PD25012L / PD25012H

Evaluation Board

User Guide

Preliminary Version

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Reference Documents

- AN-172 - BackLight Layout Design Guidelines - High Current Application Cat. No. 06-0052-080
- AN-173 - BackLight Layout Design Guidelines - Low Current Application Cat. No. 06-0053-080
- AN-174 - 36 Strings LED BackLight High Current Application Cat. No. 06-0054-080
- AN-145 - 96 Strings LED BackLight Low Current Application Cat. No. 06-0055-080
- PD24012L LED BackLight Driver Unit Datasheet, Cat. No. 06-0062-058
- PD24012H LED BackLight Driver Unit Datasheet, Cat. No. 06-0064-058
- PD23000 LED BackLight Unit Cat. No. 06-0066-058
- GUI installation User Guide, Cat. No. 06-0037-056

The above documents can be obtained via our Customer Support. To access other documents, go to our web site at http://www.microsemi.com/ and under Tech Support\Documentation, look up for the documents.

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Chapter 1 - About this Guide

1.1 Objectives

This User Guide provides both a description and operation procedures for Microsemi's Evaluation Board PD25012L/H (PD-1609-202/1). This board is used to evaluate the performance of the PD24012L/H – an Integrated Back-Light LED driver and the PD23000 - a BackLight controller. The board's operation is performed by using a Graphic User Interface (GUI).

1.2 Audience

This User Guide is intended for qualified personnel, i.e. operators and technicians who have a background in basic concepts of electronics.

1.3 Organization

This Guide is divided into several sections as follow:

Chapter 1 **About this Guide** - Describes the objectives audience organization.

Chapter 2 **Introduction** - Describes the LED BackLight Evaluation Board (EVB) main functions, features, ordering information and system architecture.

Chapter 3 **Physical Description** – Provides explanation related to the physical description (switches, jumpers, connectors

Chapter 4 **Electrical Characteristics** - Provides electrical characteristics of the BackLight Evaluation board

Chapter 5 **Detailed Circuit Description** - Provides detailed system description, internal blocks, internal intefaces.

Chapter 6 **Installation** - Provides description of the installation process.

Chapter 7 **Troubleshooting** - Provides a list of common operational malfunctions and their solutions

1.4 Abbreviations

MCU - Micro Controller Unit

CMC - Color Manager

ESPI – Enhanced Serial Peripheral Interfaces

PWM – Pulse Width Modulation

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Chapter 2- Introduction

2.1 Overview

Microsemi's Evaluation board PD25012L/H (see Figure 1) provides the designer with the perfect environment to evaluate the performance and the implementation of high and low current LED drivers based on the PD24012L/H IC and the BackLight controller MCU PD23000.

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

The Evaluation Board allows Back-Light LCD designers to evaluate Microsemi's driver solution with maximum flexibility and ease in configuration.

Most of the PD-25012L and the PD-25012H features are similar; this document describes the PD-25012L only. In cases where there is a difference between the boards, it is clearly noted!

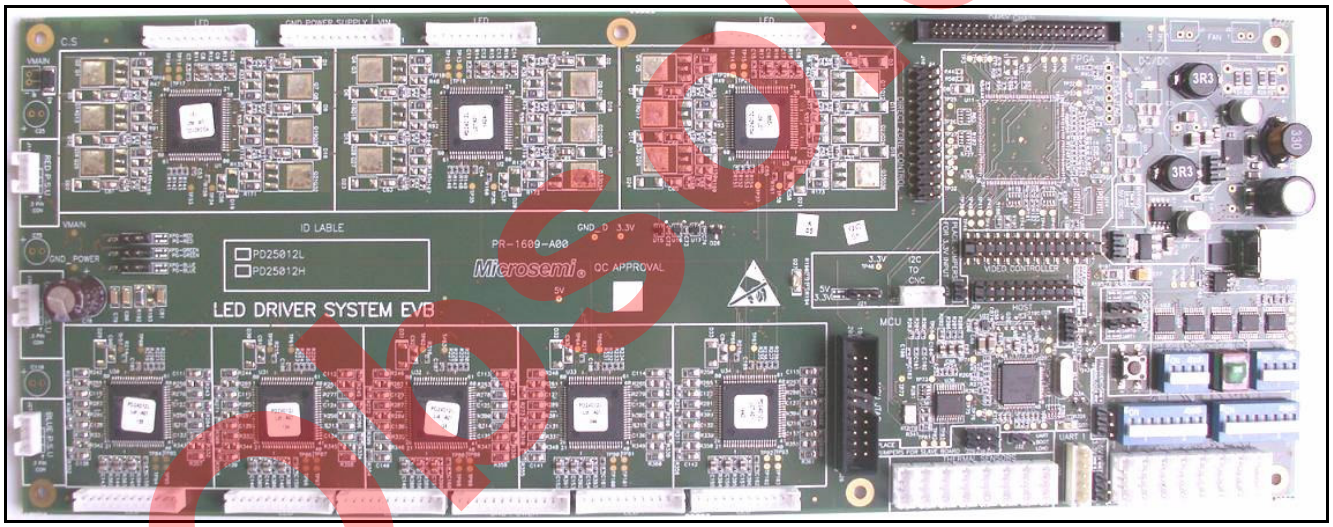

Figure 1: PD25012L/H Evaluation Board - General View

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2.2 Evaluation Boards Ordering Information

Microsemi's can provide two types (assemblies) of Evaluation Boards as shown below in the table:

Ordering number	Description
PD25012L	Eight PD24012L devices (LED drivers) with the MCU BackLight controller PD23000 operating as a low current application.
PD25012H	Three PD24012H devices (LED drivers) with the BackLight controller PD23000 operating as a high current application.

2.3 Board features

- PD25012H – three PD24012Hs high current LED drivers, up to 1.5A by external Mosfet (1.5A with port number reduction according to maximum FET junction temperature)
- PD25012L – eight PD24012Ls low current LED drivers, up to 85mA by internal Mosfet
- PD25012L/H control the RGB power supplies
- Daisy chain connection of up to three boards (a single BackLight controller PD23000 controls 9/24 PD25012L/Hs)
- On-board DC/DC 10-24Vin to 5Vout
- External host interface:
  - Communication by I^2C (slave) or UART_0
  - System control of I/O's signals
- Supports external and internal color manager (CMC)
- Supports eight external color sensors (color to voltage)
- Supports eight external thermal sensors (analog)
- Controls external fan (PWM sourced by Back-Light controller PD23000) (TBD)
- Contains on-board FPGA device for communication with video controller
- Supports UART_1 for PC and test communication
- On-board Power On Reset (POR) and Reset push-button
- Supports 'power good' signal (power good indication from the power supply)
- Clock can be generated by one of the internal clock generators, the FPGA, or by an external Host.
- UART to USB isolator for UART0 and UART1

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2.4 System Architecture

The block diagram shown in Figure 2 depicts the high and the low currnet application of the PD25012L/H Evaluation board.

A single Back-Light controller PD23000 is connected to eight LED drivers - PD24012L (three PD24012H for High current application - PD25012H) As shown in the picture the circuitis are based on a parallel connection, in which the MCU controls and monitors each of the LED drivers via a control bus, based on an enhanced serial peripheral interface (ESPI).

