DLP5534Q1EVM Evaluation Module User's Guide

The DLP5534Q1 Evaluation Module (EVM) is a complete electronic subsystem designed to drive the DLP5534-Q1 chipset. The DLP5534-Q1 chipset consists of the DLP5534-Q1, the DLPC230-Q1, and the TPS99000-Q1. When combined with illumination and projection optics, 405 nm and other LEDs this EVM can be used to develop an automotive grade projector for applications such as transparent window display utilizing phosphor film(s) embedded in a window.

Except for the DMD, there are no optical elements provided with this EVM. It is expected that this EVM is procured in order to mount to a custom designed projector.

The DLP5534Q1 EVM is not a production design. It is intended for evaluation only.

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1 User Guide Overview

This user's guide presents an overview and general description of the DLP5534Q1 EVM and provides first steps for getting started using the EVM.

1.1 What is in the DLP5534Q1 EVM

The DLP5534Q1 electronics EVM consists of a Controller PCB, an Illumination Driver PCB, cables, and a USB to SPI adapter.

1.1.1 Controller PCB

The Controller PCB shown in Figure 1 includes the DLP5534-Q1 DMD, the DLPC230-Q1 DMD Controller, and the TPS99000-Q1. It supports video inputs from either a micro HDMI or OpenLDI interface and provides the formatting and control to display the video on the DLP5534-Q1 DMD. The EVM can be controlled with either an SPI or I^2C interface. The SPI or I^2C interface can also be used to reprogram the serial Flash that is used to store DLPC230-Q1 software and configuration. An optional second SPI port is provided for monitoring the TPS99000-Q1. The EVM includes a flex interface to control the Illumination Driver PCB. The EVM has external photodiode inputs and thermistor inputs which are not used for this application.

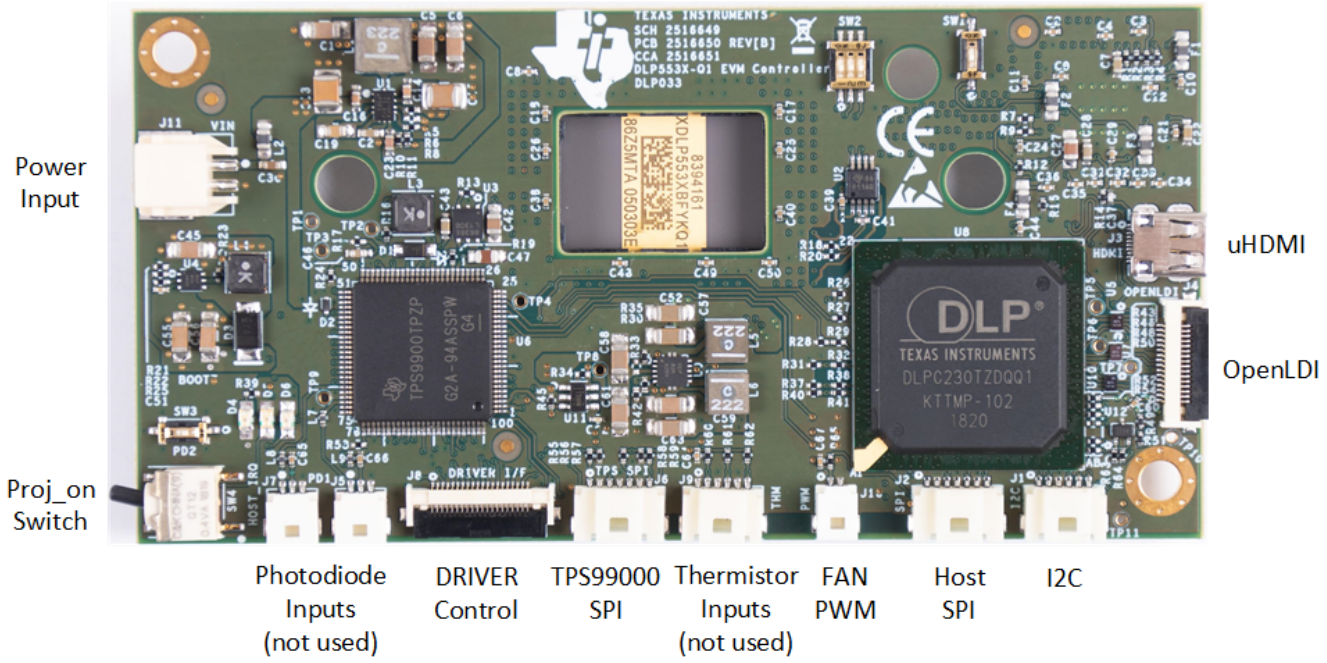

Figure 1. EVM Controller PCB

The Controller PCB contains the ports listed in Table 1. Indicator LEDs are listed in Table 2.

