

# EVM User's Guide: DLP4620SQ1EVM DLP4621Q1EVM

## DLP4620SQ1 and DLP4621Q1 Evaluation Module



### Description

The DLP4620SQ1 evaluation module (EVM) is a complete electronic subsystem designed to control the DLP4620S-Q1, DLPC231S-Q1, and TPS9900S-Q1 devices, which support RGB display applications such as augmented reality head-up displays.

The DLP4621Q1EVM is designed to control the DLP4621-Q1, DLPC231-Q1, and TPS99001-Q1, which supports monochrome applications such as high-resolution headlights.

There are no optical elements provided with this EVM, except for the DMD. Expect that this EVM is procured to mount to a custom-designed picture generation unit (PGU) or projector.

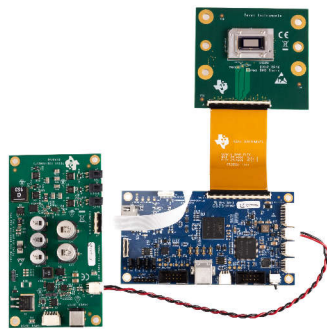
### Features

- DLP4620S-Q1 DMD board with RGB display LED driver and DLPC231S-Q1 DMD controller for DLP4620SQ1EVM kit
- DLP4621-Q1 DMD board with headlight LED driver and DLPC231-Q1 DMD controller for DLP4621Q1EVM kit
- 600MHz SubLVDS DMD interface for low power and emission

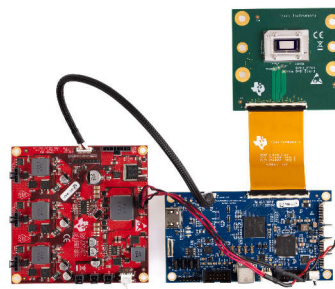
- DMDs have 0.46-inch diagonal micromirror array
  - 7.6 $\mu$ m micromirror pitch
  - $\pm 12^\circ$  micromirror tilt angle
  - Bottom illumination enables high efficiency and smaller engine size
  - 10kHz DMD refresh rates over temperature extremes
  - Compatible with LED or laser illumination
- Video input interface on controller board
  - Single OpenLDI (FPD-Link™ I) port up to 110MHz
  - 24-bit RGB parallel interface up to 110MHz
- Configurable host interface
  - Inter-Integrated Circuit (I2C) (400kHz)
  - Serial Peripheral Interface (SPI) (10MHz)

### Applications

- Augmented Reality Head-Up Display (AR HUD)
- [Transparent window display](#)
- Adaptive driving beams, glare-free beam steering, reflective traffic sign and pedestrian dimming, symbol projection



DLP4620SQ1EVM



DLP4621Q1EVM



This design incorporates HDMI® technology.

# 1 Evaluation Module Overview

## 1.1 Introduction

This user's guide presents an overview and general description of the DLP4620S-Q1 and DLP4621-Q1 EVMs and provides first steps for getting started using the EVMs.

## 1.2 Kit Contents

The DLP4620SQ1EVM consists of a DLPC231S-Q1 DMD controller board, a DLP4620S-Q1 DMD board, an LED driver board, and cables.

Similarly, the DLP4621Q1EVM consists of the DLPC231-Q1 DMD controller board, a DLP4621-Q1 DMD board, an LED driver board, and cables.

## 1.3 Specifications

### 1.3.1 Electrical Specifications

**Table 1-1. Electrical Specifications - DLP4620SQ1EVM**

PARAMETER	MIN	NOM	MAX	UNIT
<b>Input</b>				
Voltage	8	12	18	V
Power <sup>(1)</sup>		12	40	W
<b>LED Pre-Regulator Output</b>				
Voltage	6.5 or 8 <sup>(2)</sup>			V
<b>LED Driver Output Load</b>				
Voltage (Per LED Color Output)			7.5	V
Current (Per LED Color Output)			6	A
<b>Temperature</b>				
Operating DMD Temperature <sup>(3)</sup>	-40		105 <sup>(4)</sup>	°C

(1) Conditions for nominal power: white balanced LED current up to 6A, LED forward voltage = 3.5V, display duty cycle = 90/10.

(2) Pre-regulator output voltage is set by the jumper position of header H2. See [Table 2-5](#).

(3) Care must be taken to make sure that individual components and PCB do not exceed the maximum temperature when driving high-power load.

(4) Some components are only rated to 85°C. Refer to [Table 1-4](#) for a list of these components.

**Table 1-2. Electrical Specifications - DLP4621Q1EVM**

Parameter	Min	Nom	Max	UNIT
<b>Input</b>				
Voltage	8	12	18	V
Power			96	W
<b>LED Pre-Regulator Output</b>				
Voltage	3		12	V
<b>LED Driver Output Load</b>				
Voltage(Per LED Output)			12	V
Current(Per LED Output)			6 <sup>(1)</sup>	A
<b>Temperature</b>				
Operating DMD Temperature <sup>(2)</sup>	-40		105 <sup>(3)</sup>	

(1) 8A may be used, but care must be taken to ensure that individual components and the PCB do not exceed their maximum temperature

(2) Care must be taken to ensure that individual components and PCB do not exceed their maximum temperature when driving high-power load

(3) Some components are only rated to 85C. Refer to for a list of these components.

### 1.3.2 Component Temperature Ratings - DLP4620SQ1EVM

The PCB materials and most of the PCB components are rated to operate between  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ , including the DLP4620S-Q1, the DLPC231-Q1 or DLPC231S-Q1, and the TPS99000S-Q1.

Some components on board, such as switches, connectors, and indicator LEDs, do not meet this temperature rating. The specifications for EVM components which are not rated between  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  are listed in [Table 1-3](#). Refer to the EVM bill of materials to review the temperature specifications of all components used in the EVM design.

**Table 1-3. EVM Components Which are Not Rated for  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$**

Board	Reference	Part Number	Manufacturer	Description	Temperature Minimum ( $^{\circ}\text{C}$ )	Temperature Maximum ( $^{\circ}\text{C}$ )
Controller	D4	LTST-C171KRKT	Lite-On	LED, GREEN 0805	-55	85
Controller	J4	2086588131	Molex	CONN MICRO HDMI RIGHT ANGLE	-20	85
Controller	J9	1734346-1	TE Connectivity	CONN USB TYPE B RIGHT ANGLE	0	50
Controller	SW1, SW2, SW3, SW4	CVS-01TB	Copal Electronics Inc	SWITCH DIP SLIDE 1-POS 1 mm 6V	-40	85
Controller	SW6	GT12MSABETR	ITT C&K	SWITCH TOGGLE SPST RIGHT ANGLE	-30	85
Controller	U12	SN74AVC4T774PWR	Texas Instruments	DUAL SUPPLY TRANSCEIVER	-40	85
Controller	U501	TFP401AIPZPRQ1	Texas Instruments	IC PANELBUS DVI RCVR 100-HTQFP	-40	85
Controller	U503	AT34C02D-MAHMT	Microchip	EEPROM MEMORY 2 Kb	-40	85
Controller	U505, U506, U507, U509, U511	PCMF2HDMI2SZ	Nexperia	COMMON MODE CHOKE 4LN SMD ESD	-40	85
LED Driver	J2	PJ-082BH	CUI Inc	CONN PWR JACK 2.5X5.5mm SOLDER	-25	85

The DLP4620SQ1EVM is not a production design and is intended for evaluation only.

### 1.3.3 Component Temperature Ratings - DLP4621Q1EVM

The PCB materials and most of the PCB components are rated to operate between  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ , including the DLP4621-Q1, the DLPC231-Q1, and the TPS99000-Q1.

