

DLP®Products ECD 4K UHD EVM

User's Guide



Literature Number: DLPU077
March 2019

Preface	5
1 DLPLCR660TEVM and DLPLCRDC4422EVM Overview	6
1.1 Welcome	6
1.2 What is in the DLPLCR660TEVM and DLPLCRDC4422EVM Evaluation Modules (EVMs)?	6
1.3 EVM Boards	8
1.4 Other Items Needed for Operation	8
1.5 DLPLCRDC4422EVM and DLPLCR660TEVM EVM Flex Cable	9
2 Quick Start	10
2.1 Downloading the Software	10
2.2 Connecting the DLPLCR660TEVM to the DLPLCRDC4422EVM	10
2.3 Powering-up the DLPLCRDC4422EVM and preparing for the DLPLCRDC4422EVM to be programmed.....	12
2.4 Programming the DLPLCRDC4422EVM and Displaying a SPLASH image	13
2.5 Troubleshooting	20
3 Connections	21
3.1 DLPLCRDC4422EVM Connections.....	21
3.1.1 Connectors	21
3.1.2 TestPoints	23
3.2 DLPLCR660TEVM Connections	25
3.2.1 Connectors	26
3.2.2 TestPoints	26
4 Power Supply Requirements	27
4.1 External Power Supply Requirements.....	27
5 Safety	28
5.1 Caution Labels.....	28
5.2 If You Need Assistance.....	28

List of Figures

1.	DLP DLPDLCR660TEVM and DLPLCRDC4422EVM Evaluation Module	5
1-1.	DLPLCRDC4422EVM	7
1-2.	DLPDLCR660TEVM	7
1-3.	EVM System Block Diagram	8
1-4.	Flex Cable Diagram	9
2-1.	Flex Cables	11
2-2.	EVMs Connected	12
2-3.	ON/OFF Switch	13
2-4.	DeVaSys Communication Configuration	14
2-5.	USB Communication Configuration	14
2-6.	Error Message	15
2-7.	Projector Control Menu	15
2-8.	Adding DLPC4422 Projector Control File	15
2-9.	Projector Control File for the Chosen Chipset	16
2-10.	DLPC4422 Projector Control Menu	16
2-11.	Loading the Flash Image	17
2-12.	Downloading Image unto the EVM	18
2-13.	Communication Between GUI and EVMs	18
2-14.	Splash Image Displayed on DMD	19
2-15.	USB Communication Error	20
2-16.	I2C communication error	20
2-17.	Programming Mode error	20
2-18.	Device programming delay increase	20
2-19.	Tool bar and panel display settings	20
3-1.	DLPLCRDC4422EVM Connectors (Top View)	21
3-2.	DLPDLCR660TEVM Test Points and Connectors	25

Read This First

Trademarks

DLP is a registered trademark of Texas Instruments.

About This Guide

This guide explains the hardware and software features of the DLP Products DLPDLCR660TEVM and DLPLCRDC4422EVM systems. The EVM architecture and connectors will be described along with a quick start guide on how to operate the DLPDLCR660TEVM 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](#)

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](#)

DLPDLCR660TEVM and DLPLCRDC4422EVM Overview

1.1 Welcome

The DLP Products DLPDLCR660TEVM 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 UHD chipset.

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 and DLPLCRDC4422EVM Evaluation Modules (EVMs)?

The DLPDLCR660TEVM and DLPLCRDC4422EVM are designed to be used together. In fact, one cannot be operated without the other.

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

The DLPLCRDC4422EVM, which 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 the DLP660TE firmware which is available on the DLPC4422 product page. This firmware allows the DLPLCRDC4422EVM to drive the DLP660TE 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.