Table 1. Controller PCB Ports

SCHEMATIC REFERENCE	FUNCTION
J1	Host I^{2}C, PROJ_ON, HOLD_BOOT, HOST_IRQ
J2	Host SPI
J3	Micro HDMI
J4	OpenLDI (Flex connector)
J5	Photodiode 1(1)
J6	TPS99000-Q1 SPI Debug
J7	Photodiode 2(1)
J8	LED Driver Interface
J9	LED Thermistor(1)
J10	Fan PWM output (optional)
J11	Controller Power

(1) Port unused for this application. Cable not provided.

Table 2. Controller LED Indicators

SCHEMATIC REFERENCE	FUNCTION
D4 (Green)	Input power to Controller (from Illumination Driver) Off: No power connected On: Power connected
D5 (Green)	PROJ_ON Off: System Off On: System On
D6 (Red)	HOST_IRQ Off: Interrupt not asserted On: Interrupt asserted

The Controller PCB switches are listed in Table 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 it comes out of reset. These switches should be set based on the desired configuration options.

Table 3. Controller PCB Switches

SCHEMATIC REFERENCE / SIGNAL NUMBER	FUNCTION
SW1 (1)	Spread Spectrum Enable Off: Disabled On: Enabled
SW2 (1)	Host Port Checksum Select Off: CRC On: Checksum
SW2 (2)	Host Interface Select Off: Host SPI On: Host I^{2}C
SW2 (3)	Host SPI Mode Off: Mode 0 or 3 On: Mode 1 or 2
SW3	Hold in Boot Off: Do not hold in boot (continue to main application) On: Hold in boot
SW4	PROJ_ON Off: Turn off system On: Turn on system On state is toward the closest corner of the board Figure 1

1.1.2 Illumination Driver PCB

The Illumination Driver PCB shown in Figure 2 is controlled by the Controller PCB over a flex cable. Power can be input to the Illumination Driver from a lab supply. The Illumination driver provides reverse bias protection and supplies power to the Controller PCB over a separate cable. The Illumination Driver has outputs for one to three illuminators. These are typically LEDs, but it is possible other illuminators could be used. See Section 1.2.1 for input and output specifications of the EVM. Depending on operating conditions, some parts and surfaces of the PCB can be hot.

CAUTION

Hot surface. Contact may cause burns. Do not touch!

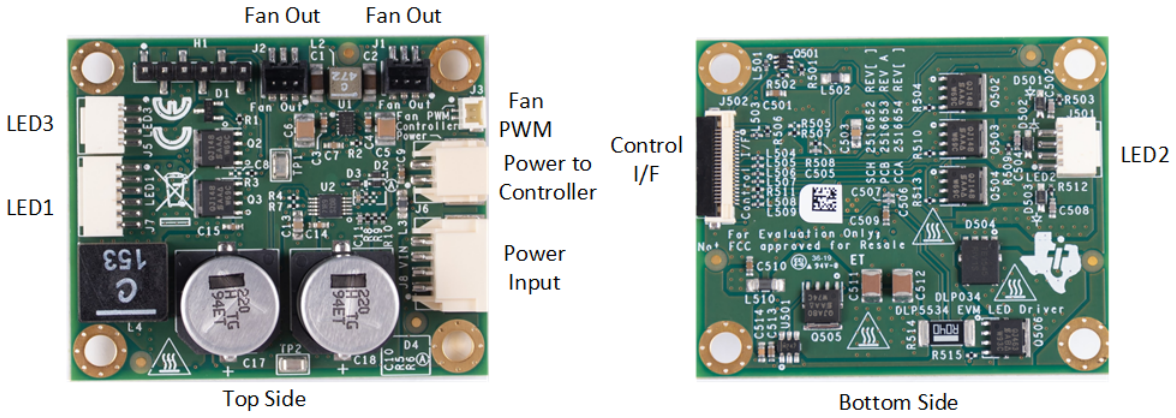

Figure 2. EVM Illumination Driver PCB

WARNING

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

The Illumination Driver PCB contains the ports listed in Table 4.

