection setting is displayed as a numerical value. A colored bar chart shows the level of the current.



(1) Percentage value of the maximum phase current
(2) Reference point, setting for overload protection I_r
(3) Bar chart, maximum phase current < alarm threshold AL1
(4) Bar chart, alarm threshold AL1 < maximum phase current < setting for overload protection I_r
(5) Bar chart, maximum phase current > setting for overload protection I_r

Metering values

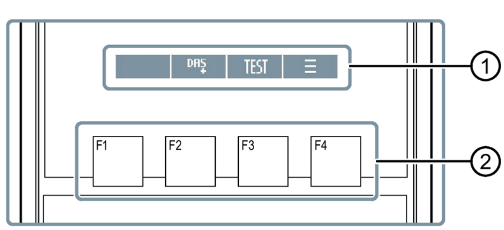
Up to six metering values can be displayed simultaneously on the ETU600 start screen.

The selection of the displayed metering values can be done with the SENTRON powerconfig configuration software.

Menu bar and operating keys

The following functions can be called up directly from the start screen with the operating keys:

- F1: Not assigned
- F2: Activate DAS+ maintenance mode (option)
- F3: Call up the test menu
- F4: Call up the main menu of the display



(1) Menu bar
(2) Operating keys

2.4.3.4 Display after a trip

Note

Trip indication via the display is only possible with an activated ETU600 electronic trip unit. Alternatively, after pressing the “QUERY” button on the ETU front, the last trip cause can be displayed via LED.

If the electronic trip unit was activated without interruption for two hours or more, the trip cause LED can light up for at least 10 s.

A trip of the circuit breaker is indicated by an orange trip cause LED, stored in the trip log of the ETU600, and shown on the display with “TRIP”.

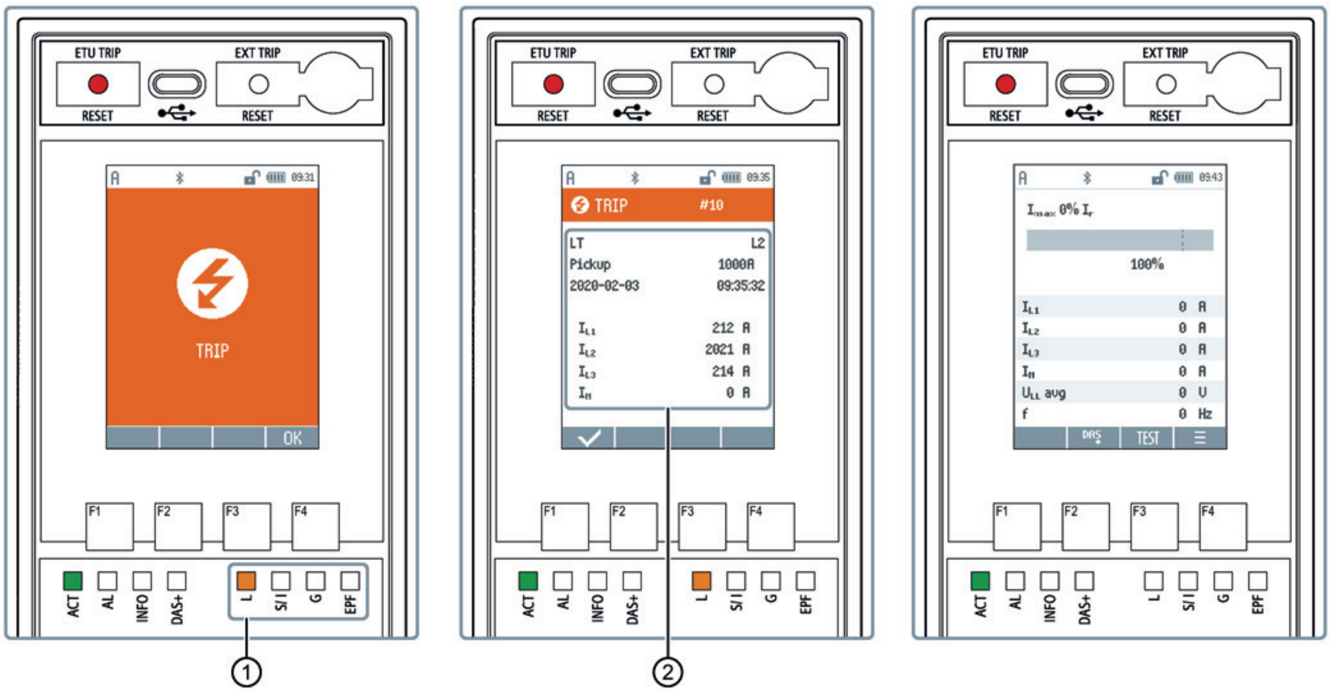
After acknowledging the trip by pressing the F4 operating key, details regarding the trip become visible. These always contain:

- Sequence number of the trip
- Trip cause with specification of the phase
- Associated setting
- Time stamp and last metering values before tripping

The trip is acknowledged via the F1 operating key. After acknowledgement, the system returns to the menu page which was displayed before tripping.

Note

For circuit breakers without external power supply or a VTM680 voltage tap module, the ETU600 will not be active after tripping. In order to obtain detailed information about the trip cause, the ETU600 can be activated via the USB-C interface via a notebook, USB power supply unit, or battery pack.



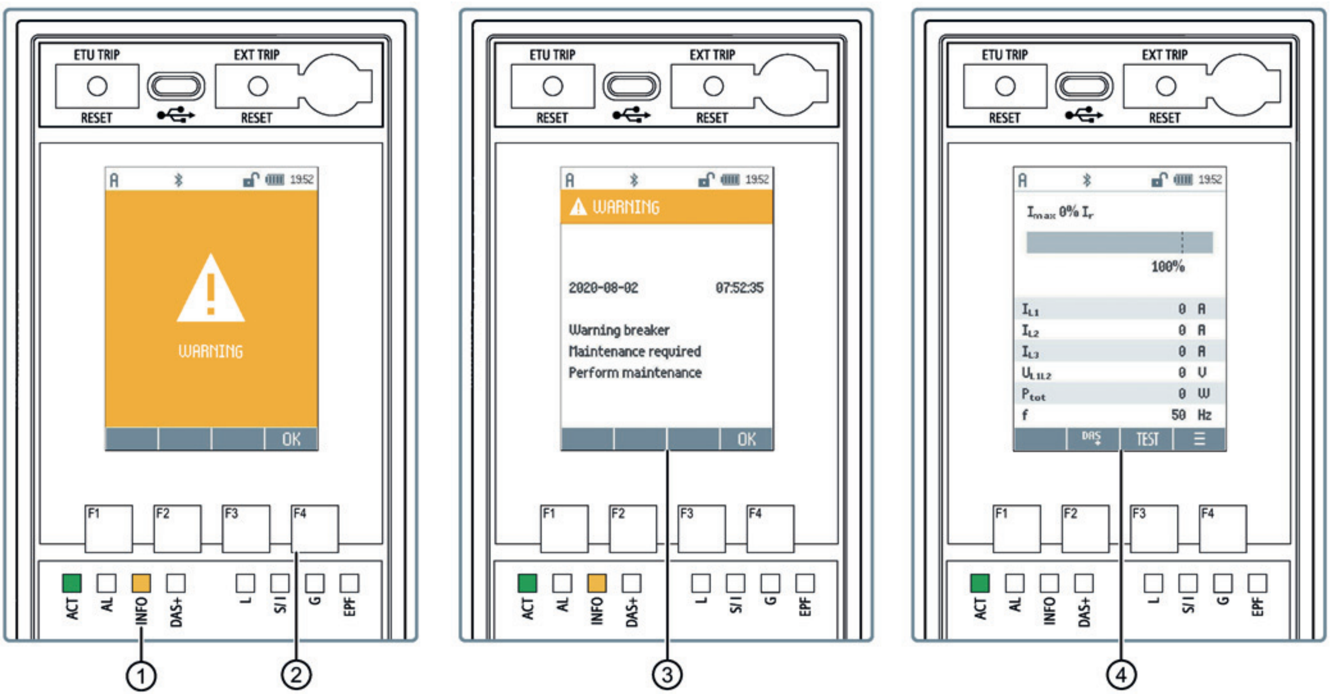
(1) Trip cause LED (here overload)

(2) Tripping details

2.4.3.5 Display in case of a warning

Warnings are indicated by a yellow INFO LED and shown on the color display of the ETU600 electronic trip unit.

