

# ST7 FAMILY

## ST7DALI EVALUATION KIT

### USER MANUAL

Release 1.0





# **ST7 FAMILY**

## **ST7DALI EVALUATION KIT**

### **USER MANUAL**

**March 2004**

**REF- DOC-ST7DALI-EVAL**

USE IN LIFE SUPPORT DEVICES OR SYSTEMS MUST BE EXPRESSLY AUTHORIZED.

STMicroelectronics PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF STMicroelectronics. As used herein:

1. Life support devices or systems are those which (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided with the product, can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can reasonably be expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

### INTRODUCTION

A microcontroller is needed for communication in DALI dimmable ballast applications. A communication protocol and the interface parameters have been defined by the leading manufacturers of lighting equipment. This interface is currently in the process of international standardization and will be included in Annex E of the IEC929/ EN60929 international standard for electronic ballast performance requirements. The draft of the standard can be obtained from the standard documentation institutions in the same way as other IEC documentation.

For more information about DALI, visit the information platform at <http://www.dali-ag.org/>

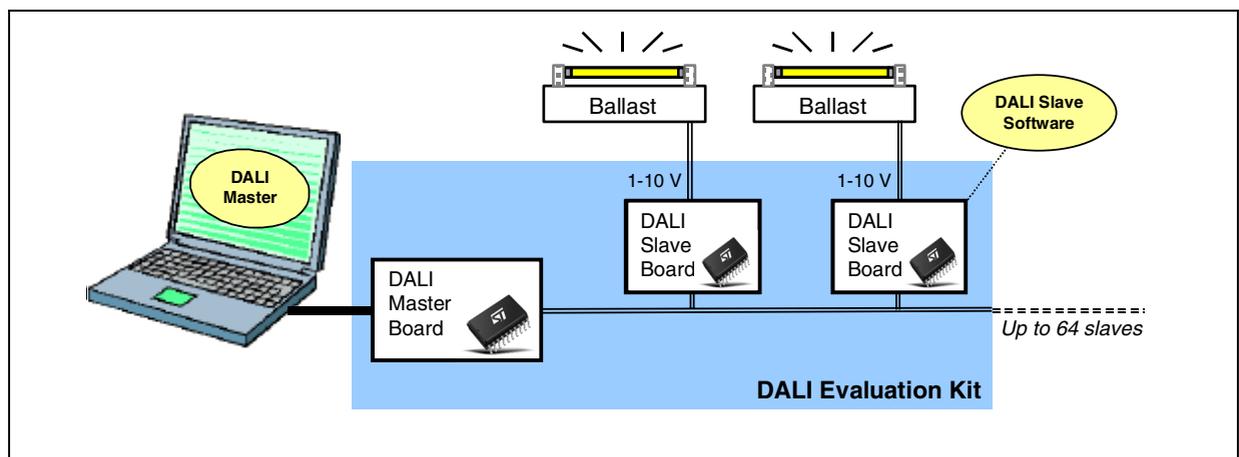
STMicroelectronics offers a dedicated ST7DALI microcontroller in its standard 8-bit ST7 micro family, and fully documented free software in ANSI-C, which is fully compliant with this standard (Annex E.4). The corresponding test procedure (Annex G) has been followed to validate the compliance. The software is described in application note AN1601.

This evaluation kit allows you to evaluate the STMicroelectronics solution.

As a first step, from a master board connected by RS232 to a user-friendly PC software, you can send DALI commands to the DALI slave boards and see the action on the light (or on yellow LED).

Then, when you start a design, you can consider the slave board itself, hardware and software, as a reference design for a DALI gateway topology.

**Figure 1. ST7DALI-EVAL Evaluation Kit**



---

# Table of Contents

---

<b>INTRODUCTION</b> .....	<b>5</b>
<b>1 KIT CHECKLIST</b> .....	<b>8</b>
<b>2 HARDWARE FEATURES</b> .....	<b>9</b>
<b>2.1 DALI SLAVE BOARD</b> .....	<b>9</b>
<b>2.2 MASTER BOARD</b> .....	<b>9</b>
<b>3 GETTING STARTED</b> .....	<b>10</b>
<b>3.1 PC SOFTWARE INSTALLATION</b> .....	<b>10</b>
<b>3.2 MICROCONTROLLER SOFTWARE</b> .....	<b>10</b>
<b>3.3 CONNECTING THE BOARDS</b> .....	<b>10</b>
<b>3.4 RUNNING THE PC SOFTWARE</b> .....	<b>10</b>
<b>3.5 BASIC COMMANDS</b> .....	<b>11</b>
3.5.1 Addressing the ballasts .....	11
3.5.2 Light level .....	12
<b>4 PC SOFTWARE FEATURES</b> .....	<b>14</b>
<b>4.1 ADDRESSING BALLASTS</b> .....	<b>14</b>
4.1.1 Full Search .....	14
4.1.2 Quick Search .....	14
<b>4.2 SIMULATE FADING</b> .....	<b>14</b>
<b>4.3 CONFIGURATION</b> .....	<b>15</b>
4.3.1 Storing a Group .....	15
4.3.2 Storing a Scene .....	16
<b>4.4 ADDRESSING COMMANDS TO A GROUP</b> .....	<b>17</b>
<b>4.5 CALLING BACK A SCENE</b> .....	<b>18</b>
<b>4.6 MANUAL DALI INTERFACE</b> .....	<b>19</b>
4.6.1 Automatic Command .....	20
4.6.2 Manual Command .....	21
<b>4.7 RUN AUTOMATED DEMO</b> .....	<b>21</b>
<b>4.8 SAVE/LOAD CONFIGURATION</b> .....	<b>22</b>

---

# Table of Contents

---

<b>5 DALI SLAVE BOARD FEATURES</b> .....	<b>23</b>
<b>5.1 LEDS</b> .....	<b>23</b>
5.1.1 Green and red LEDs .....	23
5.1.2 Yellow LED .....	23
<b>5.2 JUMPER</b> .....	<b>23</b>
<b>5.3 DALI INTERFACE</b> .....	<b>24</b>
<b>5.4 ST7DALI SOFTWARE</b> .....	<b>24</b>
<b>5.5 HALT MODE</b> .....	<b>24</b>
<b>5.6 SOFTWARE DESCRIPTION</b> .....	<b>25</b>
<b>5.7 REPROGRAMMING THE MICROCONTROLLER</b> .....	<b>25</b>
<b>5.8 DEBUGGING THE APPLICATION</b> .....	<b>25</b>
<b>5.9 USEFUL DOCUMENTATION</b> .....	<b>25</b>
<b>6 APPENDIX: BOARD SCHEMATICS AND BILLS OF MATERIAL</b> .....	<b>26</b>
<b>6.1 DALI GATEWAY SLAVE BOARD</b> .....	<b>26</b>
6.1.1 Slave board Schematics .....	26
6.1.2 Slave Board Bill of material .....	26
<b>6.2 DALI MASTER BOARD</b> .....	<b>28</b>
6.2.1 Master Board Schematics .....	28
6.2.2 Master Board Bill of material .....	29
<b>7 KIT PICTURE</b> .....	<b>31</b>

### 1 KIT CHECKLIST

The ST7DALI-EVAL evaluation kit contains the following items:

- 1 CD-ROM
- 1 Master board
- 2 Slave boards
- 1 4-wire cable (12V supply + DALI bus)
- 1 RS232 DB9 null-modem cable
- 1 AC/DC adaptor (13.5V DC 600mA)

## 2 HARDWARE FEATURES

### 2.1 DALI SLAVE BOARD

ST7DALI flash microcontroller with DALI communication module

1-10V output (standard dimmable ballast input)

DALI communication interface (This interface passes the IEC standard 60929 “Physical operational parameters” test sequences).

12V supply connector.

No need for an external resonator, ST7FDALI has an internal 1% RC oscillator

The 12V power for the board is supplied from the master board. An LD2980 linear voltage regulator converts to 5V. The board outputs an analog signal between 1 to 10V to control a standard dimmable ballast.

J1 Input connector: 12V, 0V, DALI1, DALI2

J2 output connector: 0-10V

Green and red LEDs: indicate if the slave was addressed by the last command or not

Yellow LED: Displays the 1-10V output level

### 2.2 MASTER BOARD

DALI communication interface

RS232 communication interface

AC/DC adaptor input

J1 Output connector: 0V, 12V, DALI1, DALI2

P1 Input/output connector: RS232

Green and red LEDs:

Limitation:

The master board power supply does not fully meet the DALI bus specification. It has been designed especially for this evaluation kit, to be connected to 2 slave boards only. The functionality is not guaranteed if more slaves are connected to the bus.

## 3 GETTING STARTED

### 3.1 PC SOFTWARE INSTALLATION

The PC software runs under Win NT, Win 2000, Win98 & Win95

Run the Setup.exe file on the CD-ROM. And follow the indications.

### 3.2 MICROCONTROLLER SOFTWARE

ST72C334 (master board) and ST7DALI (slave board) are already programmed.

### 3.3 CONNECTING THE BOARDS

Connect both slave boards and the master boards with the 4-wire cable

You can optionally connect a dimmable ballast, with a standard 1-10V input, to each slave board to run the demo (not provided with this evaluation kit). Otherwise, a yellow LED on the slave board allows you to see a corresponding change in the level of the lamp.

Connect the master board to the PC serial port with the RS232 null-modem cable

Connect the AC/DC adaptor to the master board

Plug the AC/DC adaptor on the mains. **Important note:** after this operation, send a Full Search command (Select “Extras” menu, item “Search for Ballasts...”) and a Quick Search command (Select “Extras” menu, item “Search for Ballasts...”).

