



# **LX23214IDB**

## **Evaluation Board**

### **User Guide**

**Revision 0.2**

#### **Reference Documents**

- LX23214IDB - 4 Channel EDGE-Lit LED Display Driver with 2 Independent DC/DC PSU Controllers, cat. no. DS\_LX23214
- AN 194 – Designing an EDGE-Lit LED BackLight System Based LX23214, cat. no. 06-0130-80



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## 1 About this Guide

This document provides a description and operation procedures for Microsemi's LX23214IDB Evaluation Board.

### 1.1 Audience

This document is intended for qualified personnel, meaning operators and technicians who have a background in electronics and are familiar with its basic concepts.

### 1.2 Organization

This guide is divided into the following sections:

- Chapter 1 **About this Guide:** Describes the objectives, audience, and organization of this guide.
- Chapter 2 **Introduction:** Describes the Evaluation Board main functions and features, and the system architecture.
- Chapter 3 **Physical Description:** Provides explanation about the connectors, indicators and test points.
- Chapter 4 **Hardware Configuration:** Provides options for hardware configuration.
- Chapter 5 **Installation:** Describes installation procedure for the System Board.
- Chapter 6 **Troubleshooting:** Provides a guide for troubleshooting.

### 1.3 Abbreviations

- PWM: Pulse Width Modulation
- $V_{DC/DC}$ : DC/DC output voltage
- $V_{in}$ : Input Voltage

## 2 Introduction

Microsemi's Evaluation Board (see Figure 1) provides designers with a platform to evaluate the performance and implementation of LX23214IDB EDGE-Lit LED Display Driver.

All necessary steps and connection instructions required to install and operate this board are provided within this document.

Backlight Demo System enables Back Light LCD designers to evaluate Microsemi's driver EDGE-Lit solution with maximum flexibility and ease in configuration.

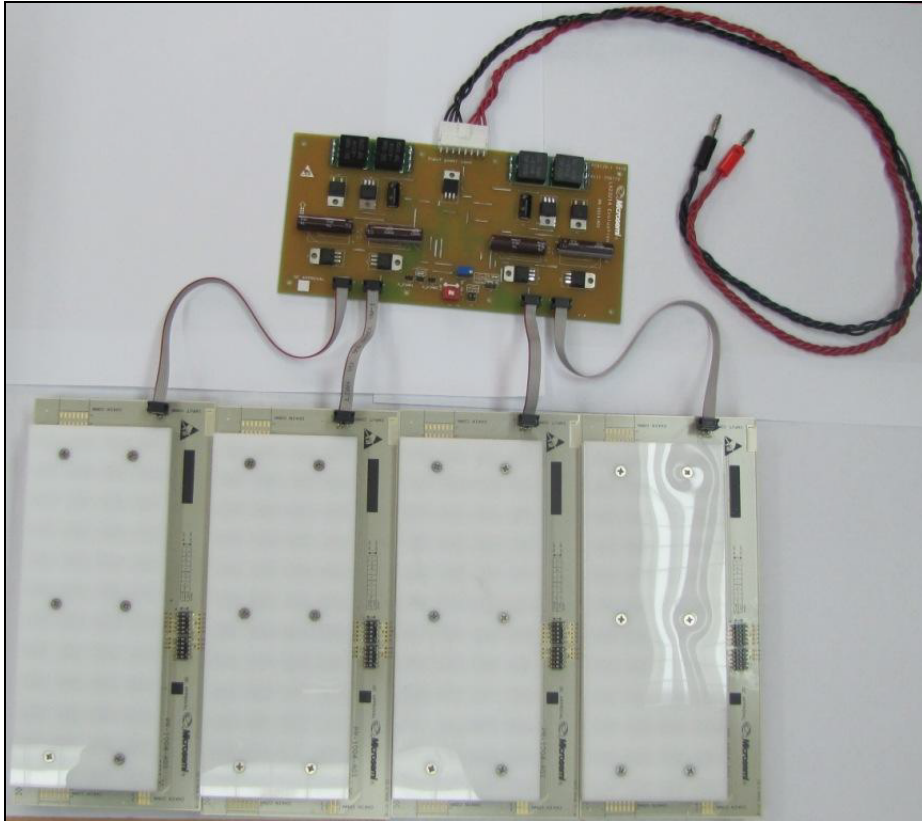


Figure 1: LX23214IDB Evaluation Board – General View

### 2.1 EVB Features

- LX23214IDB supports four LED strings
- Analog/Digital dimming input
- Minimum duty cycle 1%@120Hz
- Per string voltage monitoring for failure events detection
- Controls two DC/DCs
- LED driver inherent thermal protection
- System input voltage and output voltage monitoring
- 250mA/string
- 120V output voltage
- 140KHz DC/DC switching frequency
- RoHS compliant

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### 2.2 System Architecture

Figure 2 depicts block diagram of LX23214IDB Evaluation Board.