Table 4. Illumination Driver PCB Ports

SCHEMATIC REFERENCE	FUNCTION
J1	Fan Output
J2	Fan Output
J3	Fan PWM Input
J5	LED3 Illuminator Output
J6	Controller Power
J7	LED1 Illumination Output
J8	Input Power
J501	LED2 Illumination Output
J502	Controller to Driver Control Interface

1.1.3 EVM Cables

The EVM cables and Cheetah USB to SPI adapter are listed in Table 5 and shown in Figure 3.

Figure 3. EVM Cables

Table 5. EVM Cables

NAME	REFERENCE	QUANTITY
Cheetah™ SPI Host Adapter	A	1
Host SPI Cable	B	1
Host I^2C Cable (Includes PROJ_ON, HOLD_BOOT, HOST_IRQ signals)	C	1
Driver to Controller Power Cable	D	1
Input Power Cable	E	1
LED1 Illuminator Power Cable	F	1
LED2 Illuminator Power Cable	G	1
LED3 Illuminator Power Cable	H	1
Fan PWM	I	1
Controller to Driver Control Flex	J	1
OpenLDI Flex Cable	K	1
Micro HDMI Cable	L	1

1.2 Specifications

1.2.1 Electrical Specifications

Table 6. Electrical Specifications

PARAMETER	MIN	NOM	MAX	UNIT
Input				
Voltage (Input voltage must be higher than forward voltage of LED)	8	12	18	V
Illumination Driver Output Load				
Voltage (Per LED Color Output)			9	V
Current (Per LED Color Output)			4	A RMS
Fan Output				
Voltage		5		V
Current (total for all fans)			1	A
Temperature				
Operating DMD Temperature(1)	–40		105(2)	°C

(1) Care must be taken to ensure that individual components and PCB do not exceed their maximum temperature when driving high-power load. Force air cooling might be required to operate at high output current, high input voltage, and/or high duty cycles.

(2) Some components are only rated to 85°C. Refer to Table 7 for a list of these components.

1.2.2 Component Temperature Ratings

The PCB materials and most of the PCB components are rated to operate between –40°C to 105°C, including the DLP5534-Q1, the DLPC230-Q1, and the TPS99000-Q1.

Some components on PCBs, such as switches, connectors, and indicator LEDs, do not meet this temperature rating. The specifications for EVM components which are not rated between –40°C to 105°C are listed in Table 7. Please refer to the EVM bill of materials to review the temperature specifications of all components used in the EVM design.

Table 7. EVM PCB Components Which are Not Rated for –40°C to 105°C

Board	Reference	Part Number	Manufacturer	Description	Temperature Minimum (°C)	Temperature Maximum (°C)
Controller	D4, D5	LTST-C171KGKT	Lite-On	LED, GREEN 0805	–55	85
Controller	D6	LTST-C171KRKT	Lite-On	LED, RED 0805	–55	85
Controller	J3	685119248123	Wurth	CONN MICRO HDMI RIGHT ANGLE	–40	85
Controller	SW2	CVS-03TB	Copal Electronics Inc	SWITCH DIP SLIDE 3-POS 1 MM 6 V	–40	85
Controller	SW1,SW3	CVS-01TB	Copal Electronics Inc	SWITCH DIP SLIDE 1-POS 1 MM 6 V	–40	85
Controller	SW4	GT12MSABETR	C&K Comp	SWITCH, SPST, GULL	–30	85
Controller	U5, U7, U10, U503, U504	PCMF2HDMI2SZ	Nexperia	COMMON MODE CHOKE 4LN SMD ESD	–40	85
Controller	U501	TFP401AIPZPRQ1	Texas Instruments	IC PANELBUS DVI RCVR 100-HTQFP	–40	85

The Controller and Illumination Driver PCBs have a UL flame rating of 130°C maximum.

1.2.3 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 may not be able to output all of these resolutions, in particular 576 × 288.

- 1152 × 1152
- 1152 × 576
- 576 × 288

The recommended input source timings for the EVM's HDMI interface are specified in the DLPC230-Q1 data sheet. These timing parameters are also recommended for the OpenLDI interface.

1.2.4 SPI and I^2C Timing

For more information on SPI and I^2C specifications, see the DLPC230-Q1 data sheet.

2 Quick Start

Use the following instructions to setup your DLP5534Q1 EVM and PC.

