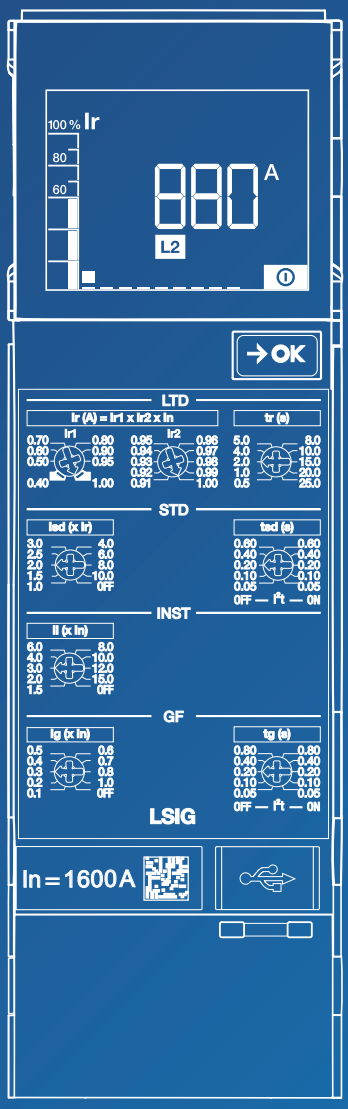
User manual

hw+

sentinel electronic trip units



hager

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Warnings and instructions

This documentation contains safety advice which must be respected for your own safety and to prevent property damage.
Safety advice relating to your own safety is identified by a safety warning symbol in the documentation. Safety advice relating to damage to property is identified by "ATTENTION".
The safety warning symbols and the wording below are classified according to the risk level.

DANGER

DANGER indicates an imminent dangerous situation which, if not avoided, will result in death or serious injuries.

WARNING

WARNING indicates a potentially dangerous situation which, if not avoided, may result in serious injuries or even death.

CAUTION

CAUTION indicates a potentially dangerous situation which, if not avoided, may result in minor or moderate injuries.

ATTENTION

ATTENTION indicates a warning message relating to equipment damage.
ATTENTION also indicates important instructions for use and particularly relevant information regarding the product, which must be respected to ensure effective and safe use.

Qualified personnel

The product or the system described in this documentation must be installed, operated and maintained by qualified personnel only. Hager Electro accepts no responsibility regarding the consequences of this equipment being used by unqualified personnel.
Qualified personnel are those people who have the necessary skills and knowledge for building, operating and installing electrical equipment, and who have received training enabling them to identify and avoid the risks incurred.

Appropriate use of Hager products

Hager products are designed to be used only for the applications described in the catalogues and in the technical documentation relating to them. If products and components from other manufacturers are used, they must be recommended or approved by Hager.
Appropriate use of Hager products during transport, storage, installation, assembly, commissioning, operation and maintenance is required to guarantee problem-free operation in complete safety.
The permissible ambient conditions must be respected. The information contained in the technical documentation must be respected.

Publication liability

The contents of this documentation have been reviewed in order to ensure that the information is correct at the time of publication.
Hager cannot, however, guarantee the accuracy of all the information contained in this documentation. Hager assumes no responsibility for printing errors and any damage they may cause.
Hager reserves the right to make the necessary corrections and modifications to subsequent versions.

Purpose of the document.

This manual is designed to provide users, electricians, panel builders and maintenance personnel with the technical information required for the commissioning and operation of hw+ circuit breakers with sentinel electronic trip units.

Field of application

This document applies to hw+ circuit breakers with hw+ sentinel electronic trip units.

Revisions

Version	Date
6LE007969Ad	November 2024

Documents to consult

Document	Reference
User manual for HW1 air circuit breakers	6LE007331A
Installation manual for HW1 air circuit breakers	6LE007893A
HW1 user maintenance guide	6LE007897A
User manual for HW2 / HW4 / HW6 air circuit breakers	6LE009210A
Installation manual for HW2 / HW4 / HW6 air circuit breakers	6LE009206A
HW2/HW4/HW6 user maintenance guide	6LE009217A

You can download these publications and other technical information from our website: www.hager.com

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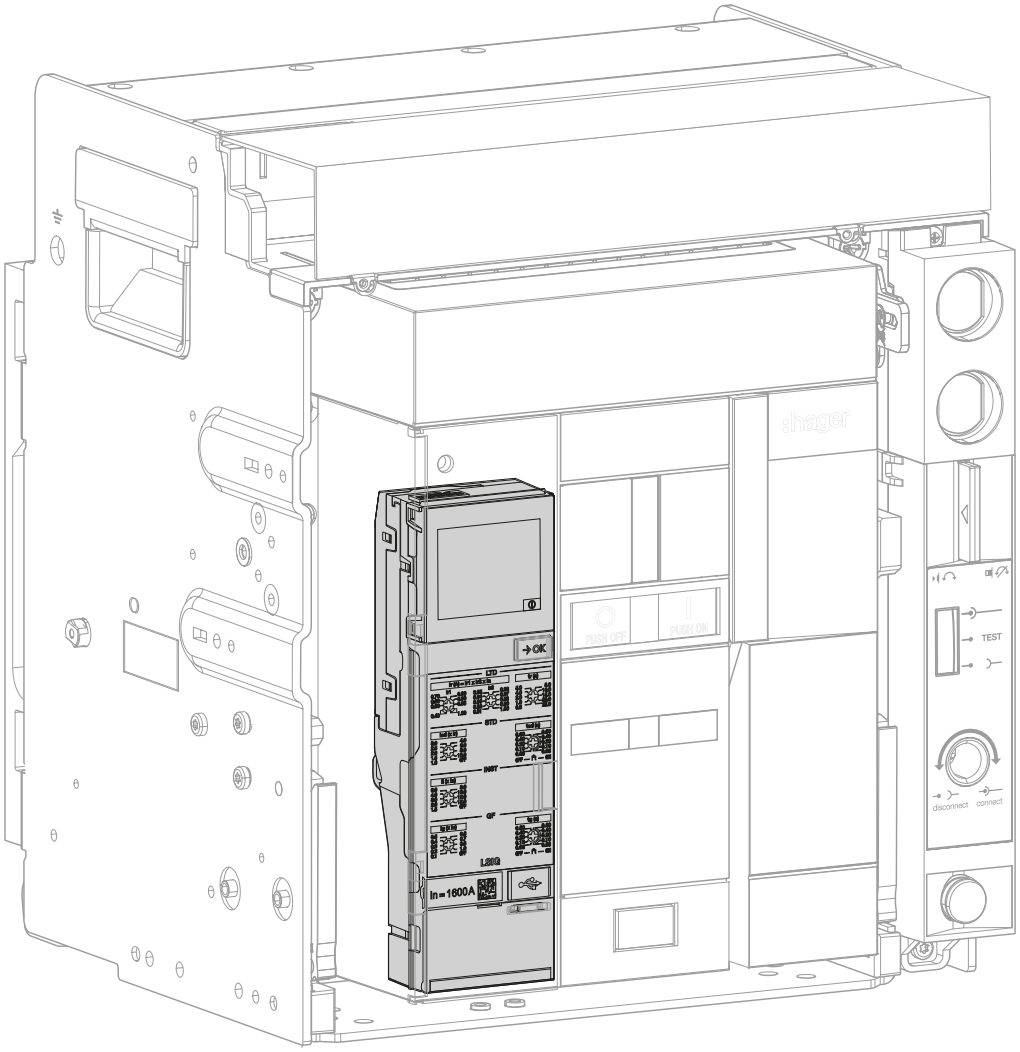
hw+ air circuit breakers are equipped with a sentinel electronic trip unit on the front to protect against overloads, short circuits and earth faults.
It has a display and dials to configure the protection settings and monitor correct operation.



The following characteristics are common to all versions of the sentinel electronic trip units:

① Display

② OK → button which can be used to:
- clear the alarm after the air circuit breaker has tripped,
- navigate through the display screens.

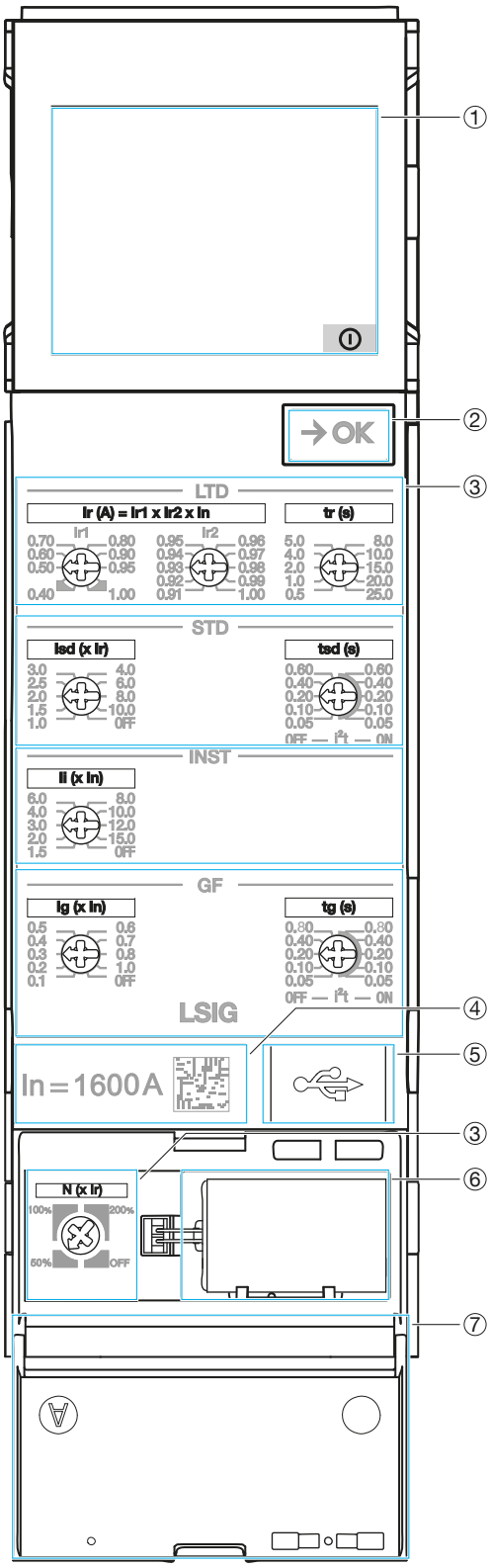
③ Settings dials of the sentinel electronic trip unit.

④ Rated current value In of the air circuit breaker. This value is shown on the rating plug fitted on the trip unit.

⑤ USB-C port to connect an external battery. This USB-C port also allows connection to a computer equipped with the **Hager Power setup** commissioning software (see Chapter 4.1 Principle).

⑥ Backup battery powering the display after electrical tripping.
This enables the display to signal the tripping and its cause.

⑦ Backup battery housing cover.

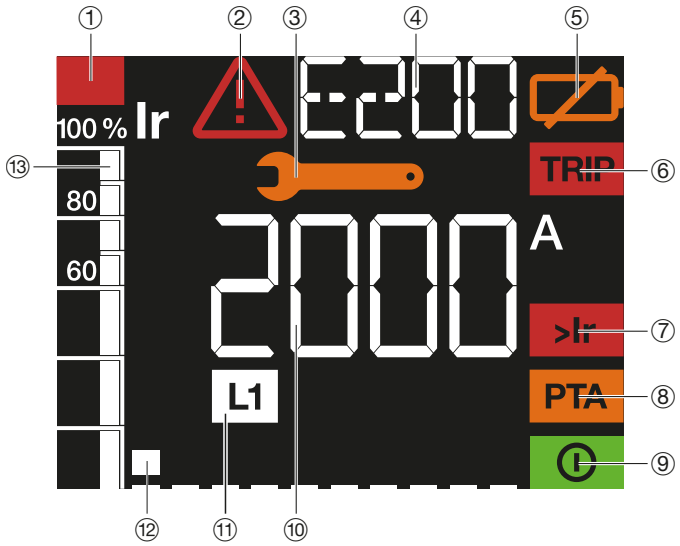


ATTENTION

The trip unit must be powered in order for it to perform its protection functions. It is powered as long as a minimum current of 20% of the nominal current In passes through the circuit breaker.
Nevertheless, it is strongly recommended that an external 24 V DC SELV power supply (recommended reference model Hager HTG911H) be connected to terminal block TU to guarantee optimal operation of the trip unit and prevent malfunctions in the electrical installation associated with a breach in the continuity of the trip unit operation.

Description of the display

sentinel trip units are equipped with a display that makes it easy to make adjustments and read what caused the tripping of the hw+ circuit breakers.



① **Overload indicator**: shows when the current exceeds 105 % of Ir.

② **Error indicator**: displayed when an error is detected.

③ **Maintenance indicator**: displayed when a maintenance intervention is required.

④ **Text display area**: displays the name of the protection parameter during adjustment or after a trip in addition to the error codes of non-critical system alarms.

⑤ **Low or missing battery indicator**: displayed if the trip unit backup battery needs changing or is not connected.

⑥ **Trip indicator**: together with the digital display zone, the text display zone and the phase display, enables the cause of the tripping to be precisely determined.

⑦ **Overload indicator**: flashes as soon as the current exceeds 105% of Ir and is lit and steady above 112.5% Ir

⑧ **Overload pre-alarm indicator**: warns of an imminent tripping risk.

⑨ **ReadyToProtect indicator**: displays and flashes when the trip unit is operational and ready to protect.

⑩ **Numerical display zone**: used to display the values of the various settings and what the tripping value was, using the following units.

A	Ampere
Â	Peak current
S	Second
I^2t	I^2t curve

Also displays the codes of the critical system alarms.

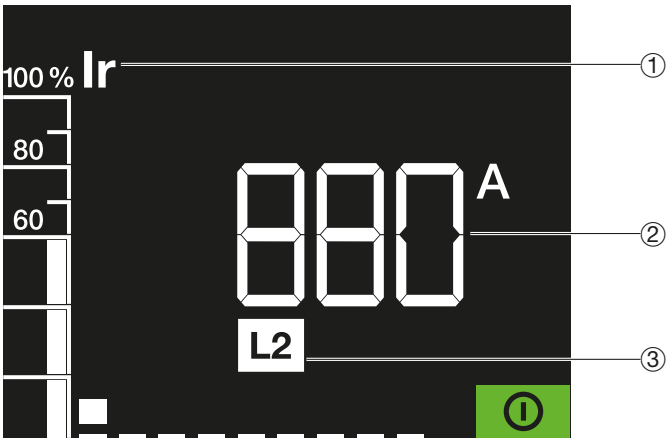
⑪ **Phase display**: Neutral on the left / Phase L1 / Phase L2 / Phase L3.

⑫ **Reference screen**: shows the number of screens in the trip unit as well as its position in the display order.

⑬ **Bargraph:** used to view the currents read on the most highly loaded phase L1, L2 or L3 as a percentage of the Ir setting.

In standby, the ReadyToProtect indicator flashes, indicating normal operation of the sentinel trip unit.

A short press of the button →OK displays a 1st screen showing the highest current of the 3 phases flowing through the circuit breaker.



① Current flowing through the circuit breaker in % of Ir.

② Value in amps of the current flowing through the circuit breaker on the most highly loaded phase.

③ Relevant phase.

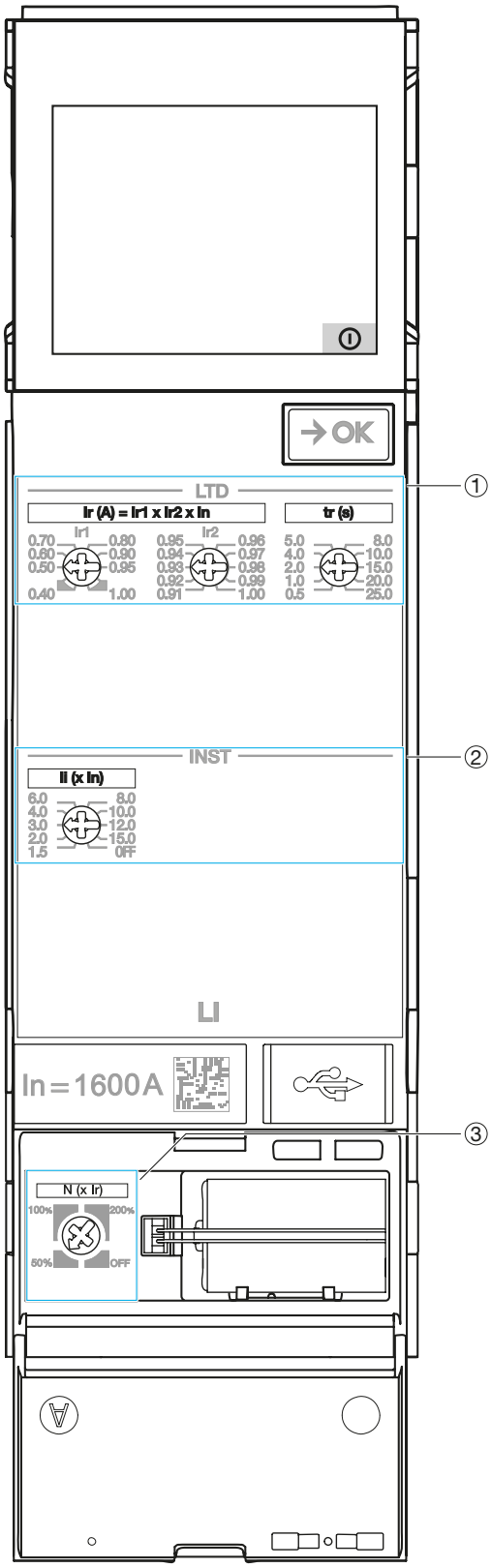
The sentinel trip unit is available in 3 versions: **LI**, **LSI** and **LSIG**

LI sentinel trip unit
The LI sentinel trip unit is used to protect long cable lines where the rated fault current is limited due to the impedance of the cable.
The dials are accessible from the front of the sentinel trip unit, allowing precise adjustment of the protection settings. The protection adjusted in this way is independent of the ambient temperature.

① LTD Long time delay protection setting

② INST Instantaneous protection setting

③ Neutral N protection setting



LSI sentinel trip unit

The LSI sentinel trip unit is used to protect cables lines and equipment requiring a wide variety of protection settings.

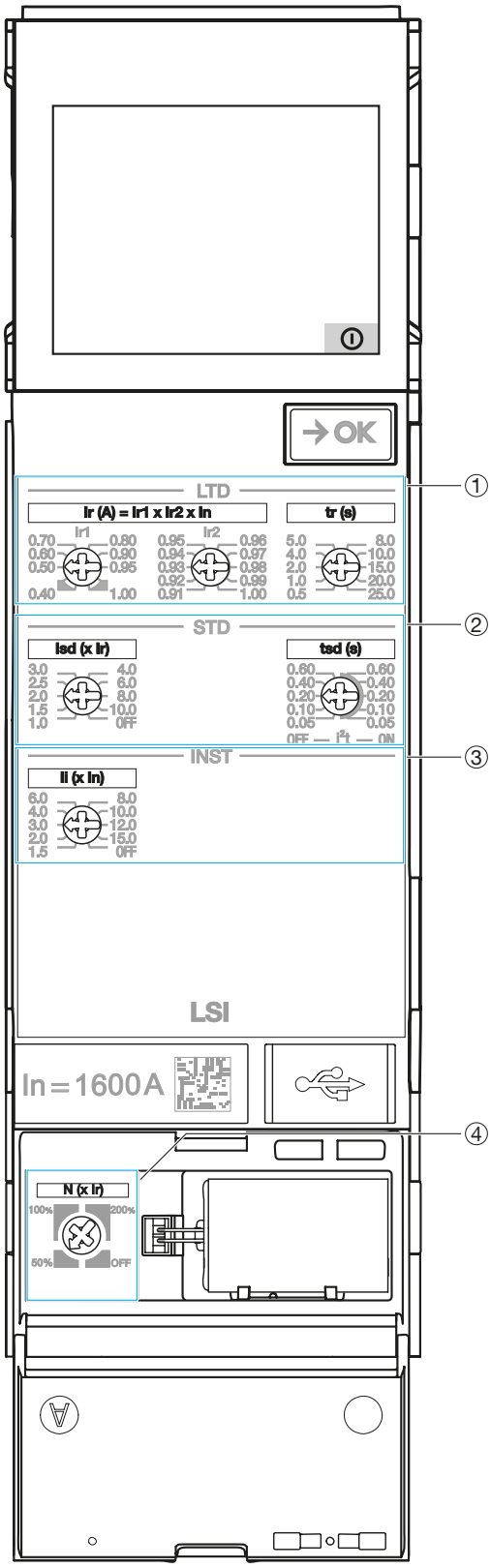
The dials are accessible from the front of the sentinel trip unit, allowing precise adjustment of the protection settings. The protection adjusted in this way is independent of the ambient temperature.

① LTD Long time delay protection setting

② STD Short time delay protection setting

③ INST Instantaneous protection setting

④ N neutral protection setting adjustment



LSIG sentinel trip unit

The LSIG sentinel trip unit is used to protect cable lines and equipment in case of TN earthing system where earth fault protection is required.

The dials are accessible from the front of the sentinel trip unit, allowing precise adjustment of the protection settings. The protection adjusted in this way is independent of the ambient temperature.