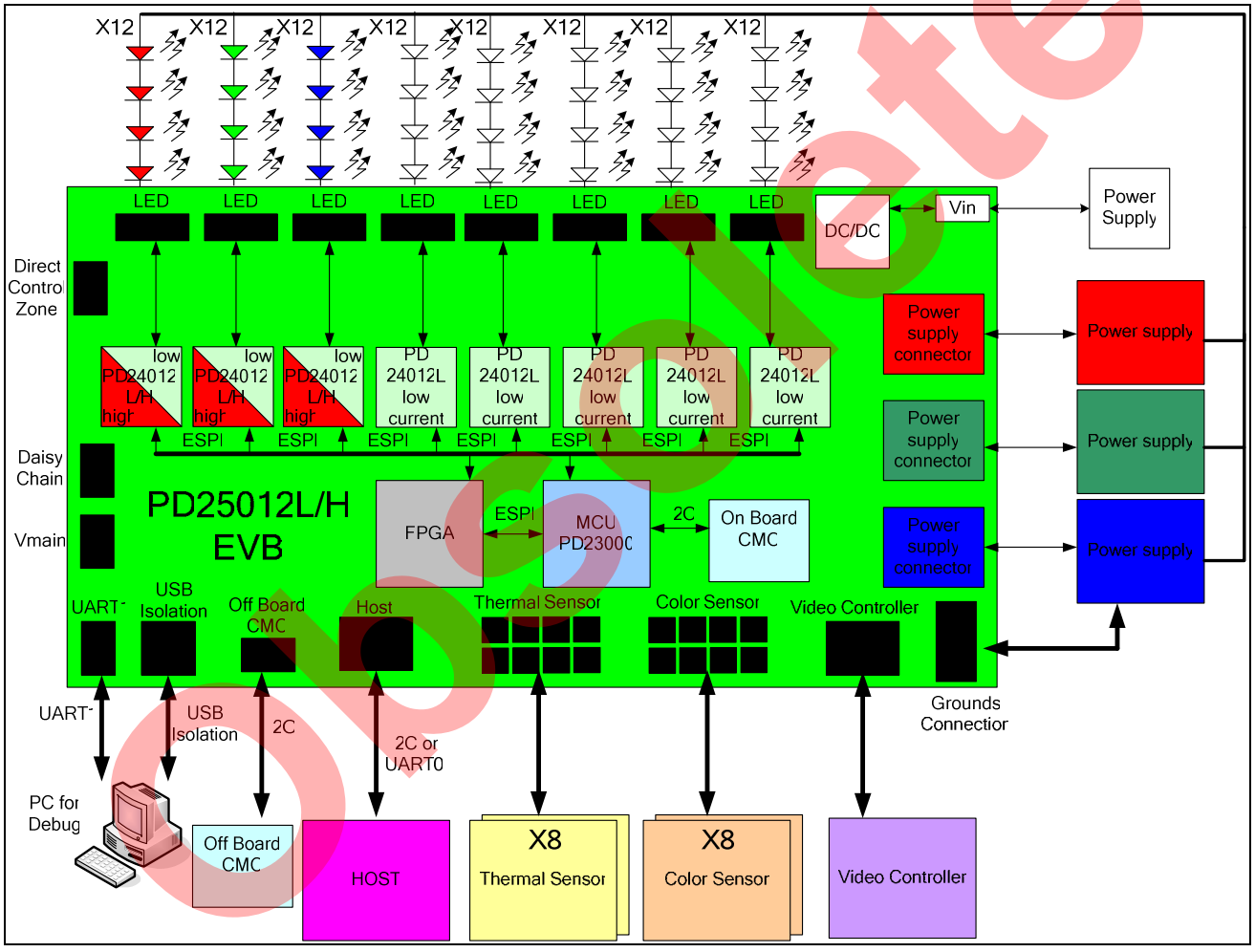

Figure 2: System Architecture - Block Diagram

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2.5 Interfaces & Connections

The board has several interfaces as follow:

1. **Host CPU** – the Host CPU can communicate with the Evaluation Board via a serial port UART0 or I^2C (J20). There are additional control and indication signals running between the Host CPU and the Back-Light controller PD23000.
2. **Power Supplies** - The power supplies' voltage are continually sampled by the MCU and can be changed using the power supply trimming (J11, J18 and J27).
3. **LEDs** - an interface (connection) between the LED strings and the LED drivers. Eight dedicated connectors (J4, J6, J7, J51, J52, J53, J55, J66) are utilized.
4. **Color sensors** - Interface between eight color sensors and the board (J34-J41).
5. **Thermal sensors** - Interface between eight thermal sensors and the board (J42-J49)
6. **UART1** – dedicated UART for PC debugger and test equipment.
7. **USB Isolation** – both UART0 and UART1 can be isolated by using the USB isolation (UART is converted to USB).
8. **Video Controller** - connection to external video controller for advanced features (J15)
9. Vin – On-board DC to DC input, fed by a dedicated external power supply (J5)
10. **Grounds connection** – R/G/B power supplies grounds. Used to close the current loop back to the power supply (J5, J54).

2.1 Physical Characteristics

The evaluation board's Physical Characteristics are described in Table 1:

Table 1: Physical Characteristics

Parameter	Value
Mechanical dimensions	320 x 136.8 x 21 mm (l x w x h)
Weight	190 g

Chapter 3- Physical Description

3.1 Package Contents

Upon opening the Evaluation Board package, verify that all parts itemized in the packing list are included. If any part is missing or seems damaged, please contact the local representative or Microsemi's Headquarters. Package contents for standard shipments are as folow:

- UART to USB drivers CD
- The latest GUI software CD

3.2 Switches & Jumpers

The evaluation board comprises switches and jumpers used to select the desired configuration states of the board. All the configuration options related to the switches and jumpers are described below:
Default configuration are indicated as 'default'.

3.2.1 Color to Analog Voltage

A single type of color sensor may be connected to the board as follows:
Color to Analog Voltage Sensor – produces an analog output signal proportional to LEDs light intensity
For easy configuration, use Table 2 and Figure 3 below:

Table 2: Selection of Sensor Type

Switch/Jumper	Future use	Color to Analog Voltage 'default'
SW6	Future use	Switched to 'Analog' position
SW5	Future use	Switched to 'Analog' position
J28	Future use	Short between pin "2" to "3"

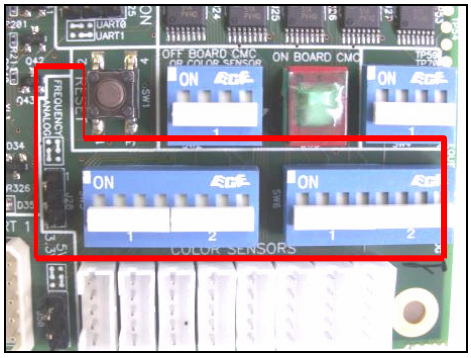

Figure 3: On-board Switches and Jumpers

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3.2.2 PD23000 as CMC Operation Switch

The board has a dedicated CMC switch used to select the desired configuration as follow:

- BackLight controller MCU PD23000 as CMC

The BackLight controller can function as a CMC (with no CMC present). To select the desired configuration use Table 3 and Figure 4:

Table 3: Selection of Desired Configuration

Switch	Future use	Future use	BackLight Controller PD23000 as CMC **'default'**
SW4	**Future use**	**Future use**	Switched to "color" position
SW2, SW3	**Future use**	**Future use**	Switched to "Off Board CMC" or "Color Sensor" position