A single LX23214IDB LED Driver controls two DC/DCs and four LED strings.

According to host's configuration the driver can be provided with digital or analog dimming information.

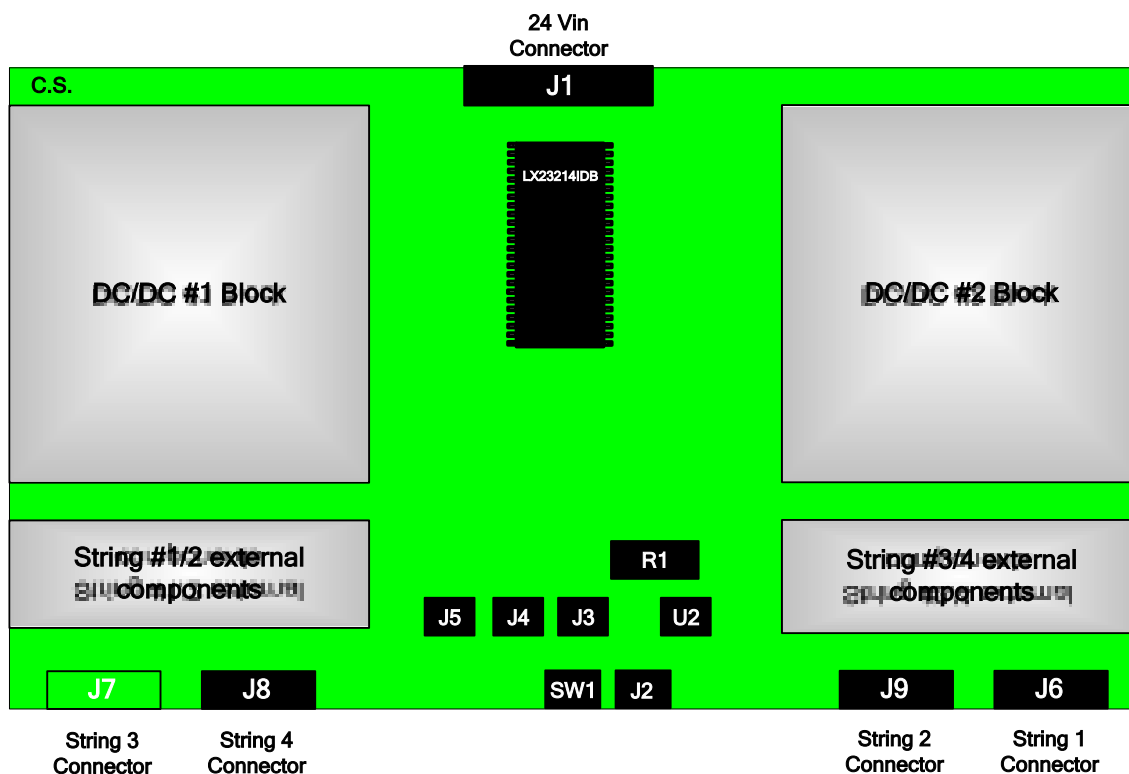


Figure 2: System Architecture – Block Diagram

### 2.3 Interfaces and Connections

The board has several interfaces:

- **LEDs:** A connection between LED strings and the LED driver output terminals. Connection is made through dedicated connectors (J6, J7, J8, J9).
- **Host:** A host can power system on/off using a switch (SW1), insert a PWM information via connectors J5 and J3 in digital dimming mode, or via J2 connector in analog dimming mode.
- **Power Supply:** 24V input, fed by an external power supply (J1).



### 3 Physical Description

The following sections describe board's connectors, test points and switches.

#### 3.1 Connectors

Table 1 lists board's connectors.