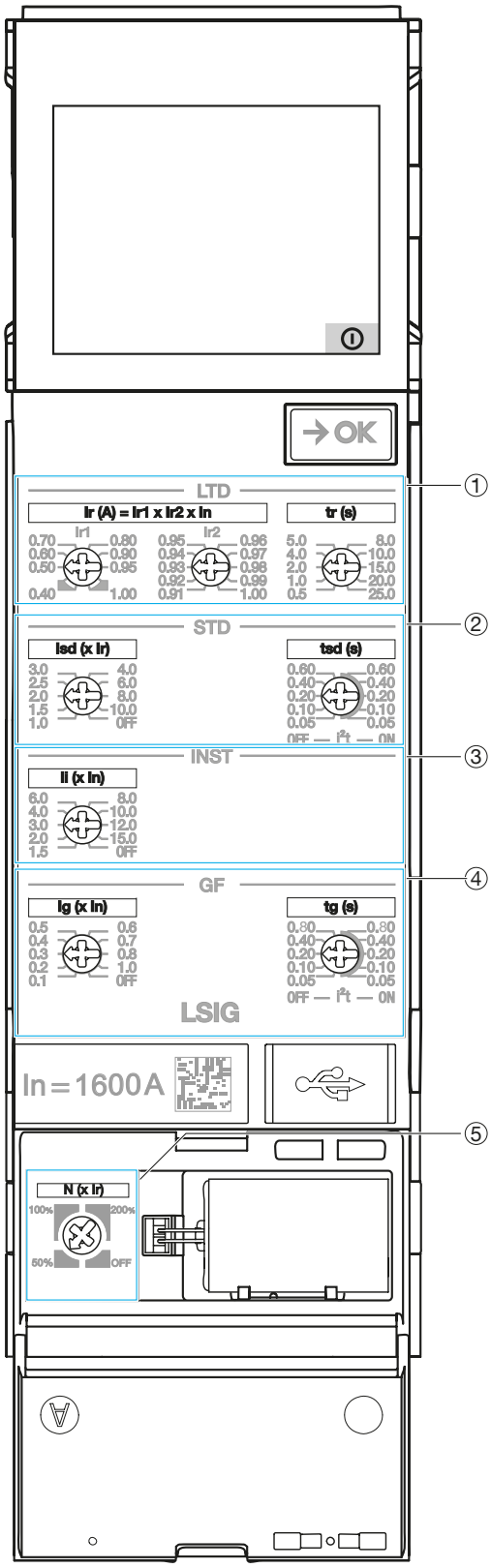
① LTD Long time delay protection setting

② STD Short time delay protection setting

③ INST Instantaneous protection setting

④ GF earth fault protection setting

⑤ N neutral protection setting adjustment



The Hager Power setup software has been designed for testing and commissioning hw+ trip units.

Thanks to the commissioning menu, it is possible to specifically generate a commissioning report proving that the protection settings comply with the short-circuit and selectivity calculations. This requires the settings to be imported from the Hagercad software.

It offers a smart way of creating the protection settings. It also allows all the trip unit parameter settings to be displayed and modified.

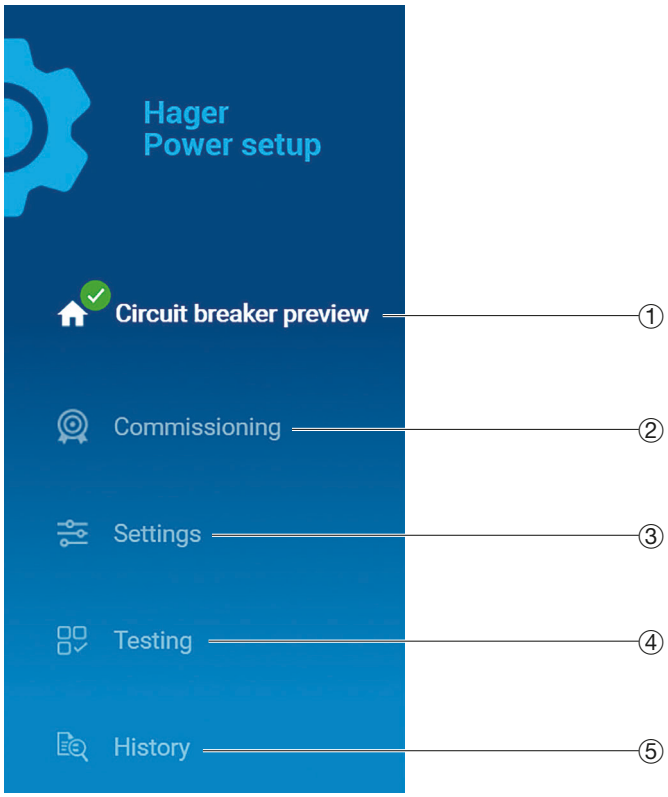
It is possible to perform a test of the hw+ circuit breakers tripping curve.

It also allows a forced electro-mechanical tripping of the circuit breakers to be performed.

It is very useful during the test phase when wiring the output contacts. It makes it possible to force the opening or closing of the OAC and ZSI output contacts.

The result of the different tests can be entered into a test report that can be generated at any time whether in the wiring workshop or during acceptance tests on site.

The functions of the Hager Power setup software can be accessed through five menus:



① Functional state of the circuit breaker, maintenance information and principal technical characteristics.

② Three-stage procedure 1. Setting, 2. Test, 3. Tripping, to commission the circuit breaker using settings data imported from the Hagercad software. Allows a commissioning report to be generated.

③ Access to all the parameter settings of the trip unit.

④ Access to the tripping curve of the manual test, the forced electro-mechanical tripping and activation of the output contacts available on the circuit breaker. Allows a test report to be generated.

⑤ Access to event history.
Display of active alarms.
Operating counters panel.

Principal functions

- Display the functional state of the circuit breaker, maintenance information and principal technical characteristics.
- Perform a commissioning by importing settings from Hagercad.
- Generate and print test reports and commissioning reports.
- Perform a manual test of the tripping curve of the hw+ circuit breakers.
- Perform a forced electro-mechanical tripping of the circuit breakers.
- Display and modify all the trip unit parameter settings.
- Display alarms in progress.
- Download and export the trip unit settings in a file in CSV format.
- Save the settings of a circuit breaker from within the Energy family to load them into one or more similar circuit breakers.
- Force the opening or closing of the OAC and ZSI output contacts.
- Display the active alarms.
- View the event logs and export them in a file in CSV format.
- Display the status of the operating counters available (handling cycles, tripping operations...).

The Hager Power setup software is available on the Hager website for your country.

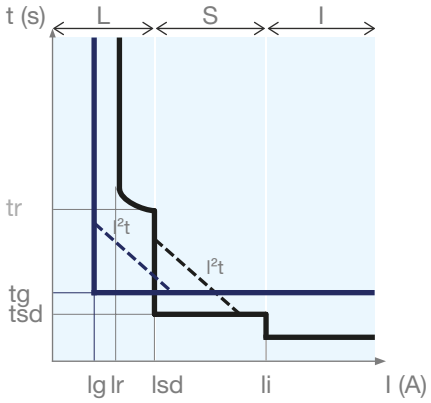
IT configuration required

	Minimal	Recommended
Operating system	Windows 10 x32 bits	Windows 10 x64 bits
Memory	4 Gb RAM	8 Gb RAM
Disk space	50 Mb	50 Mb
Components	Microsoft .NET Framework 4.7.2 .NET Core Runtime 3.1.13 .NET Desktop Runtime 3.1.13 Microsoft web view 2 v1.0.818.14	Microsoft .NET Framework 4.7.2 or higher .NET Core Runtime 3.1.13 or higher .NET Desktop Runtime 3.1.13 or higher Microsoft web view 2 v1.0.818.14 or higher
Resolution	1024x768 pixels	1280x1024 pixels

The sentinel trip unit protects against overcurrent and earth faults for all types of electrical distribution in accordance with the requirements of the standards IEC 60947-1 and 60947-2.

Protection system

- Long delay against overcurrent - **L**: Overload protection
- Short delay against overcurrent - **S**: Protection against low current short circuits
- Instantaneous against overcurrent - **I**: Protection against high current short circuits
- earth fault - **G**: Phase-to-earth fault protection
- Neutral - **N**: Protection against overloads and short circuits which may flow through and damage the neutral conductors.



L	Ir	Long time delay protection threshold against overcurrent
	tr	Long time delay against overcurrent
S	Isd	Short time delay protection threshold against overcurrent
	tsd	Short time delay against overcurrent
	I^2t ON/OFF	Short time delay protection I^2t curve against overcurrent (activated/deactivated)
I	Ii	Instantaneous protection threshold against overcurrent
G	Ig	Earth protection threshold
	tg	Earth protection time delay
	I^2t ON/OFF	Earth protection I^2t curve (activated/deactivated)
N	N	Threshold as % of the value of the neutral protection setting (adjustment of the Ir and Isd thresholds)

Protection according to ANSI	**Code**
L	ANSI 49
S	ANSI 50TD/51
I	ANSI 50
G	ANSI 50N TD/51N

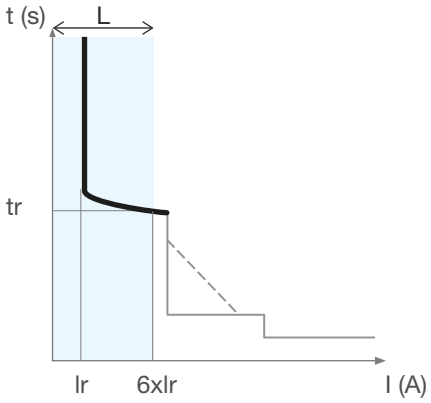
In addition to Instantaneous protection, all sentinel trip units include MCR protection (Making Current Release). This guarantees immediate tripping of the hw+ circuit breakers in cases of closing operation on a short-circuit.

Protection setting adjustment device

The protection settings can be modified using the dials and the display. All protection functions are based on the root-mean-square value (RMS) of the current to take into account the presence of current harmonics. The extensive choice of protection curve settings facilitates selectivity.

The Long time delay protection is designed to protect the cables, the busbars and the busbar trunking from current overloads. It includes a thermal memory function that temporarily stores the calculated thermal values so that the thermal effect of the cable heating remains available. The phases and the neutral pole benefit independently from the Long time delay protection. It can also be used to protect transformers or generators.

Long time delay protection curve



Long time delay protection

Long time delay parameters

L	Ir = Ir1 x Ir2 x In (A)	Long time delay protection threshold against overcurrent
	tr (s)	Long time delay against overcurrent

Adjusting the Ir threshold

The Long Time Delay protection tripping range is: 1.05 - 1.20 Ir.
The Ir current setting is adjusted using the 2 dials Ir1 and Ir2.

Rating (In)	**Pick up adjustment range Ir = Ir1 x Ir2 x In (A)**
400 A	145.6 ... 400 A
630 A	229.3 ... 630 A
800 A	291.2 ... 800 A
1000 A	364 ... 1000 A
1250 A	455 ... 1250 A
1600 A	582.4 ... 1600 A
2000 A	728 ... 2000 A
2500 A	910 ... 2500 A
3200 A	1164.8 - 3200 A
4000 A	1456 ... 4000 A
5000 A	1820 ... 5000 A
6300 A	2293.2 ... 6300 A

Adjusting the tr time delay

The tr time delay defines the tripping time of the long time delay protection for a current of 6 x Ir.
The tr time delay is adjusted using the tr dial.

tr adjustment range (s)

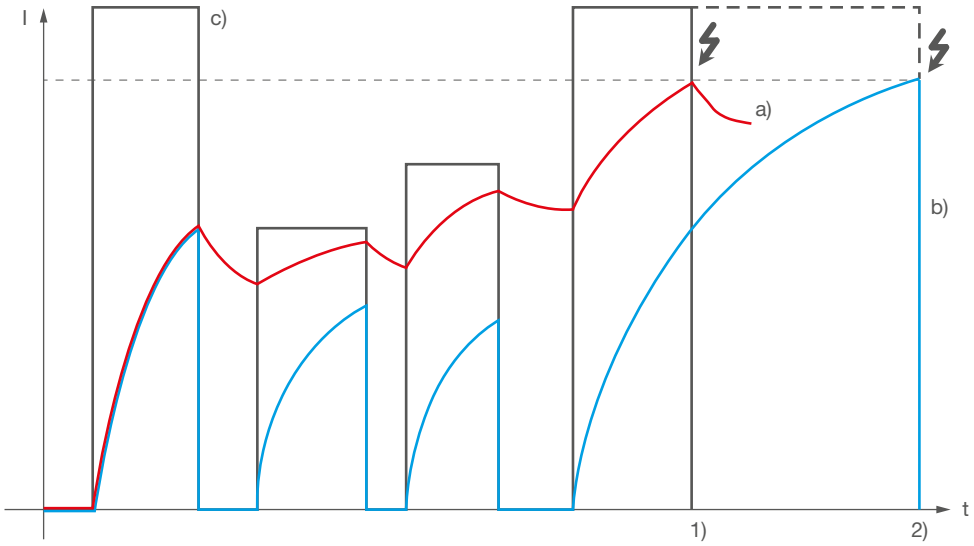
0.5	1.0	2.0	4.0	5.0	8.0	10.0	15.0	20.0	25.0

The trigger time tolerance for the long time delay protection is from 0 % to -20 %.

Example: for tr = 5 s and I = 6 x Ir, the tripping time for the long time delay protection will be between 3.98 s and 5.03 s.

Thermal image

Closure resulting from an overload, successive motor starts or a fluctuating load cause significant current swells that can potentially damage conductors (heating up, premature ageing).
Traditional Long time delay protection is not able to protect the conductors against repetitive faults of this kind because the duration of each detected overload is too short to cause effective tripping.
Thanks to its thermal memory and imaging function, the sentinel trip unit memorizes and integrates the thermal effects of the detected overloads whatever the current value. These functions are guaranteed even if the trip unit is not powered by an external power supply. This reduces the associated Long time delay time to cause effective tripping before the conductors overheat.
The thermal memory and image function of the sentinel trip unit provides optimal protection of the cables and busbars against overheating.



Tripping with and without thermal image

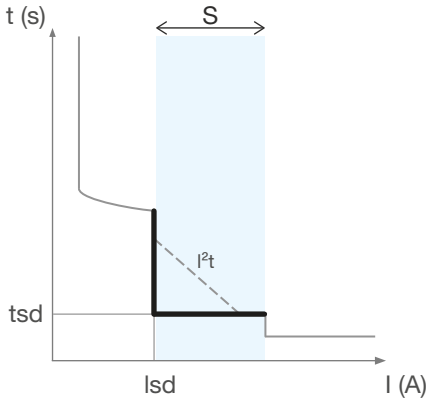
Key:
a) Calculation with thermal memory
b) Calculation without thermal memory
c) Current in the load
1) Tripping case a)
2) Tripping case b)

The example above clearly shows that the trip unit a) with thermal memory trips earlier and thus protects the conductors better than trip unit b) without thermal memory.

Note: The thermal memory and imaging function of the sentinel electronic trip units cannot be deactivated.

Short time delay protection is designed to protect against short circuits.

Short time delay protection curve



Short time delay protection

Short time delay parameters

S	OFF	Deactivation of the short time delay overcurrent protection
	Isd (x Ir)	Short time delay protection threshold against overcurrent
	tsd (s)	Short time delay against overcurrent
	I^2t (ON/OFF)	Short time delay protection I^2t curve against overcurrent

Adjusting the Isd pick-up setting

The Isd pick-up is adjusted using the Isd dial.

Isd pick-up adjustment range (x Ir)

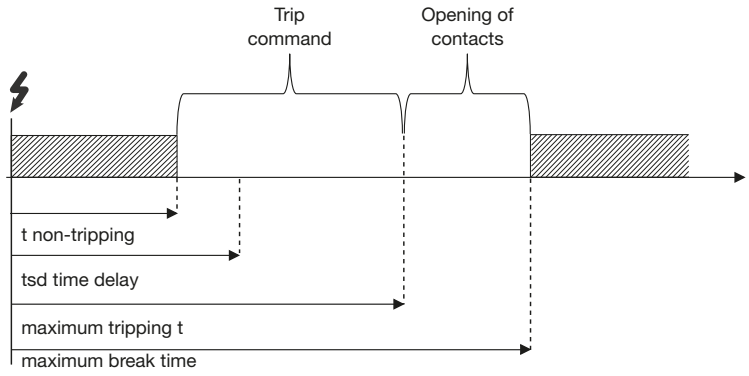
OFF	1.0	1.5	2.0	2.5	3.0	4.0	6.0	8.0	10.0

When the Isd setting is OFF, the short time delay protection is deactivated.
The Isd tripping tolerance threshold for short time delay protection is ±10%.

Adjusting the tsd time delay

The tsd time delay is adjusted using the tsd dial.

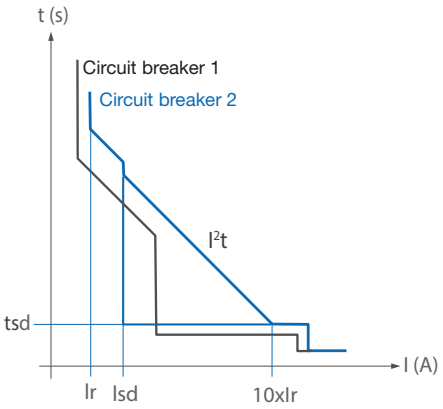
Time delay (s)	tsd I^2t OFF	0.05	0.10	0.20	0.40	0.60
	tsd I^2t ON	0.05	0.10	0.20	0.40	0.60
Non-tripping time (s)		0.025	0.075	0.175	0.375	0.575
Maximum tripping time (s)		0.1	0.15	0.25	0.45	0.65
Maximum breaking time (s)		0.12	0.17	0.27	0.47	0.67



An inverse time function $I^2t=K$ can be activated or deactivated when adjusting the short time delay.

This I^2t function makes it possible to improve selectivity with downstream devices. It is activated from the Isd pick-up and functions up to 10xIr.

Example use of the I^2t function



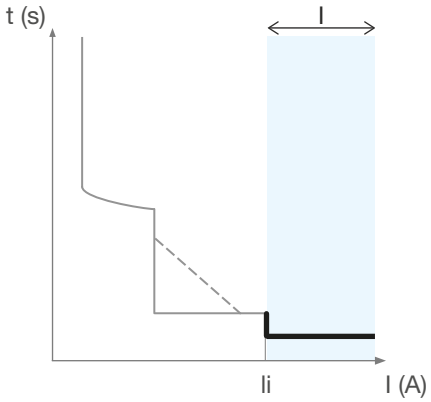
Circuit breaker 1: h3+
Circuit breaker 2: hw+

Activating the I^2t function on circuit breaker 1 achieves total selectivity, otherwise selectivity remains partial.

ATTENTION
The I^2t function is deactivated by default. Activate it if selectivity needs to be improved.

Instantaneous protection is designed to protect against high short circuit currents. This protection is time-independent.

Instantaneous protection curve



Instantaneous protection

Instantaneous protection parameters

I	OFF	Instantaneous protection deactivation
	Ii (x In)	Instantaneous protection threshold against overcurrent

Adjusting the Ii pick-up setting

The Ii pick-up is adjusted using the Ii dial.

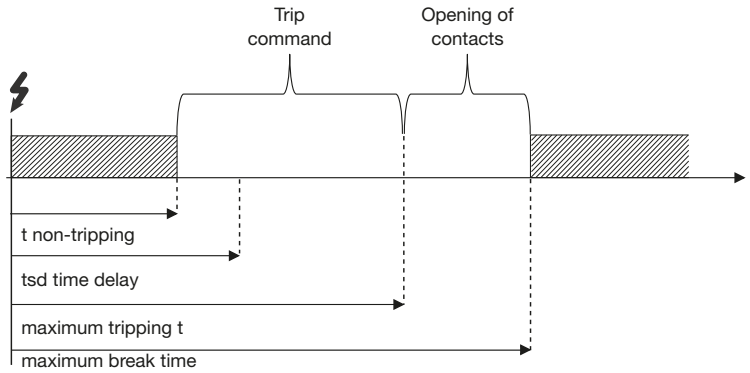
Ii pick-up adjustment range (x In)

OFF	1.5	2.0	3.0	4.0	6.0	8.0	10.0	12.0	15.0

The Ii pick-up tolerance for instantaneous protection is ±10 %.

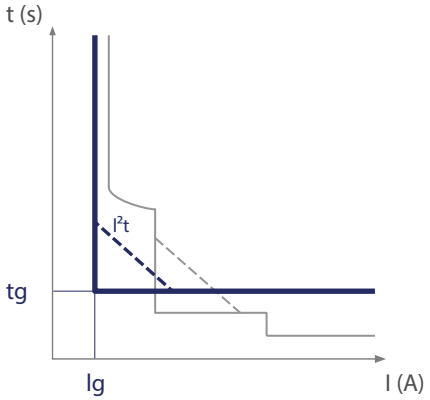
Tripping time

Instantaneous protection has no adjustable time delay.
The non-tripping time is 20 ms.
The maximum break time is 70 ms.



The earth protection is used against phase-to-earth faults. The earth fault currents can reach a high enough amplitude that they are similar to a short circuit. It is based on the calculation of the sum of the phases and the neutral current.

Earth protection curve



Earth protection

Instantaneous protection parameters

G	OFF	Deactivation of the earth fault protection
	Ig (xIn)	Earth protection threshold
	tg (s)	Earth protection time delay
	I²t (ON/OFF)	Earth I²t protection curve

Adjusting the Ig pick-up setting

The Ig pick-up is adjusted using the Ig dial.

