Converging Systems Inc.

CS-Bus Controllers

Intelligent Lighting Controller

ILC-400x Family

Version 1.0.a

Intelligent Lighting Controller (ILC-400x Controllers)

Safety Information

The ILC-400 LED Controller and specified associated components are listed under UL File-325 and has been tested by the following safety agency:

For units with provided power cords, this warning needs to be provided.

TO REDUCE THE RISK OF ELECTRIC SHOCK, THIS EQUIPMENT HAS A GROUNDING TYPE PLUG THAT HAS A THIRD (GROUNDING) PIN. THIS PLUG WILL ONLY FIT INTO A GROUNDING TYPE OUTLET. IF THE PLUG DOES NOT FIT INTO THE OUTLET, CONTACT A QUALIFIED ELECTRICIAN TO INSTALL THE PROPER OUTLET. DO NOT CHANGE THE PLUG IN ANY WAY.

POUR REDUIRE LES RISQUES DE CHOC ELECTRIQUE, CET APPAREIL EST QUIPE D'UNE FICHE AVEC MISE A LA TERRE COMPORTANT UNE TROISIEME BROCHE (BROCHE DE TERRE). CETTE FICHE NE PEUT ETRE BRANCE QUE DANS UNE PRISE AVEC MISE A LA TERRE. S'IL N'EST PAS POSSIBLE DE LA BRANCHER DANS LA PRISE, FAIRE POSE UNE PRISE APPROPRIEE PAR UN ELECTRICIEN QUALIFIE. NE PAS MODIFIER LA FICHE.
*UTILISER A L'INTERIEUR SEULEMENT

Models/Ratings-ILC-400x Family

Models:
ILC-400sa: Distribution product housed in an attractive DIN-Rail enclosure.
ILC-400oem: OEM-oriented product with configuration customized toward OEM.

(References in this document to the "ILC-400x" shall be used for common features of all of the above models)

Standalone/metal enclosure option:
ILC-400sa: Output voltage is identical to input, 6.67 amp maximum output*.
ILC-400oem: Customization as per OEM specification.

Ratings:

Input:
ILC-400x: 12-28vdc, 15 ma plus current capacity of supported LEDs (within DIN enclosure included)
Output Rating
ILC-400x: Output voltage is identical to input, 80 watts maximum (@12vdc) and 160 watts maximum (@24vdc). Either voltage maximum rated output: 6.67 amps)*.

Note: *The ILC-400x is rated as a Listed Product under UL File 2108. This listing requires that a Class 2 power supply must be utilized. Maximum rating of a Class 2 power supply is 60 watts @12vdc or 100 watts @24vdc.*

Depending upon the AC (input) / DC (output) Power Adapter that is utilized, the ILC-400x controllers can be operated in 100-240vac systems throughout the world.

Documentation Revision History

Revision	Date	Description
1.0.a	11/23/2014	Initial Documentation

Description:

The Intelligent Lighting Controller (ILC-400x) is designed to control monochromatic and RGB + White (RGBW) LED lighting elements. The ILC-400x can operate in either of these two discrete modes, but not concurrently. See the description below for these two unique modalities -- "***RGBW***" and "***4-channel monochrome***" for more information. In addition to the two modes, the ILC-400x controllers can be interfaced to virtually any third-party controller available. Please refer to the section below entitled "***Connectivity***" for more information.

<u>"RGBW Mode"</u>

With **RGB** LED elements as well as **RGB+W**(hite) elements the range of colors available is identical (16.7 million colors). The ILC-400x provides the flexibility for connecting RGB LED elements or **RGB+W** (RGB+White) elements.

RGB elements are utilized where rich color output is desired but where (i) the brightness (lumen output) possible with **RGB** elements is sufficient for the particular application, and/or where (ii) the lower Color Rendering Index (**CR**I) of the selected **RGB** elements is sufficient for targeted application.

Alternatively, **RGB+W** elements are utilized where the same rich color output is desired but where (i) the higher brightness (lumen output) possible with **RGB+W** elements is necessary for the particular application, and/or where (ii) the higher Color Rendering Index (**CRI**) of the selected **RGB+W** elements is necessary for targeted application. The only tradeoffs with using **RGB+W** LED elements over standard RGB elements is the higher cost and the reduced length of runs possible with a Class 2 rated power supplies (and the ILC-400x lighting controller). **RGB+W** devices consume approximately 80% more current than similarly configured RGB only strips,

<u>"1-4 Channel Monochrome Mode"</u>

The ILC-400x has been specifically designed to handle the intricacies of monochrome lighting seamlessly. There are four independent channels (Channels 1, 2, 3, 4) which can be used where you may wish to have independent control of four different "zones" of LED lighting. Or alternatively, you may simply any number of channels fewer than 4 for your particular application. Simply observe the maximum wattage rating for the ILC-400 and divide up your LEDs any way you wish (i.e. you can consolidate all LEDs onto a single channel or divide those LEDs into branches connected to additional channels provided that in no cases the maximum draw from all LEDS does not exceed the maximum rating for the ILC-400x controller.

<u>Connectivity</u>

The ILC-400x controller can be controlled through a number of remote control devices, including keypads, dry contact outputs, low-voltage trigger outputs, remote Infrared control, 0-10vdc dimmable ballast interfaces, IP (Internet Protocol), and computer-based signaling sources (serial communication). Compatibility with popular automation and lighting systems developed by Crestron, Savant, Lutron, Vantage, Control 4, Elan Home Systems and others can be used to support one to 254 ILC-400x controller per common IBT-100 (serial) or e-Node (Ethernet) device interfaces.

TO BE INSTALLED AND/OR USED IN ACCORDANCE WITH APPROPRIATE ELECTRICAL CODES AND REGULATIONS

Important Information:

- Carefully read the instructions appropriate for your needs.
- This control must be installed by a qualified electrician.
- For supply connections, use wires rated for at least 75 C.
- Use Copper or Aluminum Conductors.
- For indoor use only.
- Do not connect Low-Voltage to Line-Voltage Power.
- Article 725-54(a), (1) Exception No. 3 (NEC) or Canadian CE Code Handbook, Rule 16-212, Sub rule (4) requires segregation between line voltage and Class 2 (low voltage) circuits. Low Voltage/network wires should enter enclosure boxes through separated openings. Also, conductors shall be separated by at least ¼" or segregated by barriers. Check with your local electrical inspector or compliance with local/national codes and wiring practices.
- Proper short-circuit and overload protection must be provided at the circuit breaker distribution panel. You can use up to a 20A maximum circuit breaker with adequate short-circuit breaking capacity for your installation.

1   System Configuration and Design

1.1   General Overview

The Intelligent Lighting Controllers (ILC-400x) are designed to support a wide range of LED applications from the simplest systems (comprised of a single ILC-400x controller and a single strip of LED lighting elements rated at 100 watts or less @24vdc), to the most sophisticated system (comprised of up to 65,025 different ILC-400 controllers networked together each supporting LED elements of up to 100 watts each or 6.5 million watts of LED lamps)! All that is required is the requisite number of ILC-400x controllers, the specific length of LED elements, interconnect wires/power supplies rated to support the system plus any User Interface devices (keypads, remotes, etc.) with which to control the system.

1.2   LED Types Supported

The ILC-400x family of controllers support a wide range of LEDs* available in the marketplace. When the ILC-400x controller is used to control Converging Systems FLLA monochrome, RGW, or RGBW linear strips, the entire system becomes a UL/ETL/CSA Listed System and which also falls under an indemnification agreement with Philips Electronics that protects users and dealers against patent infringement suits from third-parties.

The ILC-400x controllers can support Converging Systems' **RGBW** (or **RGB**) flexible linear LED strips as well as a 1 to 4 channels of monochromatic LED devices wired to the appropriate terminals on the ILC-400x(with input voltages from 12vDC to 24vDC), **provided that the current requirements of the connected LEDs are less than the rated output of the ILC-400x controller**. In order to determine the specific length of LEDs strips that can be supported, please refer to the current requirements of the specific LED strip desired to be supported. It is important to determine the specific current of the specific type of LED strip to be connected, as these ratings vary depending on the type of LED and the number of LEDs configured on the LED flexible strip per meter. See Appendix 4 for typical ratings of LED strips.

*Note: *The ILC-400x controllers have been designed for a common anode (+) connection and multiple (color specific-R, G, B.W) negative (-) cathode return connections. In the case of monochromatic LEDs, any type of LED can be selected again presuming that its current capacity is less than the rated output for the ILC-400x controller and its anode (+) and cathode (-) connections are properly made.*

1.3   Power Supply Requirements

The voltage output of the required power supply must match the voltage requirements of the LED elements being supported (i.e. a 12Vdc LED system will require a 12Vdc power adapter; a 24Vdc LED system will require a 24Vdc power adapter). The current capacity of the power supply must support the power requirements of the LED elements being support plus a small additional overhead for the ILC-400x controller itself. See the table under Section 1.5 below for more information here. In addition, see Appendix 4 for system requirements for popular LED strips.

For example, for a simple system with one ILC-400x controller and up to 16.4' (5.0m) of RGBW linear LED elements or 33.3' (10m) of monochrome LED elements, a single 100-watt Class 2 power supply is sufficient*. However, when (i) the current capacity is exceeded for a single ILC-400x controller or (ii) when multiple states of LED output are desired (one LED strip set to red while another LED strip is set to yellow for instance), then *multiple* ILC-400x controllers need to be added into the system. In such case, a single power supply can be specified to accommodate the current requirements required of ALL ILC-400x controllers within the specific system, provided that the power supply connection to **each** ILC-400x is run as separate home run back to the common power supply. Traditionally though, most installations utilize a correctly sized power supply for each ILC-400x within the system with dedicated power connections running between a single power supply and a single ILC-400x controller

*Note: *the limitation of a NEC CLASS 2 power supply is 60 watts @12Vdc or 100 watts @24Vdc. Although other power supplies are available with larger wattage outputs, the ILC-400 Controller and associated FLLA linear LED strips should only be used with UL-1310 Listed CLASS 2 power*

supplies or specific UL-1310 Recognized CLASS 2 power supplies.

