EVM User's Guide: DLPC7540EVM

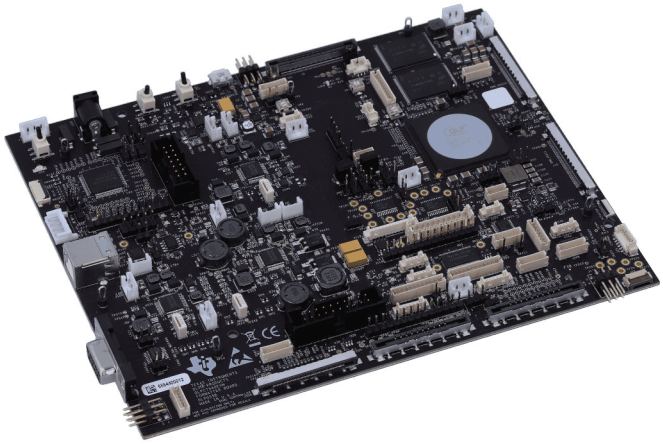
DLP® Display DLPC7540 4K UHD Evaluation Module

Description

The DLPC7540 controller EVM board, DLPC7540EVM, when combined with the DLP472TEEVM, DLP650TEEVM , or DLP471TEEVM , can accelerate the prototyping time of a DLP 4K UHD system. The DLPC7540EVM provides a design for driving either the 0.47-inch 4K UHD or 0.65-inch 4K UHD standard digital micromirror devices (DMDs), while allowing for testing with included Vx1 interface front-end system. The combination of the DLPC7540EVM with either the DLP472TEEVM, DLP650TEEVM, or DLP471TEEVM can display SPLASH, test patterns or video from the HDMI source on the DMD.

Features

- DLP472TEEVM
  - 4K UHD (3840 × 2160) display resolution
  - 5.4µm micromirror pitch
  - ±14.5° micromirror tilt (relative to flat surface)
  - Corner illumination
  - High speed serial interface (HSSI) input data bus
- DLP650TEEVM
  - 4K UHD (3840 × 2160) display resolution
  - 7.6µm micromirror pitch
  - ±12° micromirror tilt (relative to flat surface)
  - Corner illumination
  - High speed serial interface (HSSI) input data bus
- DLP471TEEVM
  - 4K UHD (3840 × 2160) display resolution
  - 5.4µm micromirror pitch
  - ±17° micromirror tilt (relative to flat surface)
  - Bottom illumination
  - High speed serial interface (HSSI) input data bus
- DLPC7540EVM
  - Supports up to 4K UHD at 60Hz
  - Supports up to 1080p at 240Hz (2D) and 120Hz (3D)
  - Supports LED, RGB laser and laser phosphor illuminations



DLPC7540EVM

This design incorporates HDMI® technology.

1 DLPC7540EVM, DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM Overview

1.1 Introduction

This guide explains the hardware and software features of the DLP® Products DLP472TEEVM, DLP471TEEVM, DLP650TEEVM, and DLPC7540EVM evaluation modules (EVMs). The EVM architecture and connectors are described along with a quick start guide on how to operate the DLP472TEEVM, DLP471TEEVM, DLP650TEEVM, and DLPC7540EVM EVMs using the DLPDLC-GUI. Specific DLP chip details and operation can be found in related component documentation.

The DLPC7540EVM was also designed to be paired with the available .47-inch 1080p EVM (DLP472NEEVM) or the .65-inch 4K UHD EVM (DLP651TEEVM) to help evaluate 1080p functionality. Please see **Section 3.1.1** for more details.

Note

Power supply, optics, illumination source, and cables are not included. See Section 1.4 .

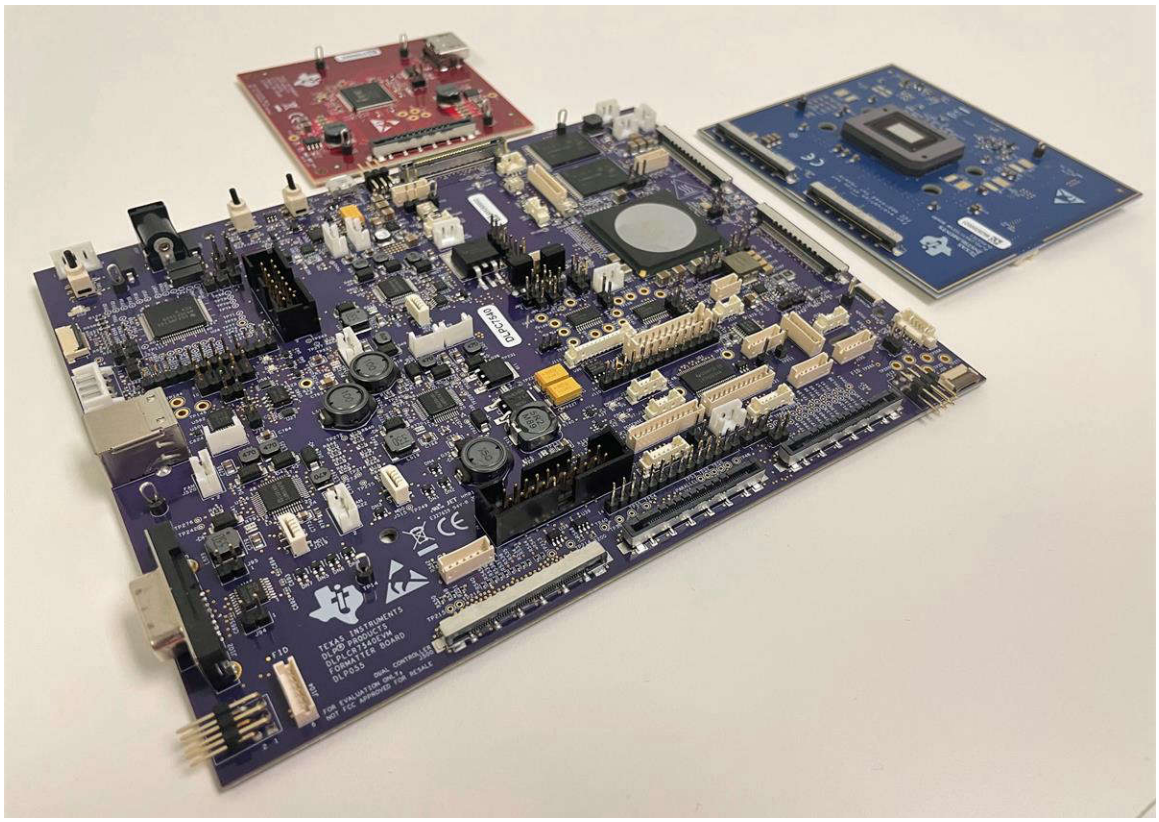


Figure 1-1. DLP Products DLPC7540EVM and DLP471TEEVM Evaluation Modules

The DLP Products DLPC7540EVM, DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM evaluation modules (EVMs) offer a reference design to enable faster development cycles for users of the DLPC7540 chips and allow evaluation of TI's DLP471TE and DLP650TE UHD chipsets. These consist of one controller EVM (DLPC7540EVM) and three DMD EVMs (DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM).

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

- Stage Lighting Systems

1.2 What is in the DLP471TEEVM, DLP472TEEVM, DLP650TEEVM, and DLPC7540EVM Evaluation Modules?

The DLP471TEEVM, DLP472TEEVM, DLP650TEEVM, and DLPC7540EVM are designed to be used in pairs. The DMD EVMs cannot be operated without the Controller EVM, DLPC7540EVM.

The DLP471TEEVM, which includes the DLP471TE display chip, the DLP472TEEVM, which includes the DLP472TE display chip, and the DLP650TEEVM, which includes the DLP650TE display chip, include the two flex cables required to connect to the DLPC7540EVM. DLPC7540EVM includes all circuitry required to drive the DLP471TE, DLP472TE, and DLP650TE display chips.

