lamaPLC Communication: DALI

Digital Addressable Lighting Interface (**DALI**) is a trademark for network-based products that control lighting. The underlying technology was established by a consortium of lighting equipment manufacturers as a successor for 1-10 V/0–10 V lighting control systems, and as an open standard alternative to several proprietary protocols. The DALI, DALI-2 and D4i trademarks are owned by the lighting industry alliance, (**DiiA**) *Digital Illumination Interface Alliance*.

DALI is specified by a series of technical standards in **IEC 62386**. Standards conformance ensures that equipment from different manufacturers will interoperate. The DALI trademark is allowed on devices that comply with the DiiA testing and certification requirements, and are listed as either registered *(DALI version-1)* or certified *(DALI-2)* on the DiiA website. *D4i* certification - an extension of **DALI-2** - was added by DiiA in November 2019.

Members of the AG DALI were allowed to use the DALI trademark until the DALI working party was dissolved on 30 March 2017, when trademark use was transferred to DiiA members. Since 9 June 2017, Digital Illumination Interface Alliance (DiiA) certifies DALI products. DiiA is a Partner Program of IEEE-ISTO.

Technical overview

A DALI network consists of at least one application controller and bus power supply *(which may be built into any of the products)* as well as input devices *(e.g. sensors and push-buttons)*, control gear *(e.g., electrical ballasts, LED drivers and dimmers)* with DALI interfaces. Application controllers can control, configure or query each device by means of a bi-directional data exchange. Unlike DMX, multiple controllers can co-exist on the bus. The DALI protocol permits addressing devices individually, in groups or via broadcast. Scenes can be stored in the devices, for recall on an individual, group or broadcast basis. Groups and scenes are used to ensure simultaneous execution of level changes, since each packet requires about 25 ms - or 1.5 seconds if all 64 addresses were to change level.

Each device is assigned a unique short address between 0 and 63, making up to 64 devices possible in a basic system. Address assignment is performed over the bus using a *“commissioning”* protocol built into the DALI controller, usually after all hardware is installed, or successively as devices are added. The Device Address is commonly a LED driver with one or many LEDs sharing the same level. A DT6 driver is for single color temperature applications, a DT8 driver is used for CCT color tuning, or RGBWW multi color applications - for example a strip where all the *“pixels”* have the same color.

Data is transferred between devices by means of an asynchronous, half-duplex, serial protocol over a two-wire bus with a fixed data transfer rate of **1200 bit/s**. Collision detection is used to allow multiple transmitters on the bus.

A single pair of wires comprises the bus used for communication on a DALI network. The network can be arranged in bus or star topology, or a combination of these. Each device on a DALI network can be addressed individually, unlike DSI and 0–10V devices. Consequently, DALI networks typically use fewer wires than DSI or 0–10V systems.

The bus is used for both signal and bus power. A power supply provides a current limited source of up to 250 mA at typically 16 V DC; each device may draw up to 2 mA unless bus-powered. While many devices are mains-powered *(line-powered)*, low-power devices such as motion detectors may be powered directly from the DALI bus. Each device has a bridge rectifier on its input so it is polarity-insensitive. The bus is a wired-AND configuration where signals are sent by briefly shorting the bus to a low voltage level. *(The power supply is required to tolerate this, limiting the current to 250 mA.)*

Although the DALI control cable operates at ELV potential, it is not classified as **SELV** (*Safety Extra Low Voltage*) and must be treated as if it has only basic insulation from mains. This has the disadvantage that the network cable is required to be mains-rated, but has the advantage that it may be run next to mains cables or within a multi-core cable which includes mains power. Also, mains-powered devices *(e.g., LED drivers)* need only provide functional insulation between the mains and the DALI control wires.

The network cable is required to provide a maximum drop of 2 volts along the cable. At 250 mA of supply current, that requires a resistance of ≤ 4 Ω per wire. The wire size needed to achieve this depends on the length of the bus, up to a recommended maximum of 2.5 mm² at 300 m when using the maximum rating of bus power supply.

The speed is kept low so no termination resistors are required, and data is transmitted using relatively high voltages (*0±4.5 V for low and 16±6.5 V for high*) enabling reliable communications in the presence of significant electrical noise. *(This also allows plenty of headroom for a bridge rectifier in each slave.)*

Each bit is sent using Manchester encoding *(a “1” bit is low for the first half of the bit time, and high for the second, while “0” is the reverse)*, so that power is present for half of each bit. When the bus is idle, the voltage level is continuously high *(which is not the same as a data bit)*. Frames begin with a “1” start bit, then 8 to 32 data bits with the most significant bit first *(standard RS-232 has the least significant bit first)*, followed by a minimum of 2.45 ms of idle.

Sources

Wikipedia (here)

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