AN1756
Application note

Choosing a DALI implementation strategy with ST7DALIF2

Introduction

This application note describes how to choose a DALI (Digital Addressable Lighting Interface) implementation strategy using the ST7DALIF2 microcontroller. As well as presenting topology options, this document also gives an introduction to the DALI standard with a description of the protocol and a list of advantages.

Please refer to *Section 4* for a list of additional documents referenced in this application note.

Contents

1 High-frequency tube lamp ballast applications

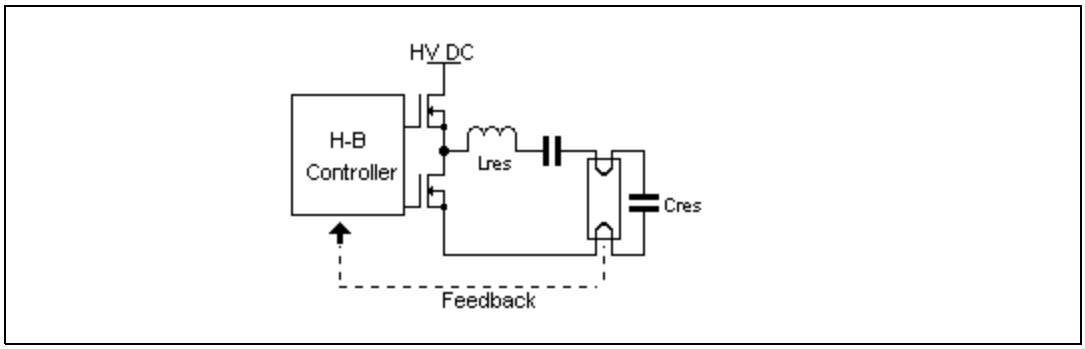
Basically, a HF-TL ballast converts the 50-60 Hz AC Line input or a DC voltage to a high frequency output, usually in the range of 25-125 kHz. A rectifier block and a DC to high frequency inverter usually make up a ballast (please refer to *1* in *Section 4: References*).

Voltage fed series resonant half bridge inverters are currently used for fluorescent lamps. This topology allows to easily operate in Zero Voltage Switching (ZVS) resonant mode, reducing the transistor switching losses and the electromagnetic interference (please refer to *2* in *Section 4: References*).

The half bridge of the inverter can be controlled in different ways with different ICs:

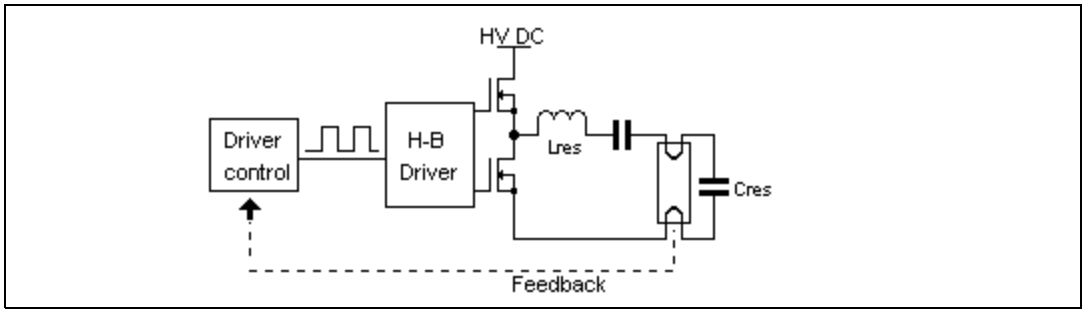
- Half-bridge controller like, for example, the **L6574**.

Figure 1. Typical topology with a half-bridge controller



- Half-bridge driver like, for example, the **L6384** + some kind of control.

Figure 2. Typical topology with a half-bridge driver



What is the difference between a half-bridge driver and a half-bridge controller?

A driver is “just” able to drive the floating (high side) transistor of a symmetric half bridge inverter, from a Pulse Width Modulation (PWM) signal. The controller also includes some form of oscillator, usually tunable by using a few external components (resistor, capacitor).

Varying the switching frequency is the mainly used control principle. This allows the current in the lamp, and therefore the output power to be modulated (please refer to *2* in *Section 4: References*). So the lamp can be dimmed and input voltage variations can be compensated.