The DLPC7540EVM which consists of a formatter board (Figure 1-2) and an HDMI input processing front-end board (Figure 1-3), includes a DLPC7540 controller, three DLPA100s which serve as the power management and motor drivers, and other system circuitry such as the Vx1 interface front-end and system fan control.

The DLPC7540EVM can be programmed with either the DLP471TE, DLP472TE, or DLP650TE firmware which is available on the DLPC7540 product page. This firmware allows the DLPC7540EVM to drive either display chip. Figure 1-2, Figure 1-3, and Figure 1-4 show the top side of all boards making up the EVMs.

Note

The DLPC7540EVM only supports two color wheels and has limited support for three color wheels system.

Note

Figure 1-2, Figure 1-3, and Figure 1-4 do not show the necessary flex cables (JF08R0R051020UA) needed to pair to DLPC7540EVM.

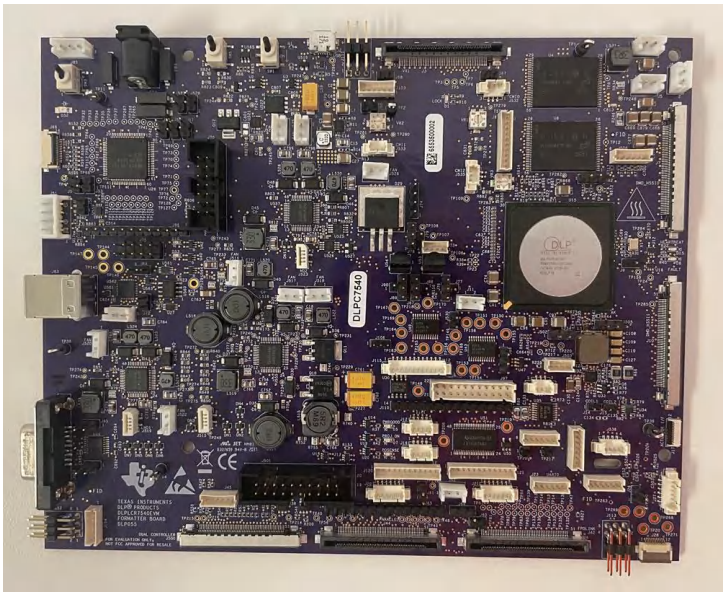


Figure 1-2. DLPC7540EVM Formatter Board

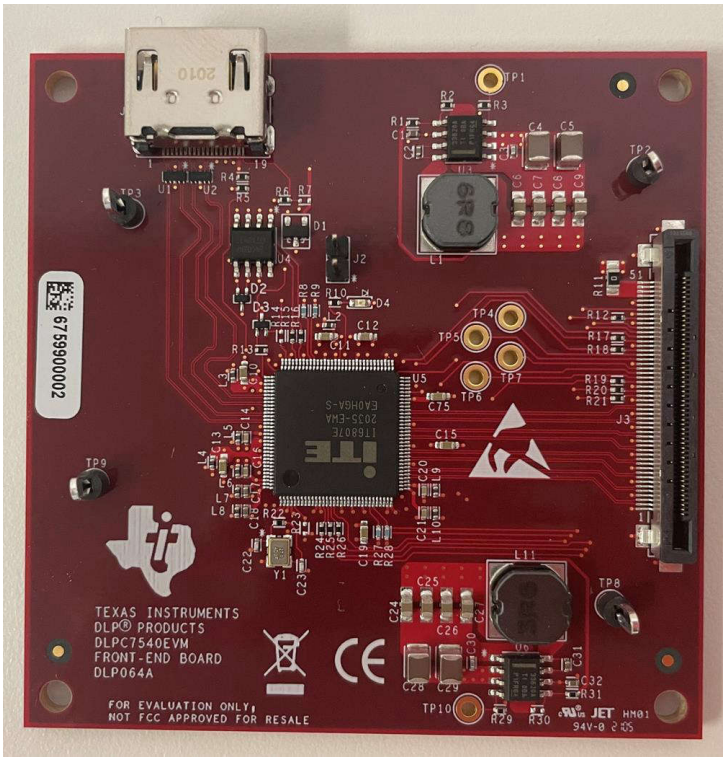


Figure 1-3. DLPC7540EVM Front-end Board

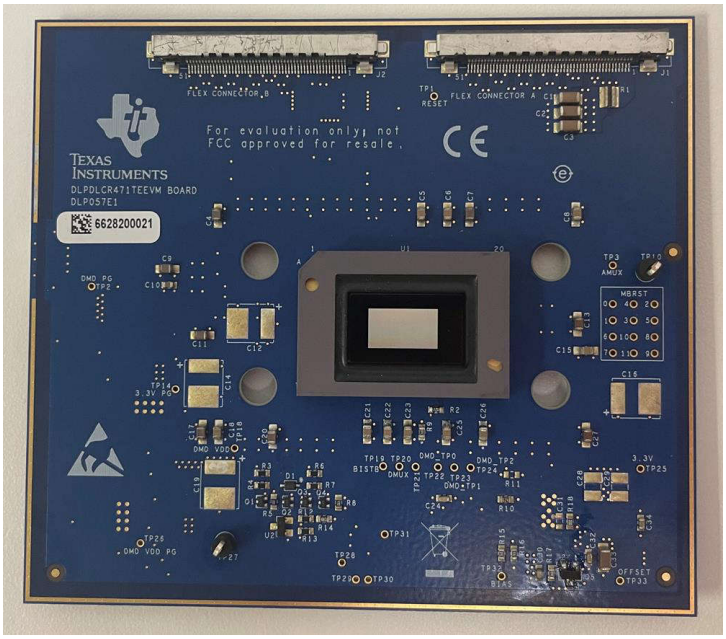


Figure 1-4. DLP471TEEVM

1.3 EVM Boards

The DLP471TEEVM, DLP472TEEVM, DLP650TEEVM, and DLPC7540EVM EVMs contain the electronics required to drive either DLP471TE, DLP472TE, or DLP650TE DMD. The DLPC7540EVM offers several interface options for USB, I2C, and trigger inputs and outputs.

The system block diagram details the functionality and control when using the DLP471TEEVM and DLPC7540EVM, as shown in Figure 1-5 .