1.4 Maximum Length of LED Strip Supported

Typically LED elements come in strips up to 5 meters in length. If more than 5 meters of LEDS (regardless if they are of single density or double density, monochrome, RGB, or RGBW type) are desired to be run continuously, *and they can be supported by the current requirements of a single ILC-400x controller (see section 1.3 above)*, then each 5 meter strip *must* be separately connected back to the ILC-400x controller. Technically, the copper connections (etch) within the LED strips **cannot** support a current draw more than required by a strip 5 meters in length (i.e. the "Maximum Run"). In such case there is a risk of fire and the manufacturer's warranty shall be considered void.

1.5 System Design Configuration Table

For system design, it is necessary to review the below table to determine system requirements.

Table 1

Number of Discrete Lighting Systems that can be individually controlled	Load in Amps of LED elements that can be supported with **each** ILC-400x[2]	Length (of typical LED strips with 24v Enhanced Brightness (EB) and 12v Standard Brightness (SB) LED lamps per meter) that can be supported with each ILC-400x[1] (under UL Listed System)	Recommended Power Supply for System[2]
1 x 4-color RGBW or RGB zone	6.67 amps for ILC-400x (UL limitation 100 watts @24vDC or 60 watts @12vDC)	**EB**-5.0 meters per ILC-400x (16.4') **SB**-6.0 meters per ILC-400x (20.0')	**EB**-Class 2 100 watt @24vDC) **SB**-Class 2 60 watt @24vDC
1 to 4 channel monochrome zones	6.67 amps for ILC-400x (UL limitation 100 watts @24vDC or 60 watts @12vDC)	**EB**-10.14 meters per ILC-400x (33.3') **SB**-12.0 meters per ILC-400x (40.0')	**EB**-Class 2 100 watt @24vDC) **SB**-Class 2 60 watt @24vDC
65,025 distinct RGBW or RGB zones	6.67 amps for ILC-400x (UL limitation 100 watts @24vDC or 60 watts @12vDC)	**EB**-5.0 meters per ILC-400x (16.4') x 65,025 devices **SB**-6.0 meters per ILC-400x (20.0') x 65,025 devices	**EB**-Class 2 100 watt @24vDC) per device **SB**-Class 2 60 watt @24vDC per device
65,025 distinct Monochrome zones	6.67 amps for ILC-400x (UL limitation 100 watts @24vDC or 60 watts @12vDC)	**EB**-10.14 meters per ILC-400x (33.3') x 260,100 devices **SB**-12.0 meters per ILC-400x (40.0') 260,100 devices	**EB**-Class 2 100 watt @24vDC) per device **SB**-Class 2 60 watt @24vDC per device

Notes:
[1] --Enhanced Brightness (**EB**) RGBW Linear LEDs require 6.0 watts per feet or 19.68 watts per meter @ 24vdc. (RGB only strips consume 3.6 watts/ft. (11.8 watts/m)
 --Standard Brightness (**SB**) RGBW Linear LEDs require 3.0 watts per feet of 9.84 watts per meter @ 12vdc. (RGB only strips consume 1.8 watts/ft. (5.9 watts/m)
 --Enhanced Brightness (**EB**) Monochrome Linear LEDs require 3.0 watts per feet or 9.84 watts per meter @ 24vdc.

Standard Brightness (**SB**) Monochrome Linear LEDs require 1.5 watts per feet or 4.92 watts per meter @ 12vdc

[2] The limitation of a NEC rated CLASS 2 power supply is 60 watts @12Vdc (or 100 watts @ 24Vdc).Specifically, the load side of the transformer must have a nameplate rating of less than 100VA (or 5 times Vout if output voltage is lower than 20v). Similar standards exist in German (VDE 0100), Canada 9CSA C 22.1), Switzerland (SEV HV1000), Great Britain (BS7671) or as international standards (IED 364- …). Other power supplies are available with larger wattage outputs. However, depending on local electrical requirements, special licenses or certifications may be required to install power supplies that do not carry (NEC) CLASS 2 ratings.

2 Mounting Instructions

The standard configuration of the ILC-400x is shown below in Figure 1. The standard offering is the DIN-rail mounted device which can be mounted on commonly available DIN rails or alternatively can be affixed to any flat surface using the detachable orange mounting tabs found on the bottom of the unit. For OEM applications, a variety of form factors are available—consult the factory for more information.
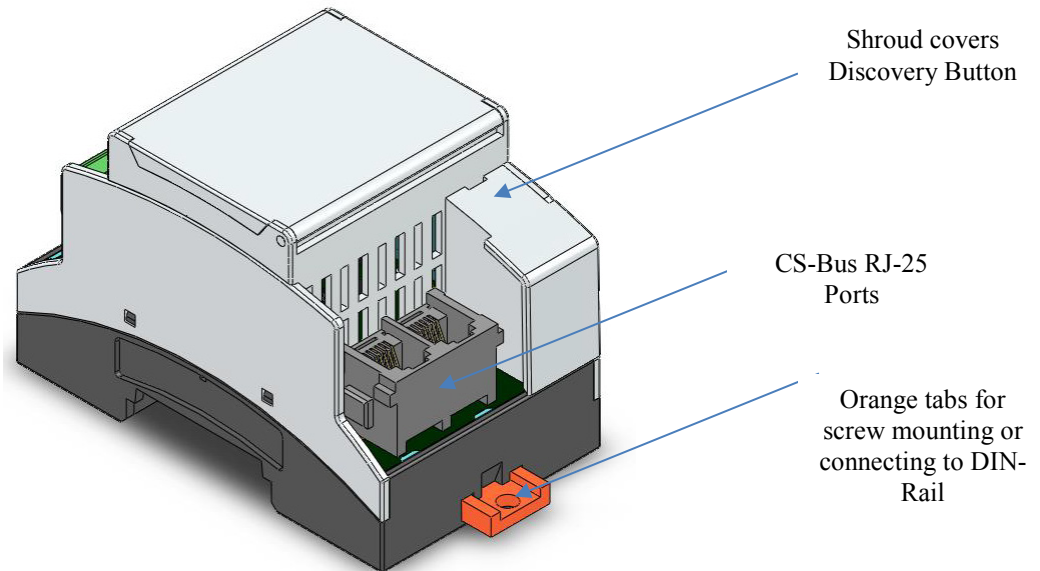

Shroud covers Discovery Button

CS-Bus RJ-25 Ports

Orange tabs for screw mounting or connecting to DIN-Rail

Figure 1 ILC-400sa configuration

Directions
a. Determine a suitable mounting location for ILC-400sa close to the LED elements that you wish to control.

b. If mounting to a DIN Rail, gently release the orange fingers on the bottom of the ILC-400 in order to enable the ILC-400x to slide onto or snap onto the DIN Rail.

If mounting to any other type of flat surface not using a DIN Rail, gently release the bottom orange pair of fingers on the bottom of the ILC-400x and affix to your substrate using appropriate fasteners and the provided holes in the orange fingers.

Note: For convenience, the ILC-400sa Controller may be mounted into a separately available NEMA metal enclosure where multiple controllers may be installed for convenience. If you are mounting

the ILC-400sa within such an enclosure, route Low Voltage wires through a separate entry or knockout from any AC supply lines present

3 Supply (Line Input) and LED (Load Output) Wiring Instructions

IMPORTANT: MAKE SURE THAT THE DC POWER SOURCE IS UNPLUGGED FROM THE ILC-400x PRIOR TO CONTINUING.

3.1 DC Power Source Connection

Directions

a. If the AC (input) / DC (output) power supply does not have a pre-installed 3-pin power connected attached, strip 1/4" (6mm) of insulation from DC power cord.

b. Connect wires as shown below:

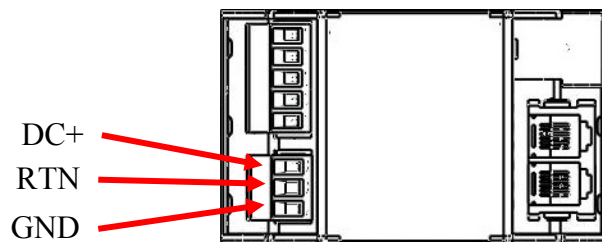| DC Input Connection Block	DC
Pin 1 (left position on connector)	+ 12 to 48Vdc (matching LED requirement)
Pin 2	Neutral (DC return)
Pin 3 (right position on connector)	Earth ground (if required to reduce electrical noise)

DC+
RTN
GND

Figure 2

c. Leave AC/DC Power Adapter unplugged until requested to turn plug into AC source.

3.2 LED Connection Block

Directions

a. If the interconnect wire furnished with your LED strip does not have a pre-installed 5-pin power connected attached, strip 1/4" (6mm) of insulation from DC power cord.

b. Connect these wires as shown below (for more information on particular LED devices see the next step as well):

LED output block	RGBW applications	Monochrome applications
Pin 1 (left position on connector)	WHITE (-)	Channel 4 (-)
Pin 2	BLUE (-)	Channel 3 (-)
Pin 3	RED (-)	Channel 2 (-)
Pin 4	GREEN (-)	Channel 1 (-)
Pin 5	Common (+) **POSITIVE ANODE**	Common (+) **POSITIVE ANODE**

WHITE
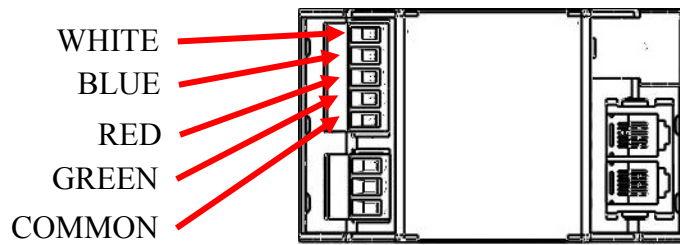BLUE
RED
GREEN
COMMON

Figure 3

c. Depending upon the type of LED elements that you wish to setup, connect those as specified below:

    i. **RGB or RGBW LED elements**
            Connect as per Case **C1** or **C2** depending upon your LED type**.**

    ii. **Monochrome LED elements** *(1 to 4 channels)*
            Connect from one to four discrete channels as specified below. For one channel, connect as per Case **M1**, for two channels connect as per Case M1 (for the first channel) and Case M2 (for the second channel). Add any additional channels by adding the appropriate channel as described in Cases **M3** and **M4** below.
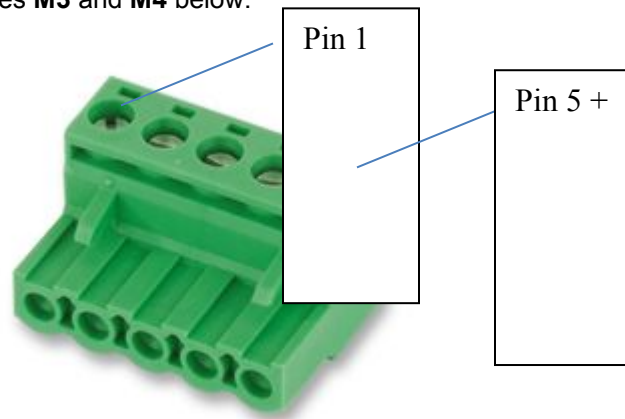

Pin 1

Pin 5 +

Figure 2

Case	LED Type	Pin 1 W	Pin 2 B	Pin 3 R	Pin 4 G	Pin 5 C+ Common Positive
C1	RGB LED strip		✓	✓	✓	✓
C2	RGB+W LED strip	✓ (White)	✓	✓	✓	✓
M1	1st Monochrome LED strip (Channel 1l)				✓	✓
M2	2nd Monochrome LED strip (Channel 2)			✓		✓
M3	3rd Monochrome LED strip (Channel 3)		✓			✓
M4	4th Monochrome LED strip (Channel 4)	✓				✓

4   CS-Bus Wiring Instructions

Background.   All CS-Bus compatible devices have either one or two RJ-25* communication connector(s) with which to interconnect the device to other compatible devices. Converging Systems Controllers (motor or lighting controllers) typically have two RJ-25 connectors while keypads and interconnect devices typically have just a single RJ-25 connector. Refer to the two tables below which describe the number of RJ-25 connectors available on various (i) CS-Bus Controllers and (ii) Interface Devices as well as their function and other specifics. Please note that on the CS-Bus Controller devices listed below which are configured with **two** (2) RJ-25 sockets, one socket is a *Powered* connector (Port 0) which provides DC power to connected Interface Devices while the other socket (Port 1) is an *Unpowered* connector which *does not provide external power* to other devices connected to it.

Note: Please refer to Appendix A for specific wiring and pin-outs for all interconnection cables.

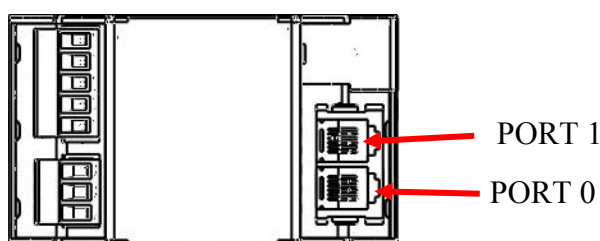Refer to Figure 4 above for the location of the two Ports on an ILC-400x LED controller.

Figure 4

Table 2a—Controllers Information

Model #/Type	CS-Bus Comm. Ports (RJ-25 sockets)	Communication Port(s) Function	External Power Required from CS-Bus to Operate Interface Device	Number of Interface Devices which can be supported directly connected to specific controller device
ILC-400x LED controller	2	Port 0 Powered Port* Port 1 Unpowered Port	NO (device receives power from DC power input connector)	1
ILC-100x LED controller	2	Port 0 Powered Port* Port 1 Unpowered Port	NO (device receives power from DC power input connector)	1
IMC-100x motor controller	2		NO (device receives power from AC connector)	2

Table 2b—Interface Device Information

Device Family	Model Numbers	CS-Bus Commun. Ports (RJ-25 sockets)	Comm Port Function	External Power Required on CS-Bus to Operate Specific Device
Keypad Devices	BSKP-2XXX	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)
Serial Interface Devices	IBT-100	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)
Lutron Interface Device	IBE-1000	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)
Light Sensor Device	IBE-1200	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)
Motion Sensor Device	IBE-1600	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)

Intelligent Relay Device	IRC-1000	1	Bi-directional communication Interface (I/F)	Yes-mandatory (Port 0)
Ethernet Interface Device	e-Node	2	Bi-directional communication Interface (I/F)	NO (device receives power from AC/DC adapter directly to unit)

***Note**: *An RJ-25 connector (sometimes referred to as 6P6C) is similar to a standard RJ-11/12 connector except it has 6 contact pins rather than 4, but the connectors outside shell is identical in appearance.*

Types of Connections. Depending upon the number and type of devices that are desired to be interconnected, specific directions are application. Refer to the table below to select the wiring instructions applicable to your specific configuration.

Table 2c-Types of Connections

Type of Connection	Reference
Single controller connected to single interface device	Section 4.1
Single controller connected to multiple interface devices	Section 4.2
Multiple controllers connected to each other	Section 4.3
Multiple controllers connected to a single interface device	Section 4.4
Multiple controllers connected to multiple interface devices	Section 4.5

General Information
- Straight (1-1, 2-2, 3-3, 4-4, 5-5, 6-6) wiring is required for all CS-Bus wiring. **Note, typically phone patch cabling with 4P4C connectors should not be used for it is often swapped or reversed. Utilization of phone patch cable that has wires swapped or reversed will void your warranty.**
- Use 22-24 AWG CAT5 (or CAT3) interconnection wires with maximum length of bus less than 4000 feet (if using 4 pair wire, simply do not use the Brown and Brown/White of 4th pair wires). Up to 255 Controllers can be implemented on a single leg or branch of a CS-Bus without the need for an IMC Repeater/Router (IMC-RTR) or e-Node.
- Up to 254 Controllers can be bussed together to a single IBT-100 (serial) interface device or e-Node (Ethernet) device.
- Up to 65,025 Controllers can be integrated into a single system with multiple IBT-100 or e-Node devices.
- CS-Bus is based on the RS-485 protocol which may require terminating resistors (120 ohm between the two RS-485 signals) at both ends of CS-Bus if sporadic communication is experienced (See Appendix 3 A3-3.2). The ILC-400x also enables built in termination through software setup if no 120 ohm resistors are available—See Appendix 5 for more information.
- If you are mounting the ILC-400 within a double gang junction box, route Low Voltage wires through a separate entry or knockout from any AC supply lines present.

4.1 CS-Bus Wiring Directions (Single Controller to Single Interface Device). (See Figure 5 below.)

Directions
a. Prepare communication wire with RJ-25 (6P6C) connectors on each end.
b. Connect the CS-Bus Controller's RJ-25-***Port 0*** (Powered Port 0) to the single RJ-25 port on the Interface Device.
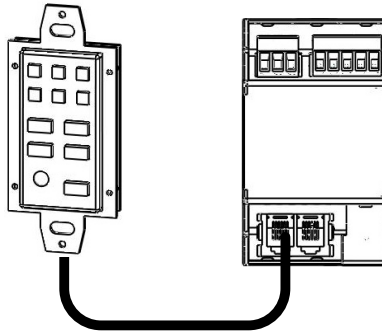
Figure 5

4.2 **CS-Bus Wiring Directions (Single Controller to Multiple Interface Devices).** (See Figure 6 below.)

Directions
a. Prepare the specific number of communication wires with RJ-25 (6P6C) connectors on each end necessary to connect all targeted devices together.
b. Refer to Table 2b above to determine how many Interface Devices can be connected to each targeted Controller. **Note--You may not connect more than the specified number of Interface Devices to a specific Controller.** If you attempt to connect more than the recommended number, ***one or more connected Interface Devices may fail to operate or their operation may be intermittent.***
c. You will need to secure a specific number of Device Insertion Modules (DIMs) that can be used to effectively "Y" or split the communication signal between a local Interface Device and the next Interface Device located "downstream." Please refer to the following formula to determine the number of DIMS which will be required for your specific application.

Number of DIMS= (# of Single Port Interface Devices) - 1

d. Next, insert a DIM into each Interface Device *except* for the last Interface Device. Please refer to Figure 4b below for more information here.
e. Connect one end of the communication wire prepared above in Step "a" into Port 0 (Powered Port) on the CS-Bus Controller and the other end into either of the available RJ-25 sockets in the DIM inserted into the first Interface Device. Again see Figure 4b below.
f. Finally, continue connecting each subsequent Interface Device to the previous Interface Device as specified in Step "d" above. Where the connection is to a DIM, utilize the open RJ-25 connector to complete the circuit. Note--the connection to the last Interface Device will be to the on-board RJ-25 connector on the Interface Device itself (rather than to a DIM device which is not needed here).
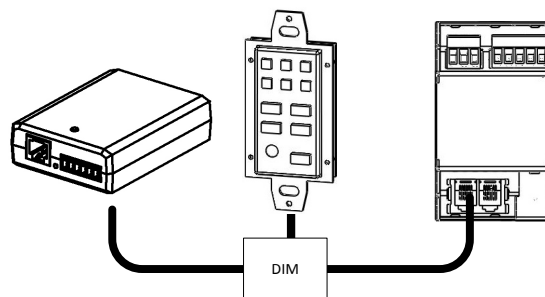

Figure 6

4.3 **CS-Bus Wiring Directions (Multiple Controllers connected to each Other).** (See Figure 7 below.)

Directions
a. Prepare the specific number of communication wires with RJ-25 (6P6C) connectors on each end necessary to connect all targeted devices together.

b. Connect the first CS-Bus Controller's RJ-25-**Port 0** (Powered Port 0) to the next sequential CS-Bus Controller's RJ-25 connector **Port 1** (Unpowered Port 1).

Alternatively multiple ILC400 can be connected using a DIN rail connector. See factory for availability
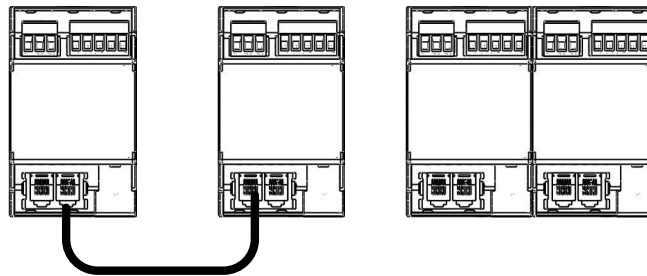

Figure 7

4.4 CS-Bus Wiring Directions (Multiple Controllers to a Single Interface Device). (See Figure 8 below.)

Directions
a. Prepare the specific number of communication wires with RJ-25 (6P6C) connectors on each end necessary to connect all targeted devices together.
b. If you wish to connect the single Interface Device **to the last** CS-Bus Controller on the CS-bus, connect all CS-Bus Controllers according to the directions in Section 4.3, and then connect the single Interface Device to the last CS-Bus Controller according to Step "b" in Section 4.1.
c. If you wish to connect the single interface device **between two** CS-Bus Controllers, then obtain a Device Insertion Module (DIM) and inset that DIM into the selected Interface Device ("**Inserted Device**").

c1. Follow the instructions in Section 4.3 to connect all sequential CS-Bus Controller to each other (until such time as a User Interface will be "inserted").
c2. Then, connect one end of a communication wire prepared above in Step "a" into Port 0 of the last sequential CS-Bus Controller device and the other end into one of the RJ-25 ports on the DIM plugged into the **Inserted Device**.
c3. Next, connect another communication wire prepared above in Step "a" into the remaining RJ-25 port on the DIM in the **Inserted Device** and the other end into Port 1 (Unpowered Port) on the next CS-Bus Controller downstream from the Inserted Device.
c4. Continue connecting each subsequent CS-Bus Controller downstream of the Inserted Device to each other following the instructions in Section 4.3
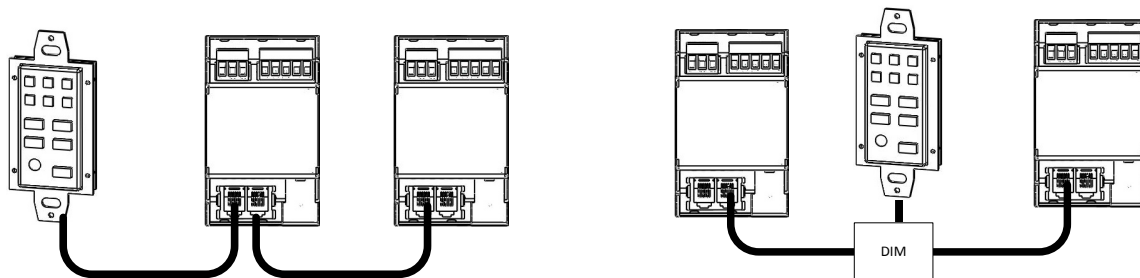

Figure 8

4.5 CS-Bus Wiring Directions (Multiple Controllers to Multiple Interface Devices). (See Figure 9 below.)

Directions
a. Prepare the specific number of communication wires with RJ-25 (6P6C) connectors on each end necessary to connect all targeted devices together.

b. If you wish to connect a second Interface Device ***immediately downstream from a 1st Interface Device at the very end of a CS-Bus network, follow the below steps***

    b1   Proceed through the directions in Section 4.4, Steps "a" and "b."

    b2.   Add the 2nd Interface by following the directions in Section 4.2, Step "e"

c. If you wish to connect a second Interface Device immediately downstream from a 1st Interface Device ***between two*** CS-Bus Controllers, follow the steps below:

    c1.   Obtain a Device Insertion Module (DIM) and inset that DIM into the selected second Interface Device ("***Second Inserted Device***").

    c2.   Follow the directions in Section 4.3, Steps "a" and "b" to interconnect all CS-Bus Controllers prior to the first Inserted Device.

    c3.   Then follow the directions in Section 4.2, Step "e" to connect the 2nd Interface Device to the 1st Interface Device.
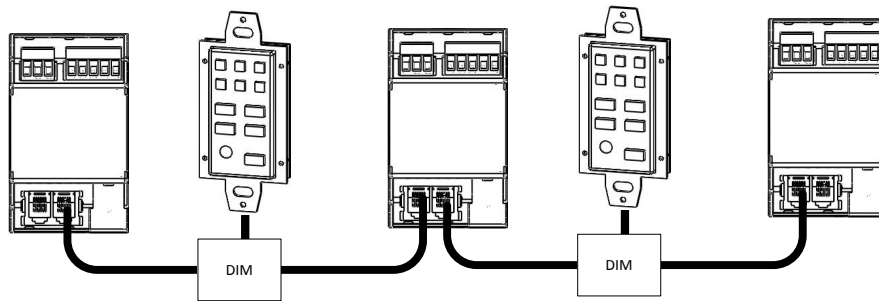

Figure 9

5   Power On/Testing

IMPORTANT: MAKE SURE THAT THE DC POWER TO ALL CONTROLLERS IS TURNED OFF PRIOR TO CONTINUING.

Directions

a. Make sure that you have installed at least one ILC-400x Controller and one User Interface Module (keypad) or have connected your CS-Bus to a remote computer through either (i) the IBT-100 (RS-232-C serial interface) or the (ii) e-Node (Ethernet to ILC-400x Controller interface) with a compatible device driver.
Note: Standalone IR devices are not compatible with the ILC-400x. If you desire to control the unit with IR, it is required that you secure a BSKP-2110L keypad and place a low-cost IR emitter in proximity of the IR receiver on the front of the keypad. No standalone IR receivers are compatible with the ILC-400x.

b. *Make sure that you have installed at least one LED load to your ILC-400 as per Section 3.2 above.*

c. **Power on ILC-400x** Controller(s) by providing DC power to the three pin connector—**pay particular attention to the three pin power connector which maps the DC – pin to the center pin**,
Note: *If you are upgrading an ILC-100 installation to an ILC-400 installation, please note the polarity of the power connector has changed. Failure to observer proper polarity will void your warranty.*

d. **Configure your ILC-400 for either RGB/RGBW mode or 1-4 channel Monochrome Mode.**

Note: The factory default for the ILC-400x is **RGB/RGBW** Mode. If you wish to use this mode, please proceed to **Step e**. below; otherwise follow the appropriate step below.

i.   **1-4 Channel Monochrome Mode**. In order to proceed with 1-4 channel Monochrome testing and operation, you will need to reboot the ILC-400x into **1-4 channel Monochrome Mode.** To do so, remove the small plastic shroud on the ILC-400 using your finger nail in the top slot of the shroud (see <u>Figure 1</u>) and depress and hold the **Discovery Button** for two (**2**) complete flash cycles (i.e. LED cycles **OFF** immediately, then turns **ON** 1st time, then a **LONG OFF**, and when turns **ON** 2nd time, quickly release button and LED turns **OFF**). Within a few seconds the Green on-board LED will once again illuminate and you will be in the **1-4 Channel Monochrome Mode**. Should you wish alternatively to change the repurpose the ILC-400x later to be in **RGB/RGBW** mode, proceed to Step ii. below.

      Note: *If you perform this operation, any dealer programmed variables within the ILC-400x will be erased*

ii.   **RGB/RGBW Mode/Factory Default Mode**. This is the factory default mode. If you for some reason you wish to reboot the ILC-400x back to the default factory **RGB/RGBW Mode**, perform the following operation: Remove the small plastic shroud (if needed). Now depress the **Discovery Button** for three (**3**) complete flash cycles (i.e. LED cycles **OFF** immediately, then turns **ON** 1st time, then a **LONG OFF**, turns **ON** 2nd time, then a **LONG OFF**, then when turns **ON** 3rd time, quickly release button and LED turns **OFF**. Within a few seconds the Green on-board LED will once again illuminate and you will be in the factory default **RGB/RGBW** Mode.

e.   **Test**. Verify each ILC-400x Controller has powered up properly by examining its **on-board status LED** indicator. Depending upon the configuration of the ILC-400x Controller and its current operational status, the ILC-400x on-board LED indicator (**green** or **yellow**) will indicate the Controller's status. In addition, verify that any connected LED loads (see the table below for your exact configuration) will illuminate as follows.

      Note: Refer only to the appropriate column for your connection

State	On-board LED indicator power on status	LED Connected LOAD power on status					
	PCB LED	RGB Load	RGBW Load	Ch1 Mono Strip	Ch. 2 Mono Strip	Ch. 3 Mono Strip	Ch. 4 Mono Strip
Unprogrammed Controller -as provided from factory, or -state after a field factory reset (See Section 5.d i)	GREEN [1]	RGB all one (so bluish white)	RGBW all on (so white LEDS are ON and RGB LEDs appear bluish)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)
Dealer Programmed Controller -state after programmed by dealer with local address set to a non-zero address (i.e. 2.1.**1** rather than the factory address of 2.1.**0**)	YELLOW [2]	RGB all one (so bluish white)	RGBW all on (so white LEDS are ON and RGB LEDs appear bluish)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)	Ch. 1 Mono LEDs on (White)

Notes:

[1]: Indicates that the unit has **not** been previously assigned a **Z**one, **G**roup, **N**ode address and still carries the factory default address of (i.e. 2.1.**0**)

[2]: Indicates that the unit has been previously assigned a non-zero in any field (**Z**one, **G**roup, **N**ode) address (i.e. 2.1.**1**)

6   Controlling the ILC-400x

6.1   Overview.

The ILC-400x Controllers contain a sophisticated color computer that can be used to select any "color" from a palette of nearly 16 millions possible choices. Rather than expecting the user to be a seasoned color scientist who well understands how to precisely mix the three primary colors of *Red*, *Green*, and *Blue*, (the constituent components from which all color of light can be created), the ILC-400x Controller implements a unique color selection tool similar to that which is integrated within color printers and monitors.

On each of the User Interface Controls (keypads, virtual keypads, web pages viewable through the e-Node), specific controls are available to choose, save and recall a color within the ILC-400x Controllers. There are three basic controls that must be understood in order to proceed. These controls are as follows:

Hue Control (H): Hue is the attribute of color that permits each to be classified as red, yellow, green, cyan, blue, magenta or an intermediate between any contiguous pair of these colors. There are two controls available with this operator—UP and DOWN. Selecting UP, increases the *Hue*, while selecting the DOWN, decreases the *Hue*.

Saturation Control (S): Saturation is typically synonymous with the vividness of hue; degree of difference from a gray of the same lightness or brightness. There are two controls available with the operator—UP and DOWN. Selecting UP increases the *Saturation*, while selecting DOWN, decreases the *Saturation*.

Lightness Control (B or V): Lightness is typically synonymous with the relative darkness or lightness of a color. There are two controls available with this operator—UP and DOWN. Selecting UP increases the *Lightness*, while selecting DOWN, decreases the *Lightness.*

Note: Typically*, with most User Interface Controls such as keypads, simply releasing a ramp UP or ramp DOWN button, stops the ramping process at the moment the button is released.*

6.2   Steps to Select a "Color"

Directions

a.   ***Check Proper Operation***. To quickly determine if your newly set-up ILC-400x system is working, hit the Preset button using any of the specified User Interface Controls documented in Appendix 2 and select one of the six presets (i.e. P1, P2, P3, P4, P5, or P-6) from a User Interface Device (keypad or remote). The connected LEDs should change color from their current setting to a factory programmed default for that particular Preset. If the LEDs do not illuminate, check your wiring, and make sure that your power supply is properly connected. If you may have inadvertently written over a "no" color (or "OFF" setting) to a particular Preset, try each additional Preset until the LEDs come alive. Now proceed to the next step.

b.   ***Select Hue.*** Provided that there is some illumination being generated from the LEDs, depress the ***Hue + button*** and you should see a distinct color shift over the next 10-15 seconds which will automatically circle around the entire color wheel. Once you have found a "color" which is roughly what you desire, release the ***Hue +*** button and the newly discovered color will "freeze." You can alternatively push the ***Hue –*** button and see the colors sequence the opposite direction over the next 10-15 seconds until they come full circle to the original color. Once you have "rediscovered" the original "color" that you previously selected, proceed to the next step.

c.   ***Select Lightness.*** Next, to alter the Lightness of the previously selected "color," depress the ***Lightness + button*** and you should see a distinct brightening of the previously selected "color." Alternatively, select the ***Lightness – button,*** and you should see a distinct darkening of the previously selected "color." You can always return to a previously selected "color" by either selecting the ***Lightness + button or the Lightness – button.*** Once you have "rediscovered" the original "color" that you previously selected proceed to the next step.

d.   ***Select Saturation.*** Next, to alter the Saturation of the previously selected "color," depress the ***Saturation + button*** and you should see a distinct change in the saturation of the color. Alternatively, select the ***Saturation – button,*** and you should see a distinct de-saturation of the previously selected "color." You can always return a previously selected "color" by either selecting the ***Saturation + button or the Saturation – button.*** Once you selected the correct Saturation value, you can now save the chosen "color" made of up discrete parameters relating to ***Hue. Lightness***, and ***Saturation.*** If you decide at any time that you wish to tweak your newly discovered "color," simply revisit steps b, c or d once again.

6.3   Steps to Select a "Color"

a.   *To Save a Color.*   Refer to Appendix 2 for your particular User Interface Device for specific directions for how to save the "color." Once you have saved your "color," you can recall that specific "color" by following the directions again in Appendix 2 for your particular User Interface Device.

7   Additional Programming Options

Numerous other programming options exist for the ILC-400x series of Controllers. Please consult any other user documentation that may have come with your system before calling customer service for more assistance. You may also wish to consult the most recent Converging Systems Third-Party Device Driver Toolkit – Programmers Guide available at

http://www.convergingsystems.com/inres_programmingdesignkit.htm

APPENDIX 1-Specifications ILC-400

Feature	Specification	Detail
Product Code	Standalone Version OEM Configuration	ILC-400sa ILC-400oem
Features	Function	LED Lighting Controller. Compatible Luminaries (LEDs) -Full Color-RGB (Red, Green, Blue, W) positive anode, R/G/B/W cathode (-) -Monochrome-Four channel (Monochrome) individually addressable
	Processing	-(RGBW Model) Built-in color computer selects a single color (hue) from over 16 million available -(Mono Mode) Built-in color computer selects a single brightness (fade level) from full ON to full OFF -Network compatible/auto discovery/network ID/diagnostics
Controls /Interfaces	Control Type	Connectivity to CS-Bus peripherals (i.e. keypads, Ethernet adapter, Serial interface adapter, 0-10vcd dimmable ballast interface)
	LED Connection	-5-pin detachable connector (for RGBW elements). -5-pin detachable connector (for monochrome LEDs)* *Note: the separate R, G, B, W outputs can be wired to four separate monochrome strips. Each channel can be populated to run at the full rated current capacity of the ILC-400 or the loads can be divided equally or non-equally among the 4 channels in any manner.
	Control	Applicable commands are found below for each mode. (Commands are subject to change – see Device Driver Toolkit for latest information)

	RGBW Mode/RGB Mode	1-4 chn. Mono. Mode
On	✔	✔
Off	✔	✔
Hue - Ramp Up/Down/Stop	✔	
Hue,H (set to any level)	✔	
Saturation - Ramp Up/Down/Stop	✔	
Sat, S (set to any level)	✔	
Brightness - Ramp Up/Down/Stop	✔	✔
Set,S (set to any level)	✔	✔
CCT (Color Temperature) - 1700K to 7000K (with Converging Systems FLLA 24V RGB strips)	✔	
SUN (Circadian Rhythm) - Ramp Up/Down/Stop	✔	✔
Red - Ramp Up/Down/Stop	✔	✔
Red,R (set to any level)	✔	✔
Green - Ramp Up/Down/Stop)	✔	✔
Green,G (set to any level)	✔	✔
Blue - Ramp Up/Ramp Down/Stop)	✔	✔
Blue,B (set to any level)	✔	✔
White - Ramp Up/Ramp Down/Stop)	✔	
White,W (set to any level)	✔	
Presets - 1-24 recall*	✔	✔
Store Levels - 1-24*	✔	✔
Effects - Recall Effect 1,2,3,4	✔	
Notify – Color, Value (for directional communication status updates)	✔	✔
Additional HSV and RGB settings for programming**	✔	
Addressing	1 channel	Up to 4 channels

*number dependent upon User Interface utilized
**See Device Driver Toolkit for full range of programming elements

	Screen Trigger Interface	Available through separate IBE-1000 adapter
	Low-Voltage Trigger	Available through separate IBE-1000 adapter
	Light-sensor control	Available through separate IBE-1200 adapter
	Motion- sensing control	Available through separate IBE-1600 adapter
	Motor Control	Dependent operations available with networked IMC-100 controller(s)
	IR Input	-Through IR receiver on front of BSKP-2100L keypad -No CS-Bus IR receivers (or third-party receivers) supported.
	Bus Specification	CS-Bus compatible. Up to 4000 foot runs using twisted pair wiring.4 conductor wiring required for standard communication, 6 conductor wiring required for intelligent peripherals. NOTE STRAIGHT 1-1, 2-2, 3-3, 4-4, 5-5, 6-6 wiring. Recommended pin-out for CAT 5 wiring or better – Blue/BlueWhite connections with twisted pairs
Connections	LED Connector	5-pin detachable LED connector
	Power Connector	3-pin DC detachable power connector (+, - mandatory, ground is optional)
	Network Connection	CS-Bus connection (input, output). Port 0-powered, Port 1-non-powered

General	Dimension
	(length x width x depth)
	    Standalone Configuration
	    OEM Configuration
		
		3.53 x 2.12 x 2.4 in (89.74 x 53.76 x 50.90mm)
		1.96 x 3.372 x 0688 in (86.42 x 49.82 x 16.63mm) pcb only without connectors plugged in—other dimensions possible

	Weight
	    Standalone Configuration
	    OEM Configuration
		
		3.3 oz. (93.55 gm)
		1.0 oz. (28.34 gm)

	Form Factor	OEM Configuration-PCB mount Standalone Configuration-integrated metal enclosure
	Housing (Standalone conf)	UL/CSA Rated plastic DIN Rail enclosure with mounting ears.
	Power Requirements	Power supply should be selected depending upon voltage of LEDs to be supported. Controller requires at minimum 40ma @5Vdc. Maximum voltage 28Vdc. Maximum load of 6.67 amps requires a similar power supply (+40 ma).
	Manufacturing	Made in the U.S.A
	Temperature Range	32-130° F (0-54° C)
	Humidity	< 90% RH, non-condensing
Compliance	Safety Approvals	ETL Listed to UL 2108. ETL listed to CSA C22.C.#9.0. Requires external constant voltage UL Class 2 Power Supply.
	RoHS	RoHS compliant
	EMI Testing	FCC Class B (home and office)

APPENDIX 2-Accessory Information

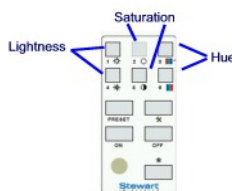## A2-1   Wall pad 11-Button Switch (Standalone Model IMC-BSKP-2011L)

Figure A2-2

Infrared Receiver.   This is a build-in Infrared Receiver to be used with compatible Infrared remote.

H--Hue (UP/DOWN).   Hue is typically synonymous with the feature of the color that allows an observer to classify it as red, orange, yellow, green, blue, indigo, and violet, etc. as determined by the dominant wavelength of the light. The TOP button of the pair increments the *Hue (red to yellow to green,etc.)* , while the LOWER button decrements the *Hue (red to magenta to blue, etc.).* Tap the respective button once and the *Hue* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

L--Lightness (UP/DOWN).   Lightness is typically synonymous with the relative darkness or lightness of a color. TOP button of the pair increases the *Lightness*, while the LOWER button decreases the *Lightness.* Tap the respective button once and the *Lightness i*ncrements/decrements until released. Tap the respective button once and the *Lightness* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

S--Saturation (UP/DOWN).   Saturation is typically synonymous with the vividness of hue; degree of difference from a gray of the same lightness or brightness. TOP button of the pair increases the *Saturation*, while the LOWER button decreases the *Saturation.* Tap the respective button once and the *Saturation* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

Preset.   To save a desired color setting, press this button before selecting any one of the six numbered buttons (1-6) and continue to hold that specific numbered button for 5 seconds until a beep is heard from the keypad. At that point, the color preset has been saved under that specific number. Alternatively, to recall a specific color setting, press this button before selecting any one of the six numbered buttons (1-6) and that particular previously set Preset will be displayed.

Color Adjustment Tool.   Press this button before selecting any one of the Hue (up/down), Saturation (up/down),and Lightness (up/down) buttons, and the appropriate adjustment available under that specific referenced buttons, will be activated.

ON.   Depress this button anytime and the lights will turn fully *ON* (HSL value of 240, 240, 240).

OFF.   Depress this button anytime and the lights will turn fully *OFF* (HSL value of 0, 0, 0).

*.   Invokes an automated sequence by illuminating each of 6 user configured presets (P1, P2, P3, P4, P5 and P6) plus two additional lighting presets (P7 and P8) each for a programmed amount of time and then recycles through the entire sequence continuously (until either the OFF button is depressed or some operation is invoked.

> **Note**: Presets 1 through 6 can be programmed with the ILC-400 while Presets 7 and 8 can be programmed with the e-Node.

A2-2   Wall pad 5-Button Switch (Standalone Model IMC-BSKP-2050)

The ILC-400x controllers are designed to operate either in a standalone manner or in conjunction with one or more separate lighting controllers (ILC-400x) or intelligent motor controllers (IMC-100x). In the case where one more ILC-400x controllers have been integrated with one or more IMC-100 controllers, specific buttons on some IMC-100 peripherals, notably the BSKP-2050, can also control specific operations on a networked ILC-400x system. See the directions below for a description of such possible interactions.
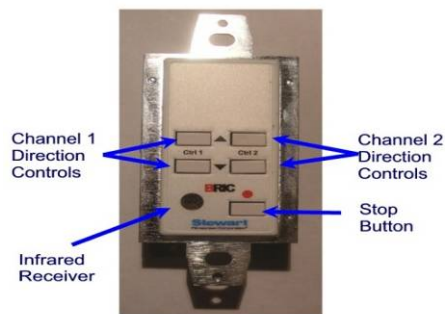

Figure A2-1

IMC-100T
Infrared Receiver.   This is a built-in Infrared Receiver to be used with compatible Infrared remote.

IMC-100T
Specific Activity Buttons-Channel 1 (UP/DOWN).   The right pair of UP/DOWN buttons activates one or connected IMC-100x Controllers *designated as Channel 1* to move motor in the selected direction. In the factory default settings, if you tap the switch once in one of the applicable directions (UP or DOWN) and then release, the IMC Controller will activate a connected bi-directional motor to travel in that appropriate direction until it reaches its desired (fully UP or fully DOWN) position.

In addition, when Channel 1 UP button is depressed, a signal is sent to a specific ILC-400x to activate *Lighting* Preset 1. If no Preset 1 had previously setup within the targeted ILC-400x system, then no triggering will occur. In addition, when Channel 1 DN button is depressed, a signal is sent to a specific ILC-400x to activate *Lighting* Preset 2. If no Preset 2 had previously setup within the targeted ILC-400x system, then no triggering will occur.

IMC-100T
Specific Activity Buttons-Channel 2 (UP/DOWN).   The right pair of UP/DOWN buttons activates one or connected IMC-100x Controllers *designated as Channel 2* to move motor in the selected direction. In the factory default settings, if you tap the switch once in one of the applicable directions (UP or DOWN) and then release, the IMC Controller will activate a connected bi-directional motor to travel in that appropriate direction until it reaches its desired (fully UP or fully DOWN) position.

In addition, when Channel 2 UP button is depressed, a signal is sent to a specific ILC-400x to activate an additional Preset which can be programmed by your dealer. In addition, when Channel 2 DN button is depressed, a signal is sent to a specific ILC-400x to activate yet another Preset which can be programmed by your dealer.

IMC-100T
🔴 Button.   Depress this button anytime while a motor moving and the motor will stop.

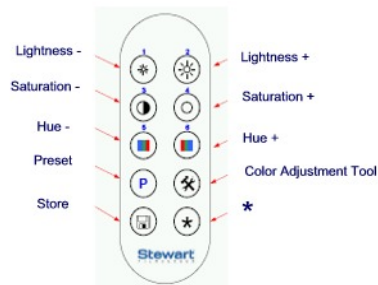## A2-3   Handheld 10-button Infrared Remote (ILC-IR-10W1)

Figure A2-3

H--Hue (UP/DOWN).   Hue is typically synonymous with the feature of the color that allows an observer to classify it as red, orange, yellow, green, blue, indigo, and violet, etc. as determined by the dominant wavelength of the light. The TOP button of the pair increments the *Hue*, while the LOWER button decrements the *Hue.* Tap the respective button once and the *Hue* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

L--Lightness (UP/DOWN).   Lightness is typically synonymous with the relative darkness or lightness of a color. TOP button of the pair increases the *Lightness*, while the LOWER button decreases the *Lightness.* Tap the respective button once and the *Lightness i*ncrements/decrements until released. Tap the respective button once and the *Lightness* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

S--Saturation (UP/DOWN).   Saturation is typically synonymous with the vividness of hue; degree of difference from a gray of the same lightness or brightness. TOP button of the pair increases the *Saturation*, while the LOWER button decreases the *Saturation.* Tap the respective button once and the *Saturation* increments/decrements by a step factor 4 (over a range of nearly 240 steps), hold the button and it will increment/decrement the value until released.

Preset.   To recall a specific color setting, press this button before selecting any one of the six numbered buttons (1-6) and that particular previously set Preset will be displayed.

Color Adjustment Tool.   Press this button before selecting any one of the Hue (up/down), Saturation (up/down),and Lightness (up/down) buttons, and the appropriate adjustment available under that specific referenced buttons, will be activated.

Store. Alternatively, to save a desired color setting, press this button before selecting any one of the six numbered buttons (1-6) and that particular color setting will be saved under that specific Lighting Preset number.

*.   Invokes an automated sequence by illuminating each of 6 user configured presets (P1, P2, P3, P4, P5 and P6) plus two additional lighting presets (P7 and p8) each for a programmed amount of time and then recycles through the entire sequence continuously (until either the OFF button is depressed or some operation is invoked.

> **Note**: Presets 1 through 6 can be programmed with the ILC-400 while Presets 7 and 8 can be programmed with the e-Node.

A2-4 Serial Interface /Firewall (IBT-100)

The ILC-400x controllers can be integrated to work with third-party automation systems that employ RS-232-C communication. A single IBT-100 serial interface adapter/firewall can support up to 254 ILC-400 controllers even with one or more separately attached User Interfaces such as keypads. The IBT-100 is self-powered and receives its power form the CS-BUS Port 0 (from any other ILC-400, ILC-100, IMC-100 or similar controller). The IBT-100 requires 6 conductor CS-Bus communication wires from a Powered Port (Port 0) from a CS-Bus compatible controller.

Note: *All CS-Bus (RJ-25 connectors) wiring utilizes CAT 5 or better wiring with **straight** (1-1, 2-2, 3-3, 4-4, 5-5, 6-6) wiring between contacts. Typically, the color coding of wires is Pin 1-Blue, Pin 2-Blue White, Pin 3-Orange, Pin 4 – Orange White, Pin 5 - Green, Pin 6-Green White. Pins 1 / 2 should utilize a Blue twisted pair, Pins 3 / 4 should utilize an Orange twisted pair, and Pins 5 / 6 should utilize a Green twisted pair.*

 See the separate instructions that come with the IBT-100 for programming information.

Figure A2-4

A software toolkit included with the IBT-100 allows easy set-up and testing of CS-Bus systems using a simple on-screen graphical user interface.
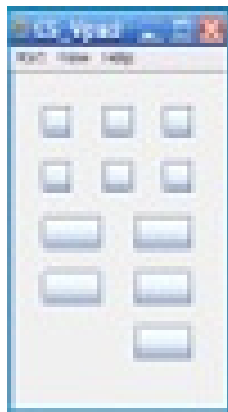
Figure A2-5
V-pad Application

A2-5 e-Node (Ethernet Connectivity solution)

The ILC-400x controllers can be integrated to work with third-party automation systems that employ Ethernet (IP) connectivity. A single e-Node can handle up to 254 ILC-400x controller even with separately attached User Interfaces such as keypads. The e-Node receives power from an attached AC to 12vDC~ 24vDC power supply. The e-Node has two (2) CS-Bus connectors that can be used to attach to separate CS-Bus networks together. Neither CS-Bus connectors on the e-Node is a Powered Port.

See the separate instructions that come with the e-Node for programming information.

Figure A2-6
e-Node

A software toolkit included with the e-Node, referred to as e-Node Pilot, allows almost an infinite number of commissioning tasks to be performed (setup) as well as network testing and remote diagnostics.
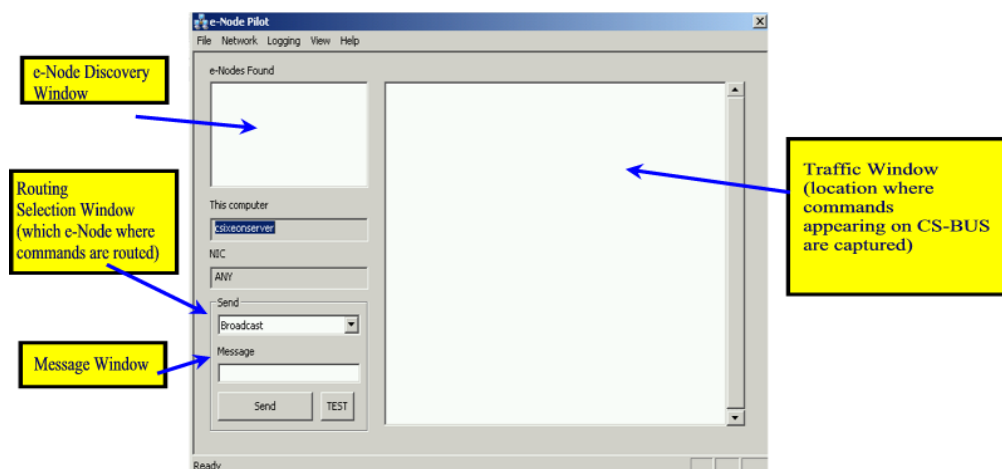
Figure A2-7
e-Node Pilot Application

Appendix 3 Technical Information-Low Voltage Wiring Diagrams

The ILC-400 has both power connections and output LED connections as well as CS-Bus connections. Refer to following diagram to understand location of Pin 1 on all connectors.

PORT1
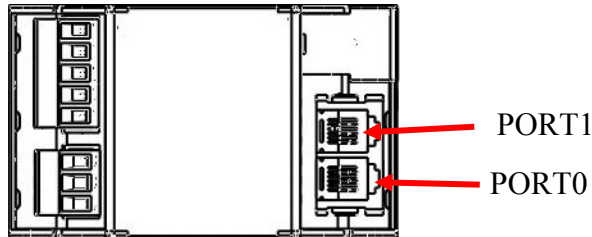
PORT0

Figure A3-1

Refer to the following tables for pin-outs on each of the two RJ-25 connectors when makng connections within the following sections..

Table A3-1

CS-Bus RJ-12 Connection (on CS-Bus Controller) (LEFT or "OUTPUT" PORT 0) (see Figure A3-1)	CS-Bus RJ-25 Connection (on CS-Bus Controller) (RIGHT or PORT 1) (see Figure A3-1)
#1 (left) IR	#1 *no connect*
#2 GND	#2 GND
#3 485-	#3 485-
#4 485+	#4 485+
#5 5V DC (regulated)	#5 *no connection*
#6 9V DC (unregulated)	#6 *no connection*

A3-1   Infrared Connections

Not Supported on CS-Bus directly

.
Note: *If you wish to control the device with IR, simply place a third-party infrared transmitter in the proximity of the IR windows on the BSKP 2110L keypad.*

A3-2   *Intelligent Peripheral Connections*

A3-2.1 CS-Bus TO IMC-BSKP-2020, IMC-BSKP-2110L (Intelligent Keypads)
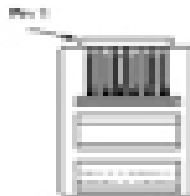
Figure A3-3

Table A3-3

CS-Bus RJ-12 Connection (on CS-Bus Controller) (LEFT or "OUTPUT" PORT 0) (see Figure A3-3)	IMC-BSKP-xx Keypad (RJ-25 connector) Pin #1 on RJ-25 plug is as marked above) (see Figure A3-3)	Suggested Color Coding*
#1 (left) IR	#1 (left) IR	Blue
#2 GND	#2 GND	Blue-White
#3 485-	#3 485-	Orange
#4 485+	#4 485+	Orange-White
#5 5V DC (regulated)	#5 5V DC (regulated)	Green
#6 9V DC (unregulated)	#6 9V DC (unregulated)	Green-White

IMPORTANT: maintain twisted pairs for pins 1/6, pins 2/5, and pins 3/4.

A3-3   CS-Bus Connections

A3-3.1 IMC-400x Controller to IMC-400x Controller Communication Wiring

Wiring Note: The preferred method of connection between multiple CS-Bus devices is to connect the "*Output*" *Port 0* of one unit to the "*Input*" *Port 1* of the next unit (see directions under Section 4.1 above). As long as you *do not plan on adding any devices* onto the CS-Bus such as IR receivers, RS-232C-RS485 adapter or intelligent keypads (which all require power), you may freely interconnect one CS-Bus Controller to another similar CS-Bus Controller without regard to the "*Output"* or *"Input"* port designation. You should routinely use 8-conductor CAT5 wire and simply cut 1 pair (the Brown and Brown/White wires) and therefore populate the RJ-25 connectors that are used to interconnect the CS-Bus devices with 3 twisted pairs (6 wires).

Pinouts: The wiring configuration is 1-1, 2-2, 3-3, 4-4, 5-5, 6-6. (straight-thru). *Do not use standard telephone pre-configured patch cords for these are REVERSED and will DAMAGE your equipment*. Preserve twists on pairs (1 and 2), on pairs (3 and 4) and pairs (5 and 6). For shorter runs you can use flat 6-conductor telephone line cord and appropriate RJ-25 connectors.

CS-Bus Connection (on IMC-100x Controller) (LEFT or "OUTPUT" Port 0) (see Figure A3-3)	CS-BUS Connection (on IMC-100x Controller) (Right or "INPUT" Port 1) (see Figure A3-3)	Suggested Color Coding*
#1 No Signal	#1 *No Signal*	Blue
#2 GND	#2 GND	Blue-White
#3 485-	#3 485-	Orange
#4 485+-	#4 485+	Orange-White
#5 5V DC (regulated)	#5 *No Signal*	Green
#6 9V DC (unregulated)	#6 *No Signal*	Green-White

IMPORTANT: maintain twisted pairs for pins 1/6, pins 2/5, and pins 3/4.

A3-3.2 RS-485 Terminators

Applicability Note: RS-485 communication is designed around end-of-bus resistor termination. This guarantees error-free communication despite external noise and other sources of interference. It is highly advised that when more than one ILC-400x Controller is interconnected, one terminator is placed on one end of the bus and another terminator is placed on the other end of the bus. It does not matter into which CS-Bus port these terminators are connectors so long as they are at the very beginning of the bus and the very end of the bus.

Table A3-4

RJ-25 connector terminator wiring)
#1 ---
#2 ---
#3 120 ohm resistor connection
#4 120 ohm resistor connection
#5 ---
#6 ---

Note: The IBT-100 has a built-in terminator so no additional terminating resistors are needed if the IBT-100 is utilized. The IBT-100 should be located for best results at the END OF THE BUS. Intelligent keypad (BSKP-2020, BSKP-2050x, BSKP-2110x) have a built-in jumper on the back of the device with a factory default setting of TERMINATION ON. If you plan on locating an intelligent keypad at a location other than at the end of the bus, *it is important to remove the terminating jumper of just simply shift it off one of its pins to remove local termination*. Other peripherals such as keypads and IR receivers do not have built-in terminating resistors, so a terminating resistor is required.

A3-3.3 CS-Bus (RS-485) to Remote External (RS-232-C) Control Device ("Intelligent Bus Translator) or IBT-100)

Example: ILC-400x to IBT-100 Intelligent Bus Translator

Note: Two alternative connection schemes can be used to connect the IBT-100 to your IMC-100x Controller network. Both work similarly (see Alternative #1 and Alternative #2 for wiring diagram).

See "IBT-100 to PC" for the wiring diagram from this device to a PC or an automation controller.

Table A3-5
Alternative #1

CS-Bus Connection (on IMC-100x and ILC-400x Controller) (LEFT or "OUTPUT" PORT 0 ONLY) (see Figure A3-1)	Intelligent Bus Translator (IBT-100) with RJ-25 connector	Suggested Color Coding*
#1 No Signal	#1 No Signal	Blue
#2 GND	#2 GND	Blue-White
#3 485-	#3 485-	Orange
#4 485+-	#4 485+	Orange-White
#5 5V DC (regulated)	#5 5V DC (regulated)	Green
#6 9V DC (unregulated)	#6 9V DC (unregulated)	Green-White

IMPORTANT: maintain twisted pairs for pins 1/6, pins 2/5, and pins 3/4.

Table A3-6
Alternative #2

CS-BUS Connection (on IMC-100x Controller and ILC-400x Controller)) (see Figure A3-1)	Intelligent Bus Translator (IBT-100) with RJ-25 connector RJ-25 connector (RS-485 only)	Suggested Color Coding*
#1 No Signal	#1 No Signal	Blue
#2 GND	#2 GND	Blue-White
#3 485-	#3 485-	Orange
#4 485+-	#4 485+	Orange-White
#5 No Connect	#5 No Connect	Green
#6 9V DC (unregulated)	#6 9V DC (unregulated)	Green-White

IMPORTANT: maintain twisted pairs for pins 1/6, pins 2/5, and pins 3/4.

Table A3-7
IBT-100 to PC Serial Port Wiring

CS-BC-232/485 Module (DB-9 Connector)	Computer RS-232C Connector (DB-9) (see Figure A3-5)
1 Not required	1 Not required
2 Controller Tx	2 PC Rx
3 Controller Rx	3 PC Tx
4 Not required	4 Not required
5 GND	5 GND

6 Not required	6 Not required
7 Not required	7 Not required
8 Not required	8 Not required
9 Not required	9 Not required

RS232 DB9 (EiA/TIA 574)

① ② ③ ④ ⑤
⑥ ⑦ ⑧ ⑨

(view into male end)

Figure A3-5

A3-3.4 ILC-400x Controller to e-Node (Internet Protocol Adapter)

A straight-thru 6-conductor wire (RJ-25 to RJ-5) should be used to connect any one CS-Bus controller to the e-Node. This will in effect interconnect all CS-Bus controllers to the e-Node. You do not need to obey any wiring restrictions relating to *Input* or *Output* connectors on the CS-Bus Controller because the e-Node has its separate power source.

Appendix 4 Power Requirements of Popular LED Strips

1.0 This is a power requirements chart for standard 4-wire tri-colored LEDs with 30 elements per meter (i.e. "single density strips").

Sections	Length mm	Meters	Inches	Feet	LEDs	Current (amps) @12volts	Wattage	Notes
1	100 mm	.1 M	3.94	.33	3	.05	.60	
2	200	.2 M	7.87	.66	6	.10	1.20	
3	300	.3 M	11.81	.98	9	.15	1.80	
4	400	.4 M	15.75	1.31	12	.20	2.40	
5	500	.5 M	19.69	1.64	15	.25	3.00	
6	600	.6 M	23.62	1.97	18	.30	3.60	
7	700	.7 M	27.56	2.30	21	.35	4.20	
8	800	.8 M	31.50	2.63	24	.40	4.80	
9	900	.9 M	35.43	2.95	27	.45	5.40	
10	1000	1.0 M	39.37	3.28	30	.50	6.00	
20	2000	2.0 M	78.74.	6.56	60	1.0	12.00	
30	3000	3.0 M	118.11	9.84	90	1.5	18.00	
40	4000	4.0 M	157.48	13.12	120	2.0	24.00	
50	5000	5.0 M	196.85	16.40	150	2.5	30.00	Maximum length of single run of this type of LED strip
130*	13000	13.00	511.81	42.65	390	6.65	79.76	Maximum length of multiple home runs of this type of LED

 *Note: Typical strips of 5 meters cannot be extended because the circuitry lack the internal current handling capacity to add additional loads to their back end. The alternative here to support longer than 5 meter strips is to run a separate "home run" connection from each 5 meter strip back to the power connector on the ILC-400x, provided the total current requirement of the LED load is less than or equal to the rated capacity of the ILC-400x controller.