Some components on board, such as switches, connectors, and indicator LEDs, do not meet this temperature rating. The specifications for EVM components which are not rated between  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  are listed in [Table 1-4](#). Please refer to the EVM bill of materials to review the temperature specifications of all components used in the EVM design.

**Table 1-4. EVM Components Which are Not Rated for  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$**

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Controller	D4	LTST-C171KRKT	Lite-On	LED, GREEN 0805	-55	85
Controller	J4	2086588131	Molex	CONN MICRO HDMI RIGHT ANGLE	-20	85
Controller	J9	1734346-1	TE Connectivity	CONN USB TYPE B RIGHT ANGLE	0	50
Controller	SW1, SW2, SW3, SW4	CVS-01TB	Copal Electronics Inc	SWITCH DIP SLIDE 1-POS 1 mm 6V	-40	85
Controller	SW6	GT12MSABETR	ITT C&K	SWITCH TOGGLE, SPST RIGHT ANGLE	-30	85
Controller	U12	SN74AVC4T774PWR	Texas Instruments	DUAL SUPPLY TRANSCEIVER	-40	85

**Table 1-4. EVM Components Which are Not Rated for –40°C to 105°C (continued)**

Board	Reference	Part Number	Manufacturer	Description	Temperature Minimum (°C)	Temperature Maximum (°C)
Controller	U501	TFP401AIPZPRQ1	Texas Instruments	IC PANELBUS DVI RCVR 100-HTQFP	–40	85
Controller	U503	AT34C02D-MAHM-T	Microchip	EEPROM MEMORY 2 Kb	–40	85
Controller	U505, U506, U507, U509, U511	PCMF2HDMI2SZ	Nexperia	COMMON MODE CHOKE 4LN SMD ESD	–40	85
LED Driver	SW1	G3T12AH-R	NKK Switches	SWITCH TOGGLE, SPDT, 28V, 100mA	–25	85

The DLP4621Q1EVM is not a production design and is intended for evaluation only.

### 1.3.4 Input Video Specifications

The following input video resolutions are supported on the HDMI and OpenLDI interfaces. These input video resolutions are programmed in the Extended Display Identification Data (EDID) EEPROM for the EVM's HDMI interface allowing a connected computer to read the supported resolutions and timing. Note that some computers are not able to output all of these resolutions.

**Table 1-5. Supported Resolutions**

Feature	0.46" Non-Diamond Down Sampling (non-DDS) Mode - HL	0.46" Non-Diamond Down Sampling (non-DDS) Mode - HUD	0.46" Diamond Down Sampling (DDS) Mode - HUD
EVM Part Number	DLP4621Q1EVM	DLP4620SQ1EVM	DLP4620SQ1EVM
Supported Resolutions	960×480, 480×240	960×960, 960×480, 480×240	1358×566, 1220×610
480×240	YES	YES	N/A
960×480	YES	YES	N/A
960×960	N/A	YES	N/A
1358×566	N/A	N/A	YES
1220×610	N/A	N/A	YES

The input source timing specified in the EVM's HDMI interface EDID are specified in [Table 1-6](#). These timing parameters are also recommended for the OpenLDI interface.

**Table 1-6. Typical Timing for Supported Source Resolutions**

Horizontal Resolution	Vertical Resolution	Horizontal Blanking				Vertical Blanking				Vertical Rate (Hz)	Pixel Clock (MHz)
		Total	Sync (Pixel Clocks)	Back Porch (Pixel Clocks)	Front Porch (Pixel Clocks)	Total	Sync (Lines)	Back Porch (Lines)	Front Porch (Lines)		
1358	566	160	32	80	48	19	10	6	3	60.02	53.29
1220	610	160	32	80	48	19	10	6	3	60	52.08
960	480	240	96	120	24	20	10	7	3	60	36
480	240	320	32	240	48	200	10	187	3	60	21.12
960	960	160	32	80	48	28	10	15	3	60	66.39

### 1.3.5 SPI and I<sup>2</sup>C Timing

For more information on SPI and I<sup>2</sup>C specifications, see the DLPC231S-Q1 data sheet ([DLPS201](#)) or the DLPC231-Q1 ([DLPS054](#)) data sheet.

### 1.4 Device Information

The DLP4620SQ1EVM kit contains the electronics required to drive a DLP4620S-Q1 DMD board for HUD applications while the DLP4621Q1EVM kit contains the electronics to drive a DLP4621-Q1 DMD board for headlight applications.

The DLP4620SQ1EVM offers interface options for I2C, SPI, and USB.

The DLP4621Q1EVM headlight kit, however, includes I2C, SPI, USB, and OpenLDI interfaces.