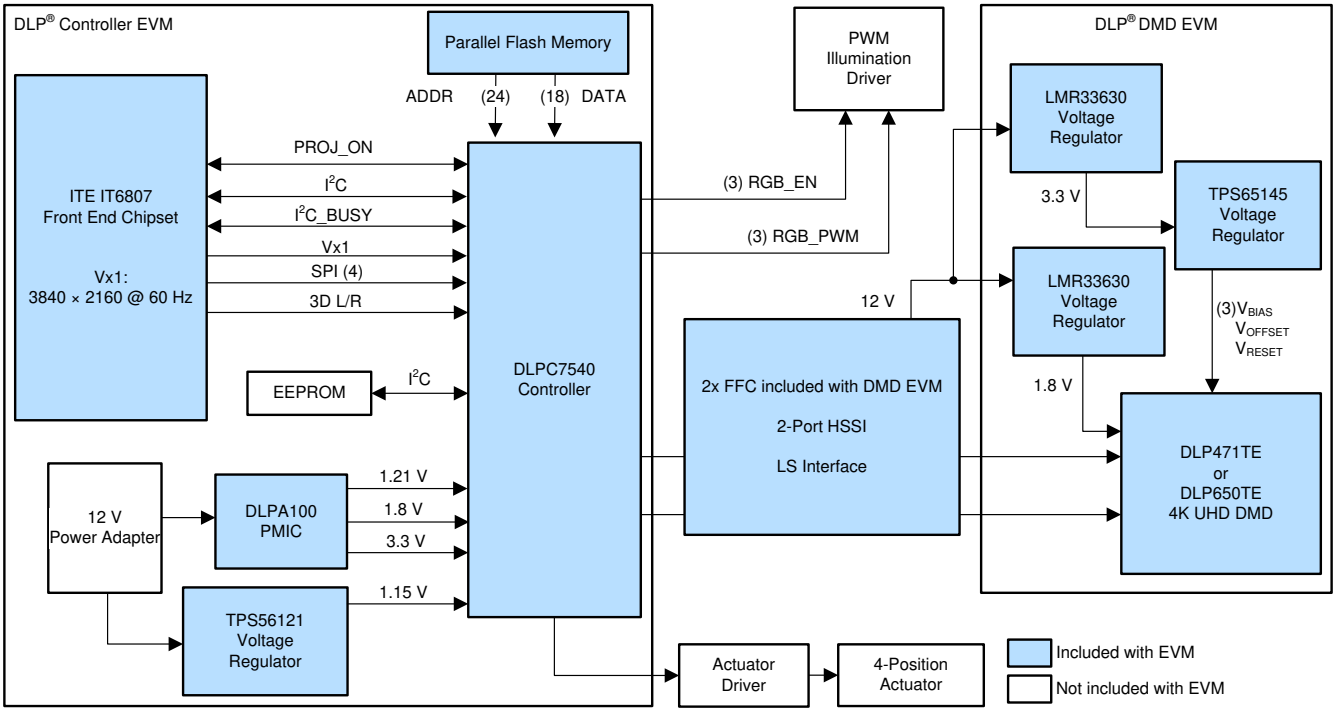


Figure 1-5. EVM System Block Diagram

The major components of the DLPC7540EVM are:

- One DLPC7540 controller
- Three DLPA100 power management and motor driver chips
- One Vx1 front-end capable of processing inputs up to 4K at 60Hz at 600MHz pixel clock

The major components of the DLP471TEEVM are:

- DLP471TE 0.47-inch 4K UHD DMD
- Two flex cables designed to connect the DLP471TEEVM to the DLPC7540EVM
- TPS65145 used to generate the DMD's offset, reset and bias voltages

The major components of the DLP472TEEVM are:

- DLP472TE 0.47-inch 4K UHD DMD
- Two flex cables designed to connect the DLP472TEEVM to the DLPC7540EVM
- TPS65145 used to generate the DMD's offset, reset and bias voltages

The major components of the DLP650TEEVM are:

- DLP650TE 0.65-inch 4K UHD DMD
- Two flex cables designed to connect the DLP650TEEVM to the DLPC7540EVM
- TPS65145 used to generate the DMD's offset, reset and bias voltages

1.4 Other Items Needed for Operation

The DLP471TEEVM, DLP472TEEVM, DLP650TEEVM, and the DLPC7540EVM 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 - required for EVM operation (see Section 2.3.1)
- Micro-USB cable: A to micro-B USB cable - required for GUI interface
- Optics
- Illumination module and source
- XPR actuator

The firmware provided on ti.com is for the sole purpose of operating the electronic components that make up the DLP471TEEVM, DLP472TEEVM, DLP650TEEVM, and the DLPC7540EVM evaluation modules. Any additions made to the EVMs such as illumination, optics, actuator, and so on require contacting Texas Instruments for additional support in including these elements specific to customer application.

1.5 DLPC7540EVM, DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM EVM Flex Cable

Electrical malfunctions can occur by stressing the flex cables connecting the DMD circuit board to the DLPC7540EVM formatter board. Stressing the flex cable can be caused by:

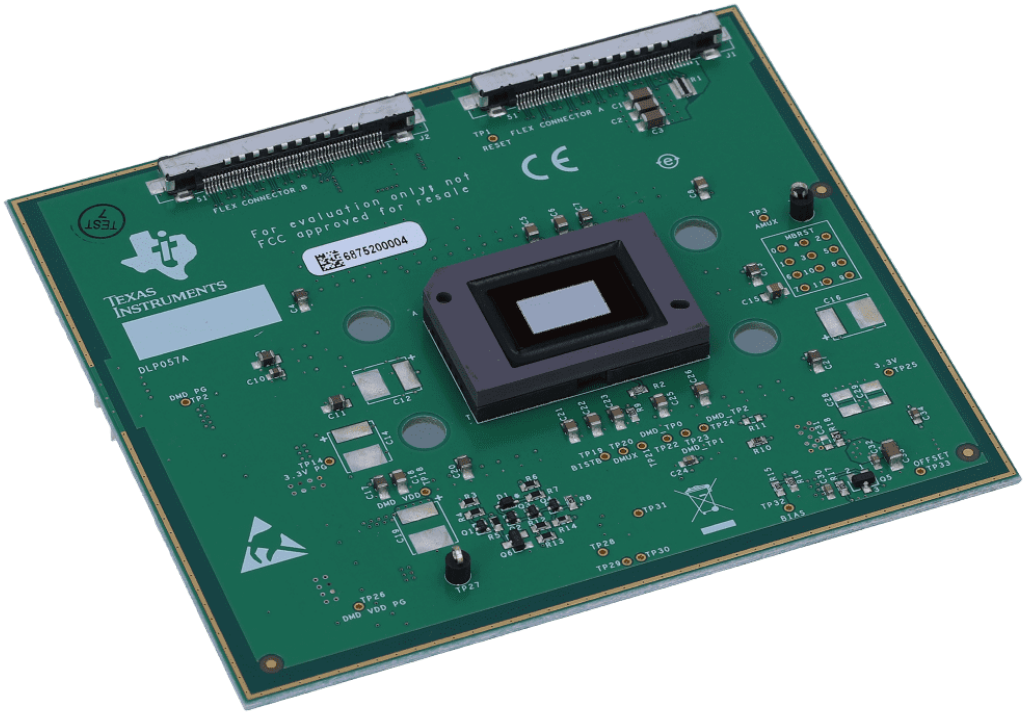
- Bending the flex cables sharply.
- Repeatedly bending the flex cables.
- Excessive insertion and extraction of flex cables to or from board connectors.

Note

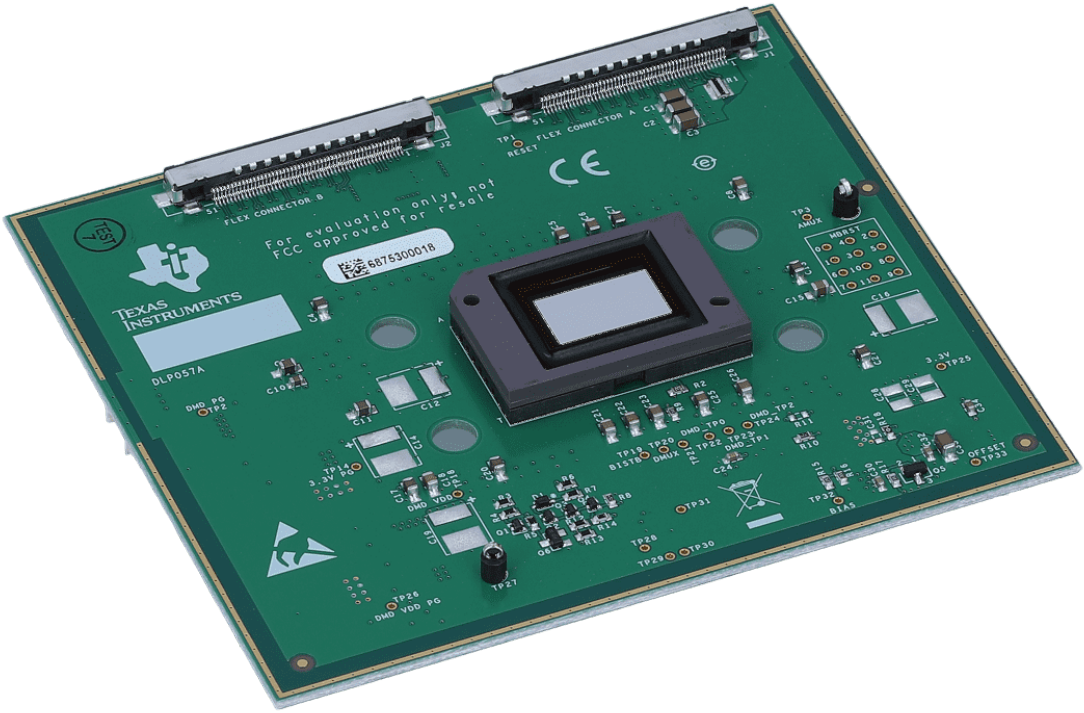
Minimize any handling or movement on the flex cables during operation.