The warning is acknowledged by pressing the F4 operating key. Afterwards, the time stamp and details of the warning will be visible on the display. After pressing the operating key F4 again, the warning disappears and the last selected menu appears.

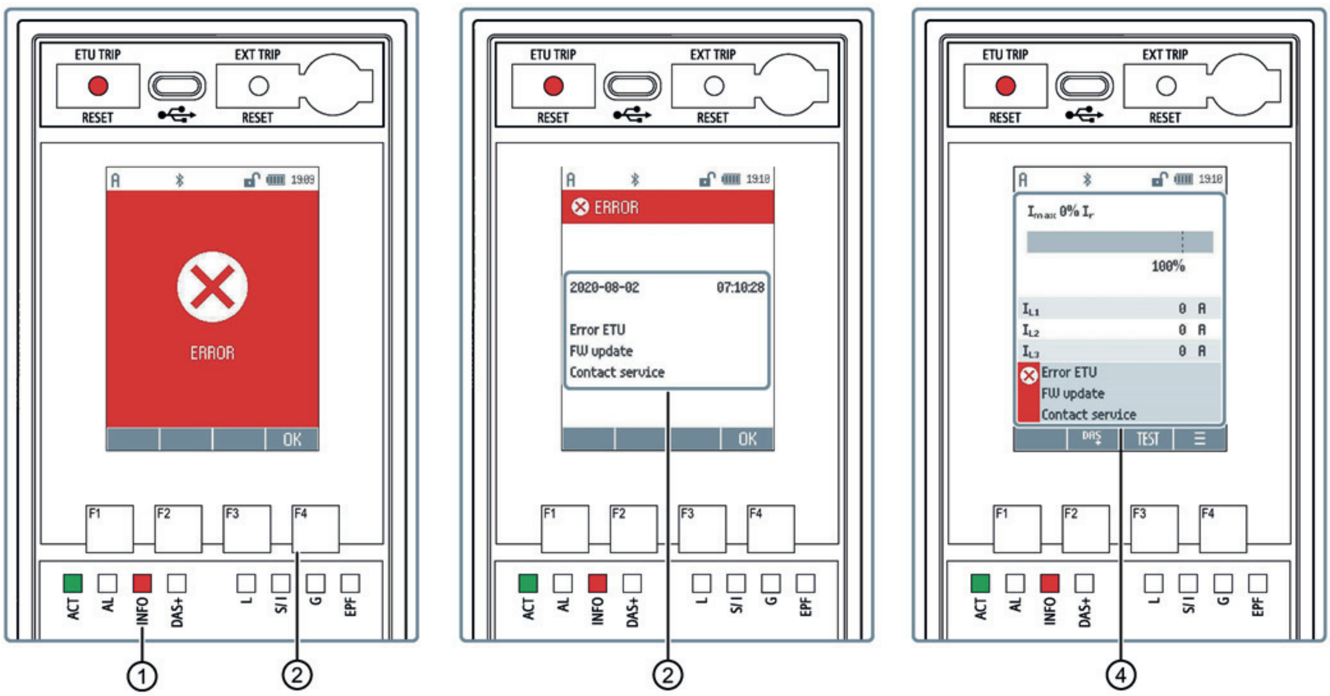


(1) INFO LED
(2) F4 operating key
(3) Details, description of the warning, and instructions for action
(4) Last selected menu

2.4.3.6 Display of an error message

Detected errors are indicated by a red INFO LED and shown on the display of the ETU600 electronic trip unit.

The error is acknowledged by pressing the F4 operating key. Afterwards, the time stamp and details of the error are shown on the display. After pressing the F4 operating key again, the full-screen error display disappears.
When the electronic trip unit is activated, a pop-up window on the display continues to indicate errors until they are eliminated and the ETU600 is restarted.



(1) INFO LED
(2) F4 operating key
(3) Error display
(4) Default screen with error display, visible until error correction

2.4.4 Interfaces

2.4.4.1 Bluetooth and USB-C interface

USB-C interface

The ETU600 electronic trip unit has a USB-C interface on the front. The electronic trip unit can be activated and parameterized via this interface.

An overview of the interfaces on the front can be found in Chapter Overview (Page 70).

The SENTRON powerconfig configuration software can be used for support. The current version of the SENTRON powerconfig configuration software can be found on the Internet (https://support.industry.siemens.com/cs/ww/en/view/63452759).

