DLP®Products ECD 4K UHD EVM

User's Guide

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Contents

Preface **5**

1 DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM Overview **6**

1.1 Welcome 6

1.2 What is in the DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM Evaluation Modules (EVMs)? 6

1.3 EVM Boards 8

1.4 Other Items Needed for Operation 9

1.5 DLPLCRDC4422EVM, DLPDLCR470TEVM and DLPDLCR660TEVM EVM Flex Cable 10

2 Quick Start **11**

2.1 Downloading the Software 11

2.2 Connecting the DLPDLCR660TEVM, or DLPDLCR470TEVM, to the DLPLCRDC4422EVM 11

2.3 Powering-up the DLPLCRDC4422EVM and preparing for the DLPLCRDC4422EVM to be programmed 14

2.4 Programming the DLPLCRDC4422EVM and Displaying a SPLASH image 15

2.5 Troubleshooting 22

3 Connections **23**

3.1 DLPLCRDC4422EVM Connections 23

3.1.1 Connectors 23

3.1.2 TestPoints 25

3.2 DLPDLCR660TEVM Connections 27

3.2.1 Test Points 28

3.2.2 Connectors 28

3.3 DLPDLCR470TEVM Connections 28

3.3.1 Test Points 30

3.3.2 Connectors 30

4 Power Supply Requirements **31**

4.1 External Power Supply Requirements 31

5 Safety **32**

5.1 Caution Labels 32

5.2 If You Need Assistance 32

Revision History **33**

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List of Figures

1. DLP DLPDLCR660TEVM and DLPLCRDC4422EVM Evaluation Module 5
1-1. DLPLCRDC4422EVM 7
1-2. DLPDLCR660TEVM 7
1-3. DLPDLCR470TEVM 8
1-4. EVM System Block Diagram 9
1-5. Flex Cable Diagram 10
2-1. Flex Cables on DLPDLCR660TEVM 12
2-2. Flex Cables on DLPDLCR470TEVM 13
2-3. EVMs Connected 14
2-4. ON/OFF Switch 15
2-5. DeVaSys Communication Configuration 16
2-6. USB Communication Configuration 16
2-7. Error Message 17
2-8. Projector Control Menu 17
2-9. Adding DLPC4422 Projector Control File 17
2-10. Projector Control File for the Chosen Chipset 18
2-11. DLPC4422 Projector Control Menu 18
2-12. Loading the Flash Image 19
2-13. Downloading Image unto the EVM 20
2-14. Communication Between GUI and EVMs 20
2-15. Splash Image Displayed on DMD 21
2-16. USB Communication Error 22
2-17. I2C communication error 22
2-18. Programming Mode error 22
2-19. Device programming delay increase 22
2-20. Tool bar and panel display settings 22
3-1. DLPLCRDC4422EVM Connectors (Top View) 23
3-2. DLPDLCR660TEVM Test Points and Connectors 27
3-3. DLPDLCR470TEVM Test Points and Connectors 29

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About This Guide

This guide explains the hardware and software features of the DLP Products DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM systems. The EVM architecture and connectors will be described along with a quick start guide on how to operate the DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM EVMs using the DLPC4422 GUI. Specific DLP® chip details and operation can be found in related component documentation.

NOTE: Power supply, optics, illumination source, and cables are sold separately. See Other Items Needed for Operation.

Figure 1. DLP DLPDLCR660TEVM and DLPLCRDC4422EVM Evaluation Module

Related Documentation from Texas Instruments

DLP660TE Data Sheet: DLP660TE Digital Micromirror Device (DMD), DLPS037
DLP470TE Data Sheet: DLP470TE Digital Micromirror Device (DMD), DLPS037
DLPC4422 Data Sheet: DLPC4422 DLP Display Controller, DLPS036
DLPA100 Data Sheet: DLPA100 Power Management and Motor Driver, DLPS040
TPS65145 Data Sheet: TPS65145 Triple Output LCD Supply with Linear Regulator and Power, DLPS053

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DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM Overview

1.1 Welcome

The DLP Products DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM evaluation modules (EVMs) offer a reference design to enable faster development cycles for users of the DLPC4422 chips and allow evaluation of TI's DLP660TE and DLP470TE UHD chipsets. These consist of two DMD EVMs (DLPDLCR660TEVM and DLPDLCR470TEVM) and one controller EVM (DLPLCRDC4422EVM)

These evaluation kits bring together a set of components providing a great starting point to evaluate a UHD DLP system for:

- Laser TV
- Enterprise Projectors
- Digital Signage
- Gaming Machines
- Smart Projectors
- State Lighting Systems

1.2 What is in the DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM Evaluation Modules (EVMs)?

The DLPDLCR660TEVM, DLPDLCR470TEVM and DLPLCRDC4422EVM are designed to be used in pairs. The DMD EVMs cannot operated with the Controller EVM, DLPLCRDC4422EVM.

The DLPDLCR660TEVM, which includes the DLP660TE display chip, and the DLPDLCR470TEVM include the two flex cables required to connect to the DLPLCRDC4422EVM. DLPLCRDC4422EVM includes all circuitry required to drive the DLP660TE & DLP470TE display chip.

The DLPLCRDC4422EVM includes two DLPC4422 controllers in master-slave mode, two DLPA100s which serve as the power management and motor drivers, and other system circuitry such as the Vx1 receiver and system fan control.

The DLPLCRDC4422EVM can be programmed with either the DLP660TE or DLP470TE firmware which is available on the DLPC4422 product page. This firmware allows the DLPLCRDC4422EVM to drive either display chip. Figure 1-1 and Figure 1-2 show the top side of each EVM.

NOTE: Figure 1-2 does not show the necessary flex cables needed to pair to DLPLCRDC4422EVM.

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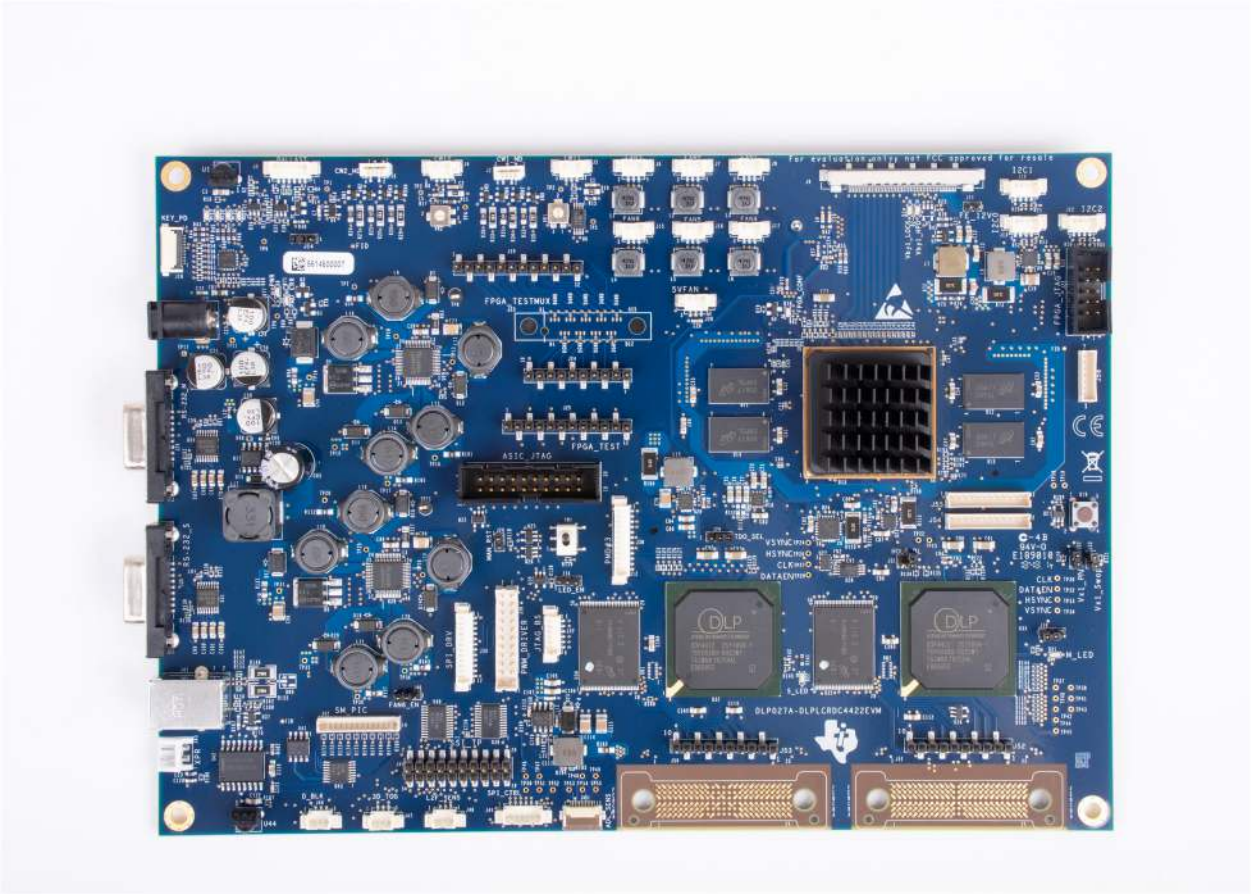