2 Hardware

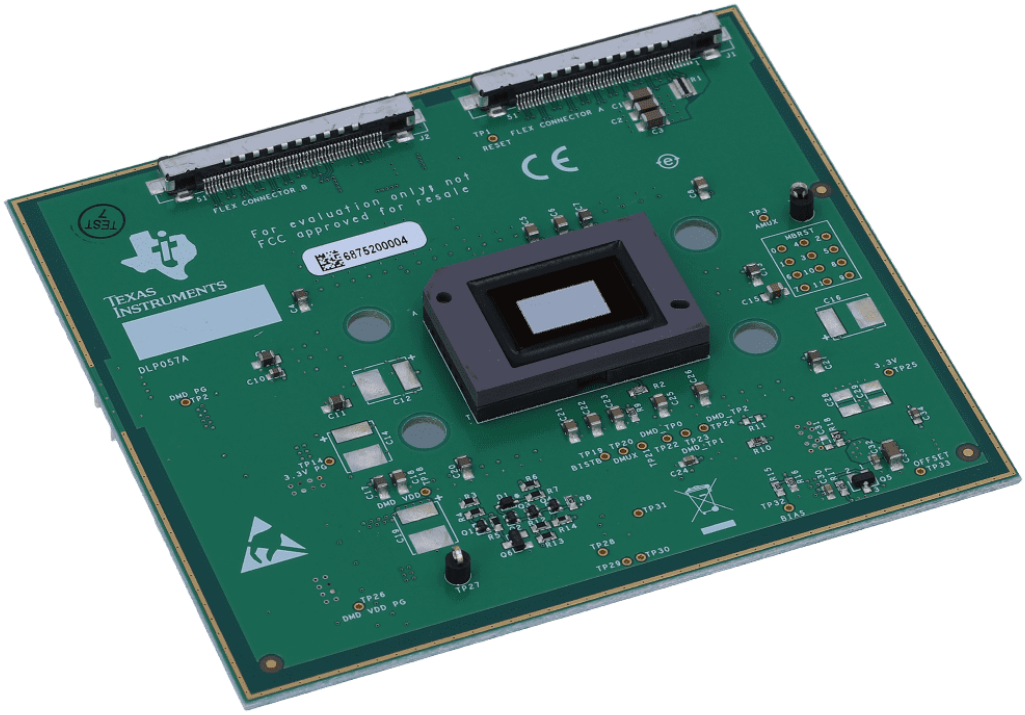
2.1 Additional Images



DLP472TEEVM



DLP650TEEVM



DLP471TEEVM

2.2 Connections

This chapter introduces all the connections and test points available on the DLPC7540EVM and DLP471TEEVM/DLP472TEEVM/DLP650TEEVM.

2.2.1 DLPC7540EVM Connections

The switches and connectors with the respective locations are shown in Figure 2-1. Note that neither cables nor the power supply are included with the module.

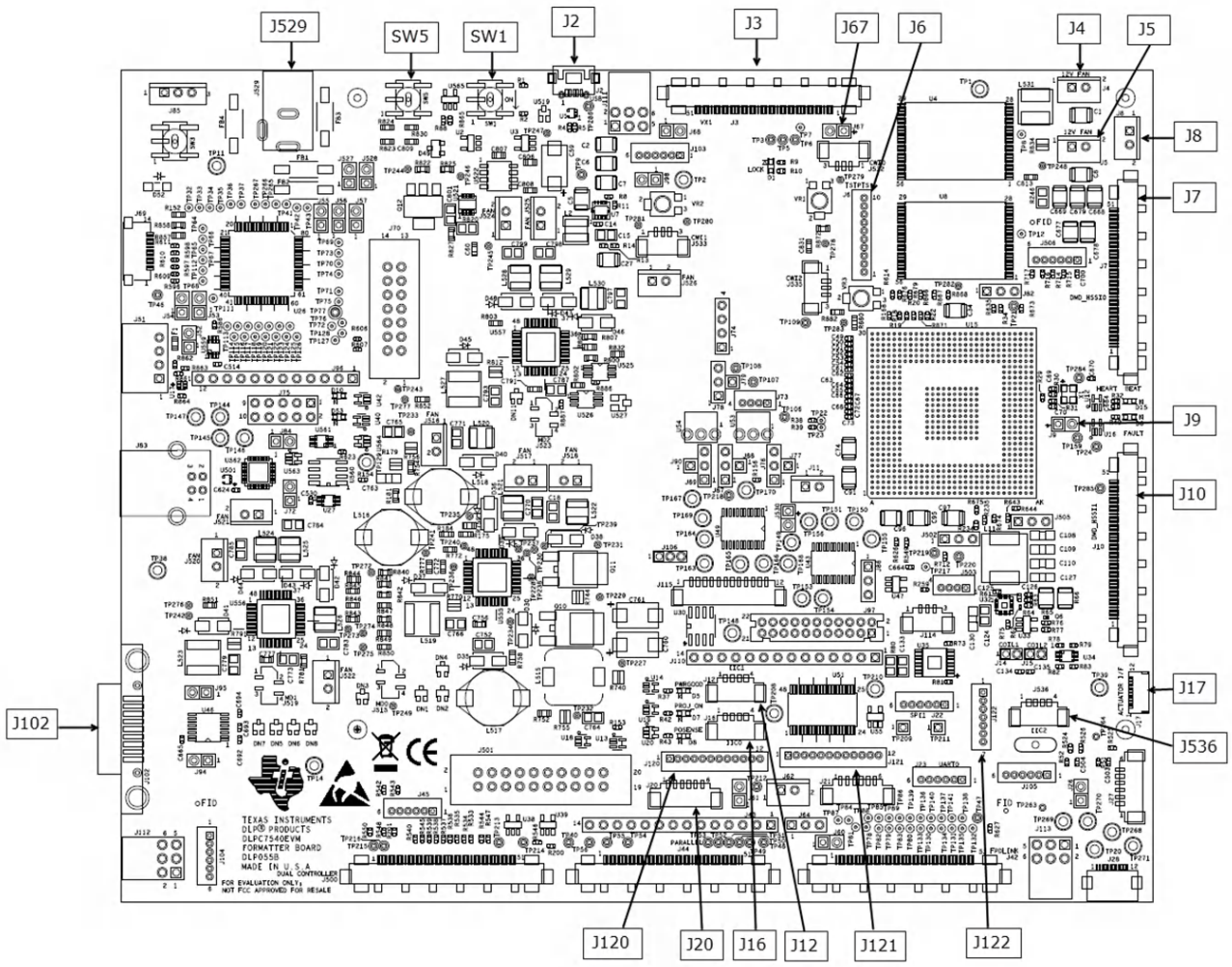


Figure 2-1. DLPC7540EVM Formatter Board Connectors

Formatter Board Connectors

1. **J2** – Micro-USB
2. **J3** – V-By-One Input
3. **J4** – 12V Fan
4. **J5** – 12V Fan
5. **J6** – Test Points Header
6. **J7** – DMD HSSI0 Flex Cable Connector
7. **J8** – 12V Fan (Heatsink)
8. **J9** – Hold Bootloader
9. **J10** – DMD HSSI1 Flex Cable Connector
10. **J12** – I2C1 Bus
11. **J16** – I2C0 Bus
12. **J17** – Actuator PWM Interface
13. **J20** – JTAG Boundary Scan
14. **J67** - 5V Enable for V-By-One Front-end Board
15. **J102** - RS232
16. **J120** - Actuator DAC Driver A/B
17. **J121** - Actuator DAC Driver C/D
18. **J122** - Actuator DAC Driver Enable
19. **J529** - 12V Input
20. **J536** - I2C2 Bus