## 2 Hardware

### 2.1 DLP4620SQ1EVM Block Diagram

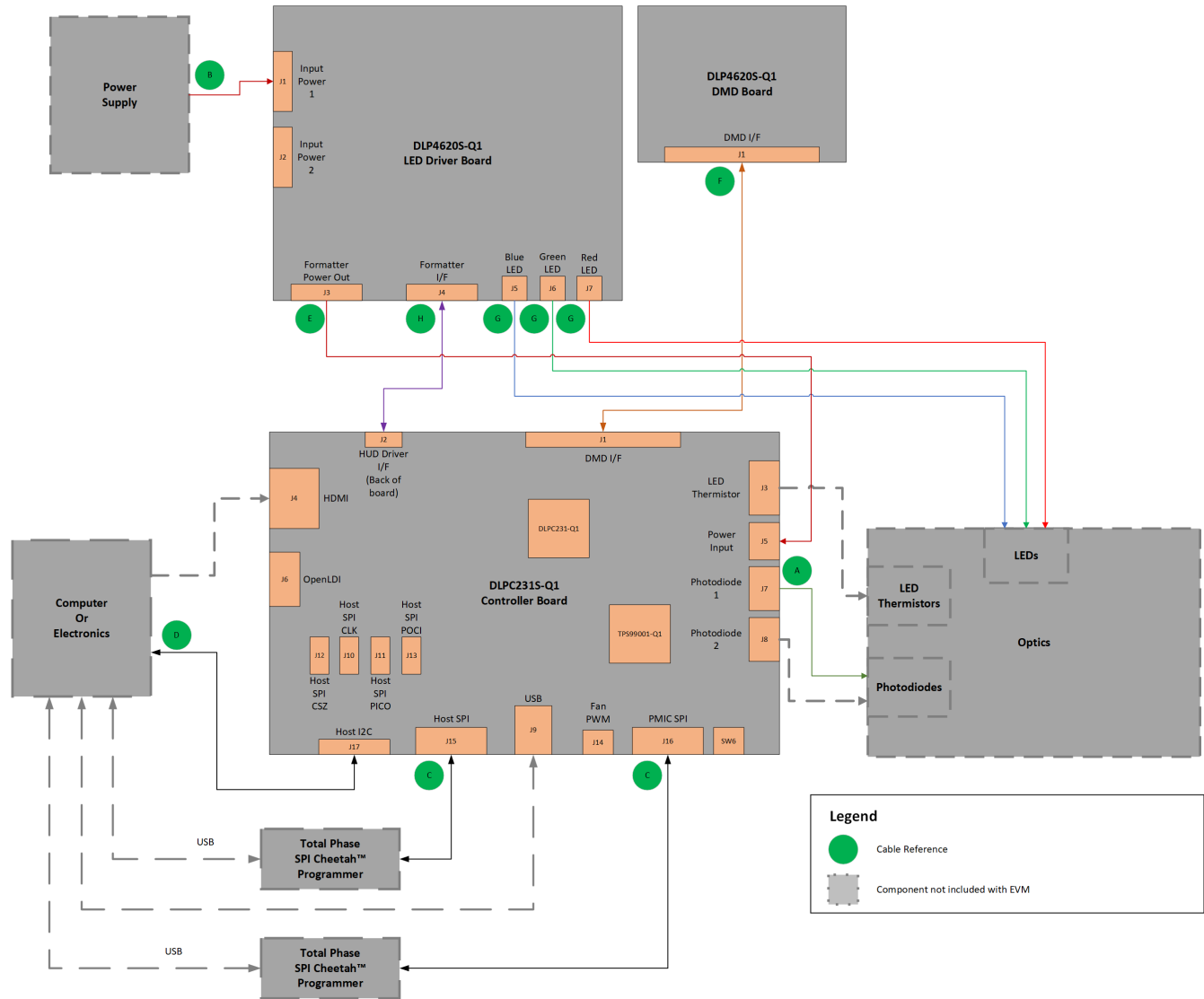
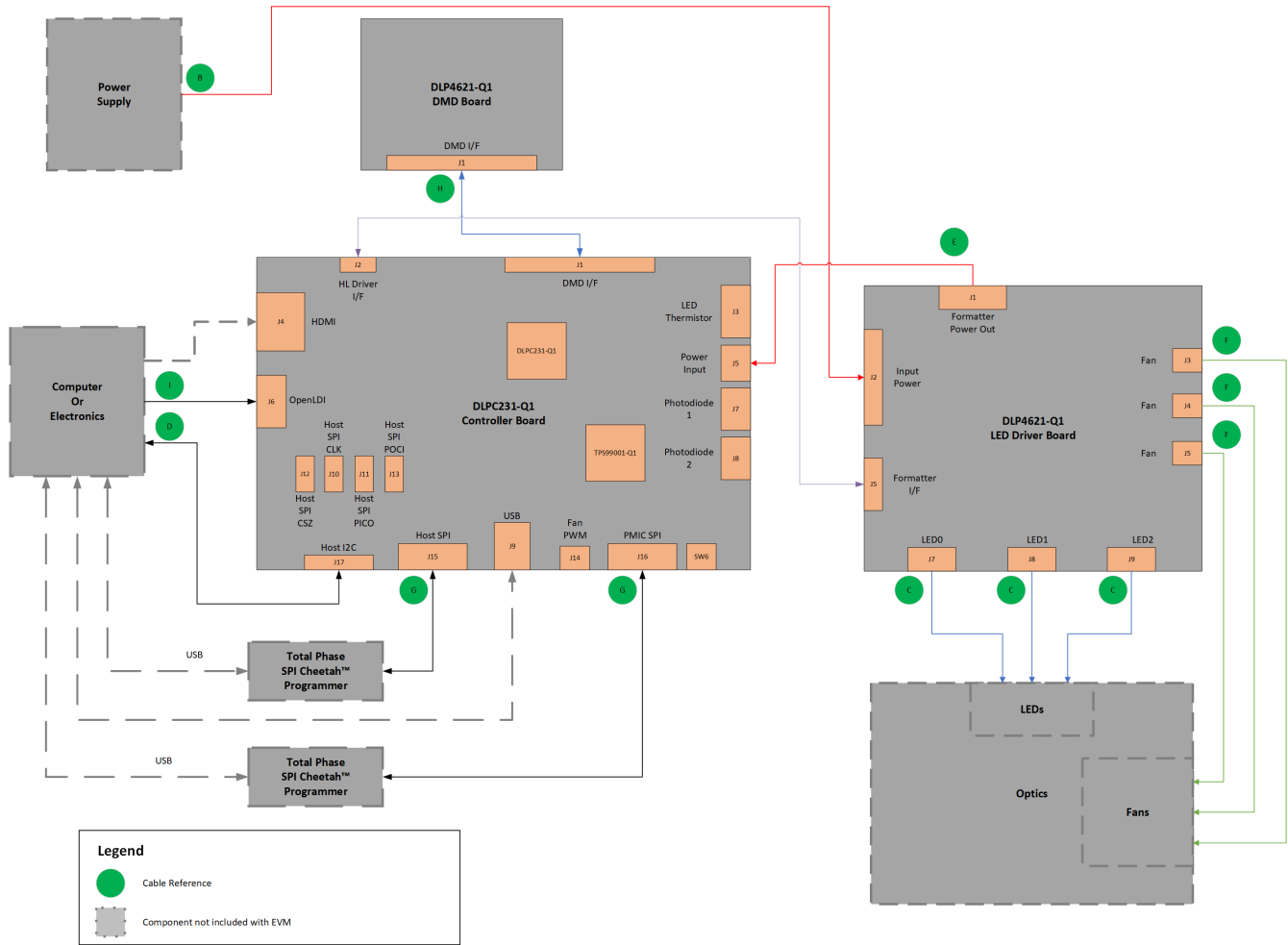


Figure 2-1. DLP4620SQ1EVM Cable Connections

A. Cable references can be seen in [Figure 2-5](#) and are listed in [Table 2-6](#).

## 2.2 DLP4621Q1EVM Block Diagram



A. Cable references can be seen in [Figure 2-8](#) and are listed in [Table 2-10](#).

**Figure 2-2. EVM Cable Connections**

### 2.3 Controller PCB

The controller PCB shown in [Figure 2-3](#) includes the DLPC231-Q1 DMD Controller and the TPS99001-Q1. The controller PCB supports video inputs from either a HDMI or OpenLDI interface and provides the formatting and control to display the video on the DLP4620S-Q1 and DLP4621-Q1 DMDs.

The controller board has a SPI port for users who wish to use a Cheetah™ SPI host adapter. However, the Cheetah host adapter must be bought separately from the EVM. This port allows for high-speed SPI communication between the controller board and host. An optional second SPI port is provided for monitoring the TPS990001-Q1 or the TPS99000S-Q1.

The controller board has an additional I2C port. The provided I2C cable includes PROJ\_ON, HOLD\_BOOT, and HOST\_IRQ, signals readily available to allow indirect control and monitoring of the EVM.

If direct SPI or I2C is not preferred, there is an on-board Cypress chip that allows for USB to SPI or USB to I2C communication.

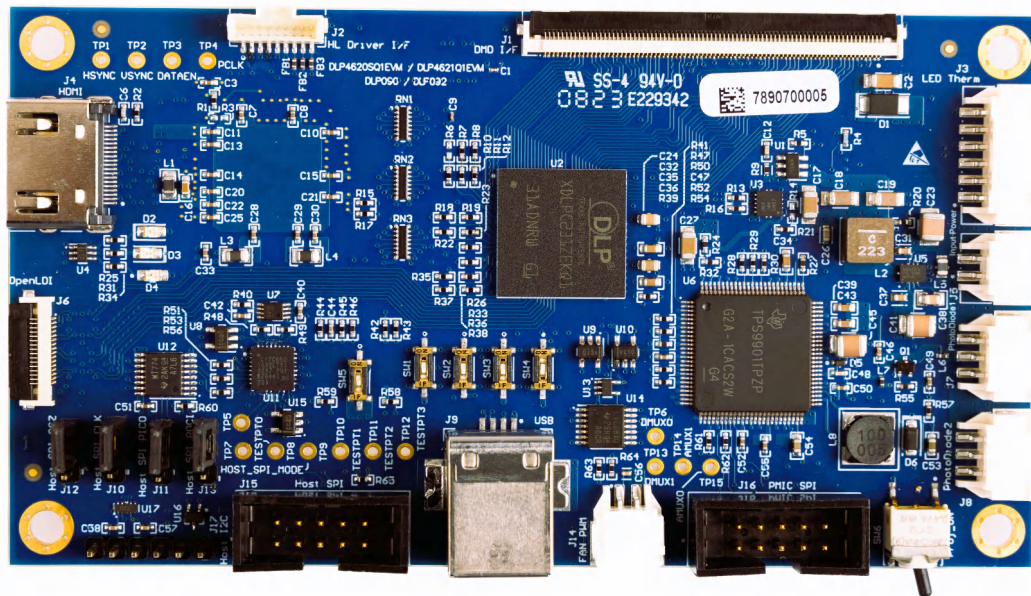
Each of these communication ports allow the user to communicate to the controller from the external world via a PC or the Automotive Control Program reference software, which speeds up the development of supported automotive EVMs. Some features include flashing new firmware onto the controller, changing test pattern generator (TPG) images, changing sources (such as TPG to HDMI), or obtaining controller or PMIC (TPS9900-Q1) diagnostics.

