

# THE DIGITAL ADDRESSABLE LIGHTING INTERFACE (DALI): AN EMERGING ENERGY- CONSERVING LIGHTING SOLUTION.

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**ABSTRACT-** The Digital Addressable Lighting Interface protocol required for digital fluorescent ballast that out performs its predecessors with respect to flexibility and functionality. The main important think of a DALI lighting control system range from advanced dimming capabilities and daylight sensing to save energy and maintenance costs. A DALI lighting control system can be beneficial to designers when trying to meet the requirements of code or recommended practices. The information in this paper is very helpful for designers decide when to consider using a DALI lighting control system. This paper give the total information such as the advantages of digitally addressable lighting, requirements of DALI system work, and limitations of DALI, and how DALI can help meet code and recommended practices. This paper concludes that study demonstrating how DALI system has the potential to save energy costs.

**Keywords-** DALI: Digital Addressable Lighting Interface, Lighting Controls.

## INTRODUCTION

Digital System controlled dimming of lighting is emerging energy savings system in Europe and spread for the world. This system is using energy shortages, increased energy costs. Fluorescent lighting is one of the most widespread methods of lighting, its need to high energy efficiency. The DALI standard includes addressable controls of individual and groups of ballasts, as well as easier installation and maintenance due to the ability to mix and match DALI components seamlessly from multiple manufacturers into complete systems. DALI ballasts are replacing old technology analog dimming systems, this system need to hardwired control of groups of ballasts and has a higher implementation cost. Non-DALI digital control methods main disadvantages are, its need to sole source, higher cost, implementation and maintenance problems.

A DALI network consists of a controller and one or more lighting devices that have DALI interfaces. Each lighting device is assigned a unique static address in the range 0 to 63, making possible up to 64 devices in a standalone system. Data is transferred between controller and devices by means of an asynchronous, half-duplex, serial protocol over a two-wire differential bus. The fixed Data transfer rate of 1200 bit/s. DALI requires a single pair of wires to form the bus for

communication to all devices on a single DALI network. The networks use the bus or star topology, or its combination.

## WHAT IS DALI?

DALI is a lighting control standard defined under the European Standard IEC 60929. DALI is using the communication and control of multiple devices such as ballast, transformers and other lighting equipment. DALI was designed to replace 1-10v analogue systems and proprietary digital systems such as Digital Serial Interface. DALI has bidirectional communication. It can be as simple as current state means On or Off or more technical, such as lamp status or battery level in the case of inverter.

## HISTORY

- Founded in Tridonic and others Europe 1990.
- Digital Serial Interface (DSI) ballasts in 1991.
- Digital Addressable Lighting Interface ballast in 1998 IEC, Dropped royalties to gain wide spread acceptance of DALI.
- DALI protocol (IEC Standard 60929, Annex E & G) advanced to voting process in year 2000.

- Adopted by other leading ballast and control manufactures, formally adopted summer of 2002.
- NEMA Controls Council History: Came to USA (and the world) 2006  
Wiring Devices, Controls, and Ballasts, Liaison with International Electro technical Commission (IEC) IESNA Controls, DALI subcommittee Established to develop a control protocol reviewed several existing systems Asked by NEMA to comment on DALI proposal true GLOBAL and OPEN standard Global Governing.
- DALI AG Review protocol compliance Body to Promote and manage the DALI protocol by manufactures 62 members as of January 2012.

**DALI/MICROCONTROLLER INTERFACE**

The Digitally Addressable Lighting Interface is optically isolated the micro-controller. Figure 1 shows interfacing between DALI and micro-controller. Two wires from the DALI are converted to the four signals.

Two of the four are the transmit signal (RB2) and receive signal. The other two signals are the communications enable (RB0) signal and the receive drive (RB1) signal. The transmit signal and the receive signal directly correlate to the levels seen on the Digitally Addressable Lighting Interface.

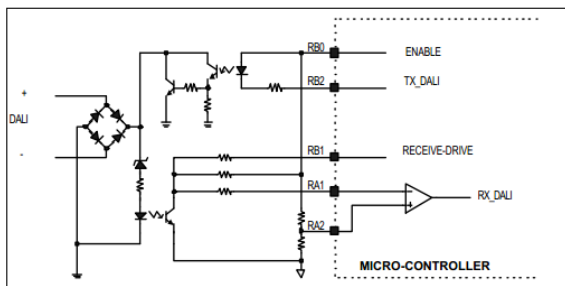


Figure 1: DALI Interface with microcontroller.

