ELP DALI 2/SELF-TEST EMERGENCY LIGHTING CONTROL GEAR

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1 General Description

The ELP DALI (Digital Addressable Lighting Interface)/Self-test Emergency Lighting control gear are designed to be compatible with the DALI Standards IEC 62386-101[1], IEC 62386-102[2], IEC 62386-202[3], IEC 62386-250[4], IEC 62386-251[5], IEC 62386-252[6] and IEC 62386-253[7] as well as the Control Gear Standards IEC 61347-2-7[8], IEC 61347-2-13[9] and IEC 62384[10] and Automatic Test System Standard IEC 62034[11].

The control gear is DALI device type 1 and device type 49 as all options have an integrated bus power supply, see section 10. When the integrated bus power supply is not enabled the control gear is suitable for use on a dedicated DALI emergency lighting system or in conjunction with other DALI compatible devices as part of a DALI general lighting system. The control gear will adopt a self-test (automatic test) mode if it is not connected to a DALI bus, or the DALI communication is missing.

Some types of ELP DALI control gear are also DALI device types 50, 51 and 52 and are D4i compliant, which means when the integrated bus power supply is enabled they are designed to be used as an intra-luminaire DALI i.e. for use within stand-alone luminaires that do not have an external wired DALI connection.

NOTE All ELP DALI emergency control gear are non-dimmable i.e. no arc power commands are supported.

2 Installation and Commissioning

An automatic self-commissioning check will be done on start-up once a permanent mains supply and the battery have been connected to the. This will ensure that the system, the emergency lamp and battery are performing correctly. Whilst this check is in progress the local LED indicator will slowly flash green and it is still possible for the control gear to be put into a function test to check emergency operation, either by a DALI “Start function test” command or by interrupting the mains supply.

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[1] IEC 62386-101:2022 Digital addressable lighting interface – General requirements – System components

[2] IEC 62386-102:2022 Digital addressable lighting interface – General requirements – Control gear

[3] IEC 62386-202:2022 Digital addressable lighting interface – Particular requirements for control gear – Self-contained emergency lighting

[4] IEC 62386-250:2023 Digital addressable lighting interface – Particular requirements – Integrated power supply (device type 49)

[5] IEC 62386-251:2023 Digital addressable lighting interface – Particular requirements – Memory bank 1 extension (device type 50)

[6] IEC 62386-252:2023 Digital addressable lighting interface – Particular requirements – Energy reporting (device type 51)

[7] IEC 62386-253:2023 Digital addressable lighting interface – Particular requirements – Diagnostics and maintenance (device type 52)

[8] IEC 61347-2-7:2012+A1:2017+A2:2021 Particular requirements for electric source for safety sources (ESSS) supplied electronic control gear for emergency lighting (self-contained)

[9] IEC 61347-2-13:2024 Particular requirements - Electronic control gear for LED light sources

[10] IEC 62384:2020 DC or AC supplied electronic control gear for LED modules – performance requirements

[11] IEC 62034:2012 Automatic test systems for battery powered emergency escape lighting

As part of the self-commissioning check, a full duration test is performed once the battery has been charged. This will take place as soon as the Lithium Iron Phosphate ($LiFePO_4$) battery is fully charged which can be up to 24 hours. If this initial charge period is interrupted, the charging is continued until the battery is fully charged. During this initial charging period the state of charge of the battery is not reported. The self-commissioning check ends after the successful completion of the duration test. The local LED indicator then changes to a steady green once the check is complete.

NOTE If a self-commissioning check that is in progress is cancelled due to the control gear receiving a DALI 229 'STOP TEST' command. It is then the responsibility of the system commissioning engineer to ensure that the control gear's self-commissioning check is completed.

Automatic self-commissioning is repeated whenever all power is removed from the control gear and then restored, equally if the battery is fully discharged after an interruption to the mains supply. If a duration test fault or a lamp fault is detected during the self-commissioning phase a full duration test will be attempted a further two times to try a clear fault. If after these attempts the fault persists the appropriate DALI status flag is set, and the appropriate code will be displayed by the local status indicator LED.

3 Operating modes

The ELP DALI control gear adapt their operating mode depending on whether a DALI bus/signal is connected.

3.1 Self-test mode

The control gear will adopt a self-test (automatic test) mode if it is not connected to a DALI bus, or the DALI communication is missing.[1] On completion of the self-commissioning check (see section 2) the self-test program starts with the first function and duration tests being carried out after randomly generated delay times which will occur as shown below. Subsequent function and duration tests occur after the test interval settings as follows:

Delay time to initial function test	randomly generated value between 0 and 7 days
Delay time to initial duration test	randomly generated value between 4 and 52 weeks

Function test interval	7 days
Duration test interval	52 weeks

If there is a requirement for self-testing not to occur at random times, it is possible to reconfigure the ELP DALI control gear so that testing occurs at a designated time and date. This is done by turning the unswitched supply to the required control gear off and on 3 times in 10 seconds at the required time and date, and once this has been done the indicator LED will fast flash 2 x red and 2 x green 4 times to indicate the new testing time and date has been set.

