DLP3030-Q1 Combiner HUD EVM
DLP3030CHUDQ1EVM

User's Guide

Literature Number: DLPU065
November 2017

Contents

1 Introduction 4
- 1.1 EVM Overview 4
- 1.2 Warnings 4
- 1.3 Specifications 5
- 1.4 Kit Contents 6
- 1.5 Electronic Boards Overview 7

2 Getting Started 9
- 2.1 Section Overview 9
- 2.2 Kit Assembly 9
  - 2.2.1 Instructions to Assemble EVM 9
- 2.3 First Power Up 14
- 2.4 EVM Software Tool Configuration 15
  - 2.4.1 Automotive Control Program (ACP) Lite and Total Phase Cheetah Software Installation 15
  - 2.4.2 How to Connect and Use the ACP Lite Tool 16
- 2.5 Connector Pinouts 18

Copyright © 2017, Texas Instruments Incorporated

List of Figures

1-1. DLP3030CHUDQ1EVM Kit Contents 6
1-2. Formatter Controller Board Front 7
1-3. Formatter Controller Board Back 7
1-4. DMD Interface Board Front 8
1-5. DMD Interface Board Back 8
2-1. DMD Flex Cable Installation Alignment 9
2-2. Installation of PGU Cables into Formatter Board 10
2-3. Installation of LED and Photodiode Cables into PGU 11
2-4. HDMI Cable Install 11
2-5. Power Cable Install 12
2-6. Combiner Glass Install 12
2-7. Securing Combiner 13
2-8. PC Video Output Mode Configuration 14
2-9. Example of C-HUD Displaying Video Content 14

List of Tables

1-1. Performance Specifications 5
1-2. Power Specifications 5
1-3. Temperature Specifications 5
1-4. DLP3030CHUDQ1EVM Kit Contents 6
2-1. Required Tools and Items 9
2-2. External Input Resolutions 15
2-3. Power Input Connector 18
2-4. SPI Communication Connector 18
2-5. Photodiode Connector 18
2-6. LED Power Connector 18
2-7. MCU JTAG Connector 19
2-8. LED Thermistor Connector 19

Copyright © 2017, Texas Instruments Incorporated

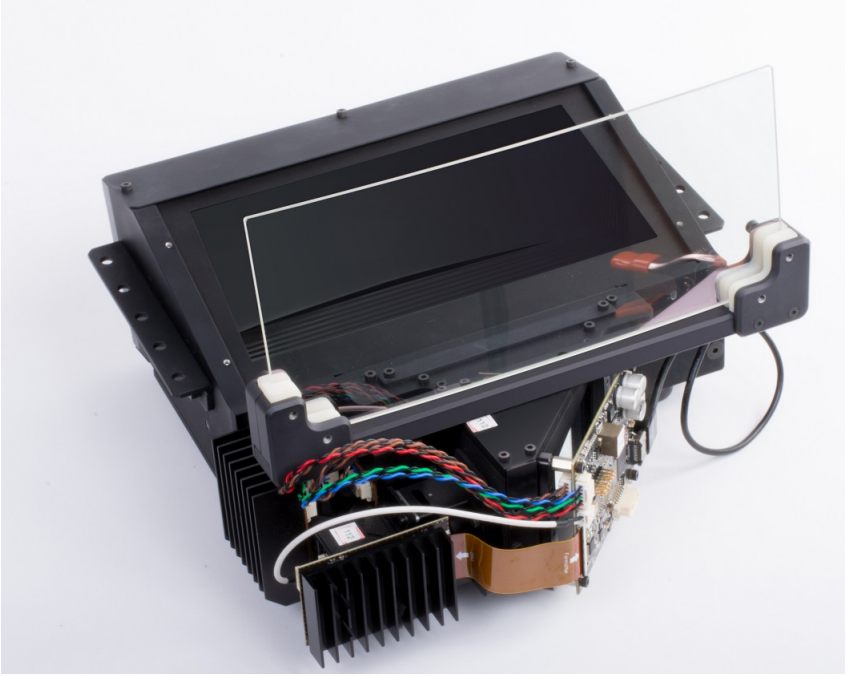
Introduction

1.1 EVM Overview

The DLP3030CHUDQ1EVM evaluation module (EVM) is a wide field of view (WFOV) combiner head-up display (C-HUD) table top demonstrator. This C-HUD demonstrator enables Tier 1 and OEM customers to demonstrate a state of the art, high-performance WFOV HUD powered by TI DLP® technology. The C-HUD is based on the DLP3030-Q1 chipset and DLP3030-Q1 PGU.

The EVM runs off of a nominal 12-V supply (not provided; see Section 2.3 for details) and accepts an HDMI input video interface.

Additionally, TI provides a software tool that can communicate via a Microsoft® Windows® PC's USB port for brightness and display mode configuration.



1.2 Warnings

CAUTION

Caution Hot surface.

Contact may cause burns.

Do not touch.

Copyright © 2017, Texas Instruments Incorporated

1.3 Specifications

Table 1-1. Performance Specifications

Resolution	WVGA (864 × 480)	**Dimming Range**	>5,000:1 (1)
Field of View	12° × 3.6°	**Contrast Ratio**	>1,000:1 (FoFo)
Virtual Image Distance	2.5 m	**Color Gamut**	125% NTSC (1)
Virtual Image Size	487 mm × 155 mm	**Overall Dimensions**	Roughly 300 mm × 275 mm × 250 mm
Eyebox Size	130 mm × 60 mm	**Power Input**	6-18 VDC
Max Brightness (Eyebox)	>34,000 cd/m^2 (1)	**Video Input**	HDMI
PGU Lumens	>70 Lumens (1)	**Control Interface**	SPI (via Cheetah USB to SPI adapter)

(1) System was calibrated at 25°C and Vbatt at 12 V.

Table 1-2. Power Specifications

PARAMETER	TEST CONDITIONS	MIN	NOM	MAX	UNIT
Vbatt Input Voltage		6	12	18	V
Power Consumption	Q8WP RGB LEDs operating at 70/30 DMD duty cycle	2 (1)	5.6 (2)	13.9 (3)	W

(1) This value defines minimum white-balanced brightness setting. With LEDs off, power consumption drops to 1.44 W.
(2) Produces 15,000 cd/m^2 on DLP3030CHUDQ1EVM or 32 lumens on DLP3030PGUQ1EVM.
(3) Produces 34,000 cd/m^2 on DLP3030CHUDQ1EVM or 70 lumens on DLP3030PGUQ1EVM.