Figure 1-1. DLPLCRDC4422EVM

Figure 1-2. DLPDLCR660TEVM

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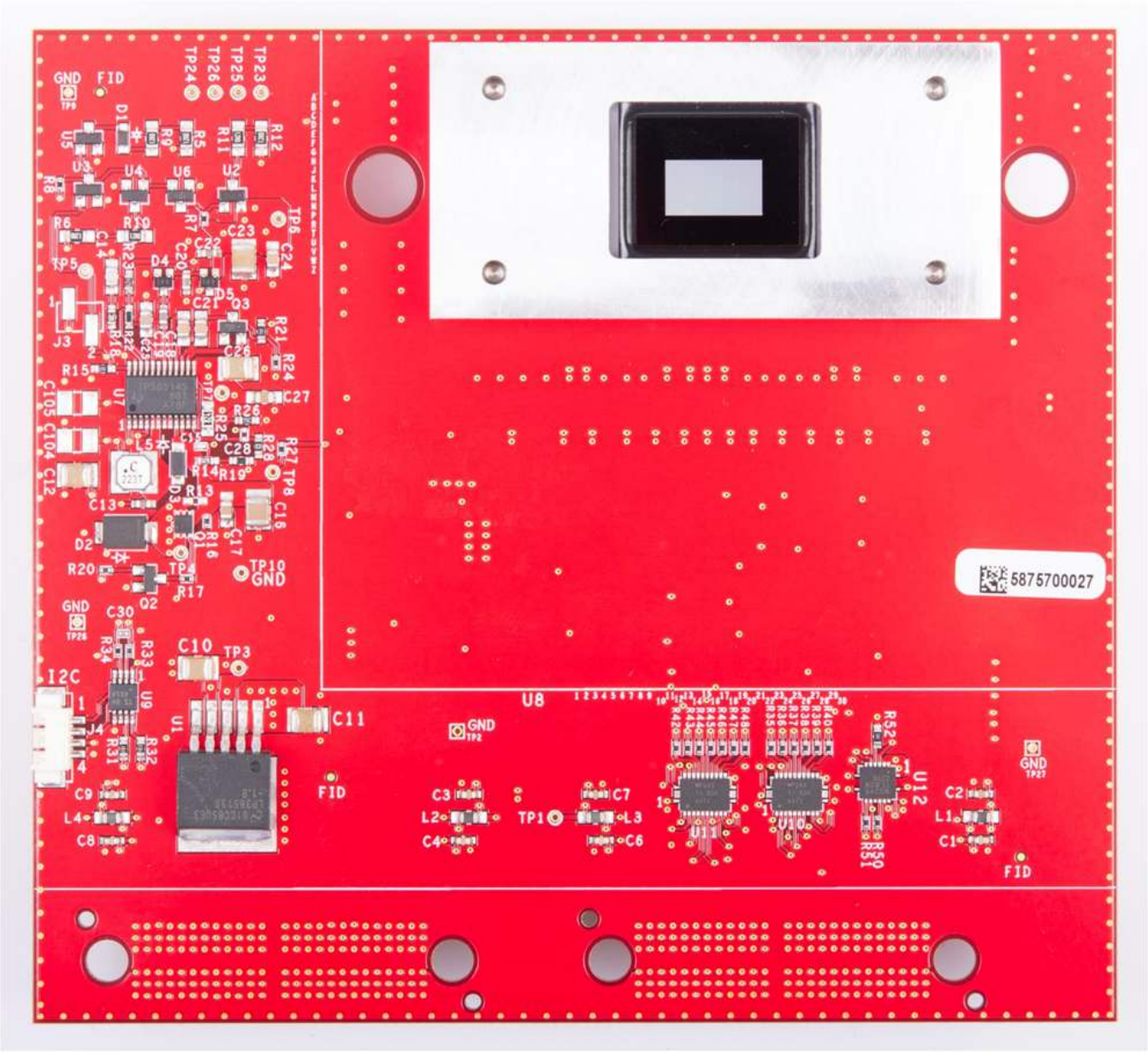

Figure 1-3. DLPDLCR470TEVM

1.3 EVM Boards

The DLPDLCR660TEVM, DLPDLCR470TEVM and DLPDLCRDC4422EVM EVMs contain the electronics required to drive either DLP660TE or DLP470TE DMD. The DLPLCRDC4422EVM offers several interface options for USB, I2C, and trigger inputs and outputs.

The system block diagram Figure 1-4 details the functionality and control when using the DLPDLCR660TEVM and DLPDLCRDC4422EVM.

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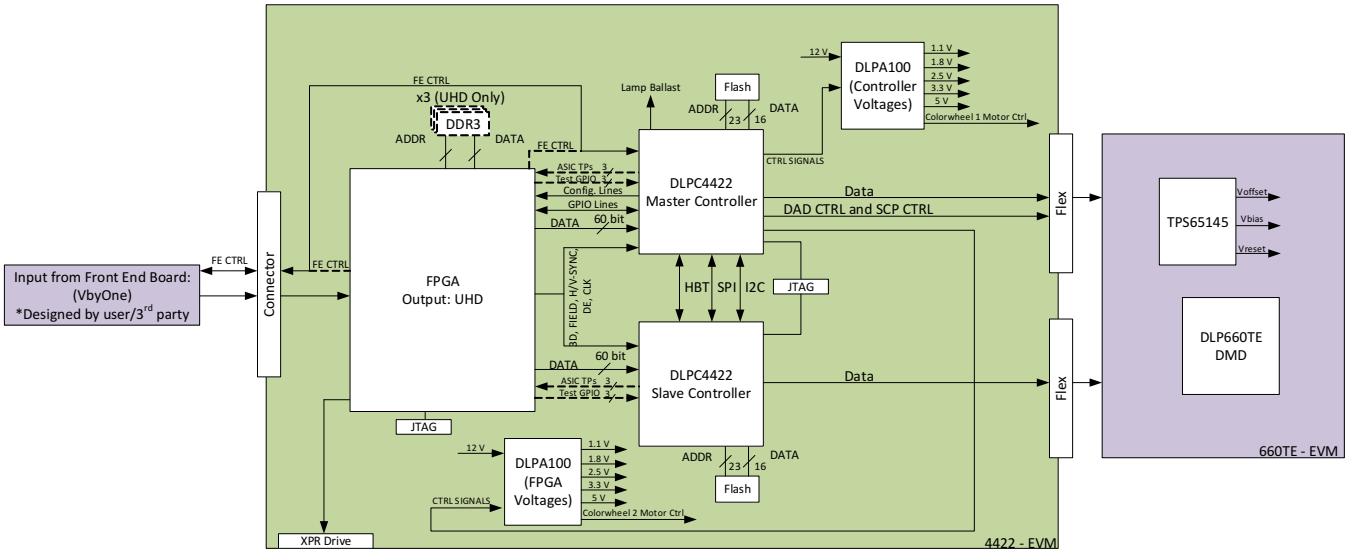

Figure 1-4. EVM System Block Diagram

The major components of the DLPLCRDC4422EVM are:

- Two DLPC4422 controllers
- Two DLPA100 power management and motor driver chips
- Altera FPGA used to split incoming Vx1 data for the two DLPC4422 controllers

The major components of the DLPDLCR660TEVM are:

- DLP660TE 0.66-inch UHD DMD
- Two flex cables designed to connect the DLPDLCR660TEVM to the DLPLCRDC4422EVM
- TPS65145 used to generate the DMD's reset voltages

The major components of the DLPDLCR470TEVM are:

- DLP470TE 0.47-inch UHD DMD
- Two flex cables designed to connect the DLPDLCR470TEVM to the DLPLCRDC4422EVM
- TPS65145 used to generate the DMD's reset voltages

1.4 Other Items Needed for Operation

The DLPDLCR660TEVM, DLPDLCR470TEVM and the DLPLCRDC4422EVM are evaluation modules (EVM) that are capable of displaying images on to the DMD. However, these EVMs do not ship with optics, illumination source, cables, power supplies, or additional hardware components. These are system parameters that are left for the user to design, the EVMs are meant to accelerate initial system design.

- Power supply (See Section 4.1)
- Mini-USB cable: A to B USB cable
- Optics
- Illumination module and source
- Front-End Vx1 Source capable of running at 600 MHz pixel clock

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1.5 DLPLCRDC4422EVM, DLPDLCR470TEVM and DLPDLCR660TEVM EVM Flex Cable

Electrical malfunctions can occur by stressing the flex cable(s) connecting the DMD circuit board to the DLPLCRDC4422EVM controller circuit board. Stressing the flex cable can be caused by:

- Bending the cable outside the area identified in Figure 1-5 (within 20.3 mm of connector plate centers).
- Repeatedly bending the flex cable(s) where the bend radius is less than 25.4 mm.
- A single bending of the flex cable(s) where the bend radius is less than 6.35 mm.

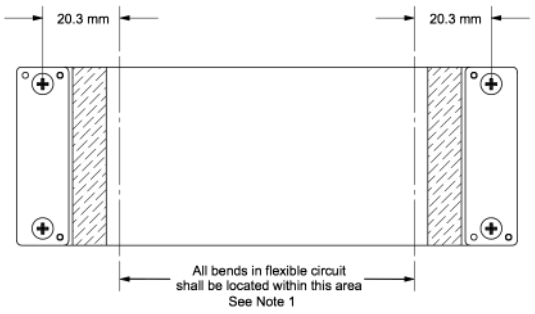

Figure 1-5. Flex Cable Diagram

NOTE: The minimum bend radius for forming flex cable (flexible) circuit is 6.35 mm

Minimize any handline/movement on the flex cables during operation

Use caution when bending the flex cable to not exceed bending guidelines explained above.

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Quick Start

This chapter offers a quick start guide on how to connect the DLPDLCR660TEVM or DLPDLCR470TEVM to the DLPLCRDC4422EVM, how to power up the DLPLCRDC4422EVM, and how to program the DLPLCRDC4422EVM to display a SPLASH image on the DMD.

