LIGHTING MANAGEMENT & CONTROL SYSTEM

PART 1 – GENERAL

1.1 INTRODUCTION

1. The overall objective is to achieve the most energy efficient lighting, with the lowest cost of ownership, without compromising user comfort or convenience.

2. Flexibility through software configuration and programming shall enhance lighting design freedom to maximise the aesthetic potential whilst facilitating energy saving measures.

3. The lighting control shall provide effective energy management and reporting of lighting load status throughout the installation. It shall provide convenient and intuitive manual control, supported by appropriate automatic operation to minimise energy consumption.

4. The lighting control system shall be modular and scaleable. It shall utilise digital network technology based on the standard open DALI protocol for local field networks, RS485 high-speed serial data compatible with Helvar SDIM protocol, DMX for intelligent luminaires and entertainment interface and Ethernet TCP/IP for the backbone infrastructure.

5. To ensure simplicity and reliability, it is a requirement that the system network controllers / routers handle network connections directly. Systems that utilise additional converters or similar intermediary devices are not acceptable.

6. System intelligence shall be distributed and reside within the lighting ballasts, LED drivers, load controllers, input devices, gateways and network routers.

7. The system shall be capable of processing command instructions from switches, sensors and other devices with sufficient speed that the user of the system sees the resulting action as a direct response to a switch being operated, or sensor triggered.

8. The installation shall be capable of forming a building wide lighting control system. Integration to BMS/BAS shall be via the Ethernet TCP/IP backbone infrastructure. The control specialist shall offer an IP driver for use with the Niagara™ platform to facilitate seamless integration. The driver shall allow connection and communication with the system network controllers / routers and provide automatic discovery of system devices.

9. Changes to the system shall be made by an Operator Workstation consisting of either a desktop PC or commissioning (temporarily connected) laptop computer. However, the PC shall not be an active control component within the system. After commissioning, the control system routers and devices shall retain all configuration and programming information required for the system to operate automatically without the PC being present.

1.2 OVERVIEW

1. The system shall be formed of local networks connected to routers. The routers themselves shall inter-connect and communicate via a backbone Ethernet network using TCP/IP.

2. It is a requirement that the lighting control system is capable of being installed as a completely separate system to other building services. However, the IP addressing of the devices shall allow sufficient range and flexibility for the system to utilise the owner's building data network and structured cabling system if required.

3. DALI networks shall utilise a suitable two-core data cable (which should be screened in electrically noisy environments). The installing contractor shall ensure that any network cable used within modular wiring or power-track type wiring systems is suitable for DALI use. To this end the contractor shall ensure that the cable type and wiring method is approved by the controls specialist.

4. RS485 and DMX networks shall use two twisted pairs overall screened cable specified for wide bandwidth RS485 use. The contractor shall ensure that the cable type and wiring method is approved by the controls specialist.

5. The Ethernet backbone cabling shall be of not lower specification than CAT 5e data cable terminated with RJ45 type connectors.

6. The system shall be designed in such a way that typically each floor of the building is provided with one or more local networks. These local networks shall then be connected together via the router devices to allow the passing of messages between different areas within the building, and also for communication to and from the Operator Workstation.

7. For reasons of data integrity, speed and reliability, mains borne signalling or R.F. networking methods are not considered an acceptable substitute for the hard wired data cable which forms the backbone of the system. However, wireless devices may be connected to the system to allow additional functions and flexibility. For example the use of a wireless networked laptop computer for commissioning.

8. All DALI devices connected to the system shall be fully compliant with the DALI Standards. Any enhancements, devices, commands, or functionality provided by the controls specialist, in addition to those covered by the DALI Standard, shall not cause any detrimental effect to the standard DALI devices or the local DALI communication network.

9. All DALI networks and devices shall utilise full DALI addressing, reporting and feedback. The use of non-addressed DALI broadcast messages will not be accepted as meeting the requirements of this specification.

10. The local DALI networks shall accommodate all luminaires and control input devices. Sensors, manual control panels and other local control devices shall connect directly to the local DALI network. Systems requiring a separate data bus for control devices are not acceptable.

11. Generally, all local control devices and interface modules shall derive their power from the DALI network and require no other external power source. Where conventional switches or specialist sensors have been specified in areas controlled by the system, these may be connected to the DALI networks by suitable DALI input interfaces.

12. Devices requiring external power supplies and/or controllers may only be utilised in exceptional circumstances. For example devices with high power consumption, such as long range microwave sensors.

13. The control system design shall be such that the DALI networks remain within the constraints imposed by the DALI Standard. To allow for future expansion or modification of the system, local DALI networks shall be designed in such a way that a minimum of 30% spare capacity is allowed with respect to both the DALI power supply maximum load, and the number of connected DALI nodes.

14. Control shall be via the logical grouping of devices. Load interfaces that are to be controlled simultaneously shall be identified collectively as a “group”. There shall be no limit to the number of load interfaces that can be included within a group. To allow freedom in respect of installation and configuration, there shall be no restrictions on how loads are functionally grouped for control with respect to their physical location or connection to the system.

15. A control input shall manipulate a “group”. Points of control shall include, but not be limited to:

    - daylight harvesting devices
    - occupancy sensors
    - timer controlled scheduled events (with or without astronomic correction based on the local longitude and latitude)
    - manual control panels
    – wireless input devices
    - switch inputs
    - voltage or current inputs
    - RS232 serial interface
    - TCP and UDP control commands via Ethernet
    – BMS / BAS

16. In practical terms there shall be no limitation to the number of load interfaces or control input devices.

17. Programming access, status monitoring, system and error reporting shall be by software application(s). Connection to the system shall be via Ethernet. Connection of multiple PCs or browsers shall be allowed to facilitate, for example, multiple point monitoring. The system shall not require the connection of a P.C. for normal operation.

18. A system’s programming shall be able to be saved to a computer file. It is expected that this shall be a feature of the programming application.

    Conversely, a saved file shall be able to be restored to a system.

19. All load interfaces and control device functions shall be nameable. The names shall be of free format to facilitate meaningful descriptions. Names shall be entered during programming but held entirely by the system. The need for separate descriptive files held on a computer shall not be acceptable.

1.3 QUALITY ASSURANCE

1 *Proven competence*

The controls manufacturer shall have a minimum of ten years proven record in the design, manufacture and world-wide support of professional lighting control equipment.

2 *Processes*

The manufacturer shall have a recognised quality system for the design, engineering and manufacturing processes registered to ISO 9001:2008.

The manufacturer shall have a recognised environmental management system for the design, engineering and manufacturing processes registered to ISO 14001:2004.

