

App Note 37 Rail-DALI cheat sheet

This app note should only be used as a guide to DALI. If you require more technical information please refer to the links at the end of this document.

History:

DALI (IEC60929) was created by the IEC standard committee to centrally control a buildings lighting system in an efficient manner, cut down wasted electricity, provide a more controllable system and an interface with more complex systems. The general operation time of these ballasts were over 24 hours and therefore not time critical so the designers opted for flexibility to the communication structure rather than speed.

They designed a system that was easy to wire, very few distance limitations and allowed a large number of ballasts on a single data circuit with no additional boosters. Unfortunately this came with several disadvantages that were not considered important, such as, limited number of individual channels and slow refresh rates.

DALI is used to change lamp states over a long period of time rather than continuous changes / dimming.

Overview:

- Two wire system that can be wired in either polarity
- A DALI circuit requires **at least one** DALI PSU
- Two way communication
- No repeaters or splitters are necessary
- Sensors can be added on the same circuit
- Up to 64 individual channels on a single circuit
- Up to 16 groups on a single circuit
- Controller can be placed at any point in the system
- Installations can be upgraded at anytime
- Variable cable distances, achievable with additional DALI PSU's *
- Unrestricted number of ballasts, achievable with additional DALI PSU's *

** Please refer to the DALI specification for more details*

Communication:

DALI communication uses a very simple and robust communication method in the form of a two wire system. This allows two way communication so that the controller can talk to individual ballasts. To change a value at an address the controller will send an address command followed by a value. The ballasts that are set to this address will implement the new value. Following some basic rules, listed below, allows the installer to quickly connect and control multiple Ballasts over long cable distances with the minimum of equipment.

Commissioning/Programming:

Once the DALI installation has been completed the ballasts have to be programmed before they can be used. This stage requires specialised equipment that assigns a unique random number to each ballast and then sets the ballasts parameters such as start address and group number. Rail-DALI does not have this function.

DALI Circuit PSU:

The main concept of a DALI circuit is that there has to be a DALI PSU added to the data wires to give the system power. It's purpose is to provide 16V @ 250mA on the data lines, creating a '1' state. For communication, the transmitting device will short this voltage to ground, creating a '0' state, and therefore the two levels needed for the data communication.

DALI Terms:

Start Address – *The channel number the ballast responds too, i.e. 1 to 64*

Group Number – *The group number the ballast responds to, i.e. 1 to 16*

DALI Circuit – *The data bus that carries all the information*

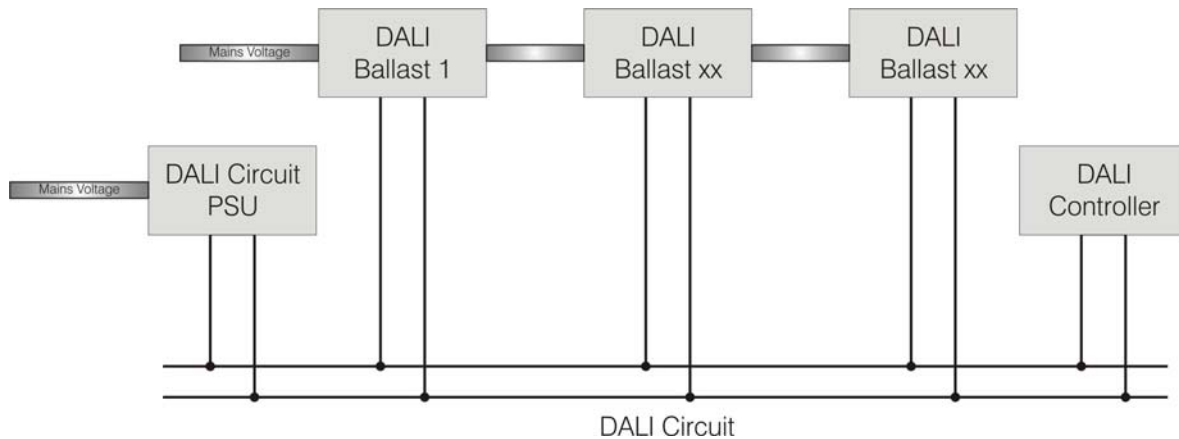
DALI PSU – *The power supply unit that must be connected to the data lines so that data can be transmitted. The number of PSU's is dependant on number of ballasts, sensors, cable distances etc*

DALI Ballast – *A lighting fixture that has a DALI communication input for external control*

Sensor – *A device that is triggered by an external state and sends out a DALI command*

Example DALI Circuit:

Below is an example system outlining the basic wiring principles of the DALI protocol.