2.1 Downloading the Software

Before programming the DLPLCRDC4422EVM, ensure the DLPC4422 GUI and DMD firmware are both downloaded on the PC. The DLPC4422 GUI will allow for operation of the EVM and the DMD firmware is required so the DLPLCRDC4422EVM knows which DMD is being controlled. If the DLPDLCR660TEVM is being used with the DLPLCRDC4422EVM, the DLP660TE firmware is needed. Else if the DLPDLCR470TEVM is used, the DLP470TE firmware is needed.

The DLP660TE firmware and DLPC4422 GUI can be found under the “Tools and Software” tab on the product pages on TI.com. These are the product pages for the DLP660TE, the DLP470TE, and the DLPC4422.

2.2 Connecting the DLPDLCR660TEVM, or DLPDLCR470TEVM, to the DLPLCRDC4422EVM

Before connecting the DLPDLCR660TEVM/DLPDLCR470TEVM to the DLPLCRDC4422EVM, locate the two flex cables that are packaged with either the DLPDLCR660TEVM/DLPDLCR470TEVM. Ensure the flex cables are not torn or damaged before connecting the DMD EVMs or the DLPLCRDC4422EVM.

The flex cables are exactly the same, meaning there is not a “right” or “left” cable. The cables are interchangeable, as long as the side of each cable labeled “DMD END” is connected to the DLPDLCR660TEVM/DLPDLCR470TEVM and the other end is connected to the DLPLCRDC4422EVM.

The steps for the connecting the EVMs are listed below:

1. Unscrew and remove the backer plate on each end of the flex cable.
2. Position the flex cable end which says “DMD END” to the backside of the DMD board.
3. Insert the two guide pins of the flex cable into the DMD board.
4. Using the guide pins, place one backer plate on the front side of the DMD board.
5. Screw the flex cable screws clockwise into the backer plate until nearly fully inserted
6. Take turns screwing in the screws so until each is lightly snug. Do not over-tighten.

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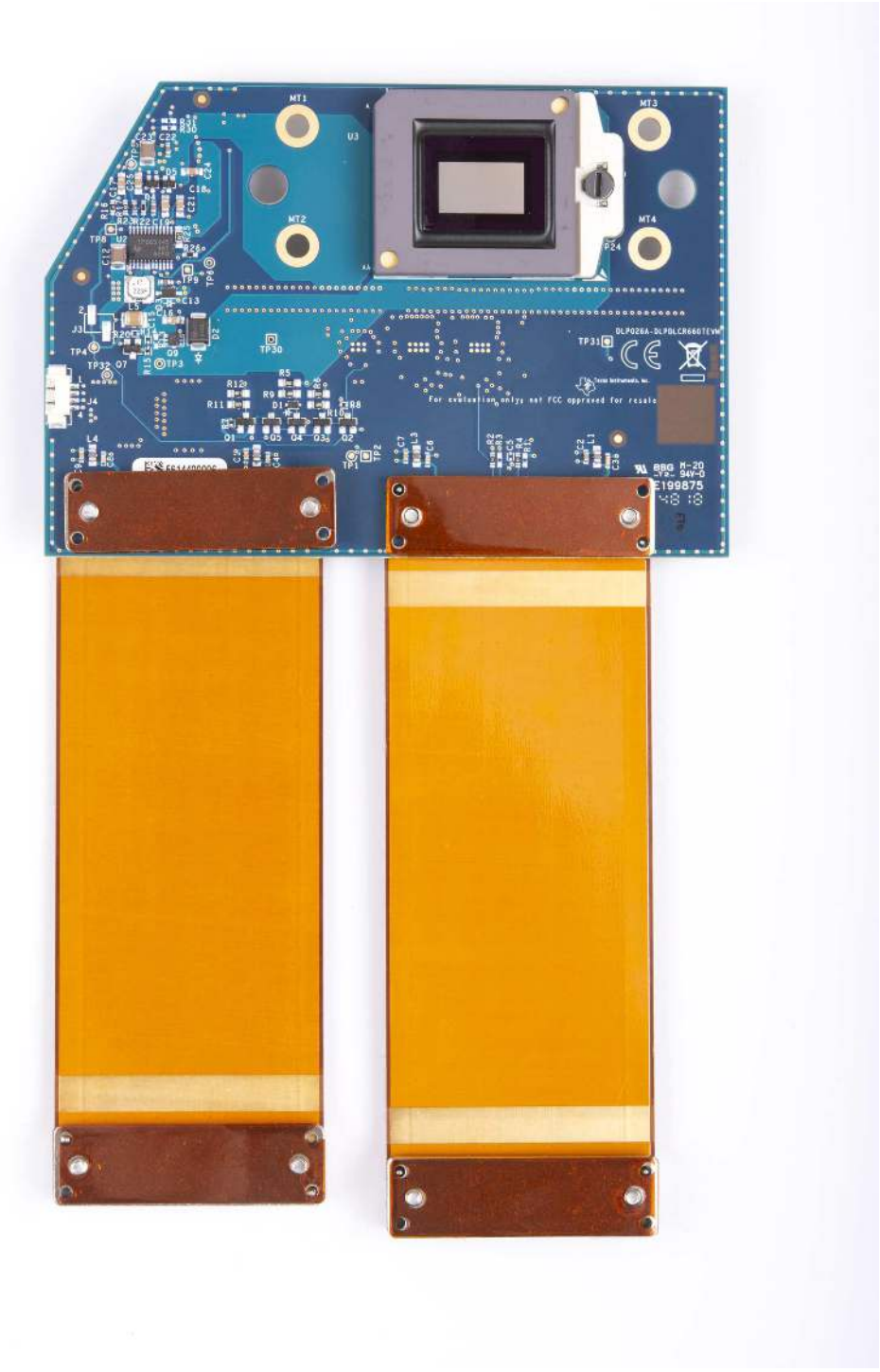

Figure 2-1. Flex Cables on DLPDLCR660TEVM

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Figure 2-2. Flex Cables on DLPDLCR470TEVM

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Repeat the above steps to connect the other end of each flex cable to the DLPLCRDC4422EVM. The EVM should look like after the flex cables have been connected to both the DLPDLCR660TEVM and the DLPLCRDC4422EVM. The process is the same for use with the DLPDLCR470TEVM.

Figure 2-3. EVMs Connected

2.3 Powering-up the DLPLCRDC4422EVM and preparing for the DLPLCRDC4422EVM to be programmed

Before powering up the EVM, ensure the included DLPLCRDC4422EVM jumpers are in the correct positions. The jumper locations are listed in Section 3.1.1 .

Table 2-1. Reference Designators

Jumper	Description (Bold Indicates Default Position)
J11 - Front End 12V	**Unistalled - Main Board is Powered From its Own AC Adaptor** Installed - Front End Board Provides Power to Main Board
J14 - Blue LED enable or Lamp Ballast	Pins 1,2 connected Blue LED Enable **Pins 2,3 connected Lamp Mode**
J28 - TDO1 or TDO2	Pins 1,2 connected TDI in to slave is from TDO1 from Master **Pins 2,3 connected TDI in to slave is from TDO2 from Master**
J29 - Manual Reset	**Uninstalled - Normal Operation** Installed - Hold in Reset
J31 - Hold in Boot Loader	**Uninstalled - Normal Operation** Installed - Hold in Boot Loader

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Table 2-1. Reference Designators (continued)

Jumper	Description (Bold Indicates Default Position)
J32 - Vx1 Swap P/N	Uninstalled - Swapping P and N **Installed - Not Swapping P and N**
J33 - Vx1 Swap Bit Order	Uninstalled - Swapping Bit Order **Installed - Not Swapping Bit Order**
J34 - LED Enable Invert	Pins 1,2 connected LED_EN inverted Pins 2,3 connected LED_EN not inverted
J38 - Light to Frequency Sensor or ADC Integrating Sensor	**Pins 1,2 connected ADC Integrating Sensor** Pins 2,3 connected Comparator Sensor
J40 - High Current Fan 5 or Fan 6	Pins 1,2 connected for High Current Fan 5 **Pins 2,3 connected for Fan 6**

Jumper J31 is the “Hold BL” jumper. This jumper is used to put the DLPLCRDC4422EVM into boot loader mode, which allows the DLPC4422 controllers to be programmed. Connect this jumper to prepare the DLPLCRDC4422EVM to be programmed.

To power up the DLPLCRDC4422EVM, a 12V, 5A power supply is needed. Ensure the power supply is functional and the switch SW1 on the EVM is set to off before connecting the power supply to the EVM. Connecting the power supply when the switch is in the off position may prevent damage to the DLPLCRDC4422EVM from poor power connections. The image below shows SW1 in the on position.

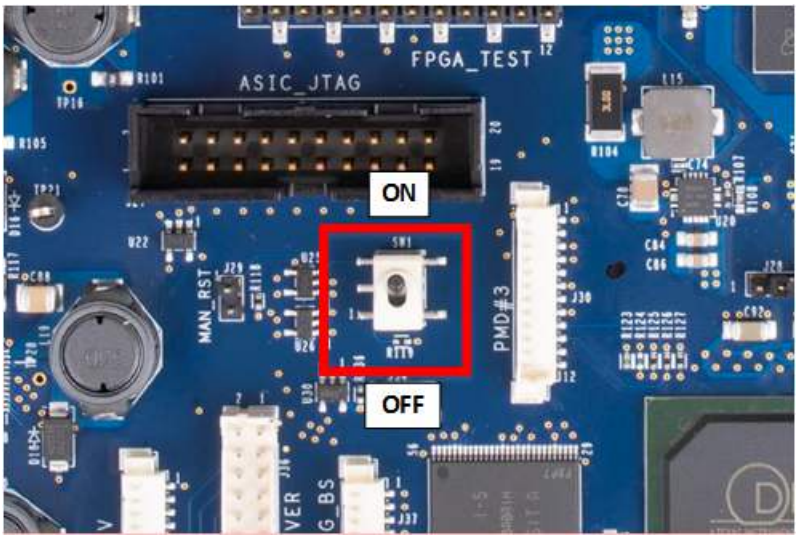

Figure 2-4. ON/OFF Switch

Once the power supply has been connected to the DLPLCRDC4422EVM, the switch SW1 can be flipped to the “on” position. You can then plug in the USB cable into the board to prepare for programming the board.