The controller board has an external photodiode input that is used to control white point and brightness over a wide dimming range. An optional second photodiode input is also provided for the DLP4620SQ1EVM kit.

The LED thermistor on the board can be used to measure the temperatures of the red, green, and blue LEDs when using the DLP4620SQ1EVM.

The headlight interface port helps control the LED brightness and PWM output from the controller for the DLP4621Q1EVM.

On the opposite side of the EVM is a HUD interface port, which helps control and monitor an illumination design such as the RGB LED driver provided in the kit. This is used for the DLP4620SQ1EVM.



**Figure 2-3. DLPC231SQ1EVM Controller PCB**

The controller PCB contains the ports listed in [Table 2-1](#). Indicator LEDs are listed in [Table 2-2](#).

**Table 2-1. Controller PCB Ports**

SCHEMATIC REFERENCE	FUNCTION
J1	DMD flex cable interface
J2	Headlight driver interface
J3	LED thermistor
J4	HDMI input
J5	Driver controller power
J6	OpenLDI input
J7	Photodiode 1
J8	Photodiode 2
J9	USB Input

**Table 2-1. Controller PCB Ports (continued)**

SCHEMATIC REFERENCE	FUNCTION
J10	Host 1/2 SPI_CLK select
J11	Host 1/2 SPI_PICO select <sup>(1)</sup>
J12	Host 1/2 SPI_CSZ select
J13	Host 1/2 SPI_POCI select <sup>(1)</sup>
J14	Fan PWM output
J15	Host SPI
J16	PMIC SPI

(1) PICO and POCI are used for *Peripheral In, Controller Out* and *Peripheral Out, Controller In*, respectively.

**Table 2-2. Controller LED Indicators**

SCHEMATIC REFERENCE	FUNCTION
D2 (Green)	PROJ_ON Off: System Off On: System On
D3 (Green)	Input power to controller (from LED driver) Off: No power connected On: Power connected
D4 (Red)	HOST_IRQ Off: Interrupt not asserted On: Interrupt asserted

The controller PCB switches are listed in [Table 2-3](#). SW4 is a toggle switch for PROJ\_ON, which is used to turn on and off the electronics. Note that parts of the board are still powered when PROJ\_ON is in the off position. SW1, SW2 and SW3 are dip switches that control the states of configuration signals the DLPC230-Q1 reads when the DLPC230-Q1 comes out of reset. These switches must be set based on the desired configuration options.

**Table 2-3. Controller PCB Switches**

SCHEMATIC REFERENCE / SIGNAL NUMBER	FUNCTION
SW1	CHKSUM_SEL Off: Disabled On: Enabled
SW2	HOST_IF_SEL Off: CRC On: Checksum
SW3	HOST_SPI_MODE Off: Host SPI On: Host I <sup>2</sup> C
SW4	SPREAD SPECTRUM ENABLE Off: Mode 0 or 3 On: Mode 1 or 2
SW5	HOLD_BOOTZ Off: Do not hold in boot (continue to main application) On: Hold in boot
SW6	PROJ_ON Off: Turn off system On: Turn on system



## 2.4 RGB LED Driver PCB - DLP4620SQ1

The DLP4620SQ1EVM can operate as a standalone system with just the controller board and the DMD board, but the EVM can be combined with an RGB LED design. The LED driver board shown in Figure 2-4 is controlled and monitored by the controller PCB over a flex cable. Power can be input to the LED driver board from a bench top supply or through a 12V, 5A barrel jack power supply. Depending on operating conditions, some parts and surfaces of the PCB can be hot.

The LED driver board has the following primary functions:

- Provides reverse bias protection and supplies power to controller board over a separate cable.
- Regulates input power to 6.5V or 8V prior to the LED driver circuitry.
- Has outputs for red, green, and blue LEDs, but other LEDs can be used.

### CAUTION



The LED driver board can reach temperatures above 55°C without proper cooling and airflow. Contact can cause burns!

### CAUTION



LED drivers (J5, J6, J7) can produce high currents of 6.5A or 8A. Do not remove these headers, and do not touch the contact points during operation!

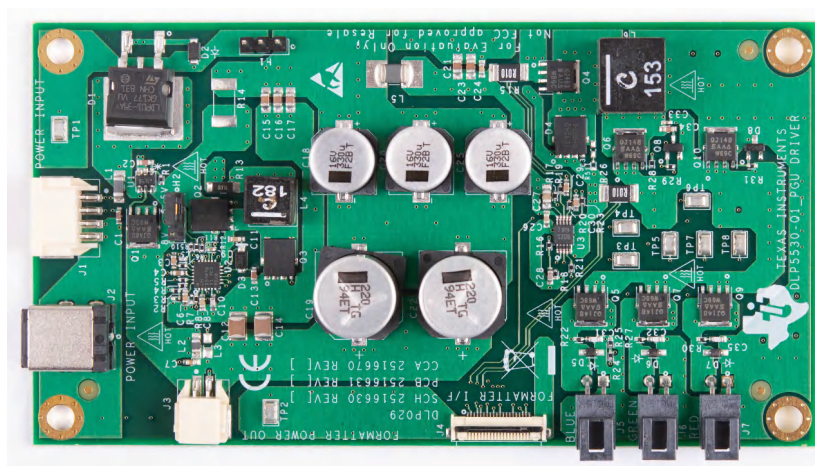


Figure 2-4. LED Driver PCB - DLP4620SQ1EVM

The LED driver PCB contains the ports listed in [Table 2-4](#).

**Table 2-4. RGB LED Driver PCB Ports**

SCHEMATIC REFERENCE	FUNCTION
J1	Input power
J2	Input power (optional)
J3	Controller power
J4	Controller-driver control interface
J5	Blue LED output - high current output up to 6A, locking and keyed connector
J6	Green LED output - high current output up to 6A, locking and keyed connector
J7	Red LED output - high current output up to 6A, locking and keyed connector