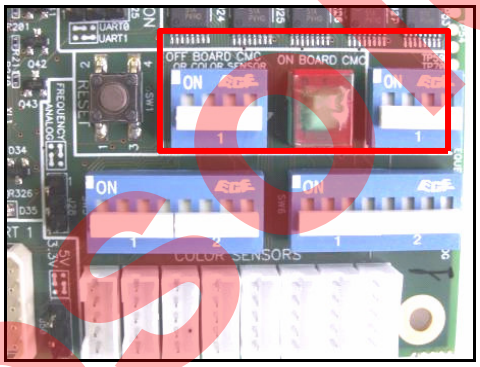

Figure 4: On-Board S4 Switch

3.2.3 UART to USB Isolation

UART to USB isolation can be performed by using the J23, J25 jumpers. The UART0 and UART1 communications are floated first and then converted to USB signals. Floating and converting can be implemented in only one communication at a time. To select the desired communication use Table 4 and Figure 5:

Table 4: Selecting the Desired Communication

Jumper	UART0 Isolated **'default'**	UART1 isolated
J23	Short between pin "1" to "2"	Short between pin "2" to "3"
J25	Short between pin "1" to "2"	Short between pin "2" to "3"

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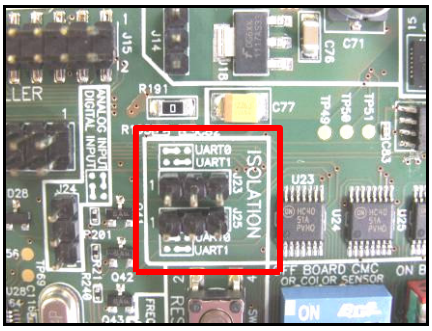

Figure 5: J23, J25.4 Jumpers

3.2.4 Color Sensors Voltages Level Jumper

Two Color sensors' level voltages are used to feed the Color sensors devices and can be selected via the J50 jumper:

- 5V feeding
- 3.3V feeding

To select the desired feeding voltage, use Table 5 and Figure 6:

Table 5: Color Sensors level Voltages Jumper

Jumper	5V Feeding	3.3V Feeding **'default'**
J50	Short between pin "1" to "2"	Short between pin "2" to "3"

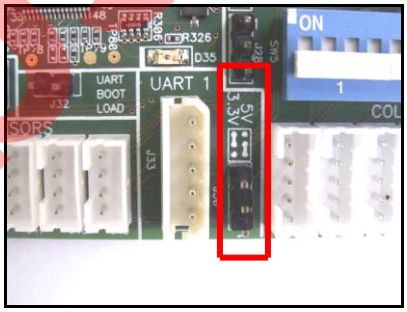

Figure 6: Color Sensors level Voltages Jumper

3.2.5 Future Use

J21 jumper connector is intended for future use

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3.2.6 Intensity Control Input Voltage Selection

A J19 jumper is used to select between voltage levels 3.3V or 5V used for intensity control.

- 5V feeding
- 3.3V feeding

To select the desired feeding use Table 6 and Figure 7:

Table 6: Intensity Control Input Voltage Selection

Jumper	5V Feeding **'default'**	3.3V Feeding
J19	No jumper	Short between pin "1" to "2"

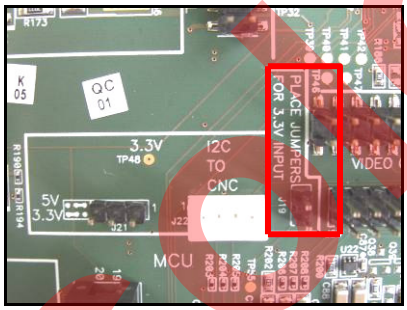

Figure 7: Intensity Control Input Voltage Selection

3.2.7 Intensity control - Analog or Digital Selection

A J24 jumper is used to select between analog or digital input for the Intensity control input voltage circuitry. To select the desired option use Table 7 and Figure 8:

Table 7: Intensity control - Analog or Digital Selection

Jumper	Digital	Analog **'default'**
J24	Short between pin "1" to "2"	Short between pin "2" to "3"

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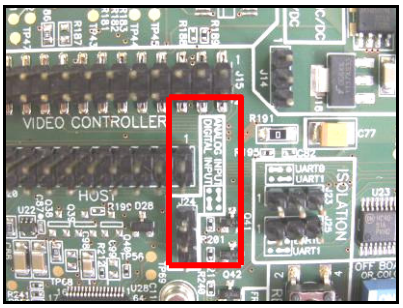

Figure 8: Intensity Control - Analog or Digital Selection

3.2.8 DC to DC Selection

J12 jumper is used to select between using the on-board DC to DC or the DC to DC bypass to feed the evaluation board. In the Bypass DC to DC option, the input voltage is also the output voltage. To select the desired option use Table 8 and Figure 9:

Table 8: DC to DC Selection

Jumper	Bypass DC to DC*	Using the on board DC to DC **'default'**
J12	Short between pin "1" to "2"	Short between pin "2" to "3"

*Verify that the board is configured (Q37,'R184, R185, R548, R549, D63, R536 removed from the board) to operate on 5V.

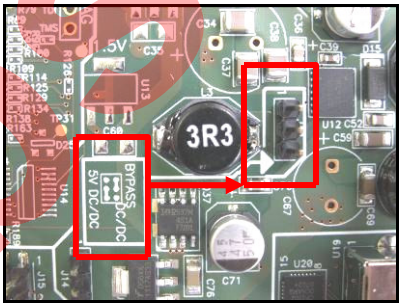

Figure 9: DC to DC Selection Jumper

3.2.9 Vsync Signal Source Jumper

A J14 jumper is used to select between two sources of the Vsync signal provided to the BackLight MCU PD23000 as follow:

- Video Controller
- On-board FPGA

To select the desired option use Table 9 and Figure 10:

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Table 9: Vsync Signal Source Jumper

Jumper	On-Board FPGA	Video Controller **'default'**
J14	Short between pin "1" to "2"	Short between pin "2" to "3"

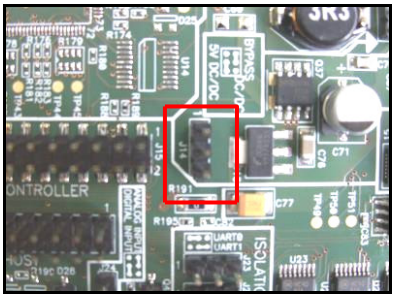

Figure 10: Vsync Signal Source Jumper

3.2.10 SLAVE Board Configuration Jumper

J29, J30, J31 jumpers are used to set the evaluation board into "Slave" configuration in order to allow three evaluation boards to be chained.

To set the "Slave" configuration use Table 10 and Figure 11:

Table 10: Setting "Slave" Configuration

Jumper	SLAVE Configuration**	MASTER Configuration **'default'**
J29	Short between pin "1" to "2"	No jumper
J30	Short between pin "1" to "2"	No jumper
J31	Short between pin "1" to "2"	No jumper

** in order to configure the board to 'slave' mode, the ESPI address resistors should be changed as specified in the PD24012L/H data sheets.

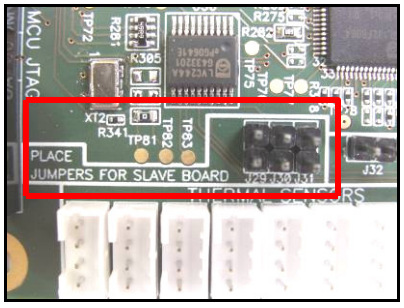

Figure 11: J29, J30, J31 Jumpers

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3.2.11 Power Good Signal Jumper

J13 J16, J17 jumpers are used to configure the usage of the PG-R/G/B and the xPG-R/G/B signals; the three Red, Blue and Green power supplies can provide 'good power supply'/'bad power supply' indications as shown in Table 12 and Figure 12.