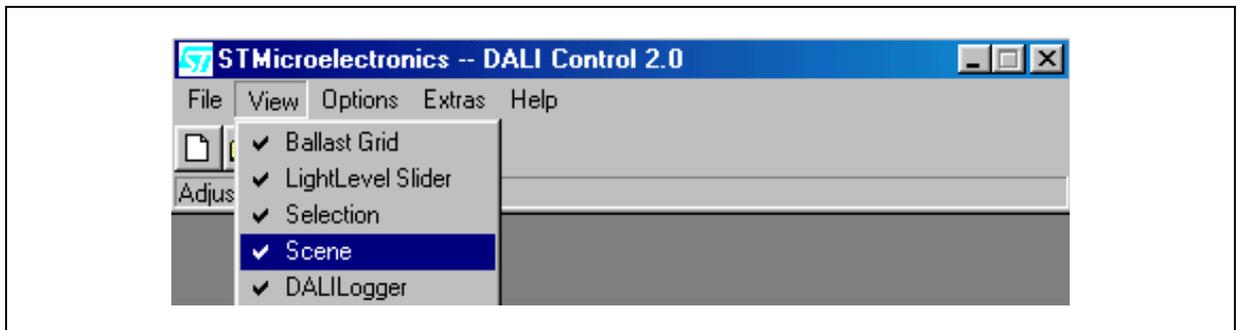
### 3.4 RUNNING THE PC SOFTWARE

On the PC, run “PowerControl” in Start/Programs/ST7Dali.

The user interface consists of a main window and 5 other windows. The main window is always visible.

Select “View” menu to choose other visible windows.

**Figure 2. Main window**



Windows:

**Ballast Grid window:** ballasts found on the bus after a Search

**Light Level Slider window:** buttons and sliders for adjusting light level parameters

**Selection window:** Buttons for selecting groups

**Scene window:** buttons for selecting scenes

**DALI logger window:** displays all DALI commands sent

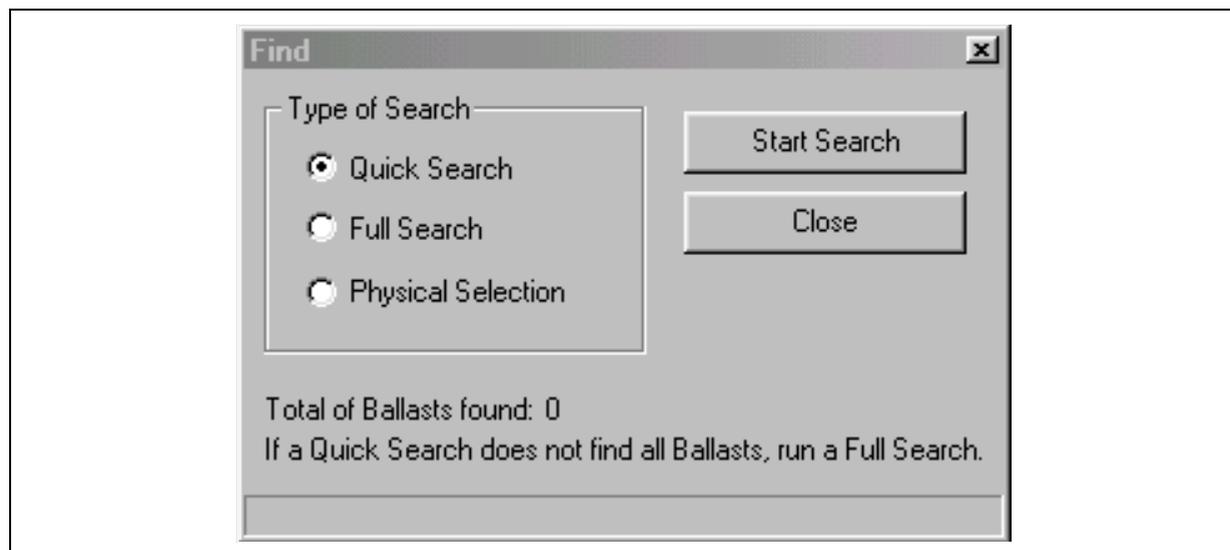
## 3.5 BASIC COMMANDS

### 3.5.1 Addressing the ballasts

Select “Extras” menu, item “Search for Ballasts...”.

The following window appears:

**Figure 3. Figure 3: Search for Ballast window**

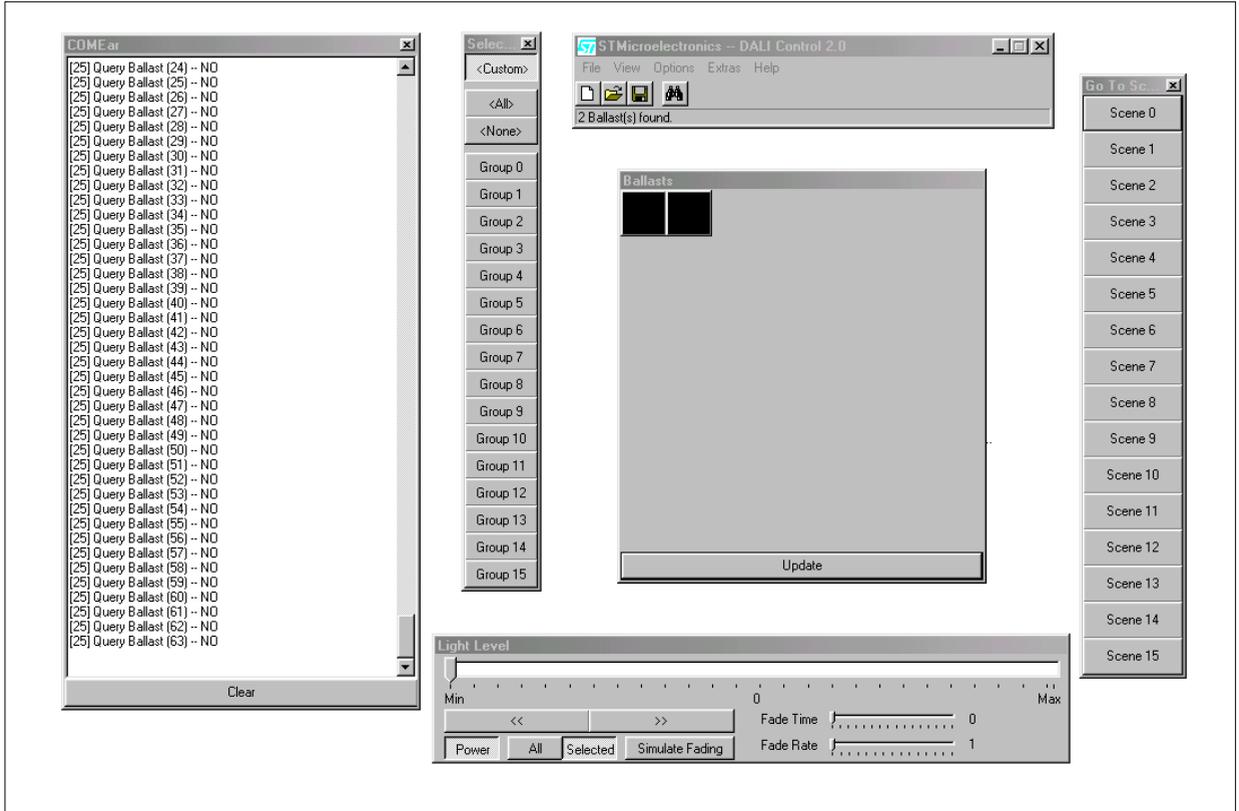


Run a “Full Search”. When it is finished, run a “Quick Search”.

The master will find two ballasts on the network. The ballast window shows these ballasts.

See [Section 4.1 Addressing ballasts](#) for more details on this topic.

Figure 4. Screen overview after a Quick Search

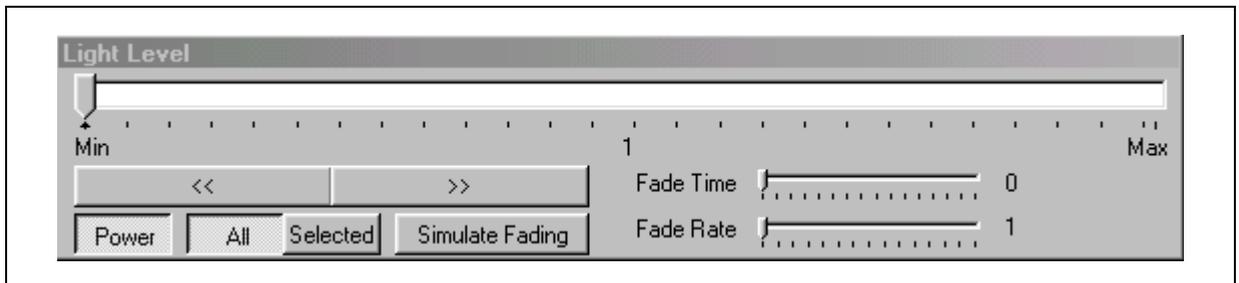


### 3.5.2 Light level

You can choose to change the light level of only selected ballasts or all ballast by pushing either the “Selected” or the “All” buttons in the “Light Level” Window.

You can change the light level by pushing the up “>>” and down “<<” buttons, or by moving the slider.