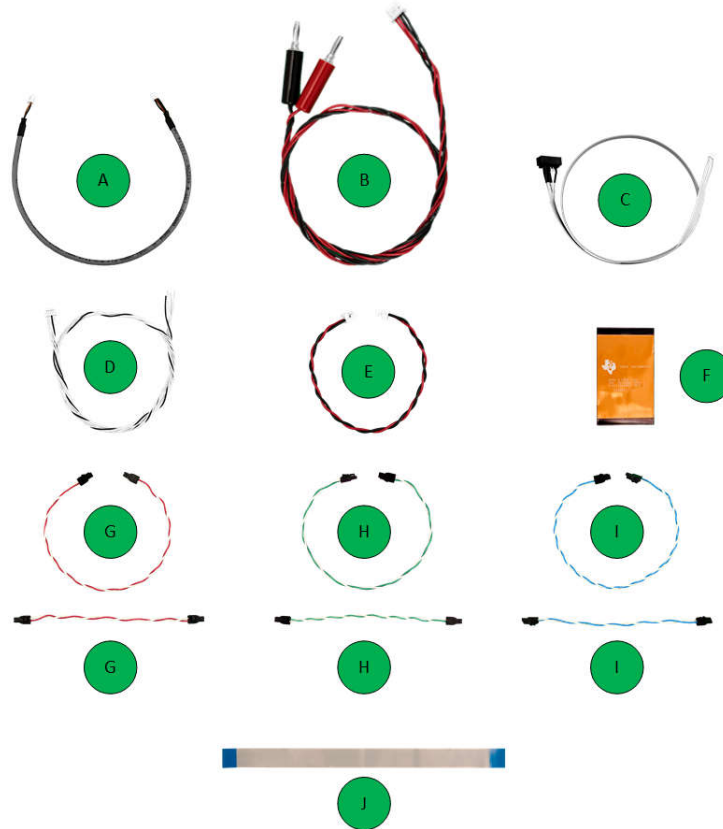
The LED driver PCB contains the headers listed in [Table 2-5](#). H2 selects the LED drive voltage. Place a jumper across pins 1 and 2 for 6.5V drive. Place a jumper across pins 2 and 3 for 8V drive. Do not hot-swap this jumper; remove and replace only with power disconnected from the board.

**Table 2-5. LED Driver Header Pins**

HEADER	PIN1	PIN2	PIN3
H1	Pre-regulated drive voltage (6.5V or 8V)	GND	GND
H2	Feedback voltage connection for 6.5V drive	Pre-regulator feedback voltage	Feedback voltage connection for 8V drive

## 2.5 Cables - DLP4620SQ1EVM

The DLP4620SQ1EVM kit contains the cables and Cheetah USB to SPI adapter listed in [Table 2-6](#) and shown in [Figure 2-5](#).



**Figure 2-5. DLP4620SQ1EVM Cables**

**Table 2-6. DLP4620SQ1EVM Cables**

NAME	REFERENCE	QUANTITY
Photodiode cable	A	1
Input power cable	B	1
Host SPI cable	C	1
Host I2C Cable (includes PROJ_ON, HOLD_BOOT, HOST_IRQ signals)	D	1
LED driver to controller board power cable	E	1
Controller to DMD board flex cable	F	1
Red illuminator power cables	G	2
Green illuminator power cables	H	2
Blue illuminator power cables	I	2
LED driver to controller board HUD interface flex cable	J	1

A block diagram for the DLP4620SQ1EVM can be found in [Figure 2-1](#).

## 2.6 LED Driver PCB - DLP4621Q1EVM

The DLP4621Q1EVM can be used as a standalone system with just the controller and DMD boards, but can be combined with an LED driver board. The LED driver board shown in [Figure 2-6](#) is designed for monochrome (white light) designs. The LED brightness can be controlled through PWM output from the DLPC231-Q1. Using the Automotive Control Program reference software *Headlight Control* tab, the PWM slider bars (PWM0, PWM1, and PWM2) control the current through each LED driver channel. Note that the PWM control can exceed the maximum current specification of some LEDs in certain LED configurations.

### Note

Some current continues to flow through the LED with a PWM level of 0, and light output can still be visible. To fully remove LED current, the system must be set to standby mode.

### CAUTION



The LED driver can reach temperatures above 55°C without proper cooling and airflow. Contact can cause burns!

### CAUTION



LED drivers (J7, J8, J9) can produce high currents up to 8A. Do not remove these headers, and do not touch the contact points during operation!

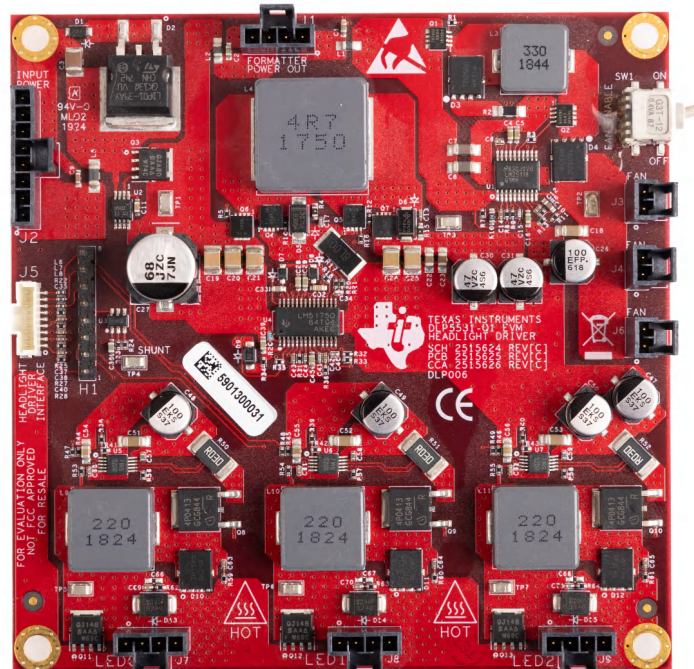


Figure 2-6. LED Driver PCB - DLP4621Q1EVM

The LED driver PCB contains the ports listed in [Table 2-7](#).

**Table 2-7. LED Driver PCB Ports**

SCHEMATIC REFERENCE	FUNCTION
J1	Controller power
J2	Input power
J3	Fan
J4	Fan
J5	Headlight driver interface
J6	Fan
J7	LED0 - High current output up to 8A, locking connector
J8	LED1 - High current output up to 8A, locking connector
J9	LED2 - High current output up to 8A, locking connector

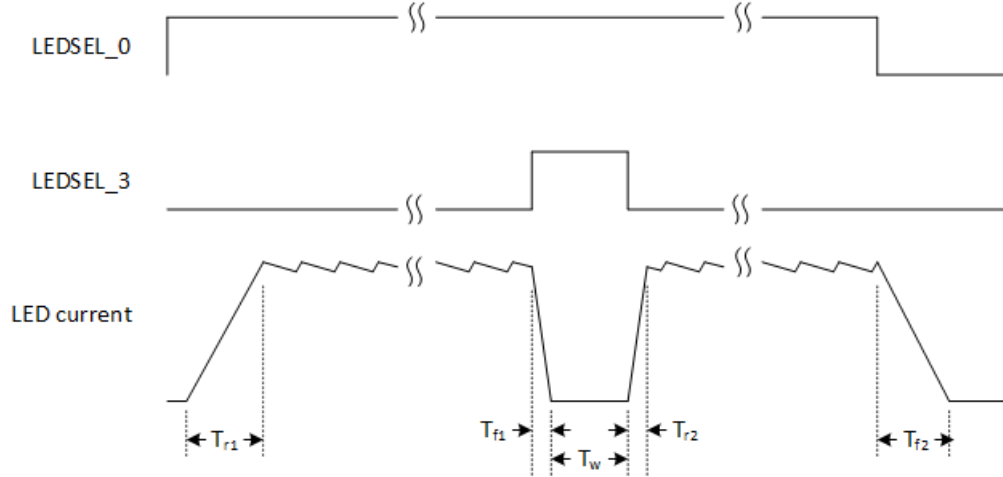
The LED driver PCB contains the following ports and switches. See [Table 2-5](#).