Ig pick-up adjustment range (x In)

OFF	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0

When the Ig pick-up is set to OFF, earth fault protection is deactivated.

Adjusting the tg time delay

The tg time delay is adjusted using the tg dial.

Time delay (s)	tg I²t OFF	0.05	0.10	0.20	0.40	0.80
	tg I²t ON	0.05	0.10	0.20	0.40	0.80
Non-tripping time (s)		0.025	0.075	0.175	0.375	0.775
Maximum tripping time (s)		0.1	0.15	0.25	0.45	0.85
Maximum breaking time (s)		0.12	0.17	0.27	0.47	0.87

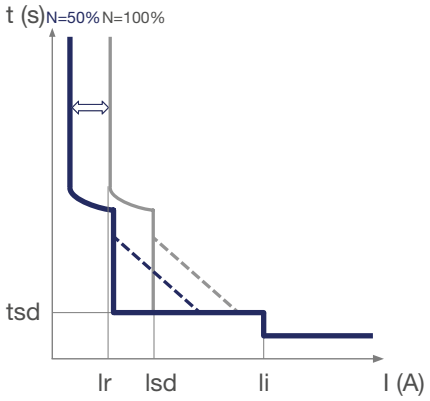
The I²t earth protection curve improves the selectivity of the earth faults with circuit breakers located upstream. This protection functions from the value of the Ir setting to the nominal value In. It can be adjusted using the tg dial.

ATTENTION

In the case of a 3-pole product, the earth fault protection is dependant on the neutral protection setting and on the presence of an ENCT external neutral sensor. If an ENCT external neutral sensor is used, it is necessary to activate the neutral protection to take into account the sum of the phases and the neutral current.

Neutral protection is factory-installed on 4P circuit breakers and as an option with the addition of the ENCT external neutral sensor on 3P versions. It is particularly useful if the neutral conductor section is less than that of the phases, or if the neutral conductor is heavily loaded (for example, in office buildings).
It uses similar tripping curve characteristics as the Long time delay, Short time delay and instantaneous protection parameters.

Neutral protection curve



Neutral protection

Adjusting the Ir and Isd neutral protection thresholds

N coefficient adjustment range (%)	Parameters impacted
OFF - 50 - 100 - 200	The percentage is applied to the adjustment value of the Ir and Isd thresholds for the phases.

For a setting at 200%, the maximum value of the neutral protection cannot exceed the maximum rating of the circuit breaker.

For example for an HW1 circuit breaker (maximum rating 1600 A) with an Ir setting at 1000 A and a neutral protection setting at 200 %, the Ir neutral threshold value will be limited to 1600 A and not 2000 A.

The Ii (Instantaneous protection) remains identical to that of the phases.

The N coefficient is adjusted using the N dial.

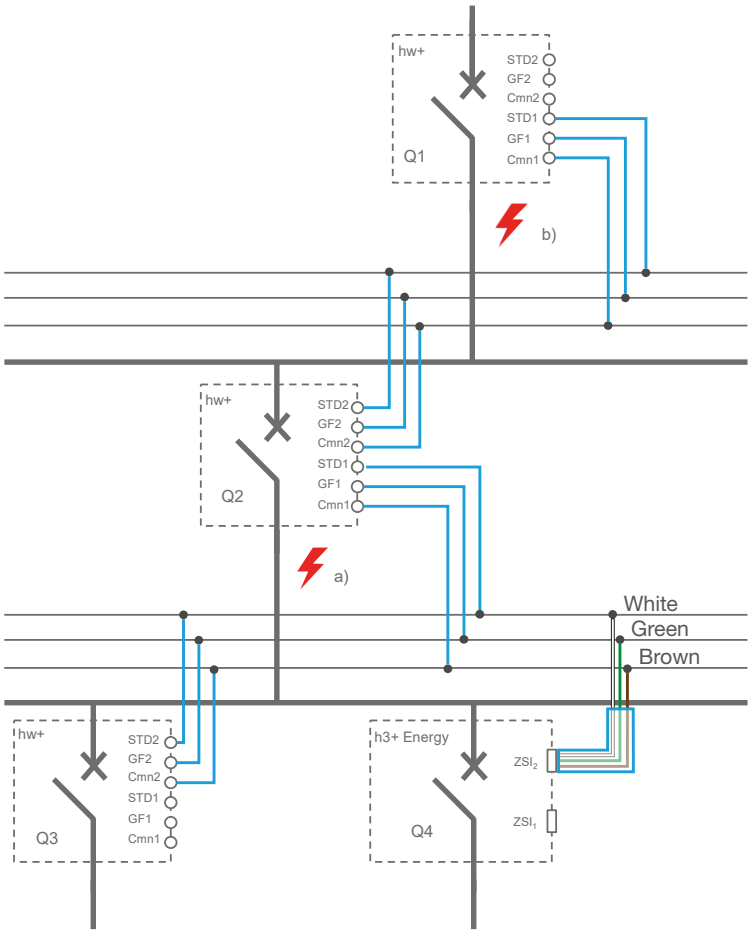
On a 3-pole product, if there is no ENCT external neutral sensor:
- it is advised to keep the setting of the N encoder dial to OFF (factory setting by default),
- if the N dial is set to 50 %, 100 % or 200%, the protection will remain inactive.

Neutral protection time delay

The time delays for neutral protection remain identical to the phase time delay adjustment values.

The Zone Selective Interlocking (ZSI) function is designed to limit the electro-dynamic constraints on the installation in case of a short circuit fault or earth fault.
The devices, conductors, bar sheathing and busbars can thus benefit from this limitation.
It reduces the time taken to clear the electrical fault while maintaining the selectivity and coordination provided by the protection settings.
The installed circuit breakers are linked together by cable to determine which circuit breaker should trip first. If an electrical fault appears between two linked circuit breakers connected together by the ZSI function, the downstream circuit breaker is unable to clear it. Thanks to zone selectivity, the circuit breaker upstream of the fault trips without waiting till the end of its time delay.
For zone selectivity to work correctly, the ZSI terminals of all circuit breakers must be connected together among themselves. The tripping time delay of each circuit breaker must be adjusted according to the chronometric sensitivity desired and the ZSI function must be activated (only on circuit breakers linked to their downstream circuit breakers).
The ZSI function applies to the Short Time Delay protection (ZSI STD) and the Earth Fault protection (ZSI GF).

Here are two examples to explain the functioning.



Zone selectivity: Example

First, circuit breakers Q1, Q2, Q3, Q4 are set to their respective thresholds enabling the expected time selectivity to be activated. The ZSI function must be activated only on the Q1 and Q2 circuit breakers.

Fault example a):
- If a fault occurs at point a), the Q1 and Q2 circuit breakers detect the electrical fault. Thanks to the ZSI cabling (in blue), the Q1 circuit breaker receives a signal from Q2 and remains closed to allow the Q2 circuit breaker to eliminate the fault. The Q2 circuit breaker does not receive a signal either from Q3 or Q4. It opens immediately, despite the previously set tripping time delay.

Fault example b):
- If a fault occurs at point b), the Q1 circuit breaker detects the electrical fault. The Q1 circuit breaker does not receive a signal from Q2, it opens immediately, despite the previously set tripping time delay.

Adjusting the ZSI protection setting

ZSI protection can be activated on the hw+ circuit breakers using the **Hager Power setup** test and commissioning software.

N.B.
It is important to keep the ZSI protection deactivated on an hw+ circuit breaker not connected to its downstream circuit breakers (ZSI STD1, GF1, Cmn1 terminals not used). If it is activated, the circuit breaker will trip immediately during an electrical fault without waiting for the end of the Short time delay and the earth fault protection time delay.

ZSI protection settings

Short time delay protection ZSI	ON-OFF (OFF by default)
Earth fault protection ZSI	ON-OFF (OFF by default)

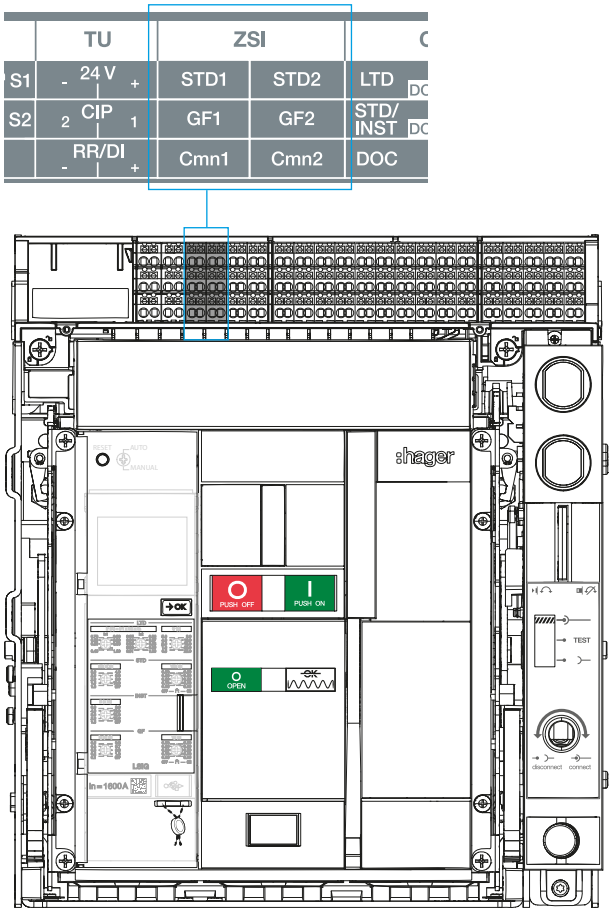
Connection of ZSI protection

hw+ air circuit breakers have 6 ZSI terminal blocks enabling the upstream or downstream circuit breakers to be connected to deploy zone selectivity (ZSI).

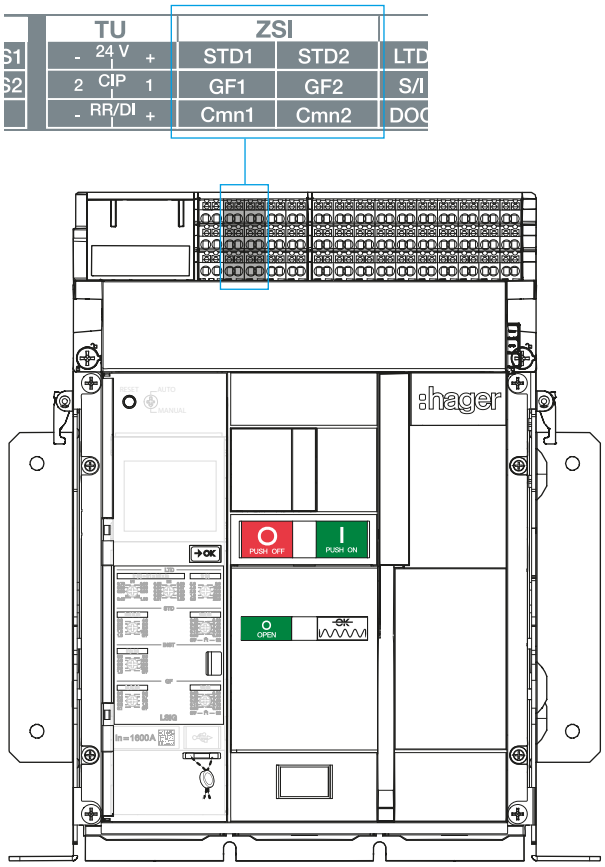
Type of connection	**Total number of circuit breakers**	**Max. distance between 2 circuit breakers**
Upstream	3	300 m
Downstream	7	300 m

Recommended connection cable: 1 to 1.5 mm^2 shielded twisted cable.

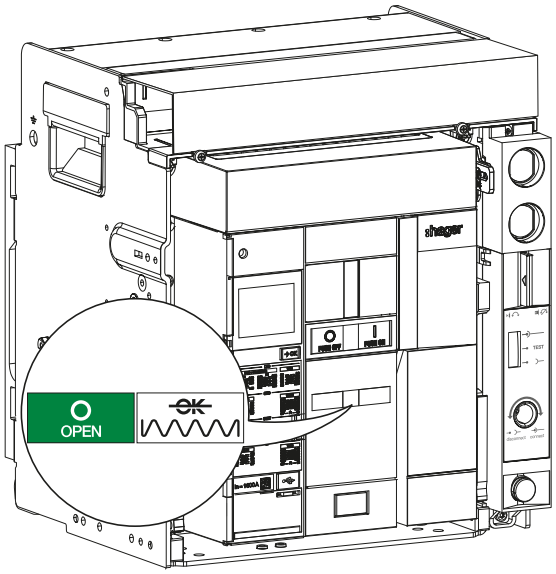
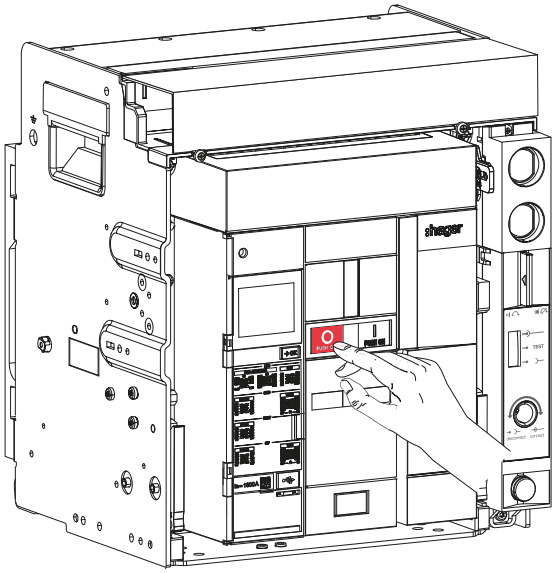
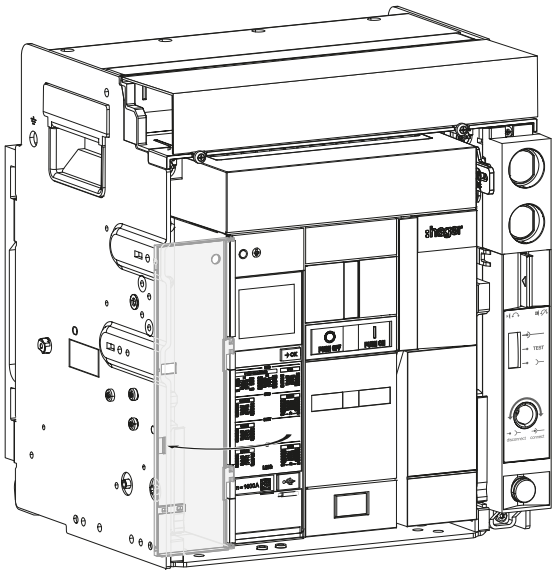
Withdrawable circuit breaker

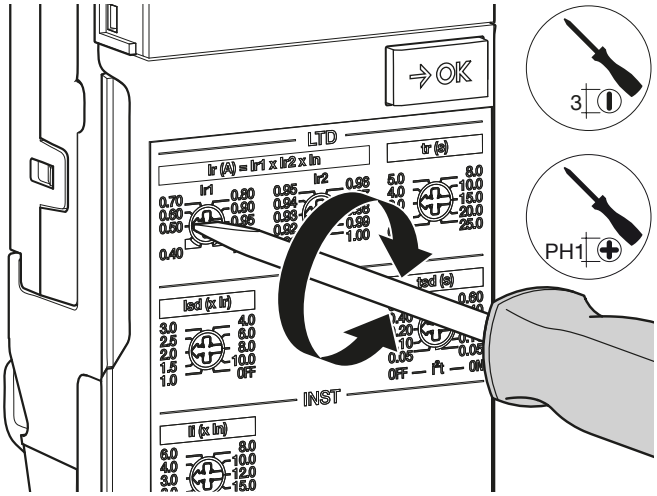
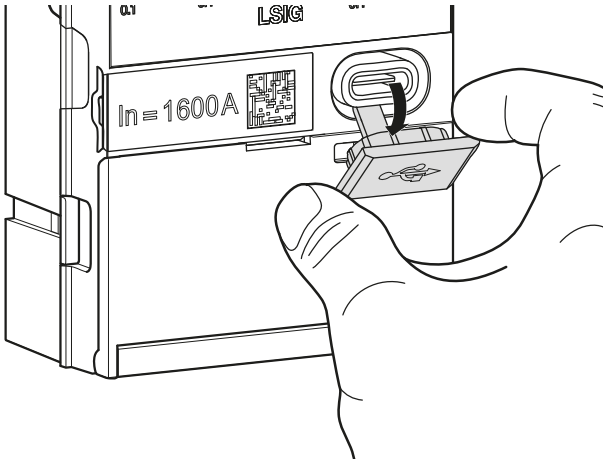
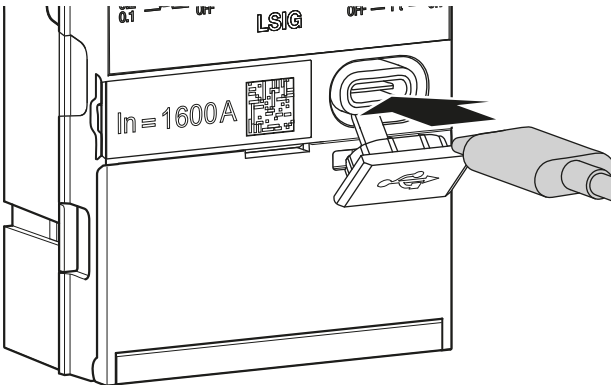


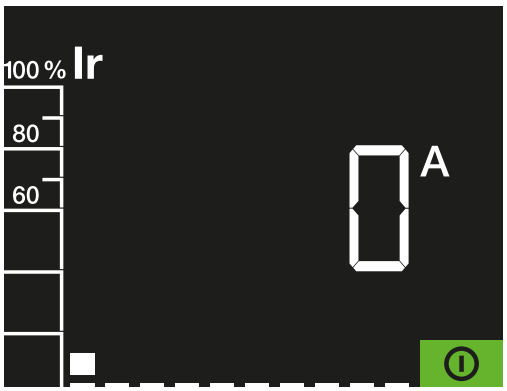
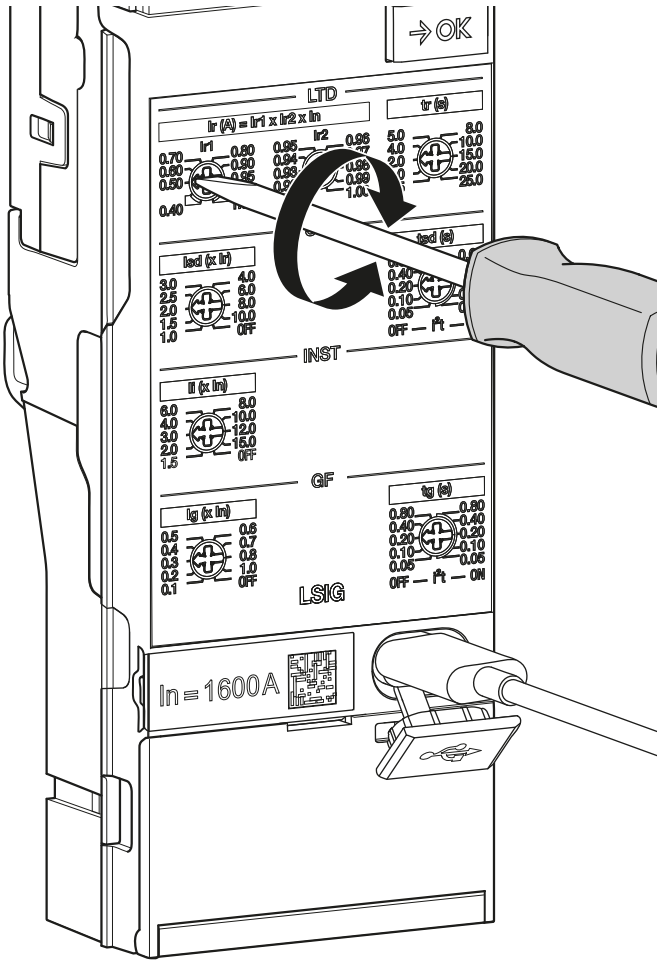
Fixed circuit breaker

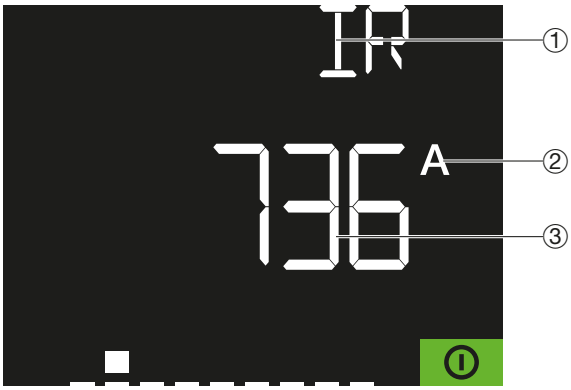
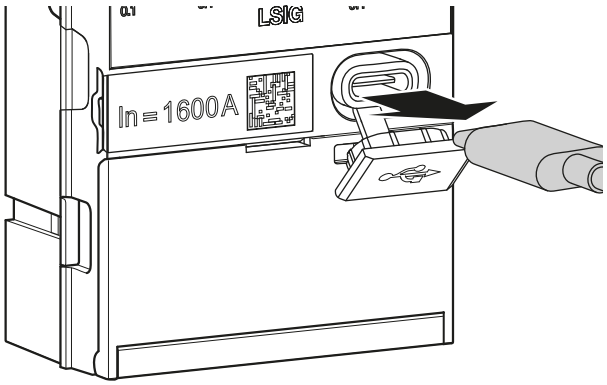
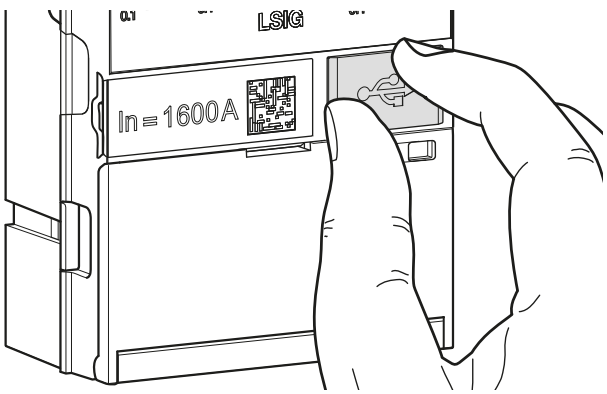


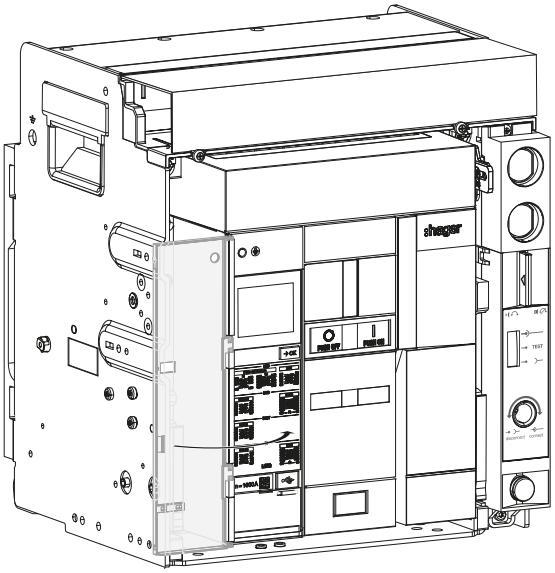
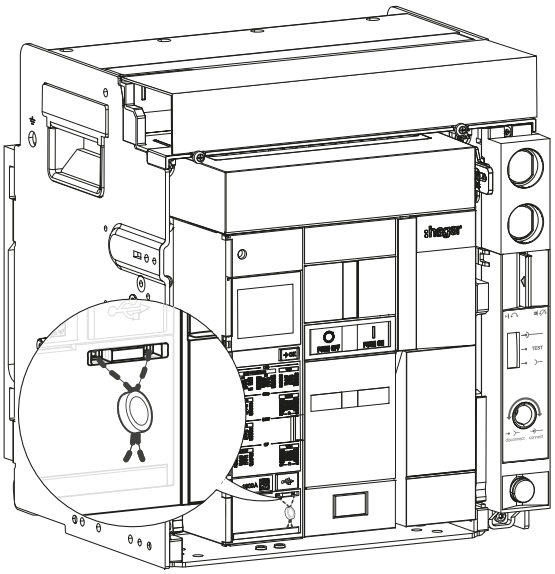
Follow the procedure below to adjust the protection devices.