2.4 Programming the DLPLCRDC4422EVM and Displaying a SPLASH image

Follow these steps in order to download and configure the DLPC4422 GUI.:

1. Download and install the DLPDLCR660TEVM Firmware SW package. The Projector Control (.projector) and Firmware binary(.img) files will be located in the install directory. The same procedure applies to the DLPDLCR470TEVM with the appropriate firmware.
2. Setting up Communication Preferences:
   a. DLPC4422 GUI supports USB and I2C communication. To change these settings, please go to Edit- >Preferences->Communication.

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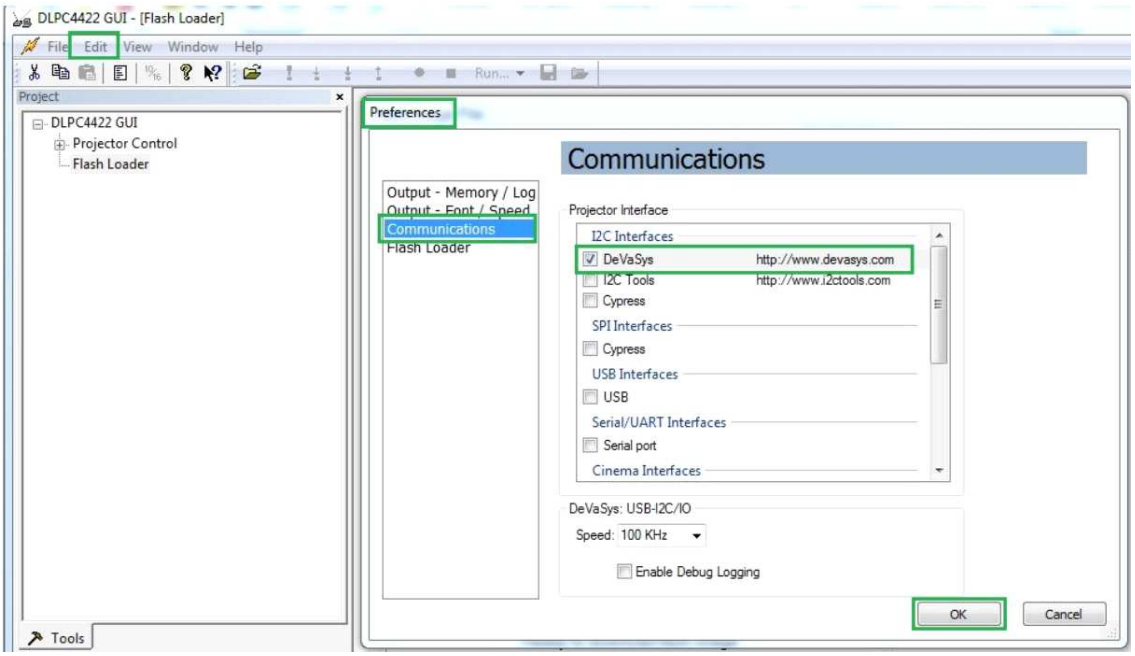

Figure 2-5. DeVaSys Communication Configuration

b. For USB, please select the USB interface. Note: USB is the preferred method to download the firmware flash image to the projector as it is much faster than I2C.

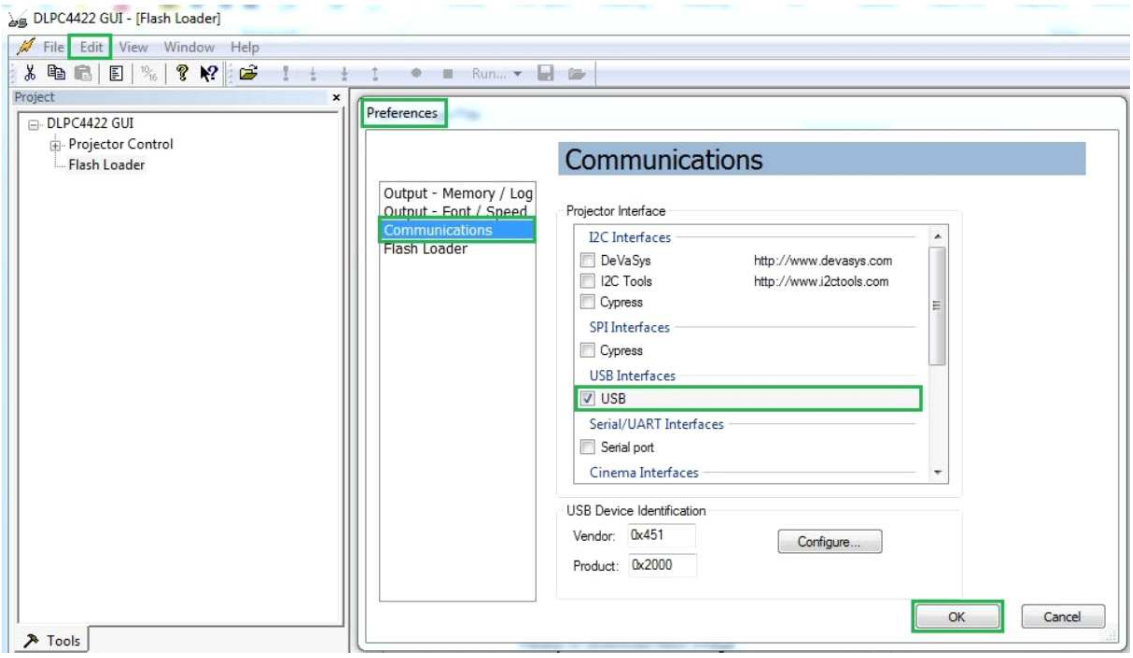

Figure 2-6. USB Communication Configuration

c. An error message may appear saying the USB driver cannot be opened. This is expected, as we have not yet enabled communication on the board. Click “OK” on this error.

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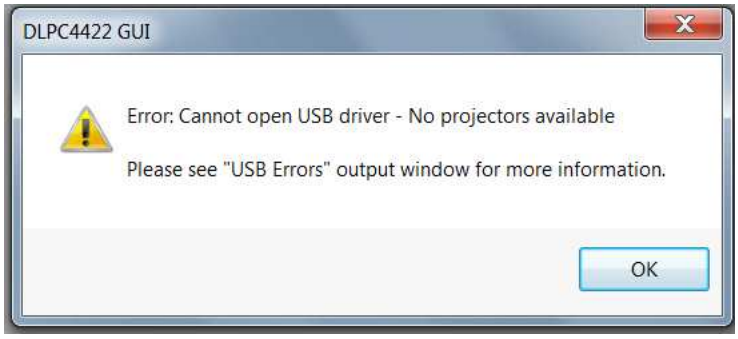

Figure 2-7. Error Message

3. Projector Control Configuration:
   a. Run the DLPC4422 GUI tool and select the Projector Control sub-tool

Figure 2-8. Projector Control Menu

   b. Select Open Projector File then select Add. Navigate to the .projector file location installed in step 1

Figure 2-9. Adding DLPC4422 Projector Control File

   c. Ensure the desired Projector Control file is checked, then select OK. Note: If you want to use one Projector Control file at a time, please deselect the files you do not want to see before selecting OK.

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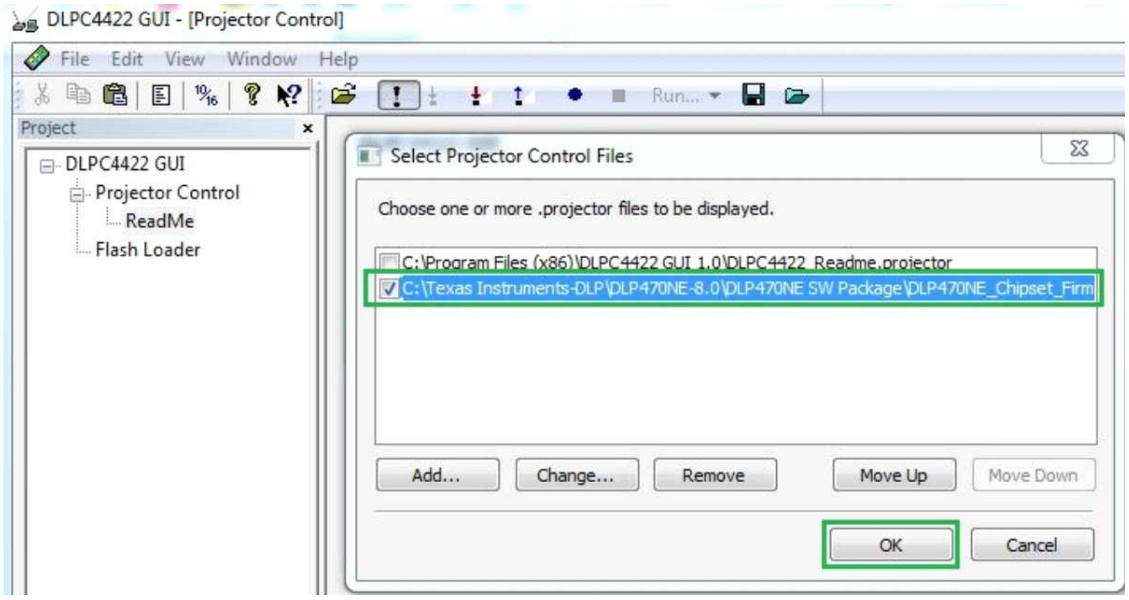

Figure 2-10. Projector Control File for the Chosen Chipset

d. Once this file is loaded, you can navigate through its pages to control a DLPC4422 controller.

