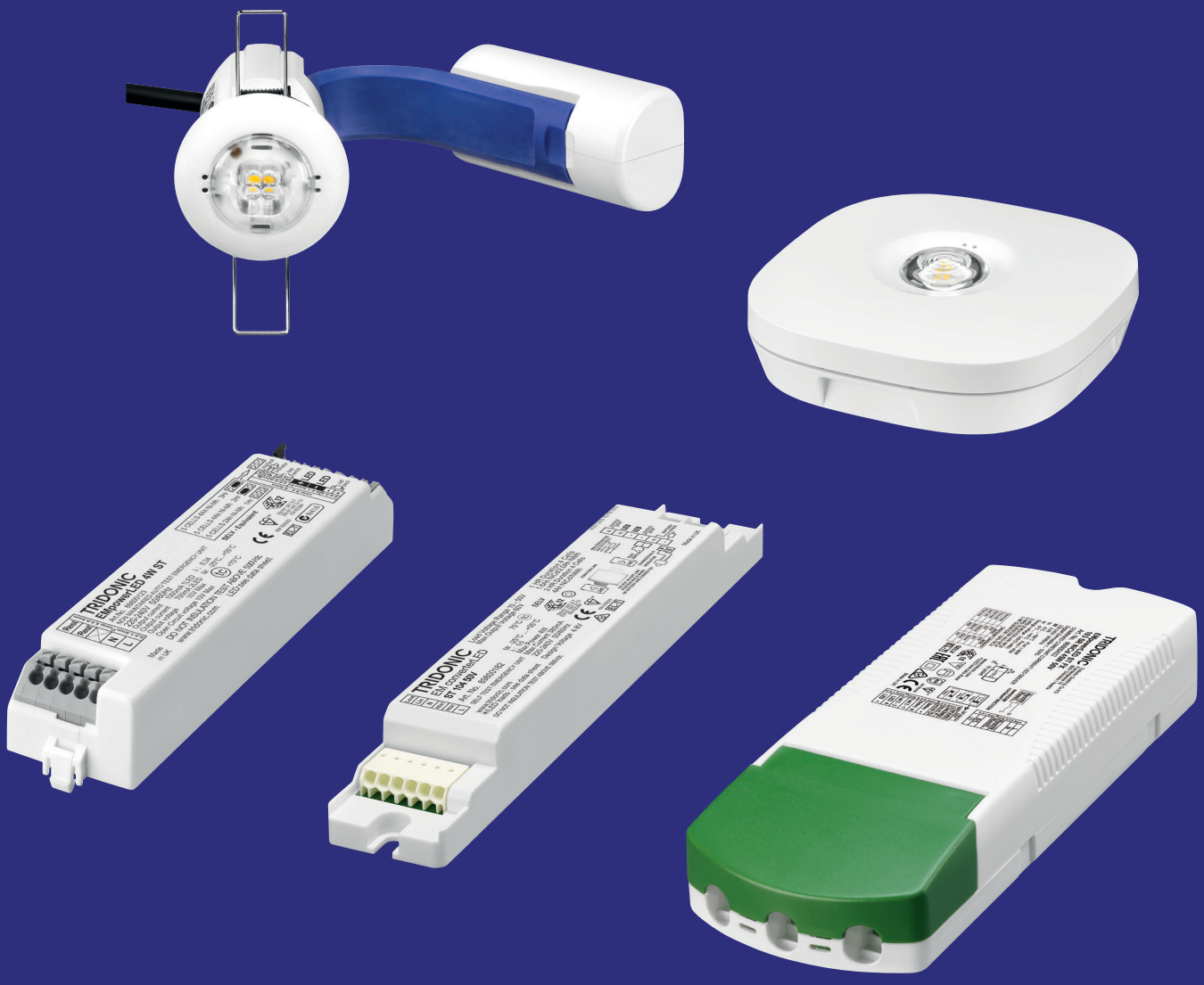
LED Solutions for Emergency Lighting

Functional Description SELFTEST Emergency Devices

Manual



TRIDONIC

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Functions in emergency operation