	Action	Illustration
1	First, ensure that the circuit breaker is switched off and displays the following information:	
2	If this is not the case, open the circuit breaker by pressing the opening push button  .	
3	Open the transparent cover protecting access to the trip unit.	

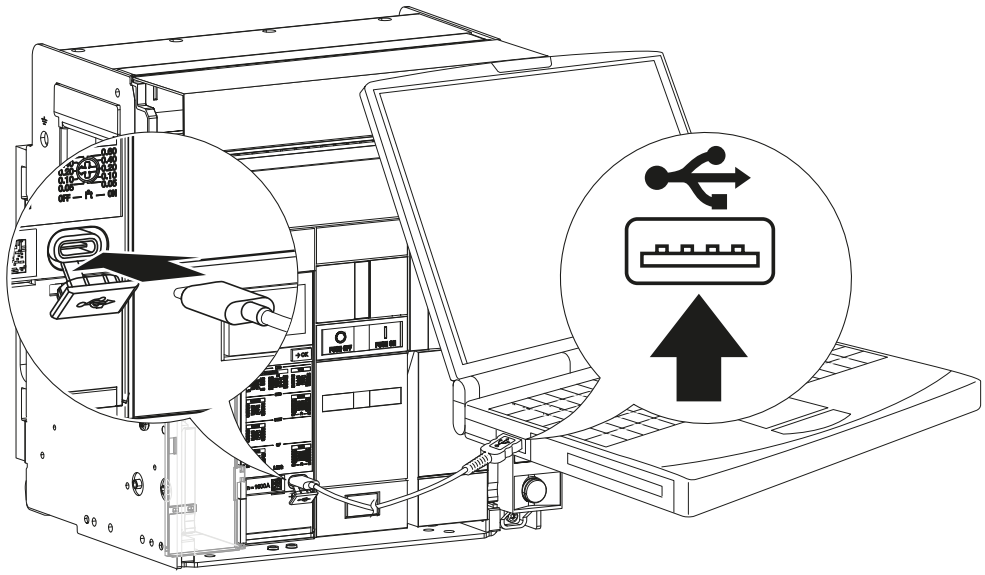
	Action	Illustration
4	Adjust as required using the dials.	
	⚠ WARNING **Risk of non-compliant settings.** The dials must be accurately set on the indexed positions. If the positioning is incorrect (between the indexed positions), the protection setting will not comply with the requirements of the installation.	
5	The trip unit must be powered in order to show the settings on the display. If necessary, remove the USB-C port cover to connect an external battery.	
6	Connect the external battery to the trip unit's USB-C port.	

	Action	Illustration
7	Check that the trip unit display switches on.	
8	Now, with each movement of the dial, show the corresponding setting...	

	Action	Illustration
8	*(continued)* ... on the display to avoid converting the dial coefficients in your head into amps or seconds.	 ① Parameter adjusted ② Parameter unit: - in amps (A) for currents, - in seconds (S) for time delays. ③ Parameter value
9	Check that if no action is performed for 30 seconds, the display returns to its standby screen.	
10	Once all the settings have been adjusted, disconnect the external battery.	
11	Close the USB-C port cover.	

	Action	Illustration
12	Close the transparent cover.	
13	Apply a seal to the cover if necessary.	

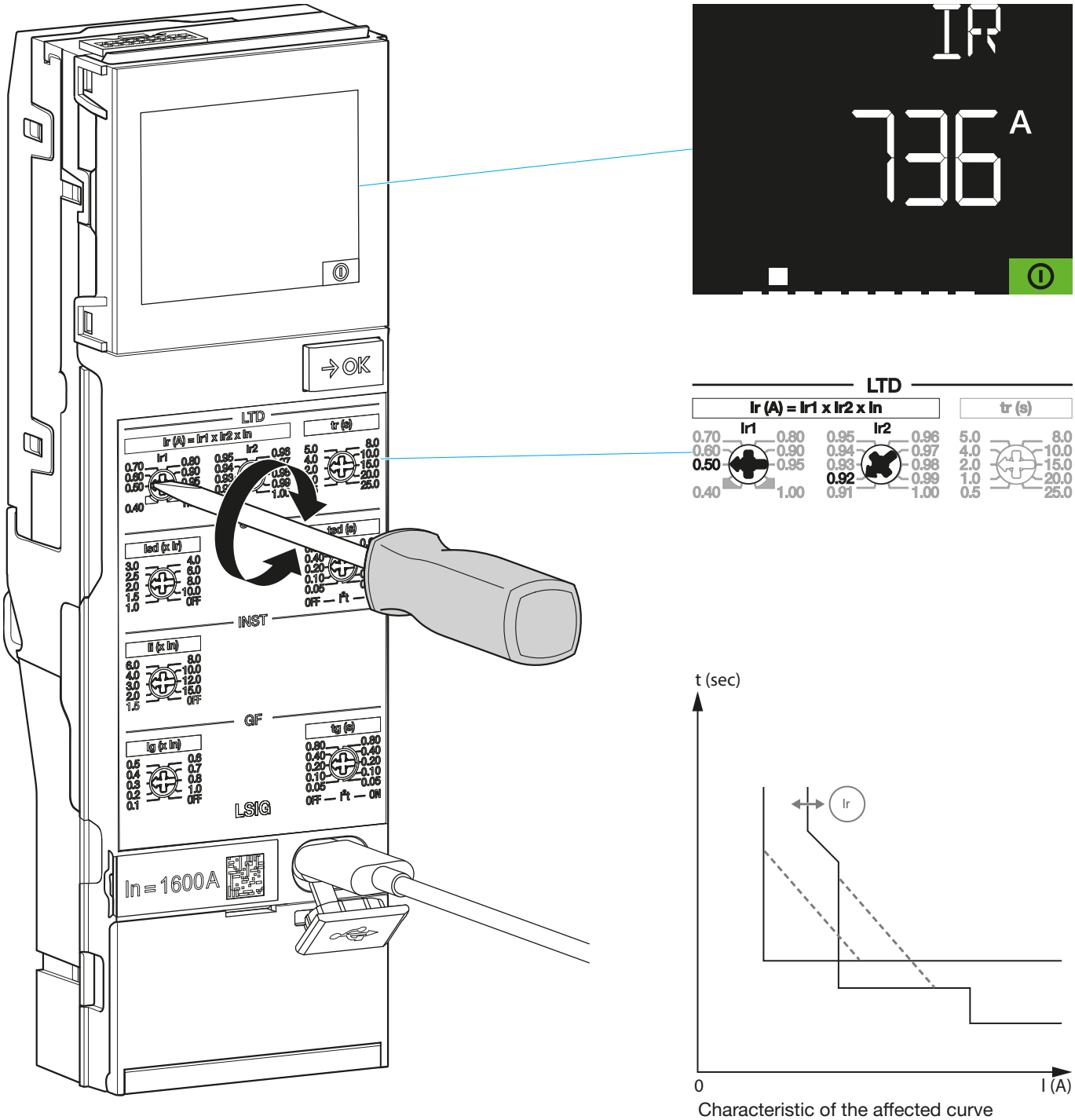
Using a computer equipped with the **Hager Power setup** testing and commissioning software, it is possible to enter protection settings according to the values recorded in the Hagercad project.
The computer must be connected to the USB-C port of the trip unit.



In our example, the circuit breaker rating is 1600 A.

Example of Ir current setting

Ir = Ir1 x Ir2 x In = 0.5 x 0.92 x 1600 = 736 A



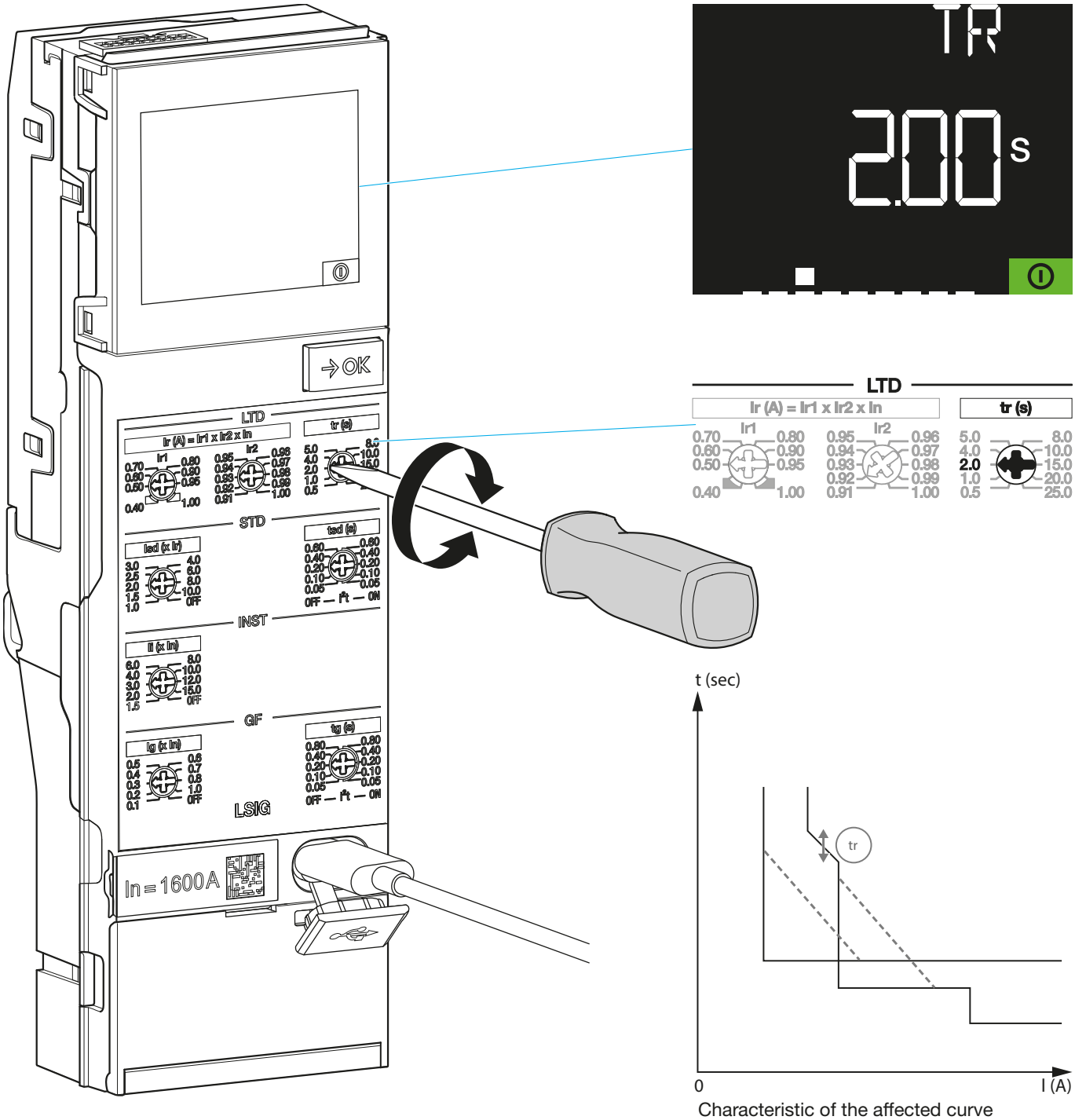
Characteristic of the affected curve

WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

Example of setting of the tripping tr time delay

tr = 2 s



Characteristic of the affected curve

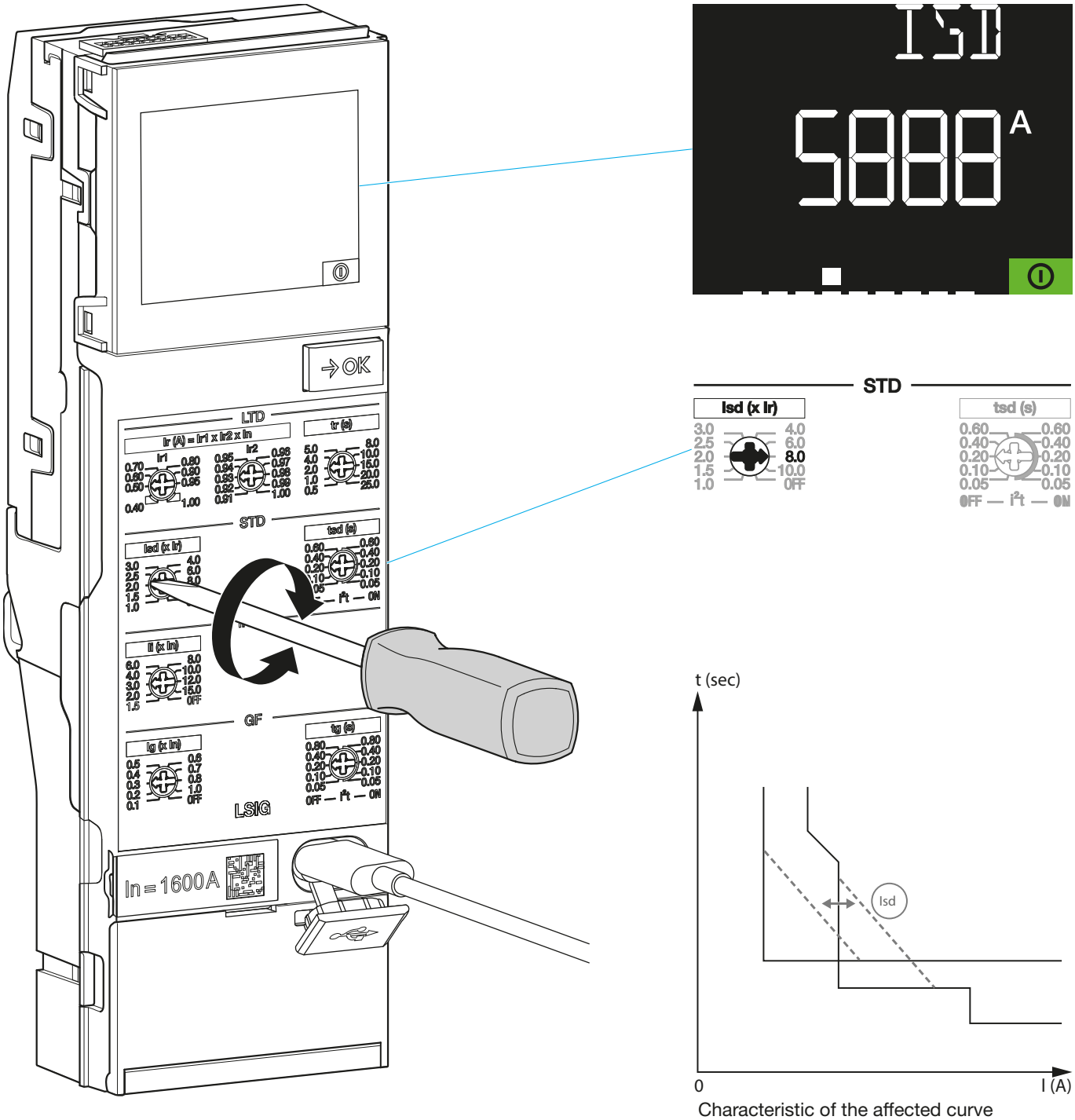
WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

In our example, the circuit breaker rating is 1600 A and Ir = 736 A.