The manufacturer shall be able to demonstrate commitment to the Waste Electrical and Electronic Equipment regulations 2006 (WEEE Directive 2002/96/EC).

3 *Certification*

All equipment shall carry CE and shall fully comply with the Restriction of Hazardous Substances regulations (RoHS Directive 2002/95/EC), proof of compliance shall be available from the manufacturer upon request.

Equipment safety shall be by the application of EN 60950-1:2006. Alternative safety standards shall only be accepted where the manufacturer can demonstrate equivalence.

Insulation electrical safety testing shall be at not less than 4 kV RMS.

All equipment shall be specified for operation to Pollution Degree 2. The working ambient temperature range shall be 0 to 40 degC and to 90%, non-condensing, relative humidity.

Mains powered load interface units shall be rated for installation category (over voltage category) II.

Electromagnetic compatibility shall be demonstrated by the application of EN 61000-6-3:2007 emission standard and EN 61547:2009 immunity standard. Alternative standards shall only be accepted where the manufacturer can demonstrate equivalence.

Electrostatic discharge immunity shall be tested by the application of IEC 6000-4-2:2009. Surge immunity simulating the effects of lightning strikes shall be tested by IEC 6000-4-5:2006.

4 *Warranty*

All equipment shall carry a minimum of two years warranty under normal use and service to be free from defects in materials and manufacture. The warranty shall include programming and commissioning carried out by the manufacturer.

During the warranty period the manufacturer shall bear the costs of replacement or repair necessitated by equipment failure the cause of which being attributable to the manufacturer.

The warranty period shall commence from when the equipment is first energised after installation.

The manufacturer shall offer repair or make available new, refurbished units or replacement alternatives to ensure maintenance of functional operation of the installed equipment for a period of six years from the commencement of warranty.

5 *Approved Manufacturers*

Helvar Limited, Hawley Mill, Hawley road, Dartford DA2 7SY, United Kingdom

PART 2 - FUNCTIONAL DESCRIPTIONS

2.1 Software

1. The system shall be provided with a comprehensive software package for the Operator Workstation that is used for the initial commissioning and setting to work of the installed devices.

2. It shall be possible to monitor the current state of the lighting and manually select preset levels or dim the lighting in any area of the building from the Operator Workstation or Browser.

3. The system shall provide full reporting of information from DALI ballasts and devices and generate alarms for failure conditions.

2.2 Groups

1. A group identifies “co-operative” devices, typically made up of a number of dimmer/load interfaces (lighting channels) and controlling user interfaces. Each group shall have a unique system number. A group is “global”, in that it can include any of the system devices regardless of their physical point of connection. All control actions and interactions shall be on the basis of group associations.

2. Any number of load interface devices shall be able to exist in any one or more of the groups. A controlling user interface shall belong to a single group only. There shall be no limit to the number of Routers that have devices defined within the same group.

2.3 Scenes

1. A “scene” is a description of the combined effect of the lighting levels made up of one or more controlled lighting channels operated collectively within a group. Variations between the channel levels can be used to set the mood, optimise the aesthetic effect or simply set practical lighting for the area. Recall of a scene is thereby a group command and as such allows any number of load interface devices to be included.

   As requirements change, during the course of a day for example, different variations, “scenes”, may be required. Typically an area will have four active scenes in addition to an off scene.

2. Scene levels shall be associated with each dimmer/load interface whereby up to 128 may be defined for each load by programming. Thereby within each group up to 128 scenes may be recalled.

   The scene levels of each dimmer/load interface remain absolute regardless of the controlling group recall.

3. To expedite programming, scenes shall be associated in blocks of 16, the first of which shall have default values pre-set. Programme assignment of a control device to a group shall automatically allocate to it this first block of scenes. However all such assignments shall remain changeable by programming.

4. Scene fade time shall be associated with the source of the scene recall. Systems with a fixed fade time per scene shall not be accepted.

   The range of the programmable fade-time shall be not less than 36 hours with a resolution not exceeding 1 second. A fade time is absolute and is the time taken for the lighting to change from current levels to those of the recalled scene regardless of the differences in start and end levels.

5. All scene levels and fade times shall be stored by the system for use by a control device.

2.4 Router

1. A Router shall be fully autonomous. Routers shall link via an Ethernet 10/100 network and use TCP/IP protocol. Each Router shall have its own IP address that shall be fully programmable and allow co-existence on public or private networks. System data exchange, programming, system interrogation, and remote access control shall be via the Ethernet network connection.

2. Commercial Lighting - A Router shall support full specification DALI networks, each offering independent control of up to 64 DALI devices. Load and user interfaces shall co-exist as required, or as physically convenient, on the same DALI network. There shall be no restrictions requiring the grouping of loads with specific controls. It shall be possible to group any mixture of loads and user interfaces, across any of the Routers in the system.

3. Architectural / Architainment Lighting - A Router shall support full specification DALI networks, each offering independent control of up to 64 DALI devices. Load and user interfaces shall co-exist as required, or as physically convenient, on the same DALI network. There shall be no restrictions requiring the grouping of loads with specific controls. It shall be possible to group any mixture of loads and user interfaces, across any of the Routers in the system.

   A Router shall support a high-speed serial network for controlling architectural dimmer cabinets. The protocol shall be compatible with Helvar SDIM and offer independent control of up to 252 dimming channels.

   A Router shall support a DMX network and shall be compatible with DMX 1990 and DMX E1.11 standards. The port shall be configurable as either DMX out or DMX in.

   As DMX out, the port shall provide up to 512 independent channel control. The start address of the controlled channels shall be programmable to any within the 512 DMX boundary.

   As DMX in, the port shall accept up to 512 channels for control of the Router dimmer port channels. The start address for the controlled channels shall be programmable to any within the 512 DMX boundary. The address mapping from DMX to dimmer port channels shall be programmable.

4. Each device shall be automatically uniquely identified. In addition a device shall be able to be named to make its identity and use clear to the user. Naming shall allow any mix or number of alphanumeric characters without a restrictive limit.

5. Each group shall be identified by a unique number given by the programmer as part of the system configuration. There shall be no restrictions on the numbering to allow such as the allocation of number blocks to specific areas for ease of programming association. In addition a group shall be able to be named to make its identity and use clear to the user. Naming shall allow any mix or number of alphanumeric characters without a restrictive limit.

6. A Router shall store group data that shall be defined and/or changed as required by programming. Any number of load interface devices shall be able to exist in any one or more of the groups. A controlling user interface shall belong to a single group only. There shall be no limit to the number of Routers that have devices defined within the same group.