21. **SW1** – Projector On Switch
22. **SW5** - Main Power Switch

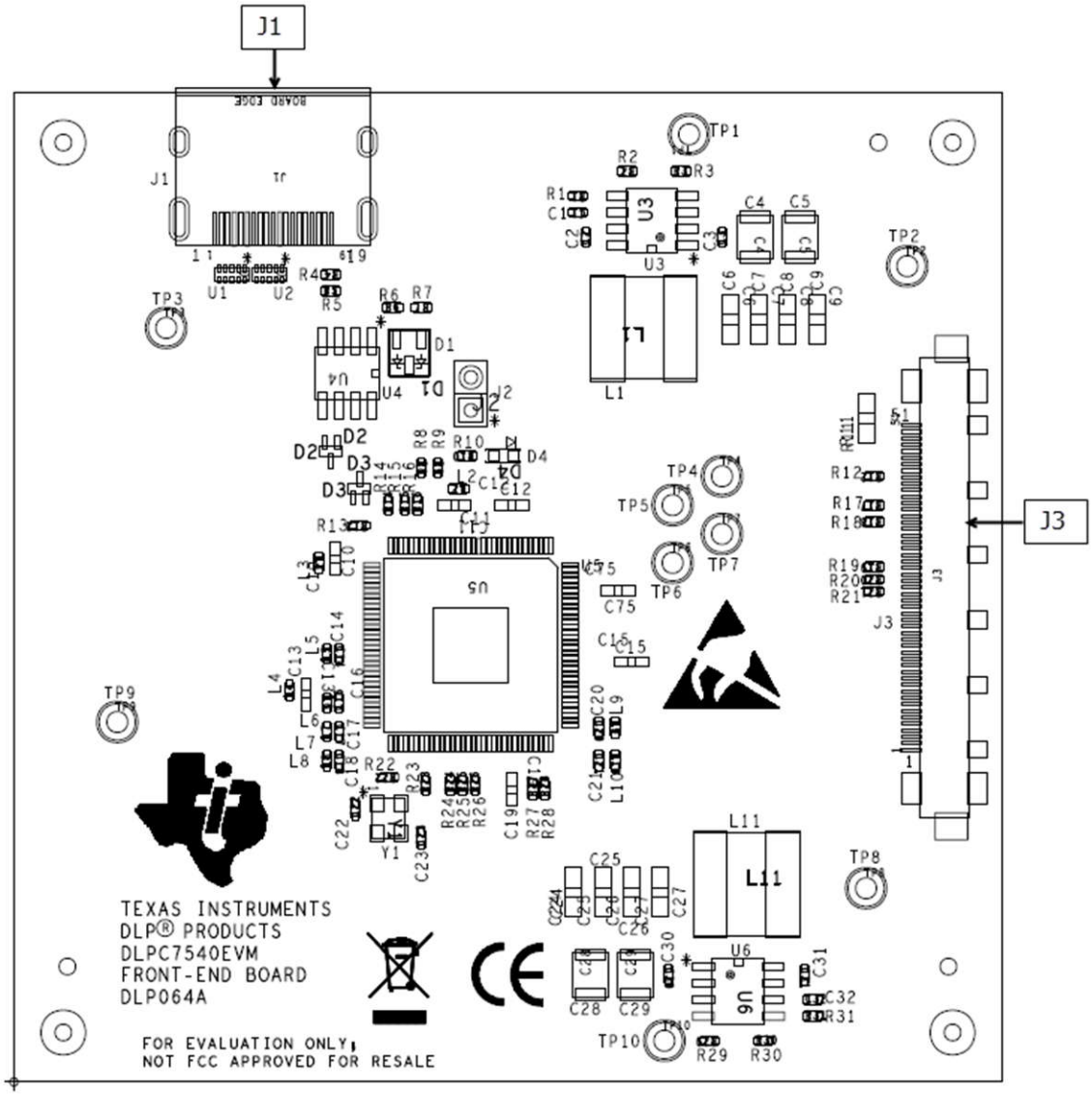


Figure 2-2. DLPC7540EVM Front-end Board Connectors

Front-end Board Connectors

1. **J1** - HDMI Input
2. **J3** - V-By-One Input

2.2.2 DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM Connections

The switches and connectors with the respective locations are shown in Figure 2-3.

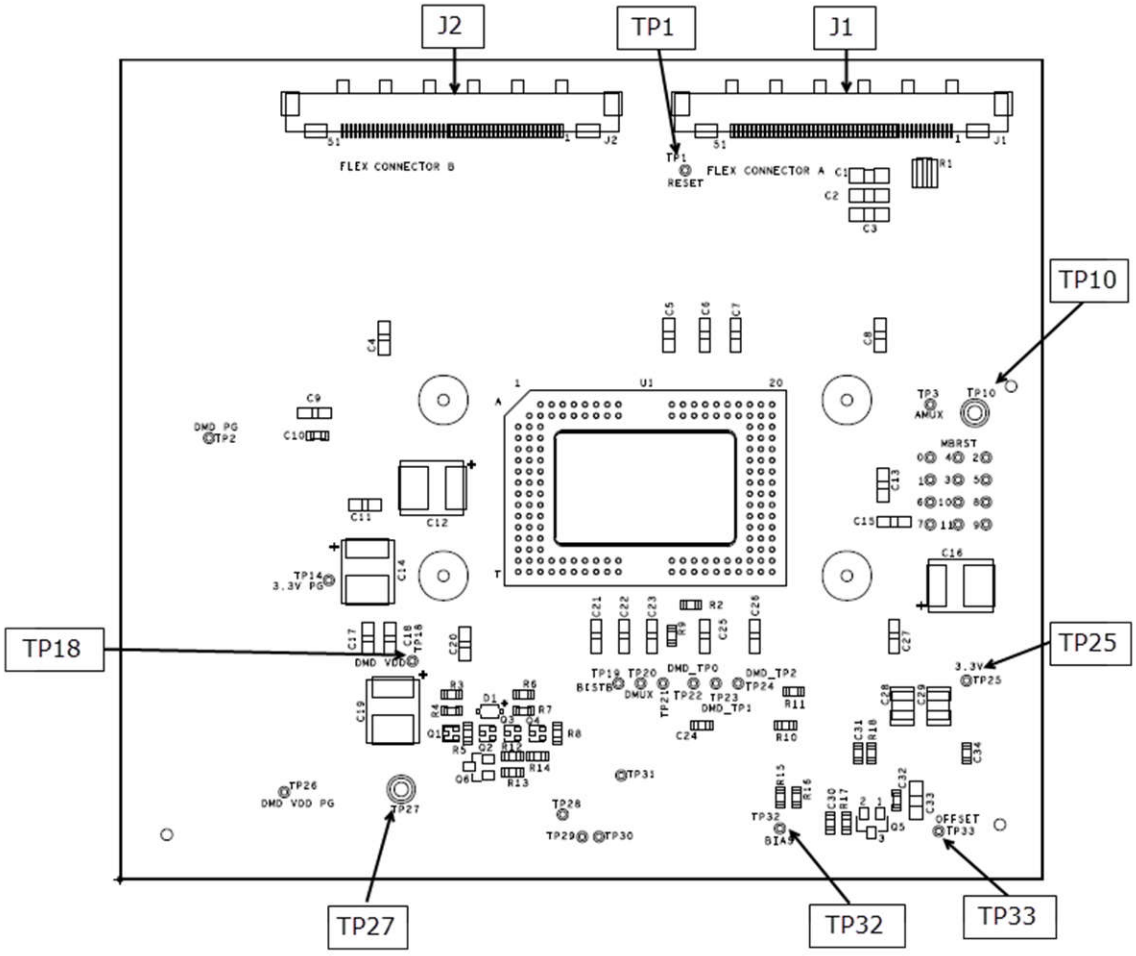


Figure 2-3. DLP471TEEVM, DLP472TEEVM, and DLP650TEEVM Test Points and Connectors

2.2.2.1 Test Points

1. **TP1** - VRESET
2. **TP10** - GND
3. **TP18** - DMD_VDD (1.8V)
4. **TP25** - 3.3V
5. **TP27** - GND
6. **TP32** - VBIAS
7. **TP33** - VOFFSET

