

1 LIGHTING CONTROL SYSTEM

1.1 Introduction

The lighting controls scope of work is based upon maximum flexibility and maximum control. It provides a digital lighting system that can typically be reconfigured without the need to re-wire, while providing control and status down to an individual ballast.

The lighting control system is to be a **DALI (Digital Addressable Lighting Interface) system** with DALI controlled fixtures and DALI controllers throughout the interior space. The lighting controllers, ballasts, transformers, drivers, emergency fittings and other electronic control gears and devices are to fully comply with the DALI standard (IEC 62386) enabling devices from multiple manufacturers to be used in the system.

DALI Lines are to be linked on an Ethernet network using DALI CONTROL BM2600-DALI Line Controllers from Monitor Software to provide computer control, configuration and analysis as well as occupant control from computers in their workstations and offices.

The lighting system must provide manual control, scheduled occupancy control, automatic occupancy control and daylight harvesting to dim down the electric lighting in response to daylight admittance.

The lighting controls are to utilize time schedules, occupancy sensors, light sensors and switches to control the lighting in the interior spaces on each floor. The overall intent is to provide electric light only when the space is occupied and to provide as little electric light as is necessary to achieve the required light level for the work plane.

The Line Controllers are to automatically monitor the status of all ballasts and emergency fittings on the DALI Lines and to provide the tools to identify and replace ballast and lamp failures.

The successful tenderer is to engage a specialist software integrator trained in DALI and the DALI CONTROL lighting system, to program and commission the system such as Monitor Software (contact Andrew Parker on 0408 367006).

1.2 System Description

The lighting control system shall consist of multiple DALI Lines linked to form a building-wide solution using intelligent BM2600-DALI Line Controllers connected on an Ethernet network.

As DALI is a distributed control system all DALI Line Controllers, DALI Group Controllers and other DALI Electronic Control Devices must co-exist enabling devices from different manufacturers to be mixed and matched to provide maximum flexibility now and in the future. Controllers must not interfere with each other in compliance with the DALI standard (IEC 62386).

The DALI system shall be capable of incorporating DALI Electronic Control Gears (ECGs) from multiple vendors including:

- Ballasts for linear and compact fluorescent lamps
- Transformers for low voltage fittings
- LED Drivers including RGB devices
- Control Gear for high pressure discharge lamps
- Relay and Output Modules
- Exit signs and Emergency light units
- Blind Controllers
- Future DALI ECGs from various manufacturers

The system is to be capable of incorporating a wide range of DALI Electronic Control Devices (ECDs) from multiple vendors including those shown in the list below. These should include but not be limited to wall and ceiling controls, occupancy sensors and light level sensors.

- BM2600-DALI Line Controllers
- Group Controllers
- Room Controllers
- Partition Controllers
- Occupancy Sensor Interfaces
- Light Sensor Interfaces
- Remote Controllers
- LCD Controllers and Touch Panels
- Access Controllers and Security Panels
- Audio Visual Systems
- SMS/Email Communications modules
- Future DALI ECDs and controllers from various manufacturers

1.3 Wiring and Installation

All light fittings are to be wired in compliance with the DALI Standard.

A single DALI Line has the following constraints:

- The maximum cable length using a cross-section of 1.5mm² is 300m.
- The maximum number of addressable DALI units is 64.
(Devices that take a DALI short address such as ballasts, transformers, emergency lighting units, etc.)
- The maximum permitted line current is 250mA.
- The sum of the current consumptions of all the DALI units from the DALI Line must not exceed the nominal current of the DALI power supply used.
- The DALI voltage range at the DALI unit must be between 9.5V and 20.5V
- The DALI voltage range at the DALI power supply must be between 11.5V and 22.5V; a typical value is 16V.

In order to provide ease of modification and expansion DALI Lines shall comprise a five-wire 240V rated soft-wiring system equal to Quick-Flex from CMS Electracom.