3.2 DALI mode

The is connected to the DALI bus via the DA +/DA- terminals, which are not polarity sensitive however if the integrated power supply is enabled the DA +/DA- terminals are polarity sensitive.

[1] Whilst in self-test mode the control gear will continue to monitor for a DALI signal and if one is detected the control gear will go into DALI mode.

Once the control gear has received a valid DALI command the control gear will enter DALI mode and will have the factory set default settings[1] as detailed below:

Prolong time	0
Test delay time	0
Function test delay time	0
Duration test delay time	0
Function test interval	7 days
Duration test interval	52 weeks
Test Execution timeout	7 days

Settings may be modified via the DALI bus using the appropriate DALI configuration commands as listed in the DALI Standard IEC 62386-202. If the DALI bus is disconnected, the control gear does not revert back to self-test mode i.e. it will not randomly generate delay times but will use the DALI mode settings.

4 Testing options when operating with a DALI bus

The control gear may be configured for either of the following two types of testing regimes when operating with a DALI bus.

4.1 Locally controlled testing

Function and duration tests are initiated by the control gear i.e. the control gear perform automatic self-testing according to the locally stored settings.

NOTE The local settings for test intervals and delay times can be set up by the system commissioning engineer. If the settings are left as the factory default values, then all the control gear will enter test at randomised times.

Polling is carried out by the master controller to monitor system operation and to log the test results.

4.2 Centrally controlled testing

Function and duration tests are initiated by the master controller if the automatic self-testing is disabled.[2]

5 Local status indicators

A single bi-colour LED indicates the control gear status. The LED shows permanent green or flashing green when conditions are normal and permanent red or flashing red if a fault condition is present. Two flashing rates are used:

Slow flash: 0.5 Hz (a flash every 2 seconds)
Fast flash: 2.0 Hz (a flash every 0.5 second)

A full description of the indicator codes is given in Table 1.

[1] Default values are defined in Table 1 of IEC 62386-202: 2022 Digital addressable lighting interface – Particular requirements for self-contained emergency lighting

[2] Automatic self-testing is disabled by setting the test interval times to zero.

CONTROL GEAR MODE	INDICATOR LED	STATUS	EMERGENCY LAMP
Mains operation mode Standby mode	Permanent green	Normal	Off
Function test in progress	Fast flashing green	Normal	On
Duration test in progress	Slow flashing green	Normal	On
Commissioning in progress	Slow flashing green	Normal	Off except during testing
Identification mode – control gear un-commissioned	Slow flashing alternating green/red	Normal	Off
Identification mode – control gear commissioned and has a short address	Flashes a 6-bit binary code for the short address where the red LED equates to 0 and the Green LED equates to 1	Normal	Off
Extended emergency mode	Off	Normal	On
Rest mode	Off	Normal	Off
Inhibit mode	Green slow flashing double pulse off 	Normal	Off
Emergency operation mode	Off	Normal	On
Self-test reconfigured indication	2x fast double pulse red followed by 2x fast double pulse green	Normal	Off
Lamp fault	Permanent red	Fault	Off
Battery / Test failure	Slow flashing red	Fault	Off
Battery charging failure	Fast flashing red	Fault	Off
Loss of mains and battery supply	Off	Fault	Off
$LiFePO_4$ battery outside of charging temperature range	Fast flashing triple pulse red	Fault	Off
Circuit failure	Fast flashing double pulse red 	Fault	Off

Table 1 - Local Indicator Codes

6 Testing

6.1 Types of test

The control gear can perform two types of tests as defined in IEC 62034:

6.1.1 Function test

A function test is a 5 second test that simulates a mains failure and checks the operation of the lamp from the battery supply.

The local LED indicator fast flashes green whilst the function test is in progress. If there is a failure during a function test[1] the local LED indicator either changes to a permanent or flashing red and the appropriate DALI status flag is set.

6.1.2 Duration test

A duration test simulates a mains failure and checks the operation of the lamp from the battery supply for the rated duration of the control gear.[2]

NOTE The battery is required to be fully charged before a duration test can be started. If the battery is not fully charged the test is delayed (see section 6.3)

The local LED indicator slowly flashes green whilst the duration test is in progress. If there is a failure during a duration test [1] the local LED indicator either changes to a permanent or flashing red and the appropriate DALI status flag is set.