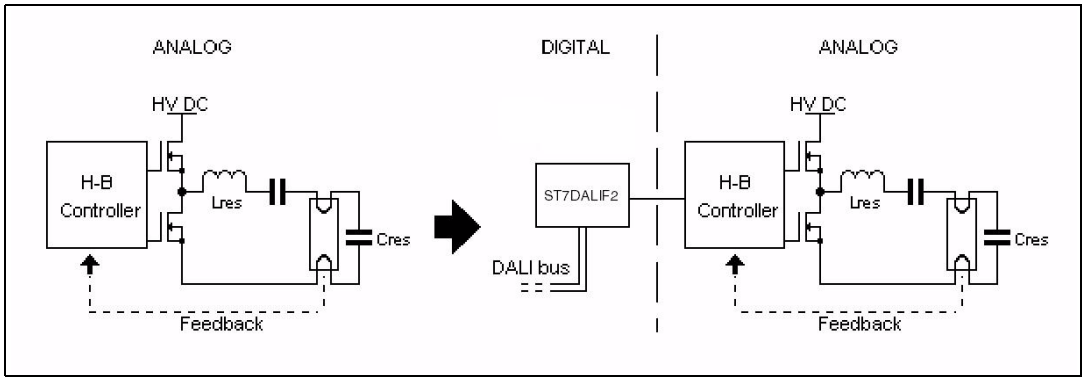
To know more about high frequency tube lamp ballast applications, please refer to *2* in *Section 4: References*.

2 Choosing an implementation strategy

In order to have a centralized control of each dimmable ballast of a room, a communication protocol is needed. DALI is an economic solution that is more and more widely possibility becoming popular in the lighting market. To find out the benefits of DALI, please refer to document *3* referenced in *Section 4*

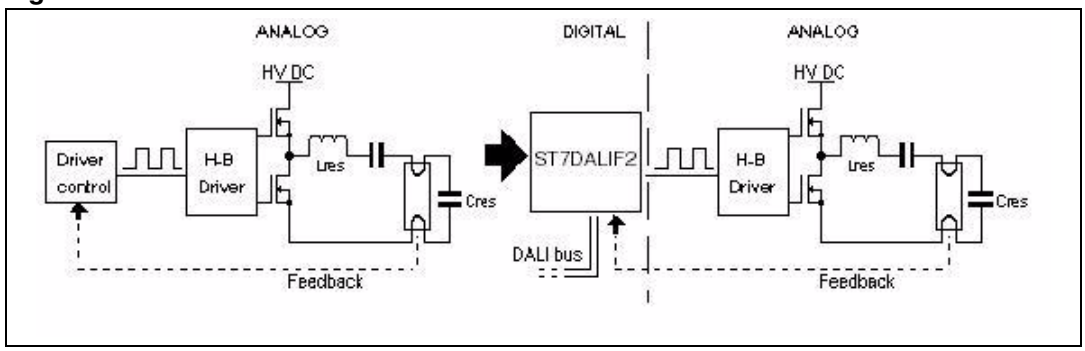
Since DALI is a digital protocol, it needs to handled by a microcontroller like ST7DALIF2. Various topologies can be used to integrate this digital communication. It can work together with a ballast controller, just for DALI communication as shown in *Figure 3*:

Figure 3. Micro handles only communication



or it can do the DALI communication and take the place of the driver control, like in *Figure 4*:

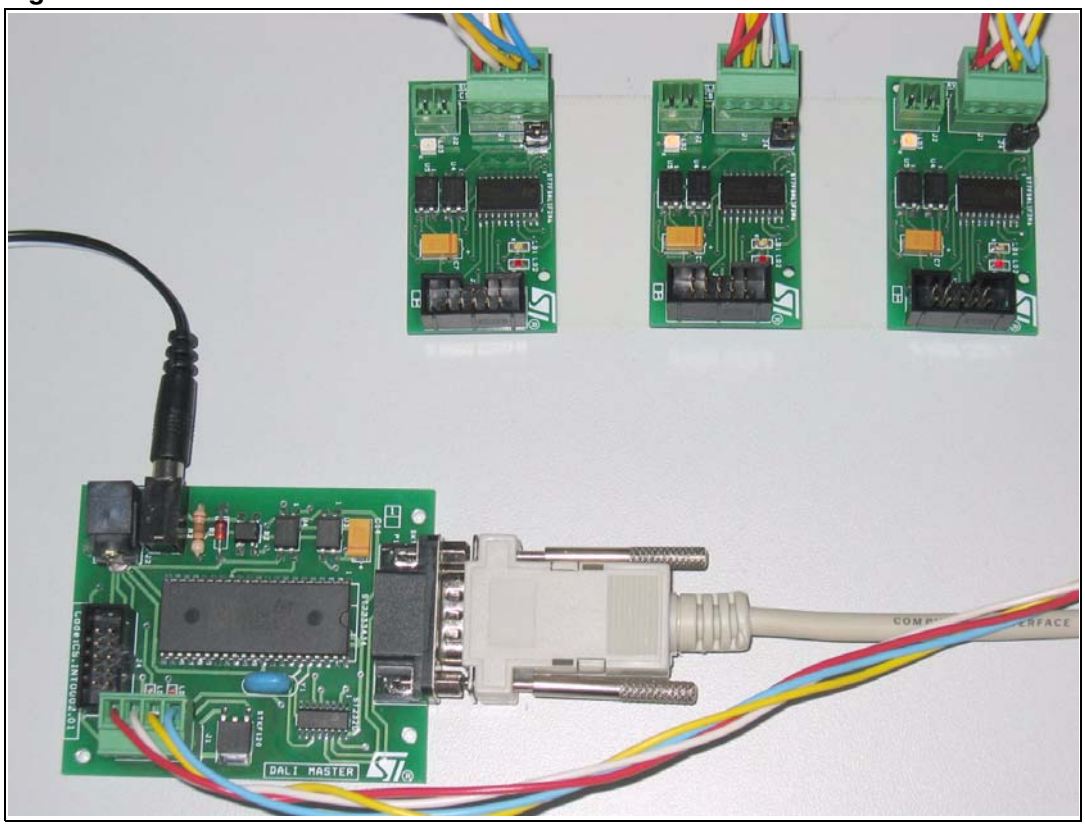
Figure 4. Micro handles communication AND control



The choice is up to the designer. Whatever solution is chosen, ST is the first semiconductor manufacturer able to provide both the right high-voltage driver or controller, as well as a microcontroller with an on-chip decoder for the DALI protocol.

To get more information on the first topology and its advantages, please refer to application note AN1900 “Hardware Implementation for ST7DALI-EVAL” or order the ST7DALI-EVAL evaluation kit.

Figure 5. ST7DALI-EVAL kit



3 DALI standard

3.1 Introduction

DALI is an acronym for Digital Addressable Lighting Interface, standardized as IEC 929. DALI is the new interface standard for lighting controls solutions defined by the lighting industry. AG-DALI is the “Digital Addressable Lighting Interface Working Group” established for joint promotion and application of the DALI Standard by leading manufacturers and institutions in the field of digital addressing of lamps and/or luminaires. For more information, refer to document *3* referenced in *Section 4*.

3.2 DALI standard protocol

The DALI protocol uses the bi-phase Manchester asynchronous serial data format. All the bits of the frame are bi-phase encoded except the two stop bits.

- The transmission rate is about 1.2 kHz. The bi-phase bit period is 833.33uS ±10%.
- A forward frame consists of 19 bi-phase encoded bits:
  - 1 start bit (0->1: logical ’1’)
  - 1 address byte (8-bit address)
  - 1 data byte (8-bit data)
  - 2 high level stop bits (no change of phase)
- A backward frame consists of 11 bi-phase encoded bits:
  - 1 start bit (0->1: logical ’1’)
  - 1 data byte (8-bit data)
  - 2 high level stop bits (no change of phase)

A forward frame consists of 19 bi-phase encoded bits: 1 start bit (logical ’1’), 1 address byte and 1 data byte. The frame is terminated by 2 stop bits (idle). The stop bits do not contain any change of phase.

A backward frame consists of 11 bi-phase encoded bits: 1 start bit (logical ’1’) and 1 data byte. The frame is terminated by 2 stop bits (idle). The stop bits do not contain any change of phase.