7. To facilitate system operational checks and expedite initial system set-up without the need to programme individual levels, a number of default level settings shall be provided for each load interface. These shall be held by the Router and shall include 100%, 75%, 50%, 25% and 0%.

   Each level setting for each load shall have a unique identity and in addition shall be able to be named to make its identity and use clear to the user. The name shall be of alphanumeric characters and without a restrictive limit to the number of characters.

   The level identity shall remain the same regardless of the origin of group recall.

2.5 Daylight Harvesting

1. The system shall provide the means of exploiting available daylight to achieve energy savings. The implementation shall use light measurement techniques to ensure the maintenance of appropriate illuminance, and shall be additional to that offered by dawn/dusk scheduling alone. Where different approaches may be best suited to the area to be controlled, alternative methods may be offered; for example “open loop” or “closed loop” controls. In all cases user comfort shall not be compromised and control methods adopted shall give operational transparency to the occupants.

2. Open area control by scene modification:
   Open, for example “leisure” or circulation areas, may use open loop control. A selected artificial lighting scene shall be automatically and proportionately modified in response to the changing daylight to maintain the desired combined illumination level of the controlled area. The proportionality shall be programmable over the range of daylight to allow site profiling to suit the structure of the area. A single sensor shall be able to be used with as many areas as required each with an individual profile. The artificial level changes shall be programmable to provide slow transitions that are aesthetically pleasing and not distracting. The location of the daylight sensor(s) shall be as specified by the lighting designer or as recommended by the controls manufacturer to ensure reliable and consistent performance through the changing seasons of a year.

3. Open area control by scene triggering:
   Artificial lighting scenes shall be automatically triggered in response to the changing daylight to maintain the desired combined illumination level of the controlled area. The trigger levels shall be programmable over the range of daylight to allow site profiling to suit the structure of the area. A single sensor shall be able to be used with as many areas as required each with an individual profile. The range of the programmable fade time shall be sufficient to allow aesthetically pleasing changes but with a resolution not exceeding 1 second.

4. Defined local area control:
   Office and work areas shall use closed loop control to ensure the maintenance of a specified illuminance. A single sensor shall monitor the controlled area, for example a desktop, and adjust the group artificial light level dynamically to compensate in real time for the variations in daylight contribution and thereby maintain a constant illuminance. The speed of tracking shall be programmable to allow subjective adjustment.

   The system shall also offer adjacent area tracking whereby areas not monitored directly by a sensor can be set to follow the controlled area either directly or as a percentage change. This is to facilitate large office control where daylight harvesting is most effective near the windows, but where light levels away from the windows may require a proportional change.

5. Multiple sensors placed within the same group shall offer light measurement averaging. There shall be no limit to the number of sensors that can be in the same group. The location of multiple sensors shall be as specified by the lighting designer or as recommended by the controls manufacturer to ensure reliable and consistent performance.

2.6 Occupancy Control

1. Energy saving shall be provided by the use of intelligent and programmable occupancy control. Presence, absence or a combined response shall be selectable for each controlled area. Multiple sensors placed within the same group shall allow co-operative control for large areas.

2. Presence detection:
   One or more suitable occupancy sensors connected to the system shall initiate the automatic illumination of a controlled area. To facilitate initial configuration the system shall offer automatically assigned levels; however there shall be no limitation on the programmable choice of levels thereafter. Dimmable loads shall have a default fade time of two seconds but shall be programmable from instantaneous to 24 hours with a resolution of one second.

3. Absence detection:
   One or more suitable occupancy sensors connected to the system shall initiate the automatic reduction in illumination of a controlled area after a time of non-occupancy (absence).

   By default the absence response shall apply whenever the controlled area is using artificial illumination, however by programming it shall be possible to programme the response to apply only to specific lighting settings. The time of absence prior to the response shall be fully programmable to 24 hours with a resolution of one second. Re-occupancy within this time-out period will reset the response as if occupancy had been continuous.

   For user comfort, the response shall be in two stages with the selection of an intermediate stage prior to assuming the unoccupied settings. The time the intermediate stage is maintained shall be programmable from 90 seconds up to 24 hours with a resolution of one second. The transition time to the intermediate and unoccupied settings shall be independently programmable to 24 hours with a resolution of one second. The default times for both shall be two seconds. The intermediate and unoccupied settings shall be fully programmable. The default levels for both shall be 0%.

4. Corridor hold:
   Additional areas shall be able to be conditionally appended to a controlled area such that access routes, stairwells and similar illumination can be maintained as needed whilst the controlled area is in use.

5. Exit delay:
   When unoccupied settings are selected for a presence controlled area other than through the sensor input, for example when a manual control panel is used, an exit delay shall be provided to allow evacuation of the area. During the exit delay “presence” sensor inputs shall be ineffective, to avoid unwanted re-selection of occupied settings. The time of the exit delay shall be programmable from 90 seconds up to 24 hours with a resolution of one second.

2.7 Scheduler

1. The system shall offer a scheduler whereby lighting settings can be automatically recalled relative to time, day and date. The scheduler shall include an “astronomic” function that can accept local latitude and longitude information and thence derive dawn and dusk times. The full data of the scheduler shall be held in each Router.

2. Synchronisation to a system master clock-calendar shall be optional and selectable between Routers and connected PC(s). In the event of a network disconnection a Router shall continue the schedule autonomously. In the event of loss of power each clock shall continue to run for not less than two days.

3. Scheduler actions shall be to the clock calendar or relative to dusk and dawn, or any mixture thereof. Time resolution shall be to one second. It shall be possible to “offset” dusk and dawn times by up to 12 hours before or after their real times and such offsets shall have a resolution of one minute.

4. There shall be no practical limit to the number of scheduled actions permitted.

2.8 Hardwired manual control panels.

1. Wall switch-plate style control panels shall provide direct user control. These shall be simple in use, ergonomically styled and largely self-explanatory in function. All controls shall include LED indicators to show current state. Multifunctional keys where the response is historically dependent upon previous operation shall be avoided.

2. Each physical panel shall have a single DALI address such that multiple functions are sub-devices of the single address.

3. Push button key panels shall provide manual recall or modification of programmed lighting group settings. Each button shall be independent and fully configurable by programming to control any

required group. There shall be no inherent limitations as to the use of each button. The number of buttons on a single panel shall be suitably limited to maintain simplicity of use.

4. Slider panels shall offer direct level control of a group lighting settings. The physical position of the slider shall relate directly to the control level. A programmable option shall allow “fade to off” or “fade to the load minimum level” when the slider is moved to its lowest setting. Multiple sliders controlling the same load interface(s) shall operate on the “last takes precedence” principal.