Overview of the main functions in emergency operation:

Area	Function	
Test function, p. 10	Automatic function and duration test	Test activation via selftest
	Function test (interval)	weekly
	Duration test (interval)	annual
Rated duration	Adjustable to 1, 2 or 3 hours [1]	✅
	Adjustable on the device via DIP switch	✅
Status display	Via two-colour indicator LED, p. 8	✅
Battery charge system	Intelligent multilevel charging system, p. 4	✅
Adjustable output current in emergency operation	Automatic adjustment by device	✅
Commissioning	Automatic	✅
Rest mode, Inhibit mode and Relight command, p. 4	Activation	Activation via DC pulse

[1] Special case: 2-hours rated duration
The first duration test will take 120 minutes, following duration tests are rated with 90 minutes. If the battery is disconnected or replaced, the next duration test will again be rated with 120 minutes.

Intelligent multilevel charging system

1.1. Intelligent multilevel charging system

The multilevel charging system is used for minimising charging times while maximising battery life. During normal functional mains operation the module charges the batteries using a specially developed charging algorithm.

- Initial charge mode:
  20 hours of high charging current at the start to prepare the new battery cells and fully charge them.
- Trickle charge mode:
  Continuous low charge to maintain battery output and reduce battery temperature.
- Fast charge mode:
  Automatic adjustment of the charge time ensures minimal overcharging:
  - 10 or 15 hours of rapid charge after a full discharge.
  - Shorter charge time after only a partial discharge.

When the permanent power supply is switched on for the first time the EM powerLED ST FX starts to charge the batteries for 20 hours in fast charge mode. This 20-hour preparatory charge ensures that the new batteries are completely charged before being used. The 20-hour recharge is also used if a new battery is connected or if the device leaves the Rest mode (see Rest mode, Inhibit mode and Relight command, p. 4).

At the end of the 20-hour charge the module automatically switches to trickle charge mode. This ensures that the batteries remain at optimum charge levels and avoids any overheating due to overcharging.

- batteries are charged with a constant charging current in trickle charge mode

After a power outage and subsequent emergency mode the EM powerLED ST FX recharges the batteries in fast charge mode. However, the charge time is set so that only the power consumed during emergency mode is replaced. If emergency mode did not last as long as the prescribed operating time the charging time will be reduced. If emergency mode extended for the full operating time the charging time will be 10 hours for modules with an operating time of 1 hour, and 15 hours for modules with an operating time of 2 and 3 hours. Once the batteries are fully charged again the module automatically switches to trickle charge mode.

In trickle charge mode the battery status is continually monitored to ensure that the charging currents and battery voltages remain within the specified limits. If these limits are exceeded error status flags are set for monitoring with the aid of a suitable control system. The status LED also shows such faults locally.

If a duration test is required while the battery is not yet fully charged the test will be postponed until charging is complete. This prevents a duration test from being carried out with a battery that is not fully charged.

NOTICE

A partially charged battery is defined as one for which the charger is operating in fast charge mode.
A fully charged battery is defined as one for which the charger is operating in trickle charge mode.

If the power supply fails during rapid charging the module will power the lamp immediately in emergency mode for as long as the charge in the batteries will allow.

1.2. Rest mode, Inhibit mode and Relight command

Emergency operation is automatically started when the mains supply is switched off. If the Rest mode is activated, the discharging of the battery will be minimized by switching off the LED output.

Rest mode and Relight function

Rest mode can be used during short periods of time when a building is completely unoccupied and the mains supply is to be switched off intentionally, for example during a holiday period. Using Rest mode prevents a full discharge and possible damages to the batteries during these times.

Rest mode has to be activated by a competent person. Activation is only possible after the mains supply has been switched off. Contrary to this, if the Inhibit mode has been activated in advance, Rest mode will be automatically switched on if the mains supply is switched off.