**Table 2-8. LED Driver Header Pins**

Schematic Reference / Signal Number	PIN1
SW1	Fan enable On position is down in <a href="#">Figure 2-6</a>

## 2.7 Driver Requirements - DLP4621Q1EVM

The DLP4621-Q1 chipset, used with LED illumination, requires illumination modulation. This LED modulation turns off the light output during micromirror reset, which improves system contrast. For the system timing specifications of the DLP4621-Q1 electronics EVM, see [Figure 2-7](#)



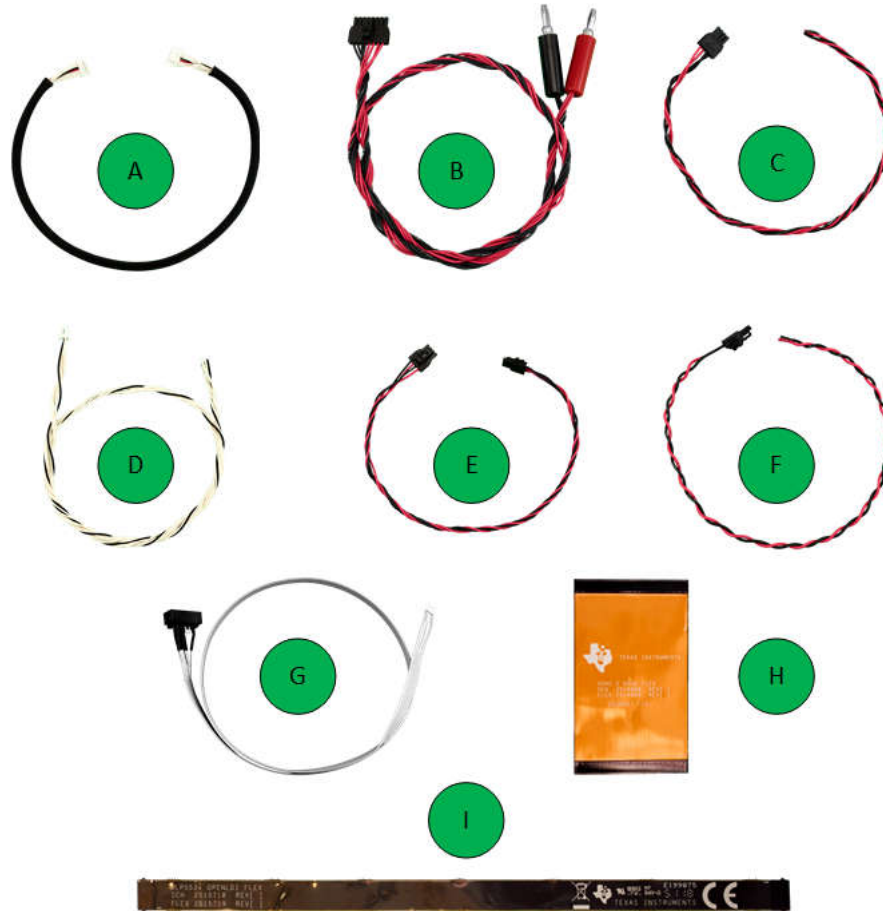
**Figure 2-7. DLP4621-Q1 Electronics EVM LED Driver Board Timing Specifications**

**Table 2-9. LED Driver Board Timing Specifications**

Parameter	Value
$T_{r1}, T_{r2}$	< 50 $\mu$ s
$T_{f1}, T_{r2}$	< 2 $\mu$ s
$T_w$	minimum = 1 $\mu$ s

## 2.8 Cables - DLP4621Q1EVM

The DLP4621Q1EVM kit contains the cables and Cheetah USB to SPI adapter listed in [Table 2-10](#) and shown in [Figure 2-5](#).



**Figure 2-8. DLP4620SQ1EVM Cables**

**Table 2-10. DLP4621Q1EVM Cables**

NAME	REFERENCE	QUANTITY
Headlight driver interface cable	A	1
LED driver power cable	B	1
LED power cable	C	1
Host I <sup>2</sup> C Cable (Includes PROJ_ON, HOLD_BOOT, HOST_IRQ signals)	D	1
LED driver to controller board power cable	E	1
Fan power cable	F	1
Host SPI cable	G	1
Controller to DMD flex cable	H	1
Open LDI flex cable	I	1


A block diagram of the DLP4621Q1EVM can be found in [Figure 2-2](#).

## 2.9 Optical Engine Requirements

The DLP4620SQ1EVM can be coupled to an optical engine (not included) to implement a head-up display function or an automotive interior projection system. The detailed requirements of the optical engine are beyond the scope of this document, but the optical engine must have separate red, green and blue illuminators. These are typically LEDs. The optical engine also needs to provide a photodiode in the illumination path before the DLP4620S-Q1 DMD. The photodiode is used to control white point and brightness output. A heat sink for the DLP4620S-Q1 DMD can be needed for operation in high temperature ambient environments, but is not included in the DLP4620S-Q1 Electronics EVM.

Similarly for the DLP4621Q1EVM, optics and mechanics are not included in the kit.

**CAUTION**



**When choosing your LED or laser component (not included with this EVM) the end user must consult the data sheet supplied by the manufacturer of the illuminator to identify the EN62471 Risk Group Rating and review any potential eye hazards associated with the illuminator chosen. Always consider and implement the use of effective light filtering and darkening protective eye wear and be fully aware of surrounding laboratory-type set-ups when viewing intense light sources that can be required to minimize or eliminate such risks to avoid accidents related to temporary blindness.**

### REACH-Affected Components

In compliance with Article 33 provision of the EU REACH regulation, we are notifying you that this EVM includes components containing at least one Substance of Very High Concern (SVHC) above 0.1%. These uses from Texas Instruments do not exceed 1 ton per year. The SVHC's are:

**Table 2-11. DLP4620SQ1EVM**

Component Manufacturer	Component Type	Component Part Number	SVHC Substance	CAS Number
ITT C&K	Switch	GT12MSABETR	Lead	7439-92-1

## 3 Software

### 3.1 Software Installation

1. Download and install the [DLPC230-Q1 Control Program Lite](#) from ti.com.
2. Install [Total Phase Cheetah USB adapter drivers](#) from the Total Phase website.

### 3.2 Quick Start - DLP4620SQ1EVM

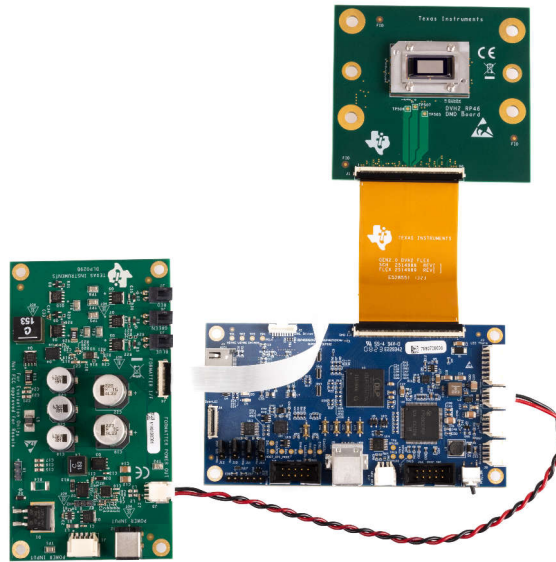
Use the following instructions to set up the DLP4620SQ1EVM and PC.

#### 3.2.1 Kit Assembly Instructions - DLP4620SQ1EVM

An example image of the DLP4620SQ1EVM without a power supply and optics is shown in [Figure 3-1](#).

1. Connect the DMD Flex Cable to the controller PCB (J1) and the DMD PCB (J1). Pin 1 is marked on the DMD flex cable. Make sure the controller side of the flex cable is aligned with the controller PCB.
2. Connect the controller to driver control interface flex to the controller PCB (J8) and the illumination driver PCB (J4).
3. Connect your host communication cable to the controller PCB and your host computer.
  - a. If using the Total Phase Cheetah SPI Adapter, follow the jumper configuration found in [Section 3.4](#).
  - b. If using a direct USB connection, then follow the jumper configuration found in [Section 3.5](#).
4. Connect the controller power cable to the controller PCB (J5) and the illumination driver PCB (J3).
5. Connect the blue illumination output cable to the illumination driver PCB (J5) to the blue illuminator in the optics engine.
6. Connect the green illumination output cable to the illumination driver PCB (J6) to the green illuminator in the optics.
7. Connect the red illumination output cable to the illumination driver PCB (J7) to the red illuminator in the optics engine.
8. Connect the photodiode cable to the controller PCB (J7) to a photodiode located in the illumination path of the optics engine.
9. Connect the HDMI cable to the controller PCB (J4). Connect the HDMI cable to PC HDMI port.
10. Connect the power input cable to the illumination driver PCB (J1).