ETU600 activation requires that the interface (USB port, USB power supply unit, power bank) can supply a current of 1.5 A or more.

Note

Using the USB-C interface

The USB-C interface of the ETU600 is designed for temporary use during commissioning, maintenance or service. No USB cable may be connected to the interface during normal operation. The Bluetooth interface makes local access possible during operation.

Bluetooth interface

Parameterization of the ETU is also possible via the integrated Bluetooth interface.

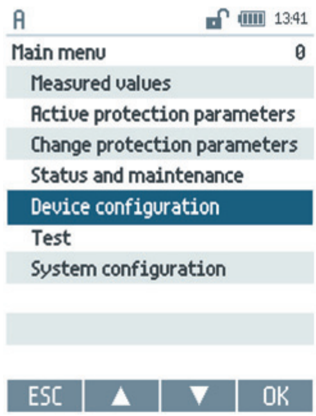
Note

Bluetooth is deactivated in the 3WA circuit breaker on delivery. Bluetooth can be activated via communication, the display of the ETU600 electronic trip unit or the USB-C interface. Bluetooth is automatically deactivated when the communication is interrupted and after a timeout.

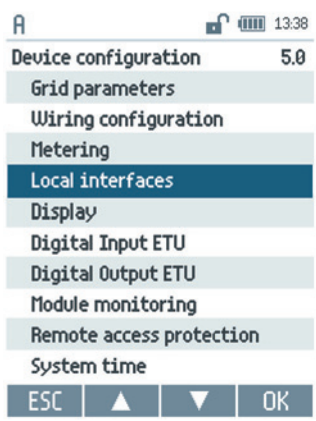
Bluetooth certifications can be found on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109784188).

To connect with a compatible device via Bluetooth, proceed as follows:

1. Select the “Device configuration” menu item in the main menu of the ETU600.

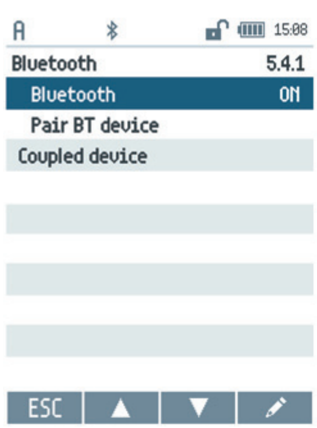


2. Select the menu item “Local interfaces”.



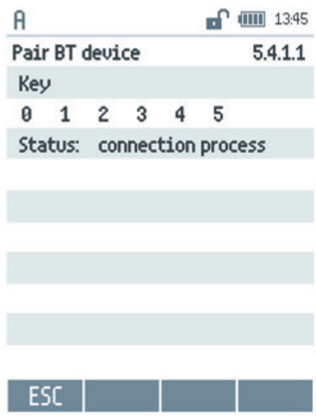
3. Select the “Bluetooth” interface and switch it on.

   Available devices and devices which have previously been paired are automatically connected.



4. If you want to connect a new device, activate pairing mode on the device to be paired and select ETU600 as the connection partner.

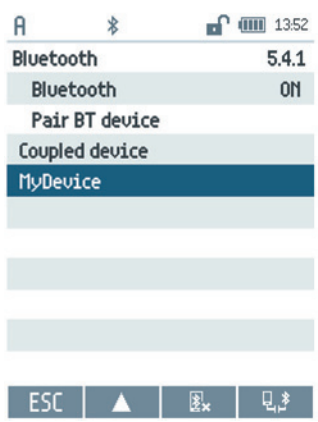
   Select the ETU600 menu item "Pair BT device".
   A connection code is displayed.



   A prompt requesting you to enter the code appears on the device to be paired.

5. Enter the displayed code on the device to be paired.

6. Pairing is complete and the connected device appears on the ETU600 display.



2.4.4.2 Digital input and output

The ETU600 electronic trip unit has one digital input and one digital output. Both can be configured on the ETU600 display in the device configuration menu or using the SENTRON powerconfig configuration software.

The 24 V input can be used for the following:

- Activating the DAS+ maintenance mode
- Switchover to the second protection parameter set (parameter set B).

The meaning of the input signal (low or high) is configurable.