By sending the Relight command both modes, Rest mode and Inhibit mode, will be deactivated. The emergency unit will switch back to the previous operating mode. If it has been in Rest mode, it will switch back to emergency mode, if it has been in Inhibit mode, it will switch back to charging mode

For all the different changes, activating Rest mode and Inhibit mode and sending the Relight command, DC voltage pulses of different lengths are used. The table at Switching between operating modes, p. 7 gives an overview of all the operating modes.

CAUTION!

Even in Rest mode there is self discharge current and an extremely small level of discharge current flowing from the batteries. If the batteries remain in Rest mode for prolonged periods of time this can lead to deep discharge and potential damage.

1.2.1. Activate Rest mode

Rest mode is activated as follows:

- Disconnect power supply
- Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"
  - The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 150 - 1,000 ms
  - The polarity of the voltage pulse does not matter

NOTICE

Rest mode cannot be activated as long as the power supply hasn't been disconnected.
The maximum number of emergency units on one bus is 100 pieces with a maximum recommended cable length of 1,000 metres.
Rest mode voltage can be applied across all emergency modules (parallel connection).

1.2.2. Deactivate Rest mode via Relight command

By sending the Relight command the Rest mode is deactivated. The emergency unit will switch back to emergency mode.
To deactivate Rest mode via Relight command, proceed as follows:

- Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"
  - The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 1,001 - 2,000 ms
  - The polarity of the voltage pulse does not matter

Rest mode and Relight function

NOTICE

Reapply the power supply does also deactivate Rest mode. In this case, the device switches from Rest mode to charge mode.

1.2.3. Activate Inhibit mode

Inhibit mode is activated as follows:

- Make sure that the mains supply is switched on
- Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"
  - The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 150 - 1,000 ms
  - The polarity of the voltage pulse does not matter

-> Emergency unit switches to Inhibit mode
-> Inhibit mode is active for a duration of 15 minutes
-> Inhibit mode is indicated by indicator LED (double pulsing GREEN)

For further information see Indicator LED, p. 8.

NOTICE

The inhibit mode must be activated before the mains supply is switched off.

1.2.4. Automatically switch from Inhibit mode to Rest mode

The emergency unit automatically switches from Inhibit mode to Rest mode if the following conditions are met:

- Inhibit mode has been activated -and-
- Within 15 minutes after activation, the mains supply is switched off

1.2.5. Automatically deactivate Inhibit mode

Inhibit mode is automatically deactivated and the emergency unit switches back to charging mode if the following conditions are met:

- Within 15 minutes after activation, the mains supply is **not** switched off

1.2.6. Deactivate Inhibit mode via Relight command

By sending the Relight command the Inhibit mode is deactivated. The emergency unit will switch back to charging mode.
To deactivate Inhibit mode via Relight command, proceed as follows:

- Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"
  - The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 1,001 - 2,000 ms
  - The polarity of the voltage pulse does not matter

Rest mode and Relight function

1.2.7. Switching between operating modes

The device has four different operating modes (Standby/Charge mode, Emergency mode, Rest mode and Inhibit mode). Depending on the initial mode and the length of the applied DC voltage pulse the device switches between these operating modes. The following table gives an overview:

Applied pulse length	Charging mode	Emergency mode	Rest mode	Inhibit mode
150 - 1,000 ms	Switches to Inhibit mode	Switches to Rest mode	-	-
1,001 - 2,000 ms (Relight command)	-	-	Switches to Emergency mode	Switches to charging mode

