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Lighting Systems

LSC

LinkLight II

MULTIPLEXER / DEMULTIPLEXER

OPERATOR MANUAL

Version 1.2

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1.0 Product Information

The LinkLight II is the second generation version of the popular Linklight Multiplexer. The LinkLight II is a bi-directional Multiplexer / deMultiplexer that may be switched to either receive Digital signals and convert them to analog levels or to receive analog levels and convert them to digital for transmission.

As a demultiplexer the LinkLight II accepts a multiplexed digital input utilising an RS485 communications link and provides 48 analog outputs of 0 Volts to + or - 10 Volts nominal (+/- 20 %). It is possible to link a number of units together to provide up to 512 analog outputs. The starting 'address' of the digital levels to be received and converted can be set between 001 and 512. Should the Digital input signal to the LinkLight II be interrupted the last signal to the dimmer racks is maintained. This feature can be switched off if need be. See section "Additional Functions" for further details.

The LinkLight II is capable of converting analog signals to multiplexed digital signals by operation of an externally accessible toggle switch. The analog input shall be 0 Volts to + / - 10 Volts DC nominal and adjustable + or - 20%. It is possible to link a number of units together to provide up to 512 multiplexed digital outputs.

The positive / negative feature is user selectable by a toggle switch accessed through the rear panel.

Standard communication modes available are DMX512 and AVAB protocols.

The LinkLight II has male and female 'XLR' microphone style connectors located on the front panel to receive and transmit the digital multiplexed signal and to interlink with other Linklights. Four DB15 type connectors either input or output the analog levels. Three thumbwheel address switches, for setting the start address in receive mode, are also located on the front panel. Valid address range is 001 to 512. Three test modes are available. The test mode is entered by setting the hundreds address switch to 7, 8 or 9 to select the desired address. See section "Test Mode" for more details.

This new model of Linklight replaces the old version fully. Some changes have occurred in the power supply and mechanical layout of the unit but the core functions are the same. Users of the older system will be instantly familiar with its operation. However, please refer to this manual for an explanation of the test functions and how to use them.

A brief listing of the test functions is printed on the rear of the unit.

2.0 Technical Specifications

Analog Input	0 to + or - 10 Volts DC nominal. Internally adjustable +/- 20%
Input Impedance	16K ohm
Analog Output	0 to + or - 10 Volts DC nominal. Internally adjustable +/- 20%
Output Impedance	470 ohm series resistor
Digital Input	RS485 differential (balanced) line on AXR style connector.
Digital Output	RS485 differential (balanced) line on AXR style connector.
Digital Protocol	DMX512 or AVAB. AVAB at various standard baud rates. 250K, 153.6K 38.4K, 19.2K, 9600, 4800, 2400 Baud
Address Range	001 to 512
Test Modes	3 different tests available when in receive mode. The test only affects the analog outputs.
Power Consumption	20 Watts
Input Supply	120 / 240V AC selectable with voltage selector inside the fuse drawer of the IEC inlet.
Dimensions	480 mm x 175 mm x 44 mm (W x D x H). 1 R.U.
Weight	3 Kg

3.0 Using The LinkLight II

3.1 Front Panel & Indicators

Figure 1

As can be seen from the diagram, the front panel consists of (from left to right) four DB15 analog input / output connectors. For the pinouts of these connectors see section titled "Analog Connector Pinouts".

Next along are the status LEDs. From left they are:

Receive Mode: A yellow LED which glows when the unit is switched to receive Digital Data

Negative: A yellow LED which glows when the unit is set to process negative analog levels.

Transmit Data: This Green LED glows when the unit is transmitting digital data

Receive Data: This Green LED glows when the unit is receiving digital data.

Data Error: This Red LED glows when the unit is receiving data and an error occurs in the data stream.

Valid Data: This green LED has three states.

- If the LED is off then the unit is not receiving valid data.
- Flashing indicates that the unit is receiving data but the address is out of range.
- If the LED stays on then the unit is receiving data in the range of the address setting.
  e.g. If the unit is receiving 200 channels of data and the address is set to 210 then the led will flash. If the address is set to 110 then the led will be on.