Example of Isd current setting

Isd = 8 x Ir = 8 x 736 = 5888 A



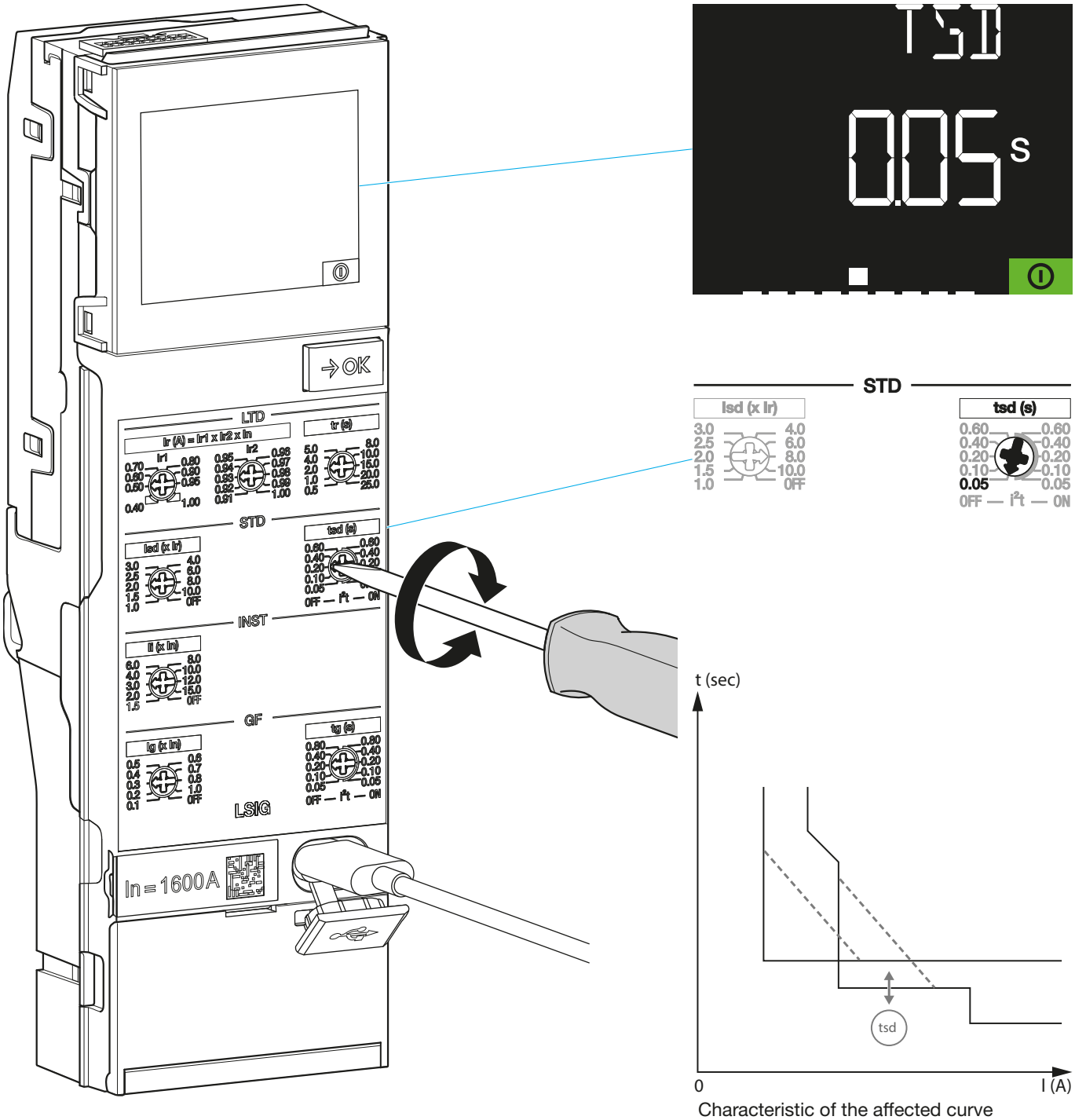
Characteristic of the affected curve

WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

Example of tsd tripping time delay setting

tsd = 0.05 s with I^2t set to OFF



Characteristic of the affected curve

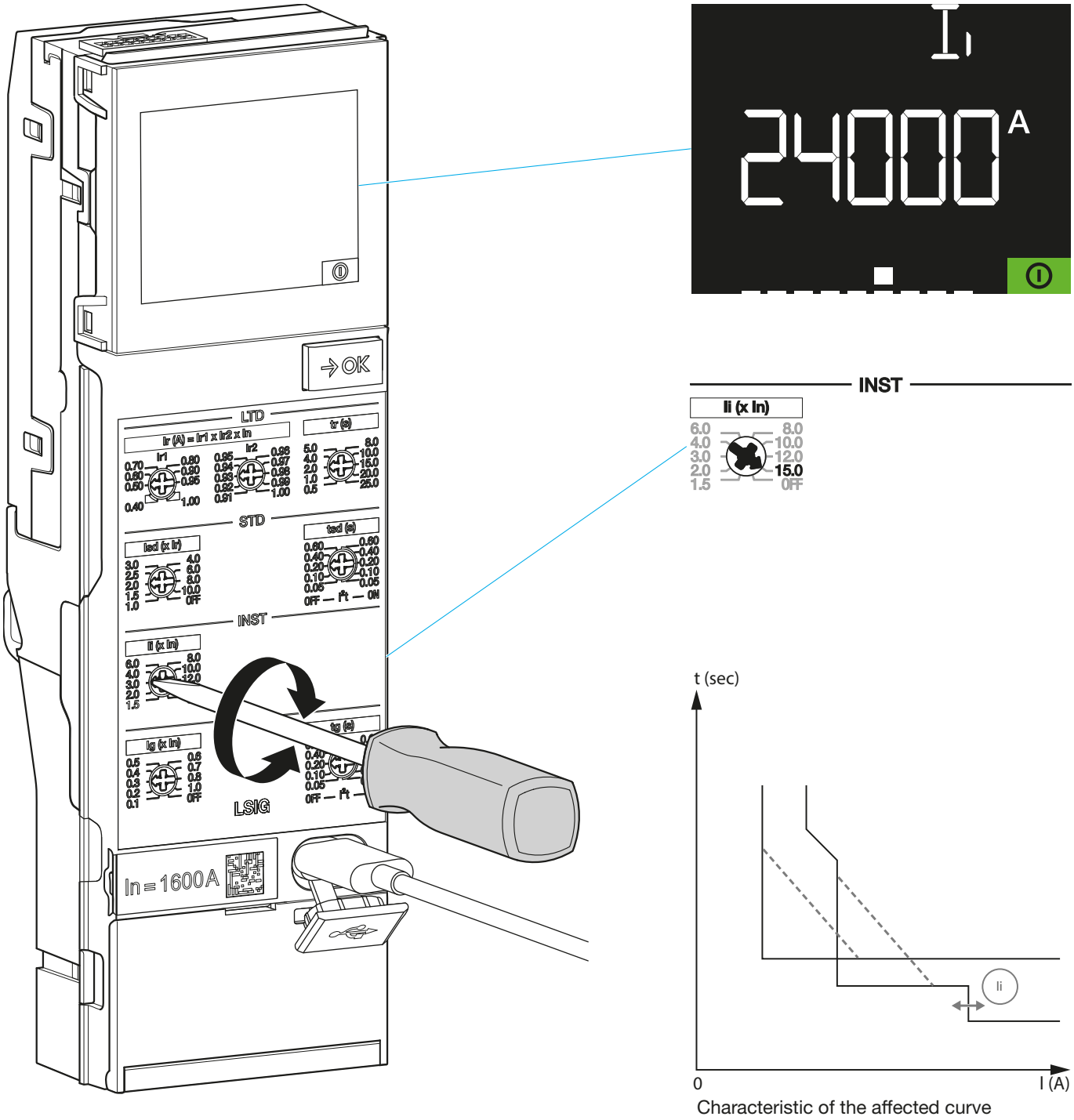
WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

In our example, the circuit breaker rating is 1600 A.

Example of Ii current setting

Ii = 15 x In = 15 x 1600 = 24000 A



Characteristic of the affected curve

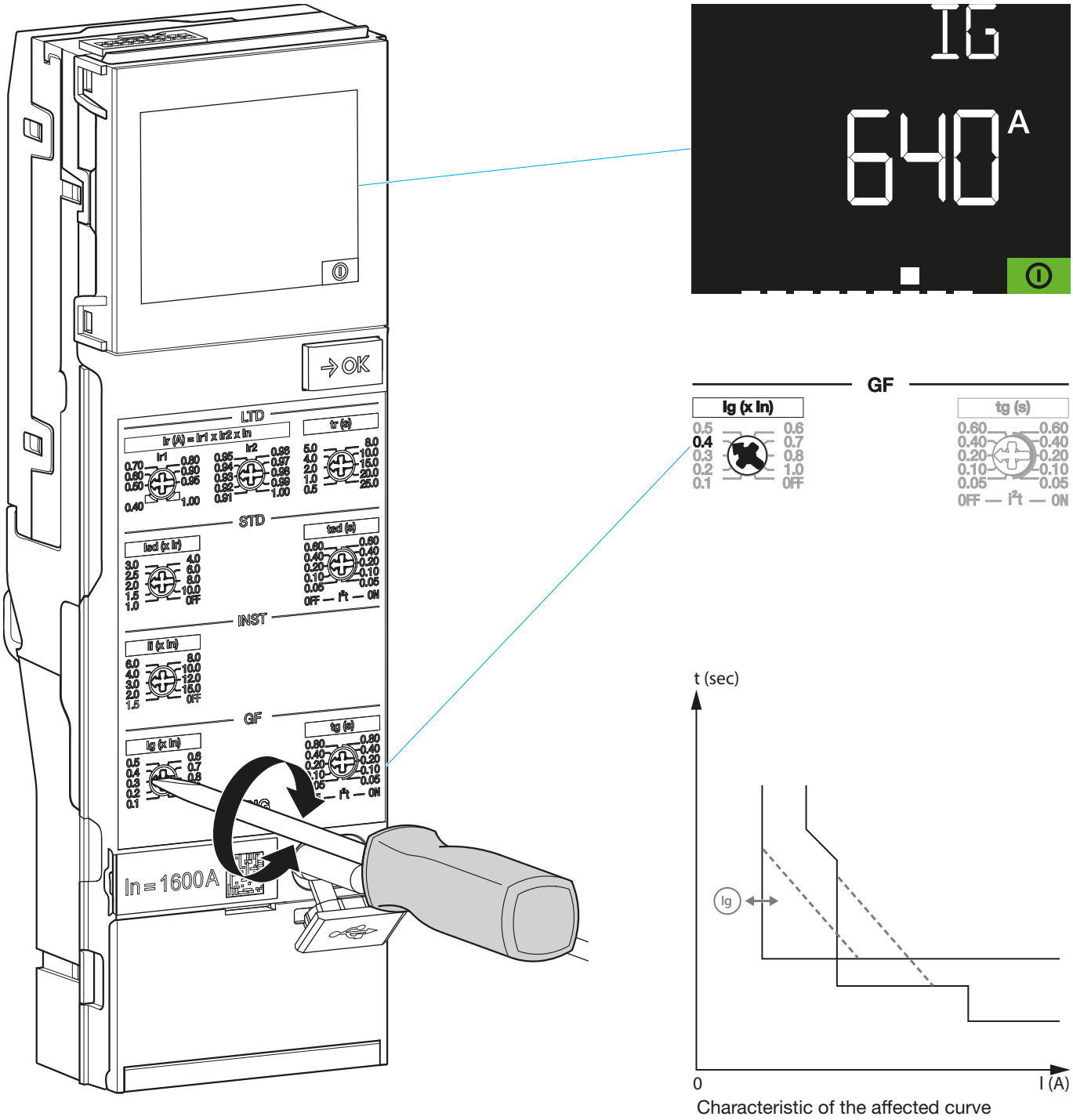
WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

In our example, the circuit breaker rating is 1600 A.

Example of Ig current setting

Ig = 0.4 x In = 0.4 x 1600 = 640 A



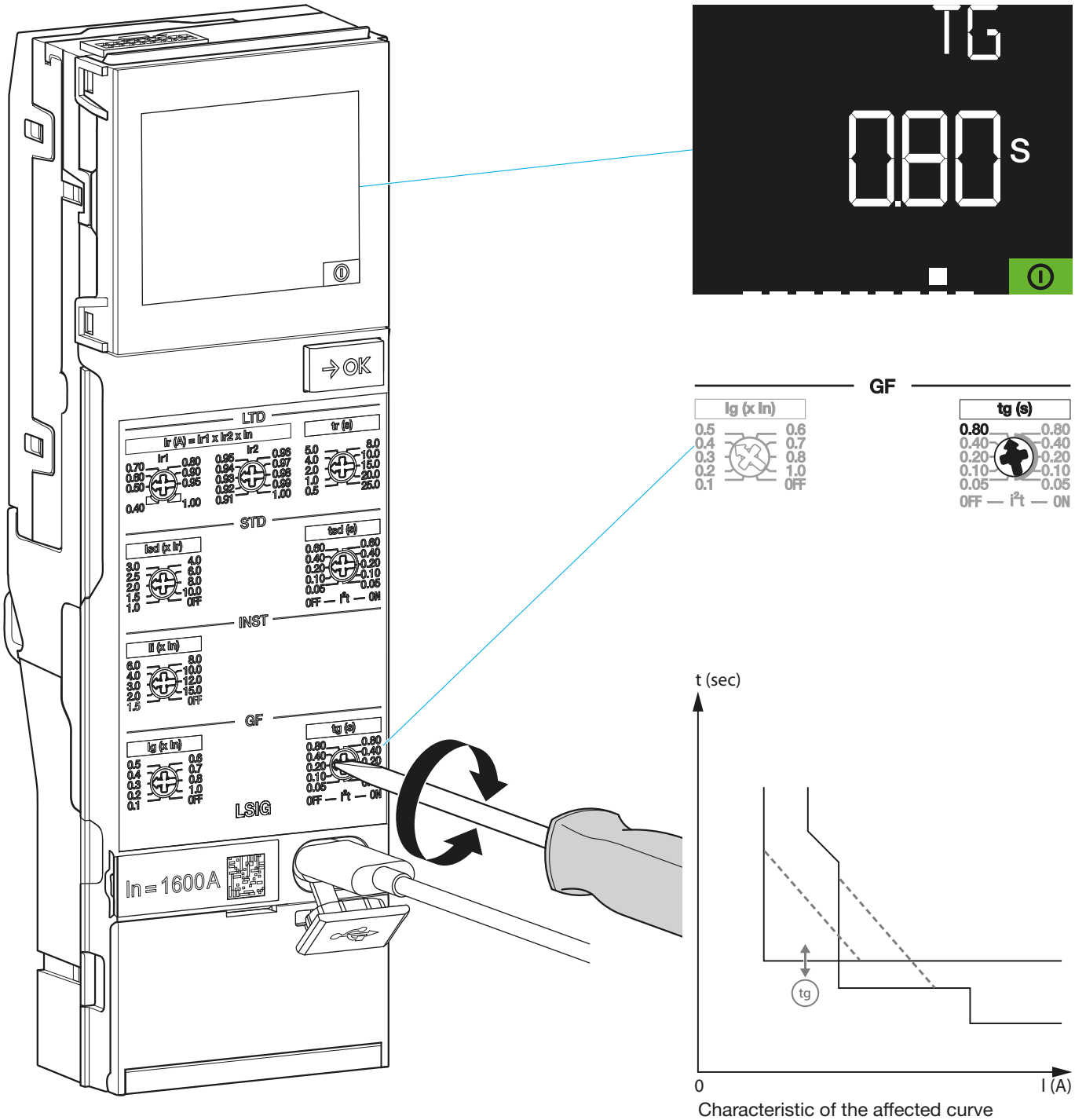
Characteristic of the affected curve

WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

Example of tg tripping time delay setting

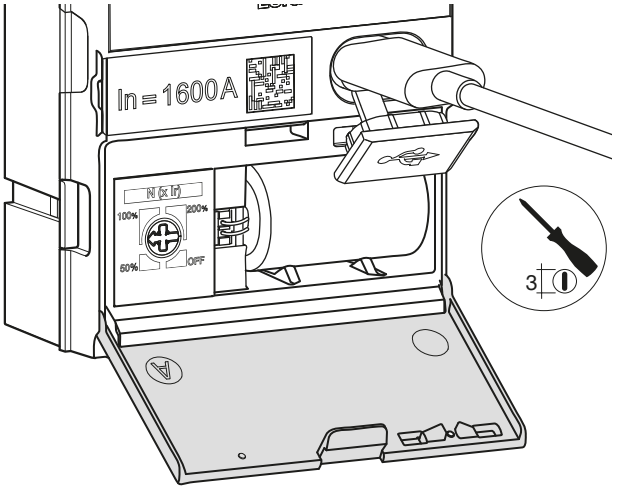
tg = 0.80 s with I^2t set to OFF



Characteristic of the affected curve

WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

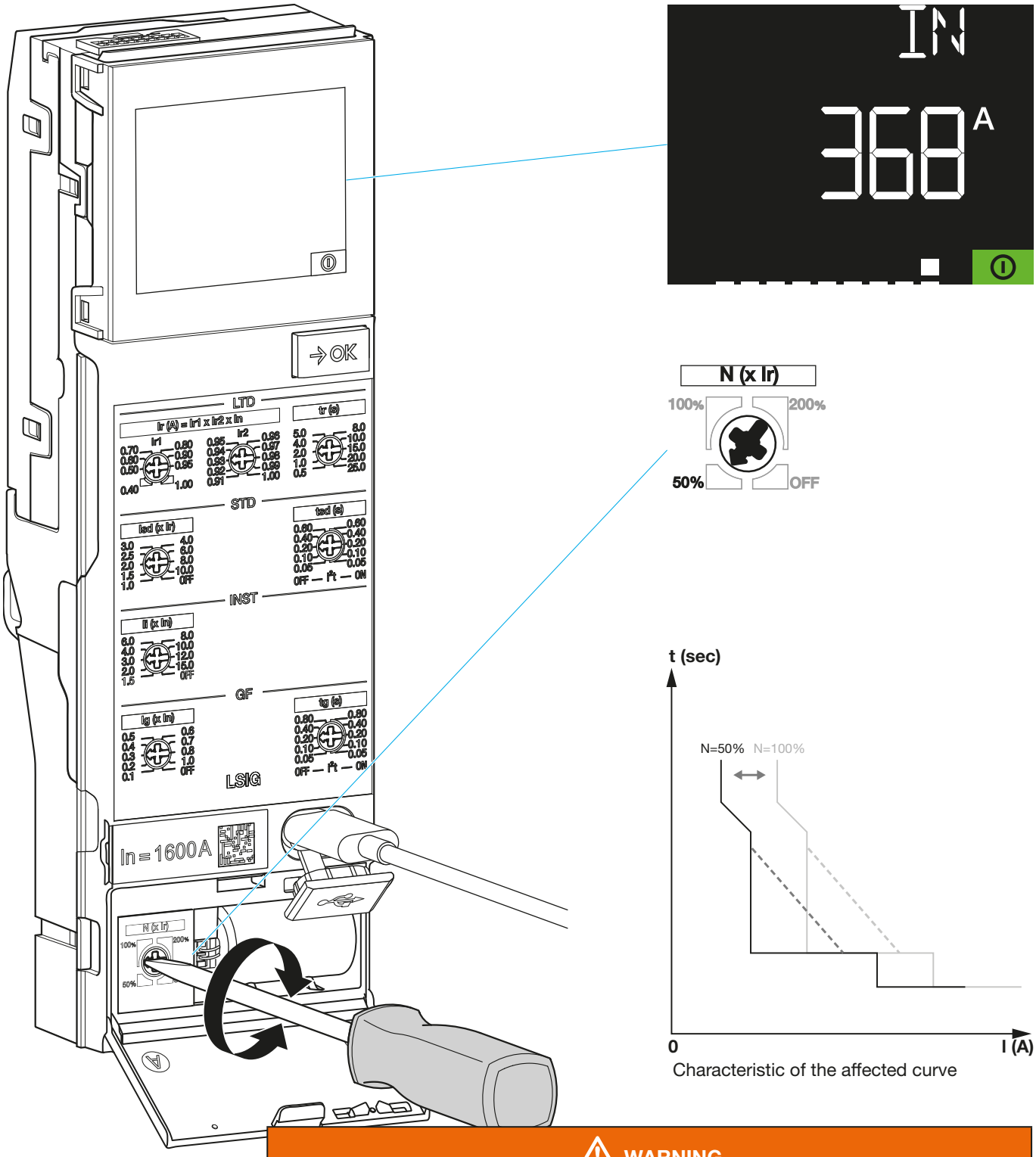
	Action	Illustration
1	Open the backup battery housing cover before connecting the USB-C socket (cf. Chapter 4.1 Principle).	
2	Adjust the desired setting then close the cover.	See the diagram on the next page.

ATTENTION
The battery housing cover cannot be opened or closed if an external battery is connected to the USB-C port

In our example, the circuit breaker rating is 1600 A.

Example of neutral protection

N = 50% x Ir = 50% x 736 = 368 A

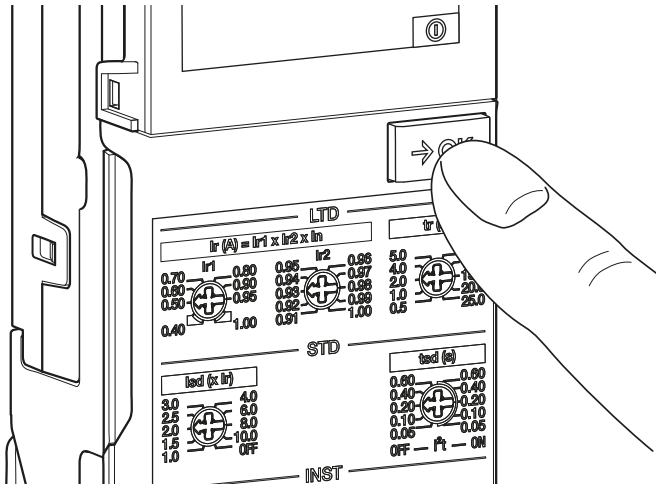
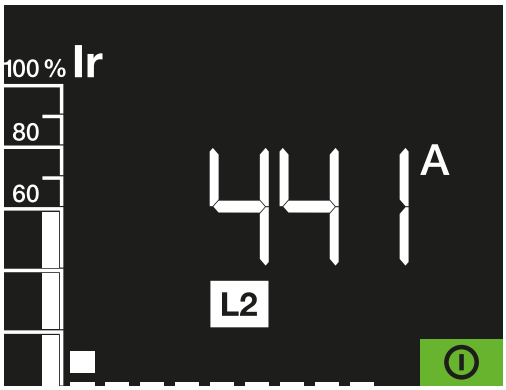


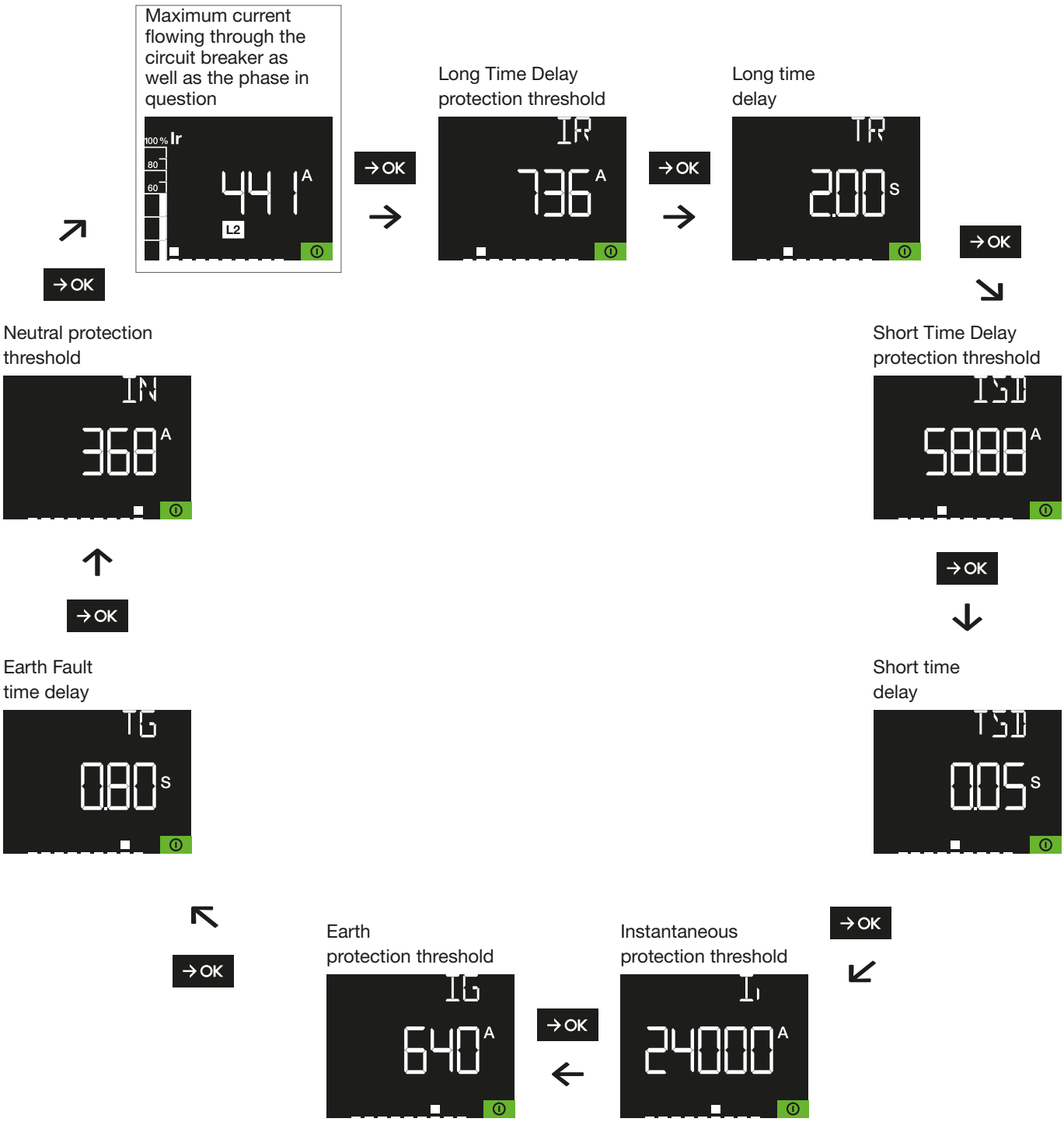
Characteristic of the affected curve

WARNING

Risk of settings that are non-compliant with the short circuit and selectivity calculations.
This example is given on an illustrative basis only to show the behaviour of the display when the dials are used.
In order to correctly adjust the trip unit, a short circuit and selectivity calculation must be performed for the installation in advance by the electrical designer. This will allow the circuit breaker to protect the installation in complete safety.

