

This document outlines the structure and principles employed in a Dynalite control system, including information on DyNet network architecture, operating concepts, system commands, device addressing and other associated features.

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system structure

The Dynalite system utilises a true distributed processing architecture, where a range of devices are interconnected over an RS485 network to form a complete control solution. Command and status information passes to all devices over this network using the event based DyNet protocol. Dynalite control devices all incorporate an integral microprocessor and non-volatile memory. All configuration data required by each device to operate is stored within the non-volatile memory of the device. DLight, Dynalite's commissioning, monitoring and control software, is used to modify configuration registers within each device.

Dynalite's distributed architecture dramatically improves reliability over systems that incorporate centralised processors, where malfunction of one device could result in total system failure. Should a single device fail in a Dynalite system, all other devices will continue to operate as normal. This distributed architecture also supports a wide range of interfaces, manufactured by Dynalite and other system vendors, to offer a robust flexible approach to control of lighting and other systems.

Dynalite's range of control products can be broadly categorised as; User Interfaces and Load Controllers. The user interface range includes user control panels, LCD touch screens, time clocks, and sensors. User interfaces are generally programmed to issue single event-based command messages onto the DyNet network, in response to a user or input action. Dynalite has developed an extensive range of controllers with a variety of output types, combinations and load ratings. Load controllers constantly listen to the network and only respond to command messages that relate to the controller's specific configuration. Control associations are established between user interfaces and load controllers using straightforward addressing and command techniques.

device addressing

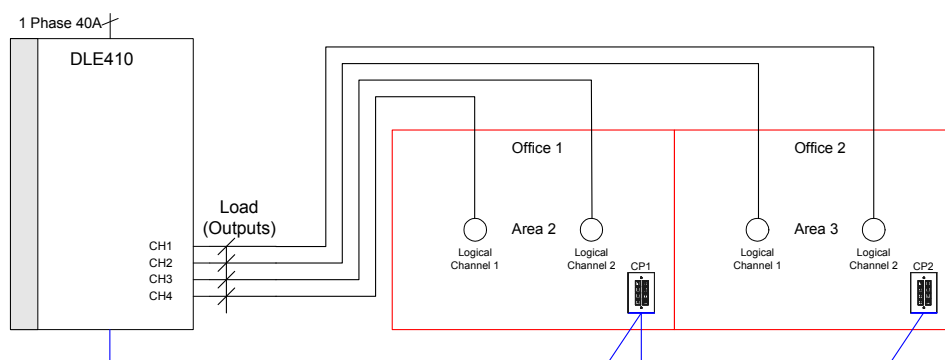
All control points of a Dynalite system have a Physical and Logical Address. Physical addresses are used primarily during system commissioning to configure devices. To identify an individual circuit connected to a load controller, a Device Type, Box Number and Physical channel number are used. Similarly for a user interface panel, a Device Type, Box Number and Physical button number are used. The term Physical refers to the individual physical attributes of the control point. For example a 12 Channel D2 Box 1 will always have 12 Physical Channels. These Channels are physically different from the Channels in 12 Channel D2 Box 2. Physical addresses are also used for reporting system diagnostic information related to hardware operation.

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Physical addressing is also used to obtain operating parameter variables from specific devices. An example of this is a technique that can be adopted with a Universal Sensor. Sensors are normally configured to directly issue commands when particular lighting levels are attained or movement is detected. However, in certain applications it may be necessary to create separate control routines external from the sensor based on the lighting level sensed or occupancy status detected. This can be achieved by directly addressing the sensor with physical messages, thus bypassing the device configuration. This feature is typically used when a monitoring system is added to the Dynalite installation such as air-conditioning control systems.

Load controller output channels and user control panel buttons are generally configured to logical Areas, independent of their physical characteristics i.e. the device they are connected to. This logical overlay enables control points to be grouped regardless of their physical association. A Logical Channel is a nominated Physical Channel that is assigned to an Area. The Dynalite system can support up to 65,535 Areas and each Area up to 65,535 Logical Channels. It is also possible to assign more than one Physical Channel to a single Logical Channel. In a lighting control application, consider the scenario of a large room with 9 Physical Channels driving downlights along the length of the wall. All of these Physical Channels can be assigned to just one Logical Channel. This simplifies operation of large installations, as the end user only has to make adjustments to one channel.