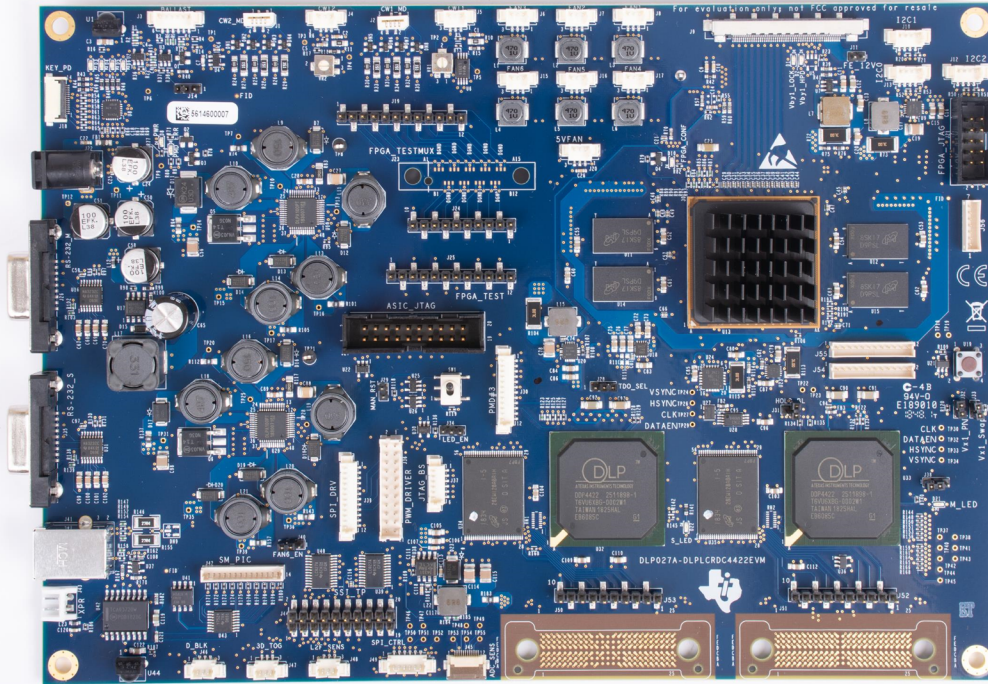


Figure 1-1. DLPLCRDC4422EVM

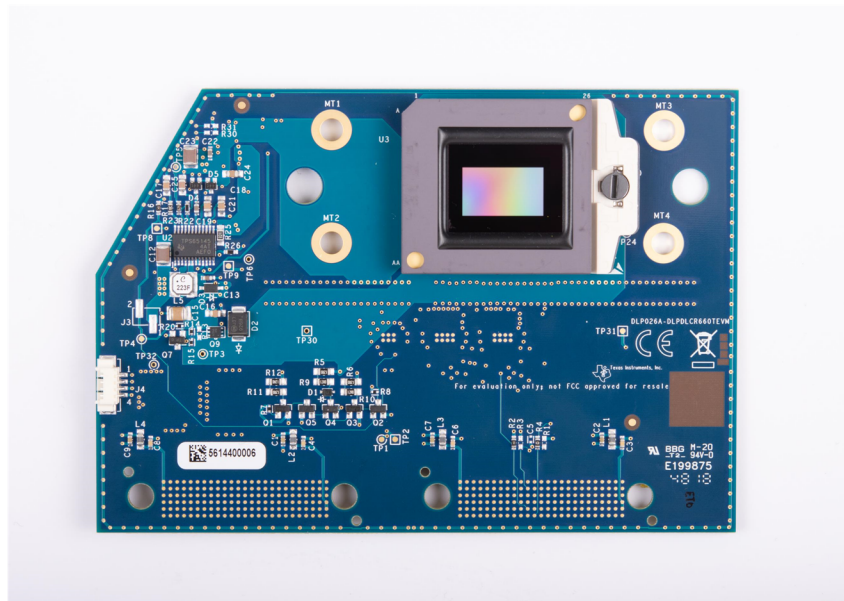


Figure 1-2. DLPDLCR660TEVM

1.3 EVM Boards

The DLPDLCR660TEVM and DLPDLRDC4422EVM contain the electronics required to drive the DLP660TE DMD. The DLPLCRDC4422EVM offers several interface options for USB, I2C, and trigger inputs and outputs.

The system block diagram [Figure 1-3](#) details the functionality and control when using the DLPDLR660TEVM and DLPDLRDC4422EVM.

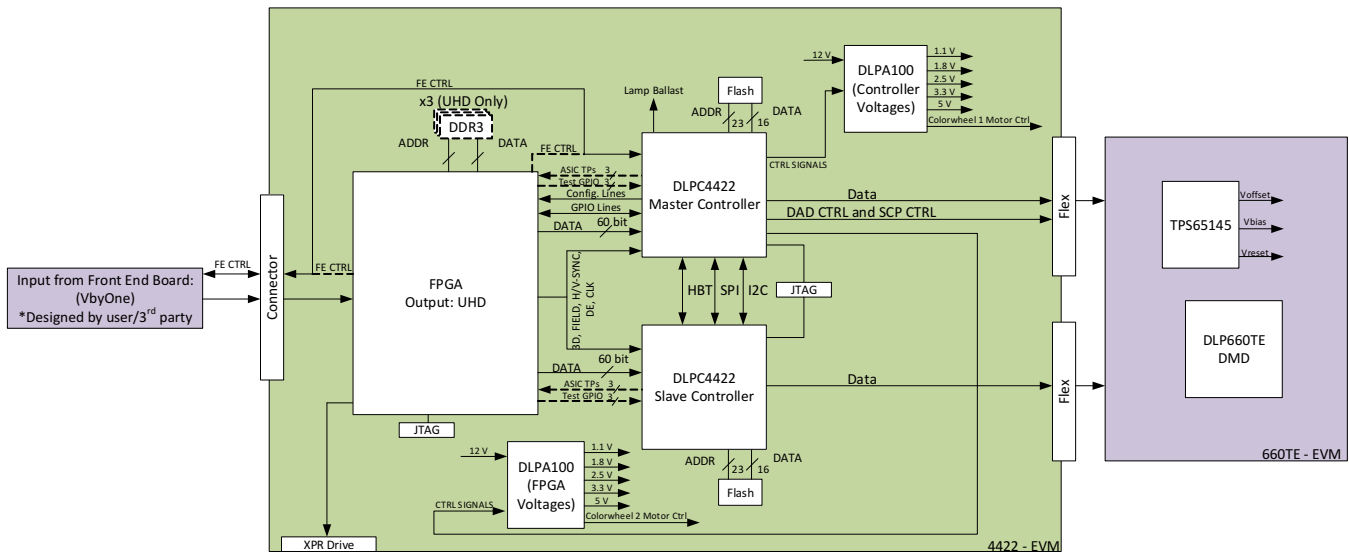


Figure 1-3. EVM System Block Diagram

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 DLPDLR660TEVM are:

- DLP660TE 0.66-inch UHD DMD
- Two flex cables designed to connect the DLPDLR660TEVM to the DLPLCRDC4422EVM
- TPS65145 used to generate the DMD's reset voltages

1.4 Other Items Needed for Operation

The DLPDLR660TEVM 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

1.5 DLPLCRDC4422EVM 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 1-4](#) (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.

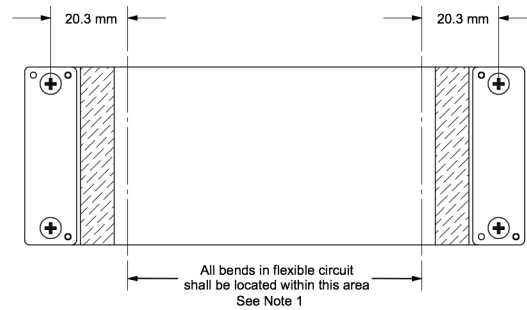


Figure 1-4. Flex Cable Diagram

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.

Quick Start

This chapter offers a quick start guide on how to connect the DLPDLCR660TEVM 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.

The DLP660TE firmware and DLPC4422 GUI can be found under the “Tools and Software” tab on the product pages on TI.com. This is the product page for the [DLP660TE](#) and the product page for the [DLPC4422](#).