To review the settings adjusted:

	Action	Illustration
1	Briefly press the button →OK.	
2	check that the following screen displays. It indicates the maximum instantaneous current as well as the phase concerned.	
3	Each short press switches between the following screens.	See the order of the screens on the next page.

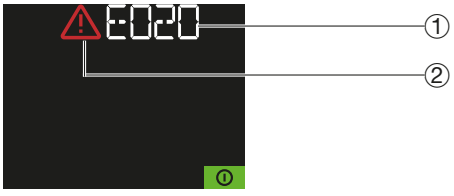


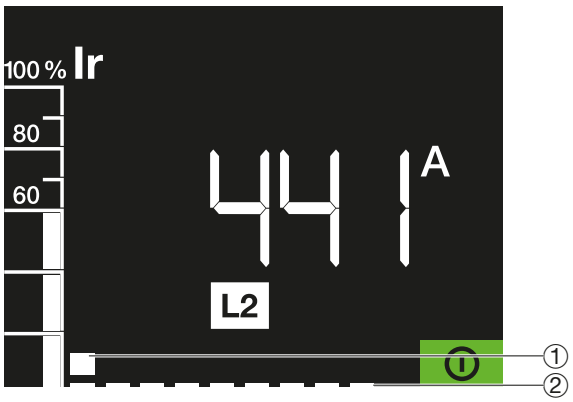
The order of the screens described corresponds to the LSIG trip unit.

ATTENTION

In case of error, an additional screen appears first. The error indicator also appears on all the screens.

1. Error code (see Chapter 6.4 System alarm).
2. Error indicator



	Action	Illustration
4	To facilitate navigation, a screen identifier ① indicates the position in relation to the number of screens available ②.	 ① Screen identifier ②
5	Check that if no action is performed for 30 seconds on the →OK button, the display returns to its standby screen.	

Trip unit	Number of screens
LI	5 - 6 in case of error
LSI	7 - 8 in case of error
LSIG	9 - 10 in case of error

DANGER

Risk of electric shock, electrocution or electric arc
Danger to life, risk of injury due to electric shock, or risk of serious injury.
Ensure that the device is only commissioned by qualified personnel who are equipped with adequate safety equipment.

For commissioning, refer to the operations described in standard IEC 61439-1 and -2.

ATTENTION

For any further information about commissioning the circuit breaker, contact Hager Technical Support.

ATTENTION

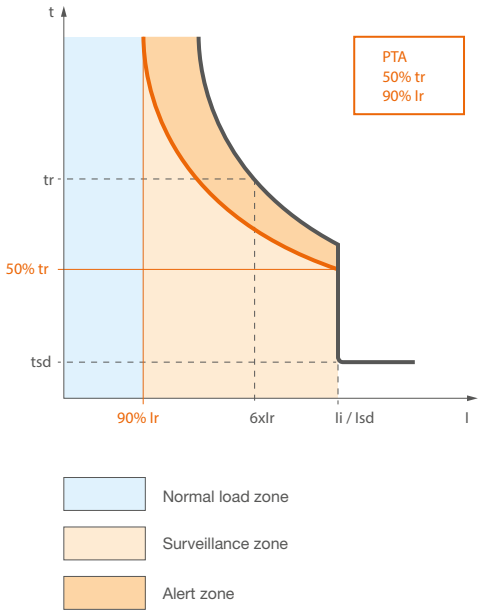
The Hager Power setup tool is recommended in order to carry out the protection settings when commissioning the trip unit or before.

The Sentinel trip unit is used to manage 4 types of alarms:
- Overload pre-alarm PTA
- Overload alarm
- Trip alarm
- System alarm

The PTA overload pre-alarm provides a warning when the situation is close to overload after a load current greater than 90% of Ir is reached. Preventive measures (load-shedding, maintenance, etc.) can then be taken before the circuit breaker trips, avoiding a powerblackout.

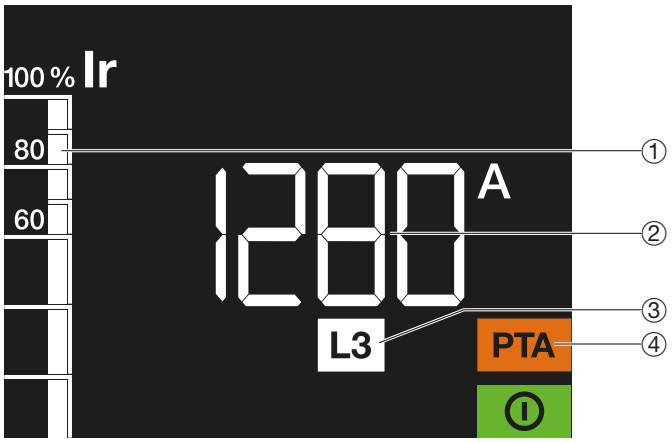
The overload pre-alarm PTA is defined by two parameters:
- The PTA threshold equivalent to 90% Ir
- The PTA time delay equivalent to 50% tr

It activates for any current (gradual rise or current peak) reaching the **surveillance zone**.



This **alert zone** is bounded on one hand by the threshold and time delay of the PTA overload prealarm and on the other hand by the Ir threshold and tr time delay.
The **surveillance zone** starts from the PTA threshold.

The PTA overload pre-alarm is signalled by a screen of this type:



① Percentage of the Ir current reached

② Value in amps of the current flowing through the circuit breaker on the most highly loaded phase

③ Relevant phase

④ Overload pre-alarm indicator:

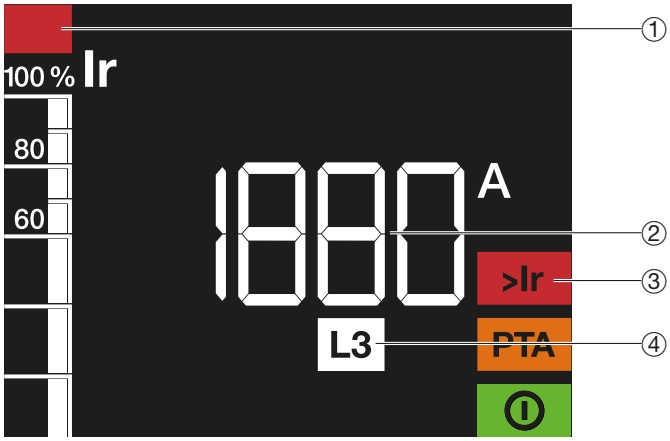
Normal load zone	Surveillance zone	Alert zone
off	flashing	fixed

Thanks to the OAC output alarm contact module available as an accessory and inserted at the rear of the trip unit, the overload pre-alarm is linked to the PTA output contact on the circuit breaker terminal block (see Installation manual 6LE007893A).

The overload alarm is activated as soon as the current ≥ 105% of the Ir value.

In the event of an overload alarm, a screen of this type is displayed with the indicators ③ and ① flashing.

Above 112.5 % of Ir, the indicator ③ is steady.



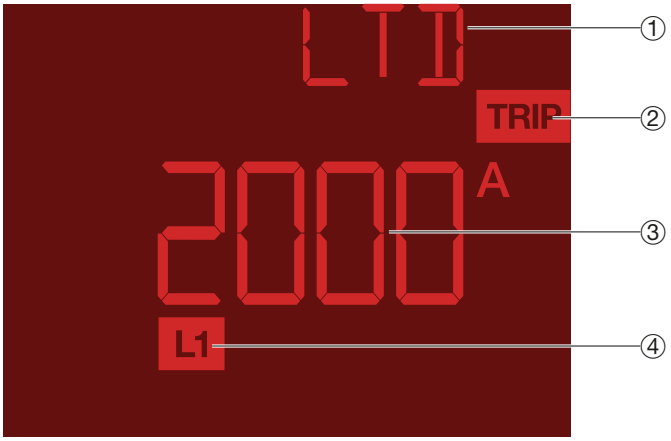
① Overload indicator

② Maximum current value reached

③ Overload alarm indicator

④ Phase in which the maximum current has been reached

If the circuit breaker trips (overload, short circuit, earth fault, trip unit fault), the circuit breaker opens. The trip unit display is then powered by its backup battery. A screen of this type flashes for a maximum of 6 hours or until the fault is acknowledged. Use of a 24 V DC SELV external power supply can extend the display beyond 6 hours.



① Display	Tripping type
LTD	Long time delay protection
STD	Short time delay protection
INST / MCR	Instantaneous protection
GF	Earth protection

② Trip indicator

③ Fault current value (only for tripping causes long delay, short delay, Instantaneous and earth protection), or error code at the origin of the tripping for a malfunction of the trip unit.

④ Phase concerned by the fault (only for Long time delay, Short time delay and Instantaneous tripping causes)

Thanks to the OAC output alarm contact module available as an accessory and fitted at the rear of the trip unit, the trip alarms are transferred to the LTD, STD/INST, GF output contacts located on the circuit breaker terminal block (see Installation manual 6LE007893A).

The system alarms signal malfunctions of the trip unit's electronic system. They can be of two types:
- critical: this is a serious malfunction. The trip unit is no longer capable of performing its protection function
- non-critical: the incident has no effect on the protection function.

Non-critical system alarms are indicated by a flashing screen of this type:

① Error indicator

② Error code

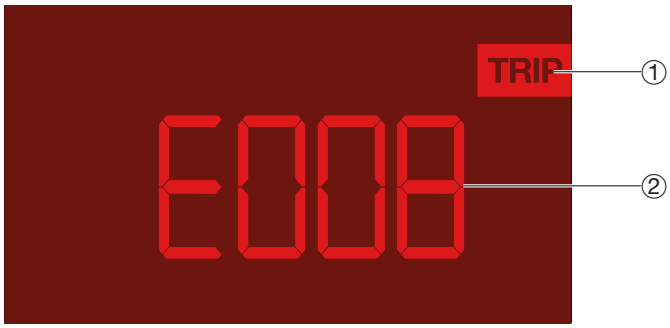
③ "Normal operation" indicator: the trip unit remains operational.

For the meanings of the different non-critical system alarms, refer to the table below:

Error code	Meaning	Recommended action
E019	Internal error 1: microcontroller error	For more information, see the maintenance guide.
E020	Faulty settings dial	
E021	High temperature of the trip unit	Check that the temperature inside the distribution board is not too high.
E022	Trip unit key or button faulty	For more information, see the maintenance guide.
E023	Digital Input faulty	
E025	Internal error 2: software error	
E027	Internal error 3: software error	
E028	Internal error 4: error detecting the open/ closed status	
E029	Internal error 5: ENCT sensor error	
E035	Internal error 7: circuit breaker configuration error	
E040	Zone Selectivity Input (ZSI) activated	Appears when the trip unit receives the ZSI signal from the downstream circuit breaker.
E042	Internal error 9: incompatibility between the trip unit and circuit breaker	For more information, see the maintenance guide.
E043	Short Time Delay and Instantaneous Protections deactivated	The Short time delay and Instantaneous protections cannot be deactivated simultaneously. Reactivate one of them.
E100 to E200	Manufacturing fault	Contact your Hager representative or local Hager technical support (contact details on the Hager website for your country).

The critical system alarms can be configured to provoke the tripping of the circuit breaker or only to signal the error code.

In the factory default settings, the critical system alarms with codes E001 to E012 are configured for tripping and are signalled by a flashing screen of this type:



① Trip indicator

② Error code

For the meanings of the different critical system alarms, refer to the table below:

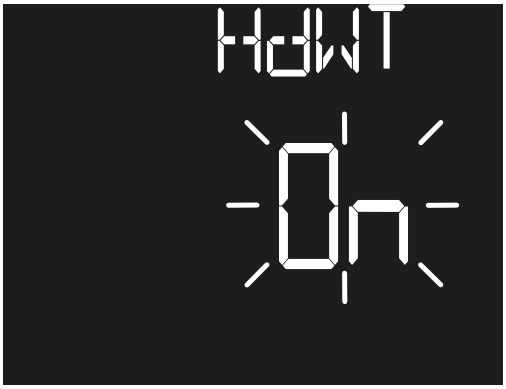
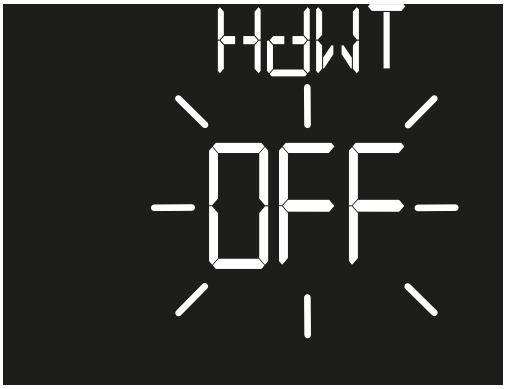
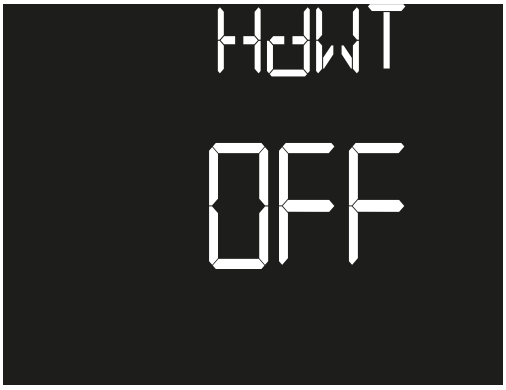
Error code	Meaning	Recommended action
E001	L1 current sensor out of service	Contact your Hager representative or local Hager technical support (contact details on the Hager website for your country).
E002	L2 current sensor out of service	
E003	L3 current sensor out of service	
E004	N current sensor out of service	
E005	MHT actuator out of service	
E006	Critical Error 4: faulty circuit board	
E007	Critical Error 3: faulty circuit board	
E008	Critical error 2: corrupted memory	
E009	Rating plug damaged	Replace the rating plug.
E010	Critical Error 5: software error	Contact your Hager representative or local Hager technical support (contact details on the Hager website for your country).
E011	Critical Error 1: faulty circuit board	
E012	Trip unit overheating	Check that the temperature inside the distribution board is not too high.

Note: the sentinel trip units have a temperature sensor that can protect them from malfunction following overheating of the sensitive internal components. The E021 non-critical system alarm issues an initial alert level when the internal temperature reaches 75°C. Reaching a temperature of 85°C will cause the display to switch off but the trip unit will remain operational until the temperature reaches 90°C which will activate the E012 critical system alarm and will cause the circuit breaker to trip.

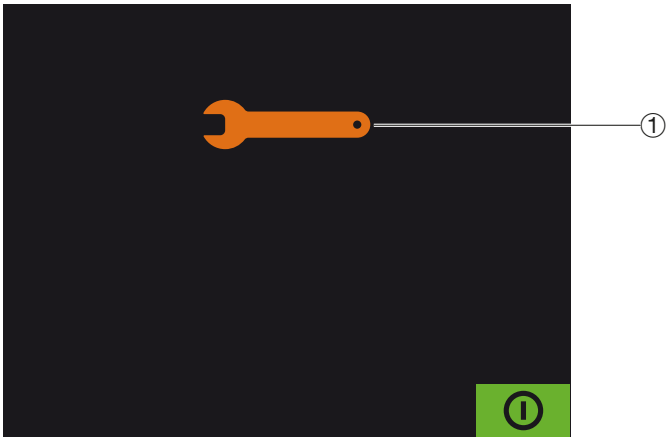
ATTENTION
For more information on the meaning of the system alarms, refer to the HW1 6LE007897A maintenance user manual or the HW2 / HW4 6LE009217A maintenance user manual.

The critical system alarms configures for a tripping operation can also be signalled on the HWF output contact of the OAC optional alarm output contacts module.

The critical system alarms are configurable via the unique HdWT parameter.
To change this parameter:

	Action	Illustration
1	Press the →OK key for longer than 10 s until this screen appears with an “ON” flashing (if the current setting is at "ON").	
2	Briefly press the →OK key to switch the display to “ON” or “OFF” according to the setting desired.	 "On" display: the critical system alarms cause the circuit breaker to trip. “OFF” display: the critical system alarms do not cause the circuit breaker to trip and are only signalled by their error code.
3	To confirm your choice, press the →OK button for longer than 3 s. The "On" or "Off" display becomes steady.	
4	Check that after 3 s without pressing the →OK button, the display reverts to its standby screen.	

When the maintenance indicator is displayed, maintenance operations are required on the circuit breaker.

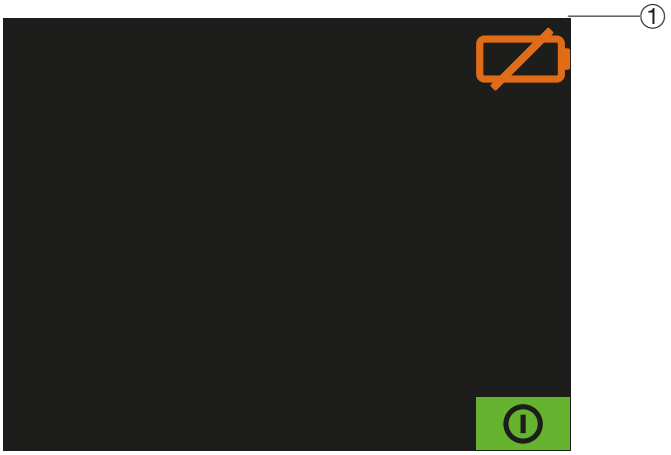


① Maintenance indicator

ATTENTION
If the maintenance indicator appears, contact your maintenance manager, Hager Technical Support or refer to the HW1 6LE007897A user maintenance guide or the HW2 / HW4 6LE009217A user maintenance guide.

When the low or missing battery indicator appears, the trip unit backup battery must be replaced.

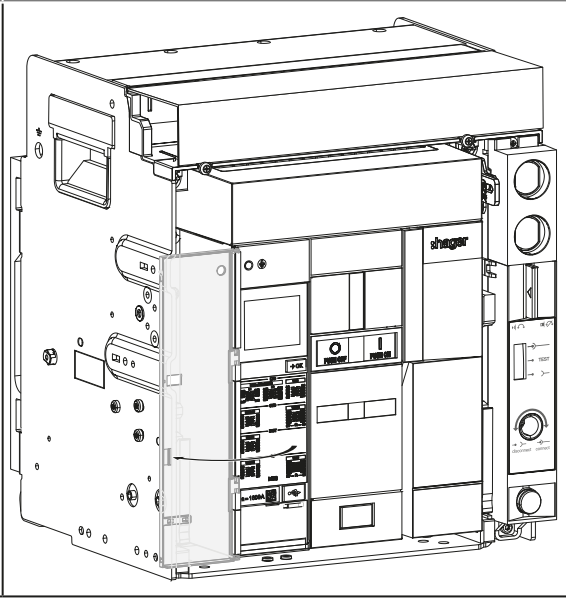
The backup battery can be replaced with the circuit breaker open or closed.