2.2.2.2 Connectors

1. **J1** - DMD HSSI0 Flex Cable Connector
2. **J2** - DMD HSSI1 Flex Cable Connector

2.3 Power Supply Requirements

2.3.1 External Power Supply Requirements

The DLPC7540EVM does not include a power supply. The external power supply requirements are:

- Nominal voltage: 12V DC -5%/+10%
- Maximum output current: 7A

- DC connector size:
  - Inner diameter: 2.5mm
  - Outer diameter: 5.5mm
  - Shaft: 9.5mm, 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.

3 Software

3.1 Quick Start

This chapter offers a quick start guide on how to connect the DLP471TEEVM, DLP472TEEVM, or DLP650TEEVM to the DLPC7540EVM, how to power up the DLPC7540EVM, and how to program the DLPC7540EVM to display a SPLASH image on the DMD.

3.1.1 Downloading the Software

Before programming the DLPC7540EVM, make sure the DLPDLC-GUI and DMD firmware are both downloaded on the PC. The DLPDLC-GUI allows for operation of the EVM. The DMD firmware is required so the DLPC7540EVM knows which DMD is being controlled. The DLP471TEEVM comes with a DLP471TE DMD which is for 4K display applications. The EVM when installed with DLP471TE DMD can operate using DLP471TE (4K) or DLP471NE (1080p) based firmware. Similarly, the DLP472TEEVM and DLP650TEEVM comes with a DLP472TE and DLP650TE DMD for 4K display applications and can operate with DLP472TE (4K), DLP650TE (4K), DLP471NE (1080p), or DLP472NE (1080p) based firmware. Any of the three types of DMD EVMs can also be retrofitted with the corresponding 1080p DMDs (DLP471NE/DLP472NE/DLP651NE) but does not have XPR operation enabled. For a summary of firmware compatibility, see Table 3-1.

Table 3-1. Flash Image Compatibility Summary

	DLP471TEEVM		DLP472TEEVM		DLP650TEEVM	
Flash Image(1)	DLP471TE DMD	DLP471NE DMD	DLP472TE DMD	DLP472NE DMD	DLP650TE DMD	DLP651NE DMD
Flash_DLPC7540_DLP471TE_LED.img	✓	✓(2)				
Flash_DLPC7540_DLP471TE_LPCW.img	✓	✓(2)				
Flash_DLPC7540_DLP471NE_LED.img	✓(2)	✓				
Flash_DLPC7540_DLP471NE_LPCW.img	✓(2)	✓				
Flash_DLPC7540_DLP472TE_LED.img			✓	✓(2)		
Flash_DLPC7540_DLP472TE_LPCW.img			✓	✓(2)		
Flash_DLPC7540_DLP472NE_LED.img			✓(2)	✓		
Flash_DLPC7540_DLP472NE_LPCW.img			✓(2)	✓		
Flash_DLPC7540_DLP650TE_LED.img					✓	✓(2)
Flash_DLPC7540_DLP650TE_LPCW.img					✓	✓(2)
Flash_DLPC7540_DLP651NE_LED.img					✓(2)	✓
Flash_DLPC7540_DLP651NE_LPCW.img					✓(2)	✓

(1) The DMD supporting firmware and DLPDLC-GUI can be found in the EVM tool folder and in the product pages on TI.com. These are the product pages for the DLP471TE, DLP471NE, DLP472TE, DLP472NE, DLP650TE, DLP651NE, and the DLPC7540.
(2) XPR operation which is required for 4K resolution is disabled.

3.1.2 Connecting the DLP471TEEVM, DLP472TEEVM, or DLP650TEEVM, to the DLPC7540EVM

Before connecting the DLP471TEEVM/DLP472TEEVM/DLP650TEEVM to the DLPC7540EVM, locate the two flex cables that are packaged with the DLP471TEEVM/DLP472TEEVM/DLP650TEEVM. Make sure the flex cables are not torn or damaged before connecting the DMD EVMs or the DLPC7540EVM.

The flex cables are exactly the same, meaning there is not a *right* or *left* cable. The cables are interchangeable.

Connect the DLP471TEEVM, DLP472TEEVM, or DLP650TEEVM to the DLPC7540EVM formatter board by connecting the two flex cables matching the board connectors as listed in Table 3-2.

Table 3-2. Flex Cables Connection Assignment

DLPC7540EVM (Formatter Board)	DLP471TEEVM/DLP650TEEVM
J7	J1
J10	J2

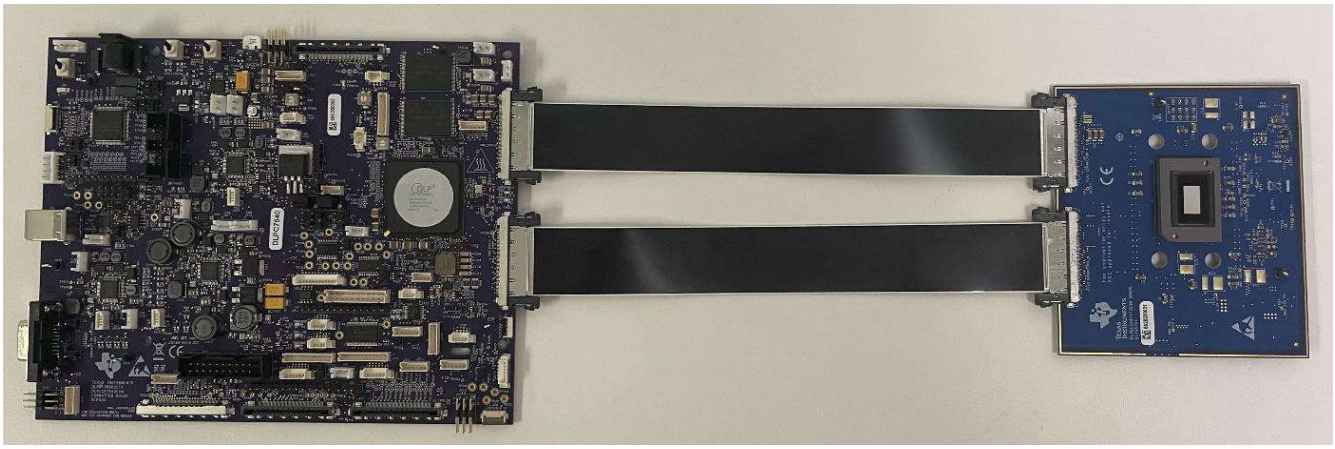


Figure 3-1. Formatter Board and DMD EVM Connected

3.1.3 Powering-up the DLPC7540EVM and Preparing to Program the DLPC7540EVM

There is only one jumper that is included with the DLPC7540EVM. This jumper is installed on J67 during normal operation between formatter and front-end boards. Before powering up the EVM for programming, make sure the included jumper is installed on J9 instead. The jumper locations are listed in Section 2.2.1.