The cable shall have the following characteristics:

Marking	Conductor Size	Wire Colour	Description
DA1	1.5 mm ²	Orange	DALI Control Wire
N	2.5 mm ²	Blue	20A Neutral Conductor
Earth Symbol	2.5 mm ²	Green/Yellow	Protective Earth
1	2.5 mm ²	Brown	20A Active Conductor
DA2	1.5 mm ²	Grey	DALI Control Wire

Luminaires shall be connected to the DALI Line via a 5-core lead and T-connector. The 5-core leads are to be made to suit but shall have a minimum length of 1.5m.

Emergency Luminaires shall be connected to the nearest DALI Line and be powered by the DALI active conductor to minimise cabling and installation costs.

1.4 DALI Line Controllers

The BM2600-DALI Line Controllers are required to link the distributed DALI Lines onto an Ethernet network to provide a building-wide DALI system. The Line Controllers provide configuration, monitoring, control, reporting and maintenance functions.

The Line Controllers are to operate independently and must continue to process local inputs and schedules when disconnected from the Ethernet network. The controllers must not be reliant on a server or other control system in order to operate.

The Line Controllers are to provide scheduling of DALI groups for scheduled occupancy, sequencing for override timers and effect lighting.

The Line Controllers shall provide local intelligence and features including:

- a) Integrated real time clock with automatic daylight savings adjustment and leap-year correction.
- b) Integrated sunrise/sunset support based on site location (latitude and longitude).
- c) Automatic Time Schedules to control groups for scheduled occupancy with support for holiday exceptions.
- d) 16 multi-function digital inputs for pushbuttons and sensors including occupancy sensors and daylight sensors and for integration with access control and security panels.
- e) 2 digital outputs for additional control and interlocking to external equipment such as fans and blinds.
- f) Up to 32 configurable sequences for override sequences, mood and effect lighting.
- g) Up to 32 configurable command lists for advanced control and effects.
- h) Support for two DALI Lines (up to DALI 128 ballasts).
- i) Zone control whereby groups on different DALI Lines are controlled together as one entity.
- j) An in-built web server for status and error reporting of DALI Line, ballast and lamp failures. The status shall include lamp hours.
- k) DALI Emergency testing and reports.
- l) Local processing. In the event of network failure or disconnection from the Ethernet network the Line Controller is to continue to run automatic time schedules and sequences and process inputs independently.
- m) Computer monitoring and configuration. The Line Controller shall allow configuration, monitoring and analysis from computers on the Ethernet network.
- n) Computer control. The Line Controller shall allow occupants to control their local lighting using their computers on the network.

The BM2600-DALI Line Controllers are to be located in the switchboard with their associated DALI line power supplies.

1.4.1 Line Controller Inputs and Input Profiles

The Line Controller inputs are required to provide manual control through the use of switches and pushbuttons, occupancy control using motion detectors and daylight harvesting using light sensors. The inputs are also used for integration with remote controls, security panels and access control systems.

The Line Controller shall provide:

- a) 16 integral digital inputs for use with switches, pushbuttons, occupancy sensors, light sensors etc.
- b) Multi-group functionality so that one input can control multiple DALI Groups. An input is not to be limited to a single group.
- c) Dynamic Input Profiles that enable an input to operate differently for Normal-hours and After-hours operation.

Examples of uses for this functionality include but are not limited to:

Wall-plate Pushbutton

Office Hours:	Single button dimmer
After Hours:	Toggle MAXIMUM/OFF with dimming override sequence (30 min 75%, 5 min 50%, 5 min 25%, 5 min OFF)

Wall-plate Pushbutton – After Hour cleaners

Office Hours:	Single button dimmer
After Hours:	Toggle 60%/OFF with override sequence (25 min MINIMUM, 5 min OFF)

After hours Occupancy sensor

Office Hours:	disabled (lights are scheduled ON)
After Hours:	30 minute Override Sequence (MAXIMUM, 20 min 50%, 5 min 25%, 5 min OFF)

Occupancy sensor with variable override

Office Hours:	60 minute Override Sequence
After Hours:	30 minute Override Sequence

Toilet occupancy – reed switch

(Toilet lights are scheduled on to MINIMUM)	
Office Hours:	MAXIMUM, 15 min MINIMUM
After Hours:	30 minute Override Sequence

- d) The inputs are to provide different functionality based on a condition.