Table 11: PG-R/G/B and xPG-R/G/B Signals

xPG-Red/Green/Blue	PG-Red/Green/Blue
"1" = power supply is not working	"0" = power supply is not working
"0" = power supply is working	"1" = power supply is working

Configure the power supplies' Indication Signals as detailed in Table 12 and Figure 12.

Table 12: Power Supplies Indication Signals Configuration

Jumper	xPG-Red/Green/Blue	PG-Red/Green/Blue	Power Supply NOT Connected * **'default'**
J13	Short between pin "1" to "2"	Short between pin "2" to "3"	Short between pin "2" to "3"
J16	Short between pin "1" to "2"	Short between pin "2" to "3"	Short between pin "2" to "3"
J17	Short between pin "1" to "2"	Short between pin "2" to "3"	Short between pin "2" to "3"

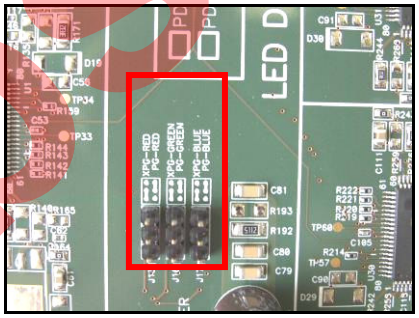

Figure 12: J13 J16, J17 Jumpers

3.2.12 Boot Load through UART Jumper

A J32 jumper is used too in cases where uploading of software to the MCU by the UART is required. Prior to uploading the software, the user should place the jumper in the "Boot load from UART" state and then reset the evaluation board. To set the 'Boot load from UART' mode use Table 13 and Figure 13.

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Table 13: Boot Load through UART Jumper

Jumper	Boot load from UART	Standard Mode **'default'**
J32	Short between pin "1" to "2"	No jumper

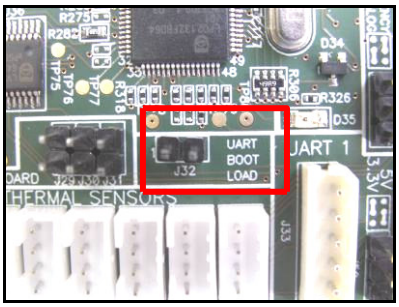

Figure 13: J32 Jumper

3.3 On-Board LED Indicators

There are several on-board LED indications as described in Table 14 and Figure 14.

Table 14: On-Board LED Indications

LED	LED's Name	Designation
D35	MCU LED Status	Indicates that the MCU system is ready
D8	FPGA LED	Optional LED connected to the FPGA for future use
D27	Power indication LED	Power indication for valid 5V on board

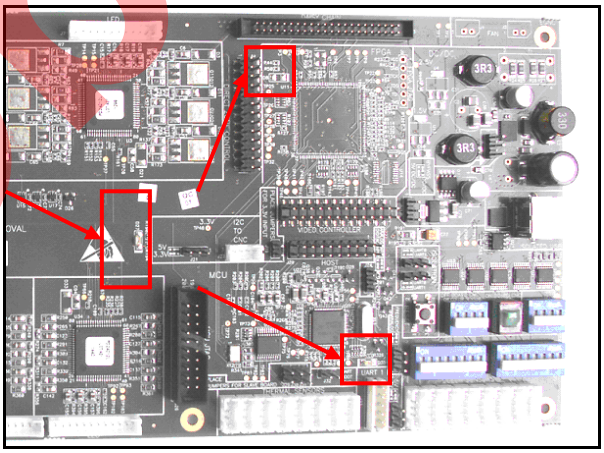

Figure 14: On-Board Indication LEDs

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3.4 Test Points

Table 15 present the On-Board Test Points and their functionalities:

Table 15: On-Board Test Points

Test Point	LED's Name	Functionality
TP3/4/5/7/8/9/22/23/ 25/26/27/28/31/32/39 /40/41/42/43/44	FPGA's spare I/O signal	These Test Points are connected to unused pins of the FPGA's spare I/O signals
TP71 TP68	I2C ADDRESS0 I2C ADDRESS1	BackLight controller PD23000 I2C address
TP78 TP76 TP77	Sensor_Mux_Select0 Sensor_Mux_Select1 Sensor_Mux_Select2	Mux address selection lines coming from BackLight controller PD23000
TP81	IRIS_clock_from_osilato r	PD24012L/H clock generated by the oscillator
TP105	3.3V	3.3V
TP104	GND_D	Digital Ground
TP106	5V	5V

3.5 Reset Button

The dedicated Reset push button SW1 (see Figure 15) is utilized to reset the following components:

- PD24012L/H
- BackLight controller PD23000
- On-board CMC
- On-board FPGA

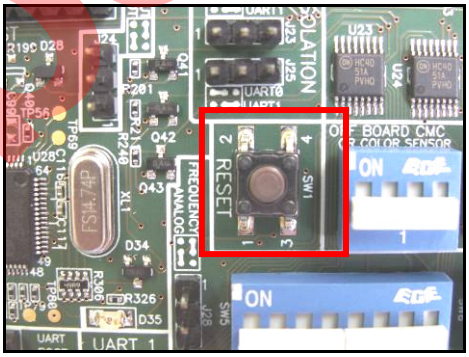

Figure 15: Reset Push Button (SW1)

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3.6 Connectors

The Evaluation Board's connectors are listed in Table 16:

Table 16: Evaluation Board's Connectors

#	Connector	Name	Description
1	J4, J6, J7, J51, J52, J53, J55, J66	LED	Connects the LED strings to the LED driver. Each connector has 12 pins for 12 LED strings.
2	J54	GND Power	Connects the ground from the power supply to the board. It carries the current that flows through the LED strings back to the power supply.
3	J5	GND Power + Vin	A 13 pins connector; 10 pins are dedicated for GND POWER. Two pins are dedicated for power supply to the DC/DC on-board circuitry
4	J11, J18, J27	Red/Green/Blue Power Supply unit	Connection from the power supplies (Red, Green, Blue) to the board.
5	J42-J49	Thermal Sensors	Connects the thermal sensors indication to the board.
6	J34-J41	Color Sensors	Connects the color sensors indication to the board.
7	J33	UART1	Non isolated UART connection for PC or for debug purposes.
8	J3	Daisy Chain	Connects up to two slave boards to the master board.
9	J10	Direct Zone Control	Allows control to the zone control signal in each chip.
10	J15	Video Controler	Connection from external video controler to the board.
11	J20	Host	Connects between the Host and the on-board MCU.
12	J9	FPGA JTAG	FPGA's JTAG
13	J20	MCU JTAG	MCU JTAG
14	J22	Future Use	Future Use
15	J1,J2	FAN	Controls the external fan (PWM sourced by MCU)
16	U19	Isolated USB	Isolates UART0 or UART1 comunication from the MCU to PC, debugger or HOST.
17	J8	Vmain	Used to supply Vmain to the board.

3.6.1 Connectors Detailed Description

1. LED Connectors (see Figure 16)

There are eight dedicated LEDs connectors, a single connector per each PD24012L/H. Each connector has 12 pin per 12 strings.

Each string's current flows from the power supply through the LEDs to the board's LED connectors (FET's drain).