Note: Please refer to the DALI specification for more details on the wiring rules.

Timings:

DALI is very slow compared to other protocols, such as DMX512, used within the lighting industry as it was designed to be flexible and easy to use and speed was not an important factor. Listed below are some timing considerations;

- A single channel value change takes 16mS
- To refresh all 64 addresses on a single circuit takes approx 1 second
- To dim a **single address** from 0 to 255 (increment of 1) would take approx 4 seconds
- To dim all 64 addresses from 0 to 255 (increment of 1) would take approx 260 seconds

Interfacing between DMX and DALI:

The main consideration when interfacing between DMX to DALI is the refresh rate. The average DMX refresh rate is up to 24 frames per second. That means it can have up to 12,288 value changes per second spread over 512 channels. Compared to DALI that is very quick as it uses a different type of communication protocol and a different data structure, i.e. it sends 512 channels of data per frame rather than individual channels. Listed below are some considerations when designing a DMX to DALI system;

- DALI takes 16mS to change the value at a single address
- DMX takes 0.08mS to change the value at a single address
- DMX is approximately 200 times quicker than DALI
- On a single DALI circuit you can only have approx 60 changes per second

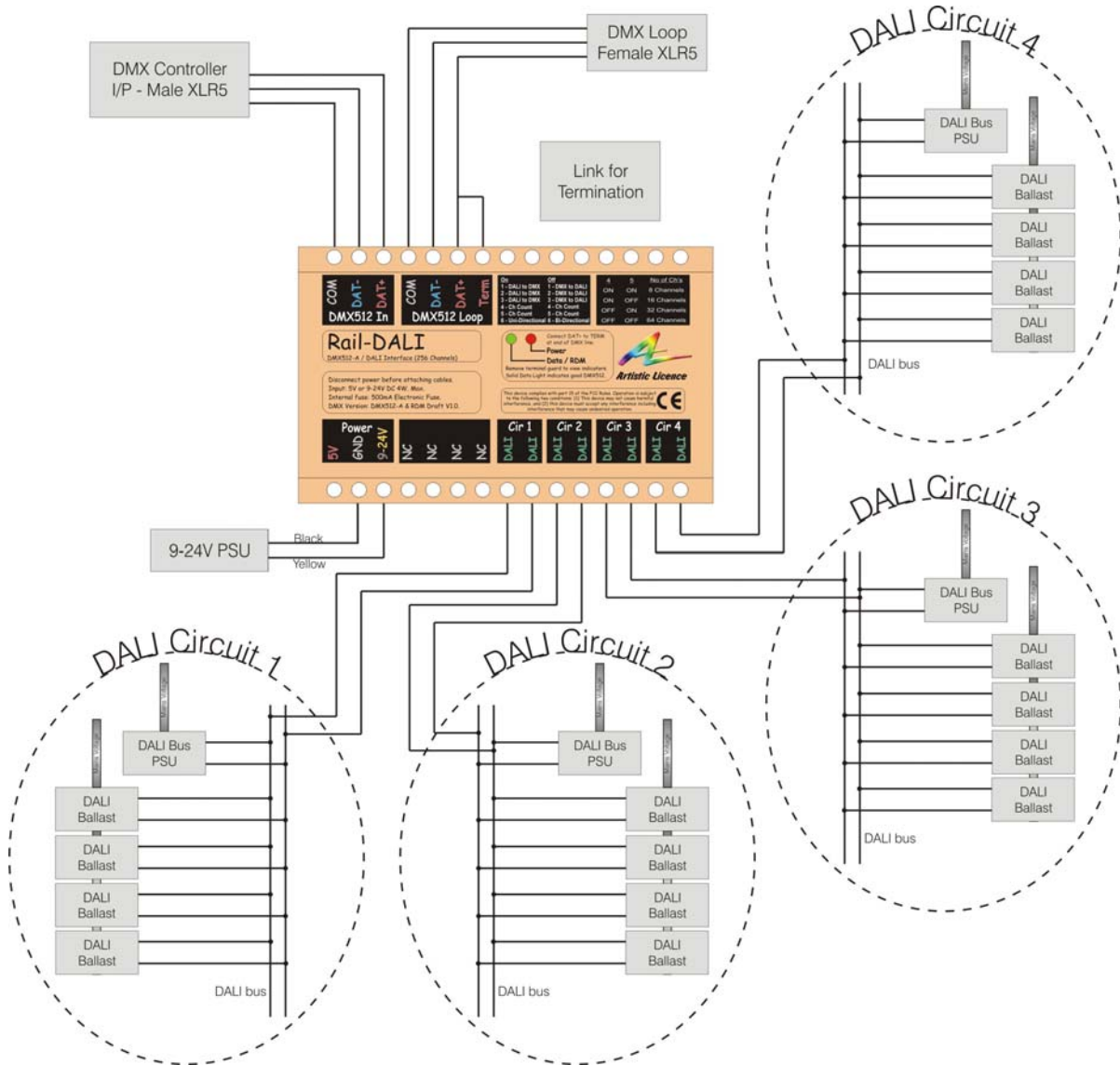
As these considerations show converting between DMX to DALI can cause speed issues if the DMX values change to frequently. Also the Rail-DALI can only transmit one DALI output at one time so to refresh all 256 channels on a Rail-DALI would take approx 4 seconds.