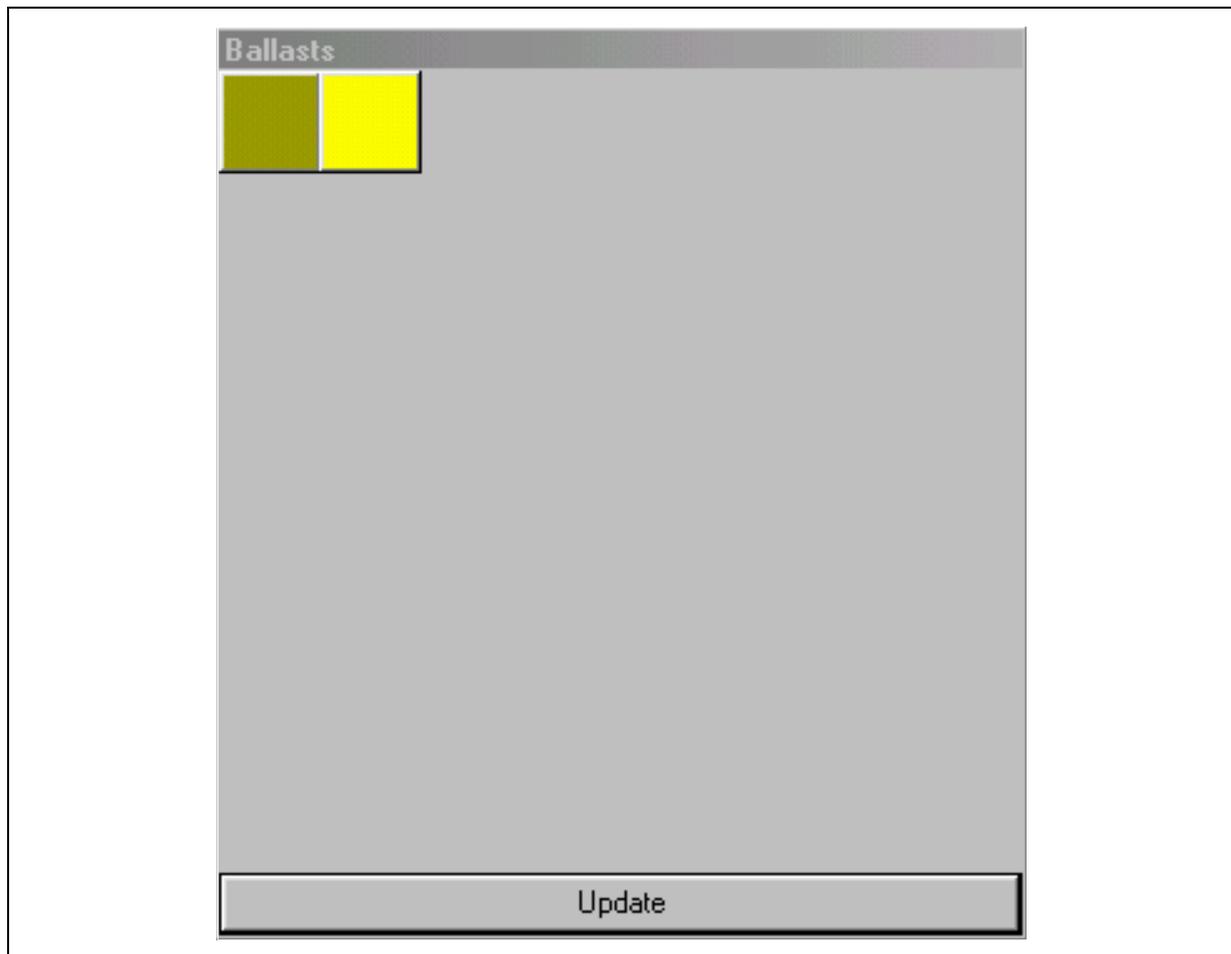
Figure 5. Light Level window



Ballasts change the light level immediately. Push the “Update” button in the “Ballasts” window to update all the ballast light level in the “Ballasts” window. To do so, the master asks each bal-

last on the network its actual level (QUERY ACTUAL LEVEL command). The colors in the “Ballast” window represent the light level (black for 0%, yellow for 100%).

**Figure 6. Ballasts window after clicking on Update**



### 4 PC SOFTWARE FEATURES

#### 4.1 ADDRESSING BALLASTS

##### 4.1.1 Full Search

A “Full Search” is an example of address allocation to be done after a DALI system installation. Each ballast (up to 64) must have a short address.

The procedure is the following:

To start the algorithm, the master sends the INITIALIZE command

The master sends the RANDOMIZE command to make each ballast generate a 24-bit random number

The master searches the ballast with the lowest random number (SEARCHADDRH, SEARCHADDRM, SEARCHADDRL, COMPARE commands) and a short address (6-bit) is assigned to this ballast (PROGRAM SHORT ADDRESS command). This ballast stores this short address in the ST7DALI E<sup>2</sup>PROM.

The programmed short address is verified (VERIFY SHORT ADDRESS command)

This ballast is removed from the search process (WITHDRAW command)

This procedure is repeated until all ballasts have a short address. The process is stopped by the TERMINATE command.

If two or more ballasts have the same short address, the addressing procedure is restarted only for these ballasts with the INITIALIZE command.

All the successive commands are displayed in the DALI logger window.

From now, every ballast on the network has a short address, stored in the microcontroller`s E<sup>2</sup>PROM.

##### 4.1.2 Quick Search

A “Quick Search” searches ballasts with a short address, connected on the DALI bus. The master uses the QUERY BALLAST command.

#### 4.2 SIMULATE FADING

This operation is done by pushing the “Simulate Fading” button in the “Slider” window.

Fade time and fade rate parameters can be adjusted by sliders. Push the “Apply” button to validate the modifications.

The fading can be done either on “All” or “Selected” ballasts.

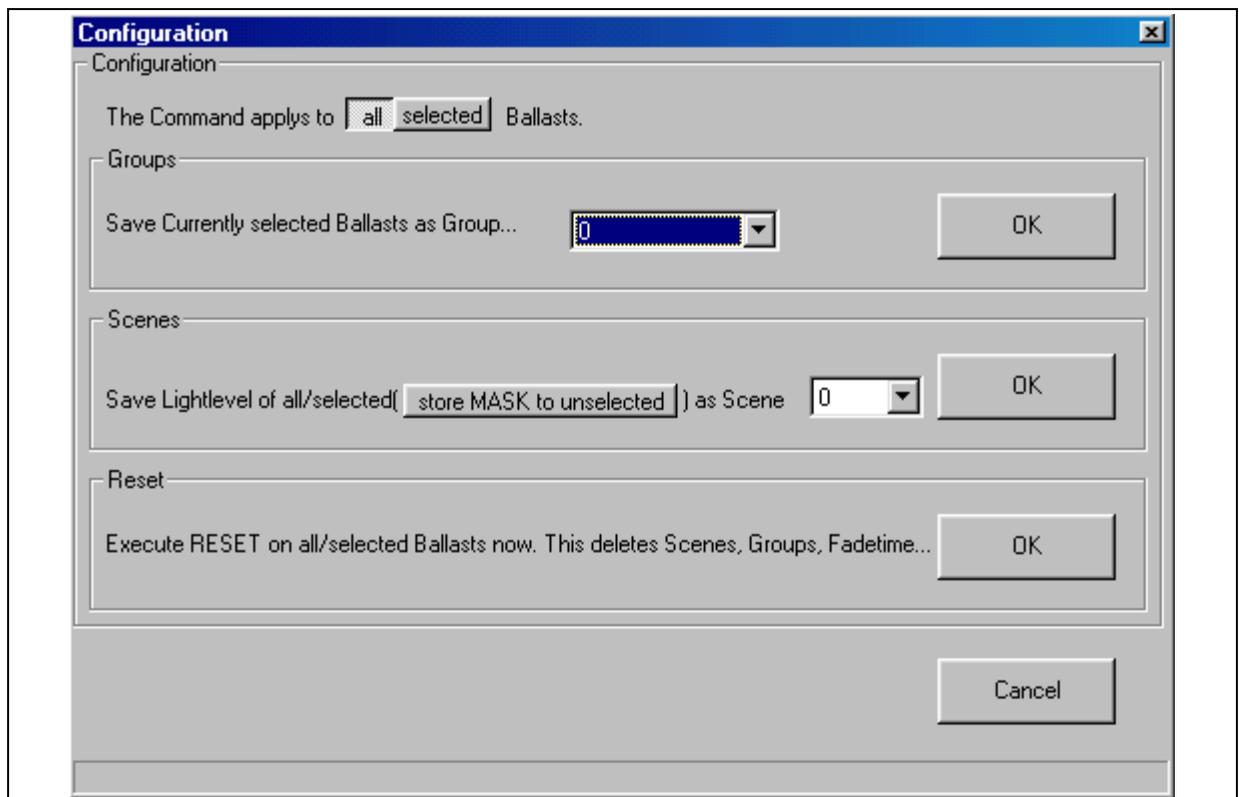
The target light level is chosen by moving the slider with the mouse. The simulation will begin as soon as you release the left mouse button, taking into account the Fade time and Fade rate parameters.

### 4.3 CONFIGURATION

Select “Options” menu, item “Configuration...”