Pin No.	Signal Name	Description
1-12	GND POWER	Ground connection to GND Power

Manufacturer - JST

Manufacture part number - B12B-PH-K-S(LF)(SN)

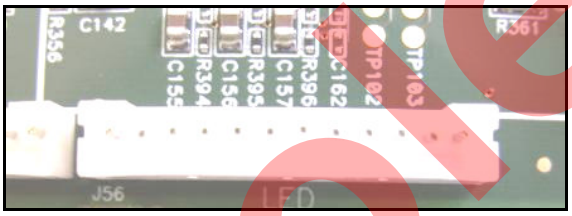

Figure 16: LEDs Connectors

2. GND POWER Connector (see Figure 17)

A 13 pin connector; the high currents from all the strings (in a High current application) flow to the ground "GND POWER". This dedicated connector connects the power supply R/G/B ground (GND POWER) to the evaluation board 's ground.

Manufacturer - JST

Manufacture part number - B13B-PH-K-S(LF)(SN)

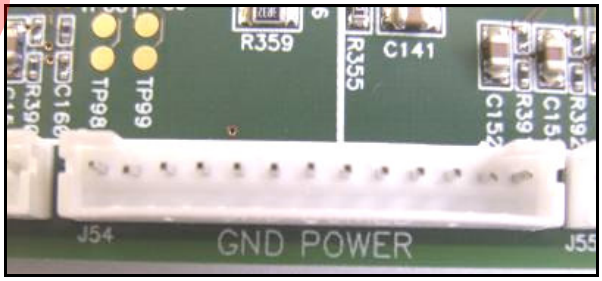

Figure 17: LEDs Connectors

3. GND POWER + Vin – 13 pin Connector (see Figure 18)

Pin No.	Signal Name	Description
4, 5, 6, 7, 8, 9, 10, 11, 12, 13	GND POWER	Ground connection to GND POWER
2, 3	Vin	Applying Vin to the on-board DC/DC circuitry (for electrical details, refer to the Electrical Characteristics section)
1	N.C	N.C

Manufacturer - JST

Manufacture part number - B13B-PH-K-S(LF)(SN)

Figure 18: GND Power + Vin Connector

4. Red/Green/Blue Power Supply

The 4- pin Red/Green/Blue Power supply connectors of all power supplies are identical and connect each power supply to the board. The below description applies for each one of them (Red, Green, Blue).

Pin No.	Signal Name	Description
1	TRIM	Trimming function - this pin provides each PD24012L/H with a direct control option of the power supply voltage. Voltage range 0V – 4V.
2	GND POWER	Ground connection to GND POWER
3	R/G/B P.S.U sample	Used for sampling of the power supply's voltage. Voltage range 0v – 60V.
4	Power Good signal	Provides the MCU with indication of 'good' or 'bad' power supply. Open drain signals, Vil=0.4V

Manufacturer - JST

Manufacture part number - B4B-PH-K-S(LF)(SN)

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Figure 19: Red/Green/Blue Power Supply Connector

5. Thermal Sensors (see Figure 20)

The 4 pin Thermal Sensors connector's description applies for all the thermal sensors. It is used to connect the thermal sensors to the board. The board supports only the following thermal sensor types:

P/N	Manufacturer
LM20	National Semiconductor
FM 20S3X	Faichild

Pin No.	Signal Name	Description
1	Vcc supply	3.3V/5V power supply provided to the thermal sensor (3.3V or 5V can be selected by using short resistors R775/R776)
2	Vthermal	Used for sampling the voltage derived from the thermal sensors. By using a dedicated formula from each thermal sensor's data sheet it is possible to calculate the accurate temperature.
3	N.C	N.C
4	VSSA	VSSA – sampling ground

Manufacturer – JST

Manufacture part number – B4B-PH-K-S(LF)(SN)

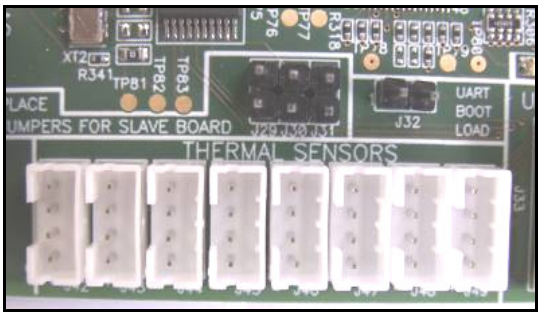

Figure 20: Thermal Sensors Connector

6. Color Sensors

The 5 pin Color Sensors connector's description applies for all the Color sensors. It is used to connect the Color sensors to the board. The board supports only the following color sensor types:

#	Manufacturer	Part number	Remarks
1	HAMAMATSU	C9303-04	Light to voltage
2	HAMAMATSU	C9303-03	Light to voltage
3	AVAGO	HDJD-S722-QR999	Light to voltage
4	Mazet	LCC8	Light to voltage

Pin No.	Signal Name	Description
1	Vcc supply	3.3V or 5V power supply to the color sensors; 3.3V or 5V can be selected by using jumper J50 (see section 3.2.4)
2	Color sensor Red	Used for sampling of the signal from the Color sensors
3	Color sensor Green	Used for sampling of the signal from the Color sensors
4	Color sensor Blue	Used for sampling of the signal from the Color sensors
5	VSSA	VSSA – sampling ground

Manufacturer - JST

Manufacture part number - B5B-PH-K-S(LF)(SN)

Figure 21: Color Sensors Connector

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7. UART1 (see Figure 22)

The 5 pin UART1 connector is used for communication with the PC (GUI) or for debugging purposes.

Pin No.	Signal Name	Description	I/O	Vil	Vih	Vol	Voh
1	Vcc supply	3.3V power supply to UART1		xxx	xxx	xxx	xxx
2	Rx	Rx signal (receive), direction is to the MCU	In	0.8	2	xxx	xxx
3	Tx	Tx signal (transmit), direction is from the MCU	out	xxx	xxx	0.4	2.9
4	GND_D	digital ground		xxx	xxx	xxx	xxx
5	N.C	N.C		xxx	xxx	xxx	xxx

Manufacturer - CviLux

Manufacture part number - CI25-05P1V00

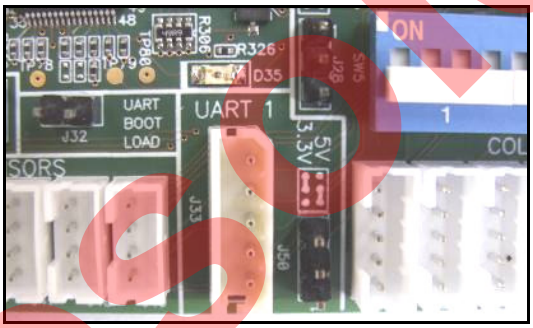

Figure 22: UART1 Connector

8. Daisy Chain (see Figure 23)

The 44 pin Daisy Chain connector is used for daisy chain connection between the Master evaluation board and the slave evaluation board (up to two slaves).

Manufacturer - CviLux

Manufacture part number - CH74442V100

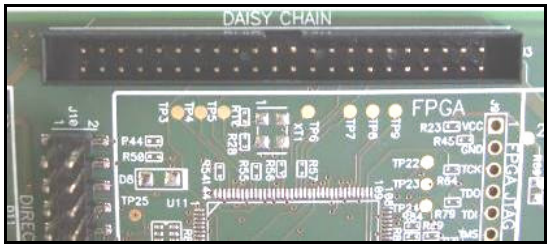

Figure 23: Daisy Chain Connector

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9. Direct Zone Control (see Figure 24)

The 26 pin Direct Zone Control connector is used for control of the Zone Control signal of each device. Each PD24012L/H has a matrix that links a specific LED string to a specific zone control signals combination, for example:

If xZoneC1 = '0' , then LED strings 1 to 4 are disabled or enabled. Each PD24012L/H has three zone control signal pins that enable or disable the LED strings in accordance with the zone control signal configuration.