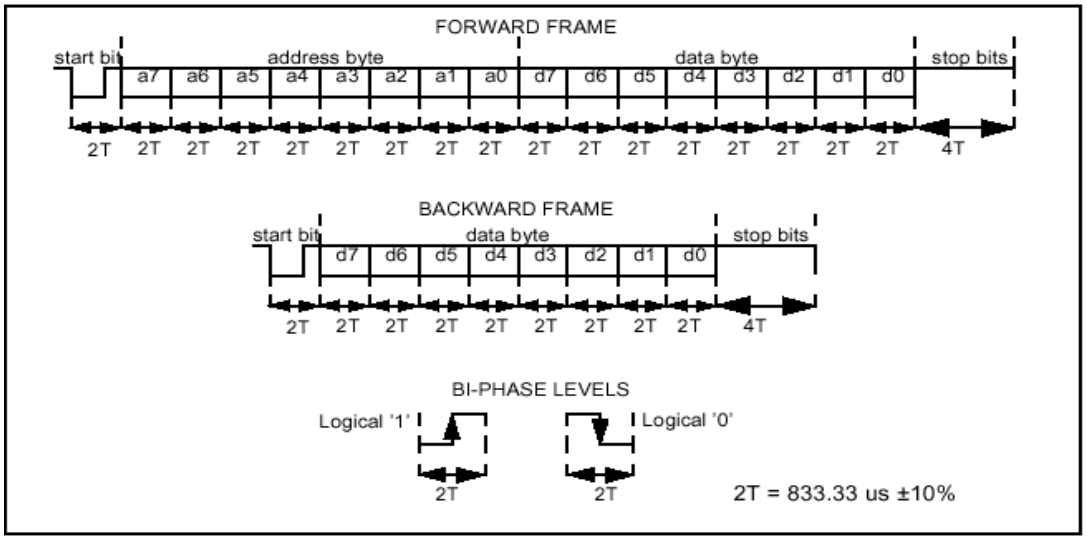
The transmission rate, expressed as a bandwidth, is specified at 1.2 kHz for the forward channel and for the backward channel.

The settling time between two subsequent forward frames is 9.17 ms (minimum).

The settling time between forward and backward frames is between 2.92 ms and 9.17 ms. If a backward frame has not been started after 9.17 ms, this is interpreted as “no answer”.

In the event of code violation, the frame is ignored. After a code violation has occurred, the system is ready again for data reception.

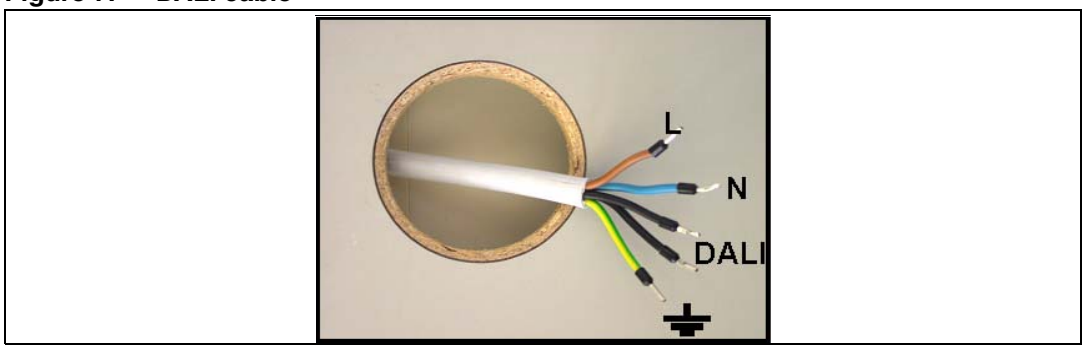
Figure 6. DALI standard frame



Only the ST7DALIF2 microcontroller has a dedicated peripheral for handling the DALI protocol! For more details, please refer to document *4* referenced in *Section 4*.

3.3 DALI system advantages

Figure 7. DALI cable



Here are the main advantages of the DALI system:

- Simple wiring: all of the units in the system are interconnected using a simple five-core cable (see *Figure 7*).
- No mains switching required: lamps can be dimmed or switched on and off using control system commands without any need for mains switching.
- Easy system re-configuration: the operation of the system can be changed quickly without any modification to the hardware.
- Easy system modification: if the lighting system needs to be enlarged, new components can be added anywhere on the DALI cable.
- It is possible to define light scenes. Scene means: a particular light level intensity. A maximum of 16 scenes can be defined.

Please refer to document *3* in *Section 4* to find out more details of what are the other benefits of the DALI standard for the end user and for specifiers and architects.

4 References

1. AN1320: L6574 & microcontroller in ballast applications
2. AN993: Electronic ballast with PFC using L6574 and L6561
3. AG DALI Internet site: http://www.dali-ag.org
4. ST7DALIF2 datasheet

5 Revision history

Table 1. Document revision history

Date	Revision	Changes
30-Nov-2003	1	Initial release.
31-May-2004	2	Added introduction chapter. Updated references.
17-Mar-2009	3	Changed product references from ST7DALI to ST7DALIF2.