**Table 1: Evaluation Board's Connectors**

Connector	Name	Description
J6, J7, J8, J9	LED strings connectors	Connect LED strings to LED driver. Each connector has 6 pins, for LED string and for $V_{DC/DC}$ .
J1	Power	An 8 pin connector; for $V_{in}$ and AGND.
J3,J5	Host	2 pin connectors; for two independet digital PWM input information
J2	Host	A 4 pin connector; for analog PWM input information

##### 3.1.1 LED Strings Connectors J6, J7, J8, J9

Table 2 lists the two dedicated LED connectors that connect to Microsemi LED demo panel (PR-1004-A01).

**Table 2: LED Strings Connectors Table – Pin Description**

Connector	Pin No.	Signal Name	Description
J6	1	$V_{DC/DC1}$	DC/DC1 output voltage to LED string anode
	2	$V_{DC/DC1}$	DC/DC1 output voltage to LED string anode
	3	VD1	LED string 1 cathode return path
	4	N.C.	Not connected
	5	N.C.	Not connected
	6	N.C.	Not connected
J7	1	$V_{DC/DC2}$	DC/DC2 output voltage to LED string anode
	2	$V_{DC/DC2}$	DC/DC2 output voltage to LED string anode
	3	VD3	LED string 3 cathode return path
	4	N.C.	Not connected
	5	N.C.	Not connected
	6	N.C.	Not connected
J8	1	$V_{DC/DC2}$	DC/DC2 output voltage to LED string anode
	2	$V_{DC/DC2}$	DC/DC2 output voltage to LED string anode
	3	VD4	LED string 4 cathode return path
	4	N.C.	Not connected
	5	N.C.	Not connected
	6	N.C.	Not connected
J9	1	$V_{DC/DC1}$	DC/DC1 output voltage to LED string anode
	2	$V_{DC/DC1}$	DC/DC1 output voltage to LED string anode
	3	VD2	LED string 2 cathode return path
	4	N.C.	Not connected
	5	N.C.	Not connected
	6	N.C.	Not connected

- Manufacturer: CviLux
- Manufacture part number: CH81-062V100



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### 3.1.2 Power Connector J1

This connection supplies working voltage for the whole LED backlight platform. Connector is connected to both high power supplies and LED driver.

**Table 3: Power Connector Table – Pin Description**

Pin No.	Signal Name	Description
1, 2, 3, 4	V <sub>in</sub>	Application input voltage
5, 6, 7, 8	AGND	Ground connection for power return

- Manufacturer: CviLux
- Manufacture part number: CI5208P1H00

### 3.1.3 Host Connectors J2, J3, J5

**Table 4: Host Connectors Table – Pin Description**

Connector	Pin No.	Signal Name	Description
J2	1	ANALOG_DIM	Analog dimming input line
	2	N.A	Not applicable
	3	AGND	Ground connection for signals return
	4	AGND	Ground connection for signals return
J3	1	DIGITAL_DIM2	Digital dimming input line
	2	AGND	Ground connection for signals return
J5	1	DIGITAL_DIM1	Digital dimming input line
	2	AGND	Ground connection for signals return

- Manufacturer: CviLux
- Manufacture part number (J3,J5): CH31-021V200
- Manufacturer: Neltron
- Manufacture part number (J2): 2213S-04G-F4

## 3.2 Test Points

Table 5 describes the on-board test points and their functions.

**Table 5: On-Board Test Points**

Test Point	TPs Name	Functionality
TP1,TP2,TP8,TP9,TP10	AGND	Analog ground
TP4,TP5,TP12	PGND1	Power ground 1
TP3,TP6,TP11	PGND2	Power ground 2
TP7	PS_SYNC	Power supplies synchronization signal
TP13	EN_BLU	System on/off signal

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### 3.3 DIP Switch SW1

A switch is been utilized for ON/OFF the LED backlight system (Figure 3).

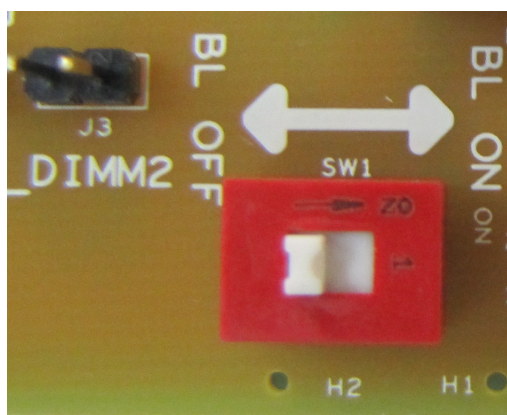


Figure 3: System On/Off Switch

### 3.4 Trimmer R1

Evaluation board contains a trimmer used for PWM duty cycle control in Analog Dimming mode (Figure 4). To use that option, system should be configured to Analog Dimming mode and INT\_A\_dimm jumper must be installed.