Table 3-3. Reference Designators

Jumper	Description (Bold Indicates Default Position)
J67 - Front End 5V	Uninstalled - 5V not supplied to J3 **Installed - Formatter board provides 5V to Front-end board over J3 connection**
J9 - Hold in Boot Loader	**Uninstalled - Normal Operation** Installed - Hold in Boot Loader

Jumper J9 is the *Hold BL* jumper. This jumper is used to put the DLPC7540EVM into boot loader mode, which allows the DLPC7540 controller to be programmed. Connect this jumper to prepare the DLPC7540EVM to be programmed.

To power up the DLPC7540EVM, a 12V, 5A power supply is needed. Make sure the power supply is functional and the switch SW5 and SW1 on the formatter board are set to off before connecting the power supply to the EVM. Connecting the power supply when the switch is in the off position can prevent damage to the DLPC7540EVM from poor power connections. The image below shows SW5 and SW1 and the operating positions.

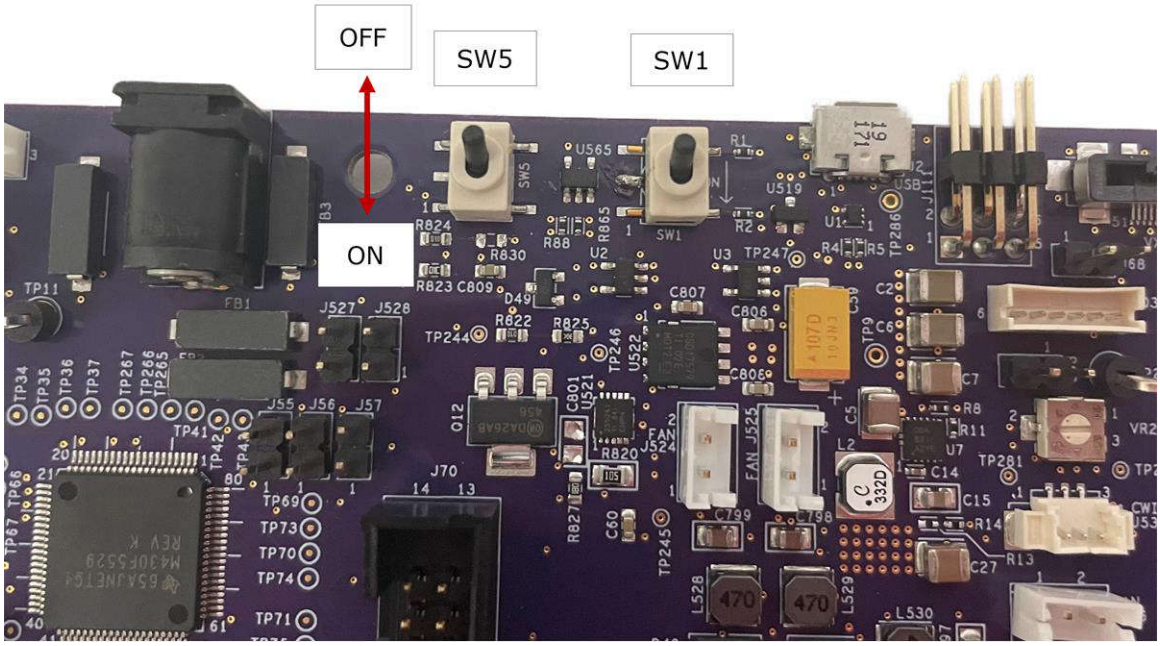


Figure 3-2. ON/OFF Switches

Once the power supply has been connected to the DLPC7540EVM, the switches SW5 and SW1 in that order can be flipped to the *on* position. Users can then plug in the USB cable to J2 of the board to prepare for programming the board. Verify that D5, D6, D7 and D15 LEDs are on.

3.1.4 Programming the DLPC7540EVM and Displaying a SPLASH Image

Follow these steps to download and configure the DLPDLC-GUI for DLPC7540 operation:

1. Download the DLPDLC-GUI and the Firmware SW package that includes the Firmware binary (.img) files for DLP471TE, DLP472TE, and DLP650TE.
2. Install and open the DLPDLC-GUI
3. Setting up communication preferences:
   a. DLPDLC-GUI supports USB and I2C communication. To change these settings in GUI, please go to Debug screen and select Connection tab.
   b. For USB, select the USB interface and click *Connect*; see Figure 3-3.

Note

USB is the preferred interface to download the firmware flash image to the EVM as USB is much faster than I2C and does not require any additional hardware.

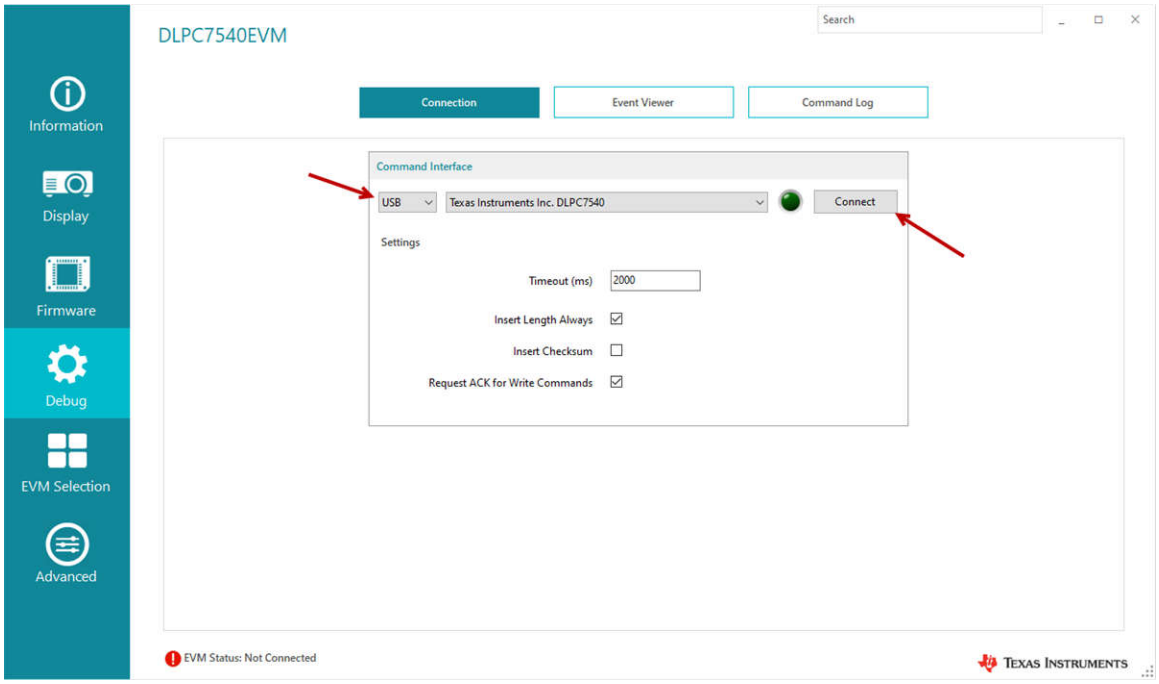


Figure 3-3. Command Interface Settings

c. Verify that EVM Status shown at bottom left of GUI says *Connected, Bootloader Mode* indicating you are ready to load image file into EVM.

4. Flash Loader Configuration:
   a. Go to Firmware screen, select Update Firmware tab. Click on the folder icon to browse for the applicable firmware depending on the actual DMD that is connected to DLPC7540EVM. Once firmware image file is selected, click on *Start Update*; see Figure 3-4.
   b. Wait for the programming progress to indicate that firmware update is complete.
   c. Turn off the EVM by toggling the SW1 and SW5 switches in that order to *off* position. Remove the jumper from J9 and install back to J67.
   d. Turn on the EVM by toggling the SW5 and SW1 switches in that order to *on* position. After about 3 seconds, users see D5, D6, and D7 LEDs steadily on and D15 LED flashing. The DLP Texas Instruments logo is visible on the DMD; see Figure 3-5.