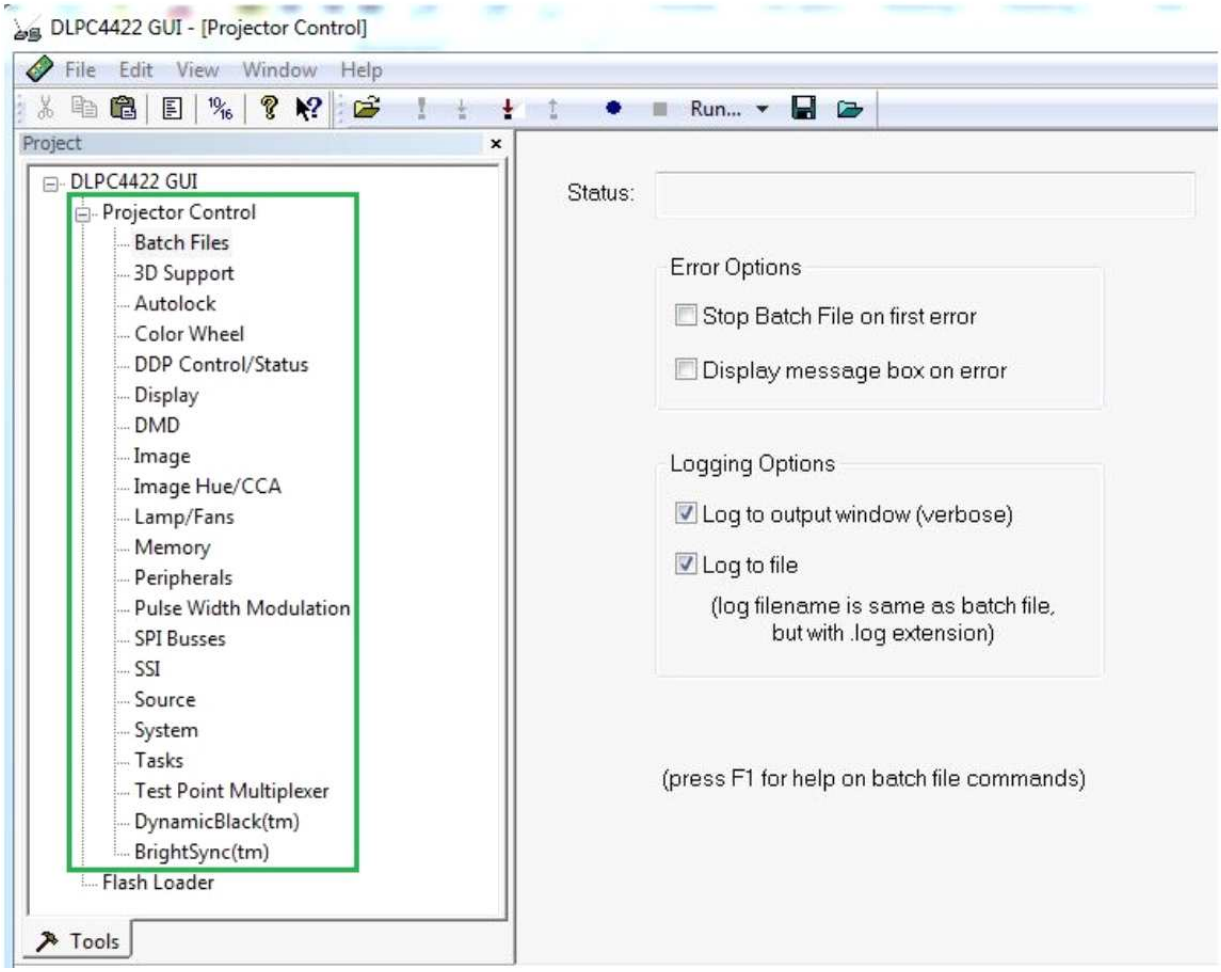

Figure 2-11. DLPC4422 Projector Control Menu

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4. Flash Loader Configuration:
   a. Select the Flash Loader sub-tool, and then select the Browse button. The default location after downloading the EXE file should be “C:\Texas Instruments-DLP\DLP660TE-8.1\SW V8.1\DLP660TE_Chipset_Firmware_v8.1”. After navigating to this directory, select the “Flash_DUAL_DLPC4422_DLP660TE_LED.img” file and click on "open".

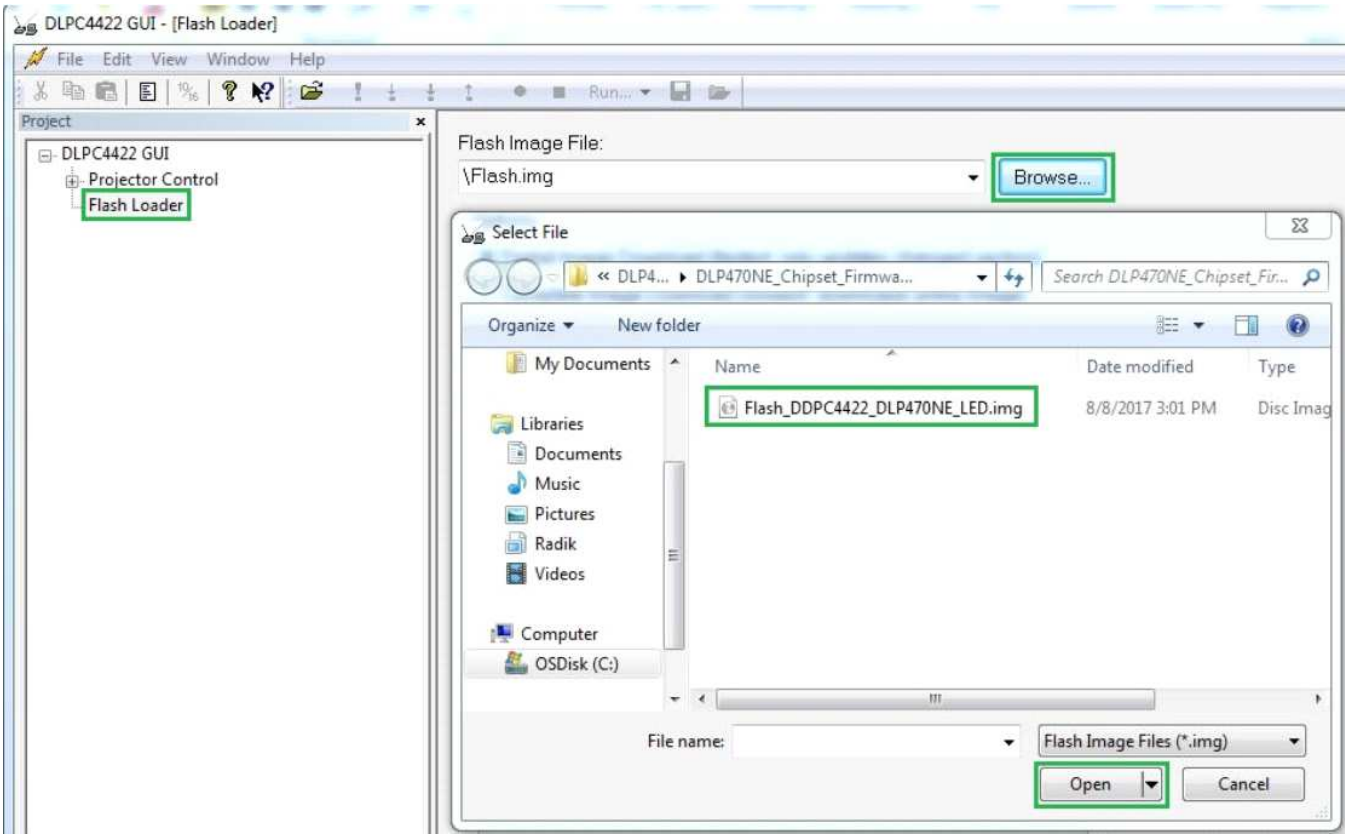

Figure 2-12. Loading the Flash Image

   b. Select Complete Image Download for first time download. The flash should have the boot loader pre-loaded; uncheck the Skip Boot Loader Area. Check this only if you need to upgrade the bootloader.