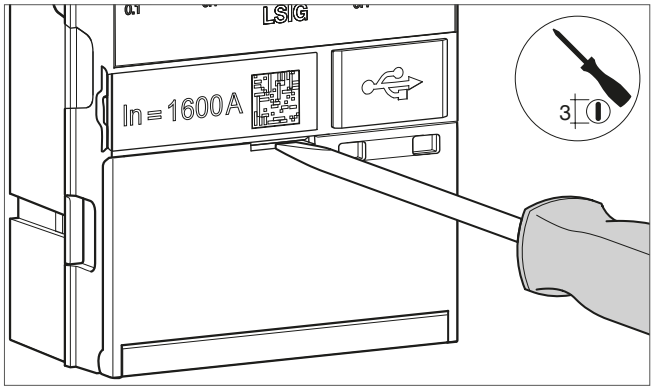
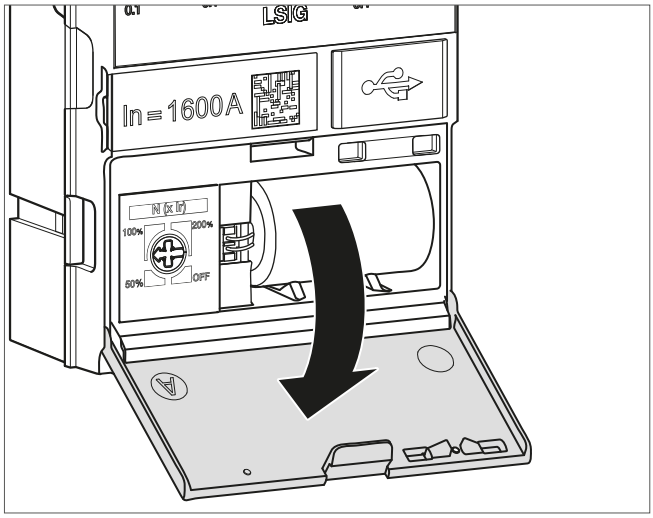
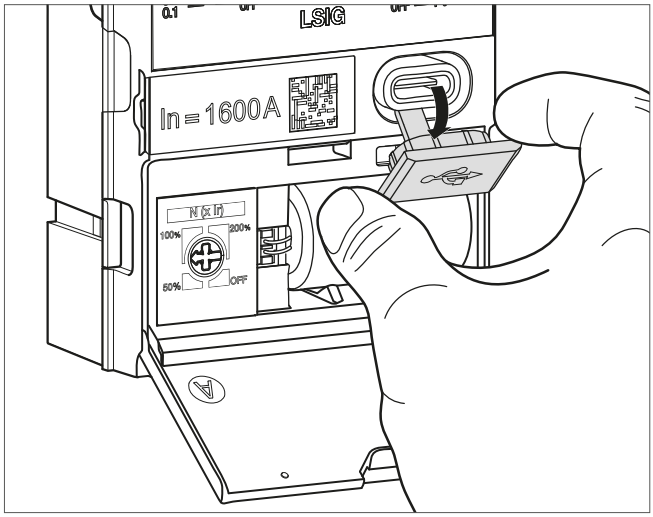


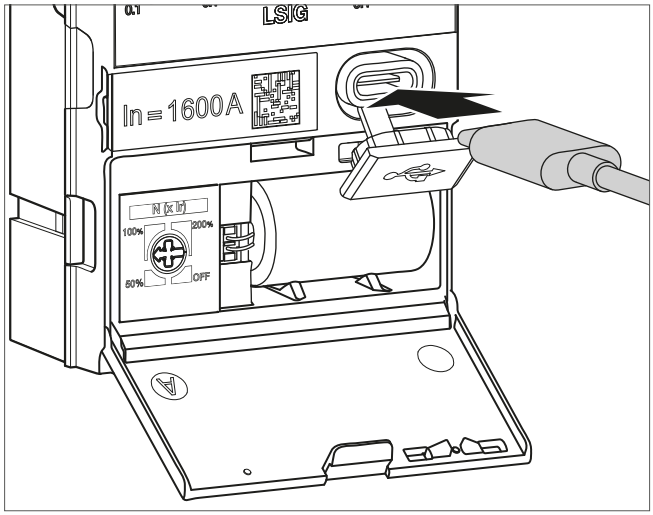
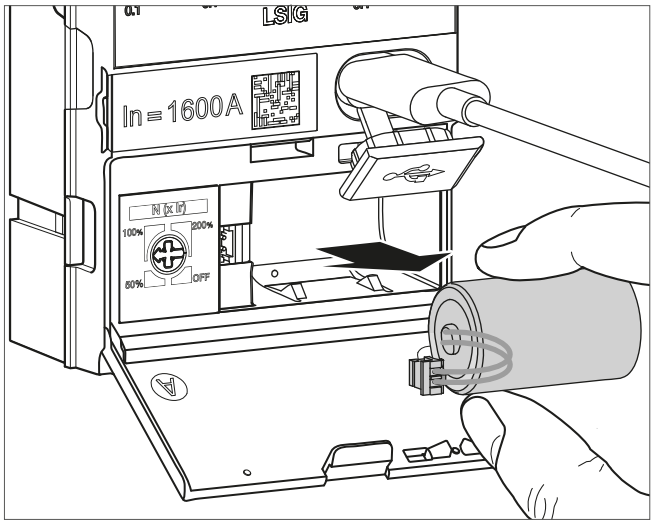
① Low or missing battery indicator

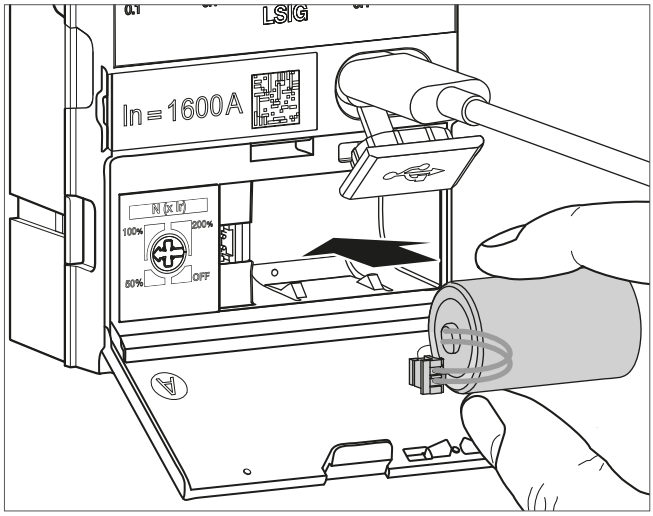
ATTENTION
If the backup battery is discharged, the trip unit will be unable to display the cause of any tripping unless an external 24V DC SELV power supply is connected or an external battery is connected on the USB-C port of the trip unit.

To do so:

	Action	Illustration
1	If required, remove the seal to open the trip unit transparent cover.	

	Action	Illustration
2	Insert a screwdriver into the notch.	
3	Then open the cover.	
4	Remove the USB-C port cover.	

	Action	Illustration
5	Then connect an external battery to the USB-C port to continue powering the trip unit's internal clock.	
6	Remove the old battery.	

	Action	Illustration
7	Replace it with a new battery.	

CAUTION

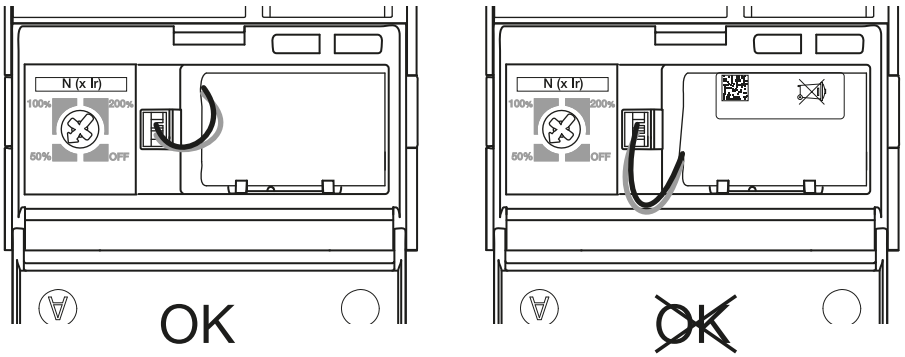
Improper handling may result in a fire or chemical reaction.

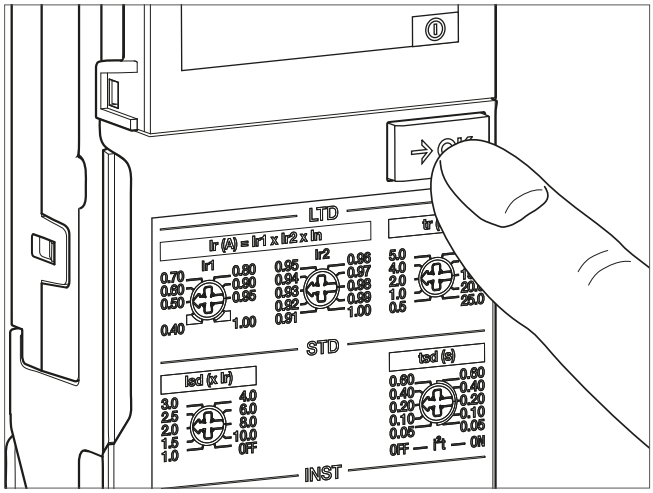
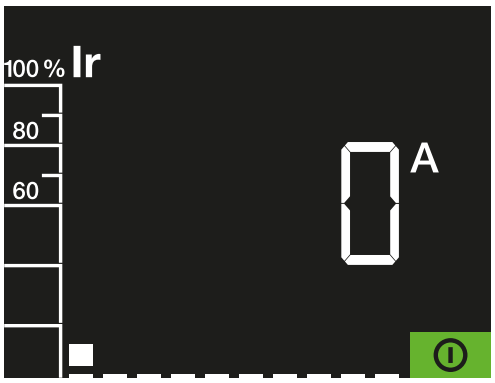
- Do not handle the battery without protection if you detect leaking electrolyte or if heat is given off.
- Place the old battery only in a place intended for recycling.
- To guarantee reliability, personal safety and material security, use only the Hager battery HWW463H, which is available as an accessory.

ATTENTION

Risk of property damage

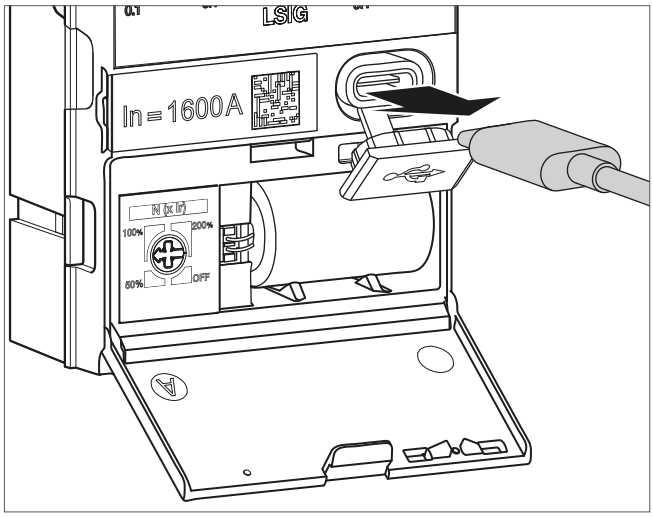
Position the back-up battery and its wiring correctly inside the housing, then close the hatch.

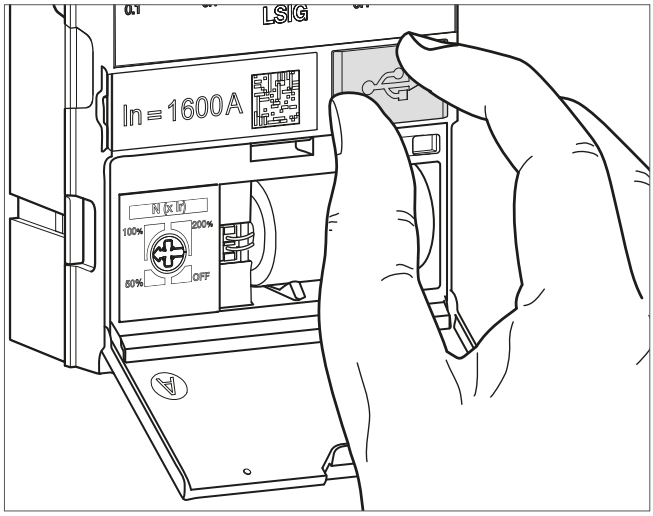
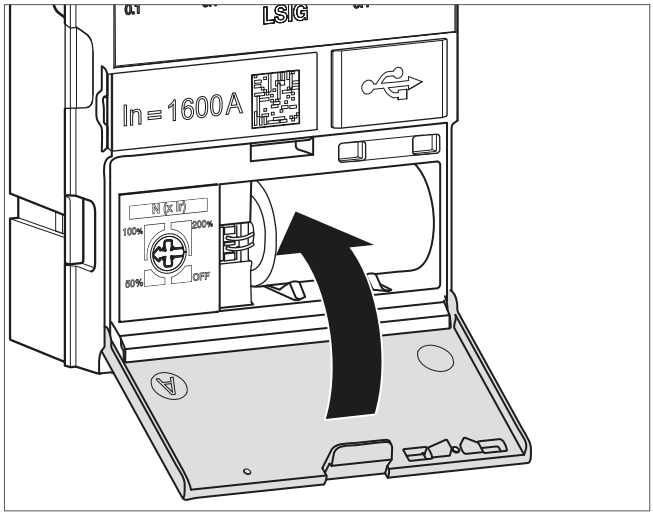
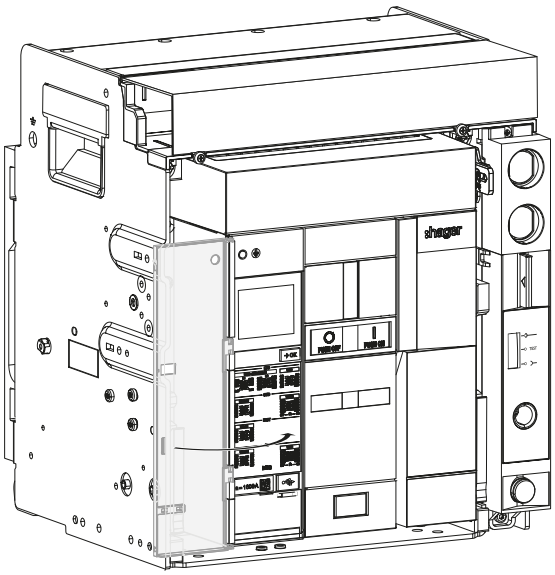


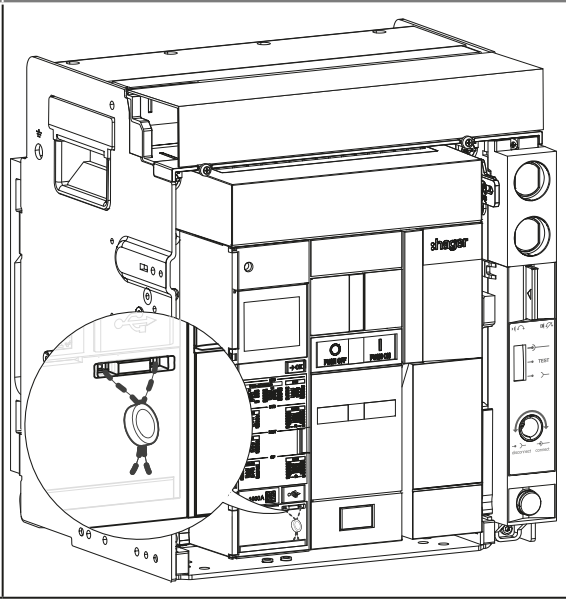
	Action	Illustration
8	Wait for the standby screen and the low or missing battery indicator to appear. Briefly press the →OK button to acknowledge the low or missing battery indicator.	
9	Check that the battery low or absent indicator disappears after 5 seconds.	

ATTENTION

- **If the battery low or missing indicator does not disappear,** resume the procedure from instruction No. 8. If the problem persists, begin the procedure again with a new battery.
- **If an error or alarm indicator appears,** refer to the Troubleshooting chapter in the HW1 6LE007897A Maintenance user guide or the HW2 / HW4 6LE009217A Maintenance user guide.

10	Remove the external battery.	

	Action	Illustration
11	Close the USB-C port cover.	
12	Close the cover.	
13	Close the transparent cover.	

	Action	Illustration
14	Apply a seal to the cover if necessary.	

The rated current value In can be modified by changing the rating plug located on the front of the trip unit.

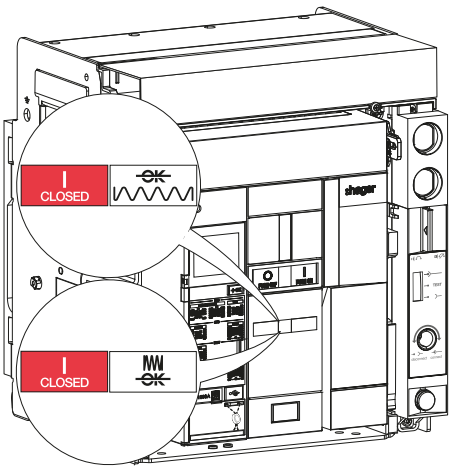
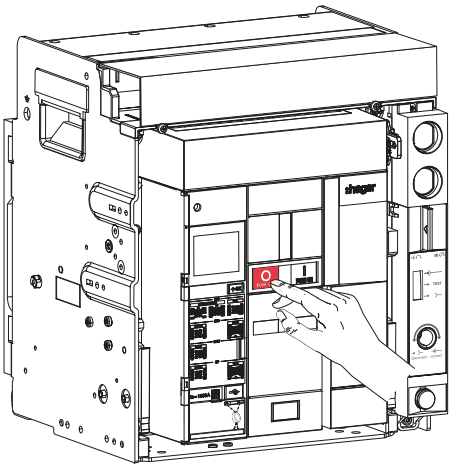
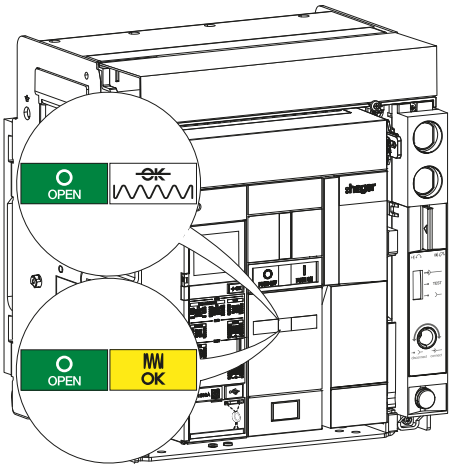
Circuit breaker reference	Maximum rated current	Possible values	Reference of rating plug
HW1	400 A	400A	HWW464HSA
	630 A	400A	HWW464HSA
		630 A	HWW465HSA
	800 A	400A	HWW464HSA
		630 A	HWW465HSA
		800 A	HWW466HSA
	1000 A	400A	HWW464HSA
		630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
	1250 A	400A	HWW464HSA
		630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
	1600 A	400A	HWW464HSA
		630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
HW2	630 A	630 A	HWW465HSA
	800 A	630 A	HWW465HSA
		800 A	HWW466HSA
	1000 A	630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
	1250 A	630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
	1600 A	630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
	2000 A	630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
		2000 A	HWW470HSA
	2500 A	630 A	HWW465HSA
		800 A	HWW466HSA
		1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
		2000 A	HWW470HSA
		2500 A	HWW471HSA

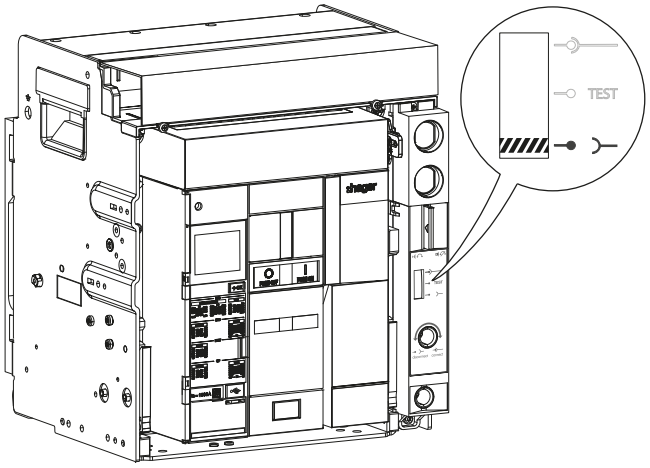
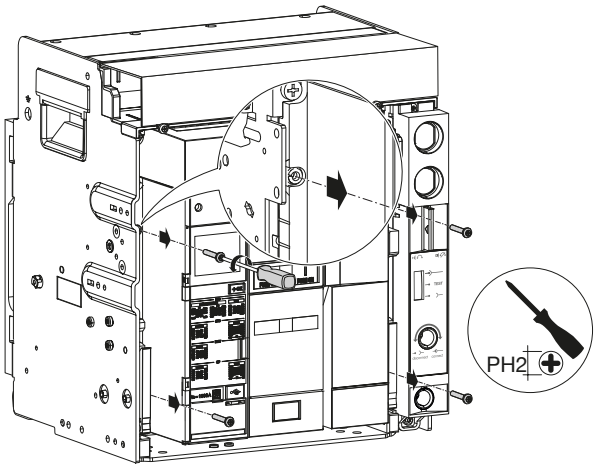
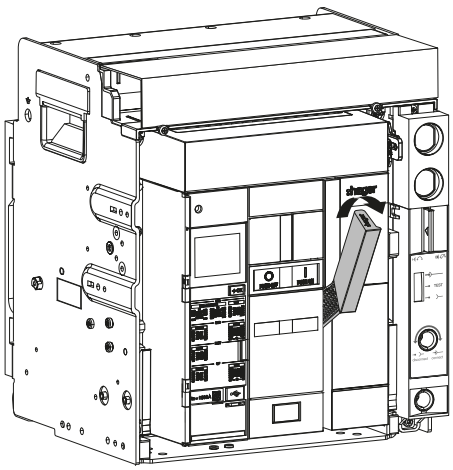
Circuit breaker reference	Maximum rated current	Possible values	Reference of rating plug
HW4	1000 A	1000 A	HWW467HSA
	1250 A	1000 A	HWW467HSA
		1250 A	HWW468HSA
	1600 A	1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
	2000 A	1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
		2000 A	HWW470HSA
	2500 A	1000 A	HWW467HSA
		1250 A	HWW468HSA
		1600 A	HWW469HSA
		2000 A	HWW470HSA
		2500 A	HWW471HSA
	3200 A	2500 A	HWW471HSA
		3200 A	HWW472HSA
	4000 A	2500 A	HWW471HSA
		3200 A	HWW472HSA
		4000 A	HWW473HSA
HW6	3200 A	3200 A	HWW472HSA
	4000 A	3200 A	HWW472HSA
		4000 A	HWW473HSA
	5000 A	3200 A	HWW472HSA
		4000 A	HWW473HSA
		5000 A	HWW474HSA
	6300 A	3200 A	HWW472HSA
		4000 A	HWW473HSA
		5000 A	HWW474HSA
		6300 A	HWW475HSA