Pin No.	Signal Name	Description	I/O	Vil	Vih	Vol	Voh
1-24	xZoneC1/2/3	Zone control signals	In	0.22	2.8	xxx	xxx
25,26	GND_D	digital ground		xxx	xxx	xxx	xxx

Manufacturer - CviLux

Manufacture part number - CH81-262M100-00

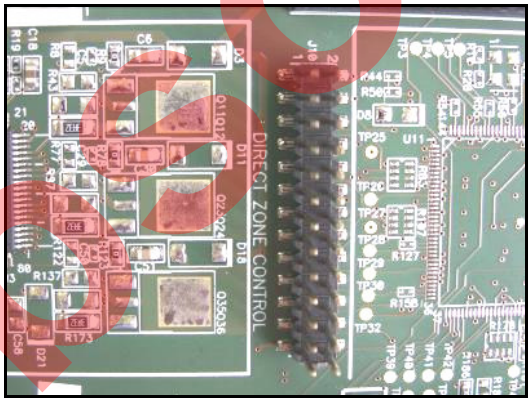

Figure 24: Direct Zone Control Connector

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10. Video Controller

The 26 pin Video Controller connector connects the Video Controller to the evaluation board. There is an option to connect the evaluation board to an external FPGA (video controller) in order to achieve advanced features such as dynamic and scanning back-light.

Pin No.	Signal Name	Description	I/O	Vil	Vih	Vol	Voh
2, 4, 6, 8, 10, 12, 14, 16, 18, 20	Spare I/O Signals	Spare I/O signals running between the on-board FPGA to the video controller connector	I/O	0.8	2	0.4	2.9
19, 24, 26	GND_D	digital ground	xxx	xxx	xxx	xxx	xxx
21, 22, 23	N.C	N.C	xxx	xxx	xxx	xxx	xxx
1	Vcc Supply	3.3V or 5V power supply (3.3V or 5V can be selected using short resistors R188/R189)	xxx	xxx	xxx	xxx	xxx
3, 5, 7, 9	ESPI Bus	Dedicated ESPI bus between the on-board FPGA and the Video Controller. This bus carries the following signals: CS (chip select), SCK (serial clock), MISO (Master In Slave Out), MOSI (Master Out Slave In)	I/O	0.8	2	0.4	2.9
11	Vsync	Synchronization signals running between the FPGA and the Video Controller	in	0.8	2	xxx	xxx
13	Hsync	Synchronization signals between the FPGA to the video controller	in	0.8	2	xxx	xxx
15	HOST_CLK	Synchronization signals between the FPGA to the video controller	in	0.8	2	xxx	xxx
17	Pull Up Resistors	3.3V or 5V pull up through 15Kohm resistors (3.3V or 5V can be selected using the resistors R186/R187)	xxx	xxx	xxx	xxx	xxx
25	IRIS_clock_from_ video_cont	Optional input clock for the on board PD24012L/H	in	0.8	2	xxx	xxx

Manufacturer - CviLux

Manufacture part number - CH81-262M100-00

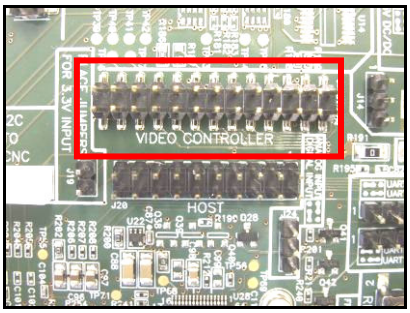

Figure 25: Video Controller Connector

11. Host (see Figure 26)

The Host 20 pin connector connects the Host to the board. The Host CPU communicates with the BackLight Controller PD23000 through the UART0 and the I^2C slave.

Pin No.	Signal Name	Description	I/O	Vil	Vih	Vol	Voh
1	I^2C SCL	I^2C slave communication between the HOST CPU (master) to the Back-Light Controller PD23000 (slave).	in	0.8	2	xxx	xxx
3, 17	I^2C SDA		I/O	0.8	2	0.4	xxx
5	xData_Ready	Optional signal, used for I^2C synchronization, whenever the I^2C data (from the MCU) is ready, this signal changes to '0'.	out	xxx	xxx	0.4	2.9
7	xSystem_Ready	After the MCU's boot finishes, this signal informs the Host CPU that the system is ready by flashing at a 1Hz rate.	out	xxx	xxx	0.4	2.9
9	UART0 Rx	UART0 communication between the Host CPU to the BackLight controller PD23000.	In	0.8	2	xxx	xxx
11	UART0 Rx		out	xxx	xxx	0.4	2.9
13	light_enable	Enables or disables the LEDs lighting	In	0.4	2	xxx	xxx
15	Intensity_Control_5V	Control of the LEDs intensity, can be digital or analog signal, can be 3.3V or 5V according to board configuration..	In	0.4	2	xxx	xxx
19, 20	GND_D	Digital ground	xxx	xxx	xxx	xxx	xxx
2	3.3V	3.3V	xxx	xxx	xxx	xxx	xxx
4	xHost_Reset	Reset signal sent from the Host CPU to reset the evaluation board.	In	0.4	2	xxx	xxx
6	HW_Version0	MCU's H/W version pins. Dedicated for coordination of the software version with the H/W version.	In	0.8	2	xxx	xxx
8	HW_Version1		In	0.8	2	xxx	xxx
10	HW_Version2		In	0.8	2	xxx	xxx
12, 14, 16, 18	N.C	N.C	xxx	xxx	xxx	xxx	xxx

Manufacturer - CviLux
Manufacture part number - CH81-202V114

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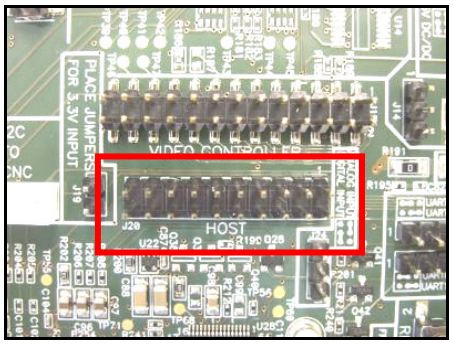

Figure 26: Host Connector

12. FPGA JTAG (see Figure 27)

The FPGA JTAG 6 pin connector connects the JTAG to the on board FPGA.

Pins No.	Signal Name	Description
1	Vcc supply	2.5V or 3.3V supply to the JTAG connection (voltages can be selected by short resistors: R45 for 2.5V and R23 for 3.3V).
2	GND_D	Digital ground
3	TCK	Dedicated JTAG signal
4	TDO	Dedicated JTAG signal
5	TDI	Dedicated JTAG signal
6	TMS	Dedicated JTAG signal

For electrical characteristics please refer to the FPGA's data sheet (Spartan-3E FPGA Family).