Table 1-3. Temperature Specifications

PARAMETER	MIN	NOM	MAX	UNIT
Operational Ambient Temperature Range	–40		105	°C
Storage Ambient Temperature Range	–40		105	°C

Copyright © 2017, Texas Instruments Incorporated

1.4 Kit Contents

Table 1-4. DLP3030CHUDQ1EVM Kit Contents

ITEM NO.	ITEM
1	DMD Interface Board
2	Formatter Controller Board
3	Total Phase Cheetah USB to SPI Adapter
4	3-in DMD Ribbon Cable (2×)
5	Photodiode Cable
6	RGB LED Power and Thermistor Cable
7	Cheetah SPI Interface Cable
8	Power Input Cable
9	6-ft HDMI cable
10	WFOV HUD PGU
11	5-mm M3 Screws (4×)
12	1-ft HDMI cable extender
13	HDMI Panel Mount Connector
14	Combiner HUD Optics
15	12-mm M3 Screws (2×)
16	10-mm M4 Screws (4×)
17	Combiner Glass Mount
18	Combiner Glass

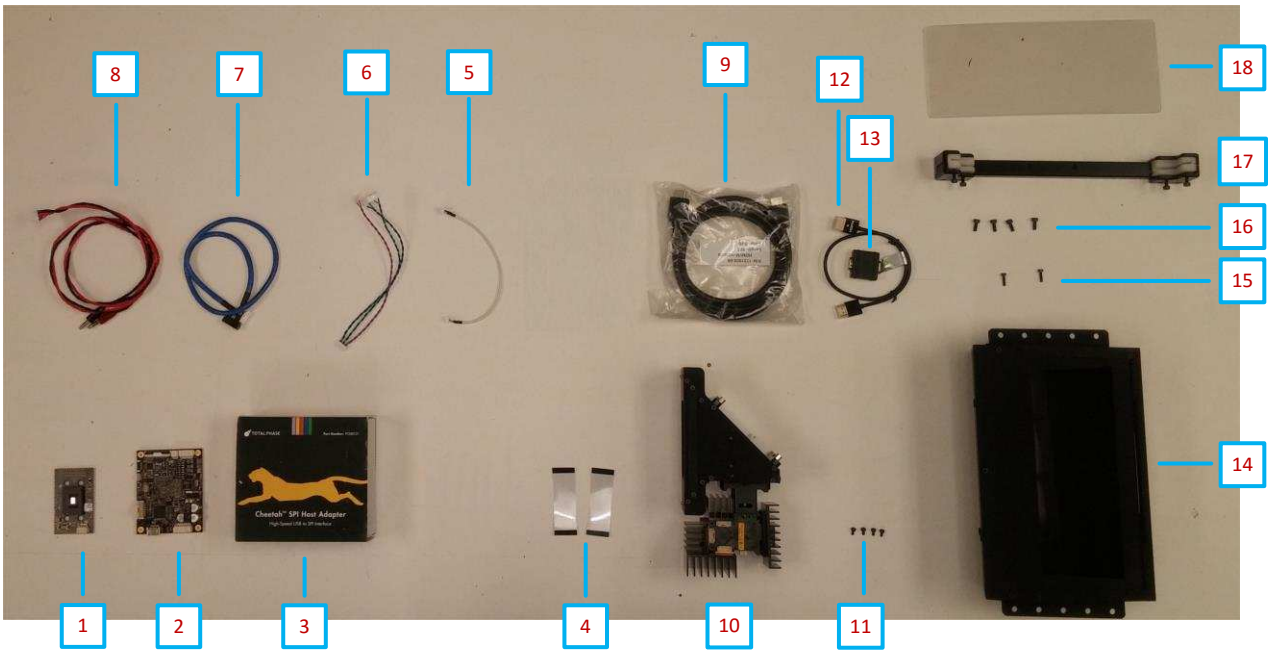


Figure 1-1. DLP3030CHUDQ1EVM Kit Contents

Copyright © 2017, Texas Instruments Incorporated

1.5 Electronic Boards Overview

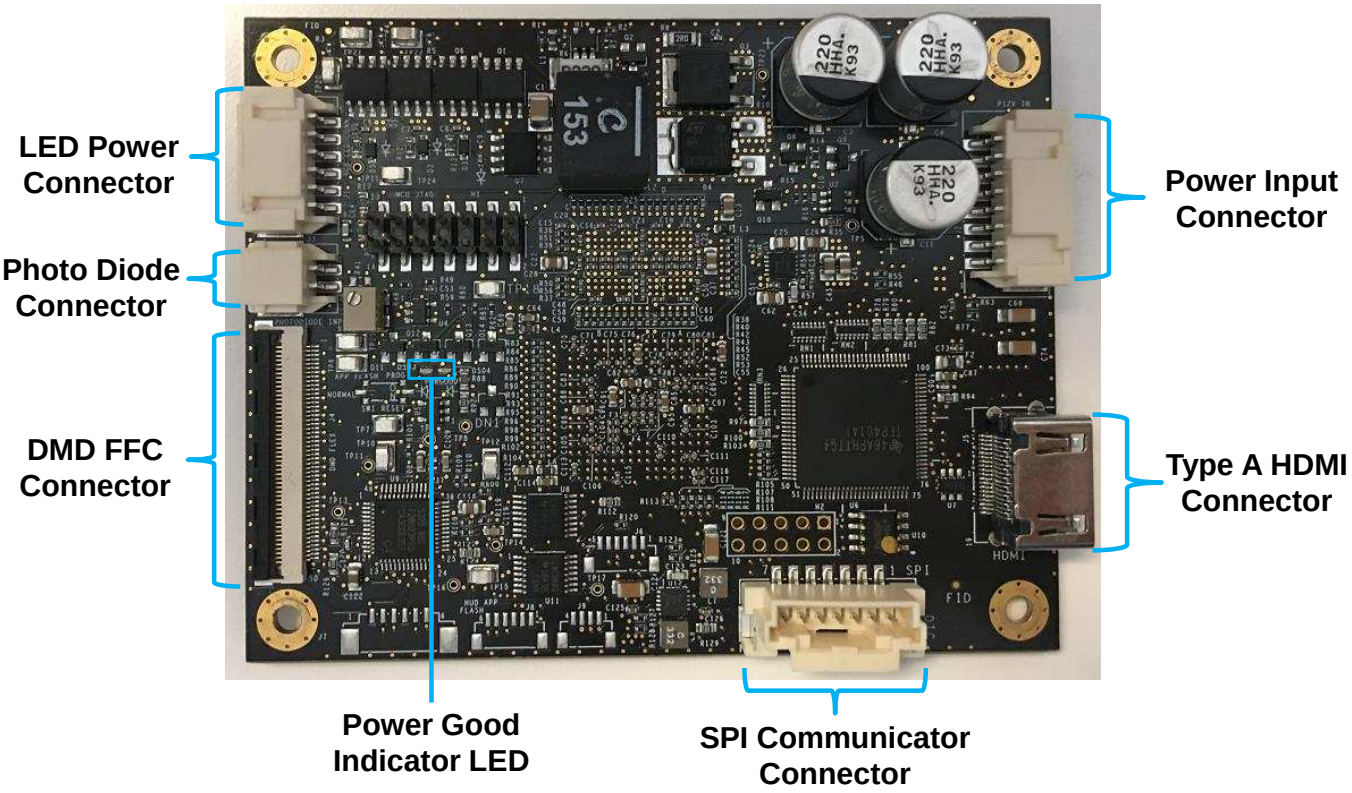


Figure 1-2. Formatter Controller Board Front

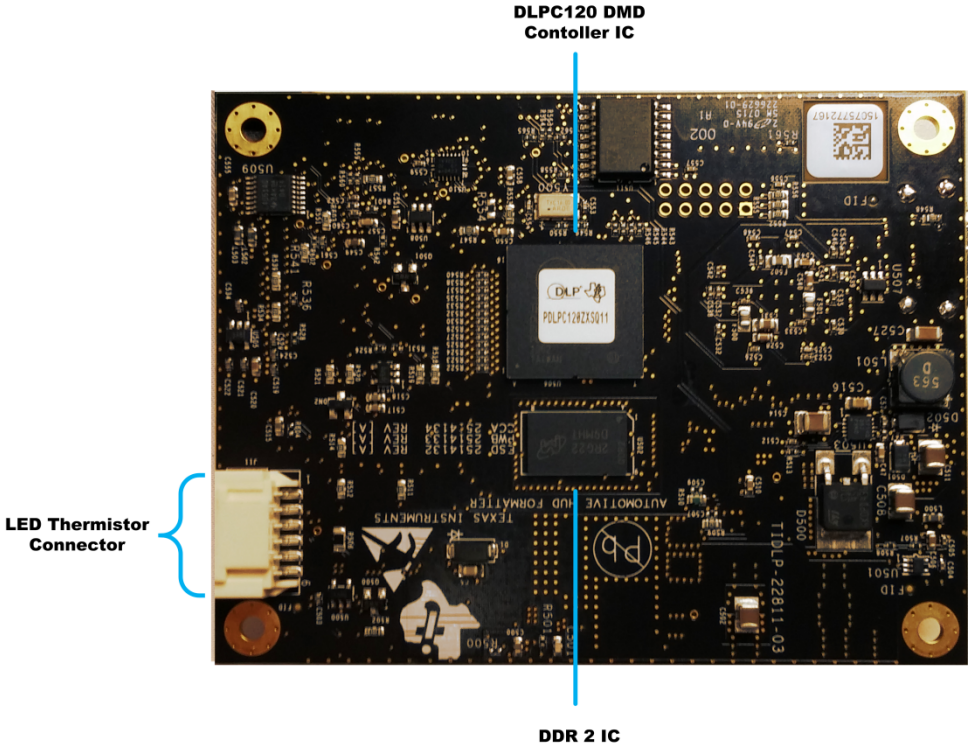


Figure 1-3. Formatter Controller Board Back