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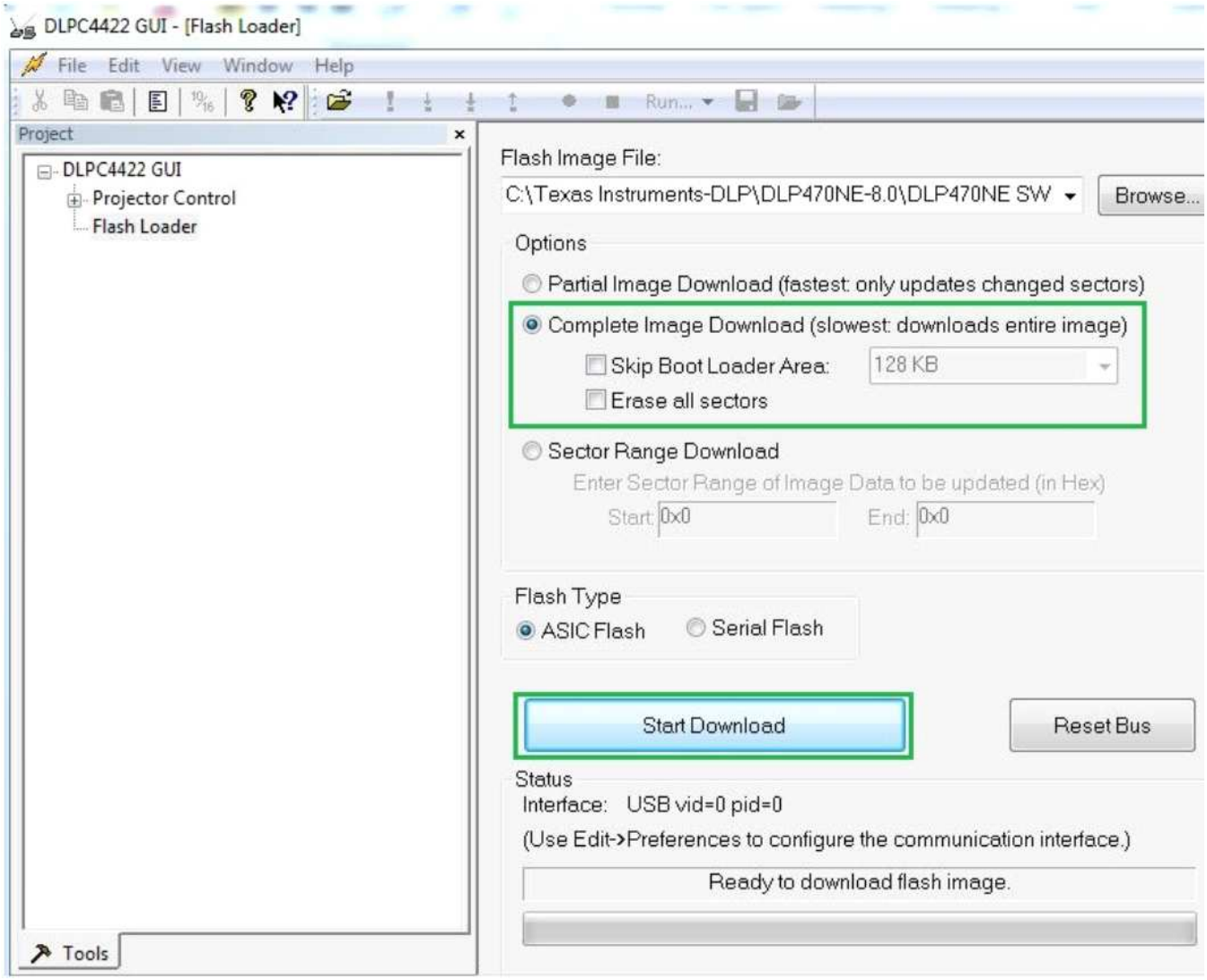

Figure 2-13. Downloading Image unto the EVM

c. 7. Connect DLPLCRDC4422EVM to PC via USB. Ensure USB communication capability by clicking “Reset Bus” on the bootloader menu in the DLPC4422 GUI. The “Status” field should look as follows:

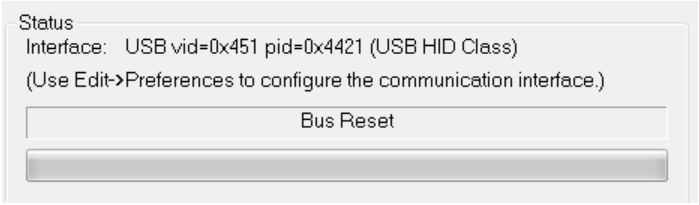

Figure 2-14. Communication Between GUI and EVMs

NOTE: If there is an issue with USB communication, turn off DLPLCRDC4422EVM and disconnect then reconnect USB cable and power on board.

d. Select Start Download to begin.

e. Click “Start Download”. The loading process should take between 5 and 10 minutes.

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f. After the download has completed, switch SW1 to “off” and switch the power to the UUT off. Remove the jumper on J31 from the DLPLCRDC4422EVM board.

g. After removing the jumper, re-enable power to the DLPLCRDC4422EVM. Switch SW1 to the “On” position. A Red LED should appear after a few seconds. The Red LED will shut off and a green LED will begin blinking. After the blinking LED appears, the DLP Texas Instruments logo should be visible on the DMD for a few seconds. The DMD should be appear as follows:

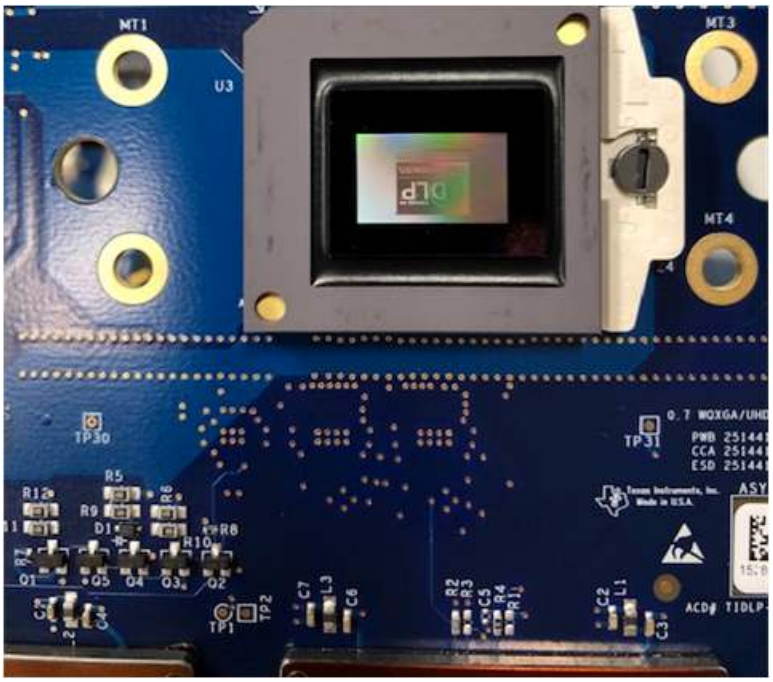

Figure 2-15. Splash Image Displayed on DMD

Turn the switch back to the “off” position before connecting the USB cable to DLPLCRDC4422EVM. The power supply does not have to be disconnected before connecting the USB cable. Once the USB cable is connected to the DLPLCRDC4422EVM (and the PC), turn the switch on the DLPLCRDC4422EVM to the “on” position.

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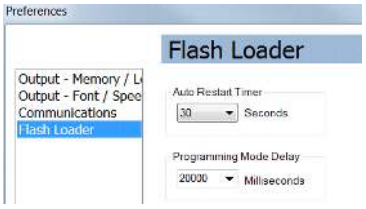
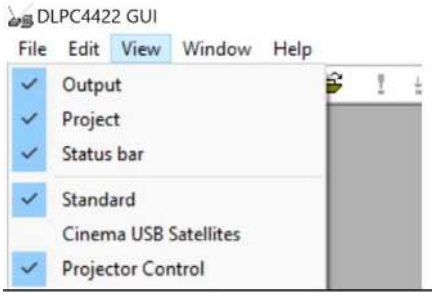
2.5 Troubleshooting

Problem	Possible solutions
USB Communication Error **Figure 2-16. USB Communication Error**	Verify the correct communication settings have been applied. Ensure the USB cable is connected both to the projector and computer.
I2C communication error **Figure 2-17. I2C communication error**	Verify the correct communication settings have been applied. Ensure a DeVaSys box and the appropriate USB and I2C cables are connected.
Programming Mode error **Figure 2-18. Programming Mode error**	Please check your connection settings and try again. Note: If this occurs only occasionally, increase the programming delay to 20000ms.  **Figure 2-19. Device programming delay increase**
Tool bars or panels missing	 **Figure 2-20. Tool bar and panel display settings**

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Connections

This chapter introduces all the connections and test points available on the DLPLCRDC4422EVM and DLPDLCR660TEVM.

3.1 DLPLCRDC4422EVM Connections

Figure 3-1 depicts the switches and connectors with their respective locations. Note that neither cables nor the power supply is included with the module.