2.0 This is a power requirements chart for ultra-bright (double density) 4-wire tri-colored LEDs with 60 elements per meter

Sections	Length mm	Meters	Inches	Feet	LEDs	Current (amps)	Wattage	Notes
1	100	.1	3.94	.33	6	.10	1.20	
2	200	.2	7.87	.66	12	.20	2.40	
3	300	.3	11.81	.98	18	.30	3.60	
4	400	.4	15.75	1.31	24	.40	4.80	
5	500	.5	19.69	1.64	30	.50	6.00	
6	600	.6	23.62	1.97	36	.60	7.20	
7	700	.7	27.56	2.30	42	.70	8.40	
8	800	.8	31.50	2.63	48	.80	9.60	
9	900	.9	35.43	2.95	54	.90	10.80	
10	1000	1.0	39.37	3.28	60	1.0	12.00	
20	2000	2.0	78.74.	6.56	120	2.0	24.00	

30	3000	3.0	118.11	9.84	180	3.0	36.00	
40	4000	4.0	157.48	13.12	240	4.0	48.00	
50	5000	5.0	196.85	16.40	300	5.0	60.00	Maximum length of single run of this type of LED strip
65*	6500	6.5	255.91	21.32	480	6.65	79.76	Maximum length of multiple home runs of this type of LED

 ***Note**: Typical strips of 5 meters cannot be extended because they lack the internal current handling capacity to add additional load to their back end. The alternative here to support longer than 5 meter strips is to run a separate "home run" connection from each 5 meter strip back to the power connector on the ILC-400x, provided the total current requirement of the LED load is less than or equal to the rated capacity of the ILC-400x controller.
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3.0   This is a power requirements chart for standard 5-wire RGBW Enhanced Brightness (EB) LEDs

WIP

4.0   This is a power requirements chart for standard 5-wire RGBW Standard Brightness (EB) LEDs

WIP

5.0   This is a power requirements chart for standard 2-wire Monochrome Enhanced Brightness (EB) LEDs

WIP

6.0   This is a power requirements chart for standard 2-wire Monochrome Standard Brightness (SB) LEDs

WIP

Appendix 5 Termination Options with ILC-400x

All Converging Systems CS-Bus devices utilize a derivative of a RS-485 bus. In order in insure accurate bus communication it is imperative to observe proper termination procedures especially if your connections involve longer runs or if those runs may be running across or proximate to noisy electrical conditions. The RS-485 bus also is a daisy-chain topology which does not permit spurs (or offshoots) from the main bus, unless those offshoots are shorter than 8 inches. In those situations, we have specified the Device Insertion Module (see Section 4.2 of the main document for more information). At the beginning of the RS-485 bus should be placed a 120 ohm terminating resistor on pins 3 / 4 of the CS-Bus. And similarly another 120 ohm resistor should be placed at the end of the bus. These locations shall be referred to as "Termination Locations."

Review the table below to understand those CS-Bus devices which have the option or capability of providing auto-termination, that is termination without providing for an external terminating resistor, then the use of that CS-Bus component makes system design even easier. If however, you cannot locate a terminating type device at those specified locations (i.e. beginning and end of CS-Bus), then you must resort to obtaining or simply building and installing your own terminating resistor (120 ohm resistor connected to pins 3 and 4 only of CS-Bus).

Device	Built-in Terminating Resistor Option	How invoked
ILC-400 lighting controller	Yes	Power on Sequence (see below for directions to invoke)
BSKP-2110K keypad		Jumper connected to Terminating location on back of keypad
BSKP-2020 keypad	No	
ILC-100 lighting controller	No	
e-Node	Yes	Always activated
IBT-100	No	

1. **Directions for Turning ON the Built-in Terminating Resistor on the ILC-400x**

   Activation of this feature can be performed in two ways. **Step a** below specifies a procedure available if you do not have access to the e-Node and the e-Node Pilot Application. **Step b** below is the recommended approach which requires a connected e-Node and the utilization of the e-Node Pilot Application. Choose the procedure that is appropriate for your situation.

   Note: If following **Step a** below, then it is recommended that you perform this operation *in advance of any dealer programming within the ILC-400 to insure that such dealer programming is not disturbed.*

   a. **Direct Sequence on the ILC-400x itself.**
   Remove the small plastic shroud on the ILC-400 using your finger nail in the top slot of the shroud (see Figure 1) and depress and hold the **Discovery Button** for four (**4**) complete flash cycles (i.e. LED cycles **OFF** immediately, then turns **ON** 1st time, then a **LONG OFF**, turns **ON** 2nd time, then a **LONG OFF**, then turns **ON** 3rd time, then a **LONG OFF,** then when turns **ON** 4th time, quickly release button and LED turns **OFF**). Within a few seconds the **Green** on-board LED will once again illuminate and you will have turned **ON** internal Termination.
   Note: *If you perform this operation before you have programmed the ILC-400x, the on-board LED will turn on GREEN, if you perform this operation after you have programmed the ILC-400x, the on-board LED will turn on YELLOW.*

   b. **e-Node and e-Node Pilot Programming.**
   -Discover the e-Node and the provide a unique UID to the ILC-400 (see separate instructions within the e-Node Commissioning Guide http://www.convergingsystems.com/customerportal/1000/installation.htm
   -Open the **BUS tab** and set **TERM** to **ENABLE**. See screen shot below for more information
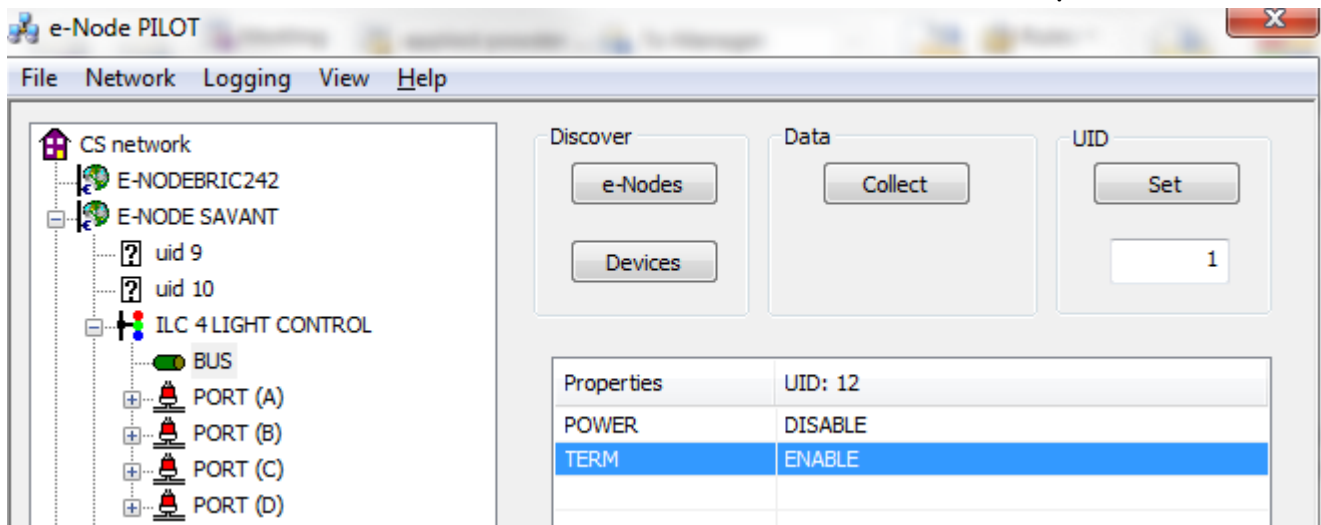
2.   **Directions for Turning OFF the Built-in Terminating Resistor on the ILC-400x**

Deactivation of this feature can be performed in two ways. **Step a** below specifies a procedure available if you do not have access to the e-Node and the e-Node Pilot Application. **Step b** below is the recommended approach which requires a connected e-Node and the utilization of the e-Node Pilot Application. Choose the procedure that is appropriate for your situation.

Note: If following **Step a** below, then it is recommended that you perform this operation *in advance of any dealer programming within the ILC-400 to insure that such dealer programming is not disturbed.*
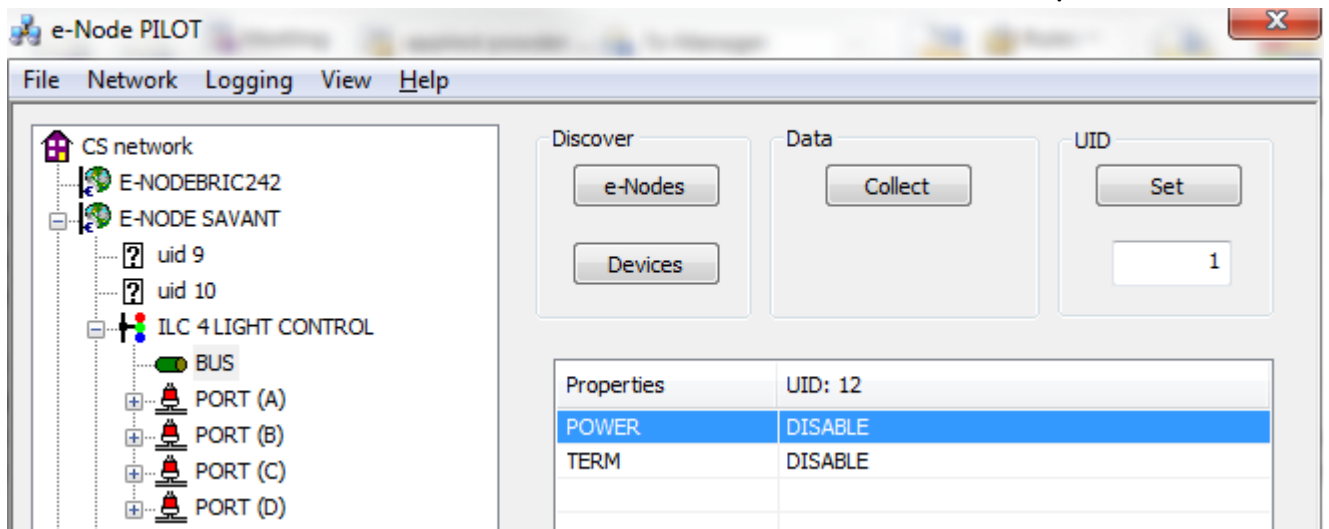
a.   **Direct Sequence on the ILC-400x itself.**
     Remove the small plastic shroud on the ILC-400 using your finger nail in the top slot of the shroud (see Figure 1) and depress and hold the **Discovery Button** for five **(5)** complete flash cycles (i.e. LED cycles **OFF** immediately, then turns **ON** 1st time, then a **LONG OFF**, turns **ON** 2nd time, then a **LONG OFF**, then turns **ON** 3rd time, then a **LONG OFF,** then turns **ON** 4th time, then a **LONG OFF** then when turns **ON** 5th time, quickly release button and LED turns **OFF**). Within a few seconds the **Green** on-board LED will once again illuminate and you will have turned **OFF** internal Termination.
     Note: *If you perform this operation before you have programmed the ILC-400x, the on-board LED will turn on GREEN, if you perform this operation after you have programmed the ILC-400x, the on-board LED will turn on YELLOW.*

b.   **e-Node and e-Node Pilot Programming.**
     -Discover the e-Node and the provide a unique UID to the ILC-400 (see separate instructions within the e-Node Commissioning Guide http://www.convergingsystems.com/customerportal/1000/installation.htm
     -Open the **BUS tab** and set **TERM** to **DISABLE**. See screen shot below for more information