- A. If communicating with the controller, then be sure to always check what the jumper configuration is. Jumpers J10, J11, J12, and J13 determine whether or not the controller recognizes SPI or USB communication.

**Figure 3-1. DLP4620SQ1EVM Cable Connections**

### 3.2.2 Powering-Up EVM

1. Connect input power cable to a power supply that meets input power specifications defined in [Table 1-1](#). The red wire is the V+ terminal and black wire is the V– terminal.
2. Turn on the supply power. Once powered up, controller PCB LED indicators (D3) illuminates green.
3. Turn the PROJ\_ON switch (SW6) ON. The ON position is away from the board, and OFF is toward the board. A controller PCB LED indicator (D2) illuminates green.

### 3.2.3 Steps to Reprogram the Onboard Flash Memory

The DLP4620SQ1EVM and DLP4621Q1EVMQ1EVM come with onboard serial Flash that is pre-programmed with software and basic configuration. The software and configuration can be updated by reprogramming the serial flash with the DLPC230-Q1 Automotive Control Program. Steps to re-program the serial flash are listed below.

1. Using the DLPC230-Q1 Automotive Control Program, which is connected to the EVM, navigate to the *Flash Program* tab.
2. Using the folder icon, select an Image File (.bin) and open.
3. Click *Program and Verify Flash Memory*.

Note that if the device is in *Display* mode, then the device automatically switches to *Standby* during programming.

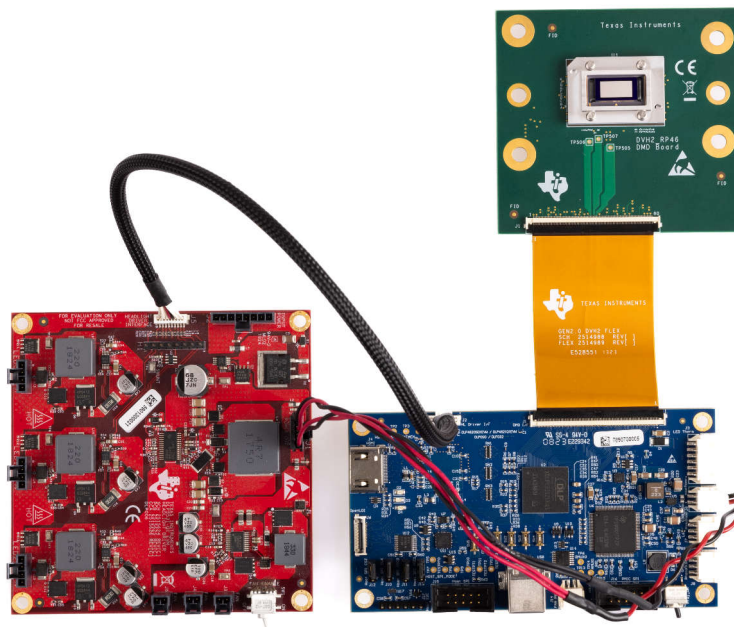
## 3.3 Quick Start - DLP4621Q1EVM

Use the following instructions to set up the DLP4621Q1EVM and PC.

### 3.3.1 Kit Assembly Instructions - DLP4621Q1EVM

An example image of the DLP4620SQ1EVM without a power supply and optics is shown in [Figure 3-2](#).

1. Connect the DMD Flex Cable to the controller PCB (J1) and the DMD PCB (J1). Pin 1 is marked on the DMD flex cable. Make sure the controller side of the flex cable is aligned with the controller PCB.
2. Connect the controller to driver control interface flex to the controller PCB (J2) and the illumination driver (J5).
3. Connect your host communication cable to the controller PCB and your host computer.
  - a. If using the Total Phase Cheetah SPI Adapter, follow the jumper configuration found in [Section 3.4](#).
  - b. If using a direct USB connection, follow the jumper configuration found in [Section 3.5](#).
4. Connect the controller power cable to the controller PCB (J2) and the illumination driver (J1).
5. Connect the LED power cable to any of the LED Driver Board LED ports (J7, J8, J9). Note that some ports can be disabled by flash setting. LED0 (J7) is in the ON position.
6. Connect the Fan Power cable to any of the illumination driver fan ports (J3, J5, J6). Confirm the fan switch on the illumination driver (SW1) is in the ON position.
7. Connect the micro HDMI cable to the controller board (J4). Connect the micro HDMI cable to the PC HDMI port.
8. Connect the Power Input cable to the illumination driver (J2).



**Figure 3-2. DLP4621Q1EVM EVM Cable Connections**

- A. If communicating with the controller, then be sure to always check what the jumper configuration is. Jumpers J10, J11, J12, and J13 determine whether or not the controller recognizes SPI or USB communication.

### 3.3.2 Powering-Up EVM

1. Connect input power cable to a power supply that meets input power specifications defined in [Table 1-1](#). The red wire is the V+ terminal and black wire is the V- terminal.
2. Turn on the supply power. Once powered up, a controller PCB LED indicator (D4) illuminates green.
3. Turn the PROJ\_ON switch (SW4) ON. The ON position is away from the board, and OFF is toward the board. A controller PCB LED indicator (D5) illuminates green.