The floating output is a normally open contact. It is available for the ETU600 with internal and external power supply and can be used for the following displays:

- Signaling of the error-free operating state of the ETU600

  When this signal is integrated into a control system, the status of the functionality of the electronic trip unit is transmitted at all times. If an internal fault is detected by the electronic trip unit or if the ETU600 is no longer able to control this output, the contact is opened and the message “Fault-free operating state of the ETU600” disappears. The function of the digital ETU output can be described as “life contact”.
- DAS+ maintenance mode
- Second protection parameter set (parameter set B) active

Technical specifications and connection

The connection is made at the secondary disconnect terminal system of the 3WA circuit breaker.

Digital input ETU-IN	
Connection	X8-5 and X8-6
Number of inputs	1
SELV/PELV suitable	✓
Rated voltage	24 V DC ±20%
Voltage value for reliable detection of a “1 signal”:	15 V DC
Current consumption at signal voltage of >15 V DC	<10 mA
Minimum signal duration	100 ms

Floating output ETU-OUT	
Connection	X8-7 and X8-8
Number of outputs	1
Contact	Normally open contact
Rated voltage	24 V DC ±20%
Maximum switching current	0.1 A at 24 V DC
Maximum continuous current	0.1 A at 24 V DC

2.4.4.3 Digital output for ground-fault alarm REF

Note

This output is only available with the ETU600 LSIG Hi-Z electronic trip unit.

The ETU600 LSIG Hi-Z electronic trip unit has a digital output for signaling a detected ground fault on the infeed side of the circuit breaker.

The ground fault can only be eliminated via the upstream medium-voltage circuit breaker. This signaling contact must therefore be integrated in the control of the medium-voltage circuit breaker.

The floating output is a normally open contact. It is available for both internal and external power supply of the ETU600 LSIG Hi-Z.

Technical specifications and connection

The connection is made at the secondary disconnect terminal system of the 3WA circuit breaker.

Floating output for ground-fault alarm REF	
Connection	X7-11 and X7-12
Number of outputs	1
Contact	Normally open contact
Rated voltage	24 V DC ±20%
Maximum switching current	15 V DC
Maximum switching current	0.1 A at 24 V DC
Maximum continuous current	0.1 A at 24 V DC

2.4.4.4 External current sensors

Current sensor for the neutral pole

The neutral current can be measured with a current sensor. With a 3-pole circuit breaker, the external current sensor for the neutral pole must be used for this purpose.

The external current sensor for the N-conductor (N-CT) is connected to the secondary disconnect terminals X8-9 and X8-10.

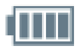
The external current sensors for the N-conductor are described in the Chapter Accessories for the ETU600 electronic trip unit (Page 313).

Current sensor for ground-fault current

For direct measurement of the ground-fault current, an external GF converter (GF-CT) can be connected to terminals X8-11 and X8-12 of the secondary disconnect terminal of the 3WA circuit breaker.

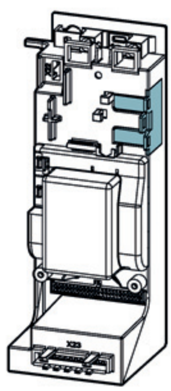
2.4.4.5 Battery

The internal clock of the ETU600 electronic trip unit is powered by a lithium battery. The charge status is shown in the status bar of the display.

 Battery full

 Battery empty, replacement necessary

The service life of the battery depends on the ambient conditions; it is at least five years. The battery can be replaced on site. To do this, the operator panel of the circuit breaker must be removed, see Chapter Preparatory and concluding installation steps for the installation of internal accessories (Page 151). The battery compartment is then accessible from the side without dismantling the ETU600.

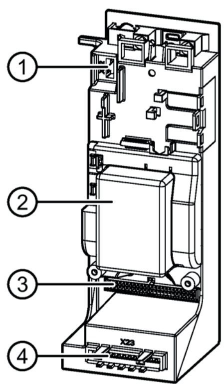


The lithium battery can be ordered as a spare part, see Chapter Replacement battery for the ETU600 electronic trip unit (Page 321).

2.4.4.6 Rear interfaces

On the rear of the ETU600 electronic trip unit, there are terminals to ensure the circuit breaker functions.

The terminals are only accessible after removing the electronic trip unit. The plug-in connections may only be disconnected for the exchange of the electronic trip unit.



