To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

R8C/25

Demonstration Example for DALI Lighting Protocol Stack

Introduction

The Demo project contains software that demonstrates the DALI lighting protocol from Renesas.

Target Device

R8C Family

Contents

1. Overview 2
1.1 Digital Addressable Lighting Interface (DALI) 2
1.2 Renesas Demonstration 2

2. Demo Setup 3
2.1 Hardware 3
2.2 Software 3
2.3 Building Code 3
2.4 Programming the Boards 3
2.5 Running the Demo 4

3. Renesas Windows GUI 5
3.1 Detailed Description GUI 6
3.2 Automatic Monitoring 7
3.3 Sending commands 8

4. Procedural Walkthrough 9
4.1 Setup 9
4.2 Verify the System Setup 9
4.3 Control the lamp individually. 9
4.4 Indirect Acr Power Control Commands 9
4.5 Change the MIN and MAX light values of a node 10
4.6 Reset all parameters back to their default 10

Website and Support 11

Revision Record 11

1. Overview

This demonstration provides an example of the capabilities of the Renesas DALI Slave protocol stack.

1.1 Digital Addressable Lighting Interface (DALI)

Digital Addressable Lighting Interface (DALI) is a protocol for controlling modern lighting systems. It is a standard set by the International Electrotechnical Commission (IEC), an international standards organization dealing with electrotechnology. The standards number is IEC-60929.

Lighting control technology has traditionally utilized analog interfaces or proprietary digital control methods. Both have disadvantages. Hard-wired analog dimming systems cannot control individual lights, are fairly complex and costly to implement, and are extremely difficult to modify for later changes in the use of an area. Proprietary digital control methods, while having greater flexibility over analog systems, are still unable to control individual ballasts for ultimate flexibility and are even higher in complexity and implementation cost.

The Digital Addressable Lighting Interface (DALI) defines a new standard for the digital communication between the individual components of a lighting system. DALI provides simplified communication and installation, yet maximum control and flexibility. Wiring is simpler. Installation costs are lower. Each ballast can be individually controlled (addressed) as well as belong to any or all of 16 different groups.

Maintenance costs are reduced through central monitoring of ballast and lamp status. Energy costs are lowered through daylight harvesting and standard controls such as occupancy sensors. Moreover, most importantly, the open standard allows interchangeability of DALI ballasts and controls from different manufacturers.

DALI has been designed in a joint effort by leading ballast and control equipment manufacturers with the idea of offering a standard to the lighting market that complies with all requirements and solves complex lighting tasks in a simple and cost-effective manner. Developed in Europe, the DALI standard is known as

Annex E of the European lamp ballast standard IEC 60929, and is progressing towards becoming a global lighting communication standard.

DALI is the ideal, simplified, digital way of communication tailored to the needs of present day lighting technology. Communication and installation have been simplified as much as possible. All intelligent components communicate in a local system in a way that is both simple and free of interference. There are no special wiring requirements - in fact, DALI wiring and power wiring may be installed in one common conduit (subject to local code). The DALI standard provides a full system solution (fixture, lamp, ballast, control and wiring). The advantages of DALI are many, benefiting everyone from the lighting designer to the facility manager and the building occupant.

1.2 Renesas Demonstration

The Controlling node in a DALI network is said to be the “Master” device while the ballast that are being controlled are said to be the “Slaves” devices. In actuality, the DALI specification only describes the required behavior for a slave device and does not include a detailed description of the master devices operations. Therefore, the behavior of the Master node is somewhat left up to the implementer of the master controller device.

For this demonstration, an LED is used to simulate the desired output from a florescent lamp on a DALI Slave device. Also, a DALI master board and PC program was created in order to send commands to the DALI slave devices for demonstration purposes. Please note that the DALI master platform was not the focus of development.

2. Demo Setup

2.1 Hardware

The following hardware is required to run the demonstration.