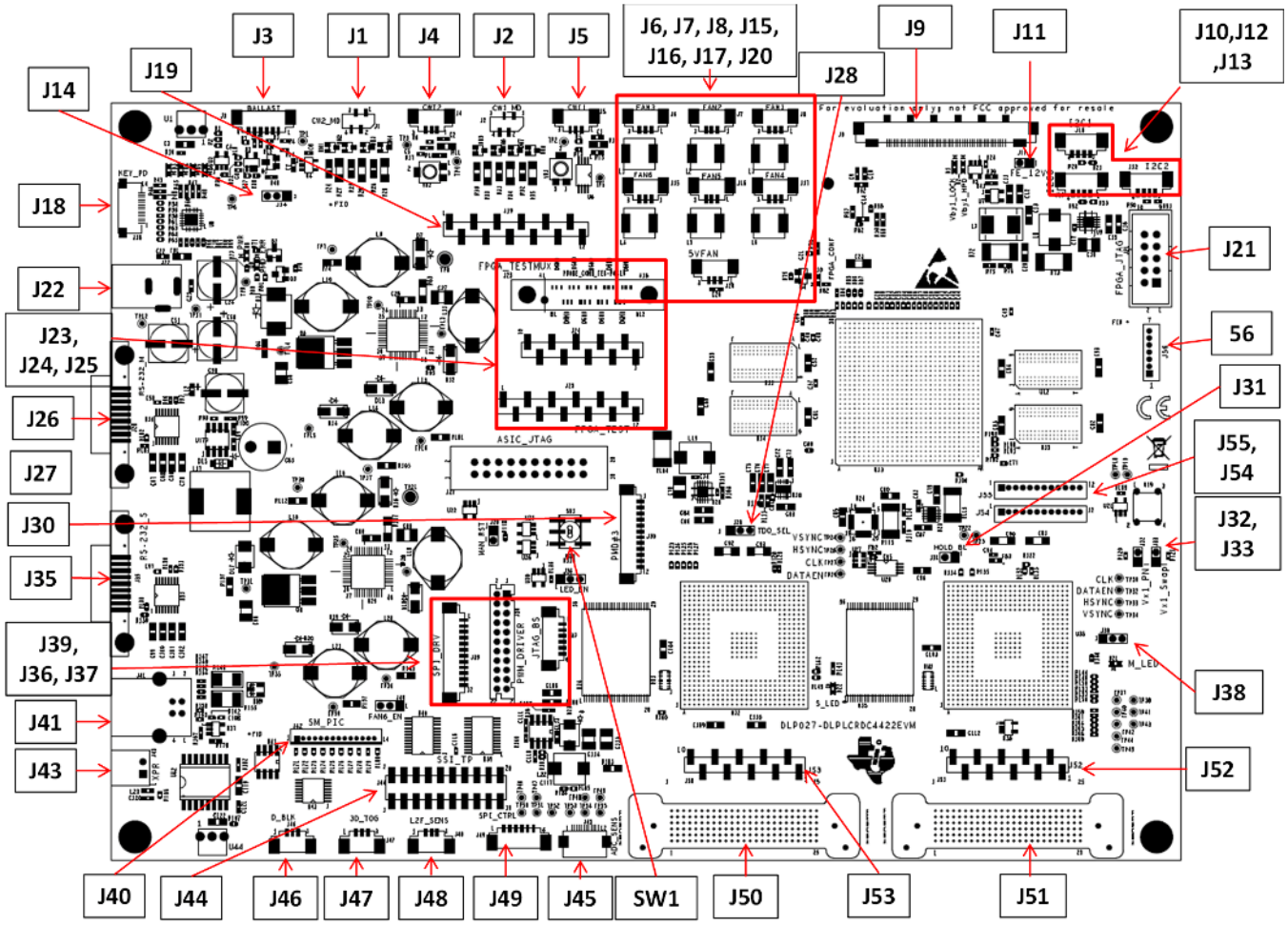

Figure 3-1. DLPLCRDC4422EVM Connectors (Top View)

3.1.1 Connectors

1. **J1** – Colorwheel #2 motor drive
2. **J2** – Colorwheel #1 motor drive

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3. **J3** – Lamp Ballast Control
4. **J4** – Colorwheel #2 Index Sensor
5. **J5** – Colorwheel #1 Index Sensor
6. **J6** – Fan #3
7. **J7** – Fan #2
8. **J8** – Fan #1
9. **J9** – V-By-One Input
10. **J10** – I2C1 Bus
11. **J11** – FE_12V
12. **J12** – I2C2 Bus
13. **J13** – I2C0 Bus
14. **J14** - Blue_LED_EN / Lamp Mode
15. **J15** - FAN #6
16. **J16** - FAN #5
17. **J17** - FAN #4
18. **J18** - Keyboard Interface
19. **J19** - FPGA Testmux Header
20. **J20** - 5V Fan
21. **J21** – FPGA_JTAG
22. **J22** - 12V Input
23. **J23** - FPGA Testmux
24. **J24** - FPGA Testmux Header
25. **J25** - FPGA Test Points
26. **J26** - RS_232_M (Master)
27. **J27** - ASIC JTAG
28. **J28** - JTAG TDO1/2 Bus Selection
29. **J29** - Manual Reset Jumper
30. **J30** - Optional DLP1000 #3 Header
31. **J31** - HOLD_BL
32. **J32** – Vx1 Swap PN
33. **J33** – Vx1 Swap Bit Order
34. **J34** - LED_EN
35. **J35** - RS_232_S (Slave)
36. **J36** - PWM SSI Driver I/F
37. **J37** - JTAG Boundary Scan
38. **J38** – ADC Sensor Interface
39. **J39** - SPI Driver and Control I/F
40. **J40** – FAN6_EN
41. **J41** – Mini-USB
42. **J42** –SM_PIC (Actuator Test Points)
43. **J43** - XPR
44. **J44** – SSI_TSP
45. **J45** – ADC Integrating Sensor Board I/F
46. **J46** – D_BLK
47. **J47** – 3D_TOG

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48. **J48** – L2F_Sens
49. **J49** – SSI SPI Control
50. **J50** – Flex Cable Connector
51. **J51** – Flex Cable Connector
52. **J52** – 4422 (Master) Testpoints
53. **J53** – 4422 (Slave) Testpoints
54. **J54** - Actuator Interface
55. **J55** - Actuator Interface
56. **J56** - Actuator Interface

3.1.2 TestPoints

1. **TP1** - LAMPLITZ_FLTR
2. **TP2** - CW1 Sense Input
3. **TP3** - CW2 Sense Input
4. **TP4** - CW_INDEX2
5. **TP5** - CW_INDEX1
6. **TP6** - LMPCTRL
7. **TP7** - P5V_M
8. **TP8** - GND
9. **TP9** - P12V
10. **TP10** - A1P8V_M
11. **TP11** - P12V
12. **TP12** - GND
13. **TP13** - CW_PWM1
14. **TP14** - P1P1V_M
15. **TP15** - P1P8V_M
16. **TP16** - P3P3V_M
17. **TP17** - P2P5V_M
18. **TP18** - ACT_SYNC_0
19. **TP19** - ACT_SYNC_1
20. **TP20** - P5V_S
21. **TP21** - GND
22. **TP22** - EXT_ARSTZ
23. **TP23** - MTR_ARSTZ
24. **TP24** - S_P1_VSYNC
25. **TP25** - A1P8V_S
26. **TP26** - S_P1_HSYNC
27. **TP27** - S_P_CLK1
28. **TP28** - CW_PWM2
29. **TP29** - S_P_DATAEN1
30. **TP30** - M_P_CLK1
31. **TP31** - P1P1V_S
32. **TP32** - M_P_DATAEN1
33. **TP33** - M_P1_HSYNC
34. **TP34** - M_P1_VSYNC
35. **TP35** - P1P8V_S

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36. **TP36** - P3P3V_S
37. **TP37** - SSP0_CSZ0
38. **TP38** - DADSTB
39. **TP39** - P2P5V_S
40. **TP40** - SSP0_CSZ1
41. **TP41** - SSP0_RXD
42. **TP42** - SSP0_CSZ2
43. **TP43** - A_SSP0_CLK
44. **TP44** - SSP0_CSZ3
45. **TP45** - A_SSP0_TXD
46. **TP46** - LED_SCLK
47. **TP47** - LED_DIN
48. **TP48** - ADC_SCLK
49. **TP49** - ADC_SDO
50. **TP50** - LED_DOUT
51. **TP51** - LED_OE
52. **TP52** - LED_DIR
53. **TP53** - ADC_RST
54. **TP54** - ADC_SDIN
55. **TP55** - ADC_CSZ
56. **TP500** - GND

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3.2 DLPDLCR660TEVM Connections

Figure 3-2 depicts the switches and connectors with their respective locations.