For example, in a partitioned room a wall-plate switch is to control the partitioned area when the partition is closed and the whole area when the partition is opened.

1.4.2 Automatic Time Schedules

In order to cater for scheduled occupancy of the building the Line Controllers shall include an integrated real-time clock and automatic schedule control.

The Line Controller shall provide:

- a) An integrated real-time clock to allow automatic time schedules to be run independent of the Ethernet network.
- b) The real-time clock is to provide automatic daylight savings adjustment and leap year correction.
- c) Sunrise/sunset support based on site location. Schedules are to be provided with a configurable offset to allow lighting to be controlled relative to dusk and dawn.
eg. Sunrise + 20 minutes
Sunset – 30 minutes
- d) Active Periods where a timer can be configured to fire only within a defined date range.
eg. From June 1 to Aug 31.
- e) Custom time schedules are to be configured for an absolute time
eg. Office Open, Monday to Friday at 8:30am
Cleaners lights, Thursdays at 8:00pm
- f) Repeat timers
eg. Run façade lighting sequence every 30 minutes from 7pm until 11pm
- g) Time schedules must be able to be configured to include or exclude holiday periods. Holiday periods are to be configurable for one or more days and are to be able to be selected as perpetual (eg. January 1, every year)
- h) Scheduled actions are to include all DALI arc levels (eg. 80%), DALI indirect commands (eg. GOTO MAXIMUM, RECALL SCENE2), Sequences (eg. 50%, 5 mins 25%, .5 mins OFF) and Command Lists.
- i) Configuration of the time schedules is to be completed from a computer over the Ethernet network.

1.4.3 Sequences

Control sequences are required to provide multi-step override timers and mood and effect lighting.

Examples of uses for sequences include:

Override sequence	30 mins 75%, 5 mins 50%, 5 mins 25%, 5 mins OFF
Delayed exit button	Goto 50%, 5 mins MINIMUM, 5 mins OFF
Façade color mixing	variations in red, green, blue over time
Mood lighting	SCENE1, 20 sec SCENE2, 30 sec SCENE3, 40 sec SCENE4

- a) The Line Controllers are to be able to store 32 sequences of up to 8 steps where each step consists of a configurable time delay and action. Longer sequences are to be achieved by linking sequences.
- b) Sequences are to be activated by a Time Schedule, from an Input or by Computer/PDA/Touch Screen via the Ethernet network.
- c) Configuration of the sequences is to be completed from a computer over the Ethernet network.

1.4.4 Command Lists

Command Lists are required to provide a series of actions to different groups in response to a timer or input. An example of a command list is may be to provide a structured shutdown of all lighting when the building is secured.

- a) The Line Controllers are to be able to store 32 Command Lists of up to 8 steps where each step consists of a target ballast, group or zone, a configurable time delay and an action. Longer command lists are to be achieved by linking command lists.
- b) Command Lists are to be activated by a Time Schedule, from an Input or by Computer/PDA/Touch Screen via the Ethernet network.
- c) Configuration of the Command Lists is to be completed from a computer over the Ethernet network.

1.4.5 Computer Control

In order to get the most out of the lighting control system it is advantageous to provide individual occupants with the ability to adjust the light level of their own workspace. This is particularly true of people working in front of a computer screen where comfort levels differ from person to person.

It is therefore a requirement of the Line Controller to accept commands from computers connected to the Ethernet network. This provision is to be provided by a desktop applet that provides the user with full control of their lighting.

The applet is to include a slider with full dimming capabilities plus buttons with the following functions: Maximum, Minimum, Off, Scene 1 to 16, Previous, Favorite 1 to 4.

The group of ballasts to be controlled is to be configurable.

1.4.6 Status and Error Information

The Line Controllers are to monitor the connected DALI Lines are to provide status and error information for DALI Lines, ballasts and lamps.