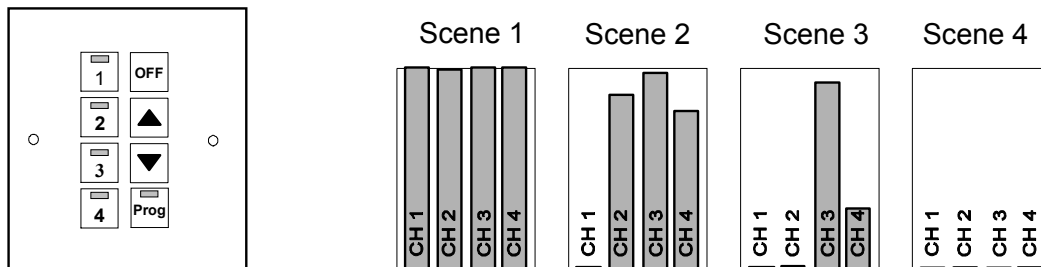
The Dynalite system can be divided into smaller subsections using logical addressing. Consider the example of a dimmer that supplies lighting circuits to 2 rooms, with a user control panel in each room. The controller lighting circuits and the control plate in Room 1 would be configured as Area 2, and the controller lighting circuits and the control plate in Room 2 would be configured as Area 3. The end result would be that the control plate set to Area 2 would only control or program circuits designated Area 2, and the control plate set to Area 3 would only control or program circuits designated Area 3, so the two rooms will operate independently of each other.



The ability to logically bind individual control channels into groups is essential in installations involving a large number of channels. Without this facility it would not be practical to view and configure the control channels assigned to any one particular Area. Configuration and maintenance of systems that do not include this provision can therefore become quite cumbersome and time consuming.

preset states

During commissioning each Dynalite load controller may be configured with a number of output states, which are referred to as Presets. Most load controllers will typically accommodate up to 170 presets. The preset defines a specific output level for each channel of the controller.



The illustration above outlines a typical lighting control application where different intensities are required for each of the four channels. These are set and stored in the controller's memory during commissioning. It is then possible to "recall" these settings from the controller's memory at the touch of a button, or at predetermined times from a time clock or automatically from an integrated building management system.

A typical application for this approach would be in a hotel coffee shop, where the proprietor requires a predetermined lighting "scene" for breakfast, another for lunch, one for dinner and another for supertime. These settings can be preset and then simply recalled at the touch of a button. The time for the change to fade from one scene to another may also be preset and stored in memory. This way the patrons do not feel any visual discomfort when the lighting changes from one mood to another over, say, 10 minutes.

operating concepts

The Dynalite system can be controlled in several different ways, dependent on application requirements. Output changes can be achieved using Area Preset, or Channel Level command messages.

The most common approach is Area Preset control where Preset states stored within the controller are recalled. Area Preset command messages will affect all control points that are assigned to the respective message Area. An example of this would be a button press on a user control panel that is configured to issue an Area Preset command, say Area 1 go to Preset 1 over 5 seconds. All load controller channels assigned to Area 1 would change to their preset 1 output state in 5 seconds. Status indicators on all user control panels with buttons assigned to Area 1 Preset 1 will also follow accordingly. Preset control is ideally suited to applications where a large number of channels are to be controlled in a single area.

The ability to recall a preset scene affecting multiple load channels in one area with a single network message is critical in architectural lighting applications. Systems that do not include provision to store presets or

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 require multiple network messages to achieve a state or scene change may produce a discernable cascade effect as the channels sequentially receive individual level commands. This often produces an undesirable 'mexican-wave' effect and network traffic complications.

Channel Level command messages can also be used to affect output change on a specific Channel within a defined Area. An example of this would be a user control panel button configured to issue the message Area 1 Channel 1 go to 50% over 5 seconds. All load controller channels assigned to Area 1 Channel 1 would go to 50% output in 5 seconds. This method can be used where individual channel control is required and the number of channels is low. It is typically used in a home or small office environments where the user wishes to manually change the load controller output levels.

programmable logic control

Several Dynalite devices also incorporate programmable logic control functionality. Using DLight software it is possible to author and embed complex programs within these devices that use arithmetic, sequential and conditional logic functions. These programs are referred to as tasks. Tasks can be controlled from within a device or from another device on the network.