### 3.3.3 Steps to Reprogram the Onboard Flash Memory

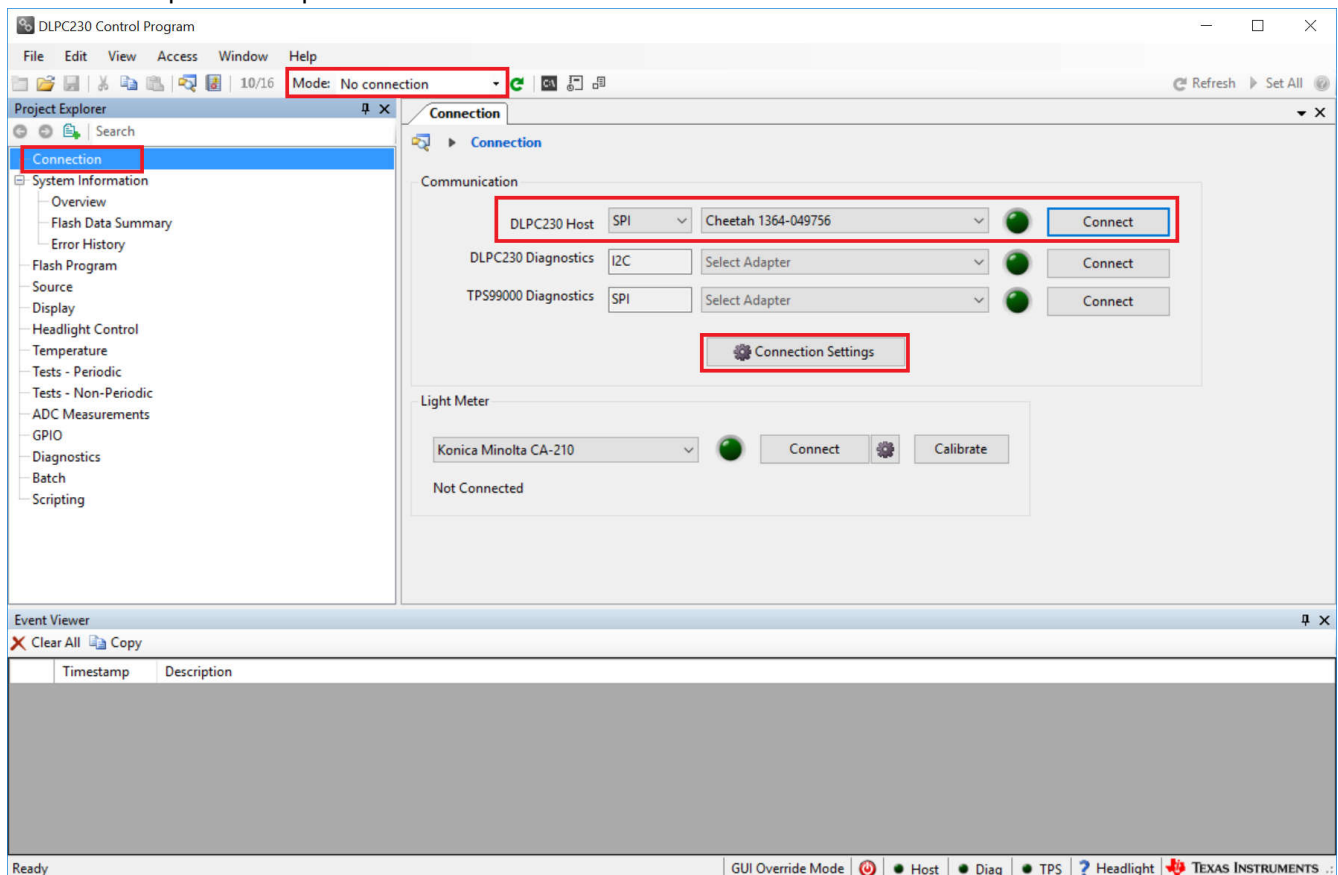
The DLP4620SQ1EVM and DLP4621Q1EVMQ1EVM come with onboard serial Flash that is pre-programmed with software and basic configuration. The software and configuration can be updated by reprogramming the serial flash with the DLPC230-Q1 Automotive Control Program. Steps to re-program the serial flash are listed below.

1. Using the DLPC230-Q1 Automotive Control Program, which is connected to the EVM, navigate to the *Flash Program* tab.
2. Using the folder icon, select an Image File (.bin) and open.
3. Click *Program and Verify Flash Memory*.

Note that if the device is in *Display* mode, then the device automatically switches to *Standby* during programming.

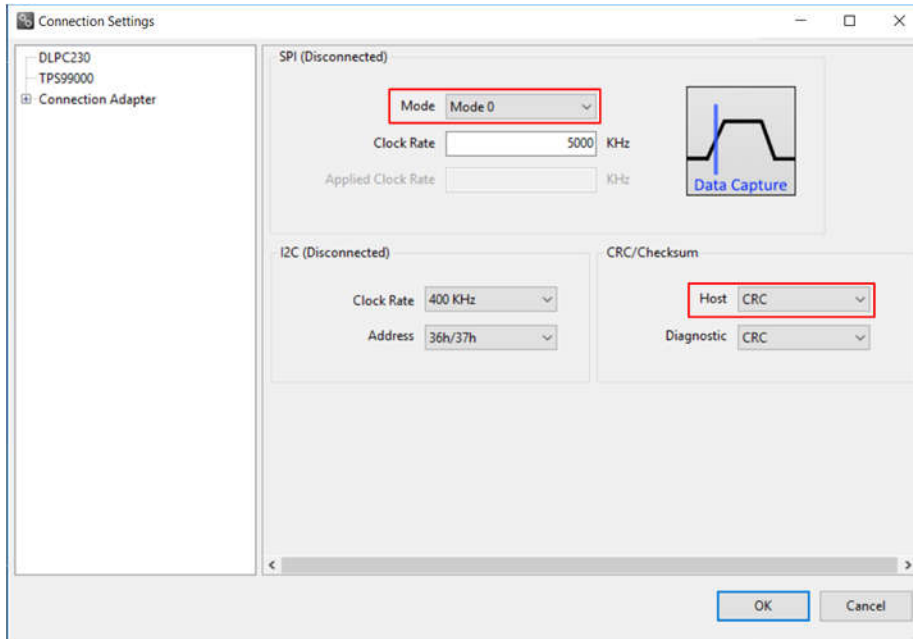
### 3.4 Connecting EVM to the DLPC230-Q1 Control Program via SPI

1. Start the DLPC230-Q1 Control Program Lite.
2. With the controller board powered off, short or populate pins 1 and 2 of J10, J11, J12, and J13 together with a jumper and then plug the SPI adapter into J2 of the controller board.
3. -On the *Connection* page, set the DLPC230-Q1 Host to SPI and select the Cheetah from the drop down menu (see [Figure 3-3](#)). Note, the Cheetah must be connected to computer with USB cable for the Cheetah to show up in the drop-down menu.



**Figure 3-3. Connecting to the DLPC230-Q1 Using the DLPC230-Q1 Automotive Control Program**

- Select *Connection Settings* to confirm the SPI configuration shown in [Figure 3-4](#) matches the controller PCB switch settings described in [Table 2-3](#). Specifically, SPI mode and CRC/Checksum can vary based on switch settings. Press *OK* once configuration is complete.



**Figure 3-4. DLPC230-Q1 Automotive Control Program Communication Settings**

- Click the *Connect* button. The green circle next to the *Connect* button lights up to indicate that connection was successful to the Cheetah Adapter.

### 3.5 Connecting EVM to the DLPC230-Q1 Control Program via USB

Setting up communication via a USB interface for the controller board is similar to the set up for SPI communication via the Cheetah™ host adapter.

- Start the DLPC230-Q1 Control Program Lite.
- With the DLPC231 controller board off, short pins 2-3 together on jumpers J10, J11, J12, and J13 of the controller board using a jumper
- On the connection page, set the DLPC230-Q1 Host to SPI and select the Cypress option from the drop down menu.
- The "Connection" Settings can be left the same way they were previously for SPI communication.
- Click the *Connect* button. The green circle next to the *Connect* button then lights up to indicate that connection was successful to USB.

## 4 Hardware Design Files

### 4.1 Schematics

Schematics for the DLP4620SQ1EVM are available for download on the product page of the EVM: [DLP4620SQ1EVM Design Files](#).

Schematics for the DLP4621Q1EVM are available for download on the product page of the EVM: [DLP4621Q1EVM Design Files](#).

### 4.2 PCB Layouts

Layouts for the DLP4620SQ1EVM are available for download on the product page of the EVM: [DLP4620SQ1EVM Design Files](#).

Layouts for the DLP4621Q1EVM are available for download on the product page of the EVM: [DLP4621Q1EVM Design Files](#).

### 4.3 Bill of Materials (BOM)

The bill of materials for the DLP4620SQ1EVM are available for download on the product page of the EVM: [DLP4620SQ1EVM Design Files](#).

The bill of materials for the DLP4621Q1EVM are available for download on the product page of the EVM: [DLP4621Q1EVM Design Files](#).

## 5 Additional Information

### 5.1 Trademarks

FPD-Link™ is a trademark of Texas Instruments.

Cheetah™ is a trademark of Total Phase, Inc.

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 Revision History

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

<b>Changes from Revision * (April 2024) to Revision A (September 2025)</b>	<b>Page</b>
• Updated HDMI trademark information.....	<a href="#">1</a>

## 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.
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  - 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.
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  - 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](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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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.

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2. 実験局の免許を取得後ご使用いただく。
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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](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

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#### 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.
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-

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.

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