The following window appears:

**Figure 7. Configuration window**



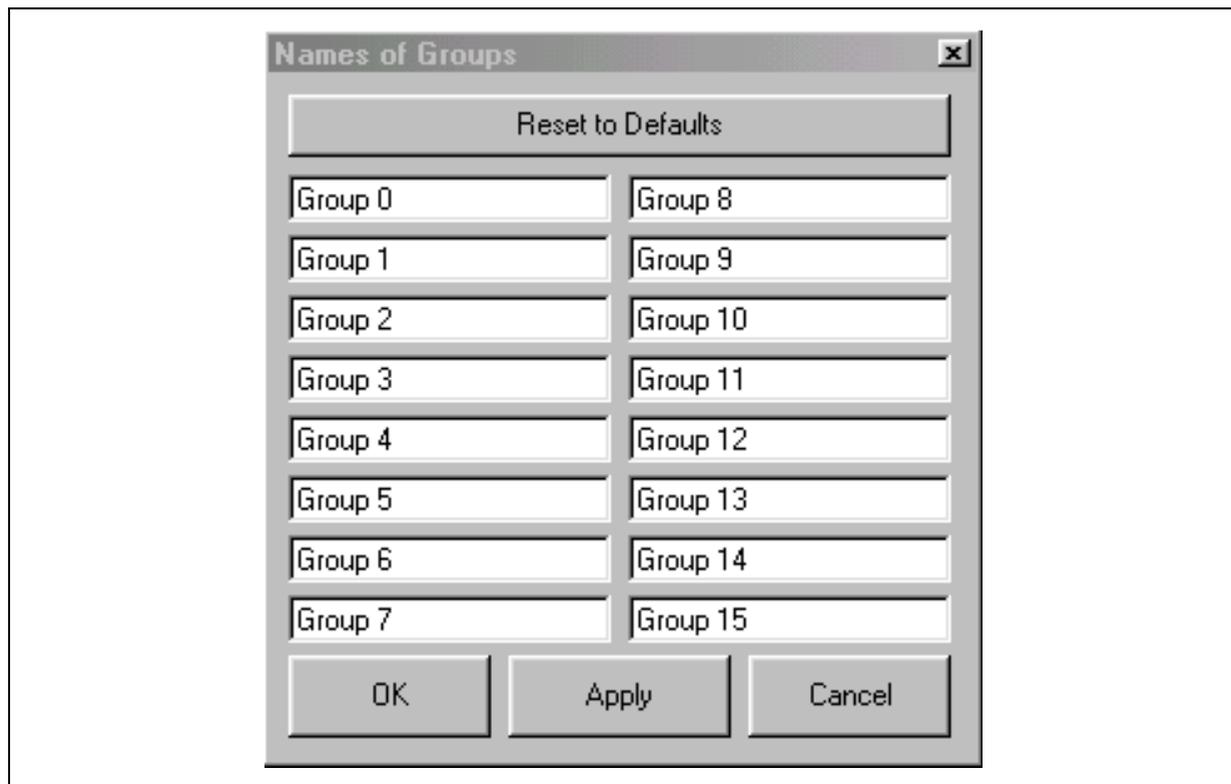
Choose if you want the following action to apply to “All” or only “Selected” ballasts by pushing the right button at the top of the window.

#### 4.3.1 Storing a Group

Choose the number x of the group you want to create with the combo. Push the “OK” button to define the group number x.

The group’s name can be customized by selecting the “Option” menu, item “Change group names...”

Figure 8. Names of groups

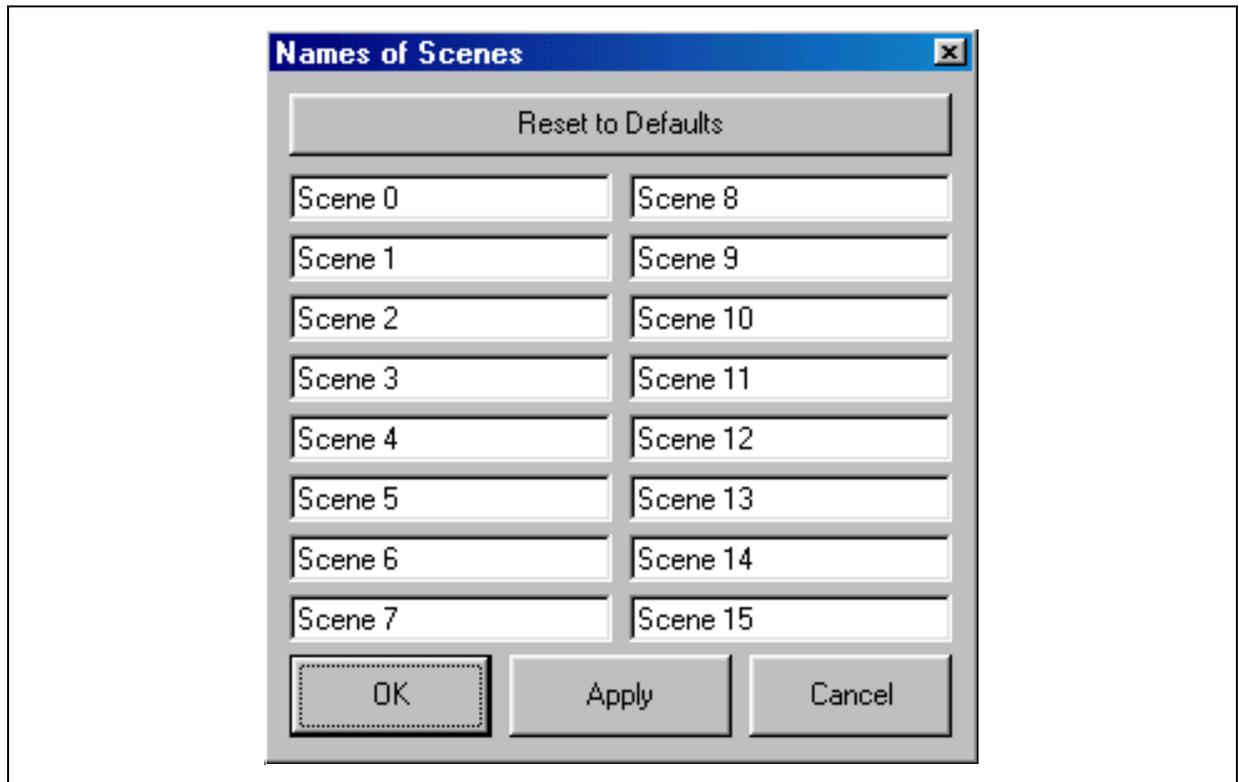


#### 4.3.2 Storing a Scene

Choose the number  $x$  of the scene you want to create with the combo. By pushing the "OK" button, the actual light level of selected or all ballasts will be stored as Scene number  $x$ . The master makes each addressed ballast storing the actual level as its scene  $x$  level.

The scene name can be customized by selecting the "Option" menu, item "Change scene names..."