Copyright © 2017, Texas Instruments Incorporated

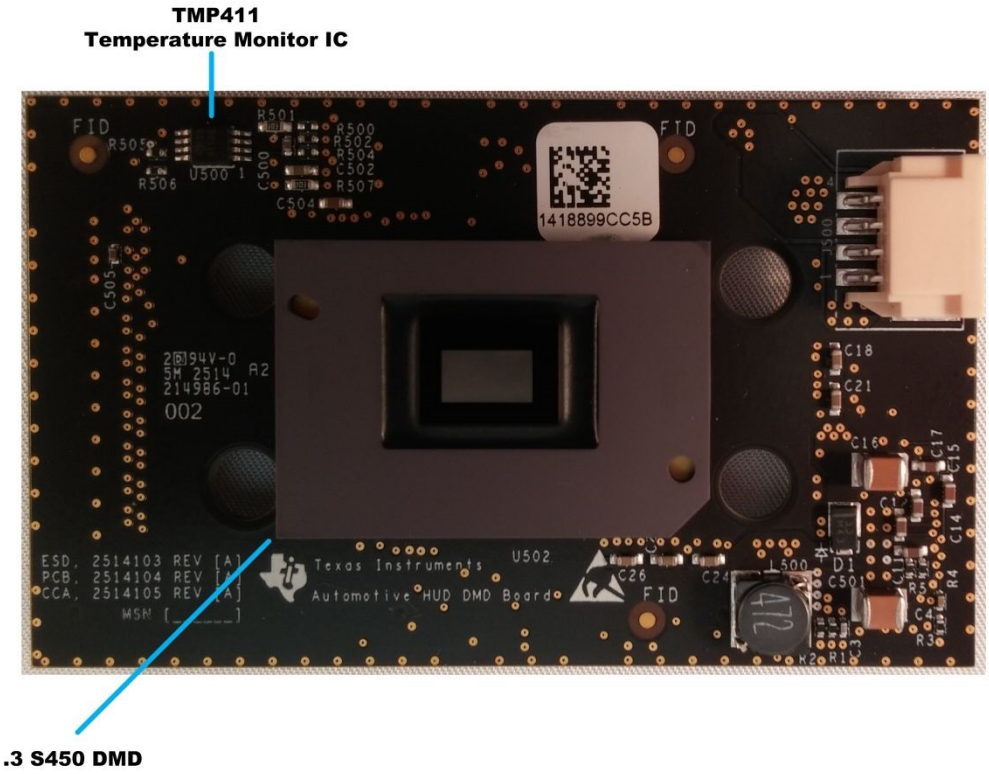


Figure 1-4. DMD Interface Board Front

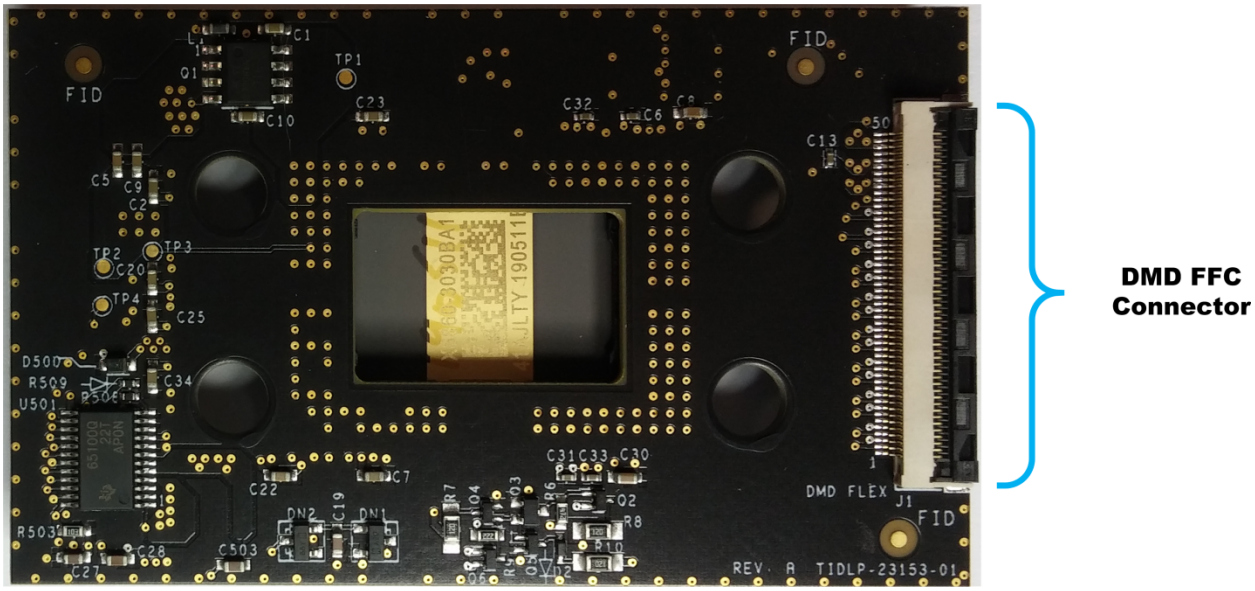


Figure 1-5. DMD Interface Board Back

Copyright © 2017, Texas Instruments Incorporated

Getting Started

2.1 Section Overview

This section will provide step-by-step instructions to display an image using the EVM. Section 2.2 contains EVM physical assembly instructions, Section 2.3 contains electrical power-up instructions, Section 2.4 contains EVM GUI installation and use, and Section 2.5 contains connector pinout tables.

2.2 Kit Assembly

Table 2-1. Required Tools and Items

ITEM NO.	ITEM
1	M3 Allen Wrench
2	M4 Allen Wrench
3	Phillips Screw Driver
4	12 V @ 3-A Power Supply

2.2.1 Instructions to Assemble EVM

- Install the DMD Ribbon Cable between the DMD Board and the Formatter Board, ensuring that it is inserted evenly across the entire connector, as shown on the right in Figure 2-1.

  Note: This connector has a latch that must be lifted when installing the cable and then clamped down to secure its position.