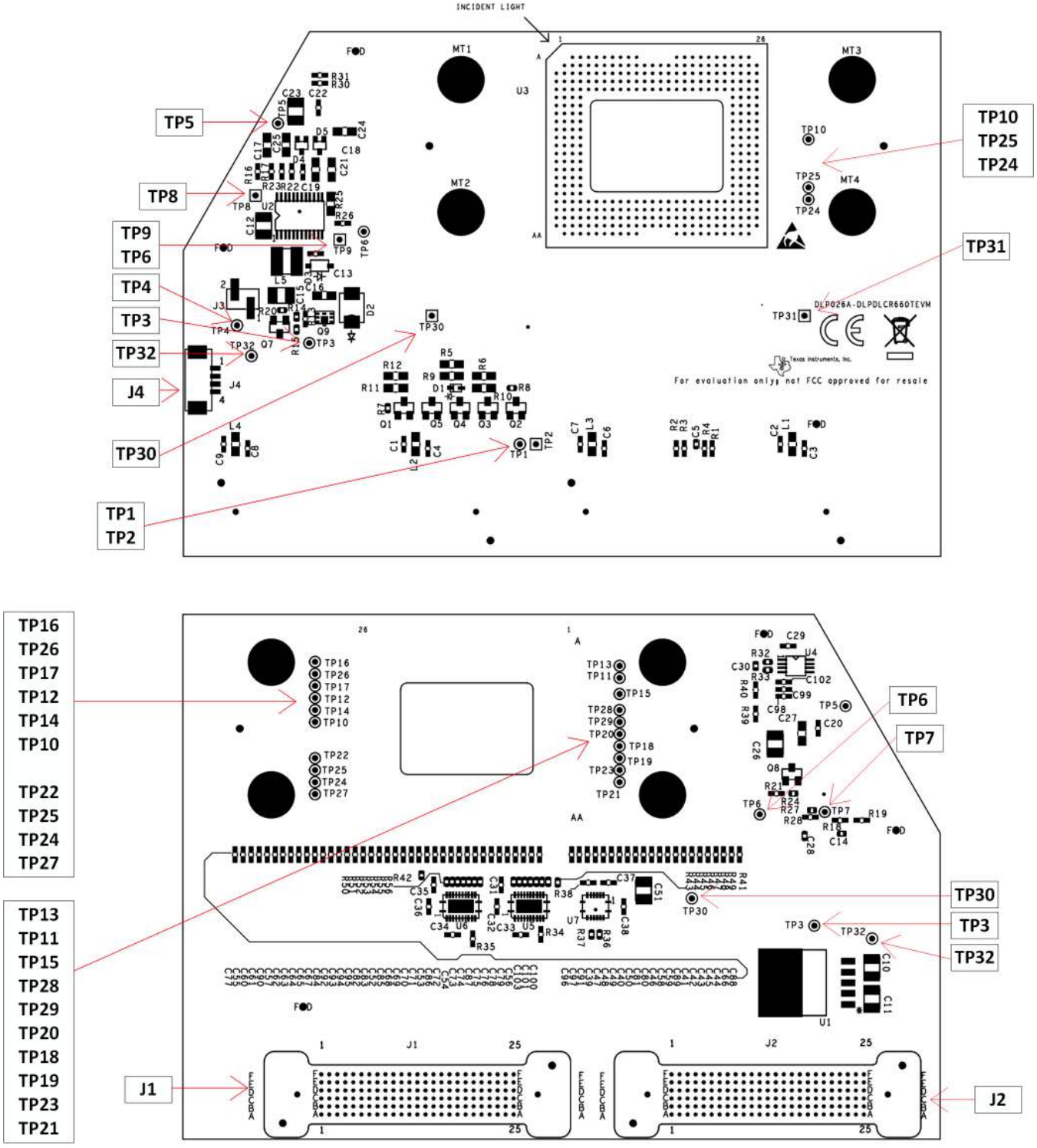

Figure 3-2. DLPDLCR660TEVM Test Points and Connectors

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3.2.1 Test Points

1. **TP1** - DMD_P3P3V
2. **TP2** - GND
3. **TP3** - VOFFSET
4. **TP4** - EN_OFFSET
5. **TP5** - VRESET
6. **TP6** - VBIAS
7. **TP7** - PG_OFFSET
8. **TP8** - GND
9. **TP9** - GND
10. **TP10** - MBRST0*
11. **TP11** - MBRST1*
12. **TP12** - MBRST2*
13. **TP13** - MBRST3*
14. **TP14** - MBRST4*
15. **TP15** - MBRST5*
16. **TP16** - MBRST6*
17. **TP17** - MBRST7*
18. **TP18** - MBRST8*
19. **TP19** - MBRST9*
20. **TP20** - MBRST10*
21. **TP21** - MBRST11*
22. **TP22** - MBRST12*
23. **TP23** - MBRST13*
24. **TP24** - MBRST15*
25. **TP25** - MBRST14*
26. **TP26** - N/A
27. **TP27** - N/A
28. **TP28** - N/A
29. **TP29** - N/A
30. **TP30** - GND
31. **TP31** - GND
32. **TP32** - DMD_P1P8V

NOTE: (*) - These signals are not internally connected in the DMD

3.2.2 Connectors

1. **J1** - Flex Cable Connector
2. **J2** - Flex Cable Connector
3. **J4** - I2C

3.3 DLPDLCR470TEVM Connections

depicts the switches and connectors with their respective locations.

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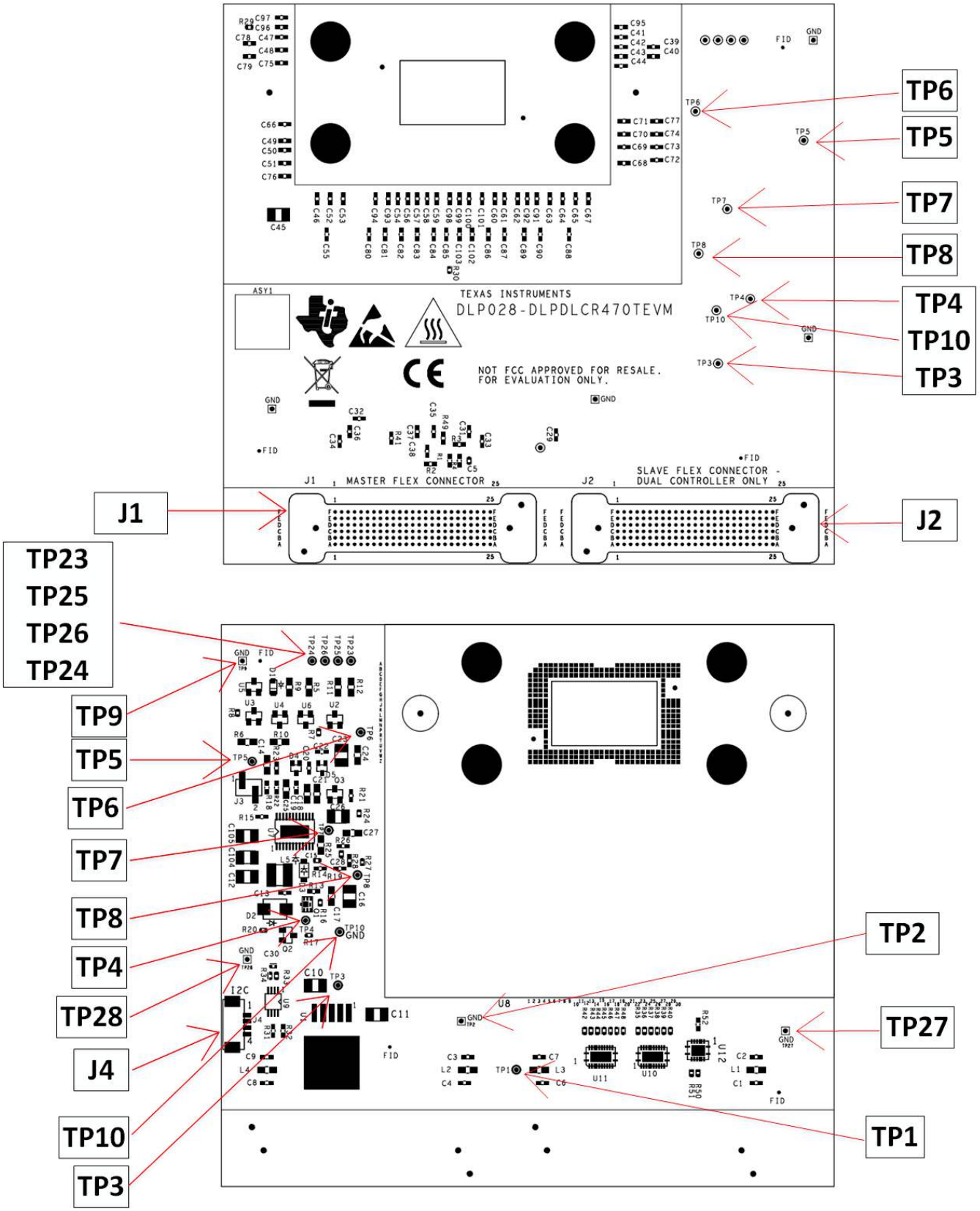

Figure 3-3. DLPDLCR470TEVM Test Points and Connectors

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3.3.1 Test Points

1. **TP1** - DMD_P3P3V
2. **TP2** - GND
3. **TP3** - DMD_P1P8V
4. **TP4** - VOFFSET
5. **TP5** - EN_OFFSET
6. **TP6** - VRESET
7. **TP7** - VBIAS
8. **TP8** - PG_OFFSET
9. **TP9** - GND
10. **TP10** - GND
11. **TP23** - BIST_A
12. **TP24**- BIST_B
13. **TP25**- BIST_C
14. **TP26**- BIST_D
15. **TP27** - GND
16. **TP28** - GND

3.3.2 Connectors

1. **J1** - Flex Cable Connector
2. **J2** - Flex Cable Connector
3. **J4** - I2C

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Power Supply Requirements

4.1 External Power Supply Requirements

The DLPLCRDC4422EVM does not include a power supply. The external power supply requirements are:

- Nominal voltage: 12-V DC -5%/+10%
- Maximum Output Current: 7 A
- DC connector size:
  - Inner diameter: 2.5 mm
  - Outer diameter: 5.5 mm
  - Shaft: 9.5-mm female, center positive
- Efficiency level: V
- A recommended power supply is
- *Digi-Key part number 993-1009-ND*, or equivalent

NOTE: External Power Supply Regulatory Compliance Certifications: Recommend selection and use of an external power supply, which meets TI's required minimum electrical ratings in addition to complying with applicable regional product regulatory and safety certification requirements such as (by example) UL, CSA, VDE, CCC, PSE, and so forth.

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Safety

5.1 Caution Labels

CAUTION

The kit contains ESD-sensitive components.
Handle with care to prevent permanent damage.

5.2 If You Need Assistance

Refer to the

DLP E2E Community support forums.

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (March 2019) to A Revision	Page
• Added DLPDLCR470TEVM to the User's Guide; a global change.	5
• Changed "Together" to "in pairs" in Section 1.2	6
• Changed "The DLPLCRDC4422EVM can be programmed with the DLP660TE firmware which is available on the DLPC4422 product page. This firmware allows the DLPLCRDC4422EVM to drive the DLP660TE chip." to "The DLPLCRDC4422EVM can be programmed with either the DLP660TE or DLP470TE firmware which is available on the DLPC4422 product page. This firmware allows the DLPLCRDC4422EVM to drive either display chip."	6
• Removed text " Note that neither the cables nor the power supply are included with the module." from Section 3.2.	27

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