2.2 Connecting the DLPDLCR660TEVM to the DLPLCRDC4422EVM

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

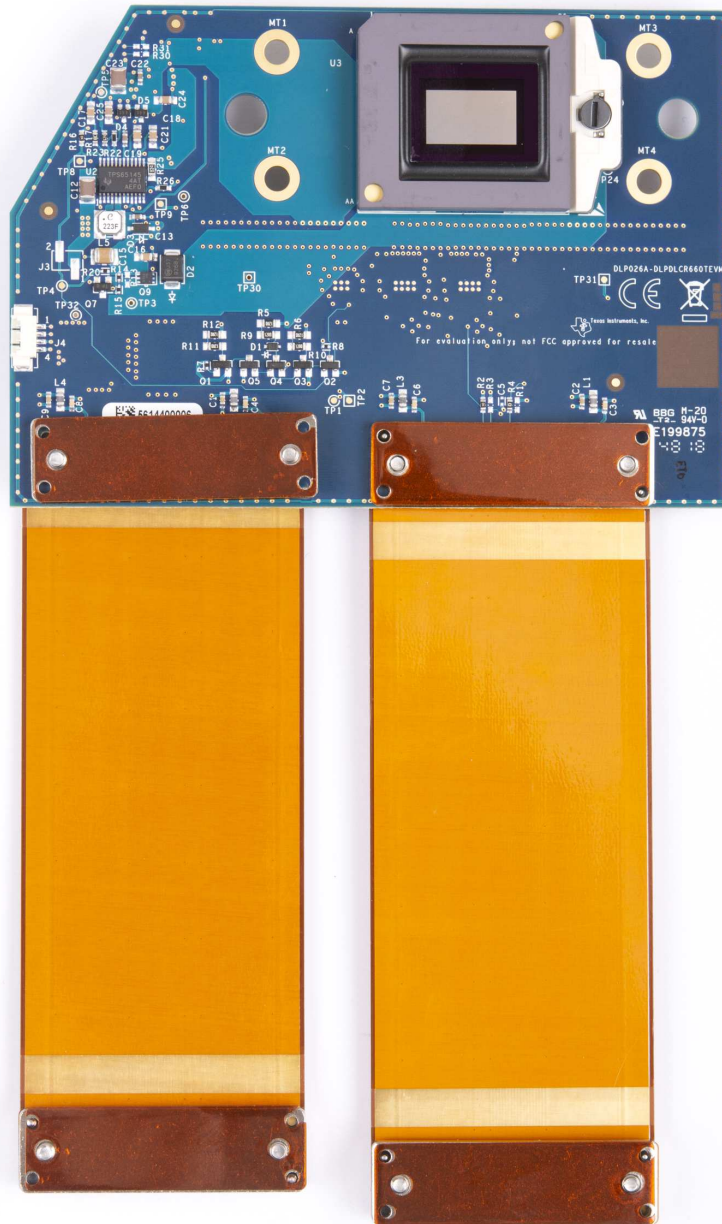


Figure 2-1. Flex Cables

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.



Figure 2-2. 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

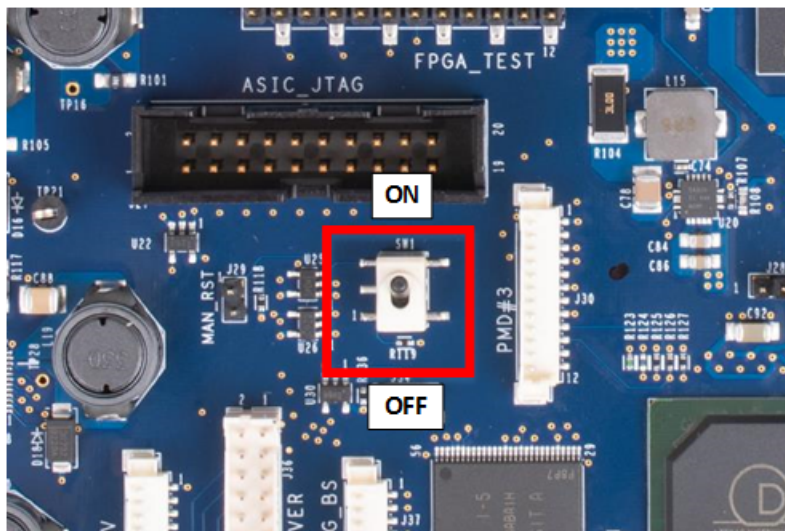
Jumper	Description (Bold Indicates Default Position)
J11 - Front End 12V	Uninstalled - Main Board is Powered From its Own AC Adaptor Installed - Front End Board Provides Power to Main Board
J14 - Blue LED enable or Lamp Ballast	Pins 1,2 connected Blue LED Enable Pins 2,3 connected Lamp Mode
J28 - TDO1 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
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

Table 2-1. Reference Designators (continued)

Jumper	Description (Bold Indicates Default Position)
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 2-3. 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.
2. Setting up Communication Preferences:
 - a. DLPC4422 GUI supports USB and I2C communication. To change these settings, please go to Edit- >Preferences->Communication.

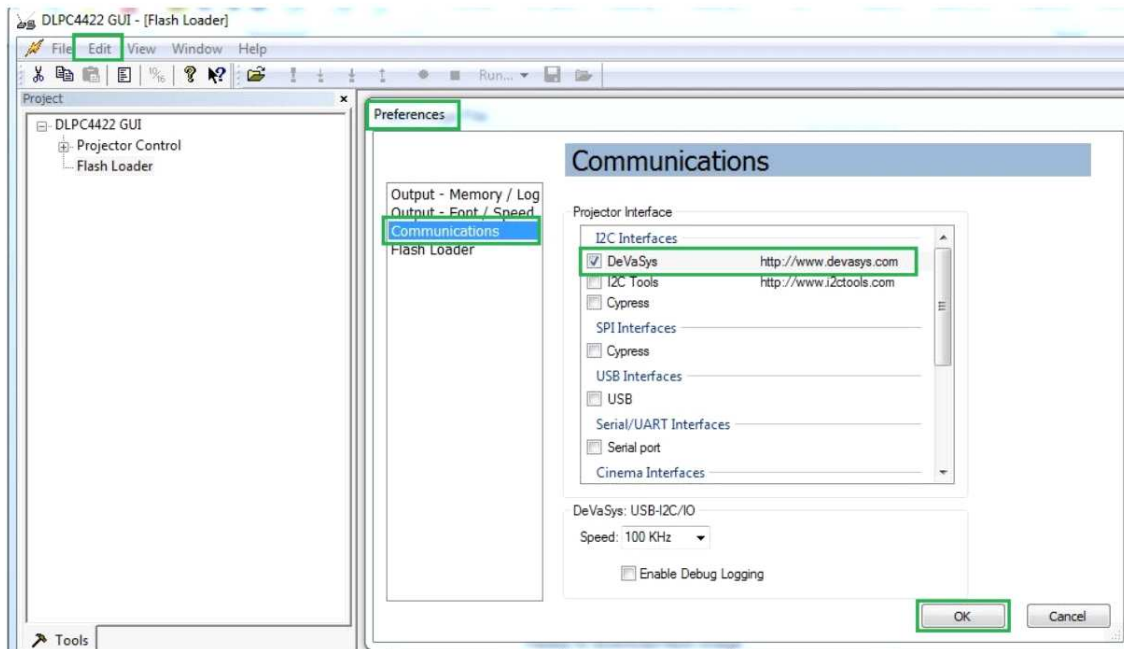


Figure 2-4. DeVaSys Communication Configuration

- 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.