Manufacturer - Neltron

Manufacture part number - 2211S-06G

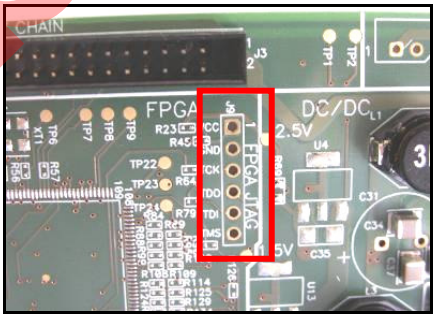

Figure 27: FPGA JTAG Connector

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13. MCU (PD23000) JTAG (see Figure 28)

The 20 pin MCU (PD23000) JTAG connector connects to the on-board MCU.

Pin No.	Signal Name	Description
1,2	Vcc 3.3V supply	3.3V power supply to the JTAG connection
4, 6, 8, 10, 12 ,14, 16, 18, 20	GND_D	Digital ground
3	xTRST	Dedicated JTAG signal
5	TDI	Dedicated JTAG signal
7	TMS	Dedicated JTAG signal
9	TCK	Dedicated JTAG signal
11	RTCK	Dedicated JTAG signal
13	TDO	Dedicated JTAG signal
15	RST	Dedicated JTAG signal
17	N.C	N.C
19	Vcc 5V supply	Optional 5V power supply to the JTAG connection (activated by short resistor R591)

For electrical characteristics please refer to the MCU's data sheet.

Manufacturer - CviLux

Manufacture part number - CH87-202V100

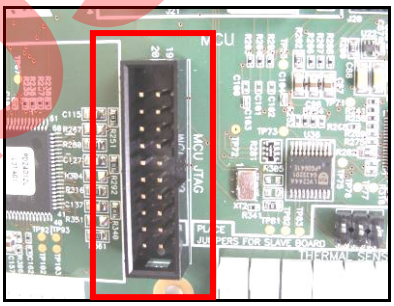

Figure 28: MCU (PD23000) JTAG Connector

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14. Future use Connector (see Figure 29)

Manufacturer - JST

Manufacture part number - B4B-PH-K-S(LF)(SN)

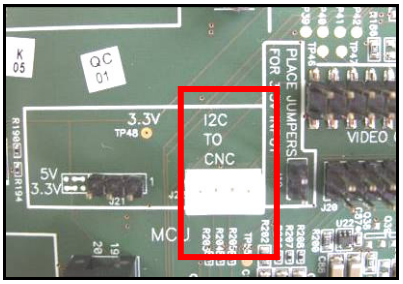

Figure 29: Future use Connector

15. FAN (see Figure 30)

The 2 pin Fan connectors are dedicated for PWM fan control produced by the MCU PD23000 (TBD).

J1

Pin No.	Signal Name	Description
1	+12V	+12V constant supply from external source applied to the fan.
2	GND_D	Fan ground that connected to Digital ground

J2

Pin No.	Signal Name	Description
1	Control Signal (GND_D)	A PWM control signal coming from the MCU PD23000.
2	+12V	+12V constant voltage from an external source (shorted to J1(1)

Manufacturer - CviLux

Manufacture part number - CI25-02P1V00

Figure 30: Fan Connectors

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16. Isolated USB (see Figure 31)

The evaluation board can communicate with a PC utilizing UART0/1 signals that were translated to USB signals (after UART isolation). This B type USB connector connects the board to the PC's USB.

Pin No.	Signal Name	Description
1	Vbus	Voltage supply from the USB bus
2	D-	Dedicated USB signal
3	D+	Dedicated USB signal
4	GND_F	Floating ground

Manufacturer - Samtec

Manufacture part number - USB-B-S-S-B-TH

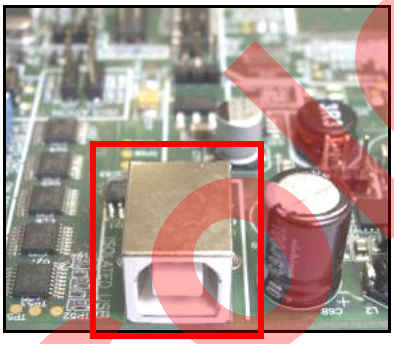

Figure 31: Isolated USB Connector

17. Vmain (see Figure 32)

The 2-pin Vmain connector is used only in cases where the evaluation board is connected to the PD25500 adapter board.

This adapter board is used while the R/G/B power supplies' maximum voltage can be up to 120 Volts. While using the PD25500, the Vmain is not produced on the PD25012L/H board, but on the correlation board. This connector is used to transfer Vmain from the PD25500 to the PD25012L/H.

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Pin No.	Signal Name	Description
1	Vmain	Vmain coming from the PD25500. It is used for voltage clamping to protect the PD24012L/H. Voltage levels are 0V – 60V.
2	GND POWER	Ground connection to GND POWER

Manufacturer - JST

Manufacture part number - B2B-PH-K-S(LF)(SN)

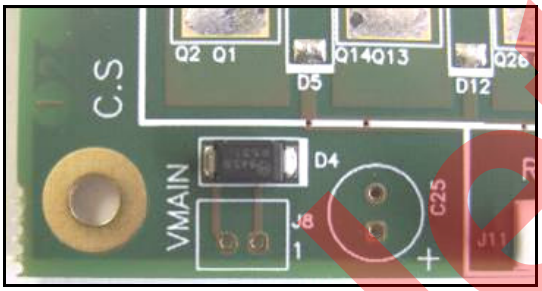

Figure 32: Vmain Connector

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Chapter 4- Electrical Characteristics

4.1 General

The evaluation board's Electrical Characteristics are described below:

Parameter	Symbol	Min.	Max.	Units
I²C master and Slave Interface				
Low level input voltage	VIL	-	0.8	V
Low level output voltage	VOL	-	2	V
SCL clock frequency (master only)	f_{SCL}		100	kHz
UART0/1				
Communication rate			115200	baud
LEDs Driver Specification				
High current string (external FETs) PD25012H	I		1.5A** (@18 ports) or 0.5A (@36 ports)	A
Low current string (internal FETs) PD25012L	I		85	mA
Power supply trim		0	5	V

** The maximum current should be with special care to the Vds voltage and the T_ambient. In a high current application, the maximum current and the maximal Tjunction of the FET (135^{0}C) must be taken into account

Parameter	Conditions	Min.	Typ	Max.	Units
Input voltage	Absolut maximum	10		26.4	VDC
input Ripple and Noise	0°C to 50°C (measured on 0.1 µF ceramic capacitor BW = 20 MHz)			240	mVp-p
Output Voltage	0<Load<maimum	4.85	5	5.15	VDC
Output Current	Vo = 5V			3	A

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Chapter 5- The Detailed Circuit Description – TBD

5.1 General

This chapter provides a detailed description of the various circuits, drivers and closed loops**Error! Reference source not found.**.

5.2 On-Board Indications

The on-board drivers operate in a 'closed loop'. The evaluation board interfaces with external sensors and thus allows reception of external indications such as:

- LED string current
- Power supply's voltage
- Thermal indication
- LED color indication

These indications allow the internal circuitries to operate in a closed loop mode and stabilize the system in accordance with the preliminary configuration instructions.

5.3 Interfaces

The evaluation board interfaces with the Host CPU via the UART0, I^2C slave and through dedicated control signals. It can also be connected to an external Video controller so as to implement advanced features such as dynamic and scanning BackLight.