Indicator LED

1.3. Indicator LED

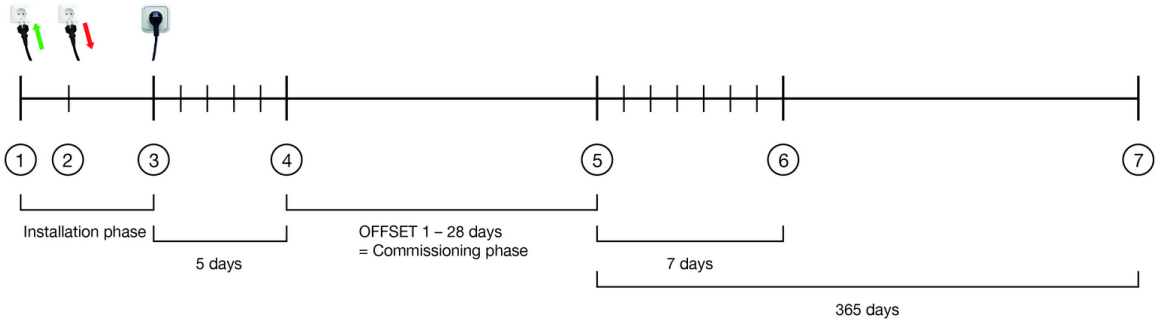
System status is locally indicated by a bi-colour indicator LED.

LED indication	Status	Description
Permanent GREEN	Standby, System OK	Mains operation, battery is charged
Fast flashing GREEN (0,1 s on - 0,1 s off)	Function test underway	
Slow flashing GREEN (1 s on - 1 s off)	Duration test underway	
Double pulsing GREEN	Inhibit mode is activated	The Inhibit mode makes it possible to set the emergency mode to "inhibited"; in this mode, the power can be turned off without switching to emergency mode. The Inhibit mode is activated by sending the inhibit signal, while the modules are still connected to mains. Just as in Rest mode, the device supports the Relight functions. After a break of 15 minutes, the inhibit mode is automatically reset.
Permanent RED	Lamp failure	Open circuit -or- Short circuit -or- LED failure NOTICE After an exchange of the LED module, the indicator LED remains permanent RED. The lamp failure indication remains set until a function test has been successfully completed (automatically with the weekly function test or immediately by briefly interrupting the power supply or by manually starting the function test with a test switch (see Starting the function test, p. 14)). The LED module's mains operation does not reset the lamp failure indication.
Fast flashing RED (0,1 s on - 0,1 s off)	Charging failure -or- device failure	Incorrect charging current NOTICE While the battery is in trickle charge mode and the mains supply is connected, the micro controller in the emergency unit monitors the charging parameters. If an error is detected or a parameter is out of tolerance, the indicator LED switches to fast flashing RED. If the error has been corrected, the indicator LED immediately switches back to GREEN and continues the charging operation of the battery.

Indicator LED

Slow flashing RED (1 s on - 1 s off)	Battery failure	Battery failed duration test or function test -or- Battery is defect -or- Incorrect battery voltage **NOTICE** Battery failed duration test or function test: If the battery does not reach full operating time, the indicator LED is slow flashing RED. After an exchange of the battery the indicator LED switches to GREEN. To guarantee a satisfactory operating time, the battery is then charged for 20 hours and a second duration test is carried out. **NOTICE** Battery is defect or incorrect battery voltage: While the battery is in trickle charge mode and the mains supply is connected, the micro controller in the emergency unit monitors the condition of the battery. If an error is detected , the indicator LED switches to RED. If the error has been corrected, the indicator LED immediately switches back to GREEN and continues the charging operation of the battery.
GREEN and RED off	Battery operation	Emergency mode: Mains disconnected -or- mains failure

Settings for emergency tests



Annotation:

(1) First connection to the power supply
(2) Phase, in which the power supply is switched on and off (possibly numerous times)
(3) Phase, in which the power supply is "permanently" connected (no interruption for at least 5 days)
(4) Delaying the commissioning test for 1-28 day
(5) Commissioning test begins
(6) First function test
(7) First duration test

Settings for emergency tests

2.1. Test times and test intervals

Devices of the EM powerLED ST FX series are tested via selftest function. The following table gives an overview of the parameters:

Test trigger	Test times	Test intervals
Test triggered by emergency lighting unit	There are two variants for setting the test time. In some cases different rules apply for the setting of the day and the time: _ Automatic setting of the function test: The time of the function test is the same as the time when the device was first connected to the power supply (see (1) in above diagram), the day of the function test is the same as the day when the commissioning test was carried out (see (5) in above diagram and Commissioning test, p. 11). _ Automatic setting of the duration test: The time of the duration test is set by the Adaptive test mode, p. 13, the day of the duration test is the same as the day when the commissioning test was carried out (see (5) in above diagram and Commissioning test, p. 11). _ Manual setting of the test time and the test day for a single luminaire via test switch (see Setting the test time for one luminaire, p. 14). _ Manual setting of the test time and the test day for all the luminaires in an emergency lighting circuit by switching the power supply on and off (see Setting the test time for all the luminaires in an emergency lighting circuit, p. 14). To prevent that the emergency lighting tests of all luminaires are carried out at the same time, each luminaire has a pre-programmed code which delays the test time for a specified time (see Commissioning test, p. 11).	Test time intervals between the tests are fixed: _ Function test: weekly _ Duration test: annual

2.2. Commissioning test

The commissioning test is a first duration test. The relevant standard (IEC 62034: Automatic test systems for battery powered emergency escape lighting) requires that such a test is carried out after the installation.

The commissioning test is often made more difficult because the power supply is switched on and off during the installation phase. This is the case, for example, if the site is powered off at night for security reasons. To address this problem, the EM powerLED ST FX monitors the power supply and will only start with the commissioning test if the power supply hasn't been interrupted for 5 days.

To prevent that all the luminaires perform the emergency test at the same time, each luminaire has a pre-programmed code with a value of 1-28, which delays the test time of that luminaire for a specified time.

- Devices with code 1 will be tested one day after the completion of the 5 day long monitoring of the power supply (that is 6 days after the uninterrupted connection to the supply).
- Devices with code 2 will be tested two days after the completion of the 5 day long monitoring of the power supply (that is 7 days after the uninterrupted connection to the supply).
- Devices with higher code numbers will be tested with a delay that corresponds to that code number.

28 days after the start of the commissioning all devices will have completed the required commissioning test.

The day of the commissioning test serves as a reference point for all further function and duration tests (see Test times and test

Settings for emergency tests

intervals, p. 11).
Function tests will be performed on the same day in a weekly interval, duration tests will be performed on the same day in an annual interval.

2.3. Weekly function test

The 5 second long, weekly function test serves to check the functionality of the emergency unit, the batteries and the LED module.

The first function test after the commissioning test would normally take place one week after the start of the commissioning test.
In the actual implementation of this and all further functional tests two aspects must be considered, however:

- To prevent that people are on the site and are disturbed by the test, the start of the function test is delayed until the switched phase is switched off.
  - If this is the case, the function test will be carried out 10 seconds later.
  - If this is not the case, because the switched phase remains permanently switched on, the function test will be carried out exactly 24 hours later, regardless of whether the switched phase is then turned off or not.

NOTICE

While waiting for the switched phase to be switched off (which can take up to 24 hours), the indicator LED shows that the test has not been carried out satisfactorily (fast blinking GREEN).

- If the function test detects a battery failure and the battery was not fully charged at the test time, the device returns to charging mode and starts the function test a second time once the battery is fully charged.

NOTICE

In this case (battery failure and battery not fully charged), the indicator LED does not show an error.
During the charging of the battery, the indicator LED shows that the function test is continuing in the background (fast flashing GREEN).
If the charging of the battery is completed and a function test has been carried out but the status still doesn't change, the indicator LED shows a battery failure (slow flashing RED).

NOTICE

If the power supply is interrupted, the information in the EM powerLED ST FX is stored for at least one week. If the power supply is interrupted for more than one week, the EM powerLED ST FX will perform another commissioning test when the power supply returns (after 20 hours initial charge mode).