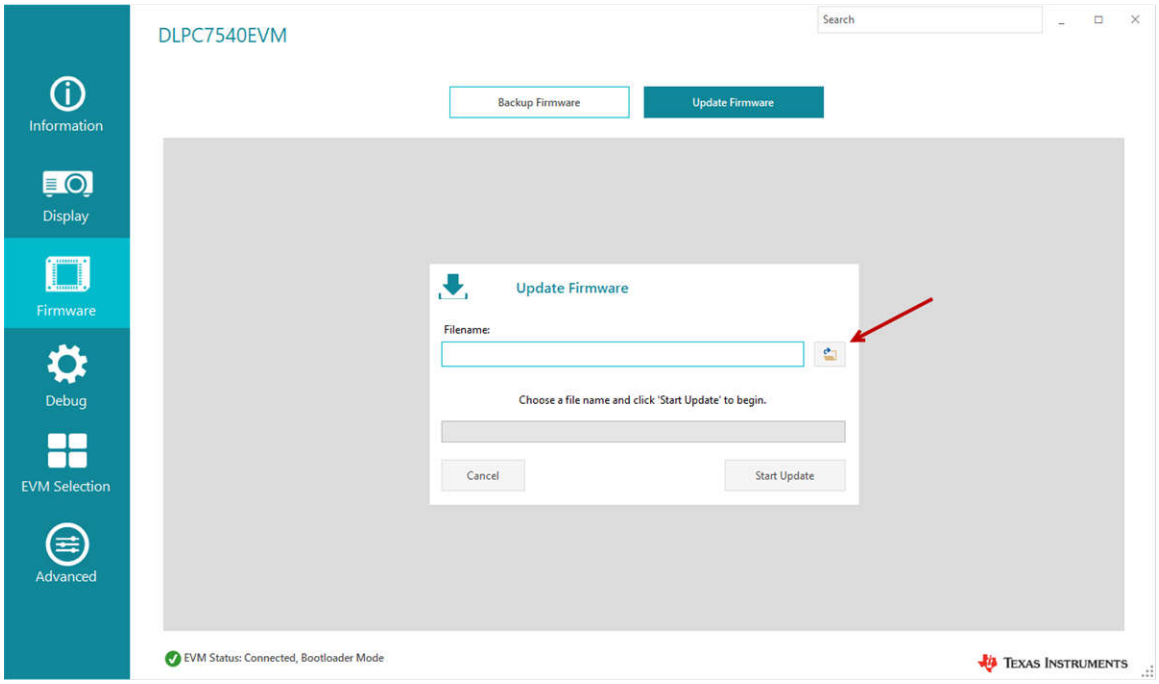


Figure 3-4. Loading the Flash Image

Note

If there is an issue with USB communication, then turn off DLPC7540EVM and disconnect then reconnect USB cable and power on board.

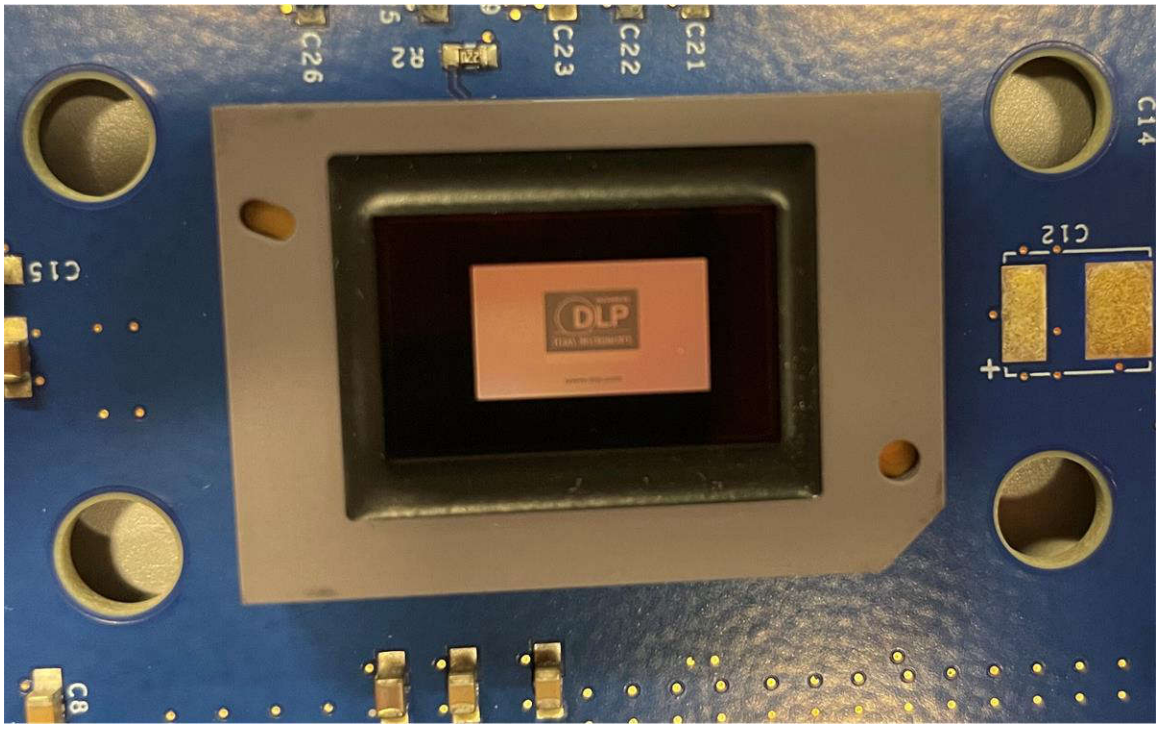


Figure 3-5. Splash Image Displayed on DMD

3.1.5 Troubleshooting

Table 3-4. Troubleshooting the Problem and the Possible Resolutions

Problem	Possible Resolutions
EVM Status: Not Connected	1. USB cable not connected. 2. Command interface not set to USB. Go to Debug screen, Connection tab and select USB as the Command Interface, click Connect. 3. If the user has gone from using Advanced mode back to the DLPDLC-GUI, then user needs to click on EVM Status message on bottom left of DLPDLC-GUI screen to reestablish connection with GUI.

4 Hardware Design Files

The design files for DLP471TEEVM are available on the EVM tool page: DLP471TEEVM.

The design files for DLP472TEEVM are available on the EVM tool page: DLP472TEEVM.

The design files for DLP650TEEVM are available on the EVM tool page: DLP650TEEVM.

The design files for DLPC7540EVM are available on the EVM tool page: DLPC7540EVM.

5 Additional Information

5.1 Safety

5.1.1 Caution Labels

CAUTION

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

5.1.2 If You Need Assistance

Refer to the *DLP E2E Community support forums*.

5.2 Trademarks

DLP® is a registered trademark of Texas Instruments.
All trademarks are the property of their respective owners.

The terms HDMI, HDMI High-Definition Multimedia Interface, HDMI trade dress, and the HDMI Logos are trademarks or registered trademarks of HDMI Licensing Administrator Inc.

6 Related Documentation

1. Texas Instruments, *DLP471TE Digital Micromirror Device (DMD)* data sheet.
2. Texas Instruments, *DLP472TE Digital Micromirror Device (DMD)* data sheet.
3. Texas Instruments, *DLP650TE Digital Micromirror Device (DMD)* data sheet.
4. Texas Instruments, *DLPC7540 DLP Display Controller* data sheet.
5. Texas Instruments, *DLPA100 Power Management and Motor Driver* data sheet.

7 Revision History

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

Changes from September 30, 2024 to October 31, 2025 (from Revision A (September 2024) to Revision B (October 2025)) **Page**

- Added HDMI trademark information..... 1

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