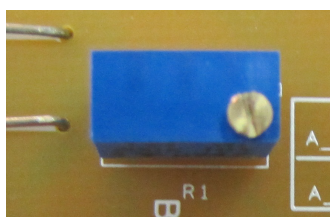


Figure 4: Trimmer – PWM Duty Cycle Control



## 4 Hardware Configuration

### 4.1 R26, R27: Fault Mode Configuration

Designers configure the required LED BackLight fault mode using these configuration resistors.

There are three fault modes:

- Latch up Fault mode – system activates FAULT signal and latches up a specific DC/DC according to the string in which fault was traced. DC/DC turns on when system receives a reset signal at EN\_BLU input or input voltage source reboot.
- Notify Fault mode – system activates FAULT signal, and DC/DC is not affected.
- Hick-up Fault mode – system activates FAULT signal then turns off a specific DC/DC, according to the string in which fault was traced, for a predefined hick-up time (defined by external resistor and capacitor on Fault pin). After turn-off time, system turns on the DC/DC, and if fault scenario is eliminated continues to operate.

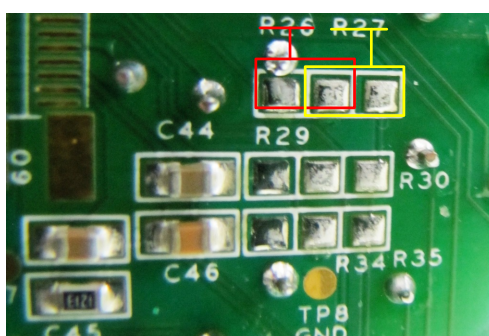


Figure 5: Fault Mode Configuration Resistors

Table 6: Fault Mode Configuration

Fault Mode configuration	Mode
R26	Latch Up Fault mode
R27	Notify Fault mode
NC	Hick-up Fault mode

**Notes:**

- Default configuration: Hick-up Fault mode

### 4.2 R29, R30: LED Staggering Mode Configuration

Designers configure the required Staggering mode using these configuration resistors. Staggering is between strings that belong to DC/DC1 and DC/DC2.

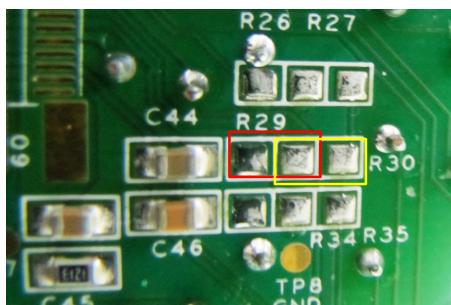


Figure 6: Staggering Mode Configuration Resistors

**Table 7: Staggering Mode Configuration**

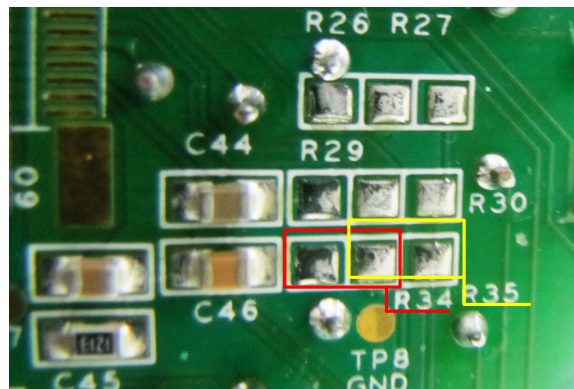
LED_STAG Configuration	Mode
R29	Short staggering (1µS)
R30	Long staggering (1/2 of LED PWM cycle)
NC	No staggering

**Notes:**

- Default configuration: No staggering mode
- LED dimming signal can be staggered in Analog Dimming mode only

**4.3 R34, R35: Dimming Mode (M0) Configuration**

Designers configure the required LED BackLight dimming mode using these configuration resistors.