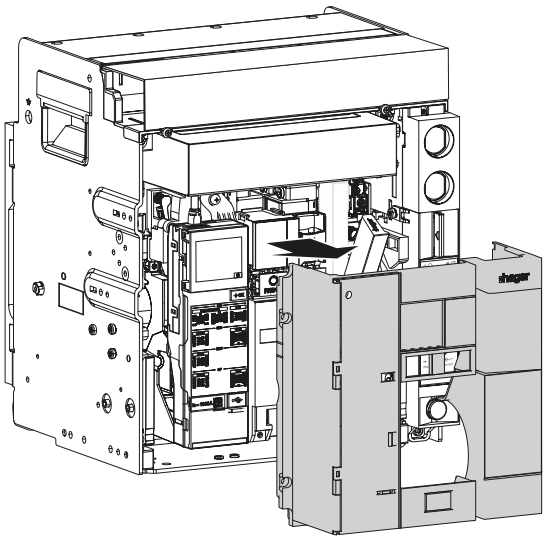
DANGER

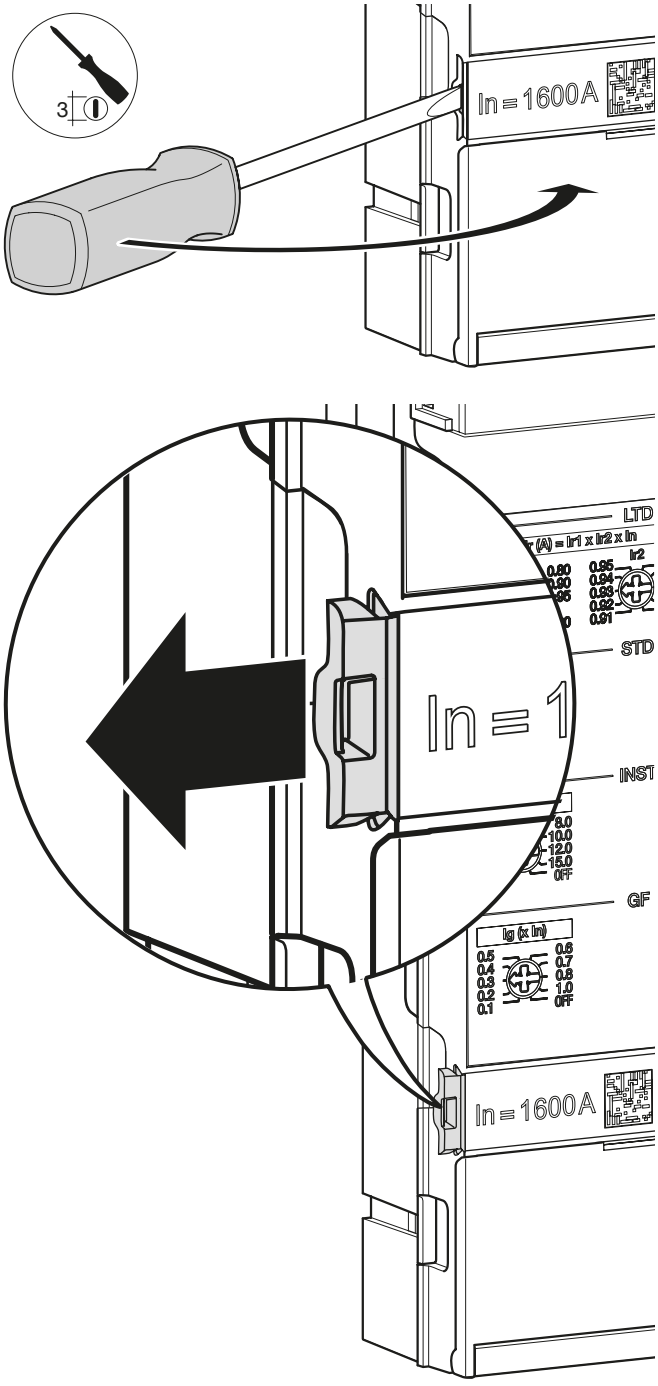
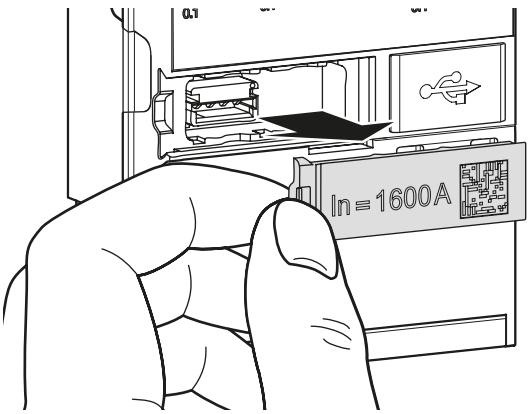
Danger to life, risk of injury due to electric shock, or risk of serious injury.
Before any intervention, ensure that the circuit breaker has been isolated from upstream and downstream power and control sources.

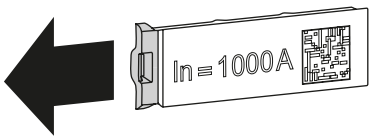
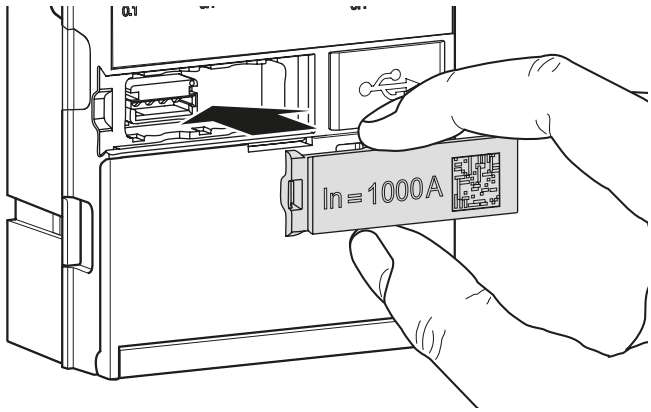
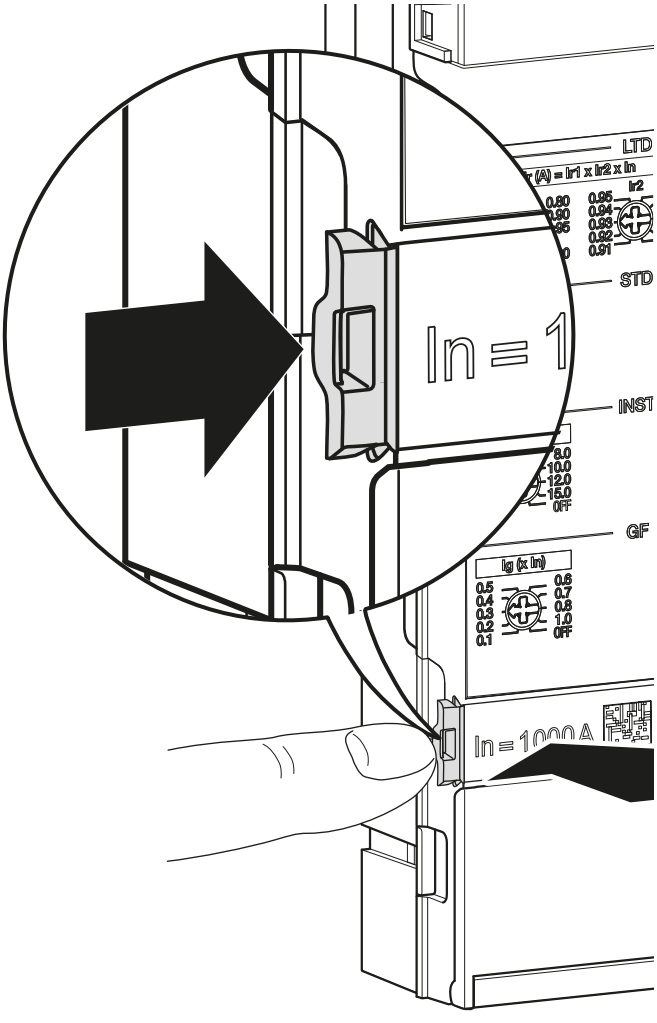
To do so:

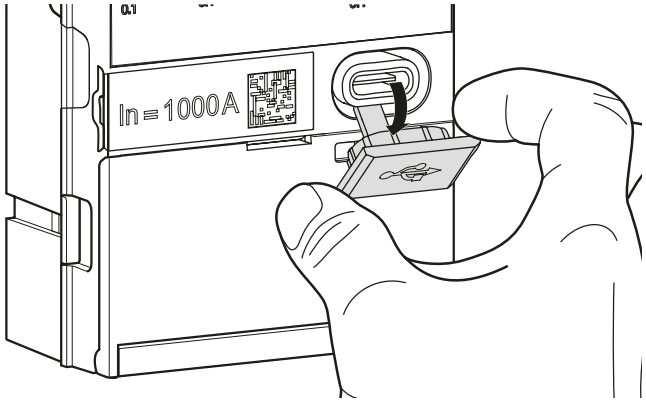
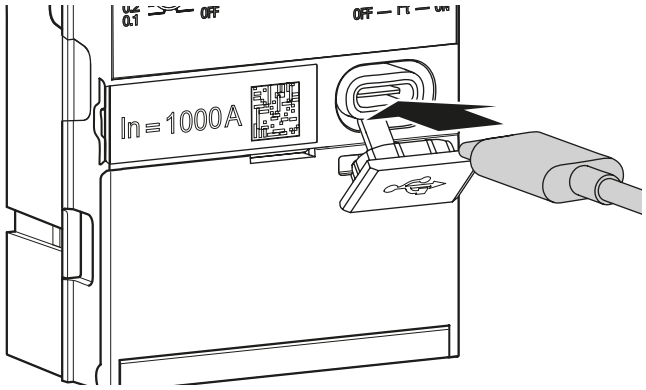
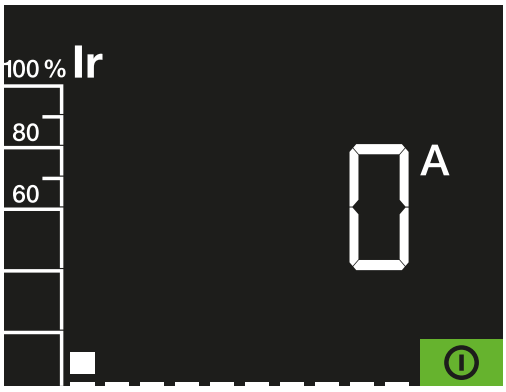
	Action	Illustration
1	The circuit breaker is closed, and the spring is discharged or charged.	
	Open the circuit breaker by pressing the opening  .	
2	check that the indicators change status.	

	Action	Illustration
3	For the withdrawable circuit breaker, place the circuit breaker in the disconnected position (see Installation Manual 6LE007893A).	
4	If necessary, remove the seal from the transparent cover, which protects access to the trip unit, then unscrew the 4 screws.	
5	Lower the charging handle.	

	Action	Illustration
6	Remove the front cover in order to access the trip unit.	

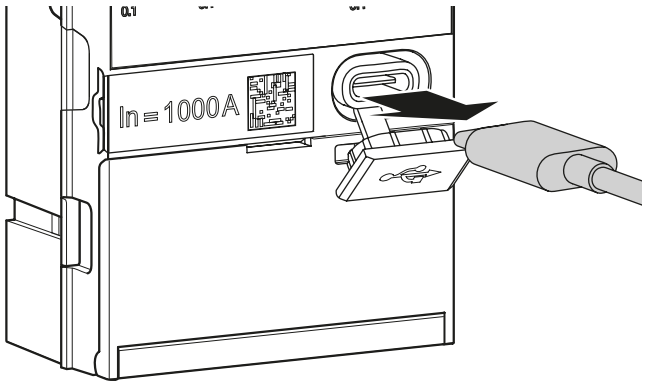
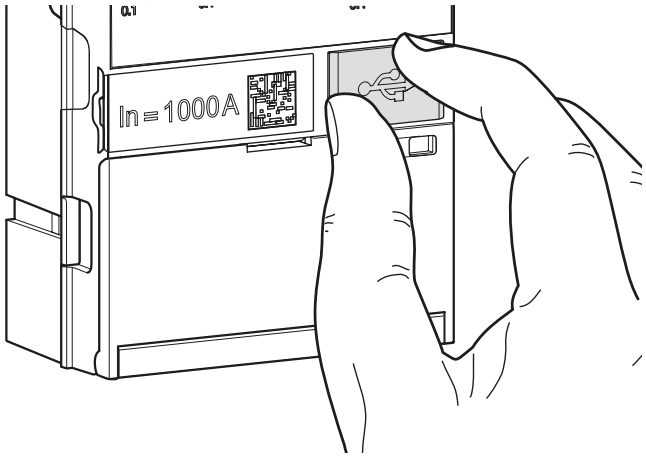
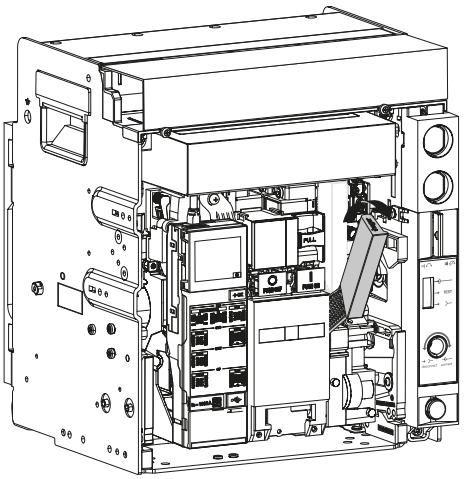
	Action	Illustration
7	Insert a flat screwdriver into the tab then apply leverage to unlock it.	
8	Remove the rating plug.	

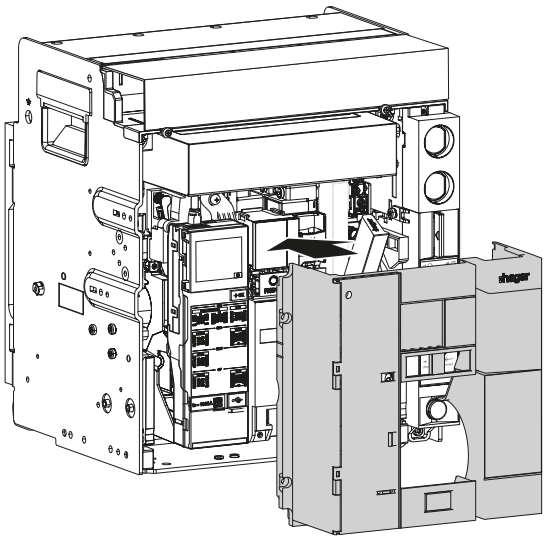
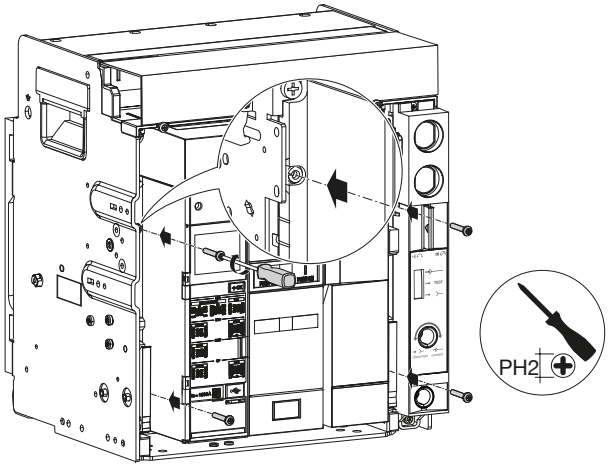
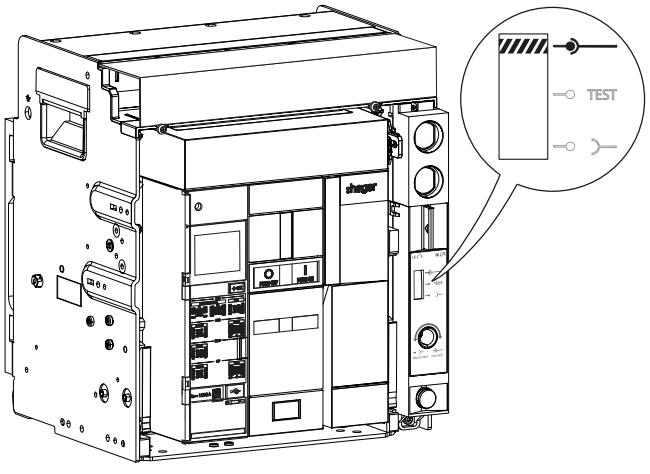
	Action	Illustration
9	Pull the tab of the new rating plug to the left.	
10	Insert the rating plug into its housing.	
11	Push the lever to the right to lock the rating plug.	

	Action	Illustration
12	Remove the USB-C port cover.	
13	Connect the external battery to the USB-C port.	
14	Check that there is no error and that the ReadyToProtect indicator appears on the trip unit screen.	

ATTENTION

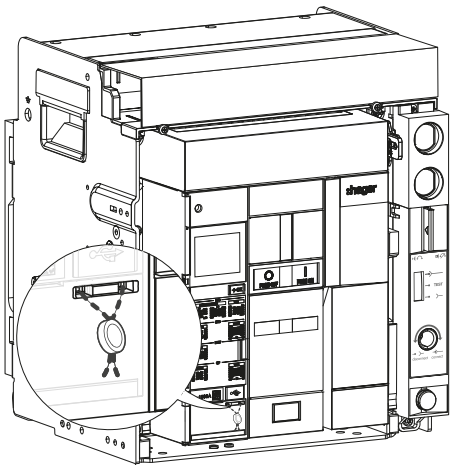
If the E009 error code is displayed, the rating plug is faulty.
Remove the external battery and replace the original rating plug or a new rating plug as described above.
If the problem persists, contact your Hager representative or local Hager technical support (contact details for your country can be found on the Hager website).

	Action	Illustration
15	Remove the external battery.	
16	Close the USB-C port cover.	
17	Lower the charging handle.	

	Action	Illustration
18	Put the front cover back on.	
19	Retighten the 4 screws.	
20	For the withdrawable circuit breaker, place it in the connected position.	

WARNING

Risk of unexpected operation.
Before closing the transparent door, check the settings.

	Action	Illustration
21	If necessary, fix a seal on the transparent cover protecting access to the trip unit.	

ANSI
American National Standards Institute. Each electrical protection corresponds to an ANSI code.

ENCT
External neutral current sensor.

GF
Earth fault protection.

HWF
Internal protection against electronic failures in the trip unit (hardware failure).

INST
Instantaneous Protection.

LTD
Long Time Delay Protection.

MCR
Making Current Release. Automatic instantaneous protection upon closure of the power contacts for short-circuit fault.

MHT
Magnetic Hold trigger. Coil connected directly to the trip unit, which activates the mechanical opening lock of the circuit breaker in case of electrical fault or action by an SH shunt trip coil or UV undervoltage release coil.

OAC
Output alarm contact.

Breaking capacity
The value of the prospective current that a switching device is capable of breaking at a stated voltage under prescribed conditions of use and behaviour.
Reference is generally made to the rated ultimate short-circuit (Icu) breaking capacity and to the service short-circuit breaking capacity (Ics).

Rated ultimate short-circuit breaking capacity (Icu)
Expressed in kA, it indicates the maximum breaking capacity of the circuit breaker. It is confirmed by a test sequence O - t - CO (according to IEC 60947-2) at Icu, followed by a test to prove that the circuit is correctly isolated. This test ensures safety for the user.

PTA
Overload pre-alarm.

STD
Short Time Delay Protection.

ZSI
Zone selectivity.

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132 Boulevard de l’Europe

67215 **Obernai - France**

Or, you may send an email to Hager Group using the following email address: sourcecoderequest.grouplevel@hagergroup.com.

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- The reference and version number of the Hager product containing the binary
- The date you received the Hager product
- Your name
- Your company name (if applicable)
- Your return mailing address and email and
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