(1) X22 terminal for trip solenoid F5

(2) Bluetooth and USB-C interface TUI600

(3) X21 terminal for ETU cable harness

(4) X23 terminal for voltage measurement

FCC und ISED NOTICE:

'This device complies with Part 15 of the FCC rules [and Innovation, Science and Economic Development Canada's license-exempt RSS standard(s)].
Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.'
Cet appareil est conforme aux CNR exemptés de licence d'Innovation, Sciences et Développement économique Canada . Le fonctionnement est soumis aux deux conditions suivantes:
(1) Cet appareil ne doit pas causer d'interférences; et
(2) Cet appareil doit accepter toute interférence, y compris Interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

FCC Radiation Exposure Statement:
Co-location of this module with other transmitter that operate simultaneously are required to be evaluated using the FCC multi-transmitter procedures.
This device complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum separation distance of 20 cm between the device and all persons.

IC Radiation Exposure Statement:
This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum separation distance of 20 cm between the device and all persons.
Cet équipement est conforme aux limites d'exposition au rayonnement IC RSS-102 définies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance de séparation minimale de 20 cm entre l'appareil et toutes les personnes

NOTICE:
Changes or modifications made to this equipment not expressly approved by Siemens AG GWA may void the FCC authorization to operate this equipment.
Class: B
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide

reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

2.4.5 Protection parameters

2.4.5.1 Parameter sets A and B

Note

Parameters can also be changed in the energized condition. However, parameters should not be changed in the energized condition, as the operator may experience unexpected tripping.

The basic protective functions of the ETU600 electronic trip unit can be set quickly and easily using the rotary switches on the front of the ETU600, see Chapter Rotary switch (Page 73).

Each rotary switch has nine permanently assigned values and the position e.SET.

If the rotary switch is set to "e.SET", the parameter can be freely selected within its limits and set via the display or by means of the SENTRON powerconfig configuration software via Bluetooth or communication.

In addition to the five parameters for the basic protective functions, there are other parameters which influence the behavior of the circuit breaker in the overcurrent range. All parameters and their basic settings are shown below.

Protective functions whose parameters cannot be selected via the rotary switches must be set via the display or with the SENTRON powerconfig configuration software via Bluetooth or communication.

The ETU600 electronic trip unit allows the storage of two different sets of parameters for the protective functions. This allows the changed protection requirements to be taken into account in the event of changed power supply conditions, e.g. in the event of emergency supply via an emergency power generator.

Each parameter set contains the following data (for basic settings on delivery from the factory, see ChapterBasic settings of parameter data sets (Page 499)):

ETU600 LSI, ETU600 LSIG, ETU600 LSIG Hi-Z		
Protective function	**Setting range**	**Settings with rotary switch**
L: Long time LT		
Tripping	Can be switched on/off	
Current setting I_r	0.4 ... 1.0 x I_n	0.5 / 0.6 / 0.7 / 0.75 / 0.8 / 0.85 / 0.9 / 0.95 / 1.0 x I_n
Tripping time t_r at 6 x I_r	At I^2t: 0.5 ... 30 s At I^4t: 0.5 ... 5 s	1 / 2 / 5 / 8 / 10 / 14 / 17 / 21 / 25 s
Characteristic LT curve	I^2t / I^4t	
Thermal memory	Can be switched on/off	
Cooling time constant	10 / 18 x t_r	
Phase failure detection	Can be switched on/off	
Overload pre-alarm PAL	Can be switched on/off	
Current setting $I_{r\ PAL}$	0.7 ... 1.0 x I_r	
Delay time $t_{r\ PAL}$	0.5 ... 1.0 x t_r	