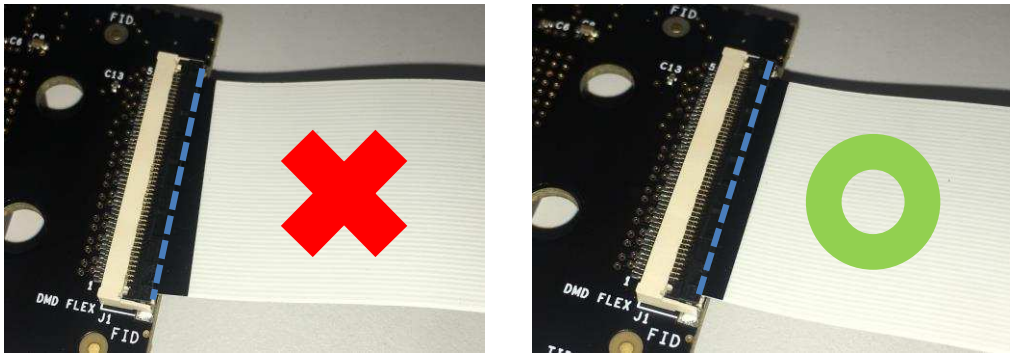


Figure 2-1. DMD Flex Cable Installation Alignment

Copyright © 2017, Texas Instruments Incorporated

- Install the LED Power Cable into the Formatter Board using the cable connector with the red, green and blue wires.
- Install the LED Thermistor Cable, part of the LED Power Cable, into the Formatter Board using the cable connector with the three brown wires.
- Install the Photodiode Cable to the Formatter Board.

CAUTION

Please ensure that the LED Power and LED Thermistor cables are installed into the proper connector, as shown in Figure 2-2. Improper installation may cause damage to the LEDs.

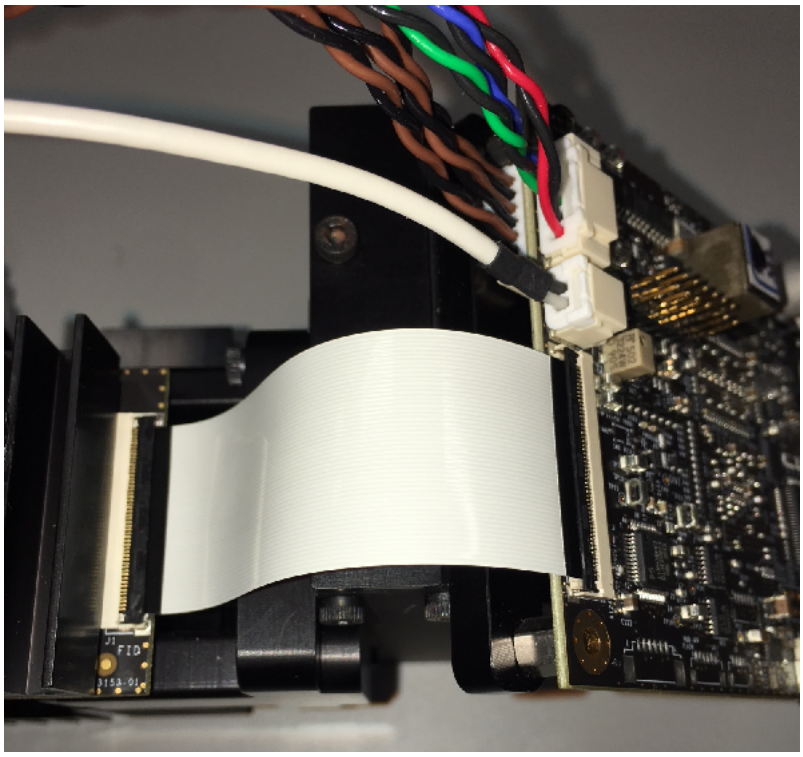


Figure 2-2. Installation of PGU Cables into Formatter Board

Copyright © 2017, Texas Instruments Incorporated

- Install the other three connectors to the matching LED color, red cable for red LED, etc. The letter representing each wire color is marked on each LED board connector.
- Install the Photodiode Cable onto the PGU near the Red LED.