The status and error information is to be available on web pages served by the integrated webserver in the Line Controller. This means that only a web-browser is required by maintenance or operations staff to monitor the system.

The Line Controller is to monitor and track lamp hours for connected luminaires and emergency fittings. If the DALI ballast does not support lamp hours then the Line Controller is to provide the tracking.

1.4.7 Maintenance and Ballast Replacement

The Line Controller is to monitor the connected DALI Lines are to provide status and error information for DALI Lines, ballasts and lamps. The maintenance software is to identify a faulty ballast and address and reconfigure the replacement ballast with a simple point and click operation.

All group, scene and configuration settings are to be restored to the DALI ballast.

1.5 Room Controller

DALI Room Controllers are required to provide control for a room or office. The Room Controller is to accept inputs from a push-to-make switch and from an occupancy sensor. The switch is required to provide the occupant with manual on/off and dimming control of room lighting while the occupancy sensor ensures that the lights do not remain on when the room is unoccupied. The DALI Room Controller shall be equal to the DALI Control DC200-RM1 from Monitor Software.

The Room Controller is to include the following features:

- Single button dimmer, eg. On|Off and Up|Down
- Occupancy Sensor input
- Manual ON / Auto ON setting

1.6 Wallplates

Wallplates with push-to-make switches are required to provide the occupant with manual control of the workspace lighting. The switches are to be configurable so that they can issue different DALI commands depending on the usage requirements of the space. The switches are to be connected to a DALI controller equal to the DALI Control DC200-INP4 from Monitor Software.

Uses of the switches include but are not limited to the following:

- Toggle button, eg. On|Off
- Single button dimmer, eg. On|Off and Up|Down
- On and Up button
- Off and Down button
- Scene button, eg, Scene 1
- Multi-scene button, eg Scene1, Scene2, Scene3, Off

A typical wallplate configuration for an office space consists of a single button providing toggle on/off and dimming capabilities. A typical configuration for a meeting room consists of a 4-button wallplate providing 2 scene buttons, an on/up button and an off/down button.

It should be noted that many buttons require an override sequence for after hours operation as detailed in the specification control schedule.

The location of the required wallplates is provided in the accompanying drawings.

1.7 Occupancy Sensor Interface

The DALI occupancy sensor interface is used to control a group of ballasts depending on the occupancy of an area as determined by occupancy sensors. The interface is to operate with one or more occupancy sensors that provide a contact closure output.

The group of ballasts to be controlled is to be configurable allowing the space to be reconfigured or modified without changing the fixture wiring.

The lighting level activated when the sensor detects a change in occupancy is to be configurable to match the use of the space.

1.8 Light Sensor Interface

The DALI light sensor interface is used to control the level of a group of ballasts depending on the light level of an area as determined by a light sensor. The light sensor interface is typically used to control a group of ballasts adjacent to a row of windows.

The group of ballasts to be controlled is to be configurable allowing the space to be reconfigured or modified without changing the fixture wiring.

When the group is on the light level is raised or lowered depending on whether the light level determined by the light sensor is above or below the setpoint.

1.9 Partition Controller

The Partition Controller is required for meeting rooms that have a movable dividing wall. The controller enables a wall switch in each room to control either the local room or the combined space depending on the position of the dividing wall. When the dividing wall is closed the wall switches control only the local room. When the dividing wall is open both wall switches control the combined space.

1.10 DALI Relay and Output Modules

The DALI Relay or Output Modules are required to provide ON/OFF control for non-dimmable loads such as fixed output electronic ballasts, incandescent lamps, fans and motors. The modules are to accept DALI commands over the DALI Line allowing modules to be placed adjacent to the load to be controlled.

The DALI Relay or Output Modules are to be provided as indicated on the accompanying drawings.

1.11 DALI Blinds Controller

DALI Blinds Controllers are required to allow blinds and curtains to be incorporated into the lighting control system where indicated on the accompanying drawings. The controller is to be fully DALI compatible allowing the blinds to be integrated into DALI scenes.