6.2 Test Initiation

Tests may be initiated in two ways:

6.2.1 Tests initiated automatically by the control gear

Control gears can perform automatic function and duration tests as per locally stored settings.

6.2.2 Tests initiated by DALI command

Function and duration tests can be requested by the DALI commands 227: START FUNCTION TEST and 228: START DURATION TEST respectively.

6.3 Delayed tests

If local conditions prevent a test from starting immediately, the start of the test is delayed, and the control gear sets the respective ‘test pending’ flag in the EMERENCY STATUS information byte.

The control gear may delay a test for the following reasons:

[1] See section 7 - Fault conditions

[2] Typically, 1 or 3 hours

- insufficient battery charge
- another test is in progress
- the permanent mains supply has been interrupted

A delayed test is executed automatically by the control gear once conditions permit.

If a delayed test cannot be executed by the control gear within the TEST EXECUTION TIMEOUT period, this is then set in the respective part of the FAILURE information byte.

7 Fault conditions

The local LED indicator is permanently red or flashes red if a fault is detected by the control gear.

7.1 Lamp fault

For a lamp fault the local LED indicator remains permanently red, and the appropriate DALI status flag is set.

A lamp fault may be recorded during a function or duration test.

7.2 Battery faults

For a battery fault the local LED indicator flashes red at either a slow or fast rate according to the type of battery fault.

7.2.1 Battery failure

If the battery is unable to supply the emergency lamp during a function test, then bit 2 (‘battery failure’) and bit 6 (‘function test failed’) of the FAILURE STATUS information byte are set. Additionally, the local LED indicator flashes red at a slow rate.

7.2.2 Battery capacity insufficient to meet rated duration

If the battery has insufficient capacity to supply the emergency lamp during a duration test, then bit 1 (‘battery duration failure’) and bit 7 (‘duration test failed’) of the FAILURE STATUS information byte are set. Additionally, the local LED indicator flashes red at a slow rate.

7.2.3 Battery not charging

If the control gear detects that the battery is not being charged, then bit 2 (‘battery failure’) of the FAILURE STATUS information byte is set. Additionally, the local LED indicator flashes red at a fast rate.

NOTE The battery charging is monitored continuously whilst the control gear is in normal Mains operation/ Standby mode. Therefore, if normal charging is restored after a failure has been detected, the fault condition clears automatically.

7.2.4 $LiFePO_4$ battery temperature outside of charging range

If the control gear detects that the temperature of a $LiFePO_4$ battery is outside of the allowable range of temperature for charging, then the battery will not be charged. Additionally, the local LED indicator flashes fast triple pulse red.

NOTE The battery temperature is monitored continuously whilst the control gear is in normal Mains operation/ Standby mode. Therefore, if normal charging is restored after a failure has been detected, the fault condition clears automatically.

7.2.5 Control gear circuit failure

If the control gear detects an internal circuit failure the local LED indicator flashes fast double pulse red.

7.3 DALI bus fault

It is the responsibility of the master controller to report if a bus fault exists, and it should be noted that the control gear does not revert back to self-testing mode.

8 Clearing fault conditions and re-commissioning

A test must be carried out to clear an indicated fault or to re-commission the system following a lamp or battery replacement.

8.1 Clearing an indicated fault

For a lamp or battery fault the cause of the fault must first be corrected and the appropriate test done to clear the indicated fault e.g. a duration test must be done to clear a duration fault.

NOTE In the case of a battery charging fault the indicated fault clears automatically once the cause of the fault has been corrected and normal charging has been restored.

A test to clear a fault may be initiated by the method described in section 6.2.

8.2 Re-commissioning the system following a lamp or battery replacement

An appropriate test must be carried out to re-commission the system following a lamp or battery replacement:

After a lamp replacement either a function or duration test is required.

After a battery replacement a duration test is required.

For control gear connected to a DALI bus, a function or duration test may be initiated via the appropriate DALI command.

For control gear operating in stand-alone mode i.e. a DALI bus is not connected a duration test may be initiated by disconnecting all power to the control gear (mains and battery) and then re-connected to initiate self-commissioning (see section 2).

9 Additional operating modes enabled via DALI command

9.1 Identification mode

Identification mode allows for the physical location to be identified during system commissioning or when locating a fault.

After receiving a broadcast START IDENTIFICATION command (240) the control gear will commence its identification sequence using the bi-colour LED to “flash” a 6 bit binary code where a red LED equates to Zero and a Green LED equates to 1. This identification sequence is preceded by a 4 second off period to denote the start of the sequence. By sending a broadcast command (240) every 9 seconds the control gear can be made to continually identify themselves.

When the control gear has not been commissioned the local LED indicator alternates red and green at a slow flash rate.