- 1 Renesas DALI Master Board w/ 9 volt, 350mA power supply
- 1 or more Renesas DALI Slave Boards
- RS232 Cable
- PC running Windows
- E8a Debugger (only for programming/debugging)

2.2 Software

Embedded Firmware:

- Renesas DALI slave demo firmware
- Renesas DALI master firmware

PC Software (for building/debugging)

- Renesas DALI GUI Interface Software
- High-performance Embedded Workshop (HEW) Version 4.04 (or later)
- Renesas M16C Standard Toolchain Version 5.43 Release 00 (or later)
- E8 or E8a Debug component for HEW
- Renesas Flash Development Toolkit (optional, for programming)

2.3 Building Code

There is no special procedure for building the Master or Slave firmware. Using the Renesas tools mentioned above, simply open the desired project in HEW and build the supplied project.

2.4 Programming the Boards

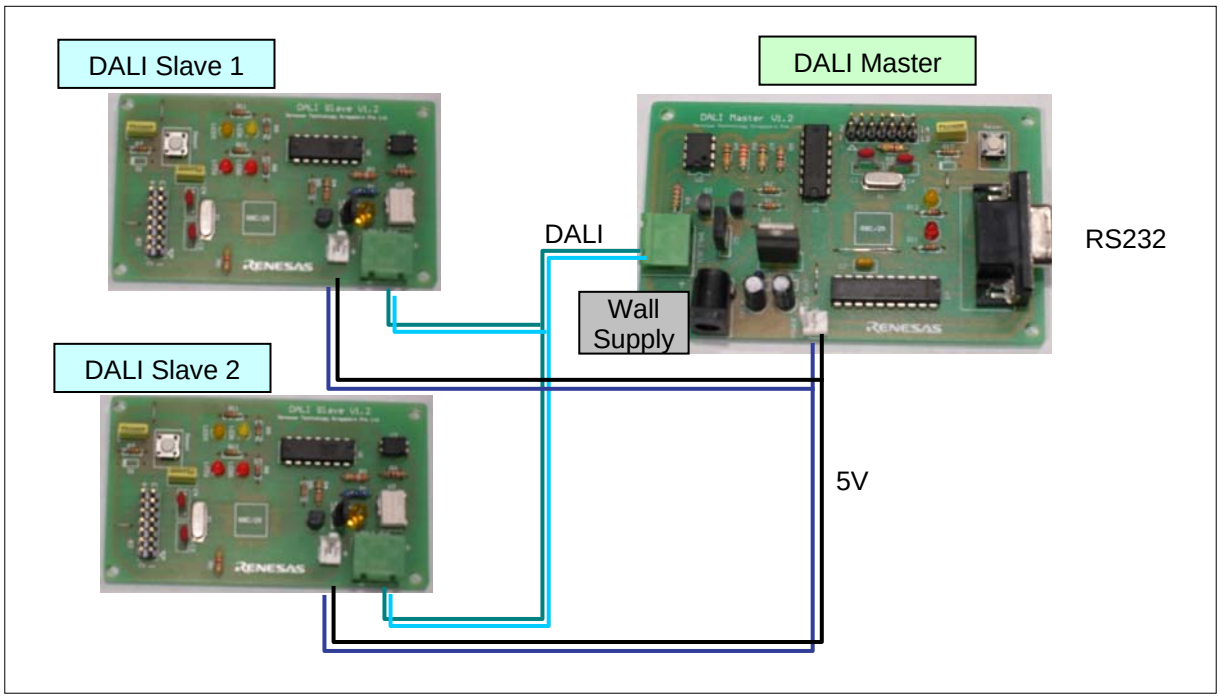
The boards provided in the DALI kit come pre-programmed with the demonstration software.

If the boards are not already programmed, you can either use the Renesas Flash Development Toolkit (FDT) software or connect in HEW using the “Flash Programming Mode” option in the debugger connection screen.

2.5 Running the Demo

To run the demo, please do the following. NOTE: The boards in the DALI kit come pre-programmed, therefore you can start at step $3.

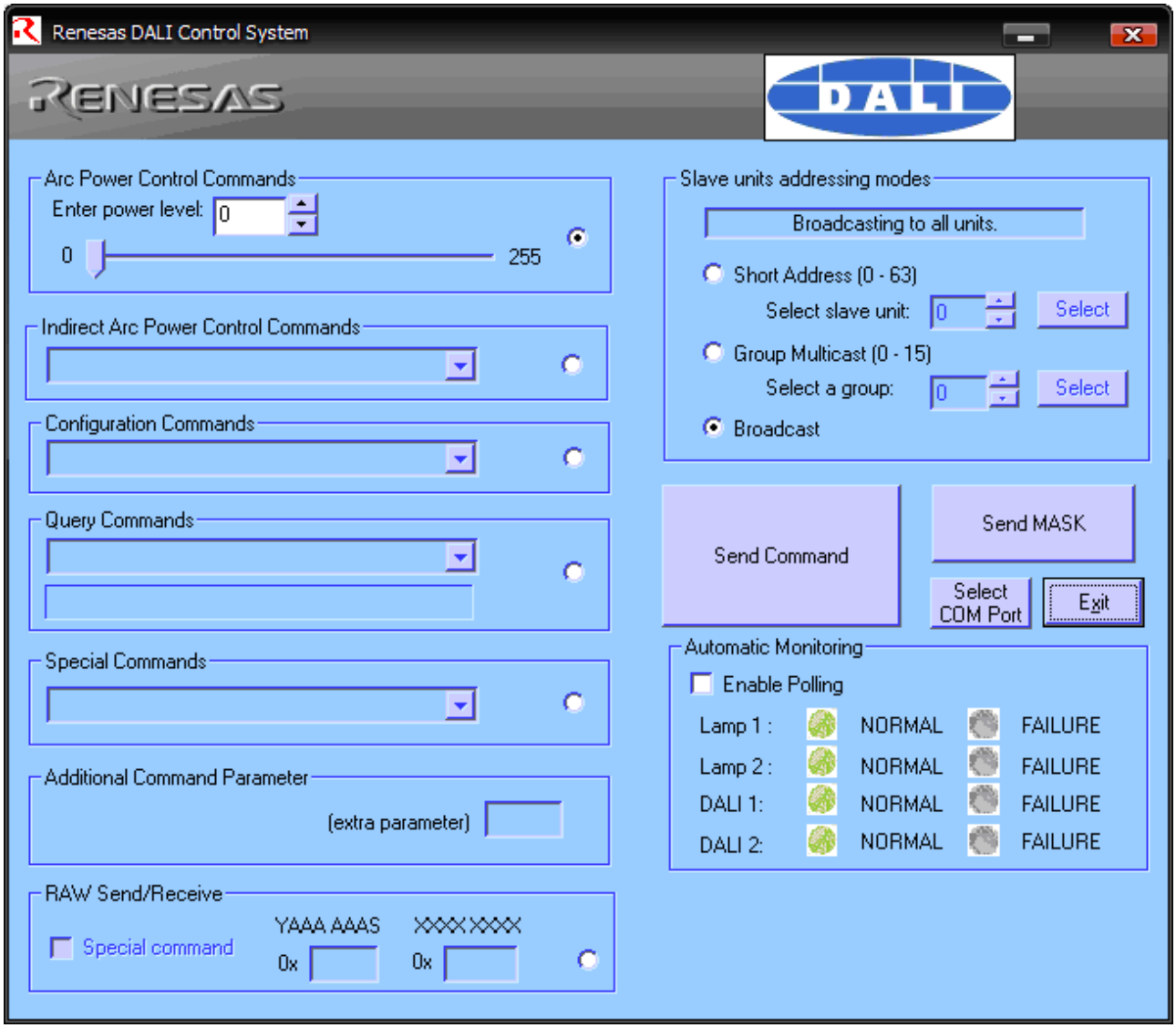
1) (Optional) Program the DALI Slave boards (each with a different short address)
2) (Optional) Program the DALI Master board
3) Hook up the DALI communication lines between all demo boards (shown below)
4) Hook up the DALI power supply lines between all demo boards (shown below)
5) Attached the RS-232 COM cable between the PC and Master board
6) Plug in the wall supply to the Master board
7) Open the PC GUI software
8) You are now ready to send commands using the PC GUI.



Connected DALI system

3. Renesas Windows GUI

Below is a screenshot the Renesas DALI Master GUI interface. This section will explain how it can be used to send DALI commands to DALI Slave boards.



3.1 Detailed Description GUI

To enable the use of any of the following groups of commands, first select the radio button to the right of the pull-down boxes.

3.1.1 Arc Power Control Commands Section

An Arc Power Control command will immediately change the light level of one or more slave boards. The lamp will be faded to the new brightness in the amount of time specified by the node's FADE_RATE setting. When using this section to send an Arc Power Control command, first enter the desire power level in the edit box, and then press the "Send Command" button. Alternatively, you can use the slider to choose a value which will then cause that value to be sent when the mouse button is released after the slider has been moved to a new position.

Arc levels range from '0' (meaning lamp OFF) to '254' (fully ON). The value '255' is called "MASK" and is sent to stop a fade currently in progress and use that instantaneous value as the new setting. The "Send MASK" button performs this same operation.

This command can be send to an individual Short Address, a Group Address or Broadcasted to all nodes.

3.1.2 Indirect Arc Power Control Commands Section

An Indirect Arc Power Control command is used to change the light level of one or more slave boards. These are simple commands that are intended to be sent by some type of light switch controller on the wall of a room.

Only the "GO TO SCENE" command requires you to also enter the desired scene value (0-15) in the parameter box.

These commands can be sent to an individual Short Address, a Group Address or Broadcasted to all nodes when the "Send Command" button is pressed.

3.1.3 Configuration Commands Section

A Configuration Command is usually sent during the initial setup phase of installation or during a later customization of the lighting setup in the room. Many commands use the Data Transfer Register (DTR) in order to specify the actual value to store as the new setting. A new DTR is *broadcasted* out to all nodes at once using the *Special Command* called "DATA TRANSFER REGISTER".

Configuration commands that deal with setting up *Groups* or *Scenes* require you to also enter the desired scene value (0-15) in the parameter box to specify what group or scene you are referring to.

These commands can be sent to an individual Short Address, a Group Address or Broadcasted to all nodes when the "Send Command" button is pressed.

3.1.4 Query Commands Section

Query Commands are using to solicit information from one or more slave nodes. Some of the uses for these queries are spelled out in the DALI specification. A DALI Master vendor could choose to use these query periodically in order to report on the status or health of your lighting network.

The value returned by a query is displayed in the section below the query command selection pull-down box. For YES/NO type commands, a response of 0xFF means YES. A response of 0x00 means NO.

Only the "QUERY SCENE LEVEL" command requires you to also enter the desired scene value (0-15) in the parameter box.

These commands can be sent to an individual Short Address, a Group Address or Broadcasted to all nodes when the "Send Command" button is pressed.

3.1.5 Special Commands

Special commands are mostly used for device initialization. Other than the "DTR" command, the "INITIALISE" command must first be sent before any other Special Command can be sent. After the INITIALISE command is sent, there is 15 minute window in which you can send special commands. You can end the 15 minute configuration window early by sending the "TERMINATE" command.

Many Special Commands require you to also enter a desired value in the parameter box. The range of the value depends on the command you are sending.

As part of the DALI protocol, these commands are always broadcasted to all nodes at once. Therefore, the address mode selection area in the GUI window is disabled when sending these commands.

3.1.6 Additional Command Parameters

This box is to enter additional parameters such as group or scene numbers depending on the command being sent.

3.1.7 RAW Send/Receive

This section is for advanced DALI users. This can be used to send out a *Forward Frame* from the master with the exact formatting you desire. The addressing mode section is disabled since you must input all 16 bits of the command frame. This section could be used for doing "negative" testing of the stack to make sure it handled malformed framed correctly. Please refer to the DALI specification on how to format these fields.

3.1.8 Slave Unit Addressing Modes

This section is used to select the intended destination address of the command packet. When selecting the Short Address or multicast Group Addressing modes, you MUST also click the "Select" button in order to switch to using that address.

Valid short addresses are 0-63. Valid Group addresses are 0-15.

3.1.9 Send Command Button

This button is used to send the command after the type of command and address mode sections have been selected.

3.1.10 Send MASK Button

This button is used to immediately send an Arc Power Control Command with a level of '255' (otherwise know as "MASK"). This command will be sent when this button is pressed regardless of what current address mode and command type settings are. This button is intended to show how sending a MASK signal during the middle of a fading operation will stop the fade.

3.1.11 Select COM port Button

To connect to the master unit, a RS232 serial port connection is required. When the program runs, the user will be prompted to select a COM port for the communication with the master unit. The user can select a new COM port in the main interface with this button after the application has already been started. COM ports 1 to 9 are supported by the program.

3.1.12 Exit Button

Exits this Windows GUI application.

3.2 Automatic Monitoring

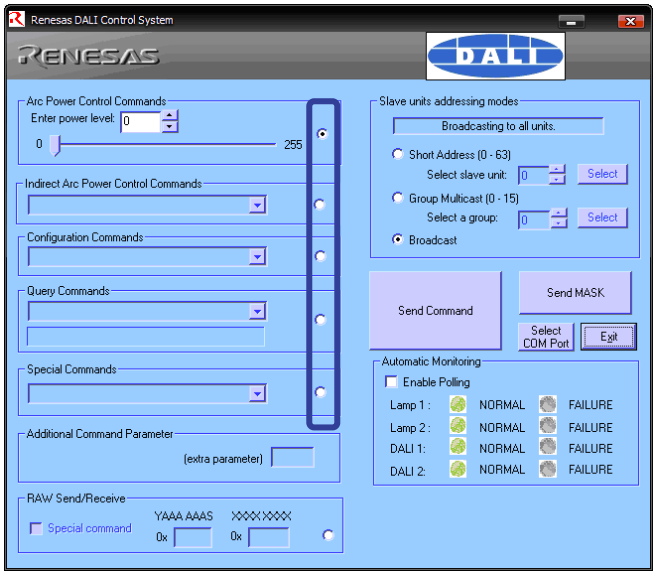
By checking the "Enable Polling" check box, the GUI will automatically start sending query command to Short Addresses '1' and '2' at a continuous rate. Using the information returned by the query commands, the GUI will automatically update the DALI communication and lamp health status images.

This can be demonstrated by connected a slave node that is already programmed with a short address of '1' or '2' and then unplugging the DALI signal line or removing the LED jumper on the slave board. When either is done, the FAILURE indicator on the GUI should become red.

3.3 Sending commands

To send a general command to one or more DALI salve boards, please follow this general procedure:

Step 1: Select the type of command to send using the radio selection boxes outlined below.



Step 2: After selecting a type of command, use either the slide or the corresponding pull-down menu to choose the command you would like to send. Note that some command required an additional parameter to be entered in the 'Additional Command Parameter section".

Step 3: Select the intended destination device(s) by using the "Slave units address mode" section at the top right of the window. NOTE: You must press the "Select" button after changing to a different Short Address or Group Address.

Step 4: Press the "Send Command" button.

NOTE: When using the Arc Power Control slider, the "Send Command" buttons is not needed.

4. Procedural Walkthrough

This section will provide you with a procedure for experiencing some DALI communications.

4.1 Setup

For this procedure, you must first have 2 DALI Slave boards connected to a master board. One slave boards should be pre-programmed with the short address ‘1’. The other slave board should be pre-programmed with short address ‘2’. The boards should all be power and the Windows GUI running and set to the correct COM port.

When power is first applied to the slave boards, the LED’s simulate ignition of a real fluorescent tube system.

4.2 Verify the System Setup

Once everything is plugged in and running, you can easily verify the system is operational by selecting the “Acr Power Control” command section and moving the slider bar back and forth (releasing mouse button after each stop) while the “slave unit address mode “ section is set to broadcast. If everything is set up correctly, each time you move the slide and release the mouse button, the LEDs on both boards should change their luminance setting at the same time.

4.3 Control the lamp individually.

1) First select the Short Address radio button
2) Then enter ‘1’ in the edit box.
3) Now press the “Select” button to register that you want to only talk to node ‘1’
4) Use the Arc Power Control slider to verify that only the LED on slave board ‘1’ changes and while the LED on slave board 2 stays the same.

4.4 Indirect Acr Power Control Commands

1) Select the Indirect Acr Power Control commands radio button. While you are still sending only to short address ‘1’, verify that that the selecting the “OFF” command and pressing the ‘Send Command’ turns the LED completely off. Then verify that the “ON STEP UP” command will then turn on the LED and set it to its minimum light level.

   NOTE: Whenever the lamp is changed from completely OFF to some ON value, the DALI stack must allow time for the ballast to warm-up and ignite the lamp gasses before attempting to set it to a specific luminance value. While on a real eBallast board this type of feedback would come from a lamp driving circuit, the LED demo is emulating this effect by flashing the LED for 2 seconds to simulate a gas ignition phase of a real florescent tube system.

2) Send the “UP” and “DOWN” commands the increase or decrease the light at a specific step amount.
3) You may send the “STEP UP” and “STEP DOWN” commands, but a 1 step change is difficult to distinguish with these LEDs.
4) Try sending the “RECAL MIN” and “RECAL MAX” values. These values are configurable on a per node basis.

4.5 Change the MIN and MAX light values of a node

1) We must first put a new value in every node's DTR. Select the Special Command "DATA TRANSFER REGSITER" and enter '32' (0x32 = 50) in the parameter box and press the Send Command button. This will put a 0x32 in every node's DTR.

2) Next Select the Configuration Command "STORE THE DTR AS MIN LEVEL" and change the node addressing back to Short Address for node '1' (make sure you click the select button). After you have done that, you can then press the Send Command button.

3) You will now notice that when you send the Indirect Arc Power Control command "RECAL MIN", the light level will go to '50' instead of the default '1'. You can also verify using the Arc Power Control slide that no matter what value you send, the lowest light level will be 50.

4) Any time a configuration command is sent, it is automatically saved to Flash memory inside the MCU. Therefore if you were to remove power to this board, and reattached power again, you will notice that the MIN LEVEL is still 50.

5) The default MAX level is 254. Using the same procedure that you just did for the MIN level, try changing the MAX level to 100.

4.6 Reset all parameters back to their default

1) In order to set all the DALI configuration parameters back to there defaults, simply send the Configuration Command "RESET" to any or all nodes. Note that each node's DALI Short Address parameter will be the only attribute that will keep its current value and not change back to the defaults. Also, this demo code has been programmed to artificially modify some attribute from their DALI defaults for demonstration purposes. These attribute and their demo defaults are:

DALI Attribute	DALI DEFAULT	Renesas Demo Default Value
Short address	0xFF (no address)	1 or 2
FADE TIME	0 (no fade)	1 (0.707s total fade time)
Group 4	Not member of Group 4	Member of Group 4
Scene 0	0xFF (not used)	Light level of 4
Scene 1	0xFF (not used)	Light level of 20
Scene 2	0xFF (not used)	Light level of 36
Scene 3	0xFF (not used)	Light level of 52
Scene 4	0xFF (not used)	Light level of 68
Scene 5	0xFF (not used)	Light level of 84
Scene 6	0xFF (not used)	Light level of 100
Scene 7	0xFF (not used)	Light level of 116
Scene 8	0xFF (not used)	Light level of 132
Scene 9	0xFF (not used)	Light level of 148
Scene 10	0xFF (not used)	Light level of 164
Scene 11	0xFF (not used)	Light level of 180
Scene 12	0xFF (not used)	Light level of 196
Scene 13	0xFF (not used)	Light level of 212
Scene 14	0xFF (not used)	Light level of 228
Scene 15	0xFF (not used)	Light level of 244

References

- DALI specification CEI/IEC60929:2006

Website and Support

http://www.renesas.com

Inquiries

http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Jul.28.2008	—	First edition issued

Notes regarding these materials

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life

   Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.

© 2008. Renesas Technology Corp., All rights reserved.