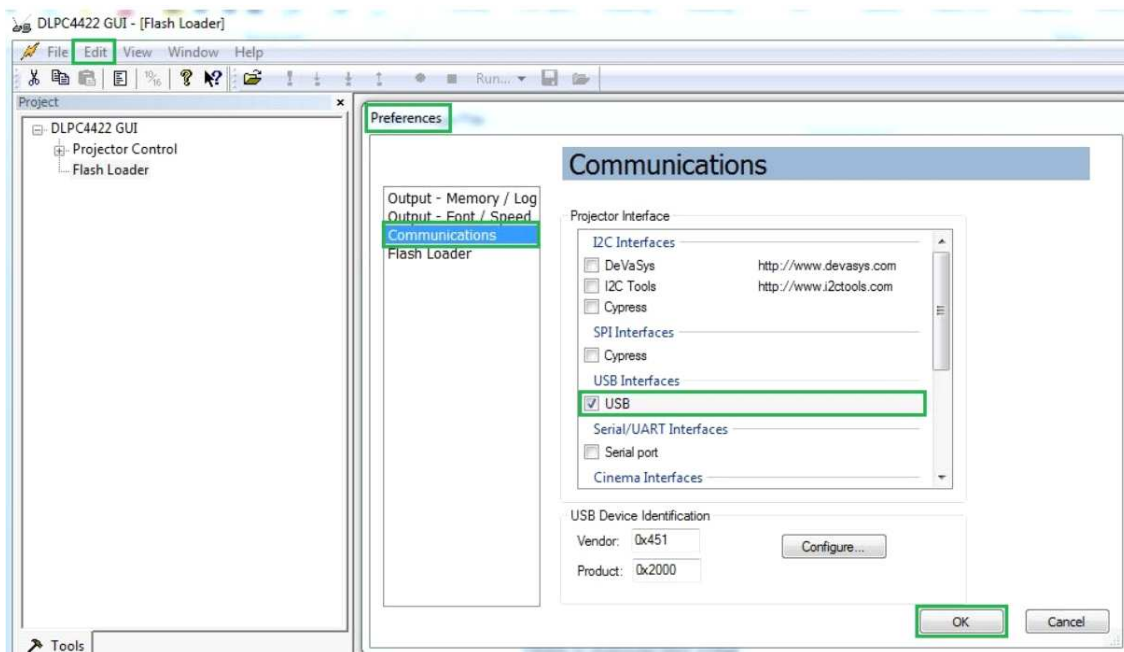


Figure 2-5. USB Communication Configuration

- 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.

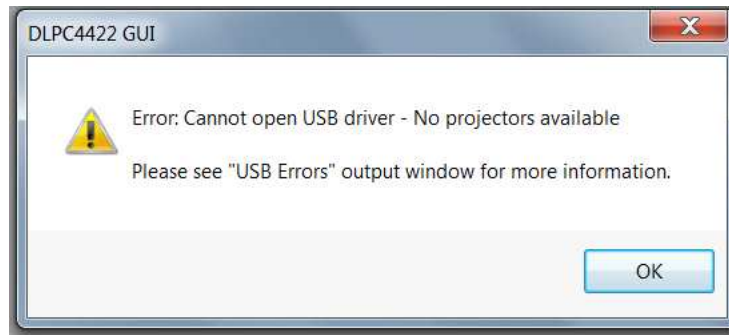


Figure 2-6. Error Message

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



Figure 2-7. Projector Control Menu

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

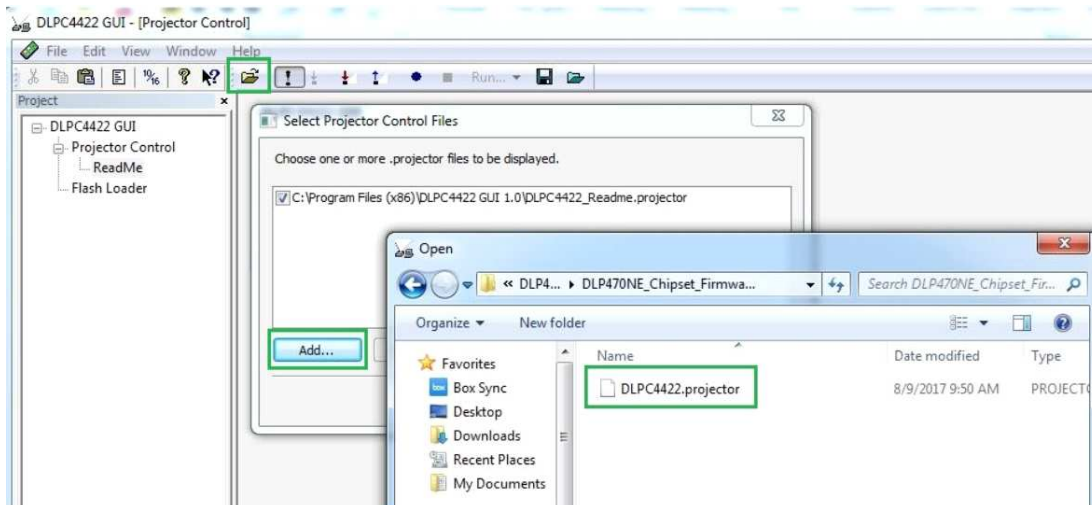


Figure 2-8. Adding DLPC4422 Projector Control File

- 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.