5. Rotary controls shall offer proportional control of a group lighting settings. The control shall be continuous, that is no end stop, and give relative change to the current settings. Clockwise rotation shall correspond to “raise” and anti-clockwise rotation to “lower”. The rate of modification shall be programmable for both slow and fast physical rotation. Where multiple rotary controls are used for the same load interface(s) then each shall give smooth relative change of the settings from the point of use with no step transitions through the change of control.

   The control shall include an integral push switch, the function of which shall be programmable. Options shall include a toggle action between an “on” level and "off”. An LED shall indicate the switch status.

2.9 IR Receiver

1. All hard wired manual control panels shall include an IR (infra-red) receiver to allow the use of a cordless controller. The nominal working range, when used in conjunction with the manufacturer’s specified transmitter, shall be four metres.

2. A minimum of seven programmable functions shall be provided. The IR functions shall be independent of, and not limited to, the functions of the control panel.

3. To permit the independent operation of multiple panels within close proximity, a programmable option shall be the choice of IR reception block. At least 10 alternative IR blocks shall be offered.

2.10 Conditional response

1. It shall be possible to create conditions for a control response. A condition shall be either true or false and thereby provide a means of logical control. The response to which the conditions are applied shall only occur if all the applied conditions are met, that is logically true.

2. A condition shall be allowed from any control input. Conditions shall thereby be able to be created by, but not be limited to, the action of a manual control panel, occupancy control, daylight harvesting, switch and voltage inputs, and scheduled events with astronomic correction based on the local longitude and latitude. Thereby any control input shall be able to apply a conditional response to any other input.

3. A conditional action shall include the ability to inhibit or permit a selected control response. (A typical application being to inhibit manual control panels out of office hours.)

4. A conditional action shall include the ability to execute an alternative control response to that of the selected source. (A typical application is the change of function of input devices when room partitions are moved.)

5. Any mixture or quantity of conditions shall be allowed to be combined by logical “and” and “or” statements.

6. Nesting of conditions shall be permitted to any depth. To simplify programming a complex set of conditions shall be able to be defined as a single condition and thereafter used as such.

2.11 Linked recall of output level settings

1. The automatic recall of two or more light level settings in sequence shall be provided by linking. There shall be no limitations as to the choice of settings to link, the order of selection, or the number of settings in the link sequence.

2. A linked setting shall be recalled at the end of a link time that shall be programmable up to 45 hours with a resolution not exceeding 1 second. The link time shall be separately programmable for each link. A link sequence shall end when the last setting in the link sequence is executed, or when a “condition” that terminates the link is applied.

3. Linking shall be permitted to any previous member of a link sequence to create a closed loop, or continuous cycle. A cycle shall continue until a “condition” that terminates the link is applied.

2.12 Serial control interface – RS232

1. An interface shall provide system control via an RS232 port. The port shall be bi-directional with separate receive input and transmit output. Port configuration shall comply with standard RS232 practice to give compatibility with PC serial com ports and third party equipment equivalents.

2. The interface shall connect to and be powered by a DALI network. However the interface shall not itself have a DALI address and shall not affect address limits. Other than by the constraints of the power supply loading there shall be no limit on the number of interfaces that may be connected to a DALI network.

3. Control shall be as if a manual push-button key was operated on the DALI network and shall thereby allow recall of any of the pre-programmed light level settings. As control shall emulate a key-press, key function changes made by programming shall automatically be effected without any changes being required to the RS232 control.

4. The RS232 port set up and protocol shall be published by the controls specialist for use by third party integrators as needed.

5. Available feedback shall include the key LED tell-back that shall allow indication of key presses originating elsewhere in the system.

2.13 BMS / BAS

1. The system shall offer BMS / BAS connectivity to the lighting system by use of IP or via a gateway, providing connection to common network protocols such as LonWorks, BACnet, and Modbus, along with many proprietary network protocols.

2. The client application shall be provided by the host BMS / BAS, or any third party equipment needing to interact with the lighting control system. The ease of interaction and presentation of data shall be entirely dependent upon the client.

3. BMS / BAS connectivity shall provide the recall and modification of group or load interface lighting levels, system status and device status where available.

4. Remote connection shall be entirely under the control of the user but typically it would be assumed to be a standard Ethernet network connection which could be the same physical layer as that of the lighting control system.

2.14 Control over Ethernet

1. The system shall allow an external client to open a TCP connection to any Router. The use of UDP shall also be permitted. Data management shall be by the lighting control system such that all data exchange shall be via the targeted Router regardless of its physical system connection. General protocol and target port numbers for incoming messages shall be provided by the controls specialist.

2. System queries shall include device type and parameters, and time and date.

3. Control shall include the recall and modification of programmed group light level settings and in addition shall allow the storing of group lighting levels and setting of time and date.

4. The system shall be able to originate user defined Ethernet messages. Entry shall be optionally in ASCII, hexadecimal or decimal with a specified target IP, port number and whether TCP or UDP is to be used. Triggering of the message shall be programmable from any system control source.

2.15 Switch input

1. An interface shall provide a connection point for one or more volt-free contact closures. Voltage source from the interface shall be isolated and at extra low voltage potential. Loop current shall be less than 1 mA.

2. The interface shall have a single DALI address such that multiple switch inputs are sub-devices of the single address. For address efficiency it is thereby preferred for each interface to handle multiple inputs.

3. The use of non-specialist cable shall be permitted with a maximum length of 50 metres.

4. Execution of control actions shall be permitted on the closing edge contact, opening contact or due to the state of the switch, open or closed. Available actions shall include those of the manual push button key panels.

5. Other than by the DALI constraints there shall be no limit to the number of switch interfaces that can be connected to a DALI network.

2.16 Analogue input

1. An interface shall provide an isolated connection point for one or more extra low voltage DC sources. The input voltage range shall be for 0 to 10 Volts and shall be scaled linearly as 0 to 100% of input. Input impedance shall not be less than 7k5 ohms.

2. The interface shall have a single DALI address such that multiple inputs are sub-devices of the single address. For address efficiency it is thereby preferred for each interface to handle multiple inputs.

3. The use of non-specialist cable shall be permitted with a maximum length of 50 metres.

4. Execution of control actions shall be permitted on a rising voltage, a falling voltage or due to the voltage level. Available actions shall include those of the manual push button key panels.

5. Other than by the DALI constraints there shall be no limit to the number of analogue interfaces that can be connected to a DALI network.

2.17 Power interruptions

1. The actions carried out at power up shall be programmable, and shall include the state of conditional responses, linking and scheduled events.