The blinds controller should have two independent control channels each with two single pole volt free contacts capable of switching the required load.

The blinds controller is to include a status LED and relay state indicators. The status LED is to provide status and fault indication. The relay state indicator LED's are illuminated when the respective relay is closed.

The relays in the blinds controller are to be internally isolated permitting separate mains phases to be controlled in one unit.

2 SELF CONTAINED EMERGENCY AND EXIT LIGHTING SYSTEM

2.1 General

The lighting system is to include monitoring and testing of the emergency luminaires and exit signs such that a separate monitored emergency lighting system is not required.

Emergency luminaires and exit signs shall be provided and installed throughout the building in compliance with the requirements of AS/NZS 2293 and the Building Code of Australia (BCA). All emergency luminaires and exit signs are to be monitored and tested in accordance with the International DALI Standard for self-contained emergency lighting converters.

The scope of the emergency and exit lighting system includes:

- Provide self-contained emergency luminaires as shown on the drawings.
- Provide self-contained exit signs as shown on the drawings.
- Provide a centrally monitored emergency lighting system using the DALI lighting control system.
- Provide automatic testing facilities for all emergency luminaires and exit signs.

The installation shall comply with the requirements of:

- AS/NZS 2293 Emergency Evacuation Lighting in Buildings
- Building Code of Australia
- Local Government Authority
- Fire Brigade

2.2 Emergency Luminaires

2.2.1 Single Point Emergency Luminaires

All self-contained, non-maintained, single point fittings shall be provided complete with batteries, charger and DALI electronic control gear. The emergency luminaires shall be either 10W quartz halogen or T5 8W fluorescent as scheduled on the drawings.

2.2.2 Integral Type Emergency Luminaires

Where shown on the drawings, normal lighting luminaries shall incorporate a non-maintained emergency lighting lamp, a self-contained power pack and DALI electronic control gear.

2.2.3 Illuminated Exit Signs

All illuminated exit signs shall incorporate a maintained emergency lighting lamp, a self-contained power pack and DALI electronic control gear.

All exit signs shall be of pictograph type with running man and directional arrows. The signs shall be capable of being mounted on ceiling, wall or suspended.

2.3 Addressing and Identification

All emergency luminaires and exit signs shall be addressed with other luminaires on DALI Lines. The luminaires shall be identified by their unique DALI Line and fitting address which shall be displayed on an approved label adhered to the luminaire. The address shall correspond with the log book identification and as-installed drawings.

All emergency luminaires and exit signs shall provide visual feedback to the DALI emergency identify command in order to easily locate a luminaire.

2.4 Automatic Testing

All emergency and exit lighting shall be able to perform a battery discharge test according to the required emergency standard (e.g. IEC 62034, AS/NZS 2293).

In order to maintain the integrity of the emergency lighting system, duration testing shall be conducted in sections so that adjacent emergency luminaires are not tested together.

Tests may be initiated manually from the computer, scheduled by BM2600-DALI Line Controllers, triggered by a switch at the switchboard or started automatically by the luminaire using the built-in DALI auto test function.

2.4.1 Emergency Status

The BM2600-DALI Line Controller and the Emergency Monitor software shall indicate the status of the emergency luminaires as designated by the DALI emergency standard. The control system shall display when the fitting is in emergency stand-by mode, when a test is pending or running, and the date and result of the last test.

In the event of a failed test the BM2600-DALI Line Controller and the Emergency Monitor software shall indicate the reason for the failure as reported by the emergency failure information as stipulated by the DALI emergency standard.

The result of a test and its validity shall remain unchanged until a new test is performed.

If a test can't be started or is interrupted due to an emergency situation (mains failure), the test shall be automatically delayed until the battery is recharged.

2.4.2 Reporting

Results of discharge tests at practical completion shall be recorded and stored in the logbook. The logbook shall be retained on site.

The system shall be capable of displaying the lamp hours of a luminaire in normal operation and in emergency operation.