ETU600 LSI, ETU600 LSIG, ETU600 LSIG Hi-Z		
Protective function	**Setting range**	**Settings with rotary switch**
L: Long time LT, neutral conductor		
Tripping	Can be switched on/off	
Current setting I_N	3-pole: 0.2 ... 2.0 x I_n 4-pole: 0.2 x I_n ... $I_{n\,max}$	
Current setting $I_{N\,PAL}$	0.7 ... 1.0 x I_N	
S: delayed short circuit protection ST		
Tripping	Can be switched on/off	
Current setting I_{sd}	0.6 x I_n ... 0.8 x I_{cw}	1.5 / 2 / 2.5 / 3 / 4 / 5 / 6 / 8 / 10 x I_r
Tripping time t_{sd}	0.02 ... 0.4 s	At I^2t = OFF: 0.08 / 0.15 / 0.22 / 0.3 / 0.4 s At I^2t = ON: 0.1 / 0.2 / 0.3 / 0.4 s
Characteristic ST curve	I^0t / I^2t	
Reference point $I_{ST\,ref}$	6 ... 12 x I_r	
Intermittent acquisition	Can be switched on/off	
S: Directional short time dST (optional)		
Tripping	Can be switched on/off	
Current setting I_{sd} FW	0.6 x I_n ... 0.8 x I_{cw}	
Current setting I_{sd} REV	0.6 x I_n ... 0.8 x I_{cw}	
Tripping time t_{sd} FW	0.05 ... 0.4 s	
Tripping time t_{sd} REV	0.05 ... 0.4 s	
I: instantaneous short-circuit protection INST		
Tripping	Can be switched on/off	
Current setting I_i	1.5 x I_n ... 0.8 x I_{cs}	1.5 / 2 / 3 / 4 / 6 / 8 / 10 / 12 / 15 x I_n
Reverse power protection RP (optional)		
Tripping	Can be switched on/off	
Setting P_{RP}	0.05 ... 0.5 x P_n	
Tripping time t_{RP}	0.01 ... 25 s	
DAS+ maintenance mode		
Current setting $I_{i\,DAS+}$	1.5 ... 10 x I_n	
Current setting $I_{g\,DAS+}$	with LSIG GFx option plug Residual depending on the size • Size 1 / 2: 100 ... 2000 A • Size 3: 400 ... 2000 A Direct: 15 ... 2000 A	
Tripping time $t_{g\,DAS+}$	0 ... 5 s	

ETU600 LSIG		
Protective function	**Setting range**	
G: Ground-fault protection GF		
Tripping	Can be switched on/off	
Method of ground-fault detection	Residual	Detection of the ground-fault current through calculation of the total current in all phases of the N-conductor
	Direct	Direct measurement of the ground-fault current using a current transformer
	Dual	UREF protection zone: Detection of the ground-fault current through calculation of the total current REF protection zone: Measurement of the ground-fault current using an external current transformer
Characteristic GF curve	with LSIG GFx option plug	I^0t / I^2t / I^4t / I^6t
Current setting I_g with LSIG GFx option plug	Residual acquisition method	Depending on the size: • Size 1 / 2: 100 ... 2000 A • Size 3: 400 ... 2000 A
	Direct acquisition method	15 ... 2000 A
Tripping time t_g	For I^xt = OFF	0 ... 5 s
	For I^xt = ON at 3 x I_g	0 ... 30 s
Intermittent acquisition	Can be switched on/off	
G: Ground-fault GF alarm		
Alarm	Can be switched on/off	
Current setting $I_{g\ alarm}$ with LSIG GFx option plug	Residual acquisition method	Depending on the size: • Size 1 / 2: 100 ... 5000 A • Size 3: 400 ... 5000 A
	Direct acquisition method	15 ... 5000 A
Alarm time $t_{g\ alarm}$	0 ... 0.5 s	

ETU600 LSIG Hi-Z		
Protective function	**Setting range**	
G: Ground-fault protection GF Hi-Z		
Tripping	Can be switched on/off	
Method of ground-fault detection	Residual	Detection of the ground-fault current through calculation of the total current in all phases of the N-conductor
	Dual Hi-Z, for high-impedance connection of the external current transformers	UREF protection zone: Detection of the ground-fault current through calculation of the total current REF protection zone: Measurement of the ground-fault current using an external current transformer combination
Characteristic GF curve	with LSIG GFx option plug	I^0t / I^2t / I^4t / I^6t
Current setting I_g with LSIG GFx option plug	UREF protection zone	Depending on the size: • Size 1 / 2: 100 ... 2000 A • Size 3: 400 ... 2000 A
	REF protection zone	15 ... 2000 A
Tripping time t_g	For I^xt = OFF	0 ... 5 s
	For I^xt = ON at 3 x I_g in UREF protection zone	0 ... 30 s
Intermittent acquisition	Can be switched on/off	
G: Ground-fault GF alarm		
Alarm	Can be switched on/off	
Current setting $I_{g\ alarm}$ with LSIG GFx option plug	UREF protection zone	Depending on the size: • Size 2: 100 ... 5000 A • Size 3: 400 ... 5000 A
Alarm time $t_{g\ alarm}$	0 ... 0.5 s	

Switching between the parameter sets

Switching between the parameter sets A and B can be done manually via:

- Display of the ETU600
- Digital ETU600 input on circuit breaker, terminals X8-5 and X8-6
- Input signal on a digital input/output module
- Switchover command via a communication module
- SENTRON powerconfig configuration software

For security reasons, parameter set B can only be deactivated using the same method by which it was activated.

2.4.5.2 Enhanced protective functions EPF parameters

In addition to the two sets of protection parameters A and B, enhanced protective functions are optionally available for the ETU600 electronic trip unit.

Parameters			Setting range	Condition	Basic setting
Unbalance					
	Current unbalance		–	1)	–
		Can be switched on/off	–	–	Off
		Setting	5 ... 50%	–	50%
		Tripping time	0 ... 15 s	–	0 s
	Voltage unbalance		–	2)	–
		Protective function can be enabled/disabled	–	–	Off
		Setting	5 ... 50%	–	50%
		Tripping time	0 ... 15 s	–	0 s
Harmonic analysis					
	THD current		–	1)	–
		Can be switched on/off	–	–	Off
		Setting	3 ... 50%	–	50%
		Tripping time	5 ... 15 s	–	5 s
	THD voltage		–	2)	–
		Can be switched on/off	–	–	Off
		Setting	3 ... 50%	–	50%
		Tripping time	5 ... 15 s	–	5 s
Voltage					
	Undervoltage U_{LL}		–	–	–
		Can be switched on/off	–	–	Off
		Setting	100 ... 1100 V	–	100 V
		Tripping time	0 ... 15 s	–	0 s
	Overvoltage U_{LL}		–	–	–
		Can be switched on/off	–	–	Off
		Setting	200 ... 1200 V	–	1200 V
		Tripping time	0 ... 15 s	–	0 s
	Undervoltage U_{LN}		–	–	–
		Can be switched on/off	–	–	Off
		Setting	60 ... 600 V	–	100 V
		Tripping time	0 ... 15 s	–	5 s
	Overvoltage U_{LN}		–	–	–
		Can be switched on/off	–	–	Off
		Setting	120 ... 690 V	–	690 V
		Tripping time	0 ... 15 s	–	0 s

Parameters			Setting range	Condition	Basic setting
Power					
	Forward power		–	3)	–
		Can be switched on/off	–	–	Off
		Setting	1 ... 12000 kW	–	2400 kW
		Tripping time	0 ... 15 s	–	0 s
	Reverse power		–	3)	–
		Can be switched on/off	–	–	Off
		Setting	1 ... 12000 kW	–	2400 kW
		Tripping time	0 ... 15 s	–	0 s
Frequency					
	Underfrequency		–	2)	–
		Can be switched on/off	–	–	Off
		Setting	40 ... 70 Hz 4)	–	f_n - 10 Hz
		Tripping time	0 ... 15 s	–	0 s
	Overfrequency		–	2)	–
		Can be switched on/off	–	–	Off
		Setting	40 ... 70 Hz 4)	–	f_n + 10 Hz
		Tripping time	0 ... 15 s	–	0 s
Phase rotation					
	Phase rotation		–	2)	–
		Can be switched on/off	–	–	Off
		Tripping time	0 s	–	0 s

1) Max.(I_{L1}, I_{L2}, I_{L3}) ≥ 100 A

2) Max.(U_{L1L2}, U_{L2L3}, U_{L3L1}) >50 V

3) I_{Lx} ≥ 100 A and U_{LxN} >30 V

4) Depending on parameterized rated frequency f_n

2.4.5.3 Parameter DAS+ maintenance mode

The settings for the DAS+ maintenance mode are independent of a protection parameter set.

Parameters		Setting range	Condition	Basic setting
DAS+ maintenance mode				
	Can be switched on/off	–	–	Off
	Current setting $I_{i\ DAS+}$	1.5 ... 10 x I_n	–	1.5 x I_n
	Current setting $I_{g\ DAS+}$	1)	Ground-fault protection available	$I_{g\ min}$
	Time setting $I_{g\ DAS+}$	0 / 0.05 ... 5 s	Ground-fault protection available	0.1 s

1) Depending on size and option plug
$I_{g\ min}$: Sizes 1 and 2 = 100 A; size 3 = 300 A
$I_{g\ max}$: 5000 A with option plug LSIG GFx