For a basic installation that only requires minimal changes, i.e. house lights, which can be controlled over a longer period of time a fully loaded Rail-DALI can be used. However if the installation requires a higher rate of refresh then only one output from a Rail-DALI should be used.

Example Application Using Rail-DALI:

The diagram below is an example of how to control up to 256 addresses spread over four separate DALI circuits using a Rail-DALI. The input to the system will be from a standard DMX controller. This is then translated into DALI with reference to the start addresses.

This example would only be used when the changes that are required are minimal, i.e. only changing state of several ballasts per second.



Note: You require a separate DALI Circuit PSU for each output on the Rail-DALI

Common Problems:

When interfacing between DMX to DALI there are usually the same common problems:

- 1) The significance of the DALI Circuit PSU is not understood
Every DALI circuit must have at least one DALI PSU for the communication protocol to work.
Without this power supply unit there will be no power of the data lines.
- 2) The different refresh rates are not taken into consideration
As documented earlier, DMX is approx 200 times faster than DALI. If the DMX values change at multiple addresses simultaneously a time lag will develop as the changes are transmitted on the DALI network.
For example if we consider two DMX packets, the first packet has channels 0 to 64 at 0%. The second packet has channels 0 to 64 at 100%. If the system was using one Rail-DALI to control a fully loaded circuit (i.e. with 64 ballasts) it would take one second to implement all of these changes! You would see a stepping on the individual ballasts.
- 3) Standard dimming curves are being used on low resolution ballasts
A standard dimming curve in DMX generally increments the value by 1 for each step. That would require 255 commands that Rail-DALI has to transmit. On a low resolution ballast this kind of resolution would be seen so changing the dimming curve to increment by the value of 5 or 10 would reduce the number of commands Rail-DALI has to transmit.
- 4) Confusion over how to control lamps, i.e. address or group control
Rail-DALI has four personalities:
Personality 0 –
Broadcast channel mode, i.e. all 64 channels on an output is controlled by one DMX channel
Personality 1 –
Broadcast group mode, i.e. each DALI group (16 groups), controlled by a single DMX channel, broadcast on all outputs
Personality 2 –
Individual group mode, i.e. each DALI group on each individual output is controlled by a separate DMX channel
Personality 3 –
Individual channel mode, i.e. each DALI Channel on each individual output is controlled by a separate DMX channel
- 5) Installation problems, i.e. assigning start addresses
Rail-DALI is not capable of setting the fixtures start address. This is done during the commissioning/programming stage. However you can re-assign the sub-devices start address within Rail-DALI using RDM. This will allow the DMX channels to be re-directed.
- 6) Rail-DALI seems to be stepping or missing steps
This is caused by the buffer being over run. If there are too many changes occurring in DMX (i.e. more than 60 a second if using one output) the buffer will be overloaded and some of the changes will be deleted. To overcome this, reduce the number of changes on the DMX controller.
Also by reducing the number of ballasts on a circuit or the number of outputs in use on the Rail-DALI will improve refresh rates as less commands need to be sent.

For more information about DALI please visit:

<http://www.dali-ag.org/>

For more information about DALI Circuit PSU's please visit:

<http://www.helvar.com> – Digidim Power Supply (401)