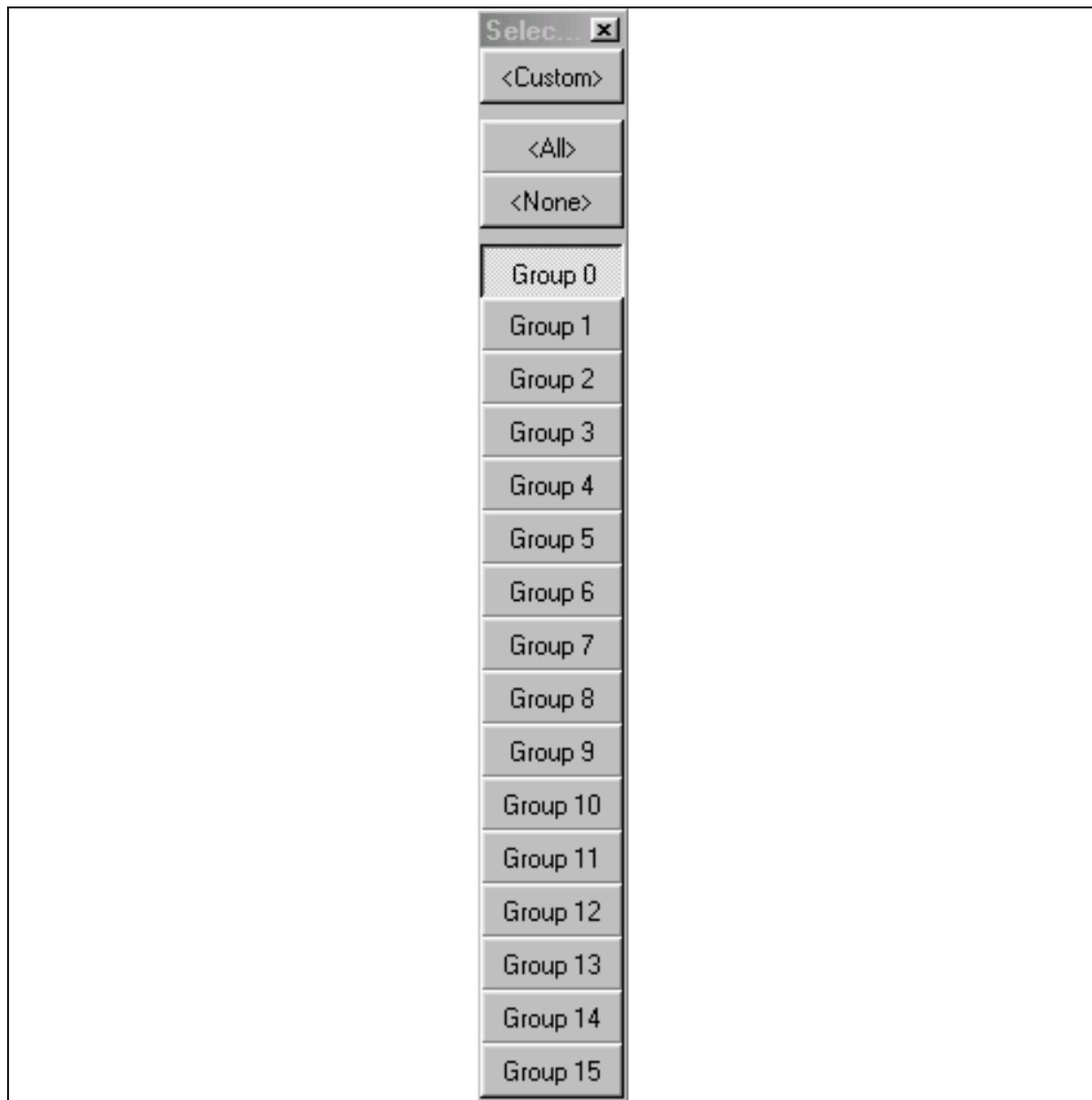
Figure 9. Names of scenes



#### 4.4 ADDRESSING COMMANDS TO A GROUP

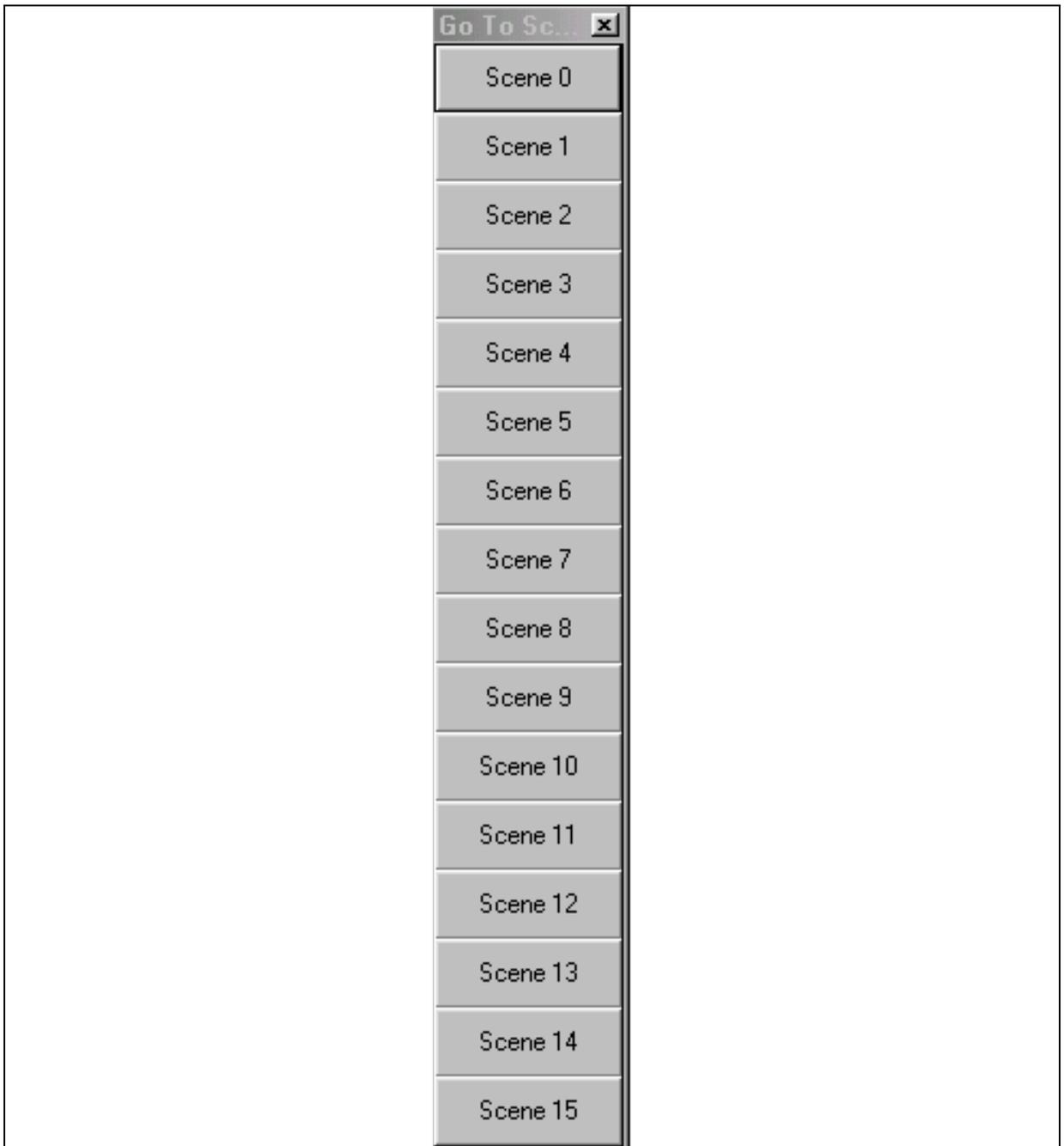
Select a group by pushing the corresponding button in the “Groups” window.

Figure 10. Group window



#### 4.5 CALLING BACK A SCENE

A scene can be called back by pushing the corresponding button in the "Scene" window. The master sends a GO TO SCENE, and a QUERY ACTUAL LEVEL command to every ballast. Each ballast outputs the level corresponding to this scene, previously stored in the microcontroller's E<sup>2</sup>PROM.

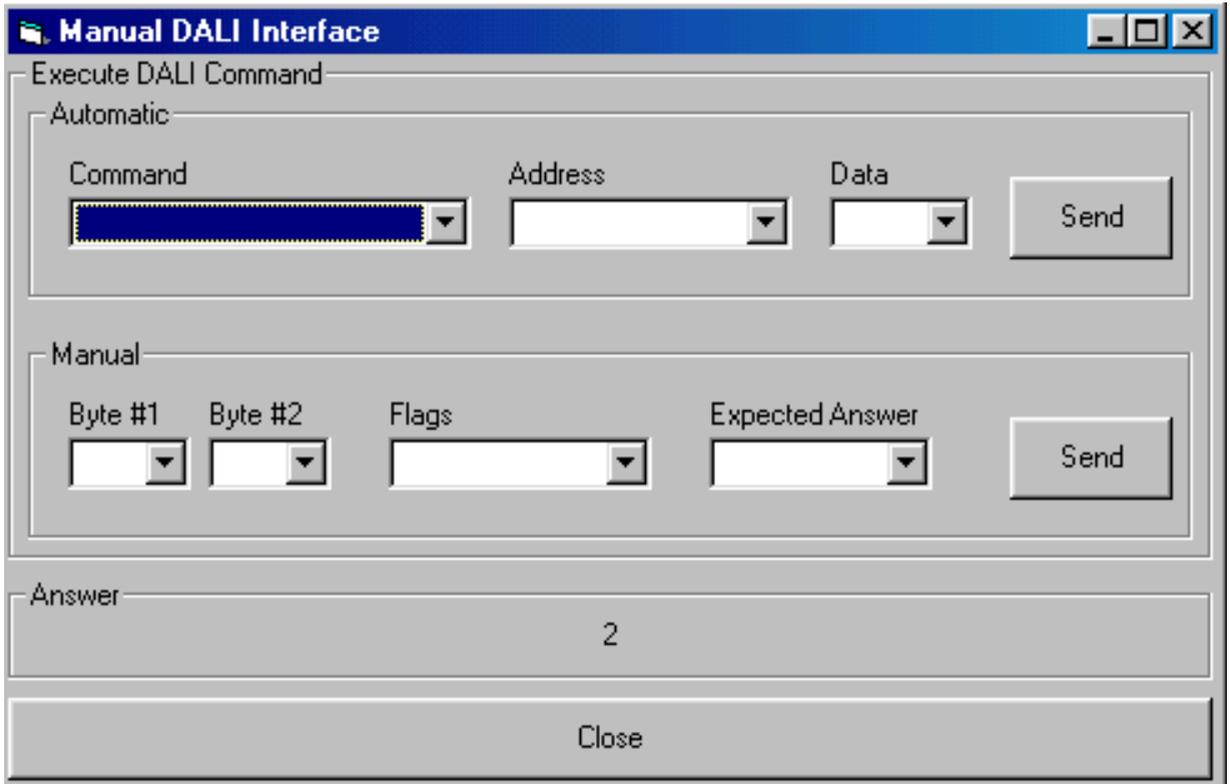
**Figure 11. Scene window**

#### 4.6 MANUAL DALI INTERFACE

Select the "Options" menu, item "Send DALI command..."

The following window appears:

Figure 12. Manual DALI interface window



#### 4.6.1 Automatic Command

An “Automatic” command can be sent by choosing a command in the “Command” combo box. All DALI commands defined in the EN60929 are available (See summary of the command set in draft, section E.4.3.5).