**Figure 7: Dimming Mode Configuration Resistors**

There are three Dimming modes:

**Table 8**

M0 Configuration	Mode
R34	Analog "+" mode
R35	Analog "-" mode
NC	Digital Direct mode

- In Analog "+" mode, increasing analog control voltage at Analog\_DIMM input, causes LED dimming duty cycle to rise.
- In Analog "-" mode, decreasing analog control voltage at Analog\_DIMM input, causes LED dimming duty cycle to rise.
- In Digital Direct mode, LED dimming is controlled by PWM information at Digital\_DIMM1/2 input signals.

**Notes:**

- Default configuration: Digital Direct mode

#### 4.4 J4: Digital\_Dimm1+ Digital\_Dimm2 Short Jumper

Digital\_Dimm1 and Digital\_Dimm2 are two independent input digital dimming controls. Dimming information can be acquired by applying PWM information at a frequency range of 100Hz to 2KHz. LED output dimming frequency and duty cycle are same as digital dimming input. Digital\_DIMM1 signal controls LED strings 1 and 2. Digital\_DIMM2 signal controls LED strings 3 and 4.

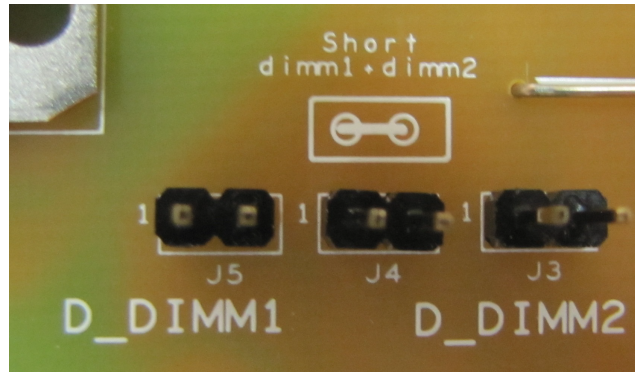


Figure 8: Digital\_Dimm1/2 Short Jumper

Designers can short Digital\_Dimm1 signal with Digital\_Dimm2 signal using J4 jumper, and use common LED PWM information for both channels.

#### 4.5 U2: Internal/External Analog Dimming Configuration

Designers have two options for providing analog dimming information:

- Install U2 jumper to Ext\_A\_dimm mode and provide analog dimming from external power supply via J2 connector.
- Install U2 jumper to Int\_A\_dimm mode and provide analog dimming with trimmer R1.

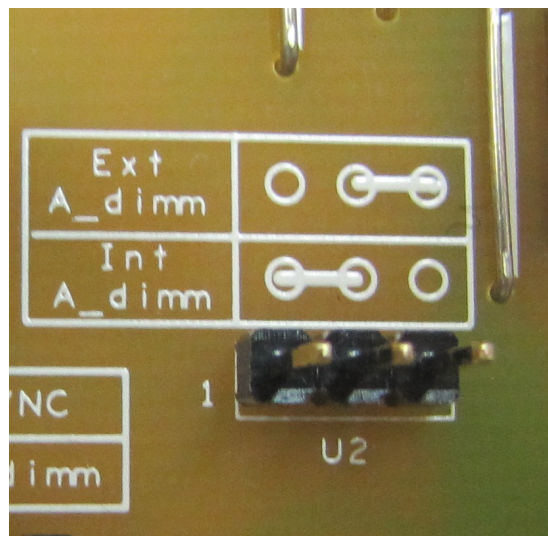


Figure 9: Internal/External Analog Dimming

## 5 Installation

The following chapter describes the steps required for installing and operating the Evaluation Board.

### 5.1 Preliminary Steps and Safety Precautions

- Connect all required peripherals prior to powering board.
- Do not perform a hot-swap!
- Verify board is properly configured prior to turning on power supply.

#### **WARNING!**

Do not look directly at the LED panel when system is operating and LED panels are illuminating.

### 5.2 LED Demo Panel Configuration

The following paragraph describes the steps required for LED panel configuration.

The panel contains 48 high-power white LEDs connected in series as one string and 10 configuration switches that bypass groups of LEDs (see Figure9). Users can configure the LED string LED count to any LED number they need.

Single LED forward voltage is 3.25V@250mA, therefore for 120V output-voltage 37 LEDs are needed.