2.1 Kit Assembly Instructions

A diagram of all the EVM cable connections is shown in Figure 4.

1. Connect the Controller to Driver control Interface flex to the Controller PCB (J8) and the Illumination Driver PCB (J502).
2. Connect the Host SPI cable to the Controller PCB (J2) and the Cheetah adapter. Connect the Cheetah adapter's USB cable to PC.
3. Connect the Controller Power cable to the Controller PCB (J11) and the Illumination Driver PCB (J6).
4. Connect the LED 1 Illumination output cable to the Illumination Driver PCB (J7) to the LED 1 illuminator in the optics engine.
5. If there is a second illuminator connect the LED 2 Illumination output cable to the Illumination Driver PCB (J501) to the LED 2 illuminator in the optics.
6. If there is a third illuminator connect the LED 3 Illumination output cable to the Illumination Driver PCB (J5) to the LED 3 illuminator in the optics engine.
7. Connect the Micro HDMI cable to the Controller Board (J3). Connect the Micro HDMI cable to PC HDMI port.
8. Connect the Power Input cable to the Illumination Driver Board (J8).
9. If there are fans connect them to LED Driver Board (J1 and J2).
10. If fan PWM is utilized then connect the Fan PWM cable from controller (J10) to LED Driver (J3).

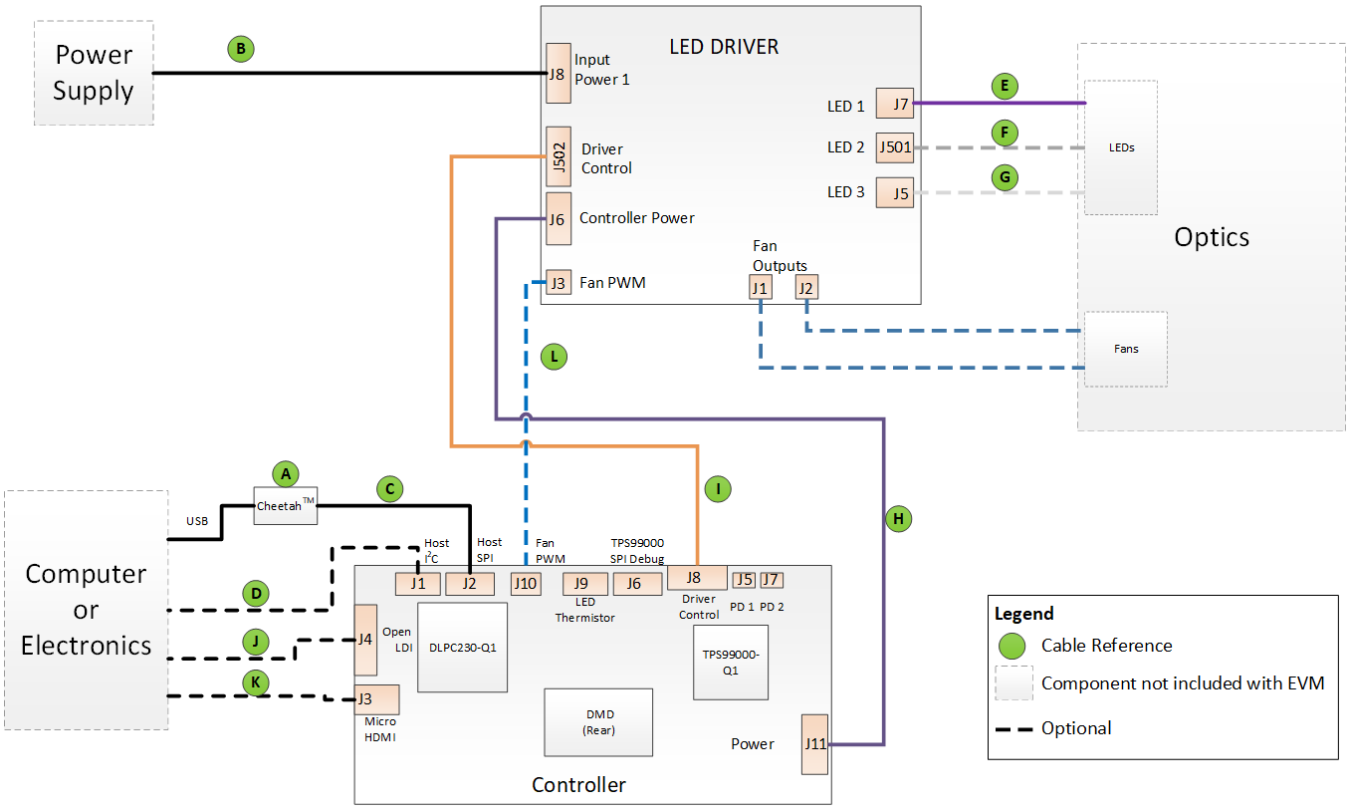

Figure 4. EVM Cable Connections

2.2 Software Installation

1. Install the DLPC230-Q1 Control Program (http://www.ti.com/mysecuresoftware).
2. Install Total Phase Cheetah USB adapter drivers (https://www.totalphase.com/products/usb-drivers-windows).

2.3 Powering-Up EVM

1. Connect input power cable to a power supply that meets input power specifications defined in Table 6. 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) should illuminate green.
3. Turn the PROJ_ON switch (SW4) ON. The ON position is towards the closest corner of the board. A Controller PCB LED indicator (D5) should illuminate green. It is also acceptable to leave the PROJ_ON switch in the ON position when powering on and off.

2.4 Connecting EVM to the DLPC230-Q1 Control Program

1. Start the DLPC230-Q1 Control Program.
2. On the connection page set the DLPC230-Q1 Host to SPI and select the Cheetah from the drop down menu (see Figure 5). Note that the Cheetah must be connected to computer with USB cable for it to show up in the drop down box.