The second combo box allows the recipient(s) to be chosen:

Broadcast: all ballasts connected on the DALI bus

Group xx: all ballasts in the xx group (xx between 0 and 15)

Short yy: ballast with the short address yy (yy between 0 and 63)

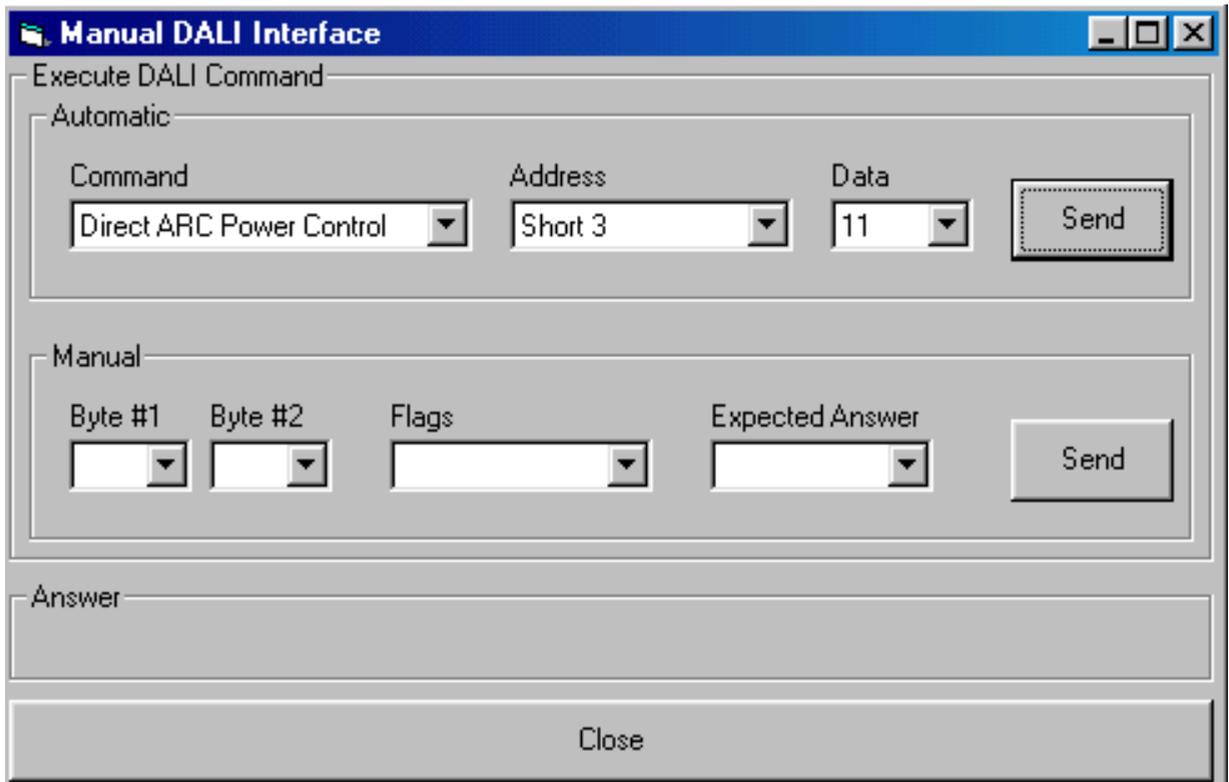
The third combo box is the data associated with the command. This parameter can be irrelevant, depending on the command. But it always needs to be filled out.

If the command is a “Query” command, the answer of the ballast addressed is displayed at the bottom of the window. (If the query is addressed to more than 1 ballast, an error occurred)

Example:

In the following window, a push on the “Send” button will put the light level of the ballast which has the short address 3 to a level of 11.

Figure 13. Light Level window



#### 4.6.2 Manual Command

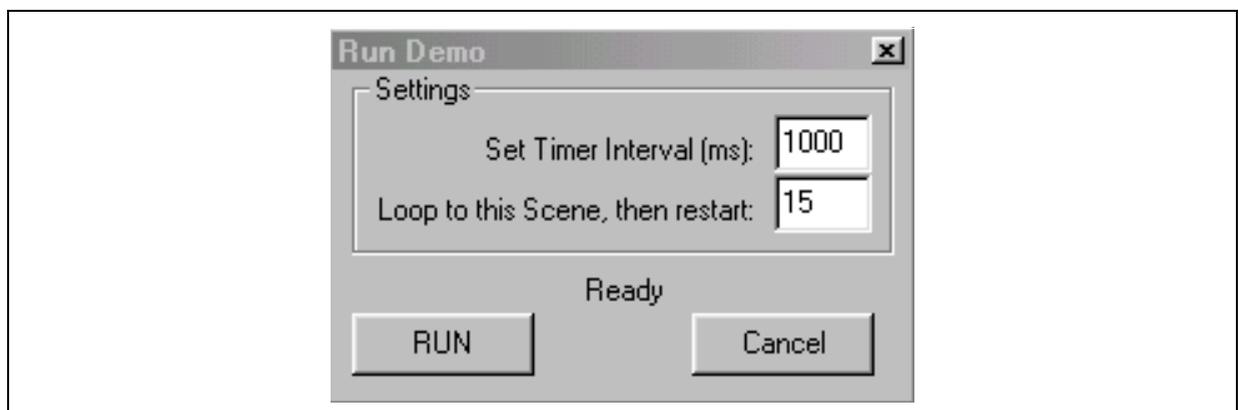
In this way the user has to fill the 2 bytes. Refer to EN60929 to know command codes.

#### 4.7 RUN AUTOMATED DEMO

Select the “Extras” menu, item “Run automated demo”.

The following window appears:

Figure 14. Automated demo configuration window



Set the timer interval  $x$  and the last defined scene  $y$ .

Push the “RUN” button to start the demo.

The master will go from Scene 0 to Scene  $y$ , and then restart from Scene0, with an interval of  $x$  milliseconds between each.

### 4.8 SAVE/LOAD CONFIGURATION

Select the “File” menu, item “Save...” to save the actual configuration.

Select the “File” menu, item “Load...” to load a configuration.

## **5 DALI SLAVE BOARD FEATURES**

### **5.1 LEDS**

#### **5.1.1 Green and red LEDs**

The green or red LED on each slave board indicates if the board was addressed or not by the last command sent by the master.

For example, if you select both ballasts before changing the light level, the green LED will be switched on both slave boards. On the other hand, if you select only one ballast before sending a command, the green LED will be switched only on one addressed slave, and the red LED will be switched only on the slave that is not concerned by the command.

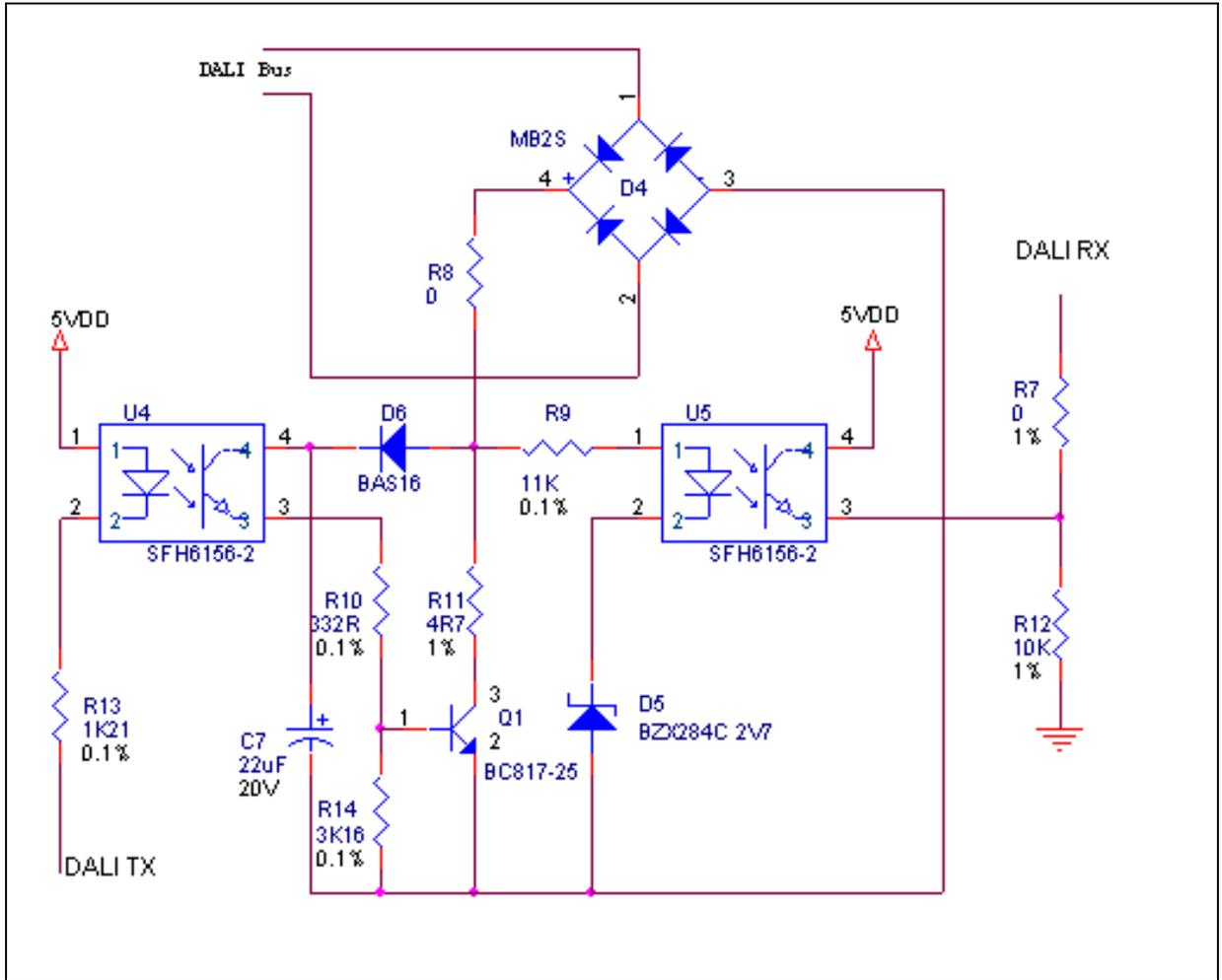
#### **5.1.2 Yellow LED**

The yellow led displays the 1-10V output level corresponding to the light level. It is especially useful if you do not want to connect a ballast to the 1-10V output.