For receiving higher voltage logic on the DALI is translated to 5 volt logic at the micro-controller, and for transmission, the 5 volt logic is translated to the higher voltage logic on the DALI. The ballast achieves very low power by controlling the communications circuit with the communication enable signal and the receive-drive signal. During normal operation the PIC16F628 enables the communication circuitry with the communication enable signal. It requires only a pair of wire to form the bus to communication to all devices on a single DALI network.

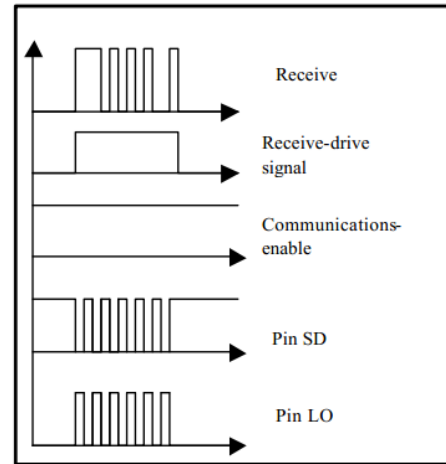


Figure 2: Communication Signals DALI/Microcontroller

**DESIGN OF DALI BALLAST**

Digital lighting controls offer many advantages over analog control system. But its implementation has been seen as a very challenging technically and costly. Designing analog dimming (1-10Volts) ballast using dimming fluorescent lighting. However, analog control is complex to implement, because the control logic is hard wired and thus flexibility if needs to change. Additional changes with analog systems are the additional components needed, such as relays and voltage drops in the control lines. Voltage drops in the control lines can result in differing luminance settings for every ballast. DALI systems solve these problems. Wiring is simplified by having each ballast on the same two-wire digital bus and a power circuit, this lowering implementation costs.

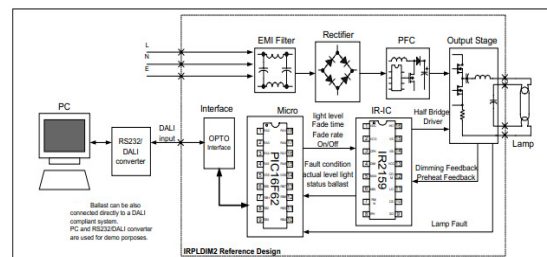


Figure 3: Design of DALI Ballast.

**ADVANTAGES**

DALI Advantages Over an analog system-

- Two-way communications for obtaining operating status and performance of luminaries. This ability to generate reports showing location of failed lamps and additional fixture performance items helps reduce maintenance and energy costs.
- Individual fixture addressing of up to 64 addresses provides cost-effective control of individual fixtures and allows re-configuring space lighting groups without re-wiring.

- With 16 programmable scenes and groups stored in the ballast, the user can define lighting scenes based on occupant tasks while groups provide the ability to control individual fixtures included in multiple control zones.
- Control compatibility across multiple suppliers letting users to mix and match and obtain consistent control operation.
- DALI is an open standard not exclusively owned by a single company.
- It requires only a pair of wire to form the bus to communication to all devices on a single DALI network.
- Unlike for example high-speed RS485 it doesn't insist the cabling is a "daisy-chain", " stars" and "T's" are perfectly acceptable giving the installers flexibility
- The DALI System is not defined as SELV (Safety Extra Low Voltage) and therefore can be run next to the mains carrying cables or a part of a multicore cable that includes mains power.

#### **LIMITATIONS**

- In Early models of some DALI Ballasts the DALI requirement for permanent memory Was mis interpreted to mean EEPROM exclusively. This meant that every update to the fade rate or fade time for example was written to EEPROM. Moreover, no protection for the EEPROM lookup table was implemented, which exacerbated the problems caused by over written EEPROMS. The number of times an EEPROM can be rewritten is limited 200K - 10M times. In current generations of these DALI devices RAM is used in preference to EEPROM during normal operation, which has dramatically reduced the number of EEPROM writes and thus avoided problems with overwritten EEPROMS.
- The data has to run on mains-rated cable, with 600v isolation and at least a 1mm cross-section rather than using a thinner data cable.
- The volt-drop should be less than 2 volts from the start to the ends of the line thereby Forcing disciplined planning by the installers.
- Its slow communication speed 1200 bits per second can mean a visible delay in large installations with a lot happening.

#### **CONCLUSION**

DALI is a solution of energy shortages. It reduces the 20 to 30 percent of energy use, maintenance costs, and improves building aesthetics. The Digital Addressable Lighting Interface (DALI) is a digital protocol for the controlling of lighting in buildings, such as electrical ballasts and dimmers. Each module of operating equipment with a DALI interface can be communicated with over DALI individually. Using a bidirectional data exchange, a DALI controller can query and set the status of each light. As a

standalone system, DALI can be operated maximum 64 devices as well as DALI can be used as a subsystem via DALI gateways.

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