NOTICE

If the power supply is interrupted during battery replacement, the EM powerLED ST FX loses its memory contents. When the power supply returns, the EM powerLED ST FX will charge the battery for 20 hours and then perform a commissioning test.

Settings for emergency tests

2.4. Annual duration test

The annual duration test checks whether the batteries are able to ensure the required operating time of 1, 2 or 3 hours.

The first duration test after the commissioning test would normally take place exactly one year after the start of the commissioning test.
In the actual implementation of this and all further duration tests two aspects must be considered, however:

- To prevent that the duration test is carried out at a time of maximum hazard or highest presence density, the device automatically uses the adaptive test mode, p. 13 to determine a suitable test time.
- Furthermore, the test time can be set manually (see Functionality of the test switch, p. 13).

NOTICE

If the power supply is interrupted during battery replacement, the EM powerLED ST FX loses its memory contents. When the power supply returns, the EM powerLED ST FX will perform another commissioning test (after 20 hours initial charge mode).

2.5. Adaptive test mode

Adaptive test mode sets the time for the duration test to a time of minimum risk and minimum presence.

This is achieved by monitoring the switched phase of the lighting. This tells the emergency lighting unit which times the lighting is switched off (i.e. no one is in the room) and the unit stores these times. If non-presence of more than five hours is detected the start time for the duration test is set to two hours after the start of the non-presence time.

Example:
A room is not used between 8 pm and 6 am. The lights are switched off. The duration test will therefore begin at 10 pm. This provides a certain buffer before the start and after the end of the duration test, and the batteries can be recharged after the duration test before the room is in use again.

Room usage is monitored on a monthly basis and the time for the duration test is constantly adjusted. This allows for seasonality in room usage to be taken into account.

If a suitable time cannot be found (perhaps because the room is in use round the clock) the duration test is performed at the time set during startup (this is the time when the emergency lighting unit was first connected to the power supply). If subsequently a suitable period is found the time for the duration life test will be suitably adapted.

If none of this is successful because the startup time is unsuitable and no other suitable period can be found, the time for the duration test can be set manually (see Setting the test time, p. 14).

2.6. Functionality of the test switch

The optional test switch enables you to make a series of settings manually.

Settings for emergency tests

NOTICE

The test switch can remain permanently connected and used as a startup tool.

2.6.1. Starting the function test

_ A short press on the button (0.15 - 1 s) starts a function test lasting 5 seconds.
-> The indicator LED flashes GREEN.
-> The result of the function test is displayed on the two-colour indicator LED.

2.6.2. Starting the test mode

_ A longer press on the button (1 - 10 s) switches the light source to emergency mode but does not perform a time controlled function test.
-> On release of the button the emergency units switch back to charge mode.
-> The indicator LED goes off for 1 second and then on for the rest of the time (maximum of 9 seconds).

2.6.3. Setting the test time

The time and day for the function and duration test is stored in the internal timer. To change the test time, the timer needs to be reset. The previously stored test time will be deleted and replaced by the time of resetting.

NOTICE

Resetting the timer deactivates the adaptive test mode, p. 13. Because of this, the test time is no longer adapted to the room usage of the building. The function test and duration test is always carried out at the newly set test time.

The timer can be reset for one luminaire or for multiple luminaires:

Setting the test time for one luminaire

_ Holding down the button (> 10 s) resets the timer.
-> The indicator LED goes off for 1 second and then shows GREEN and goes off again after 10 seconds.
-> By going off after 10 seconds the indicator LED confirms that the timer has been successfully reset (to the current time).

Setting the test time for all the luminaires in an emergency lighting circuit

_ If the unswitched power supply of an emergency lighting circuit is switched on and off 5 times within 60 seconds, the timers for all the emergency units in the emergency lighting circuit is reset (to the current time).