### **5.2 JUMPER**

This jumper allows you to measure the ST7DALI microcontroller current consumption (particularly in halt mode).

## 5.3 DALI INTERFACE



## 5.4 ST7DALI SOFTWARE

The software is compliant with Annex E of the IEC929/ EN60929 standard.

A tester performing all the tests defined in Annex G of the standard has been used to validate the ST7DALI DALI software.

Refer to AN1601 for a description

## 5.5 HALT MODE

The ST7DALI-EVAL evaluation board can be used to measure the extremely low consumption of the microcontroller in Halt mode, by measuring the voltage on jumper 4.

### 5.6 SOFTWARE DESCRIPTION

The DALI slave software is described in AN1601.

Source code and environment setup files for STVP7 are included in the CD-ROM.

The software can be compiled with both Cosmic and Metrowerks compilers.

### 5.7 REPROGRAMMING THE MICROCONTROLLER

The microcontroller can be reprogrammed through the ICP connector using:

STMicroelectronics ST7 Flash STICK

Softec InDART ST7F/D ([www.softecmicro.com](http://www.softecmicro.com))

### 5.8 DEBUGGING THE APPLICATION

The user can debug in two different ways:

- Emulation using a ST7MDT10-EMU3 (in this case, solder a DIP20 to SO20 device adaptor/socket onto the board. See ST7MDT10-EMU3 Probe User Guide, section 3.6).
- In circuit debugging with a Softec InDART ST7F/D ([www.softecmicro.com](http://www.softecmicro.com)).

### 5.9 USEFUL DOCUMENTATION

Related documents are:

**AN1601** - Software Implementation for ST7DALI-EVAL

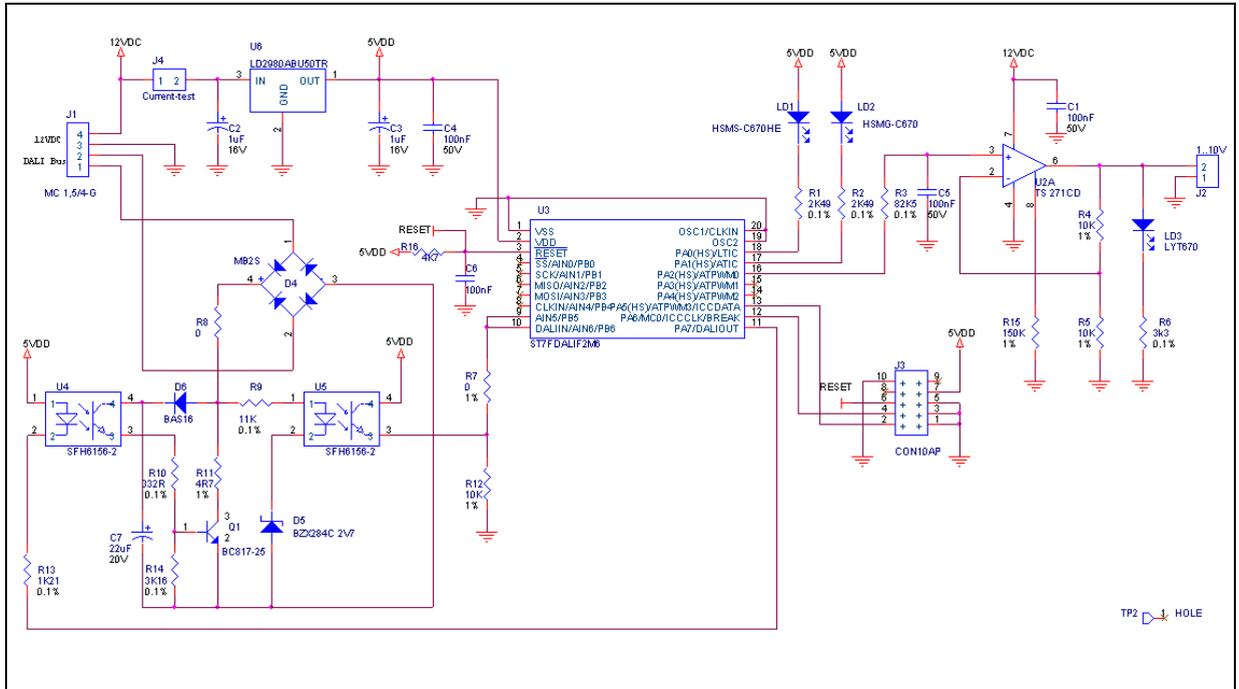
**AN1756** - Choosing a DALI Implementation Strategy with ST7DALI

**AN1900** - Hardware Implementation for ST7DALI-EVAL

## 6 APPENDIX: BOARD SCHEMATICS AND BILLS OF MATERIAL

### 6.1 DALI GATEWAY SLAVE BOARD

#### 6.1.1 Slave board Schematics



#### 6.1.2 Slave Board Bill of material

Item	Qty	Reference	Value	Voltage	%	Footprint	Description	Ref RS
1	2	C2, C3	1uF	20V	10%	3216	Tantalium	262-4327
2	4	C1,C4,C5,C6	100nF	50V	10%	0805	X7R	264-4416
3	1	C7	22uF	20V	10%	6032	Tantalium	262-4636
4	2	R1, R2	2K49	1/4w	0.1%	0805	Resistor	215-2850
5	1	R6	3K3	1/4w	1%	0805	Resistor	223-0499
6	1	R3	82K5	1/4w	0.1%	0805	Resistor	215-4525
7	3	R4,R5,R12	10K	1/4w	1%	0805	Resistor	223-0562
8	2	R7,R8	0	1/4w	1%	0805	Resistor	223-0146
9	1	R9	11K	1/4w	0.1%	0805	Resistor	215-3544

## APPENDIX: BOARD SCHEMATICS AND BILLS OF MATERIAL

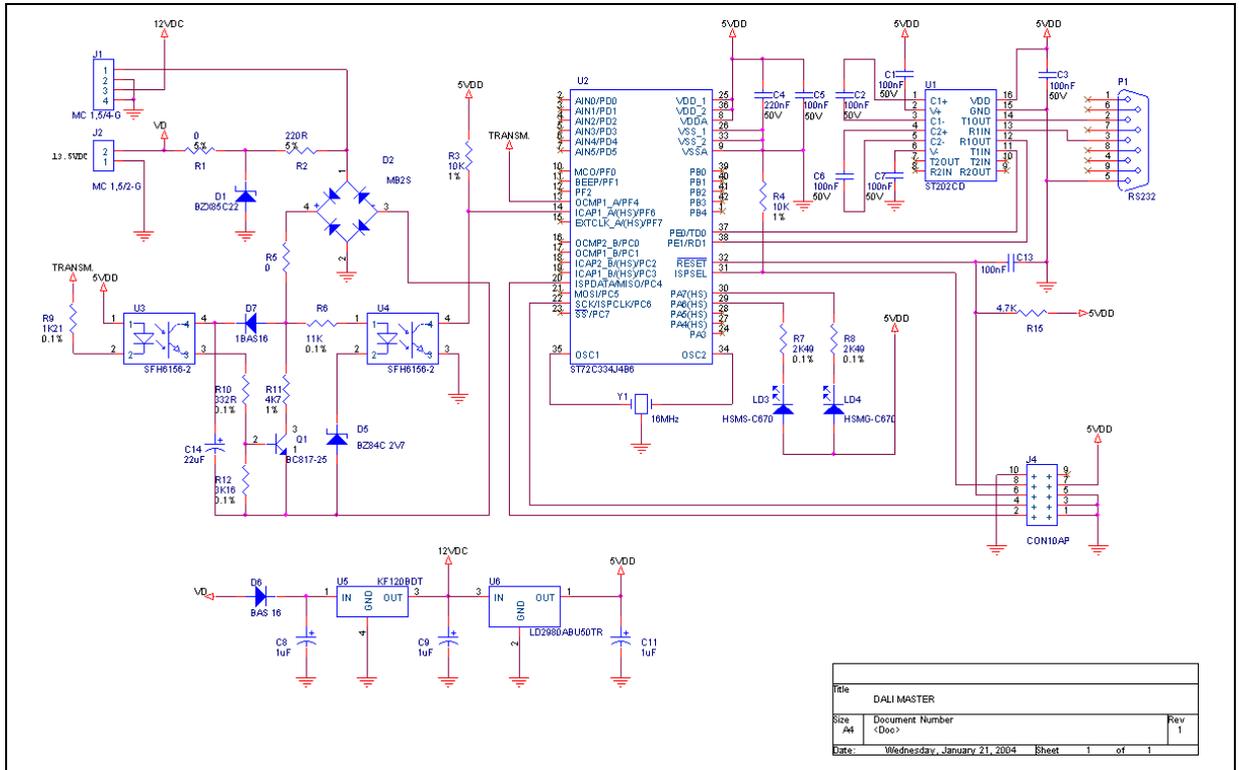
Item	Qty	Reference	Value	Voltage	%	Footprint	Description	Ref RS
10	1	R10	332R	1/4w	0.1%	0805	Resistor	215-1914
11	1	R11	4R7	1/4w	1%	0805	Resistor	344-6279
12	1	R13	1K21	1/4w	0.1%	0805	Resistor	215-2513
13	1	R14	3K16	1/4w	0.1%	0805	Resistor	215-2951
14	1	R15	150K	1/4W	1%	0805	Resistor	223-0714
15	1	R16	4K7	1/4w	1%	0805	Resistor	223-0528
16	1	LD1	HSMS-C670HE			0805	Red Led CMS 2mA	429-546
17	1	LD2	HSMG-C670			0805	Green Led CMS 2mA	429-568
18	1	LD3	LYT670				Yellow Led	428-830
19	1	D4	MB2S				Bridge Diode	269-366
20	1	D5	BZX284C2V7			0805	Zener 2.7V	216-9599
21	1	D6	BAS-16			SOT23	Diode	436-7773
22	1	U2	TS271CD			SO8	Operational amplifier	STM
23	1	U3	ST7FDALIF2M 6			SO20	Micro	STM
24	2	U4, U5	SFH6156-2			SO4	Optoisolator output NPN Transistor Input DC	284-1190
25	1	U6	LD2980ABU50 TR			SOT89	ULTRA LOW DROP VOLTAGE REGULA- TORS	STM
26	1	Q1	BC817-25			SOT23	NPN Transistor	STM
27	1	J1	MC 1,5/4-G	Connect			Connector, PCB, header, 3.81mm pitch, 4 way	220-4850
28	1	J2	MC 1,5/2-G	Connect			Connector, PCB, header, 3.81mm pitch, 2 way	220-4822
29	1	J4		Connect			Current Sense	251-8086
30	1	J3	Connector	Connect			Connr, rect, header, IDC, low profile box, straight mount, 10 way	120-7230