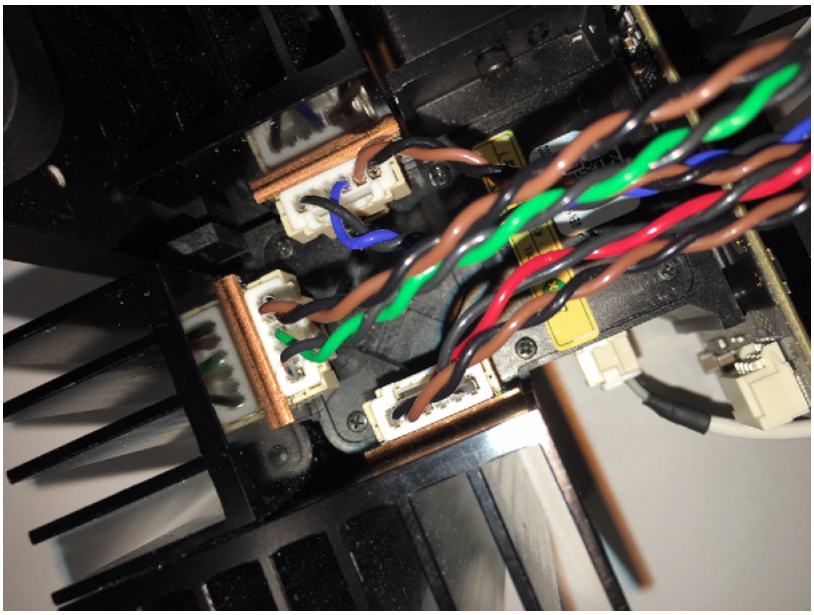


Figure 2-3. Installation of LED and Photodiode Cables into PGU

- Install the HDMI cable into the HDMI connector on the Formatter Board.

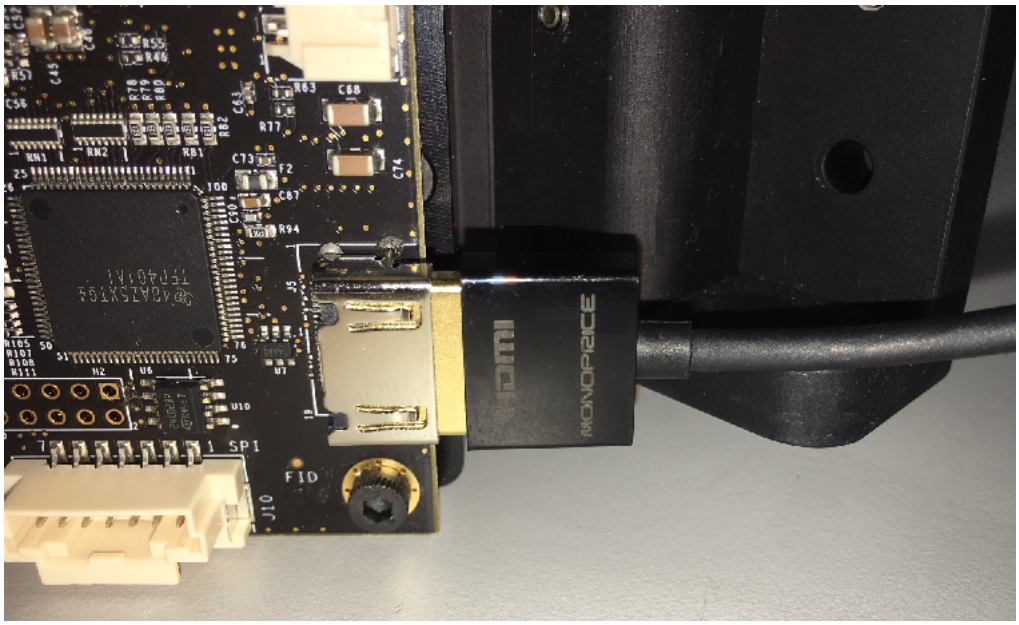


Figure 2-4. HDMI Cable Install

Copyright © 2017, Texas Instruments Incorporated

- Install the Power Input Cable into the Formatter Board.

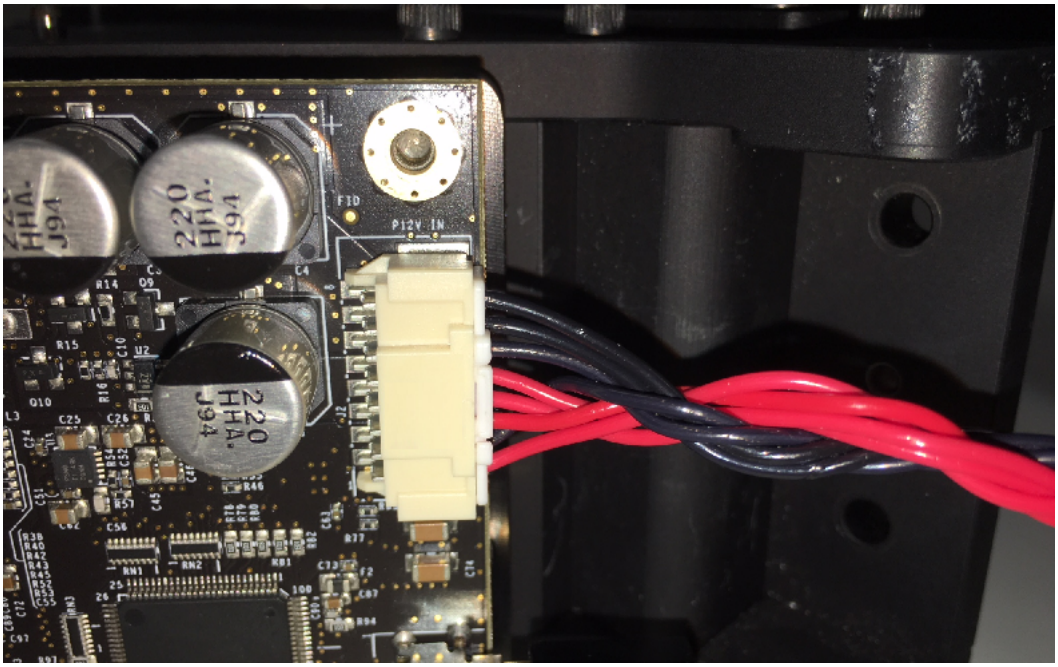


Figure 2-5. Power Cable Install

- Install the Combiner Glass into the Combiner Glass mount.

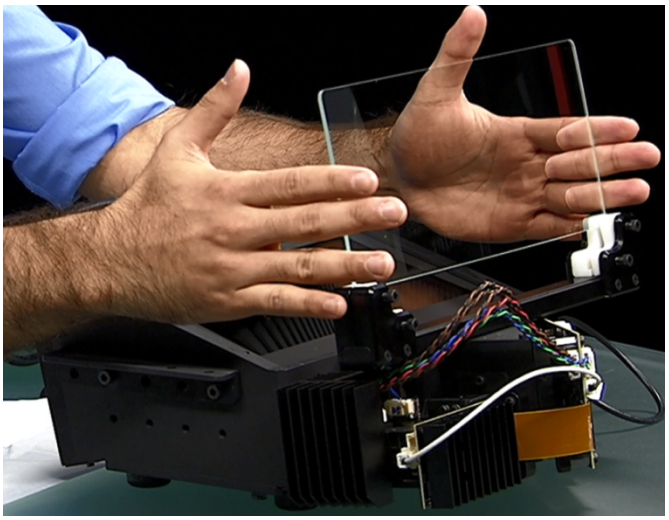


Figure 2-6. Combiner Glass Install

Copyright © 2017, Texas Instruments Incorporated

- Gently use the set screws on the Combiner Glass mount to ensure that the Combiner Glass is secure.

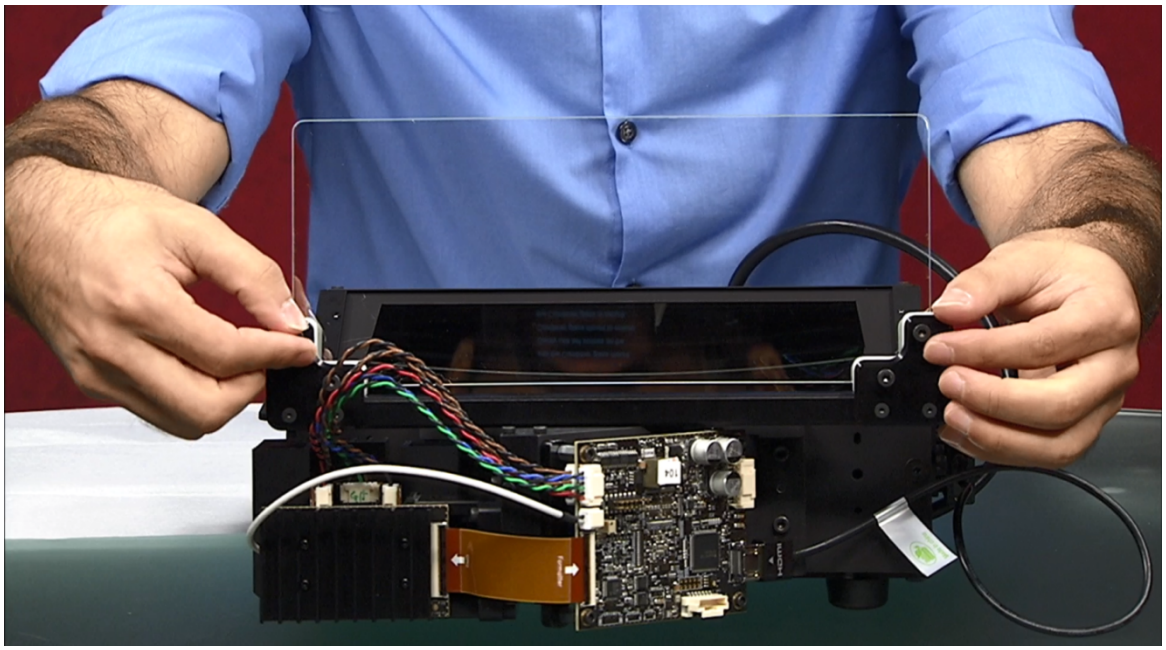


Figure 2-7. Securing Combiner

- Install one end of the HDMI cable into the HDMI connector on the side of the housing.
- Plug the other side of the HDMI cable into a compatible computer.
- Continue to Section 2.3 for instructions on how to power up the system.

Copyright © 2017, Texas Instruments Incorporated

2.3 First Power Up

Instructions to Power on HUD Package

- Procure a 12-V (3-A) supply.
- Power off the supply.
- Install the banana connectors on the Power Input Cable into the power supply. The red cable goes to the V+ terminal, and the black cable goes to the V– terminal.
- Power on the supply.
- Once the system is powered up, a green indicator light on the Formatter Board will illuminate, and the computer will detect an additional display called DLP_WVGA. See Figure 1-2 to locate the indicator LED.
- If the PC is trying to duplicate the image on the EVM and the monitor, then the PC resolution can be changed. To fix this, change the PC's external monitor setting to "Extend."
  - Press "Windows + P" key combination, then select "Extend" as shown in Figure 2-8.

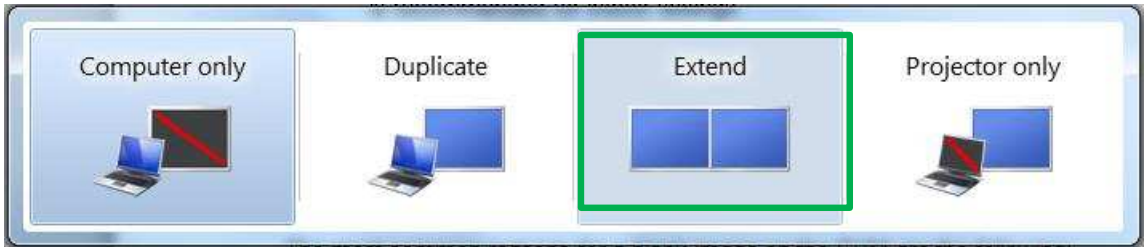


Figure 2-8. PC Video Output Mode Configuration

- The EVM will now be displaying the video content.

Figure 2-9. Example of C-HUD Displaying Video Content

- For control options, like dimming the display or changing the input source settings, please reference Section 2.4 to install the Cheetah USB to SPI Adapter and Automotive Control Program (ACP) Lite on your computer.

Copyright © 2017, Texas Instruments Incorporated

2.4 EVM Software Tool Configuration

TI provides a software graphical user interface (GUI) tool, called the Automotive Control Program (ACP) Lite, which can be used to configure behavior of the EVM. The following functions are supported with ACP Lite, among others:

- Brightness / Dimming Control
- Image Orientation Flip
- Display Mode Configuration
  - Internal Splash Images
  - Internal Test Patterns
  - External Video Resolutions via HDMI (refer to Table 2-2 for list of supported resolutions)

Table 2-2. External Input Resolutions

RESOLUTION		
960 × 480	960 × 250	960 × 240
960 × 160	864 × 480[(1)]	854 × 480
854 × 240	853 × 480	852 × 480
800 × 480	640 × 480	640 × 240
640 × 160	500 × 250	480 × 240
400 × 240	320 × 240	320 × 160
320 × 120	—	—

(1) 864 × 480 is the default input video resolution on system power-up.

2.4.1 Automotive Control Program (ACP) Lite and Total Phase Cheetah Software Installation

The ACP Lite and Total Phase Cheetah software are necessary to control the EVM. Follow the procedure below to download and install the ACP Lite and Total Phase Cheetah drivers.

Note: The Total Phase Cheetah drivers and cheetah.dll are not distributed by Texas Instruments. Login credentials must be created for www.totalphase.com/ in order to download the required software.

1. Install Automotive Control Program (ACP) Lite
   - Login to www.ti.com/tool/DLP3030CHUDQ1EVM
   - Navigate to the software downloads section.
   - Download Automotive Control Program (ACP) Lite installer package.
   - Extract the ZIP file.
   - Run setup.exe.
   - Follow default installation instructions to completion.
2. Install Cheetah drivers
   - Download and install USB drivers for the Cheetah from www.totalphase.com/products/usb-drivers-windows

     Note: The installation program should be “Run as administrator” by right-clicking.
3. Download and Move cheetah.dll file
   - Download Flash Center software from www.totalphase.com/products/flash-center/
   - From the downloaded folder, copy cheetah.dll
   - Paste cheetah.dll file into ACP installation directory, found at the following location if the default install options were followed:
     - C:\Program Files (x86)\Texas Instruments\Automotive Control Program Lite [version number]\
   - Close and re-open the ACP Lite tool

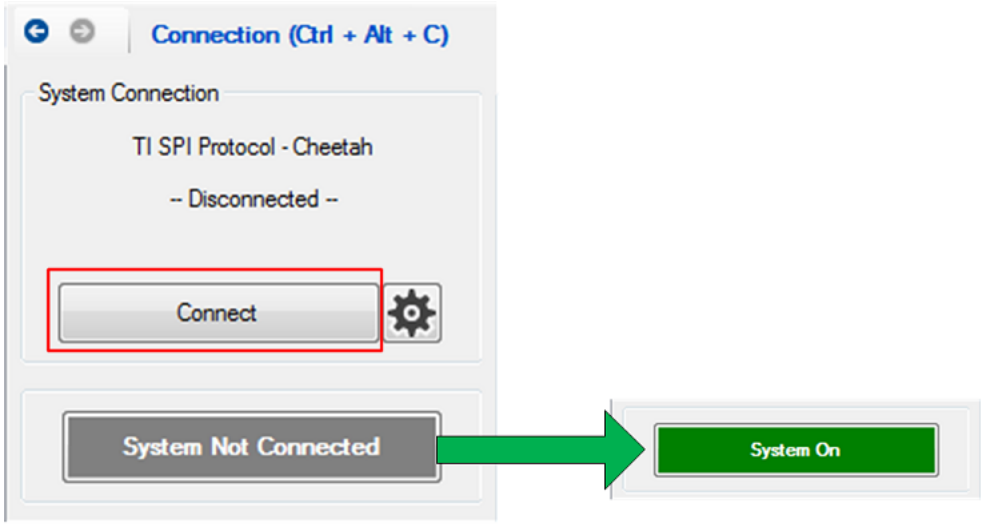
Copyright © 2017, Texas Instruments Incorporated

2.4.2 How to Connect and Use the ACP Lite Tool

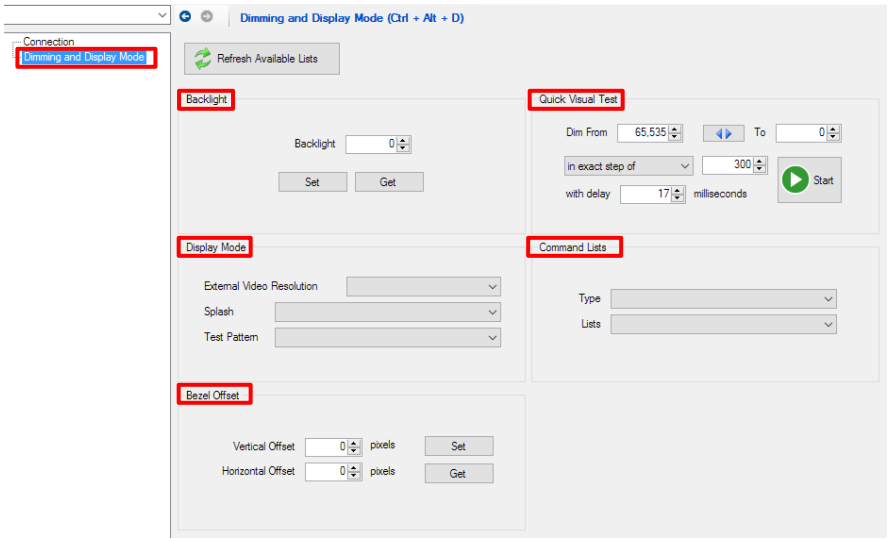
This section explains how to connect to a PC to the EVM and display images or videos.

Follow these steps to display an image:

1. Install the Automotive Control Program and Cheetah Drivers as described in Section 2.4.1 above.
2. Ensure the HDMI cable is connected from the PC to the Type A HDMI Connector on the LED Driver Board. See Figure 1-2 to locate the HDMI connector.
3. Connect the USB cable from the PC to the Cheetah board, and connect the SPI cable from the Cheetah board to the LED Driver Board. See Figure 1-2 to locate the SPI connector.
4. Open the Automotive Control Program (ACP) Lite tool.

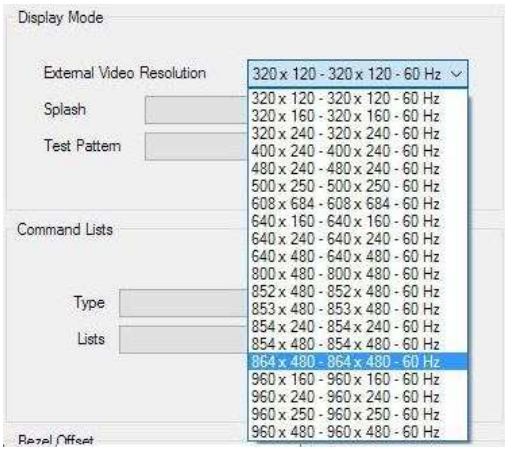


5. Click Connect as shown in the image above. The “System Not Connected” box will turn to “System On."
6. Navigate to Dimming and Display Mode page.

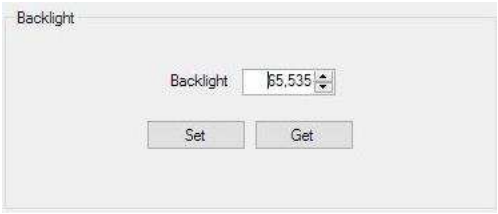


Copyright © 2017, Texas Instruments Incorporated

7. In the Display Mode section, select an external video resolution, splash image, or test pattern to display. The EVM is configured to operate with an external video resolution of 864 × 480 on initial power-up.



8. To adjust brightness, change Backlight parameter. Backlight value range is 0 to 65535. Backlight 700 to 1000 is recommended for indoor settings.



Copyright © 2017, Texas Instruments Incorporated

2.5 Connector Pinouts

This section describes the pinout signals for each of the connectors of the electronics boards. Refer to Figure 1-2 and Figure 1-3 for the location of each connector.

Table 2-3. Power Input Connector

REFERENCE DESIGNATOR		CONNECTOR	
J2		MOLEX 5023520800	
PIN #	SIGNAL NAME	TYPE	NOTES
1	Vbatt	Power Input for Digital Circuits	6-V to 18-V Input (0.3-A max @ 12 V)
2	Ground	Ground for Digital Circuits	Ground 0.3-A max @ 12 V
3	Vbatt LED	Power Input for LED Driver Circuit	6-V to 18-V Input (2-A max @ 12 V)
4			
5			
6	Power Ground	Ground for LED Driver Circuit	Ground (2-A max @ 12 V)
7			
8			

Table 2-4. SPI Communication Connector

REFERENCE DESIGNATOR		CONNECTOR	
J10		MOLEX 5600200700 (1)	
PIN #	SIGNAL NAME	TYPE	NOTES
1	SPI CLK	SPI Clock	100-Ω Impedance Matched to Pin 4, Ground
2	3.3V	Power	
3	SPI SOMI	SPI Master In Slave Out	100-Ω Impedance Matched to Pin 3, 3.3
4	Ground	Ground	
5	SPI SIMO	SPI Master Out Slave In	100-Ω Impedance Matched to Pin 6, Ground
6	Ground	Ground	
7	SPI CSZ	SPI Chip Select	

(1) This connector is used for general system controls, such as dimming and video mode configuration.

Table 2-5. Photodiode Connector

REFERENCE DESIGNATOR		CONNECTOR	
J3		MOLEX 5023520200	
PIN #	SIGNAL NAME	TYPE	NOTES
1	PD Cathode	Cathode	The cathode is connected to the cable shield
2	PD Anode	Anode	The anode is noise sensitive and connected to the cable center conductor

Table 2-6. LED Power Connector

REFERENCE DESIGNATOR		CONNECTOR	
J1		MOLEX 5023520600	
PIN #	SIGNAL NAME	TYPE	NOTES
1	Blue LED Cathode	Cathode	
2	Blue LED Anode	Anode	Common Anode
3	Green LED Cathode	Cathode	
4	Green LED Anode	Anode	Common Anode
5	Red LED Cathode	Cathode	
6	Red LED Anode	Anode	Common Anode

Copyright © 2017, Texas Instruments Incorporated

Table 2-7. MCU JTAG Connector

REFERENCE DESIGNATOR		CONNECTOR	
H1		FCI 95278-101A14LF[1]	
PIN #	SIGNAL NAME	TYPE	NOTES
1	TMS	Piccolo JTAG Mode Select	
2	TRSTn	Piccolo JTAG Reset	Active Low
3	TDI	Piccolo JTAG Data Input	
4	Ground	Ground	
5	3.3V	Power	
6	No Connect	No Connect	This pin is cut off to key the connector
7	TDO	Piccolo JTAG Data Out	
8	Ground	Ground	
9	TCK	Piccolo JTAG Clock	
10	Ground	Ground	
11	TCK	Piccolo JTAG Clock	
12	Ground	Ground	
13	EMU0	Piccolo Programmer Output	Not used, pulled high to 3.3 V
14	EMU1	Piccolo Programmer Output	Not used, pulled high to 3.3 V

(1) This connector was designed to be compatible with the XDS100 and XDS510 programmers from Spectrum Digital.

Table 2-8. LED Thermistor Connector

REFERENCE DESIGNATOR		CONNECTOR	
J11		MOLEX 5023520600	
PIN #	SIGNAL NAME	TYPE	NOTES
1	Ground	Ground	
2	Blue Thermistor	Anode	
3	Ground	Ground	
4	Green Thermistor	Anode	
5	Ground	Ground	
6	Red Thermistor	Anode	

Copyright © 2017, Texas Instruments Incorporated

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ('TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products http://www.ti.com/sc/docs/stdterms.htm), evaluation modules, and samples (http://www.ti.com/sc/docs/sampterms.htm).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2017, Texas Instruments Incorporated