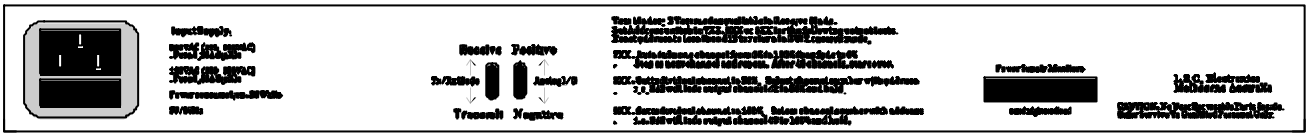
Test Mode Active: This Red LED glows when the unit is running one of the three available system tests.

Next across is the "Address Set" switch. This is used to set the first channel receive or transmit address. e.g. If this was set to 151 then analog output channel 1 will respond to input data channel 151. Data channel 152 will drive analog channel 2 and so on. The address switch is also used to drop into test mode. By setting the address to 7XX, 8XX or 9XX, the Linklight II will drop into test mode and start to execute the selected test. See section titled "Test Mode" for further details.

Next in line are the digital data input / output connectors. These are XLR style connectors connected together pin to pin. When in transmit mode, digital data originates from the internal electronics and is present on both connectors but by convention only connect to the female connector. The end of the line should always be a female connector. Conversely connect to the male connector when sending data to the Linklight. In this case the female connector will allow a 'daisy chain' connection to the next device.

3.2 Rear Panel

Figure 2



The rear panel from left to right has the following:

An IEC power supply inlet connector with integral fuse holder and voltage selector. This is for connection to the local mains to power the unit. If your local supply is 220-240V AC then ensure the voltage selector is set to 240.
If the local supply is 100-120V AC then ensure the selector is set to 120. To change the setting of the selector, remove the fuse drawer (use your finger nails). Remove the insert with the metal tongue on it and turn it 180 degrees. re-insert the selector and note that the labelling on the front has changed to read the correct value. Put the fuse back in the holder and re-insert the fuse drawer. It will only go in one way as it is polarised.

Note: All units are shipped set to 240V AC operation.

Next along the rear panel are the mode select switches. First up is Tx/Rx setting. Using a small screw driver to get to the switch, push it up to set Receive mode (Digital to analog) or down to set Transmit mode (analog to Digital). The unit will need to be turned off and back on (RESET) to change modes.

The next switch is the analog output polarity select. Push it up to set positive (0V to +10V DC) or down to select negative (0V to -10V DC). The unit does not need to be reset to effect this change.

At the right hand end of the unit are 5 recessed Red LEDs which reflect the status of the internal power supplies. There are 5 internal power supplies and a LED glowing for each indicates that the supply is operating. Should the unit fail to function, check that all the LEDs are on (not flickering or excessively bright or dim). If not then refer service to LSC technicians or our authorised agents.

4.0 Digital to Analog Conversion

Digital to Analog conversion is more commonly referred to as demultiplexing. The digital data line has the channels information multiplexed into it. Channel 1 comes first, then channel 2 then channel 3 and so on. A unit running as a demultiplexer will pick out the relevant channel information and produce analog levels on the output. To convert a digital data stream (DMX512 or AVAB) into analog levels, the LinkLight II must be set to Receive mode. Flick the Transmit/receive switch on the rear panel UP to set receive mode. Reset the unit by turning off then on at the mains, and note the status of the front panel LEDs. You will need to establish whether your dimmers (or scrollers or whatever you are connecting this unit to) is positive or negative polarity. Set the appropriate switch setting with the polarity switch and note that the front panel LED reflects the correct status.

Next set the address to 001. Channel 1 of the analog will now be controlled by channel 1 in the digital data stream. The output channels are sequential so if the address is set to 001 then the 48 analog outputs will be controlled by the first 48 channels of the digital data stream. The address can be set to anything in the range 001 to 512. So multiple units can be connected together to form a large D to A system. For example if you need to demultiplex 144 channels in sequential order, set the first unit to 001, the second unit to 049 and the last unit to 097. There is no restriction about the order of addressing of each unit. So for example the first unit could be set to 049, the second to 001 and the last to 097. Or any other combination.

Also you may have multiple units addressed to the same value e.g. 012. In this case, analog channel 1 of all units will be controlled by channel 12 of the digital data stream. This can be helpful for driving lots of lights/dimmers off of a small desk.

Also the address of units may overlap. e.g. the first unit may be set to 002, the second to 030 and the third set to 220. These are all valid settings.

With digital data being sent to the unit, the 'Receive Data' LED should glow.

5.0 Analog to Digital Conversion

As Digital to Analog conversion is demultiplexing, Analog to Digital conversion is known as multiplexing. It is the ordering or channel level information onto a single wire so that channel one comes first, then channel 2 then 3 and so on. For analog to digital conversion in the LinkLight II, set the Tx/Rx switch to Transmit and reset the unit. Set the polarity switch of the unit to the correct polarity so as to match the control console. Note that the front panel LEDs reflect these settings. Set the address to 001 and the unit should send digital information out the data connectors. The 'Transmit Data' LED should glow and the unit start to convert channels. Note that the address setting must be set to 001 for the unit to work, unless the unit is running as a co-transmitter with a second LinkLight. See the next section for more details.

5.1 Connecting Multiple Units Together

A single LinkLight II will convert 48 analog channels to a 48 channel digital data stream. However, if the need arises to convert more than 48 channels then the LinkLight can do the job. A second unit can be connected into the first by simply connecting their digital data lines together. That is, the output of the first unit (Data Out) connects to the input (Data In) of the second. The Data Out of the second unit can then be run off the dimmers or whatever the digital signal is controlling. The address of the first unit *must* be set to 001. The address of the second unit *must* be set to 049. If a third or fourth unit needs to be connected, the data output of one unit feeds the next Data Input and the addresses *must* increment in steps of 48. (001, 049 ,097, 145, 193.....).
In this case both the 'Transmit Data' and 'Receive Data' LEDs will glow on all units.

6.0 Additional Functions

In addition to the multiplexing / demultiplexing functions of the LinkLight II, the unit can also perform a few more functions.

Test Mode: Three tests are available to test analog output / dimmer circuits. See section 'Test Mode' for more details.

Different Data Speeds: The Linklight II will send or receive its digital information at varying baud rates and protocols as required.

Data Lost: Two modes are available here. In mode 1 if the Incoming Digital data is lost the Linklight II will retain the last received data indefinitely (until power is removed or more digital data is received).
In mode 2 the analog outputs will drop to 0 Volts after 1 second if the digital data is lost. This is helpful where the Linklight is used to control units like motor drives. If data is lost the motor will stop.

6.1 Digital Data Speed and Protocol Options

The standard protocols used in the lighting industry are DMX512 and to a lesser degree AVAB. The LinkLight II supports both but is factory set to DMX512. To change the setting between DMX512 and AVAB it is necessary to change some switch settings inside the unit on the circuit board. Remove power to the unit and remove the cover. On the circuit board there is a 4 way DIP type switch and an 8 way DIP switch. The 4 way DIP switch sets the mode and the 8 way switch sets the Data speed or Baud rate. See table below for setting details.

Protocol and Speed	**DIP4 switches 1-4**	**DIP 8 switches 1 -8**
DMX512 250Kbps	off , * , * , *	on , off , on , off , off ,off , off , off
AVAB 153.6Kbps	on , * , * , *	off , off , off , on , off , off , off , off
AVAB 38.4Kbps	on , * , * , *	off , on , off , off , off , on , off , off
AVAB 19.2Kbps	on , * , * , *	off , on , off , off , on , off , off , off
AVAB 9600bps	on , * , * , *	off , on , off , off , off , off , off , on
AVAB 2400bps	on , * , * , *	off , on , off , off , off , off , on , off

* denotes has no effect on speed.

Reset the unit (power off then on) after changing these settings.

6.2 Data Lost Settings

As mentioned above the LinkLight II will either hold the lost data indefinitely or clear all outputs after 1 second depending on the setup.

To hold the data indefinitely set DIP switch 4, switch 2 to off.
To clear outputs after data lost set DIP switch 4 Switch 2 on.

7.0 Test Mode

The LinkLight II has three built in test modes. They are only available when in receive mode and so will only drive the analog outputs (either polarity). By setting the address switch anywhere between 700 and 999 i.e. 7XX, 8XX or 9XX, the LinkLight II will drop into test mode. The LED 'Test Mode Active' will glow when the unit is executing tests.

The different test are outlined below but they are also printed on the rear panel of the LinkLight II.

Test 1: AutoFade one channel from 0 to 100% then back to 0. Step to the next channel and repeat. After 48 channels, start over again. This is a timed fade of about 2 seconds from 0 to 100% to 0. Valid address settings are 700 to 799. That is, this function is activated whenever the address setting is between 700 and 799 inclusive.

Test 2: Set individual channel level to 50%. The selected channel as set by the tens and units address switch, will be faded up to 50% in about 1 second and hold. When a new channel is addressed the old channel will snap off and the new one fade in to 50% over 1 second and hold. Valid address settings are 801 to 848.

Test 3: Same as Test 2 but the selected output will fade up to 100% over 2 seconds and hold. Valid address settings are 901 to 948.

To exit test mode simply set the address switches to between 000 and 512. The 'Test Mode Active' LED will go out.

8.0 Appendix 1: DMX512 DIGITAL DATA TRANSMISSION

1.0 SCOPE

This Standard describes a method of digital data transmission between controllers and dimmers. It covers electrical characteristics, data format, data protocol, connector type, and cable type.

2.0 APPLICABILITY

This standard is intended as a guide for:

1. Equipment manufacturers and system specifiers who wish to integrate systems of dimmers and controllers made by different manufacturers.

2. Equipment manufacturers seeking to adopt a basic controller-dimmer digital transmission protocol.

Although widespread adoption of this standard is sought by USITT, compliance with the standard is strictly voluntary. Furthermore, it is not intended as a replacement for existing protocols already manufactured, but rather as an addition to existing protocols which will broaden the installed base of controllers and dimmers that can communicate with each other.

3.0 CROSS REFERENCE

See EIA standards EIA-422A and EIA-485 available from:

Electronic Industries Association
Standards Sales Office
2001 Eye Street NW
Washington DC 20006
Ph. 202-457-4900

4.0 ELECTRICAL SPECIFICATIONS

The standard shall follow EIA Standards EIA-485 (an enhanced version of EIA-422A) with regard to all electrical characteristics including line driver and receiver selection, line loading, and multi-drop configurations.

4.1 COMMON MODE VOLTAGES

Equipment designers are advised to pay particular attention to the Common Mode voltage provision of EIA-485 in the choice of transmitter and receiver components and general system implementation.

4.2 ELECTRICAL ISOLATION

This Standard and EIA-485 make no general provisions for electrical isolation. However, suitable optical isolation, transformer isolation, or other means may be employed to prevent the undesirable propagation of voltages which exceed the Common Mode limits of EIA-485. The inclusion of such general isolation does not, however, alter the requirement that a transmitter or receiver conform to EIA-485.

5.0 DATA PROTOCOL

Data transmitted shall be in asynchronous serial format. Dimmer level data shall be transmitted sequentially beginning with dimmer 1 and ending with the last implemented dimmer, up to a maximum of 512. Prior to the first level transmitted, a RESET signal shall be transmitted followed by a NULL START code. Valid dimmer levels shall be 0 to

255 decimal (00 to FF hexadecimal) representing dimmer control input levels of OFF to FULL in a linear relationship. These numeric values shall not necessarily have any relationship to actual dimmer output, which shall be determined within the dimmer itself.

5.1 RESET SIGNAL

The RESET signal (Timing Diagram Designation #1) shall consist of a BREAK lasting 88 µSeconds (two frame times) or any longer duration. A BREAK shall be defined as a high-to-low transition followed by a low of at least 88 µ Seconds. All dimmers and other receiving devices shall interpret any such BREAK as a terminator for any pending transmission/data packet and its end as the start of the MARK AFTER BREAK and START code sequence at the beginning of the next packet.

5.1.1 Mark After Break

The duration of the MARK that separates the RESET/BREAK and the START code (Timing Diagram Designation #2) shall be not less than 8 µSeconds nor greater than 1 Second. All DMX512/1990 transmitters shall produce a MARK AFTER BREAK of not less than 8 µSeconds. All receivers shall recognise a MARK AFTER BREAK of minimum 8 µ Seconds. receivers also capable of recognising the shorter 4 µSeconds MARK AFTER BREAK specified in the 1986 DMX512 specification and produced by some transmitters in the field may be so identified and marked as per Paragraph 11.0

5.2 NULL START CODE

The NULL START code shall be defined as a properly framed NULL character (all zeros) following a RESET. The NULL START code is the data packet identifier which identifies subsequent data as sequential dimmer level information.