5.4 Color Closed Loop

The color management function is implemented by the PD23000. The color closed loop is preset by the user by using the on-board jumpers and switches (see section 3.2 for more details).
The loop can operate in any of the following configurations as follow:

- **PD23000 with CMC operation** – In these configurations the PD23000 MCU receives color indication from the color sensors connected to J35-J41. The illumination data is then transmitted to the drivers via the MCU when an ESPI communication command is issued.
- **PD23000 without CMC operation** – in these configurations there is no need for CMC (for example when white LEDs are utilized).
- **External CMC operation** – in this configurations CMC operation is performed by the Host side, The color data is then transmitted to the drivers via the ESPI2 signals.

5.5 Voltage Closed Loop

The power supply output voltage is trimmed in order to achieve the adjusted current and the minimal power dissipation on the internal\external MOSFETs.

The PD24012L/H samples the drain voltage and uses the three dedicated TRIM pins in order to set the power supplies output voltage.

Chapter 6- Installation

6.1 General

The following chapter describes the steps required in order to install and operate the evaluation board.

6.2 Preliminary Considerations & Safety Precautions

- Verify that the board's power supply is turned on before the peripheral components are turned to on
- Connect all the required peripherals prior to powering the board.
- Do not perform hot swap in any case!
- Verify that the board is well configured prior to turning on the power supply.

6.3 Initial Configuration

It is highly important to verify that the evaluation board is well configured prior to starting any operation.

Before using the evaluation board, make sure that all switches and jumpers are in default position as described in section 3.2 - "Switches& Jumpers".

Configure the evaluation board according to the specific application (see section 3.2 - "Switches& Jumpers").

6.4 Software Setup (GUI)

Please refer to the GUI installation document (TBD)

6.5 Hardware Setup

6.5.1 LED Back-Light System Setup

Connect all the peripheral components to the board as shown in Figure 33. Refer also to Table 16: Evaluation Board's Connectors to verify that all connections are well performed.

Verify that the board's configuration is properly performed (refer to section 3.2).

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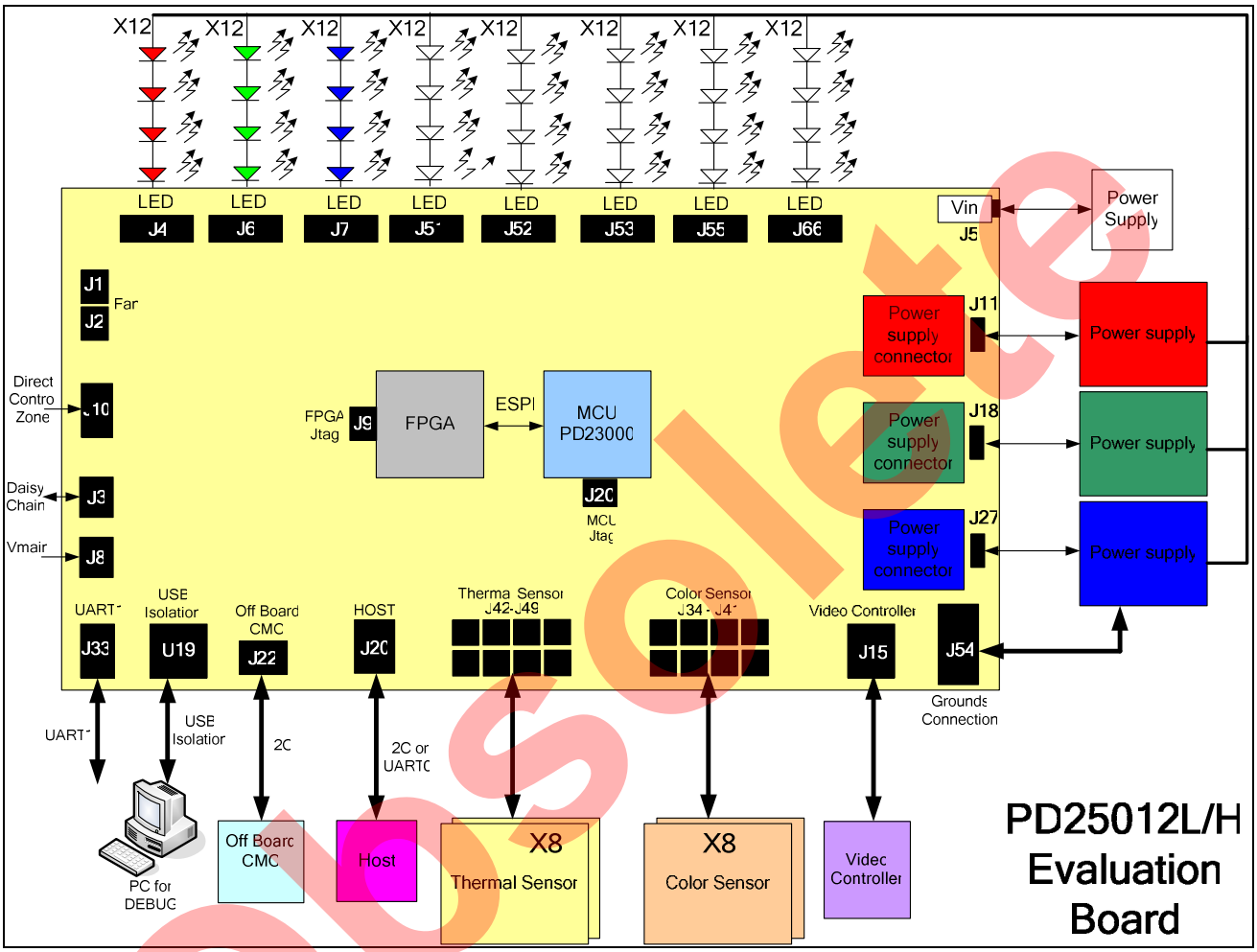

Figure 33: Hardware Setup

6.5.2 UART to USB Isolation Setup

Prior to performing the following steps for UART isolation, make sure that the GUI software is installed (refer to the GUI installation User Guide TBD).

1. Use the 'UART to USB' S/W provided CD to Install the 'UART to USB' drivers on the PC.
2. Configure the board to isolate UART1 or UART0 using J23 and J25 (see section 3.2.3).
3. Connect USB connector U19 from the evaluation board to the PC.
4. Start the GUI software and select the communication port in accordance with the virtual communication port that appears upon installing the 'UART to USB' drivers.

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Chapter 7- Troubleshooting

The following chapter provides a list of common operational malfunctions and their solutions:

#	Problem	Solution
1.	The board is not responding and not functioning	1. Check the power connection to the board 2. Verify that the 5V indication LED is 'ON' 3. Verify that all the instructions mentioned in chapter 6 have been properly carried out.
2.	When the board is provided with 5V, the board is not responding and not functioning	1. Verify that the board is configured to work with 5V (bypass the DC/DC)
3.	There is no communication between the GUI and the Evaluation board.	1. Check the connection between the evaluation board and the PC 2. Verify that the USB to UART drivers are installed (see Para. 6.5.2) 3. Verify that the GUI COM. connection is configured for the appropriate PC COM (see Para 6.4) 4. Check the UART0/1 configuration (section 6.5.2)
4.	The LED string current exceeds 2% deviation from the set current (see Para 6.4).	1. Verify that the set current value is above the minimal current (50% from the maximum current) 2. Verify that the trimming connection to all the power supplies exist
5.	When switching the system to 'ON' part or all the strings indicate 'short' status (see Para 6.4).	3. Verify that the power supply output voltage does not exceed the string's V_Forward maximum value +16V.

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Revision History:

Revision Level / Date	Para. Affected/Page	Description
0.2 / 08/ 2007		Initial revision

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