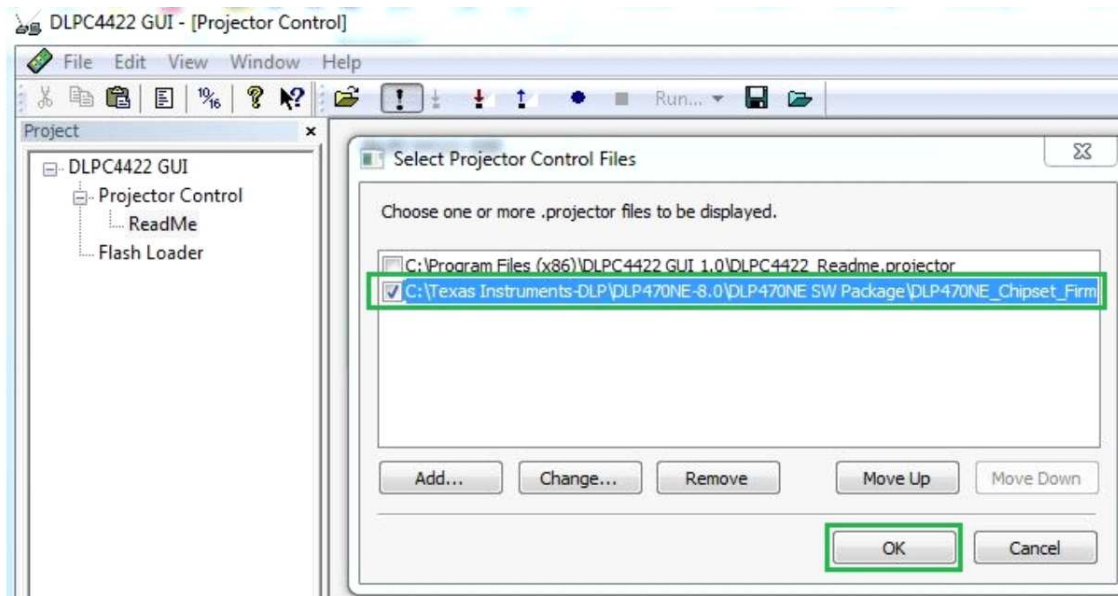


Figure 2-9. Projector Control File for the Chosen Chipset

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

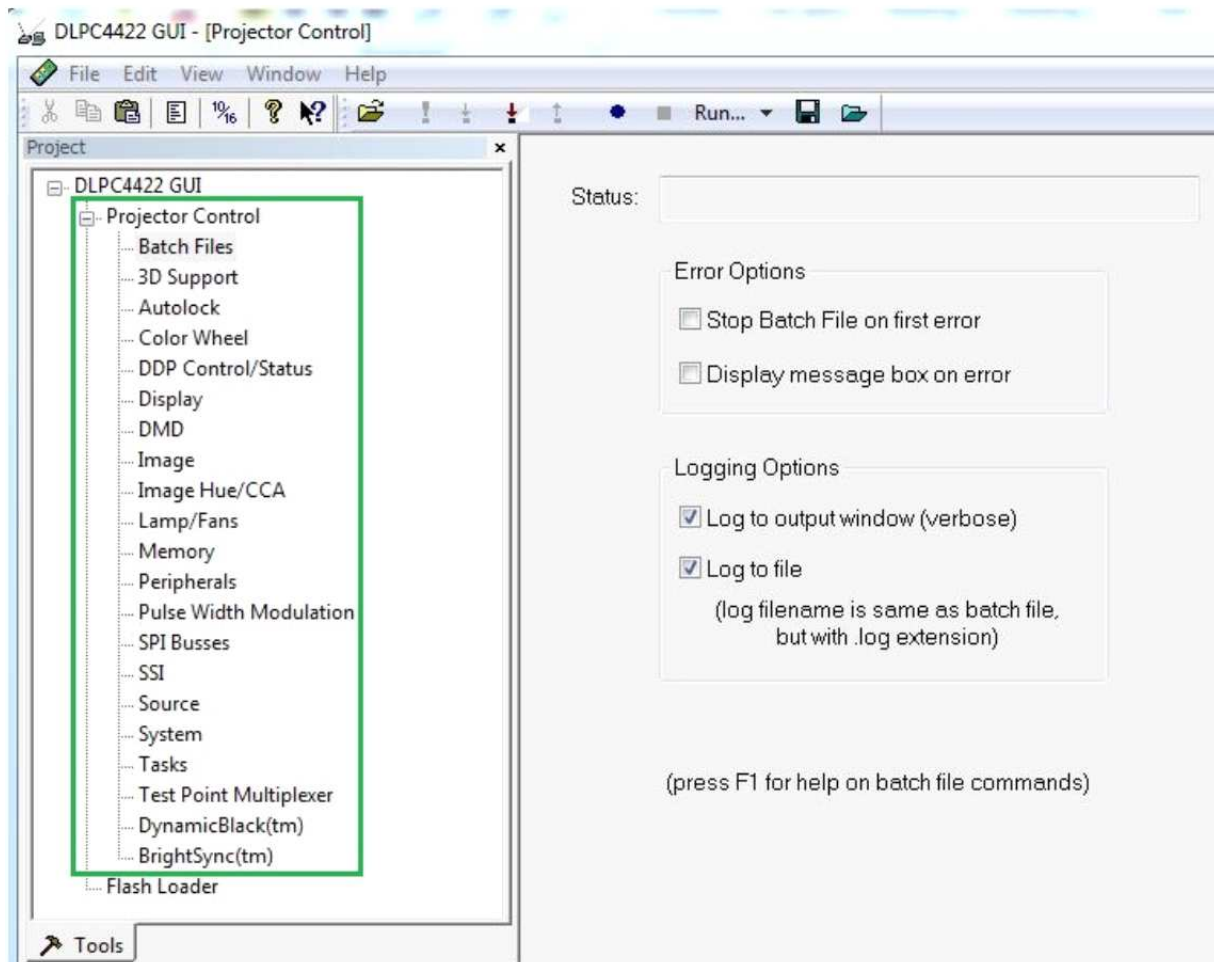


Figure 2-10. DLPC4422 Projector Control Menu

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".