9.2 Extended emergency mode

Extended emergency mode allows the emergency operation to be extended following the restoration of the mains supply. Typical applications include HID lamps, which when used for normal lighting may not re-light immediately following the restoration of the mains supply.

The extended emergency mode may be set via DALI command from 0 to 127.5 minutes (in units of 0.5 minutes). The default factory setting is 0.

9.3 Extended test duration mode

The extended test duration enables continued operation of the emergency luminaire in a duration test exceeding its rated duration. If the emergency control gear cannot complete the extended test duration, the duration test shall be flagged a s a failure.

NOTE in some countries, emergency lighting installers are required to initially test emergency luminaires for a longer time than the rated duration. This allows for battery degradation over the lifetime of the battery.

9.4 Inhibit mode

The activation of inhibit mode causes emergency luminaires to be extinguished during active emergency mode automatically upon loss of the mains supply.

Inhibit mode is activated via the DALI command 225: INHIBIT when the control gear is in normal operating (standby) mode.

NOTE To prevent inadvertent loss of emergency operation, inhibit mode is automatically cancelled by the control gear after a 15 minute timeout period. To maintain the inhibit mode longer, requires the inhibit command to be repeated within the 15 minute timeout period, whereupon the control gear resets the timeout period for a further 15 minutes.

Whilst in inhibit mode the local LED indicator is off and slow flashes a double green pulse.

If the mains supply is lost, the operation is as described for rest mode (see section 9.3). Inhibit mode is then cancelled automatically when the mains supply is restored.

NOTE It is the responsibility of the person operating the DALI system to ensure that the activation of inhibit mode does not result in a hazardous condition in the event of actual mains failure.

9.5 Rest mode

The activation of rest mode allows emergency luminaires to be extinguished during active emergency mode to prevent unwanted discharge of batteries (e.g. if a building is unoccupied).

Rest mode is activated via the DALI command 224: REST when the control gear is in active emergency mode.

Whilst in rest mode the local LED indicator is off.

Rest mode is cancelled automatically when the mains supply is restored.

The number of days that the control gear can stay in rest mode and then still be able to provide 50% rated duration is dependent on the battery type and is shown below:

B091T - $LiFePO_4$ 6.4V 1.8Ah 1P2S 18650 cells – 3.9 days

B092T - $LiFePO_4$ 6.4V 2.3Ah 1P2S 22650 cells – 5.0 days

B093T - $LiFePO_4$ 6.4V 3.4Ah 1P2S 26650 cells – 7.4 days

B099T - $LiFePO_4$ 9.6V 3.4Ah 1P3S 26650 cells – 11.4 days

B097T - $LiFePO_4$ 3.2V 1.8Ah 1PS1 18650 cell – 13.8 days

B100T - $LiFePO_4$ 3.2V 1.8Ah 2P1S 18650 cells – 27.8 days

NOTE It is the responsibility of the person operating the DALI system to ensure that the activation of rest mode does not result in a hazardous condition in the event of actual mains failure.

9.6 Installation inhibit mode

To reduce loss of battery capacity caused by repeated cycling of the mains supply during the installation and commissioning period, an installation inhibit mode can be implemented for up to 150 hours.

Installation inhibit mode is activated in normal operating (standby) mode using the commands PERFORM SELECTED FUNCTION (DTR1, DTR0) and QUERY SELECTED VARIABLE (DTR0) which can be used to set or query these variables.

The factory default value of “installation inhibit hours” is zero.

10 Integrated bus power supply

ELP DALI 2 emergency control gear are supplied with an integrated bus power supply which can be enabled using two different methods dependent on the control gear type. In both cases memory bank 201, location 0x06 is used to indicate the bus power supply status.

NOTE ELP emergency control gear with the integrated bus power supply enabled should not be used on a bus with another DALI power supply. If another DALI power supply is detected on initial power up, the control gear will switch the integrated bus power supply off and will only switch the integrated bus power supply back on once the other DALI power supply has been removed.
If the ELP emergency control gear with the integrated bus power supply enabled detects a short circuit on the bus, the control gear will switch the integrated bus power supply off for 8 seconds before switching the bus power supply back on for 10 seconds. If the short circuit on the bus is still detected the process is repeated until such time as the short circuit is removed whereupon the integrated bus power supply will remain enabled after the 10 second phase.

10.1 NFC enabled integrated bus power supply

Control gear which has the Near Field Communication (NFC) interface can have the integrated bus power supply enabled on or off via the ELP/NFC application on a mobile phone or tablet, or via a Feig NFC desktop reader connected to a PC loaded with the ELP/NFC software.

10.2 Hardwire link enabled integrated bus power supply

Control gear with this feature requires a shorting link to turn on the integrated bus power supply, removing the link will turn the supply off.