Tasks are often used in applications where a single input or user interface action is required to deliver control over multiple areas. An example in architectural lighting applications would be a "welcome" function on a user control panel located at an entry point to a residence or office. When operated the task issues a sequence of area preset commands required to illuminate an access path through the installation.

system commands

The Dynalite system utilises a range of commands that can be assigned to any user interface control or device input during system configuration. The assigned command is issued on the DyNet network when a corresponding user or input action occurs. The following table summarises the range of control commands that are commonly used.

Preset Recall Commands	
Set Area/Channel to Preset	Recall Preset # for all Channels assigned to logical Area # in # seconds
Set Area/Channel to Off	Set all Channels assigned to logical Area # to off in # seconds
Level Recall Messages	
Set Area/ Channel to Level	Set all Channels or Channel # in logical Area # to Level # over # seconds
Ramping Commands	
Ramp Area/Channel Up	Start Ramping all Channels or Channel # toward 100% at a # ramp rate
Ramp Area/Channel Down	Start Ramping all Channels or Channel # toward 0% at a # ramp rate
Stop Ramping Area/Channel	Stop all Channels or Channel # in logical Area # from ramping

Stop Ramping Area/Channel And Programme Preset	Stop all Channels or Channel # in logical Area # from ramping and program current levels to preset
Area Control Commands	
Program Levels to Preset	Save present output Levels in logical Area # to current Preset
Set area to Panic Mode	Set all channels in logical Area # to the Panic Preset, disable and lock all user interface panels assigned to the respective logical Area
Revert Area to Unpanic Mode	Unlock and enable all user interface panels in logical Area #
Enable/Disable Panels	Enable/Disable all user interface panel buttons assigned to logical Area #
Enable/Disable Motion Detectors	Enable/Disable motion detectors assigned to logical Area #
Enable/Disable Photo Electric Detectors	Enable/Disable all photo electric detectors assigned to logical Area #
Set Area Preset Offset	Apply offset of # to all future Preset messages received by logical Area #
Set/Clear Area Links	Set/ Clear area links between channels assigned to logical Area #
Status Commands	
Area Status	
Request/Reply Current Preset	Request current Preset in logical Area #. System replies with current Preset # for respective logical Area #.
Request/Reply Current Area Link State	Request current area links between channels assigned to logical Area #
Channel Status	
Request/Reply Channel Level	Request current Channel Level # for logical Channel # in logical Area #. System replies with current Channel Level # for respective logical Channel # in respective logical Area #

The Dynalite system supports many commands beyond those outlined above. Further details are available on request.

global functions

It is possible to send every area on a network to a single Preset using Area 0 (zero) as the target Area. There are implications when adopting this method where different 3rd party devices are in use such as curtains etc. For this reason Preset messages to specified Areas are the preferred method of global control.

combining control spaces

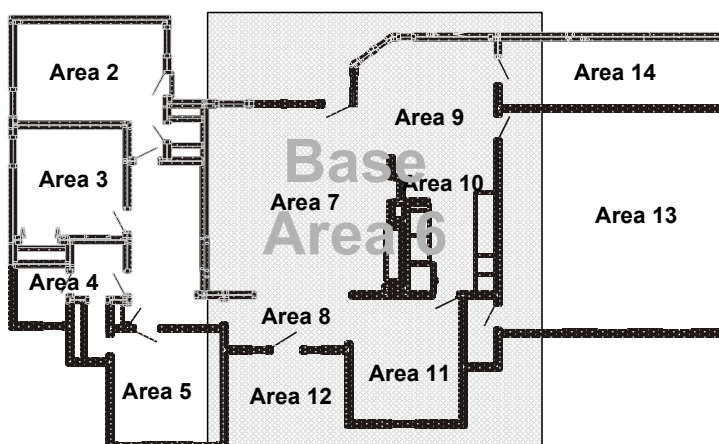
Applications where de-mountable partitions are being used (typically in areas such as hotel ballrooms, training rooms and conference centres) will require the control system to combine and separate groups of control devices. It is usual that each space has its own user control panel. When the partitions are opened or closed, thus dividing a room, it is most important that the control system for the lighting should also combine or

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 segregate in harmony with the partition status. In practice this means that when a room is divided, the control panel in one section must not be able to control the lighting in another section. However, as soon as the partition is opened, both control panels should work in parallel. This completely automates the room-combining function, so the user does not have to worry about configuring the system to suit the current arrangement. Dynalite's Join or Area Link functions can be used to combine or separate control groups in these applications.

The Join function is suitable for applications where there are a small number of separate sections involved. The Join function enables an Area to be divided into a number of sub sections. Sub sections can be combined and separated using the appropriate Join command. Area linking should be used in applications involving a large number of sections. This function modifies the load controllers to temporarily assign channels to more than one Area. With area linking it is possible to create temporary control links between up to 24 independent Areas with unidirectional or bi-directional control for each area in the link. The obvious main difference between this method and Join is the ability of area link to combine a greater number of areas.

A dedicated Base Link Area can also be used to act as a global area for Channels assigned to that Base Link Area and is useful as a global control for a block of Areas. The channels to be controlled are assigned during commissioning and can be in one of the 24 areas above the dedicated Base Link Area. Area linking is unidirectional, so if areas 7 and 10 for example, are to work in tandem there must be two area link messages sent; one message to link area 7 to area 10 and one message to link area 10 to area 7.

In the example below areas 7-12 are all independent areas that can be controlled with standard preset messages. Assigning them to base link area 6 means that if and when required, any of the six areas shown can be linked to any of the other areas causing it to listen to another area's messages as well as its own. It could be possible; for example, if all areas indicated by base link area 6 were to be used together for a function, all the areas could be linked and controlled together with a single DyNet message.



Area linking can also be used to provide a pseudo global Area other than Area 0. It is possible to create a pathway of light through a number of different areas by sending a single control message to the base link area.

network watchdog

Fail safe operation of the Dynalite system can be maintained through the Network Watchdog feature. This involves broadcasting a special data packet (the Watchdog Tick) to all load controllers across the network at programmed intervals. If a particular controller does not receive these messages within a predefined period, the controller will default to an assigned panic preset or to a specific preset stored in the load controller. This ensures that all controllers revert to a safe operating state should any part of the network cabling be physically severed, or there is a load controller failure.

status indicator tracking

User control panels incorporate LED status indicators on all buttons to indicate the current preset state of an Area. When a Preset message is transmitted on the network, indicators will illuminate on any user control panel button that is also assigned to that Area Preset. Indicators for buttons assigned to other presets within the same Area will turn off. In this way the panels will always indicate the current state of an area.

In some circumstances it may be necessary to change the state of some or all button status indicators on a user control panel. The Dynalite system enables status indicators to be controlled independently using an appropriate physical command message. It is also possible to change the state of specific button status indicators while leaving others in their current state.

diagnostic functions

The Dynalite system also supports a number of advanced diagnostic functions, which include Device Online/Offline status, Circuit Breaker Trip Reporting and Circuit Run Time Tracking.

Device Online/Offline status enables all devices to be periodically polled to determine if they are visible on the network and operating normally. Invoking this function in DLight software ensures that network or device failures are identified promptly.

Load controllers that incorporate the Circuit Breaker Trip reporting function will broadcast a message on the DyNet network when a load circuit breaker on the controller trips. The message identifies the Physical device and channel affected by the tripped circuit breaker. These messages can be used to alert maintenance personnel of faults so that remedial action can be promptly carried out.

Controllers that support Circuit Run Time tracking will continuously record the accumulated operating time for each output channel. Run time data for each controller can be queried or reset at any time. This information can be used by a site management system for scheduling periodic maintenance, such as lamp replacement intervals on lighting fixtures.

the physical network

Dynalite products utilise RS485, which is an industry standard method of data transmission as detailed in the TIA/EIA-485-A specification, with some variations. (For more information on the TIA/EIA-485-A specification: www.tiaonline.org)

The TIA/EIA-485-A specification defines a UL (Unit Load), which declares that an RS485 driver must be able to drive 32 ULs. This means that an RS485 network supports 32 nodes, when each node bears a unit load on the line. Dynalite products use 1/8 UL drivers and we recommend up to 128 devices on a network segment.

Another important variation from the TIA/EIA-485-A specification is the addition of an extra conductor that carries a DC supply, which is generated by an integral power supply contained within all mains powered devices and is used to energise those devices that do not connect to mains power, such as motion detectors and wall mounted control panels.

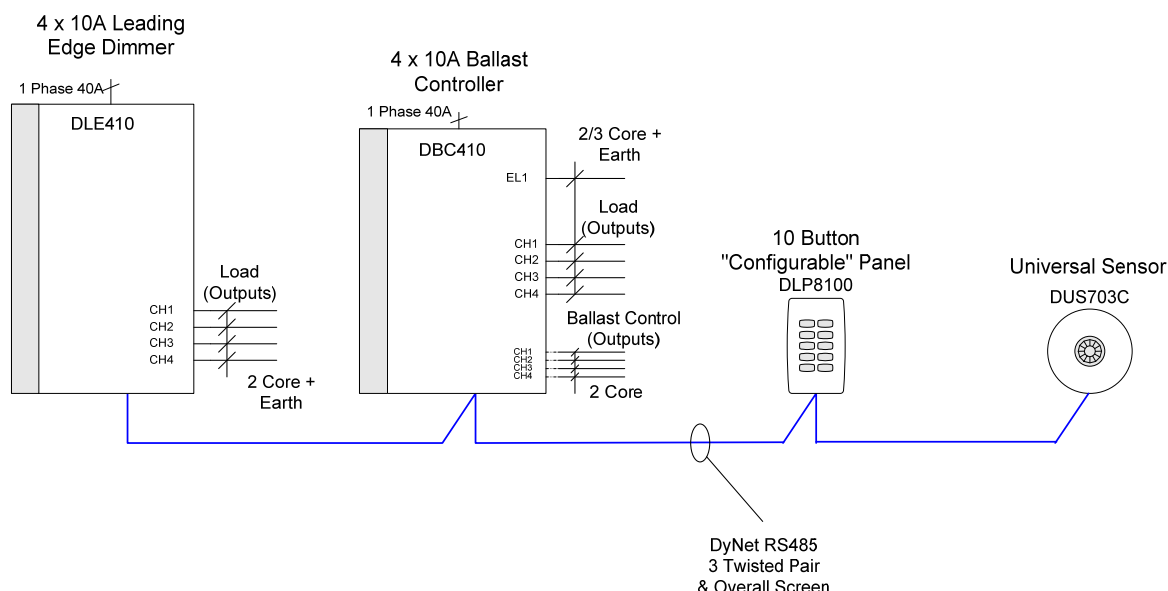
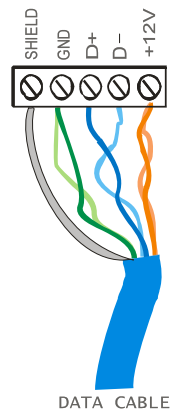


Figure 1: Typical small DyNet Network

Devices are simply connected with a general purpose 3 twisted pair and shield data cable that loops around to all devices as depicted in Figure 1. If using CAT5 cable the 4th pair can be left as a spare or used as a drain wire. The connections are as follows:

Terminal	Cable	Recommended Colour Coding
Shield	Drain wire (or CAT5 spare pair)	Shield (or Brown pair)
GND	1 pair paralleled	Green pair
D+	½ pair	Blue
D-	½ pair	Blue / White
+12V	1 pair paralleled	Orange pair

Note the conductors that carry the DC supply are both wires in the pair paralleled. This is to avoid the DC supply suffering voltage drop on long cable runs. A 5-way pressure pad terminal strip is provided on devices for data cable termination. Some devices also have an RJ12 connector for temporary connection of portable and programming devices.



Some sites require far more devices than the 128 maximum allowed on a single network segment. A typical application is a multi story building, with each floor containing a network of devices. The network segment for each floor is called a Spur. All spurs are joined together via a Trunk, which is quite often installed in a riser, linking all floors together.

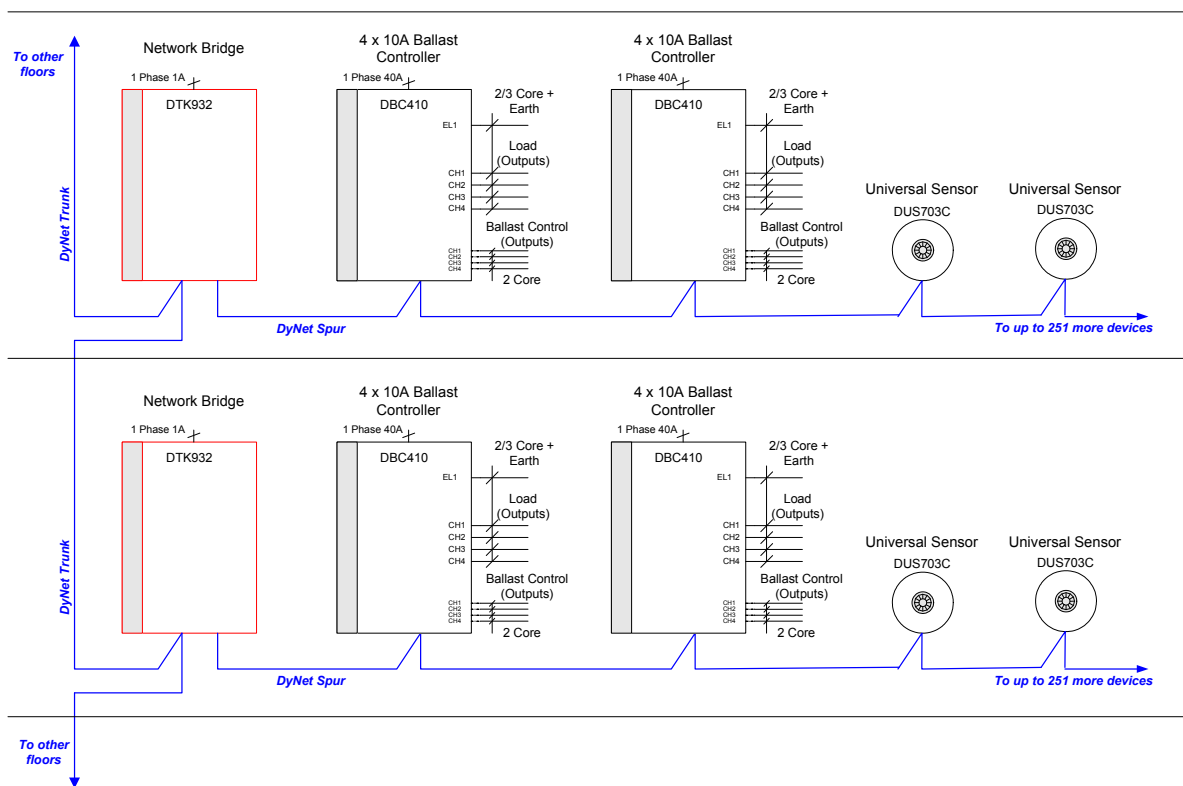


Figure 2: Larger DyNet Network utilising trunk & spur technology

Note the spurs do not directly connect to the trunk, but are connected via Network Bridges. A Network Bridge has two RS485 ports that are optically isolated from each other, which will assist to isolate any faults to a single spur only and also provide galvanic isolation. The use of Network Bridges allows the maximum number of devices on a single network to be 16,776,960. Network Bridges may also be used as repeaters when cable runs exceed 1,000 metres. In addition to optical isolation, the Network Bridge can also be configured as a packet filter for security and network load balancing purposes.

dynet 2 protocol properties

Packet Length:	Variable, 12 to 1024 bytes
Integrity Checking:	16 bit Fletcher Checksum
Baudrate:	9600 baud to 460800 baud (device dependant)
Data Word Format:	8 bit data, 1 start bit, 1 stop bit, no parity (8N1)
Message Tracking:	Source network address embedded in each packet
Logical Areas:	65534, 0 = All Areas
Logical Presets per Area:	65519 editable, 16 predefined
Logical Channels per Area:	65534, 0 = All Channels
Fade times per message:	0 to 23.3 hours @ 100mS resolution
Physical Channels per device:	65534, 0 = All Channels
Physical Device Types:	254
Physical Box Numbers per Device Type:	65535