2. The recovery from a power interruption shall be deterministic. It shall either continue as if no interruption had occurred, that is restore settings as they were prior to the interruption including the correct state of scheduled events, or power up in a programmable defined way.

2.18 Fault resilience

1. The system shall be fault resilient whereby a device or cable failure shall not compromise the remaining system elements. Failure of a DALI sub-net shall in no way inhibit operation of remaining sub-nets baring the loss of interaction. Loss of integrity of the backbone Ethernet shall not inhibit autonomous operation of the remaining segments.

2. In the event of a device failure the system shall provide automatic configuration and programming of a replacement part such that service repair is by failed device substitution only. There shall be no mandatory requirement of holding pre-configured/programmed devices or the need of expert user knowledge of the Operator Workstation for routine maintenance.

PART 3 - PRODUCTS

3.1 Software platform

1. The controls specialist software package shall run under Microsoft Windows 7™, Microsoft Windows XP™ and Microsoft Vista™.

2. The package shall include defined operating modes that shall include:
   - Monitoring of the system and its components
   - Live interaction with system elements
   - Live programme editing
   - Offline programme editing

   Programmable password access shall allow operator security levels to inhibit accidental system changes.

3.2 Router

1. The Router shall be in the form of a modular plastic enclosure for EN 50022 M36 DIN rail mounting, of not more than nine module widths.

2. Status indicators shall be visible with the Router mounted showing operation of the communications ports, facilitating installation and system checking.

3. Commercial Lighting - The Router shall be self-contained, requiring only a protected mains supply for operation, and shall accept any AC supply in the ranges 90 - 250 Volts and 45 - 65 Hz without adjustment. The requirement for additional external power supplies is not acceptable.

   DALI ports:
   DALI ports of double insulation rating shall be provided, each with integral 250mA DALI supply.

   DALI ports shall be independent, each allowing the individual control of up to 64 DALI devices.

4. Architectural / Architainment Lighting - The Router shall be self-contained, requiring only a protected mains supply for operation, and shall accept any AC supply in the ranges 90 - 250 Volts and 45 - 65 Hz without adjustment. The requirement for additional external power supplies is not acceptable.

   DALI ports:
   DALI ports of double insulation rating shall be provided, each with integral 250mA DALI supply.

   DALI ports shall be independent, each allowing the individual control of up to 64 DALI devices.

   Dimmer port:
   Full specification high-speed RS485 port of double insulation rating from both the mains supply and DALI port. Connection shall be via a two-part screw terminal connector. A separate terminal shall be provided for the earth screen connection. The use of a common 0 volt reference and screen connection shall not be accepted. Optional cable termination shall be provided.

   DMX port:
   Full specification high-speed RS485 port of double insulation rating from both the mains supply and DALI port. Connection shall be via a two-part screw terminal connector. A separate terminal shall be provided for the earth screen connection. The use of a common 0 volt reference and screen connection shall not be accepted. Optional cable termination shall be provided.

   Compatible with DMX 1990 and DMX E1.11 standards. The port shall be configurable as either DMX out or DMX in and shall be RDM ready.

   As DMX out, the port shall provide up to 512 independent channel control. The start address for the controlled channels shall be programmable to any within the 512 DMX boundary.

As DMX in, the port shall accept up to 512 channels for control of any load interface connected to the Router. Control across Routers shall be via Group control.

5. Network connection:
   Ethernet network connection shall be via an RJ45 connector for 10/100 Mbit operation over Cat5e cabling. This Medium Dependent Interface port shall provide automatic crossover (auto MDI/MDI-X) to allow the use of common cable termination practice and thereby shall avoid the need of selective crossover cabling.

6. Memory:
   The data for all connected devices and all associated system data shall be held in non-volatile memory, and shall be retained for not less than 10 years in the event of loss of power.

3.3 Sensors

1. Integrated Sensor:
   An integrated ceiling-mounting unit shall provide luminance measurement, occupancy sensing and IR remote control reception. The three sensor elements shall be separate to ensure no interaction and to give defined performance. The unit shall be of a low profile, suitable for flush mounting into a standard ceiling tile using a nominal 55 mm diameter hole.

2. PIR Sensors:
   Occupancy detectors using PIR technology. A range of sensors shall be available to suit various applications such as small office, large office and high bay. Detectors shall have options for ceiling and surface mounting. Sensitivity shall be programmable from the specialist software package.

3. Microwave sensors:
   Occupancy detectors using microwave technology. A range of sensors shall be available to suit various applications such as open plan, corridor and warehousing. Detectors shall have options for ceiling and surface mounting. Sensitivity shall be programmable from the specialist software package.

4. External Daylight Sensor:
   Photodiode sensor with linear scaling for daylight measurement up to 150,000 LUX. IP 55 rated housing and UV resistant.

5. The DALI connection shall use two-part screw terminal connectors to allow disconnection of the sensor module whilst maintaining the DALI wiring integrity.

6. The sensor shall be powered from the DALI network. Other than the DALI power constraints and the limits imposed by DALI addressing there shall be no limit to the number of sensors supported by the system.

3.4 Specialist occupancy sensor interface

1. Where a specialist sensor is appropriate the controls specialist shall offer an interface that shall allow connection of the sensor to the DALI network. The choice of sensor shall be in collaboration with the controls specialist to ensure compatibility to the system. Where practicable the interface shall allow powering of the sensor from the DALI.

2. Functionality shall be the same as that of the integrated occupancy sensor.

3. The interface shall be of small size capable of being fitted internal to the sensor with nominal dimensions of 20x50 mm by 10 mm thick plus captive connection leads.

3.5 Hardwired Manual Control Panels

1. Controls shall connect to one of the DALI networks of a Router. Communication and the provision of operating power shall be via the DALI network. Maximum current drawn by an individual control shall not exceed 10 mA.

2. Controls shall be mountable within a BS 5733:1995 back-box of 47 mm depth. Construction shall be modular such that a control panel is made up of one or more control modules. Modules shall clip into single gang or double gang module mounting frames for attachment to the back-box.

   A single gang frame shall accept a single control module and fit into a single gang back-box. A double gang frame shall accept up to three control modules and fit into a double gang back-box. Any mixture of control modules shall be permitted. A matching blanking module shall be used when less than three modules are required in a double gang back-box.

3. The DALI connection shall use two-part screw terminal connectors to allow disconnection of the scene control panel whilst maintaining the DALI wiring integrity. The connector shall be 6-way internally linked as three pairs to facilitate link-through wiring of the DALI pair and optional screen without the need for terminal sharing of the wiring.