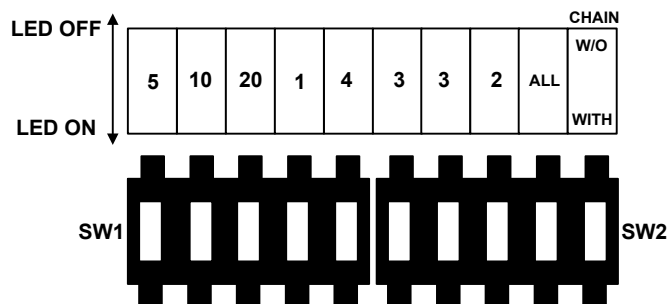


Figure 9: LED Number Configuration Switches and PCB Silk

- W/O WITH switch – LED string chaining switch. For applications with output-voltage lower than 150V this switch should be moved to W/O.
- 5, 10, 20, 1, 4, 3, 3, 2 switches – LED number configuration switches.

For example:

V <sub>LED</sub>	Total LED	SW “5”	SW “10”	SW “20”	SW “1”	SW “4”	SW “3”	SW “3”	SW “2”
63V	20	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
63V	20	ON	ON	OFF	OFF	OFF	OFF	ON	ON
120V	37	ON	ON	ON	OFF	OFF	OFF	OFF	ON

- ALL switch – LED string short circuit switch. To short circuit entire string, move switch to LED OFF. To release the short, move switch to LED ON.

#### 5.2.1 Fault simulation using the LED Demo Panel

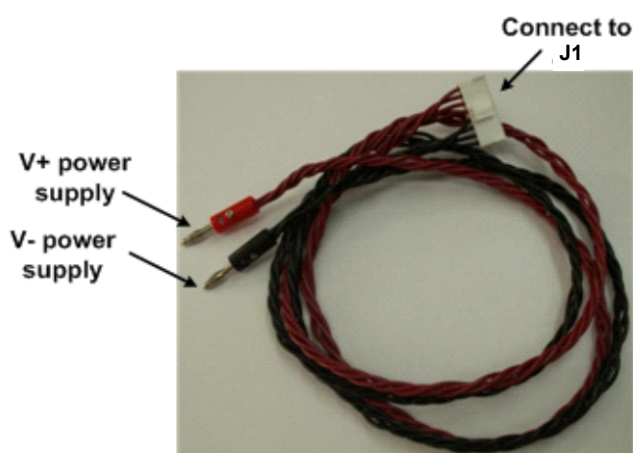
During normal system operation users can perform various fault conditions using the LED Demo panel switches.

- Open string – By moving “W/O WITH” switch to WITH
- Short entire string – By moving “ALL” switch to LED OFF
- LED short – Users should choose LED number to be shorted and move suitable switch to LED OFF.

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### 5.3 Hardware Setup

1. Set power supply to 24V output.
  - Verify its minimum current capability; power supply must provide 7A.
2. Connect the power cable to J1 connector (Figure 1010).
3. Plug the power cable connectors to the power supply.
  - Red connector is plugged in the positive output terminal.
  - Black connector is plugged in the negative output terminal.



**Figure 10: Power Cable**

4. Connect LED loads to LED Strings Connectors J6, J7, J8, and J9.
6. Turn on the 24V power supply.
7. Connect signal generator to connectors J3 and J5 during direct digital dimming mode or power supply to connector J2 during analog dimming mode.
8. Switch SW1 to BL\_ON position.
9. Evaluate the system.



## 6 Troubleshooting

Table 9 provides a troubleshooting guide. Scenarios defined in the table are simple and do not take into account human error or multiple failures. Corrective action is to be done in a sequential manner.

**Table 9: LED System Board Troubleshooting Guide**

Symptom	Corrective Action
System Board does not power up; no voltage on $V_{12V}$ (C23) and $V_{DD}$ (C44) pins	<ol style="list-style-type: none"> <li>1. Verify power is applied to the 24V cable.</li> <li>2. Verify correct polarity is supplied to Board.</li> <li>3. Check power cable at J1 is well connected.</li> </ol>
LED strings do not illuminate.	<ol style="list-style-type: none"> <li>1. Ensure a proper connection between EVB and LED panel.</li> <li>2. Verify SW1 switch is set to BL_ON.</li> <li>3. Verify dimming information is provided.</li> <li>4. Verify fuses F1 and F2 are conducting.</li> </ol>



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### Revision History:

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0.2 / 04/2011		Added paragraph "LED Demo Panel Configuration"

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