5.3 OTHER OPTIONAL START CODES

In order to provide for future expansion and flexibility in controlling devices other than dimmers, this standard makes provision for 255 additional START codes (1 through 255 decimal, 01 through FF hexadecimal). For this reason, a dimmer receiver must not accept as 8-bit level data, any data packet with a START code other than a NULL START following the RESET.

5.4 MAXIMUM NUMBER OF DIMMERS

Each data link shall support up to 512 dimmers. Multiple links shall be used where larger numbers of dimmers are required.

5.5 MINIMUM NUMBER OF DIMMERS

There shall be no minimum number of dimmers on the data link. DMX512 data packets with levels for less than 512 dimmers may be transmitted, provided that the conditions of this Standard, including Paragraphs 5.0 and 5.0.8 are observed.

5.6 DEFINED LINE BETWEEN FRAMES

The time between any two frames of a data packet (Timing Diagram Designation #8) may vary between 0 µSeconds and 1 Second. The line must remain in the "marking" state during any such idle period greater than 0 µSeconds. A receiver must be capable of accepting a data packet having no idle time (0 µSeconds) between any of its frames.

5.7 DEFINED LINE STATE BETWEEN DATA PACKETS

Regardless of START code or length, every data packet transmitted on the data link must begin with a RESET, MARK AFTER BREAK and START code sequence as defined above. The time between the second stop bit of the last data byte/frame of one data packet and the falling edge of the beginning of the RESET for the next data packet (Timing Diagram Designation #9) may vary between 0 µSeconds and 1 Second. The line must remain in an idle

("marking") state throughout any such period greater than 0 µSeconds. Transmitters, therefore, may not produce multiple BREAKs between data packets. Receivers must, however, be capable of recovering from multiple BREAKs produced by data line errors.

5.8 MINIMUM BREAK SPACING

The period between the falling edge at the start of any one BREAK shall be not less than 1196 µSeconds from the falling edge at the start of the next BREAK.

6.0 DATA FORMAT

The data transmission format for each level transmitted shall be as follows:

BIT POSITION	**DESCRIPTION**
1	Start Bit, Low or SPACE
2 -9	Dimmer level Data Bits, Least Significant Bit to Most Significant Bit, Positive Logic.
10,11	Stop bits. High or MARK
parity	Not transmitted

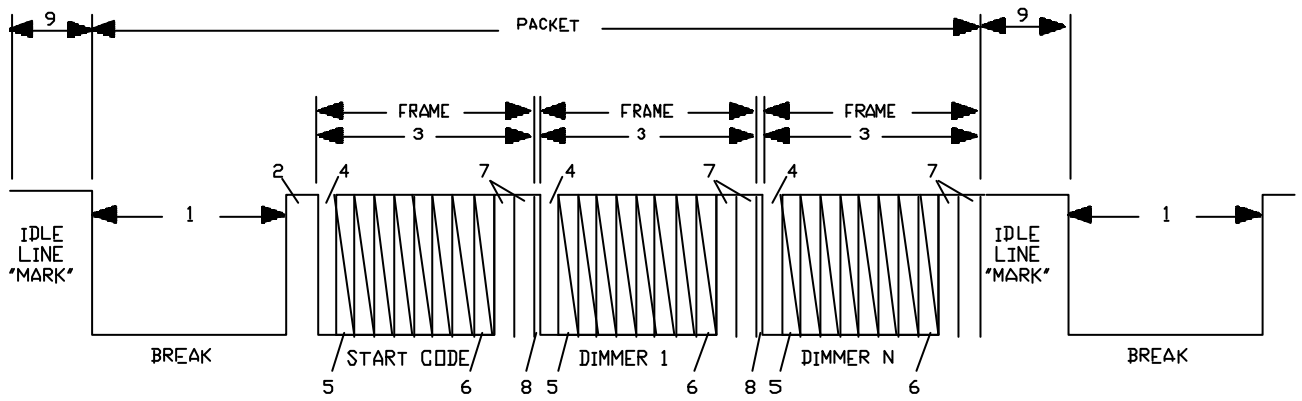
7.0 DATA RATE

The data rate and associated timing shall be as follows:

Data Rate:	250 Kilobits per second
Bit time:	4.0 microseconds
Frame time:	44.0 microseconds
Maximum update:	22.71 milliseconds
Rate for 512 dimmers including RESET and START	4.03 times per second

7.1 TIMING DIAGRAM

Figure 41



DESIGNATION	DESCRIPTION	MIN	TYP	MAX	UNIT
1	"Space" for BREAK		88.00	88.00	µSEC
2	"Mark" between BREAK			8.00	µSEC
	and START code			1.00	SEC
3	Frame Time	43.12	44.00	44.88	µSEC
4	Start Bit	3.92	4.00	4.08	µSEC
5	Least Significant Data Bit	3.92	4.00	4.08	µSEC
6	Most Significant Data Bit	3.92	4.00	4.08	µSEC
7	Stop Bit	3.92	4.00	4.08	µSEC
8	"Mark" Time between Frames	0.00	0.00	1.00	SEC
9	"Mark" Time between Packets	0.00		1.00	SEC

8.0 LOSS OF DATA TOLERANCE

The receiving device must maintain, for a minimum of 1 Second, the last valid level received for each connected dimmer. Designers of transmitters are reminded that a low number of dimmer level (START CODE 00) updates may be interpreted by a receiver as loss of data.

8.1 RECEIVER DATA RATE TOLERANCE

DMX512/1990 is intended to make possible the interconnection of lighting control equipment by different manufacturers. It does not specify the minimum performance levels of connected equipment, either in terms of the number of updates per second produced by a transmitter, or by requiring that all level updates on the data link be used by receiving product.

The performance of any product incorporating a DMX512/1990 receiver must, however, not be degraded by the presence at its input of the continuous transmission of data packets containing any number of dimmer levels up to the maximum update rates specified in Section 5 Paragraph 7.0 above.

9.0 CONNECTORS

Where connectors are used, the data link shall utilise 5-pin "XLR" style microphone connectors. Some manufacturers of this connector are:

Switchcraft
ITT Cannon
Neutrik

9.1 CONNECTOR SEX

Female connectors shall be utilised on controllers or other transmitting devices and male connectors shall be utilised on dimmers and other receiving devices. In cases where an optional second data link is implemented using the spare pins of the connector for directional transmission, female connectors shall still be utilised on the controller.

9.2 CONNECTOR PIN DESIGNATION

Connector Pin Designations shall be as follows:

PIN 1 - Signal Common (Shield)
PIN 2 - Dimmer Drive Complement (Data 1 -)
PIN 3 - Dimmer Drive True (Data 1 +)
PIN 4 - Optional Second Data Link Complement (Data 2 -)
PIN 5 - Optional Second Data Link True (Data 2 +)

10.0 CABLE

Cable shall be shielded twisted pair approved for EIA-422/EIA-485 use. Examples of suitable cable are:

- Belden 9841
- Alpha 5271 (one pair, no spares provided)
- Belden 9842
- Alpha 5272 (two pairs, one as a spare)

11.0 MARKING AND IDENTIFICATION

Equipment conforming to this Standard may be marked "USITT DMX512/1990" or DMX512/1990".

Only receivers capable of accepting a 4 μSecond MARK AFTER BREAK may be marked and identified as "USITT DMX512/1990 (4 μSec)" or "DMX512/1990 (4 μSec)".

Compliance with this Standard is the responsibility of the manufacturer, and such marking and identification does not constitute certification or approval by the USITT.

9.0 Appendix 2: Analog Connector Pinouts

Connector # 1

Channel Number #	DB15 Pin Number
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12

Connector # 2

Channel Number #	DB15 Pin Number
13	1
14	2
15	3
16	4
17	5
18	6
19	7
20	8
21	9
22	10
23	11
24	12

Connector # 3

Channel Number #	DB15 Pin Number
25	1
26	2
27	3
28	4
29	5
30	6
31	7
32	8
33	9
34	10
35	11
36	12

Connector # 4

Channel Number #	DB15 Pin Number
37	1
38	2
39	3
40	4
41	5
42	6
43	7
44	8
45	9
46	10
47	11
48	12

Pins 13, 14 and 15 of each connector are at 0 Volts or Ground Potential.

10.0 Appendix 3: Warranty

LSC Lighting Systems (Aust) Pty. Ltd. warrants each unit it manufacturers to be free from defects in material and workmanship under normal use and service.