# APPENDIX: BOARD SCHEMATICS AND BILLS OF MATERIAL

Item	Qty	Reference	Value	Voltage	%	Footprint	Description	Ref RS
31	1		Connector	Connect			Connector, PCB, screw terminal, cable mount, 3.81 mm pitch 2 way	220-4658
32	1		Connector	Connect			jumper link	334-561

## 6.2 DALI MASTER BOARD

### 6.2.1 Master Board Schematics



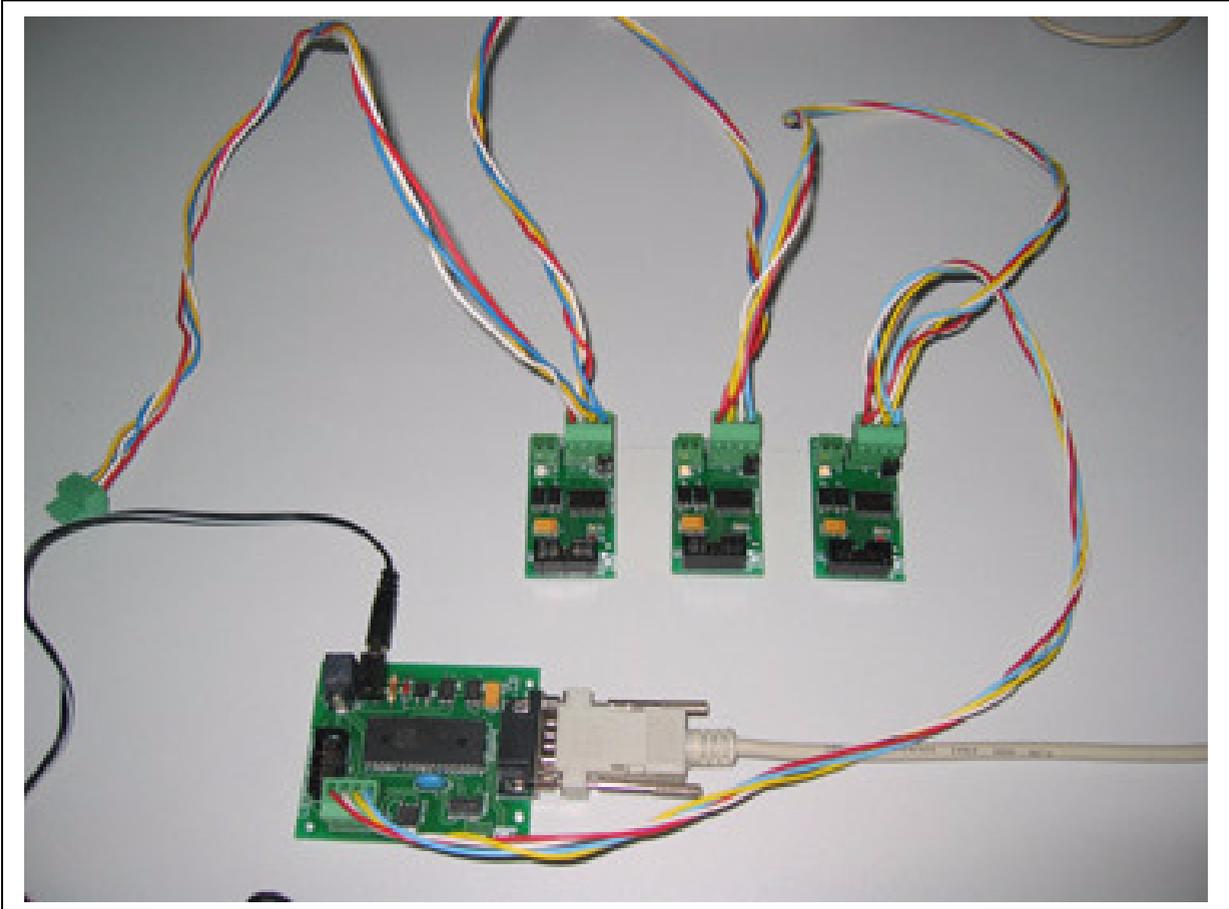
**6.2.2 Master Board Bill of material**

Item	Qty	Reference	Value	Voltage	%	Foot print	Description	Ref RS
1	7	C1,C2,C3,C5,C6,C7,C13	100nF	50V	10%	0805	Capacitor Type X7R	264-4416
2	1	C4	220nF	50V	10%	0805	Capacitor Type X7R	264-4438
3	3	C8, C9, C11	1uF	20V	10%	customer	Tantalium Capacitor	262-4327
4	1	C14	22uF	20	10%	customer	Tantalium Capacitor	262-4636
5	2	R1,R5	0		1%	0805	Resistor	223-0146
6	1	R2	220	1/2W	5%	RC05	Resistor	132-337
7	2	R3,R4	10K	0.1W	1%	0805	Resistor	223-0562
8	1	R6	11K	0.1W	0.1%	0805	Resistor	215-3544
9	2	R7,R8	2K49	0.1W	0.1%	0805	Resistor	215-2850
10	1	R9	1K21	0.1W	.1%	0805	Resistor	215-2513
11	1	R10	332R	0.1W	.1%	0805	Resistor	215-1914
12	1	R11	4R7	0.1W	.1%	0805	Resistor	344-6279
13	1	R12	3K16	0.1W	.1%	0805	Resistor	215-2951
14	1	R15	4K7	0.1W	1%	0805	Resistor	223-0528
15	1	D1	BZX85C22	22V		DO41	Diode Zener	812-544
16	1	D2	MB2S	200V		TO-269AA	BRIDGE SMD	269-366
17	1	LD3	HSMG-C670 HE			0805	Red Led SMD	429-546
18	1	LD4	HSMG-C670			0805	Green Led SMD	429-568
19		D5	BZ84C2V7	2.7V		0805	Diode Zener	216-9599
20	1	D6,D7	BAS16			SOT23	Diode	436-7773

## APPENDIX: BOARD SCHEMATICS AND BILLS OF MATERIAL

Item	Qty	Reference	Value	Voltage	%	Foot print	Description	Ref RS
21	1	X1	CSA16.0 0MXZA04 0				Murata 16Mhz (or CST16.00MXWA0C3 or CSACV16.00MXA040Q or CSTCV16.00MXA0H3Q)	179- 3810
22	1	Q1	BC817- 25			SOT23	NPN Transistor	STM
23	1	U1	ST7202C D			SO16	RS-232 DRIVERS AND RECEIVERS	STM
24	1	U2	ST72C33 4J4B6			SDIP42	Micro	STM
25	1	U3,U4	SFH6156 -2			SO4	Opto-isolator	284- 1190
26	1	U5	KF120BD T/ L78M15C DT			DPAK	VERY LOW DROP VOLT- AGE REGULATORS	STM
27	1	U6	LD2980A BU50TR			SOT89	ULTRA LOW DROP VOLT- AGE REGULATORS	STM
28	1	J1	Connec- tor				Connector, PCB, header, 3.81mm pitch, 4 way	220- 4850
29	1	J2	Jack				PCB socket 2.5mm	286- 8763
30	1	J4	Connec- tor				Connr, rect, header, IDC, low profile box, straight mount, 10 way	120- 7230
31	1	P1	RS232				RS 232 SOCKET for PCB	457-484
32	4-wire cable, terminated with three Connectors for cable mounting RS code 220-4670							

7 KIT PICTURE



“THE PRESENT NOTE WHICH IS FOR GUIDANCE ONLY AIMS AT PROVIDING CUSTOMERS WITH INFORMATION REGARDING THEIR PRODUCTS IN ORDER FOR THEM TO SAVE TIME. AS A RESULT, STMICROELECTRONICS SHALL NOT BE HELD LIABLE FOR ANY DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES WITH RESPECT TO ANY CLAIMS ARISING FROM THE CONTENT OF SUCH A NOTE AND/OR THE USE MADE BY CUSTOMERS OF THE INFORMATION CONTAINED HEREIN IN CONNECTION WITH THEIR PRODUCTS.”

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics.

All other names are the property of their respective owners

© 2004 STMicroelectronics - All rights reserved

STMicroelectronics GROUP OF COMPANIES

Australia – Belgium - Brazil - Canada - China – Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -  
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States

[www.st.com](http://www.st.com)