4. Integral IR receiver lens shall be discrete and of a significantly smaller proportion to manual controls. The lens shall give wide-angle coverage with a high sensitivity cone of nominal 60 degrees.

5. Control panel fascia options shall include, but not be limited to, white plastic, polished brass and brushed stainless steel and shall use “secret fixing” (no visible screws or fastenings). In addition the manufacturer shall offer custom panel solutions to allow continuity of style and finish where standard panel options are unsuitable.

6. Push-button modules:
   Buttons shall give mechanical movement with tactile feedback of operation. Button style, size and spacing shall give easy operation without risk of multi-button operation. The buttons shall be organised in columns of not more than 4 buttons and not more than two columns to a single module. LED tell-back indication shall be integral to the button.
   Module variants shall include:

   Two button, pre-configured as “on” and “off”.
   Two button, pre-configured as “level raise” and “level lower”.
   Five button, pre-configured as four levels and “off”.
   Seven button, pre-configured as four levels, “off”, “raise” and “lower”.
   Eight button, pre-configured as seven levels and “off”.

7. Rotary control module:
   The control shall be of large diameter and low profile for ease of use. Tactile feedback shall give feel of rotation.

   The integral push switch shall be concentric to the rotary. The mechanical movement shall be sufficient to give good tactile feedback.

8. Slider module:
   Single or twin slider controls shall be offered in a single module. Sliders shall be vertical to the module and shall have a nominal travel of 30 mm. The LED indicating an active slider shall be integral to the slider control. The control knob shall be circular and similar in size to that of a push-button control.

9. EnOcean Wireless Gateway:
   EnOcean control panels shall connect to one of the DALI networks of a Router via a gateway. Communication and the provision of the gateway operating power shall be via the DALI network. Maximum current drawn by the gateway shall not exceed 20 mA.

   Each EnOcean gateway shall support up to 20 EnOcean control panels.

3.6 Switch & voltage input unit

1. The Input Interface Unit shall be in the form of a modular plastic enclosure for EN 50022 M36 DIN rail mounting, of not more than four modules width. It shall provide eight inputs, four of which shall be optionally configurable as DC voltage analogue inputs.

2. The unit shall be powered from the DALI network and require not more than 10 mA for operation.

3. The DALI connection shall use two-part screw terminal connectors to allow disconnection of the input unit whilst maintaining the DALI wiring integrity. The connector shall be 6-way internally linked as three pairs to facilitate link-through wiring of the DALI pair and optional screen without the need for terminal sharing of the wiring.

4. All input connections shall use screw terminals that allow the connection of flexible cable of up to 2.5 sq.mm. Cable lengths up to 50 metres shall be permitted.

5. All inputs shall be double insulated from the DALI supply.

6. When configured for switch use the inputs shall be suitable for use with volt-free contact closures, and with such input shall provide 0.5mA loop current.

7. When configured for analogue use, the inputs shall be suitable for connection to devices such as light sensors giving a DC output voltage. The working range shall be 0 to 10 Volts DC with an input impedance of 7.5 kohms. Connection of up to ±15 Volts shall be tolerated without damage.

3.7 Miniature input unit

1. A miniature input unit is intended to provide a convenient interface for mechanical switches used in wall switch-plates and such items as room partition detection switches.

2. A cable inline style unit shall provide four switch inputs in a compact form for installation in locations such as an electrical back-box. Nominal dimensions shall be 20x30 mm by 10 mm thick excluding the connecting cable.

3. A terminal style unit shall provide four switch inputs together with four connections for LED tellback indication. Nominal dimensions shall be 23x30 mm by 15 mm thick including the terminals.

4. A unit shall be powered from the DALI network and require a maximum of 8 mA.

5. The inputs need not be isolated from the DALI network. The inputs shall accept volt-free contact closure and provide 0.5 mA loop current.

3.8 IR Remote

1. The remote control shall be application specific, without unnecessary buttons or functions; and preferable limited to seven functions in total.

2. The unit shall be battery powered, lightweight, and easily held within the hand. The battery shall be a common, readily available type and easily changed.

3. The functions shall include “off”, “raise”, “lower” and four light settings. The different functions shall be clearly identified.

4. Each remote control shall offer a means of selection to the matching panel reception block to avoid the need for dedicated remote control spares. The selection of reception block shall be by an internal switch to avoid accidental operation.

3.9 Luminaires

1. All luminaires shall be equipped with ballasts or drivers meeting the DALI specification in respect of remote control.

2. To obviate any compatibility issues and as far as is practicably possible, the same manufacturer should produce the control system and luminaire ballast or driver. Otherwise the contractor shall ensure that the control system and luminaires are compatible in consultation with the manufacturers concerned.

3. In the event that a luminaire is specified for which no DALI control-gear exists, control-gear compliant to the EN 60929 1-10V analogue control standard shall be substituted. In accordance with the specification of the lighting designer these should then be either circuit controlled or individually controlled by the use of suitable DALI compatible load controllers from the control specialist's product range.

3.10 Enclosures – DIN Rail

1. Dedicated load interfaces shall be self-contained mains powered modules, requiring only a protected mains supply for operation, and shall accept any AC supply in the ranges 90 - 250 Volts and 45 - 65 Hz without adjustment.

2. An interface shall be in the form of a modular plastic enclosure for EN 50022 M36 DIN rail mounting.

3. Power connections shall use screw terminals and allow for the connection of flexible cable of up to 2.5 sq.mm.

4. DALI loading shall not exceed 2 mA.

5. General lighting dimmers shall have universal load handling suitable for, but not limited to:
   - Mains voltage incandescent lamps
   - LED lamps, mains voltage
   - LED lamps, low voltage using dimmable driver
   - Low voltage halogen lamps using dimmable conventional transformers
   - Low voltage halogen lamps using dimmable electronic transformers
   - Cold cathode lamps using dimmable conventional or electronic transformers

   Alternative dimming laws shall allow programme selection of the most suitable for the desired visual impact. The laws shall include but not be limited to a linear light law and the IES square law.

   The dimmed output shall be regulated to compensate for supply voltage and frequency fluctuations. For a 10% change in supply voltage the output shall change by less than 1%, limited to the supply as maximum. There shall be no visible change in output with a frequency change of up to 4 Hz per second, within the working range of 45 to 65 Hz

   The power losses per channel shall not exceed 1% relative to its full load rating. Standby losses shall not exceed 0.01% of the dimmer rating.

6. Ballast controllers shall provide power switching and isolated extra low voltage control. The control protocol shall be programmable and shall include, but not be limited to,
   - 1 to 10 Volts as per EN 60929
   - DALI Broadcast
   - 0 to 10 Volts source control
   - PWM
   - DSI™

   Control drive shall allow connection of up to 50 controllable ballasts; assuming a maximum ballast loading of 2 mA.