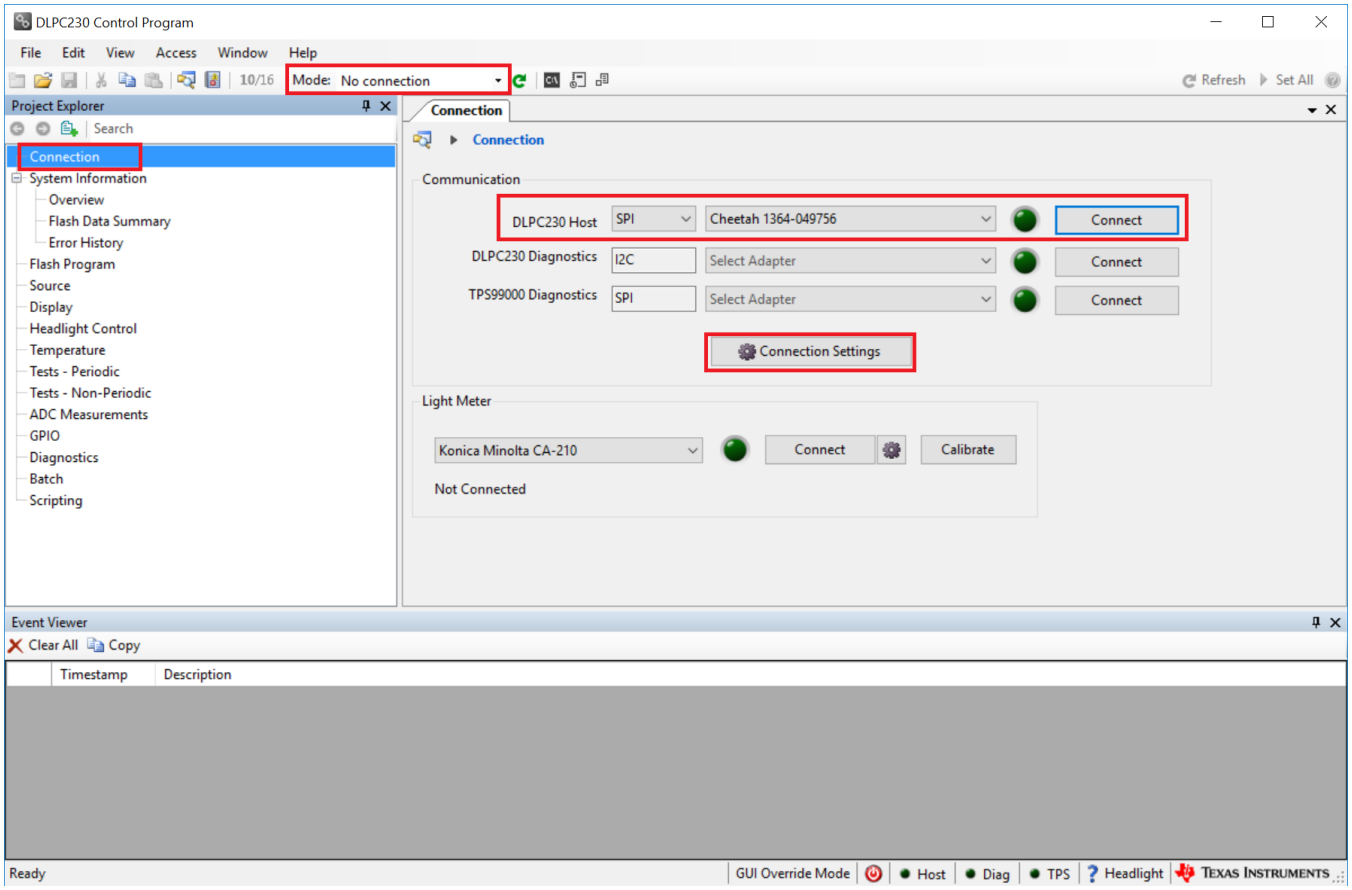

Figure 5. Connecting to the DLPC230-Q1 Using the DLPC230-Q1 Automotive Control Program

3. Select "Connection Settings" to confirm the SPI configuration shown in Figure 6 matches the Controller PCB switch settings described in Table 3. Specifically, SPI mode and CRC/Checksum may vary based on switch settings. Press "OK" once configuration is complete.

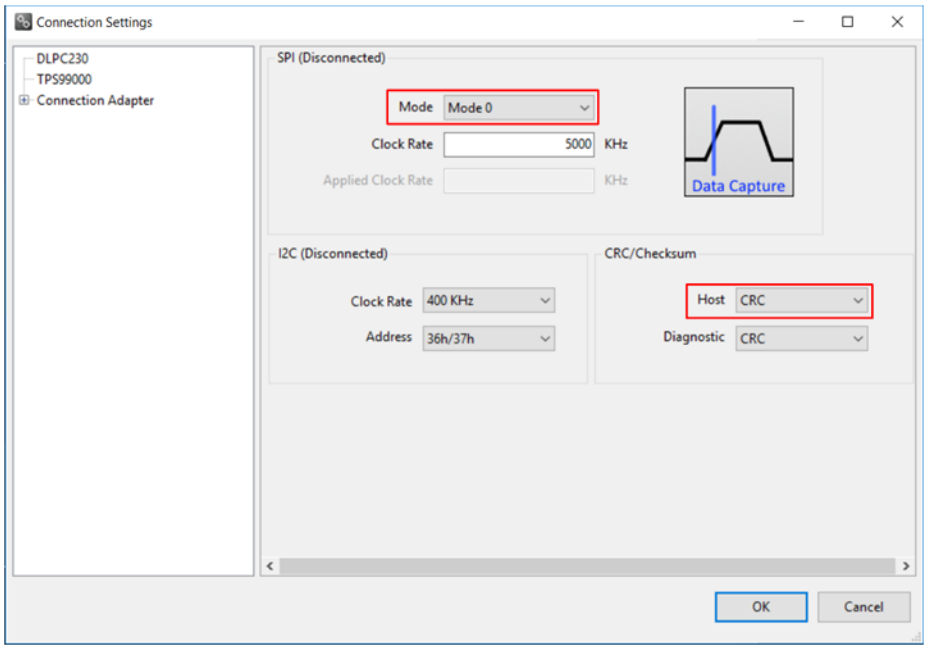

Figure 6. DLPC230-Q1 Automotive Control Program Communication Settings

4. Click the Connect button. The green circle next to the Connect button should then light up to indicate that connection was successful to the Cheetah Adapter.

2.5 Steps to Reprogram the Onboard Flash Memory

The DLP5534Q1 EVM comes with onboard serial Flash that is pre-programed 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 it.
3. Click "Program and Verify Flash Memory."

Note that if the device is in Display mode, it will automatically be switched to Standby during programming.

3 Optic Engine Requirements

The DLP5534Q1 EVM can be coupled to an optical engine (not included) and phosphor film (not included) to implement a transparent window display function. The detailed requirements of the optical engine are beyond the scope of this document, but the optical engine should have a 405 nm illuminator. Other illuminators above 405 nm are also possible. A heatsink for the DLP5534-Q1 DMD might be needed for operation in high temperature ambient environments, but is not included in the DLP5534Q1 Electronics EVM.

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