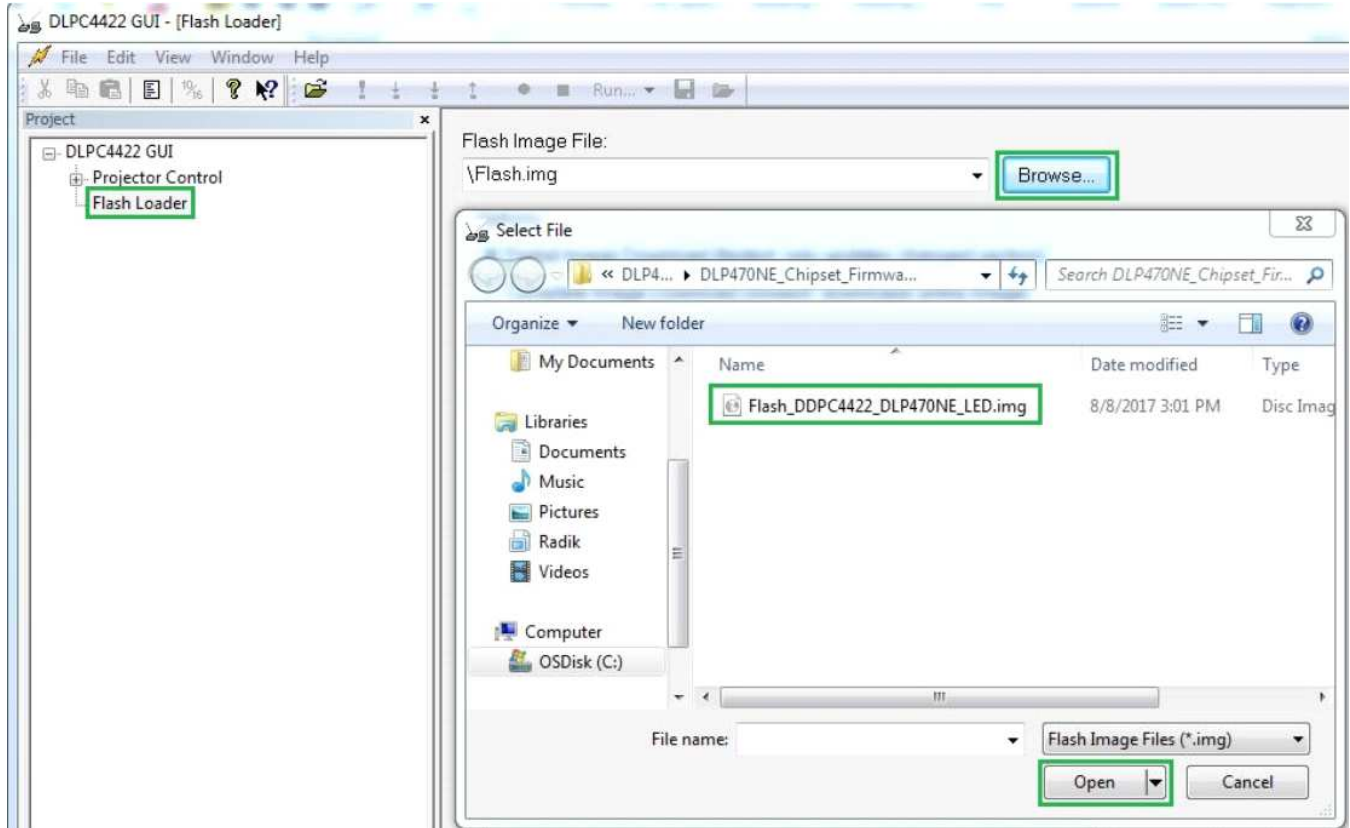


Figure 2-11. Loading the Flash Image

- b. Select Partial or Complete Image 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.

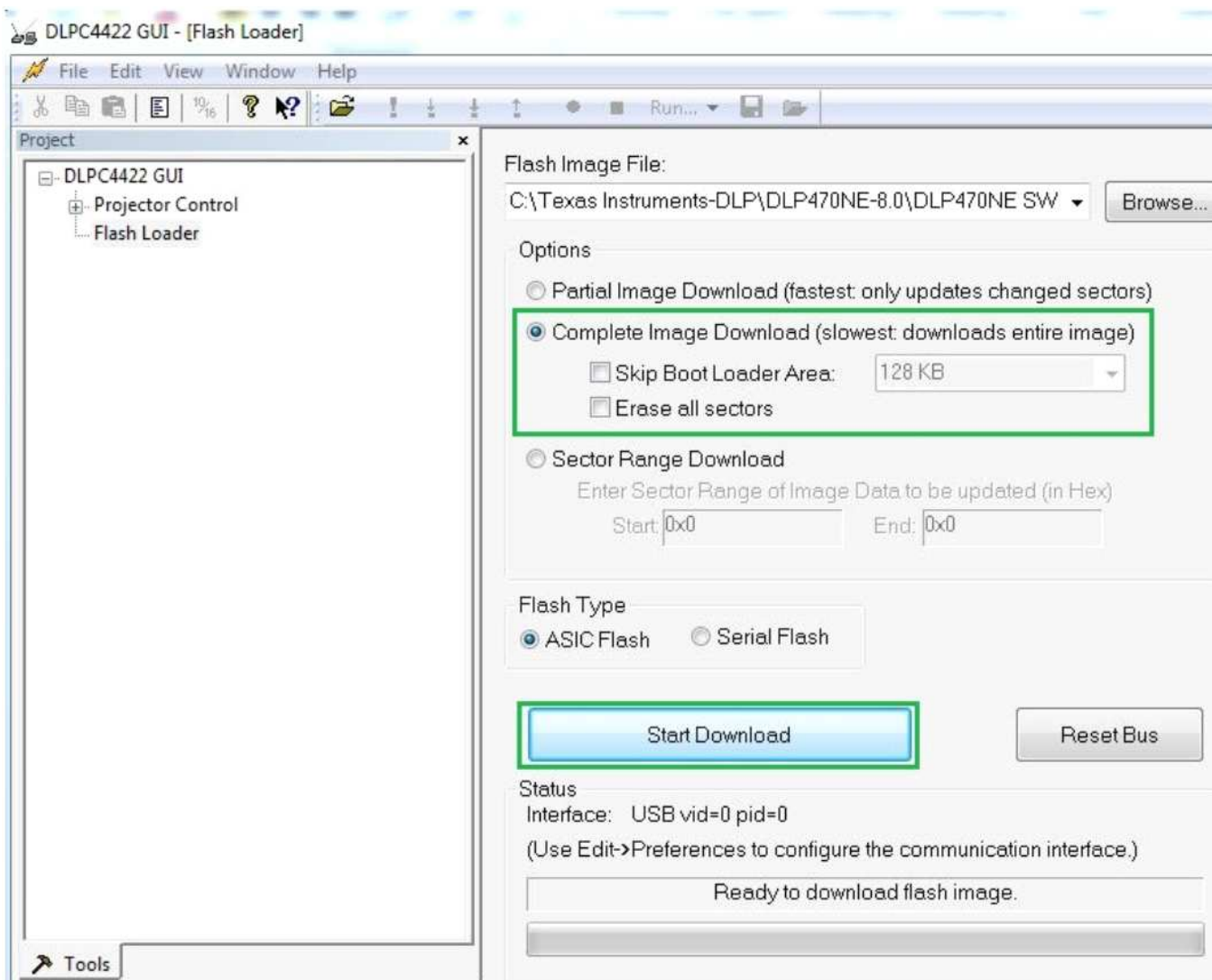


Figure 2-12. Downloading Image into the EVM

- 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:

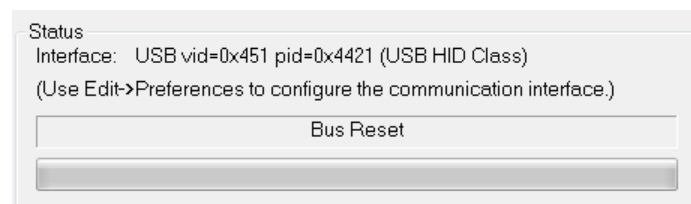
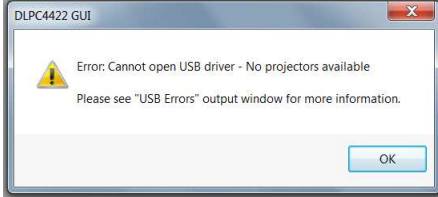
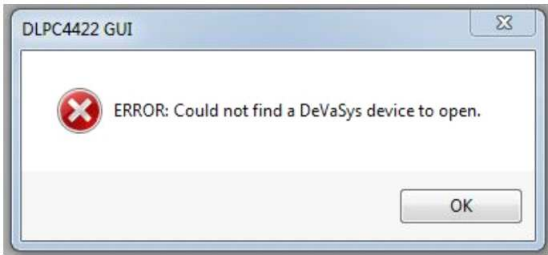

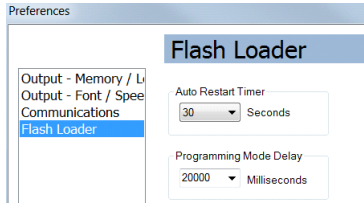
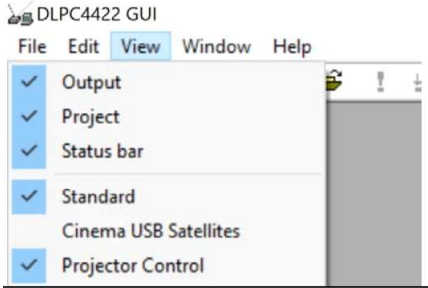


Figure 2-13. Communication Between GUI and EVMs

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.

2.5 Troubleshooting

Problem	Possible solutions
<p>USB Communication Error</p>  <p>Figure 2-15. USB Communication Error</p>	<p>Verify the correct communication settings have been applied. Ensure the USB cable is connected both to the projector and computer.</p>
<p>I2C communication error</p>  <p>Figure 2-16. I2C communication error</p>	<p>Verify the correct communication settings have been applied. Ensure a DeVasys box and the appropriate USB and I2C cables are connected.</p>
<p>Programming Mode error</p>  <p>Figure 2-17. Programming Mode error</p>	<p>Please check your connection settings and try again. Note: If this occurs only occasionally, increase the programming delay to 20000ms.</p>  <p>Figure 2-18. Device programming delay increase</p>
<p>Tool bars or panels missing</p>	 <p>Figure 2-19. Tool bar and panel display settings</p>

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.

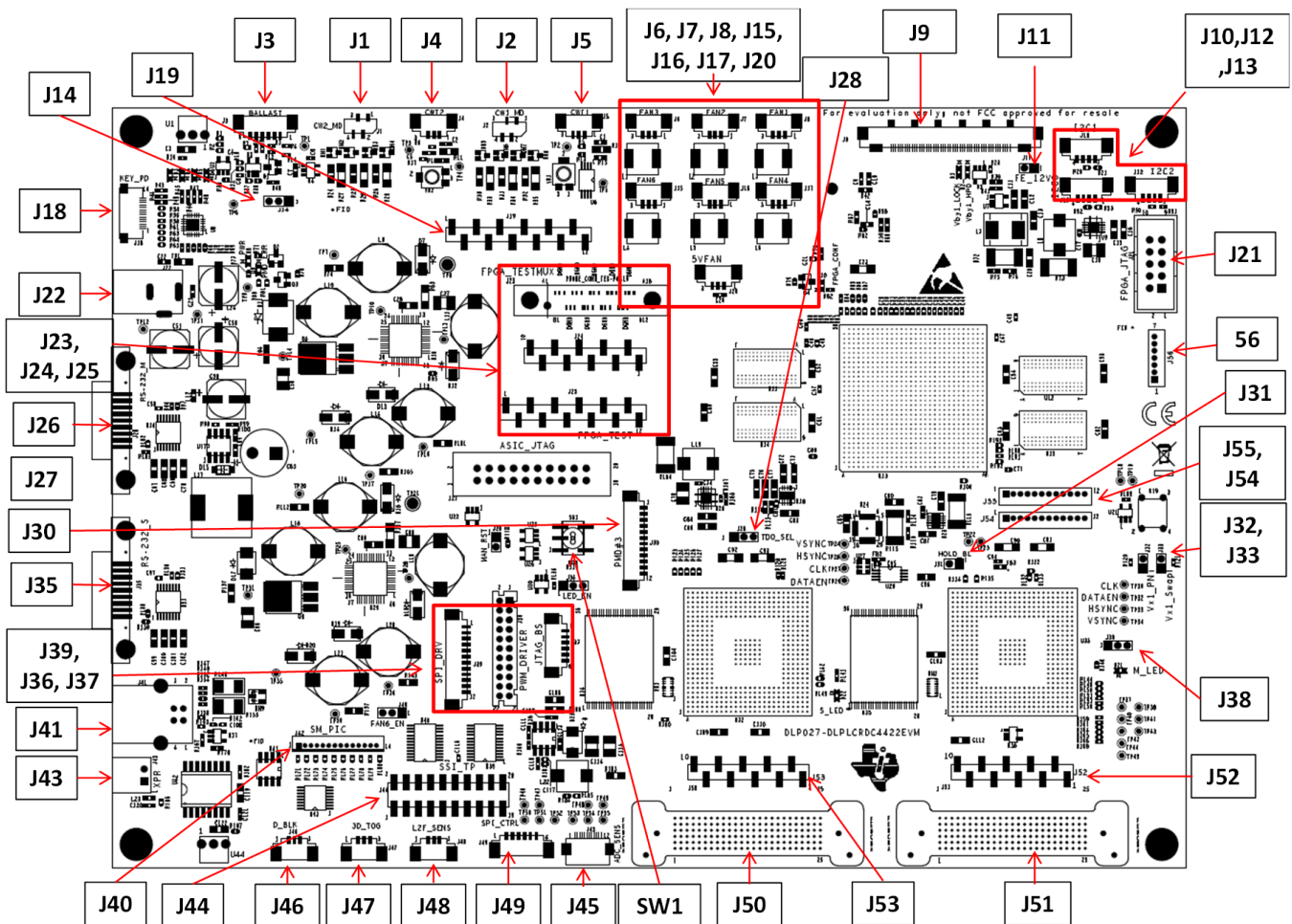


Figure 3-1. DLPLCRDC4422EVM Connectors (Top View)

3.1.1 Connectors

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

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

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

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

3.2 DLPDLCR660TEVM Connections

Figure 3-2 depicts the switches and connectors with their respective locations. Note that neither the cables nor the power supply are included with the module.