Power switching shall be by use of electro-mechanical relays having high inrush rating suitable for switching electronic fluorescent ballasts in accordance with the requirements of EN 60929 for 1-10V controllable ballasts.

Switching arrangement shall be single pole normally open contacts. Air gap off shall be maintained by the absence of leakage components allowing contactor control for high current or multi-phase circuit loads.

7. Switching units shall use electro-mechanical relays having high inrush rating suitable for low power factor loads such as fluorescent ballasts. Air gap off shall be maintained by the absence of leakage components. Where snubber components are required these shall be fitted by the contractor as specified by the load supplier and in compliance with the recommendations of the controls specialist.

   Switching arrangement shall be single pole normally open contacts.

8. Control shall be user selectable and shall be DALI, DMX or via a high-speed RS485 serial link and shall be compatible with the Helvar SDIM protocol. The RS485 unit loading shall be such as to allow not less than 250 channels to be controlled on a single link without repeaters or other intermediary devices.

3.11 Enclosures - Wall Mounting

1. Dimmer cabinets shall be wall-mounting, fully self-contained multiple channel units embodying the protective switch-gear, cable management and field wiring terminals. The enclosure shall be of metal construction of IP 20 rating and shall have an anti-corrosion finish or be protectively painted.

   Access to switch-gear shall be restricted by means of a lockable door that incorporates a viewing window for checking the switch-gear status.

   The controls specialist shall be able to supply cabinet variants as appropriate to achieve installation and cost efficiencies.

2. Construction of the cabinets shall be two-part whereby a chassis frame shall provide the means of mounting and shall contain all site-wiring power cable termination points, incoming protective switch-gear and outgoing load terminals. For ease of circuit identification the load terminals shall be organised in triples with associated controlled live, neutral and earth connections.

   Cable access shall be provided from the top, base and rear of the frame. A clear run shall be provided to allow cable transit through from top to base, the cross sectional area of which shall not be less than 80 sq. cm. Where gland plates are provided these shall include a suitable quantity of knockouts of 20 mm and 25 mm diameter.

3. The dimmer component shall be a fully enclosed self contained multiple channel module capable of being easily fitted and removed from the wall mounting chassis frame without the need of specialist tools and without the need to disturb field wiring. This shall facilitate completion of site wiring and testing prior to dimmer installation and thereafter service exchange.

4. Power connections to the dimmer module shall be by means of chassis frame pre-wired flying leads with plugs. Parking connectors shall be provided within the frame such that each channel can be linked through as required for circuit wiring checks or circuit operation in the absence of the dimmer module.

5. The dimmer module shall be a fully self-contained unit embodying all control and power management circuitry. User interface shall be via graphical display and push buttons with menu driven function selection. All programmable parameters and test functions shall be available via the menu to allow full manual operation in the absence of Router control.

6. The cabinets and/or variants thereof, shall provide 230 Volt 50/60 Hz single or three-phase operation. Operational limits shall be not less than 90 to 260 Volts with auto-tracking of frequency from 45 to 65 Hz. Cabinet rating shall be up to a maximum of 63 Amps per phase.

   The contractor shall ensure the correct power feed rating and protection to the cabinets.

7. Individual channel ratings shall be up to 10 Amps RMS for an ambient temperature of 40 degC.

   Higher ambient temperatures shall be permitted by means of channel de-rating up to a maximum ambient of 50 degC. The temperature-rating relationship shall be provided by the controls specialist and the contractor shall ensure compliance with loading limits.

8. Incoming power distribution and protection and individual channel load terminals shall be pre-wired. There shall be sufficient wiring space to accommodate cable termination loop allowance.

9. General lighting dimmers shall have universal load handling suitable for, but not limited to:
   - Mains voltage incandescent lamps
   - LED lamps, mains voltage
   - LED lamps, low voltage using dimmable driver
   - Low voltage halogen lamps using dimmable conventional transformers
   - Low voltage halogen lamps using dimmable electronic transformers
   - Cold cathode lamps using dimmable conventional or electronic transformers

   Alternative dimming laws shall allow programme selection of the most suitable for the desired visual impact. The laws shall include but not be limited to a linear light law and the IES square law.

   The dimmed output shall be regulated to compensate for supply voltage and frequency fluctuations. For a 10% change in supply voltage the output shall change by less than 1%, limited to the supply as maximum. There shall be no visible change in output with a frequency change of up to 4 Hz per second, within the working range of 45 to 65 Hz

   The power losses per channel shall not exceed 1% relative to its full load rating. Standby losses shall not exceed 0.01% of the cabinet rating.

10. Ballast controllers shall provide power switching and isolated extra low voltage control. The control protocol shall be programmable and shall include, but not be limited to,
    - 1 to 10 Volts as per EN 60929
    - DALI Broadcast
    - 0 to 10 Volts source control
    - PWM
    - DSI™

    Control drive shall allow connection of up to 50 controllable ballasts; assuming a maximum ballast loading of 2 mA.

    Power switching shall be by use of electro-mechanical relays having high inrush rating suitable for switching electronic fluorescent ballasts in accordance with the requirements of EN 60929 for 1-10V controllable ballasts.

    Switching arrangement shall be single pole normally open contacts. Air gap off shall be maintained by the absence of leakage components allowing contactor control for high current or multi-phase circuit loads.

11. Switching units shall use electro-mechanical relays having high inrush rating suitable for low power factor loads such as fluorescent ballasts. Air gap off shall be maintained by the absence of leakage components. Where snubber components are required these shall be fitted by the contractor as specified by the load supplier and in compliance with the recommendations of the controls specialist.

    Switching arrangement shall be single pole normally open contacts.

12. Control shall be user selectable and shall be DALI, DMX or via a high-speed RS485 serial link and shall be compatible with the Helvar SDIM protocol. The RS485 unit loading shall be such as to allow not less than 250 channels to be controlled on a single link without repeaters or other intermediary devices.

13. Each dimmer module shall have a hard-wire level override input to allow connection of such as fireman's switch if required. The input shall be suitable for use with a volt-free contact closure. The input shall appear as a high impedance voltage source not exceeding 5 Volts. A single input shall be used for all channels of a module, however the override level shall be individually programmable for each channel.

14. Each module shall have a user interface to allow channel set-up configuration and circuit testing prior to system control by a Router. The interface shall be menu driven with an information display for clarity of operation.

    A lock-out facility shall allow a controlling Router to inhibit local parameter changes of a configured system.

15. All programmable features shall be retained indefinitely by the dimmer in the event of power loss.

3.12 Blinds controller

1. A DALI controlled interface shall allow the control of two motor controlled blinds, curtains, shutters or similar loads.

2. Each channel shall consist of two separate 10A single pole normally open power relays functionally interlocked for blind control. Each channel shall have programmable options for open/close operation or power/up-down. The run time (time the relays are closed) shall be programmable in one-second increments to not less than four minutes.

3. To accommodate variations in blind design the power relays shall be configured as volt-free double insulated circuits to allow freedom of supply and load connections, including multi-phase and extra low voltage DC operation.

3.13 RS232 AV Interface

1. An RS232 Interface Unit shall be in the form of a modular plastic enclosure for EN 50022 M36 DIN rail mounting, of not more than two module widths. It shall provide both transmit and receive ports. Both ports shall fully comply with RS232 voltage and current drive specifications.

2. The unit shall be powered from the DALI network and require not more than 15 mA for operation.

3. The DALI connection shall use two-part screw terminal connectors to allow disconnection of the input unit whilst maintaining the DALI wiring integrity. The connector shall be 6-way internally linked as three pairs to facilitate link-through wiring of the DALI pair and optional screen without the need for terminal sharing of the wiring.

4. RS232 connections shall use screw terminals that allow the connection of flexible cable of up to 2.5 sq.mm.

5. The RS232 ports shall be double insulated from the DALI.

PART 4 – GLOSSARY

Absence detection	*Where lights that have been turned on via a user interface or some other means, are automatically turned off once an area has been vacated*
Architectural lighting control	*A control system that is used in conjunction with light sources to enhance a buildings architectural features or to create a particular ambiance in a space*
ASCII	***A**merican **S**tandard **C**ode for **I**nformation **I**nterchange. A code for information exchange between computers and devices made by different companies*
Astronomic time clock	*A time clock that calculates sunrise and sunset for a given location on the earths surface*
AV	***A**udio **V**isual*
Ballast	*An electrical device for starting and regulating fluorescent and discharge lamps*
BAS	***Building Automation System***
BMS	***B**uilding **M**anagement **S**ystem*
Building background files (plans)	*A drawing imported into the control system software which allows the display of typically, a reflected ceiling plan of the area concerned. The plan details the building footprint and principle features such as cellular offices, meeting rooms etc.*
CAT 5e	*Four pair of twisted telephone wires capable of up to 100 million bits (100Mbps) data transmission for up to 100 meters*
Closed loop control	*A control system in which all adjustments necessary to maintain the system occur automatically through a direct feedback signal from the sensor*
Corridor hold	*A control scenario which will maintain ("hold") on lighting (typically a corridor or circulation areas), when other lighting is on. Also known as Corridor Linking or Group Dependency*
DALI	***D**igital **A**ddressable **L**ighting **I**nterface*
DALI broadcast	*Where Dali signals are transmitted from a device in an unaddressed format*
Daylight harvesting	*A technique where natural daylight passing into a space through windows and skylights is used to allow a reduction in the amount of artificial light provided*
Ethernet	*A local area network allowing several computers and/or devices to transfer data over a communications cable.*
Exit delay	*A delay between selecting an off command and the lights turning off*
Hexadecimal	*A numbering system in base 16. A single 8-bit byte can be fully represented as two hexadecimal digits*
Icons	*A pictorial image used in a graphical user interface to represent a luminaire or other device*
Illuminance	*The density of the luminous flux incident on a surface*
Interface	*A connection point between two systems, or a user and a system*
IP addressing	*The numerical sequence that serves as an identifier for an Internet server or device*
IR (infra-red) receiver	*A device that receives infrared signals, typically from a hand held transmitter*
LED	***L**ight **E**mitting **D**iode*
LED tell-back	*A visible indication of the selected button of a control panel by the use of an LED*
Lighting load	*A light source, lamp or connected circuit of lights*
LMS	***L**ighting **M**anagement **S**ystem*
Grouping	*A number of luminaires or circuits which are configured in software to work cooperatively*
Luminaire	*A light fixture containing one or more light sources*
Mains borne signalling	*A method that utilises a control signal superimposed on a mains power system without the*

	need for separate control cables
Modular wiring	*A pre-manufactured cabling system consisting of plug together wiring sections and distribution hubs*
Network node	*A device or item of equipment occupying a single unique address point on a system network*
Networking wireless routers	*A device for connecting to a system using wireless connection*
Occupancy sensors	*A device for detecting the presence of a person or people within in a space*
OLE	***O**bject **L**inking and **E**mbedding.* Allows objects from one application to be embedded within another
OPC	***O**pen **P**rotocol **C**onnectivity. A set of connectivity standards for automation from the OPC Foundation*
Open loop control	*A control system where the resultant action is not directly monitored by the controlling sensor. e.g. an external sensor controlling internal lighting.*
Operator Workstation	*Desktop or Laptop PC used to set-up, configure and monitor a lighting control system*
PC	***P**ersonal **C**omputer*
Power-track	*Multi pole Bus Bar style, electrical power distribution system*
Presence detection	*Where a sensor is used to turn lights on when presence is detected within the sensor coverage area, and off again once the area is vacated*
R.F.	***R**adio **F**requency*
RoSH	*European directive relating to the **R**estriction of **H**azardous **S**ubstances*
Rotary control	*A user interface consisting of a rotary knob. The knob is rotated to increase or decrease light level*
Router	*A device for connecting Dali networks together using an Ethernet network. The router also retains the system configuration information for its connected Dali networks*
RS232 serial interface	*A standard for serial data transmission between computers and peripheral devices*
Scene control panels	*Programmable multi button user interface*
Scheduler	*An automatic programme which generates system event commands according to the time of day*
Sensors	*Devices for detecting presence or light level etc.*
Serial com ports	*A communications port for passing information in a serial data stream e.g. RS 232*
Slider panels	*A user interface consisting of a linear slider. The slider is raised or lowered to increase or decrease light level*
TCP/IP	***T**ransmission **C**ontrol **P**rotocol / **I**nternet **P**rotocol*
UDP	***U**ser **D**atagram **P**rotocol. A protocol within the TCP/IP protocol suite that is used in place of TCP. UDP is known as a stateless protocol, as it makes no provision for acknowledgement of packets received*
Volt-free contact	*A pair of contacts that are neither connected to any other point or earth, and can therefore be used in any circuit*
WEEE	*European directive relating to **W**aste **E**lectrical and **E**lectronic **E**quipment*
Windows™ XP	*An operating system from Microsoft's Windows family of operating systems*