CONVERGING SYSTEMS

Integration Note

Automation/Lighting Panel Manufacturer:	Lutron Electronics Co. Inc.
Platforms:	**RadioRA2**
Versions:	All Lutron setup software (Essentials and Inclusive)
Specific Profile/Driver Version:	No driver required from Lutron. e-Node version 2.9 or later. Pilot software 4.4 build 2 or later. Note: newer functionality may require newer versions of e-Node firmware and/or Pilot software
Website location for profiles/drivers	No drivers required other than built-in functionality to e-Node device
Document Revision Date:	May 14, 2015

OVERVIEW AND SUPPORTED FEATURES

The Lutron lighting systems, RadioRA2 and HomeworksQS support the Converging Systems' family of motor and LED lighting control products using the Converging Systems e-Node device. This integration note is customized for the **RadioRA2** platform. If you desire to develop compatibility with HomeworksQS systems, please see the separate Integration Note referencing the HomeworksQS system.

Integration of the Converging Systems' platforms are enabled from Lutron keypads, and Android and iOS devices both locally and remotely.

CURRENT PROFILES SUPPORT THE FOLLOWING FEATURES

The following commands can be supported by installer entered commands into the Lutron setup page within the e-Node Ethernet device. Those commands which currently cannot be supported are grayed out.

LED Lighting Commands

General CS-Bus	Key Digital Naming	ILC-100	ILC-400	e-Node DMX

Commands	Convention[1]			
General LED Control Commands				
ON	Node_On	✓	✓	✓
OFF	Node_Off	✓	✓	✓
EFFECT,n (>1)	Execute_Effect	✓	✓	N/A
STORE,#	Store_Preset	✓	✓	✓
RECALL,#	Recall_Preset	✓	✓	✓
DISSOLVE.1=XX	Set_Dissolve_Rate	✓	✓	N/A
DISSOLVE.2=XX	Set_Dissolve_Rate	✓	✓	N/A
DISSOLVE.3=XX	Set_Dissolve_Rate	✓	✓	N/A
DISSOLVE.4=XX	Set_Dissolve_Rate	✓	✓	N/A
SEQRATE=XX	Set_Sequence_Rate	✓	✓	N/A
SUN_UP	Sun_Up	✓	✓	N/A
SUN_DOWN	Sun_Down	✓	✓	N/A
SUN.S	Set_Circadian_Value	✓	✓	N/A
HSB (HSL) Color Space Commands				
FADE_UP	Fade_Up	✓	✓	✓
FADE_DOWN	Fade_Down	✓	✓	✓
SET,L	Set_Brightness	✓	✓	✓
HUE_UP	Hue_Up	✓	✓	✓
HUE_DOWN	Hue_Down	✓	✓	✓
HUE,H	Set_Hue_Value	✓	✓	✓
SAT_UP	Sat_Up	✓	✓	✓
SAT_DOWN	Sat_Down	✓	✓	✓
SAT_S	Set_Saturation_Value	✓	✓	✓
STOP	STOP	✓	✓	✓
COLOR=H.S.L	Set_Preset_HLS Colorspace	✓	✓	N/A
PRESETH.X=XXX .XXX.XXX	Set LED Presets/HLS Color spacer for preset x	✓	✓	N/A
RGB Color Space Commands				
RED,R	Set_RED_Value	✓	✓	✓
GREEN,G	Set_GREEN_Value	✓	✓	✓
BLUE,B	Set_BLUE_Value	✓	✓	✓
VALUE=R.G.B	Set RGB Values	✓	✓	N/A
WHITE,W	Set WHITE_Value	✓	✓	N/A
VALUE=R,G,B,W	Set RGBW Values	✓	✓	N/A
PRESET.X=XXX.X XX.XXX (3-color)	Set LED Presets/RGB Color spacer for preset x	✓	✓	N/A
PRESET.X=XXX.X XX.XXX.XXX (4-color)	Set LED Presets/RGB W Color spacer for preset x	✓	✓	N/A
STOP	???	✓	✓	✓

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Correlated Color Temperature (CCT) Commands				
CCT,XXXX	SET_Correlated_Color_ Temp	✓	✓	N/A
CCT_UP	Color_Temp_Up	✓	✓	N/A
CCT_DOWN	Color_Temp_Down	✓	✓	N/A
Bi-Directional Commands				
COLOR=?	Automatic polling within Driver	N/A	N/A	N/A
VALUE=?	Automatic polling within Driver	N/A	N/A	N/A
PRESETH.X=?		N/A	N/A	N/A
PRESET.X=?		N/A	N/A	N/A
Accessory Enode Command/Setup Parameters				
Verbose Mode				
UDP Port 4000/5000		✓	✓	✓
Telnet Login with Authentication (with e-Node		✓	✓	✓
Telnet Login without Authentication		✓	✓	✓

Notes:

Motor Commands (WIP currently)

General Commands	Key Digital Controls Naming Convention	IMC-100	BRIC (“Bric Mode”)	
General Motor Control Commands				
UP		✓	✓	
DOWN		✓	✓	
STOP		✓	✓	
RETRACT		✓	✓	
STORE,#		✓	✓	
RECALL,#		✓	✓	
PRESET.X=XX.XX				
Bi-Directional Commands				
STATUS=?		N/A	N/A	
POSITION=?		N/A	N/A	

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Accessory Enode Command/Setup Parameters				
Verbose Mode				
UDP Port 4000/5000				
Telnet Login with Authentication (with e-Node		✓	✓	✓
Telnet Login without Authentication		✓	✓	✓

CURRENT PROFILES DO NOT SUPPORT THE FOLLOWING FEATURES

Other than any features that are grayed out below, any features specified below are currently unsupported.

Any feature not specifically notes as supported should be assumed to be unsupported

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WIRING DIAGRAM (for RadioRA2)

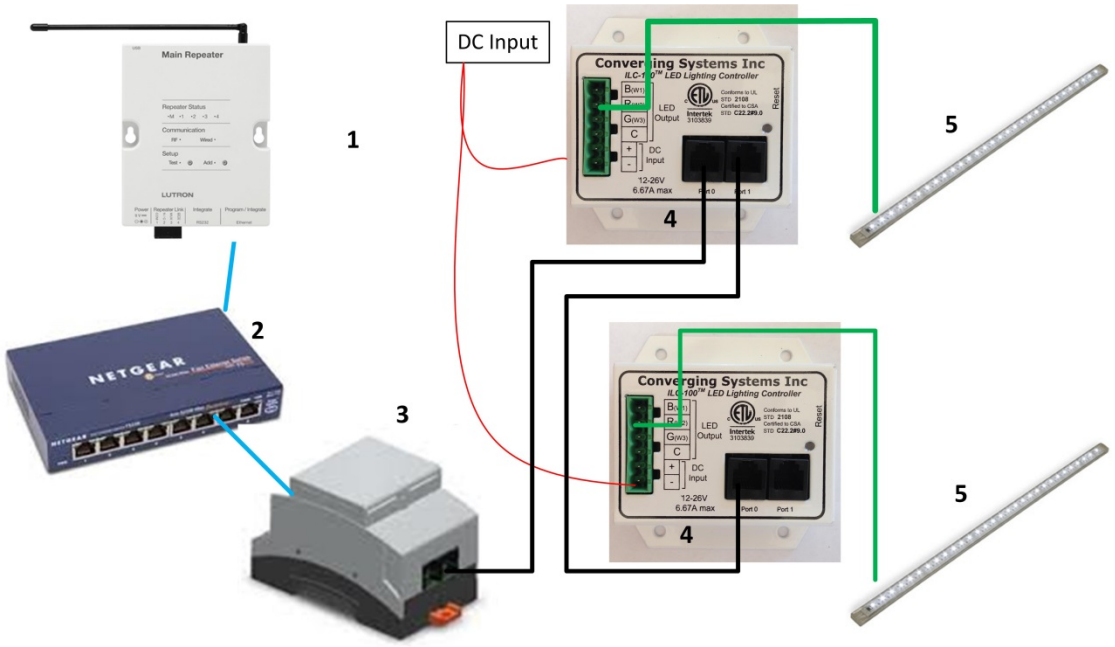

Figure 1

Wiring/Configuration Notes:

1. Maximum length of CS-Bus cabling from e-Node to the last ILC-100 using CAT5e or better cabling (and obeying the 1-1 pin-out requirements for the RJ-25-RJ25 cable) = 4000 feet
2. Maximum number of ILC-100 controllers and Converging Systems' keypads (if provided) that can exist on a single network connected to a single e-Node device = 254
3. Maximum number of e-Nodes that can exist on a Lutron RadioRA2 or HomeworksQS system = 254

BILL OF MATERIALS (for RadioRA2)

#	Device	Manufacturer	Part Number	Protocol	Connector Type	Notes
1	RadioRA2 processor	Lutron	RR-Main-REP-WH	Ethernet	various	
2	Network Switch	Various	Various	Ethernet	RJ-45	
3	e-Node	Converging Systems	e-Node	Ethernet	RJ-45 (for Ethernet) RJ-25 for local bus	
4	Lighting Controller (or Motor Controller)	Converging Systems	ILC-100 or IMC-100 or (Stewart BRIC)	CS-Bus protocol	RJ-25 for CS-Bus communication	Must terminate beginning and end of bus with 120 ohm

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						resister on pins 3/4
5	Flexible Linear Lighting (FLLA) RGB or RGBW luminaries	Converging Systems	FLLA-RGB-xxx FLLA-RGBW-xxx		3-color 4 pin 4-color 5 pin 1-color 4 pin	

Theory of Operation

The Converging System network controller and one or more connected CS-Bus compatible devices (LED or projection screen motors) is made operational with the targeted Lutron system by following a few simple steps. No drivers or changes to Lutron equipment in general are required to establish communication with Converging Systems equipment, although you may wish to fine tune the button logic in your Lutron project to generate the type of output commands which will most effectively control the Converging Systems equipment.

The following steps summarize the steps that will be required to complete this process. Details for each Step can be found immediately after this section. You may also choose to jump forward to the below table for a summary of all topics documented within this Integration and focus on only those sections which might be most relevant for your particular project.

-**Step 1**. Complete your Lutron programming with RadioRA2 Essentials or Inclusive software. Establish a **Telnet Username** with **Telnet Password** that you can allocate to enable the Converging Systems network connection.

-**Step 2**. Customize any actual Lutron hardware devices or Lutron phantom keypads (usually for sliders on the Lutron app) with specific types of buttons optimized to achieve the results desired. (Lutron button logic varies depending upon how they were programmed initially by the installer within the applicable Lutron software.)

-**Step 3**. Input a minimum amount of communication information in order to have the Converging Systems' e-Node processor establish a Telnet connection to the RadioRA2 processor (**IP address** of Lutron processor, dedicated **Telnet Username** and **Telnet Password**).

-**Step 4**. Establish links between targeted Lutron button pushes on Lutron hardware devices (or buttons or sliders on the Lutron app) and the desired behavior of the Converging Systems' lighting or motor controller(s).

Section	Subtopics	Section

STEP 1 (Telnet info and Lutron processor IP address)

Program into your Lutron processor a ***dedicated*** **Telnet Username** and **Telnet Password** for a Telnet channel that can be dedicated to the Converging Systems' interface. Telnet channels cannot be shared, so if you wish to have the Lutron Home Control + app and the Converging System application running, it is necessary to establish two separate Telnet channels for these two operations to occur. You can enter this Telnet information within the Lutron software **Settings/Integration/Telnet Login** tab as seen below in Figure 3.

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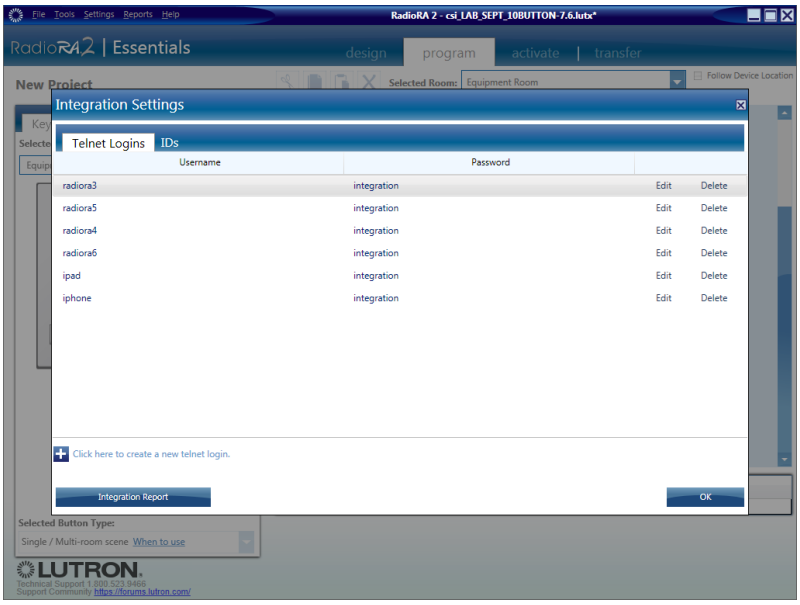

Figure 2

Also, take note of the IP address of your Lutron processor which is available from your **Design Tab**

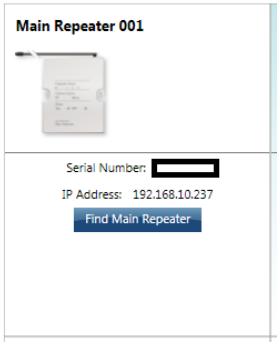

Figure 3

Now enter the dedicated **Telnet Username** and **Telnet Password** below along with the **IP address** of your Lutron processor into the attached spreadsheet in Appendix 3 at the end of this Integration Note for future reference:

STEP 2 (Lutron button-type programming)

Within RadioRA2, buttons can be created to behave in several discrete manners. Those relevant to our setup instructions are specified below. These button operations are summarized on the

table below and described in further detail after the table. It is important to understand the discrete operations for how button behave, for the Converging Systems connected devices can only be programmed to respond to those output commands generated by Lutron. If those buttons do not generate the correct Lutron output codes, Converging Systems' products cannot properly respond. PERIOD.

Button Type	Operation	Lutron system software output				Cases where this type of button is desirable
		Push	Release	Double Push	Extended hold	
Type 1	Standard type	"**3**"	N/A	N/A	N/A	ON, OFF, HUE UP, MOTOR DOWN, STOP
Type 2	Adv. Setting type	N/A	"**4**"	N/A	"**5**"	All of the above commands PLUS User Recall button which you want to double as a Store button when held for 10 seconds. **Note**: **If you don't care about doubling up on the functionality of buttons, disregard Type 2 buttons.**
Type 3	Special FADE UP/DOWN	"**3**"	"**4**"	N/A	N/A	FADE UP, or FADE DOWN (or MOTOR UP, or MOTOR DOWN)

Type 1- Standard operation. This is standard and most common operation that can be used for the bulk of Converging Systems' operations such as *ON, OFF, RECALL n, MOTOR UP, STOP* and to initiate a *HUE UP, SATURATION UP* or similar type operation. In this case the Lutron system generates a "**3**" from the Lutron processor, and no other output strings are possible.

Note: within RadioRa2, all buttons except the ***FADE DOWN and FADE UP*** buttons generate a "**3**" from the Lutron processor when these buttons are first depressed (except if they are programmed as a Type 2 button—see below). There is no separate output command stream generated by Lutron in this case for a button release.

Type 2-Advanced Settings. As an option, the Lutron programming software allows a hardware button to be pressed and held for ten seconds to generate a different output sequence. In this case, if the button is depressed and then released quickly, the Lutron system generates a "**4**" as a button operation. If the button is held for 10 seconds and then released, the Lutron system generates a "**5**" instead (note in this case there is never a "**3**" generated by ANY Button from the entire keypad that is being programmed). **This is the recommended option where you (i) want to establish a dual mode of operation of a button (like to Recall a previously saved color and then to SAVE that color state for future recall). You can right click on the non-button areas of the keypad being programmed within the Lutron software and pick the Advanced Settings tab as seen in Figure 5 below.**

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Note: As long as there **no** other buttons on the keypad that you are programming that would be impacted by such a SAVE operation, Converging Systems recommends that this **Type 2 Advanced Setting** button type be used on all keypads that are dedicated to Converging Systems operation because separate button operations can be leveraged (together) saving money for the customer.

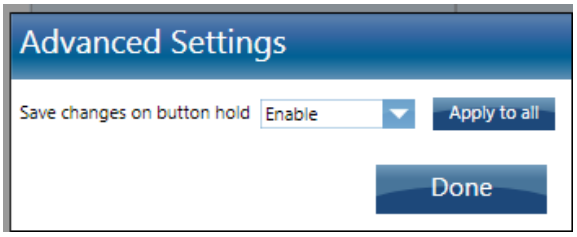

Figure 4

Type 3- Special FADE (up and down) BUTTONS. Within RadioRA2, these are the only two buttons that have a different operation. These buttons are reserved for FADE type operations. When these buttons are pressed, the Lutron system generates a "**3**" but when these buttons are released, there is the special case of a "**4**" being generated. This logic is particular good only for our FADE UP and FADE DOWN LED commands which would provide a STOP command when the button is released.

Required Action (Potentially). Now with this information in mind, update any of your Lutron Essentials or Inclusive programming for each button programmed that you wish to trigger a Converging Systems' event in a unique way, if required. Also, take note within the **Lutron Integration Report** seen in Figure 6 can be found the **Integration IDs** that will be used later in this Integration Note to link Lutron button pushes with Converging Systems' invoked CS-Bus commands.

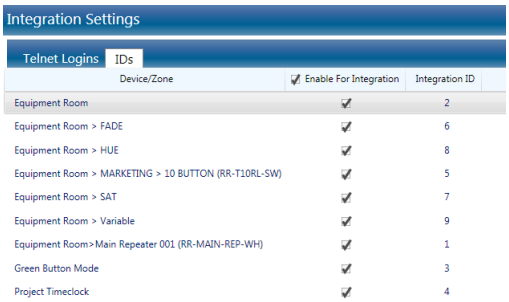

Figure 5

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STEP 3 (e-Node communication setup for Lutron/e-Node)

You will next need to enter several communication parameters within the e-Node Pilot Min requirements for this operation

- Computer running Windows XP or later OS, preferably with a wired Ethernet connection to a local router using CAT5 type cabling
- Converging Systems E-Node Ethernet adapter, connected using CAT5 cabling to the above router.
- Download of the latest version of e-Node Pilot application, unzipped and operating on your computer platform
- Powered up and connected ILC-x00 controller using straight thru (1-1) wiring using a 6-pin RJ-connector (Do not use 568A or 568B wiring and simply chop of the browns because this does not preserve twisted pairs on pins 1 / 2, 3 /4 , and 5/ 6 which is required).

Recommended RJ-25 6P6C connections 6 wires		
e-Node Side	**ILC-x00 side**	**Color of wire**
Pin 1	Pin 1	blue
Pin 2	Pin 2	Blue/white
Pin 3	Pin 3	Orange
Pin 4	Pin 4	Orange/white
Pin 5	Pin 5	Green
Pin 6	Pin 6	Green/white

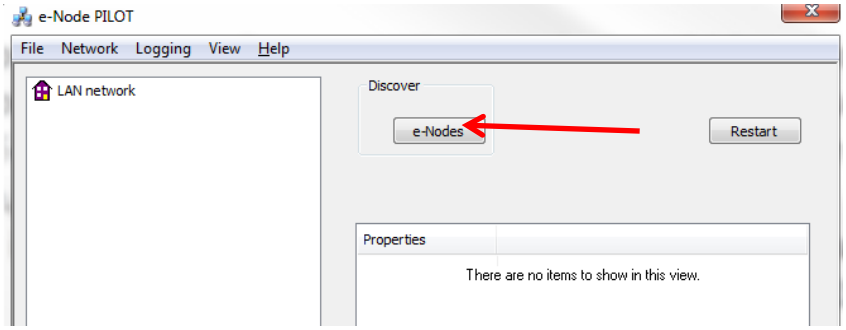
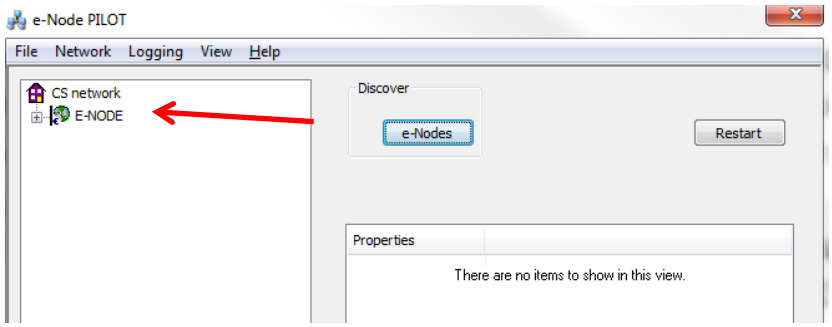
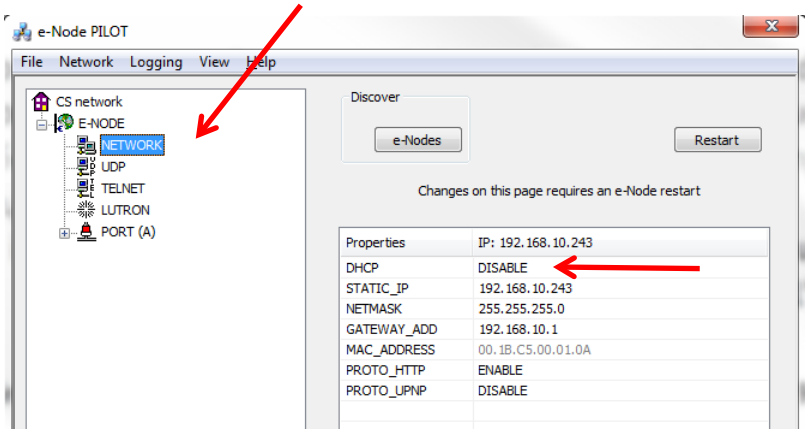
Suboptimal RJ-11 4P4C connection 4 wires		
e-Node Side	**ILC-x00 side**	**Color of wire**
Pin 1	Pin 1	Orange
Pin 2	Pin 2	Blue
Pin 3	Pin 3	Blue/white
Pin 4	Pin 4	Orange/white

Note: For the purposes of commissioning if *you do not have* 6P6C RJ-25 connectors, you can use standard 4-pin RJ11 connectors, but follow the wiring directions above preserving twisted pairs on Pin 2/3 and Pins 1 /4. **This cable will not work for keypad communication or IBT-100 communication**.

Please follow the below steps under "**e-Node Programming**" when using the e-Node for Ethernet communication or to set-up specific loads (lighting or motor) with unique, non-zero, **Z**one/**G**roup/**N**ode or **ZGN** addresses.

e-Node Programming

Step	Step Overview	Details
EN-1	**e-Node IP Address** setting Set up the e-node with an appropriate	The e-Node permits either Static or Dynamic Addressing. It is recommended to change the addressing to Static for following the below instruction: -Launch the e-Node Pilot application.

	Static or Dynamic IP address. Refer to the separate "e-Node Quick Start Guide" on how to make such settings.	 -Select the **View e-Node** tab and select the Discover **e-Node** button**.** Any e-Node(s) connected on the same network will appear as shown.  -Select the **+** mark in front of the e-Node found to expand the menu.  -Review the **DHCP** entry, the factory default is ENABLE which means **DHCP** is activated. DISABLE for **DHCP** refers to static IP addressing. If you wish to set a **STATIC** IP address, enter the following variables ***in the order specified below:***

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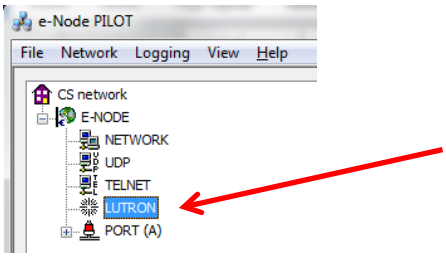
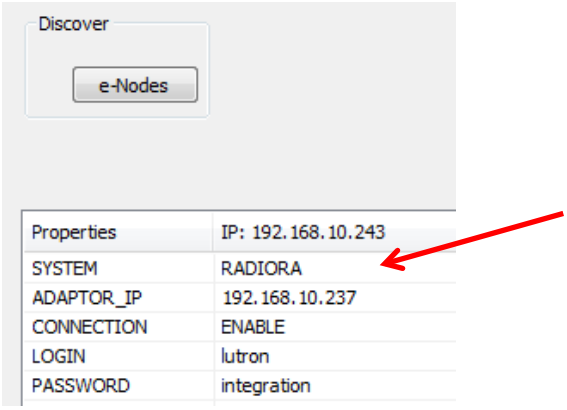
<table>
<tr>
<td></td>
<td></td>
<td>
<table>
<tr><td>STATIC_IP</td><td>xxx.xxx.xxx.xxx</td><td>Your new static IP address</td></tr>
<tr><td>GATEWAY_ADD</td><td>xxx.xxx.xxx.xxx</td><td>Typically the address of your network’s gateway</td></tr>
<tr><td>FINALLY and only after you have set the above variables, select DHCP</td><td>And Set to DISABLE</td><td>Now reboot the e-Node for this to take effect.</td></tr>
</table>
-Note: Generally it is recommended that only STATIC addressing be used for ease of setup.
</td>
</tr>
<tr>
<td>EN-2</td>
<td>Set the e-Node settings for communication with the current Lutron target platform (RadioRA2).</td>
<td>-Select the Lutron tab within the View e-Node view.
 

-For a RadioRA2 system, select RADIORA (or RADIORA2 if listed).
 

Note: The Converging Systems e-Node/Lutron driver is only compatible with RADIORA2 systems and even though earlier versions of e-Node firmware abbreviated RADIORA2 systems as “RADIORA,” you should select “RADIORA” even though there is</td>
</tr>
</table>

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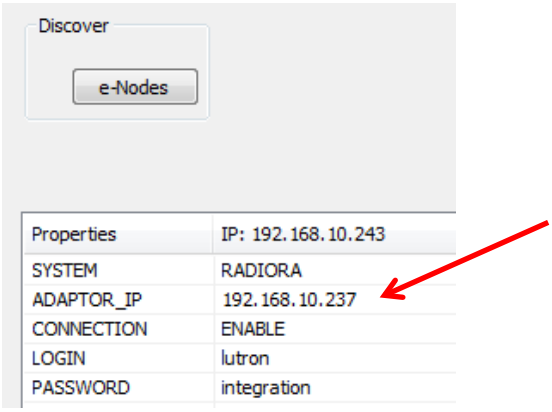
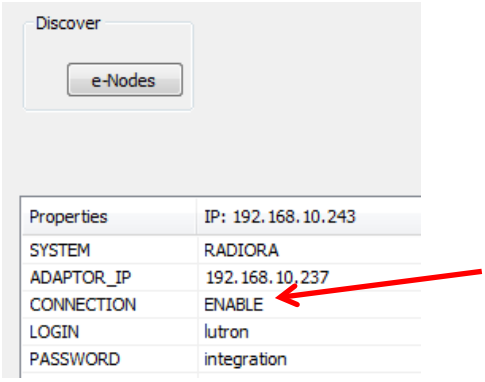
no compatibility with RadioRa systems.

-Set the **ADAPTOR_IP** address for that of the Lutron RadioRa2 processor (which address can be obtained using the Lutron Essentials software setup utility package).

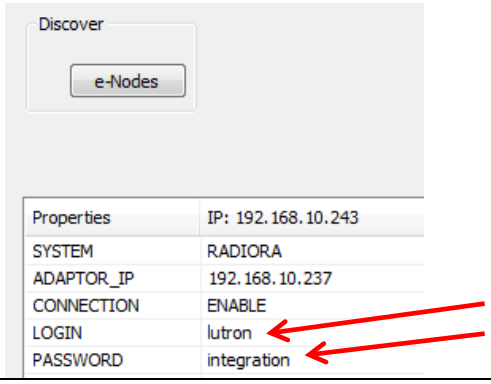


-Enable the **CONNECTION** tab (representing the Telnet client function) to **ENABLE** to turn on the Telnet Client function within e-Node to enable communication with the Lutron processor.



Note: The e-Node supports both Telnet ***Client*** communications (for communication from the Lutron processor) as well as Telnet ***Server*** communications (for communication to other third-party Control systems), both of which can be used concurrently. For this purposes of this Integration Note, we are only dealing with the Telnet Client settings available under the **Lutron tab**.

-Finally enter an applicable **LOGIN** and **PASSWORD** entry for an available Telnet channel that you previously set-up within the

		Lutron setup software similar to how you might have set up an iPad® Login/Password field if you were going to run the Lutron Home Control+ application. 

STEP 4 (CSI CS bus commands linkage to Lutron button pushes)

The final step is to enter within the spreadsheet in Appendix 3 at the end of this ***Integration Note*** data relating to the targeted (i) Lutron button push, (ii) with a particular Integration ID, (ii) with a particular type of button push ("3", "4", "5", "6", etc.) , and (iv) the desired Converging Systems CS-Bus command that will be triggered onto the CS-Bus when a the specific Lutron button push is encountered by the e-Node. Finally after this is done, a subset of that data can be entered into the e-Node Pilot application. **Although this seems complex, it is very quick to do and usually takes just a few minutes to complete an entire project.**

Flowchart. The following flowchart shows that if a Lutron identified button (that is to say, a button with a known Device ID, a known button number, and a known mode of operation output string, such as a "3", a "4" or a "5") is activated, the software logic within the e-Node is able to translate that button push into a compatible CS-Bus command that can be directed to any CS-Bus compatible controller on that CS-Bus. In the below example, the noted button push generates a Telnet string of **~DEVICE,5,1,3** which is then translated by the e-Node to a CS-BUS command (entered by the programmer) as a **#2.7.1.LED=RECALL, 1** (in our example). This command causes the targeted Lutron button push to cause the Converging Systems lighting controller to turn on the factory programmed RED or Recall 1 color setting.

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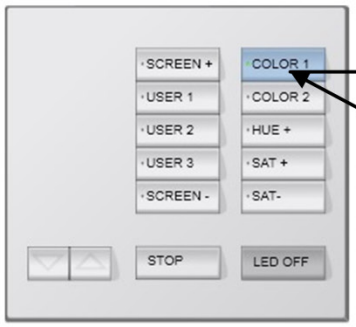
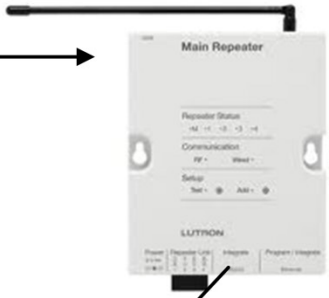
Theory of Operation- From Lutron Button Push to Converging Systems Controller Operation



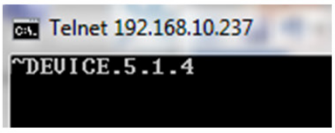
RadioRA2 keypad

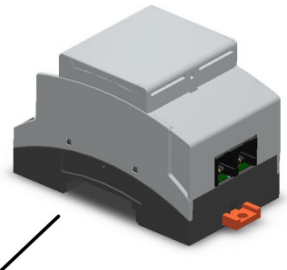
Device ID: 5
Button: 1
Operation: 4



RadioRA2 processor

Lutron command on bus





IP Address of e-Node: 192.168.10,243

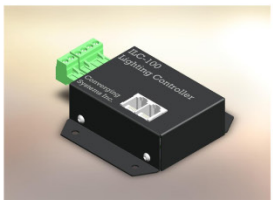
E-Node Pilot entry for "Track (1)" data corresponding to particular Lutron button push of:

Properties	IP: 192.168.10.243
TRACK (1)	5,1,4

E-Node Transmits this Look Up Table (LUT-1) command referencing Track(1)

Properties	IP: 192.168.10.243
LUT (1)	#2.7.1.LED=RECALL,1

E-Node Transmits this command to CS-Bus compatible device



[22:08:10] (192.168.10.243) #2.7.1.LED=RECALL,1(PRI 8);

Figure 6

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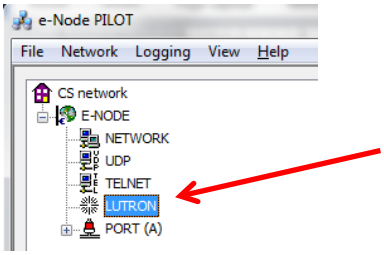
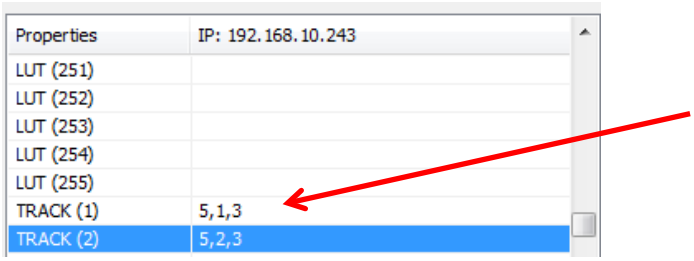
e-Node "Lutron Tab" Programming.

The above diagram details the logical process that occurs from the point in time that a Lutron keypad button is pressed until a linked Converging Systems command is issued. From this information, you can determine exactly want operations you wish to cross-connect between Lutron and Converging Systems.

You will enter that data in the form shown in the example below into the e-Node Pilot application under the **LUTRON** tab (again using the spreadsheet provided in Appendix 3 for easy of data entry) and then from that spreadsheet, **you can now can easily transcribe that data directly into the e-Node Pilot application within the LUTRON tab**. Pay particular attention to the use of PERIODS (rather than commas) and make sure for each entry where there is a TRACK entered, the associated LUT is populated.

Step	Step Overview	Details
LT-1	Set-up the **TRACK(n)** entry to what Lutron button push operation you want **monitor** and to which you desire the Converging Systems' controller to respond.	-Within the **View e-Node** view, once again select the **Lutron** tab (if you are not already there).  -Scroll down until you see the first **TRACK(n)** entry (where "n"  -From your spreadsheet, enter the **Device ID, Button Number, and Button Operation** code in the format X,Y,Z from your spreadsheet in Appendix 1 (commas not periods). In the above example, TRACK(1) has been set to the following:

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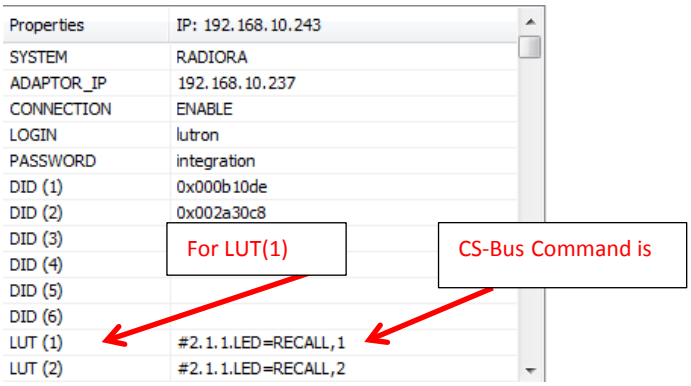
		<table><tr><td>Device ID</td><td>5</td></tr><tr><td>Button Number</td><td>1</td></tr><tr><td>Button Operation</td><td>3</td></tr></table>
LT-2	Set-up the **LUT(n)** entry for the Converging Systems operation that you wish **to have performed** when a matching TRACK(n) command with the same "n" value is received.	-Scroll down until you see the **LUT(n)** entry for the same "**n**" value that you set in **Step LT-2** above.  -From your Appendix 1 Spreadsheet, enter the Converging Systems CS-Bus command that you want to have triggered for a specific "**n**" when an incoming **TRACK** for the same "**n**" value is received. For example, if you wanted a device with a **Z**one, **G**roup, **N**ode (**Z/G/N**) address of 2.1.1. to invoke a Recall,1 command, here would be the entry: <table><tr><td>When a TRACK(n) received</td><td>This CS-Bus command will be triggered (to be entered under LUT(n) field</td></tr><tr><td>TRACK(1)</td><td>#2.1.1.LED=RECALL,1</td></tr></table> **Note**: There is limited error-handling within PILOT, so must check your work carefully, and if all the data entries are valid, immediately after you populate the fields, your e-Node will be able to make the proper translations and your system should be operational.

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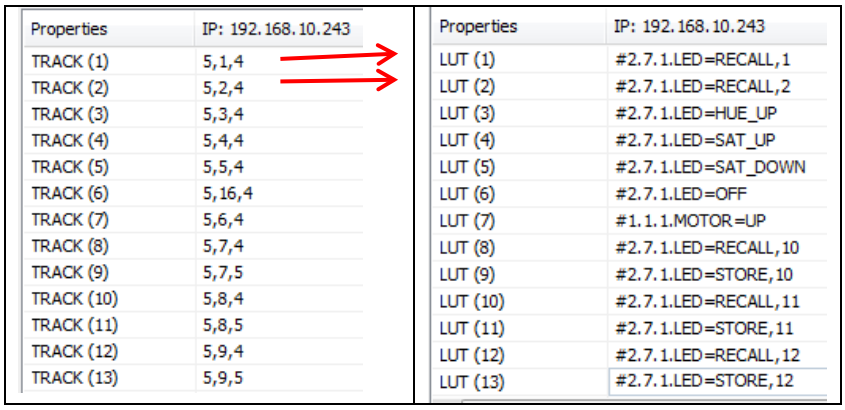
LT-3	Continue Process until all **LUT(n)** and **TRACK(n)** are entered for all Lutron button push/CS-Bus operations that you wish to program.	Logically then, there would be a matching **LUT(n)** for each **TRACK(n)** programmed. Here is a screen shot of the programming that is described below under Example #1.  Properties / IP: 192.168.10.243 TRACK (1) 5,1,4 → LUT (1) #2.7.1.LED=RECALL,1 TRACK (2) 5,2,4 → LUT (2) #2.7.1.LED=RECALL,2 TRACK (3) 5,3,4 → LUT (3) #2.7.1.LED=HUE_UP TRACK (4) 5,4,4 → LUT (4) #2.7.1.LED=SAT_UP TRACK (5) 5,5,4 → LUT (5) #2.7.1.LED=SAT_DOWN TRACK (6) 5,16,4 → LUT (6) #2.7.1.LED=OFF TRACK (7) 5,6,4 → LUT (7) #1.1.1.MOTOR=UP TRACK (8) 5,7,4 → LUT (8) #2.7.1.LED=RECALL,10 TRACK (9) 5,7,5 → LUT (9) #2.7.1.LED=STORE,10 TRACK (10) 5,8,4 → LUT (10) #2.7.1.LED=RECALL,11 TRACK (11) 5,8,5 → LUT (11) #2.7.1.LED=STORE,11 TRACK (12) 5,9,4 → LUT (12) #2.7.1.LED=RECALL,12 TRACK (13) 5,9,5 → LUT (13) #2.7.1.LED=STORE,12
LT-4	Programming Note	There is no requirement for the order in which you add commands, with the only caveat being that the **TRACK(n)** and **LUT(n)** index numbers for the same operation must relate to each other. Specifically, TRACK(**1**) is associated with LUT(**1**), TRACK(**2**) is associated with LUT(**2**), TRACK(**3**) is associated with LUT(**3**). There are a total of 255 unique **TRACKS**, and therefore 255 associated **LUTS** that can be utilized by programmer. You can have duplicate entries from one **TRACK(n)** entry to another **TRACK(n)** entry to enable two different CS-BUS commands to be invoked from the same LUTRON button push, which is effectively an easy way to program a macro in this environment, conceptually.
LT-5	Note on Testing /Troubleshooting	We highly recommend launching the e-Node Pilot application and selecting the **VIEW TRAFFIC** window to make sure the proper commands that have been programmed can be seen on the CS-BUS. We can almost guarantee that if there is no appropriate CS-BUS commands appearing in the VIEW TRAFFIC window, then the **TRACK** and **LUT** entries ***were not properly entered***. You can also launch your computer's TELNET application, to verify the expected Lutron command strings are appearing on the IP bus. If those commands are NOT appearing on the IP bus, then there is no way the Converging Systems' e-Node can do its work.

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Example 1

Following is a simple example all of the button programming on the specified 10-button RadioRA2 keypad (RR-T10RL).

Note: This assumes that all buttons have been programmed using the **Type 2 Advanced Setting** option. In case, the standard **Type 1 Standard Setting** has been chosen all the "4" below should be replaced by a "3" under the Lutron output string column, and Track(**9**) and Track(**11**) and Track (**13**) operations will be unobtainable.

Marked Lutron Button*	Desired Action	Lutron output string	CS Bus resultant command
Color 1	-On button push, causes controller to go to Preset 1 (Recall, 1).	TRACK(**1**)=5,1,4	LUT(**1**)#2.7.1.LED=RECALL,1
Color 2	-On button push, causes controller to go to Preset 2 (Recall, 2).	TRACK(**2**)=5,2,4	LUT(**2**)#2.7.1.LED=RECALL,2
HUE UP	-On button push, causes controller to go start incrementing the HUE variable. Note: just a button push will start this operation, a release will do nothing in RADIORA2	TRACK(**3**)=5,3,4	LUT(**3**)#2.7.1.LED=HUE_UP
SAT UP	-On button push, causes controller to go start incrementing UP the SAT variable. Note: just a button push will start this operation, a release will do nothing in RADIORA2	TRACK(**4**)=5,4,4	LUT(**4**)#2.7.1.LED=SAT_UP
SAT DOWN	-On button push, causes controller to go start incrementing down the SAT variable. **Note**: just a button push will start this operation, a release will do nothing in RADIORA2	TRACK(**5**)=5,5,4	LUT(**5**)#2.7.1.LED=SAT_DOWN
LED OFF	-On button push, causes controller to turn any already ON LEDS to turn OFF.	TRACK(**6**)=5,16,4	LUT(**6**)#2.7.1.LED=OFF
SCREEN UP	-On button push, causes connected projection screen to MOVE UP. **Note**: With RadioRA2, a button release will not issue a STOP command	TRACK(**7**)=5,6,4	LUT(**7**)#1.1.1.MOTOR=UP
USER 1	-On button push, causes LEDS to	TRACK(**8**)=5,7,4	LUT(**8**)#2.7.1.LED=RECALL, 10

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	go to a USER 1 setting (in this case RECALL location #10) -If the button is held for 10 seconds, the system stores the current color state into memory location #10	TRACK(**9**)=5,7,5	LUT(**9**)#2.7.1.LED=STORE,10
USER 2	-On button push, causes LEDS to go to a USER 1 setting (in this case RECALL location #11) -If the button is held for 10 seconds, the system stores the current color state into memory location #11	TRACK(**10**)=5,8,4 TRACK(**11**)=5,8,5	LUT(**10**)#2.7.1.LED=RECALL,11 LUT(**11**)#2.7.1.LED=STORE,11
USER 3	-On button push, causes LEDS to go to a USER 1 setting (in this case RECALL location #12) -If the button is held for 10 seconds, the system stores the current color state into memory location #12	TRACK(**12**)=5,9,4 TRACK(**13**)=5,9,5	LUT(**12**)#2.7.1.LED=RECALL,12 LUT(**13**)#2.7.1.LED=STORE,12
SCREEN DOWN	-On button push, causes connected projection screen to MOVE DOWN. **Note**: With RadioRA2, a button release will not issue a STOP command	TRACK(**14**)=5,10,4	LUT(**14**)#1.1.1.MOTOR=DOWN
STOP	-On button push, stops all Saturation, HUE, and FADE processes already in motion. -In addition, as an option, if the keypad is also set to control a projection screen, a button push will issue a MOTOR STOP as well.	TRACK(**15**)=5,17,4 TRACK(**16**)=5,17,4	LUT(**15**)#2.7.1.LED=STOP LUT(**16**)#1.1.1.MOTOR=STOP
FADE DOWN	-On button push, FADES LEDS DOWN -On button release, STOPS the fade process	TRACK(**17**)=5,24,3 TRACK(**18**)=5,24,4	LUT(**17**)#2.7.1.LED=FADE_DOWN LUT(**18**)#2.7.1.LED=STOP
FADE UP	-On button push, FADES LEDS UP -On button release, STOPS the fade process	TRACK(**19**)=5,25,3 TRACK(**20**)=5,25,4	LUT(**19**)#2.7.1.LED=FADE_UP LUT(**20**)#2.7.1.LED=STOP

*Note: **(color indicates Type 1, Type 2 or Type 3 button logic—see pages 7 and 8)**

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Appendix 1

Home Control+ Slider Application Notes

This section details Level 2 more sophisticated programming techniques. Two important topics will be covered:

-Lutron LED Button Logic handling

-Slider utilization within the Home Control+ application.

The following illustrations provide some sample user interfaces (UI) where sliders are integrated for the Home Control+ application. In addition, detailed examples showing programming steps that can be followed to insure that the Lutron indicator LED logic implemented on Lutron hardware dimmers and Lutron touchscreen buttons operate predictably. A sample project with all of these steps embedded is also available as a download from Converging Systems' website.

A. Standard Keypad Control—Standard Buttons with Operational Lutron Button LED indicators

Below can be seen a screen that reveals standard and actual hardware Lutron keypad previously programmed. Some of these buttons refer to the control of Converging System's LED lighting control products, while other buttons refer to the control of Converging Systems' motor (projection screen) control products. Your specific application may vary.

Programming Steps. Actual programming steps are detailed on pages 11-13 above. No changes are required to generate this specific screen within the Home Control + application.

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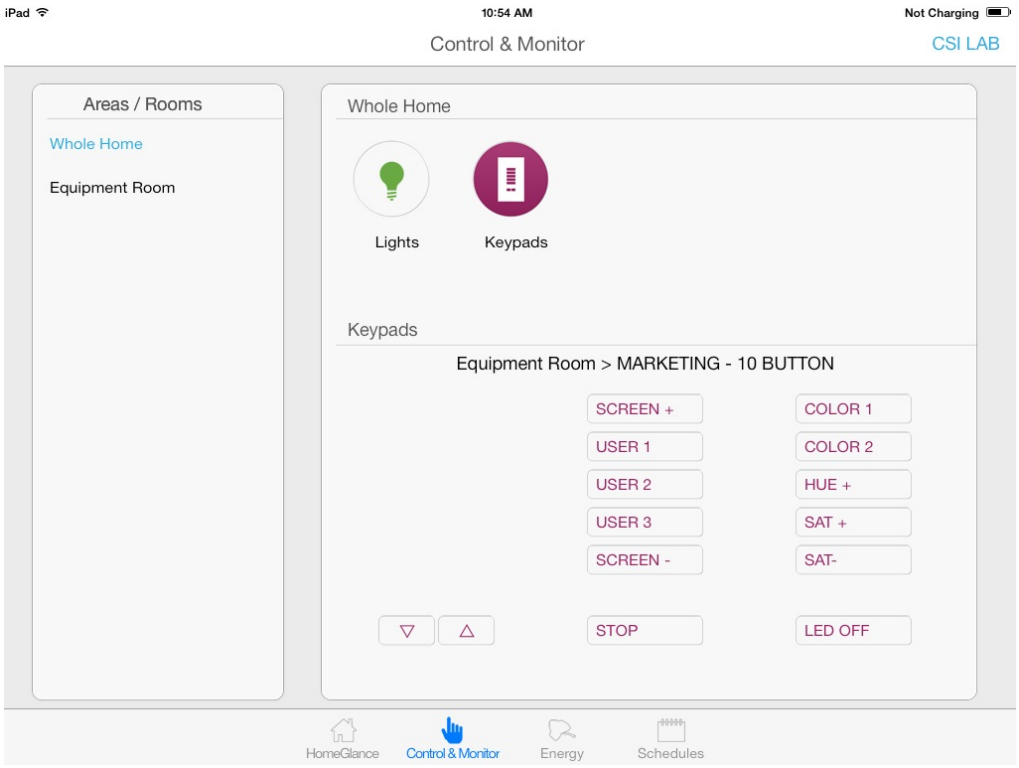

Figure 7

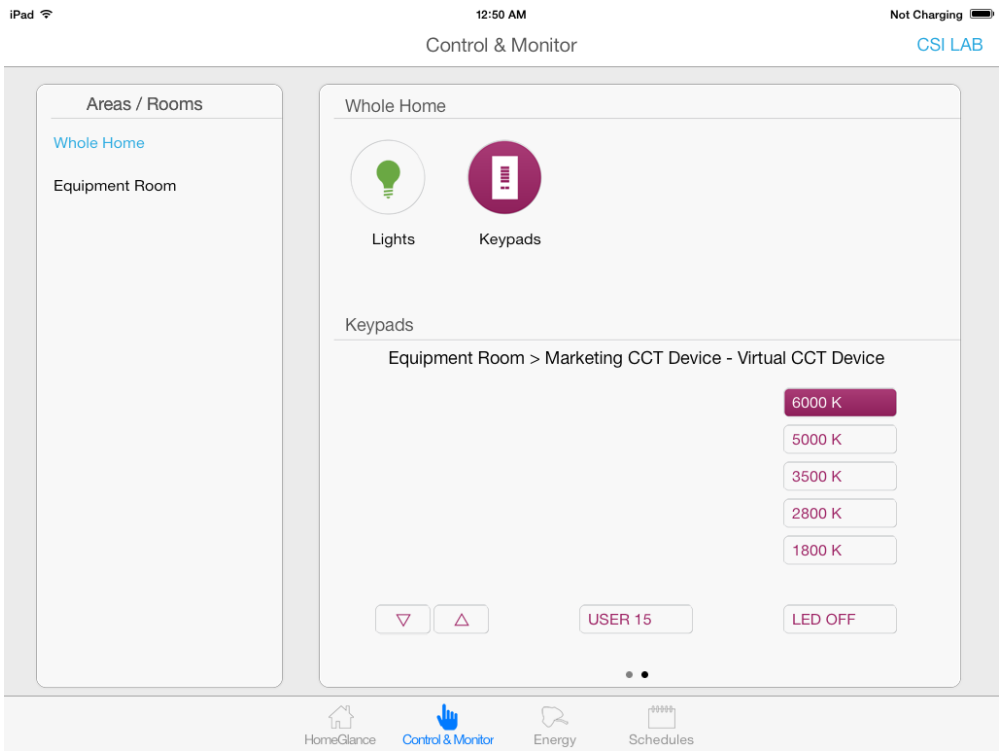

Figure 8

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B. Slider Control (Full color Hue, Saturation, Brightness as well as Correlated Color Temperature Control--CCT)

Below can be seen two screens that reveal (i)standard **Hue**, **Saturation**, and **Brightness** control as well (ii) **Correlated Color Temperature** (CCT) control. All of these controls are derived from the creation of set of Lutron phantom keypads with the Lutron Essentials or Inclusive applications but which utilize a derivative of the standard CS-Bus command set to interrelate with sliders only.

Programming Steps. Actual programming sets for the e-Node Pilot application are provided after the screens.

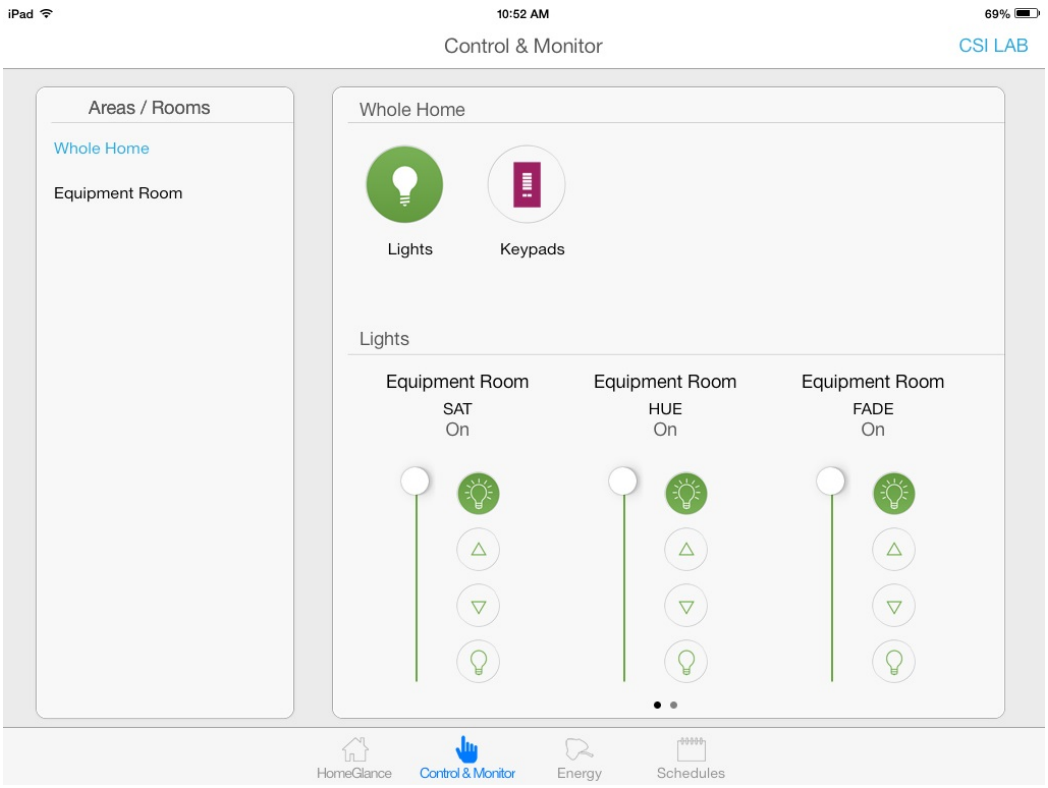

Figure 9

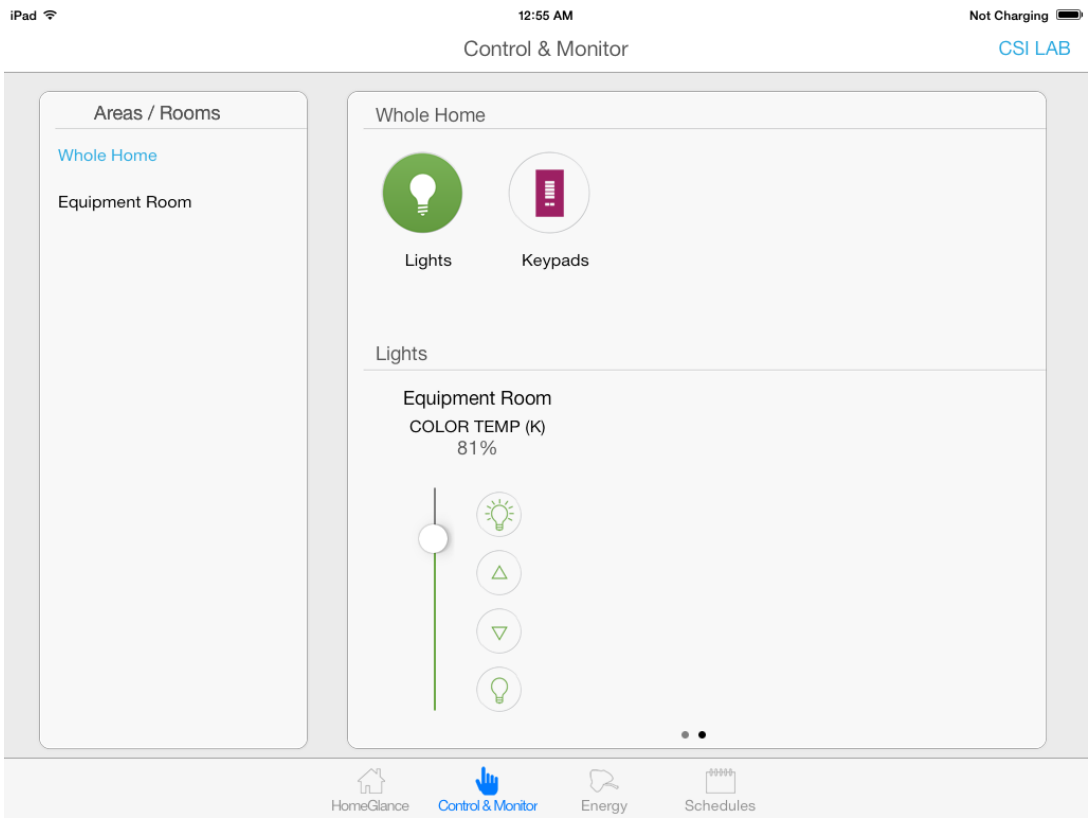

Figure 10

Programming Steps

The above Slider can be easily integrated into the above project with the insertion of the following steps:

Marked Lutron Button*	Desired Action	Lutron output string entry	CS Bus resultant command
Hue Slider	-On movement of slider from 0% to 100%, Hue commands are transmitted to CS-Bus system. **Note:** HUE of 0 or 100% equates to RED, while a HUE of 80 equates of GREEN, and a HUE of 160 equates to BLUE	TRACK(**50**)=8,1 **Note**: there is no trailing comma and third number in this slider case	LUT(**50**)#2.7.1.LED=HUE **Note**: there is no trailing characters after the HUE command in this slider case
Sat Slider	-On movement of slider from 0% to 100%, SAT commands are transmitted to CS-Bus system. **Note:** SAT of 0 is fully saturated (very white) while a SAT of 100 preserves the HUE of the	TRACK(**51**)=7,1 **Note**: there is no trailing comma and third number in this slider case	LUT(**51**)#2.7.1.LED=SAT **Note**: there is no trailing characters after the SAT command in this slider case

	original selected color		
Brightness Slider	-On movement of slider from 0% to 100%, Brightness (FADE) commands are transmitted to CS-Bus system. **Note:** FADE of 0 is fully OFF (dark) while a FADE of 100 is fully ON	TRACK(**52**)=6,1 **Note**: there is no trailing comma and third number in this slider case	LUT(**52**)#2.7.1.LED=SET **Note**: there is no trailing characters after the SET command in this slider case
CCT Slider (Color Temperature)	-On movement of slider from 0% to 100%, Correlated Color Temperature (CCT) commands are transmitted to CS-Bus system. **Note:** CCT of 0% equates to a CCT of 1800K while CCT of 100% equates to a CCT of 7000K	TRACK(**53**)=10,1 **Note**: there is no trailing comma and third number in this slider case	LUT(**53**)#2.7.1.LED=CCT **Note**: there is no trailing characters after the CCT command in this slider case

Appendix 2

Common Mistakes

Common Mistakes

1. Forgetting to set turn on the Telnet Login under the **TELNET** page (to ENABLE). The Lutron processor does require a valid username and password, If **TELNET** is set to no login, the e-Node and the Lutron processors will fail to communicate.

2. Forgetting to input accurate Zone/Group/Nodes addresses within the LUTRON tab. The factory defaults will work with some systems but certainly, if your particular lighting or motor controllers do not function, check these addresses.

3. Forgetting to press the **RESTART** button within e-Node Pilot application after changes on the **NETWORK**, **TELNET**, or **LUTRON** pages are made.

4. Forgetting to match a valid LUT for each related TRACK within e-Node Pilot or the web application.

5. Forgetting to properly use COMMAS within the TRACK section or failure to properly use PERIODS within the LUT section of the e-Node Pilot application.

Here is an example that works (commas with TRACK and periods with LUT):

TRACK(1) 5,1,4	LUT(1) #2.7.1.LED=FADE_UP

Here is an example THAT WILL NOT WORK

TRACK(1) 5.1.4	LUT(1) #2,7,1,LED=FADE_UP

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Appendix 3

Spreadsheet

Telnet Username	
Telnet Password	
IP address of the Lutron primary processor	___ ___ ___, ___ ___ ___, ___ ___ ___, ___ ___ ___

(note **RED BOLD Column Entries** below are required for Programming)

Lutron button targeted for connection to Converging Systems LED or Motor operation							**Desired outcome when Lutron button is pushed**	**Command that needs to be entered into e-Node Pilot application[1]**
Index		Button Alias[1]	**Integration ID**	**Button Number**	**Button Logic**		Descriptive Summary[2]	**Actual programming string[3]**
		Recall 1	(e.g.) 5•	(e.g.) 1•	(e.g.) 3•		(e.g.)Color goes to Recall 1	(e.g.) #2.1.1.LED=RECALL,1
(1)								
(2)								
(3)								
(4)								
(5)								
(6)								
(7)								
(8)								
(9)								
(10)								
(11)								
(12)								
(13)								
(14)								
(15)								
(16)								
(17)								
(18)								
(19)								
(20)								
(21)								
(22)								
(23)								
(24)								

(Up to 256 indexes are available, please make additional copies of this table as needed.)

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[1]Note: CS-Bus commands that can be utilized are described in a separate document entitled “Third-Party CS-Bus Device Driver Toolkit-Programmers Guide (DDK) which can be downloaded from http://www.convergingsystems.com/inres_programmingdesignkit.htm

[2]These entries are not required for programming but are only provided to assist in the programmer’s ease of project documentation.

[1]These programming strings assume a pre-programmed CS-Bus device with a Zone address of 2, a Group address of 1, and Node address of 1. The factory default for lighting controllers is Z.G.N= 2.1.0 while the defaults for motor controllers is Z.G.N=1.1.0. The e-Node Pilot application is required to change the factory default address to a unique address. The device address shown above as #2.1.1 can be any address from 1-254 per field. This address would need to have been programmed for the specific device being controller using the e-Node Pilot application also available from Converging Systems at http://www.convergingsystems.com/customerportal/1000/downloads.htm#anch4

Appendix 4

DMX Options

Note on DMX Lighting Devices. There are many third-party lighting devices available in the marketplace that support the DMX512 lighting standard ("standard for digital communication). DMX devices were originally utilized for theatrical interior and architectural lighting application only, but recently their adoption rate has grown in other areas where colored lighting is desired. DMX 3-color lighting fixtures utilize the Red, Green, Blue (RGB) color space which although practical for theatrical uses and the trained lighting designer is quite limited for traditional dimming application ***for the technology inherently lacks the most basic dimming slider*** which would preserve a specific hue while lowering the brightness to full off. But that has all changed now...

Converging Systems' e-Node/dmx. Converging Systems has developed an adaptation of its lighting/dimming technology currently available within its ILC-x00 line of LED controllers and has re-purposed that technology into a separate product known as the e-Node/dmx. The existing e-Node/Lutron drivers compatible with the ILC-x00 LED controllers can also drive directly the e-Node/dmx (color engine/dmx translator), and the e-Node/dmx makes the necessary color adjustments within its own processor to translate incoming commands to outgoing DMX commands **and transmits those directly onto *a DMX bus***. What is unique about this implementation is that the Converging Systems' hue-accurate dimming technology (with a built-in dimmer slider) can now drive DMX fixtures by using RTI device drivers already in existence for other Converging Systems' products. (See the listing of commands that are supported with the e-Node/dmx device see LED Commands in this document.)

Please follow the directions which follow to drive DMX fixtures from a LUTRON System

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WIRING DIAGRAM (for DMX control using e-Node/dmx and IP)

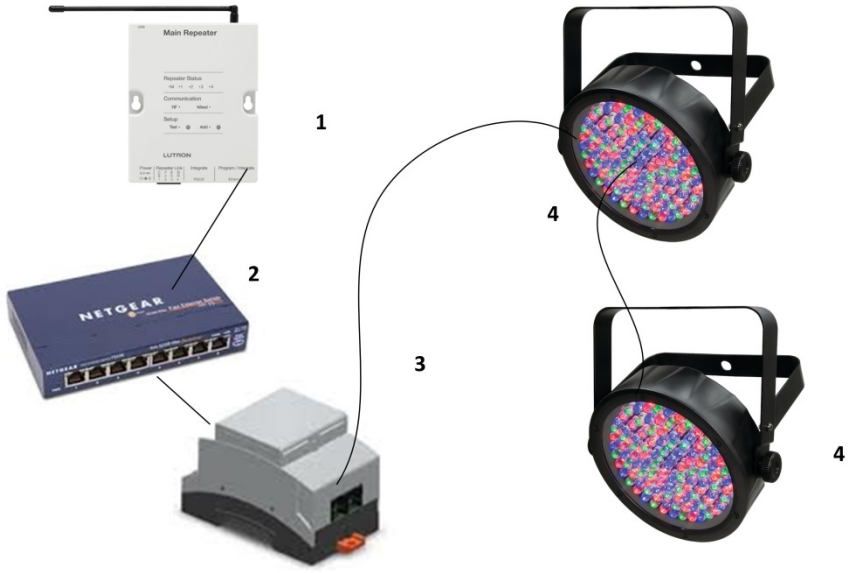

Figure 11

Wiring/Configuration Notes:

1. Maximum length of CS-Bus cabling from e-Node to the last DMX fixture using DMX cabling = 1200 meters (3,900 feet)
2. Maximum number of DMX fixtures connected to a single e-Node/dmx device = 32. If more than 32 fixtures are required, implement additional e-Node/dmx devices.
3. Maximum number of e-Nodes that can exist on a Lutron system = 254

BILL OF MATERIALS (for IP control)

#	Device	Manufacturer	Part Number	Protocol	Connector Type	Notes
1	RadioRA2 processor	Lutron	RR-Main-REP-WH	Ethernet	various	
2	Network Switch	Various	Various	Ethernet	RJ-45	
3	e-Node/dmx	Converging Systems	e-Node/dmx	Ethernet	RJ-45 (for Ethernet) RJ-25 for local DMX bus	
4	Third party DMX fixtures	Various	Various	DMX512	RJ-25 for DMX communication	Must terminate final OUT or THRU connector on last DMX fixture using a 120 ohm resistor

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e-Node Programming/Device Programming

Minimum requirements for this operation.

-e-Node/dmx with power supply
-Necessary cabling to connect e-Node/dmx to first DMX fixture (see "e-Node Interfacing with DMX Guide"). For reference the pin-outs on the e-Node/dmx are as follows:

Pin	Signal
1	Not Used
2	DMX Ground
3	RS485 -
4	RS485 +
5	Not Used
6	Not Used

Note: Even though Converging Systems recommends that RJ-25 6P6C plugs should be used for most CS-Bus wiring, the DMX wiring can utilize a 4P4C RJ11 plug.

e-Node/dmx Programming

Step	Setting	Choices
DMX-1	e-Node/dmx setup	Follow the directions under e-node Programming at the beginning of this Integration Note **Step EN-1** and **EN-2**.

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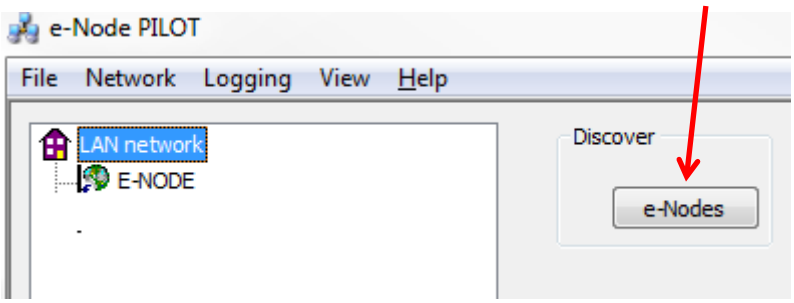
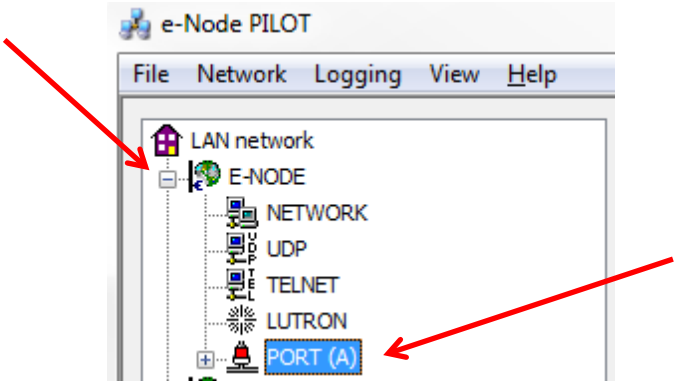
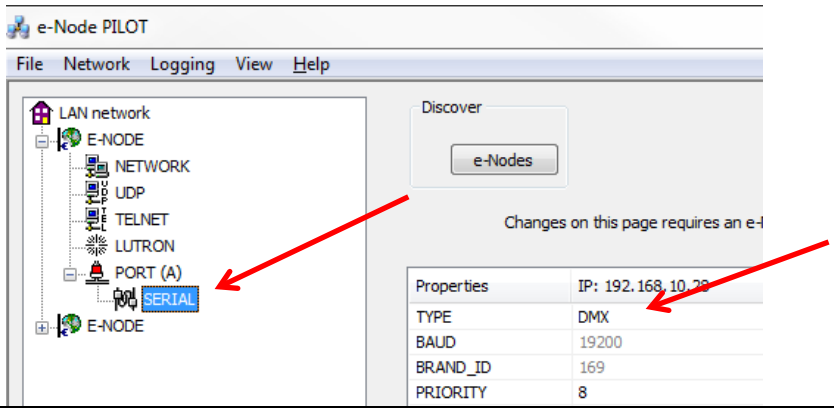
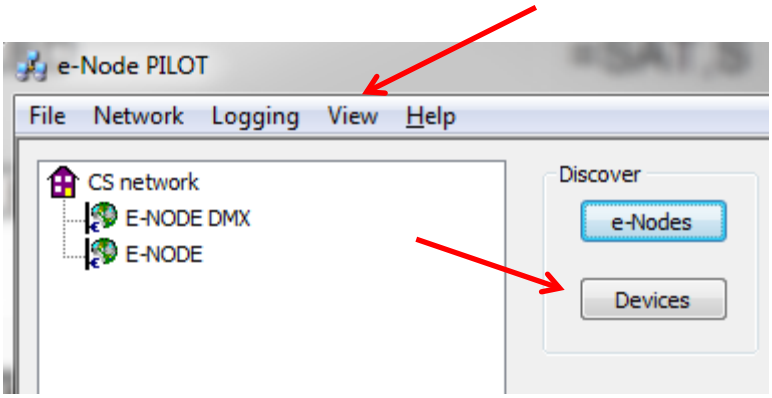
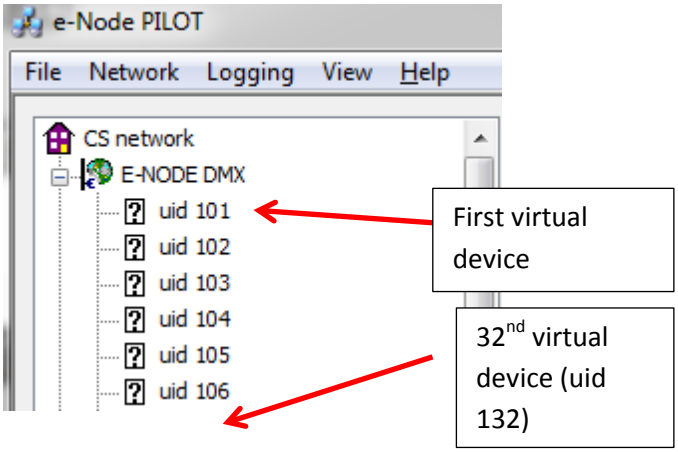
DMX-2	Verify the e-Node DMX is set to communicate to DMX fixtures	-Select the **View e-Node** tab and select the Discover **e-Node** button**.** Any e-Node(s) connected on the same network will appear as shown.  -Select the + mark in front of the **e-Node/dmx** that you wish to program to expose the sub-tabs.  -Expand the **PORT(A)** tab and then expand the **Serial** tab. 

		-Verify that after the **TYPE** entry, the data field indicates **DMX**. If it does not indicate **DMX**, select **DMX** from the pull down menu and reboot the e-Node/dmx in order to make this setting active. **Note**: the e-Node/dmx can also be configured to communicate with standard CS-Bus devices (ILC-100, ILC-400) and therefore only when this entry is set to DMX, will the e-Node/dmx properly communicate to DMX fixtures.
DMX-3	Device Discovery	-Select the **View Map** tab and select the Discover **e-Node** button**.** Any e-Node(s) connected on the same network will appear as shown. -Select the Discover **Devices** button.  -Immediately 32 virtual "DMX Devices" will appear as follows:  **Note**: this picture shows the first 6 devices discovered. In a real example, all 32 virtual devices will appear.

DMX-4	Set up Device Addressing	The DMX data packet is mapped to CS messages by assigning a unique Zone. Group. Node number to three successive DMX channels. These are mapped as shown in the following table:

Fixture	DMX Channel Allocation	CS-Zone.Group. Node
1	1-3	2.1.1
2	4-6	2.2.1
3	7-9	2.3.1
4	10-12	2.4.1
5	13-15	2.5.1
6	16-18	2.6.1
7	19-21	2.7.1
8	22-24	2.8.1
9	25-37	3.1.1
10	28-30	3.2.1
11	31-33	3.3.1
12	34-36	3.4.1
13	37-39	3.5.1
14	40-42	3.6.1
15	43-45	3.7.1
16	46-48	3.8.1
17	49-51	4.1.1
18	52-54	4.2.1
19	55-57	4.3.1
20	58-60	4.4.1
21	61-63	4.5.1
22	64-66	4.6.1
23	67-69	4.7.1
24	70-72	4.8.1
25	73-75	5.1.1
26	76-78	5.2.1
27	79-81	5.3.1
28	82-84	5.4.1
29	85-87	5.5.1
30	88-90	5.6.1
31	91-93	5.7.1
32	94-96	5.8.1

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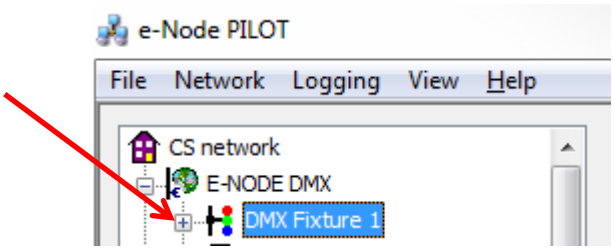
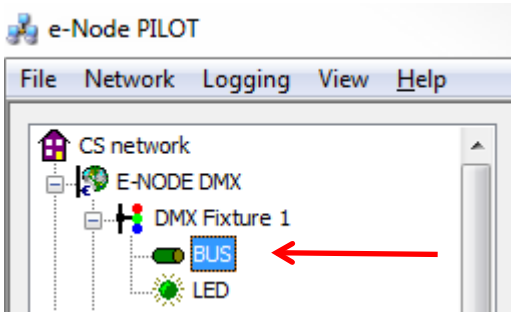
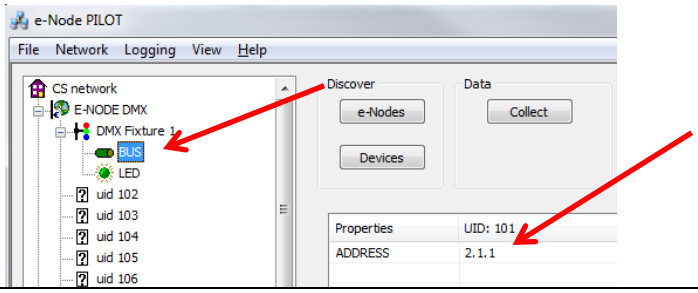
		-To see these entries, click on the **?** in front of any particular **uid** listing which will expand its directory.  -After the directory is expanded, you will see these entries:  -If you desire to change any **Z**one/**G**roup/**N**ode address, click on the **BUS** entry, and change the address as appropriate. 
DMX-4	Proceed through standard **LUT/TRACK** Programming.	In this case, you will not be programming the ILC-100 or ILC-400 devices, so you proceed to standard **LUT/TRACK** Programming (**Steps 4** onwards above in the main body of this Integration Note). Note: the e-Node/dmx takes care of everything else!!!

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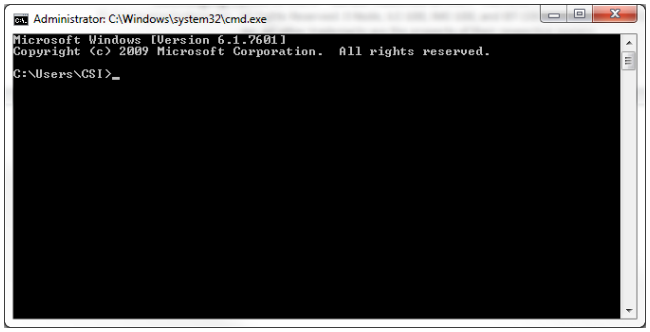
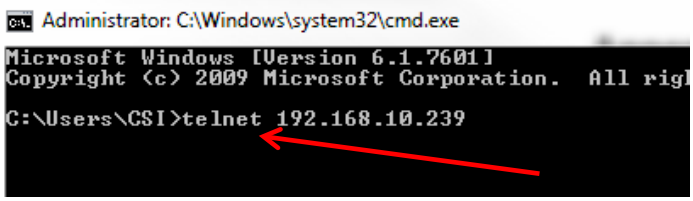
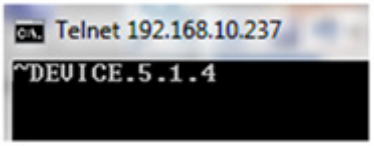
Appendix 5

Troubleshooting/System Monitoring

Using Telnet Tools

Step #	Step Overview	Detail
A5.1.1	Launch MS-DOS Telnet application. **Note**: If the Telnet utility is not immediately available on your PC, you will need to add it under Add Programs—it is a Windows utility available but not always installed.	-Enter the command prompt but typing in "CMD" in the search box within your PC.  -Launch the Telnet application by typing in the following command followed by the IP address for your Lutron processor. 
A6.1.2	Monitor Lutron button pushes to verify if the Device ID, Button Push, and Button operation are being accurately transmitted through Telnet.	Here is representative Telnet output stream indicating that a button from the following device has been pushed.  In this case, the parameters represented by this Telnet output stream represent the following: Device ID: 5 Button: 1

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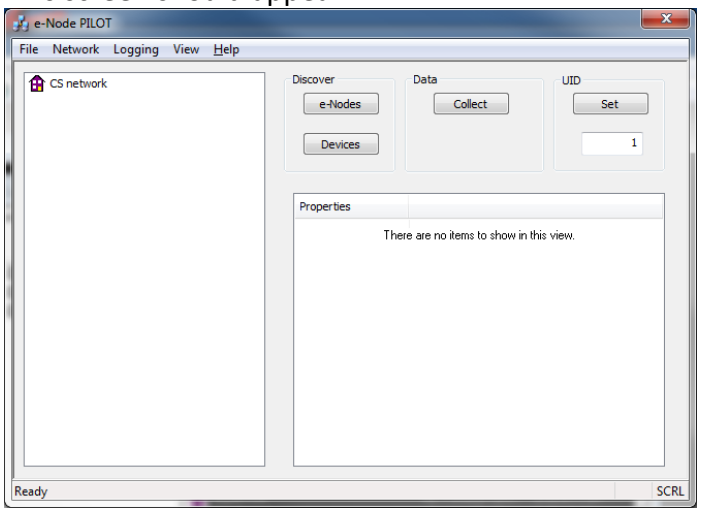
		<table><tr><td>Number</td><td></td></tr><tr><td>Button Operation</td><td>4</td></tr></table> Thus if you are seeing a 5,1,4 from Lutron but you have entered a TRACK(n) of **5,2,4** into the e-Node, and nothing is happening, you have just discovered why. Change the TRACK(n) entry, and try once again.

Using Converging Systems' Tools

Step #	Step Overview	Detail
A5.2.1	Launch **e-Node Pilot** application	This screen should appear 
A5.2.2	Discover e-Node devices(s)	Select **View Map** and press the **Discover e-Node** button. If your e-Node can be seen, you should see it appear under CS-Network

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		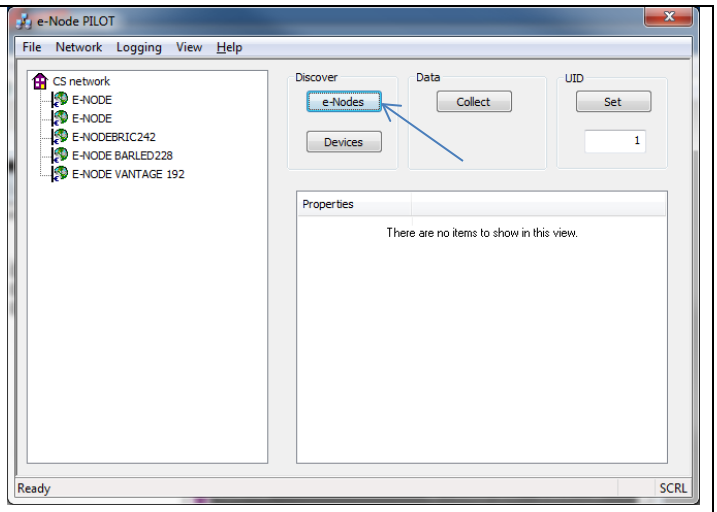
A5.2.3	Discover Devices	Next press the **Discover Device** button. Any connected loads (i.e. ILC-100 or motor controllers) should appear