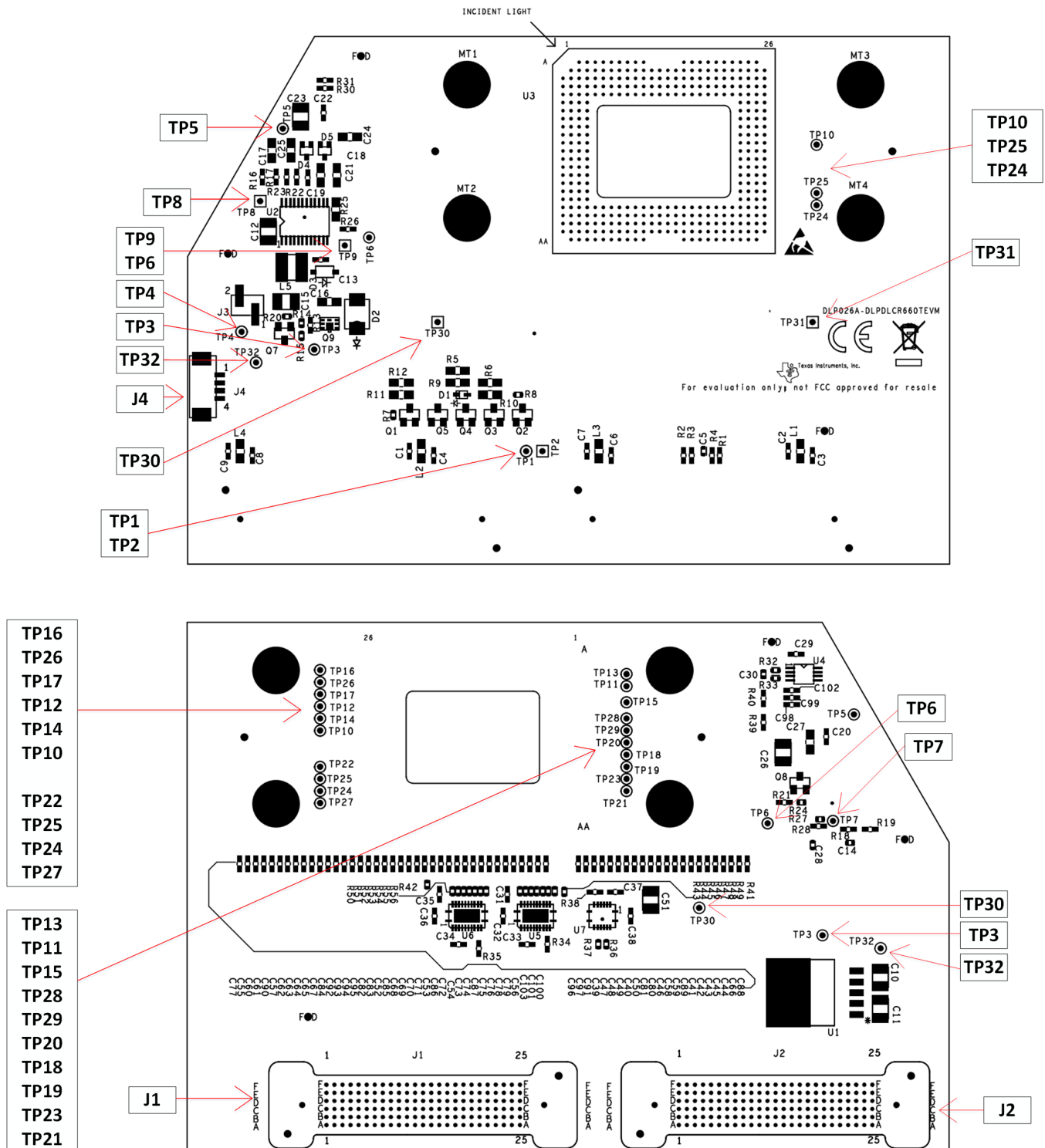


Figure 3-2. DLPDLCR660TEVM Test Points and Connectors

3.2.1 Connectors

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 TestPoints

1. **J1** - Flex Cable Connector
2. **J2** - Flex Cable Connector
3. **J4** - DMD_P3P3V

Power Supply Requirements

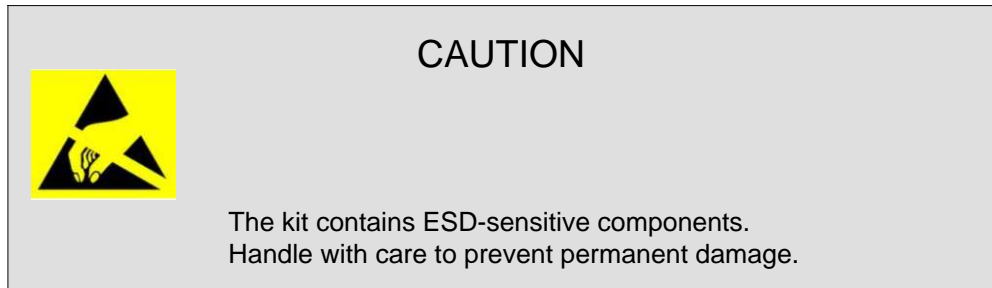
4.1 External Power Supply Requirements

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.

5.1 Caution Labels



5.2 If You Need Assistance

Refer to the

[DLP E2E Community support forums](#).

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page 電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

-
- 4 *EVM Use Restrictions and Warnings:*
 - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
 - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
 - 4.3 *Safety-Related Warnings and Restrictions:*
 - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
 - 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
 5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
 6. *Disclaimers:*
 - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
 - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
 7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
-

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated