EVM User's Guide: DLP2021AM263Q1EVM

DLP2021AM263Q1EVM Evaluation Module

Description

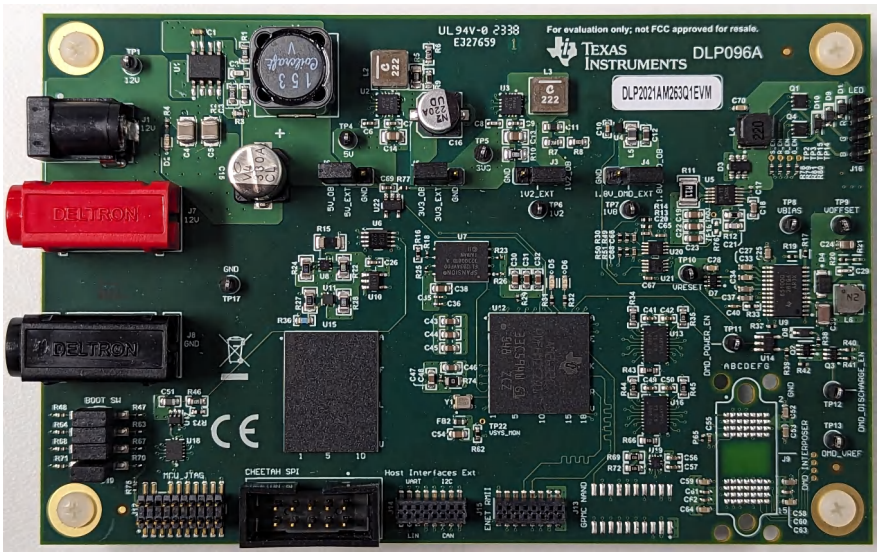
The DLP® products DLP2021AM263Q1EVM is an electronic only system designed to enable accelerated evaluation of the DLP2021-Q1 chipset. The DLP2021-Q1 digital micromirror device (DMD) interfaces with a Sitara MCU-based DMD controller to enable a graphics processing unit (GPU) free system architecture. The 4-bit wide eMMC flash interface of the Sitara MCU allows for fast memory reads to support 25-fps playback, and fast writes to enable on the fly re-programming of image/video content. Daughtercard sockets on this EVM enable automotive and industrial centric interfaces such as 10BASE-T1S Ethernet or CAN-FD. This EVM is compatible with single white LED and RGB LED illumination sources. The DLP2021LEQ1EVM is not a production design and is intended for evaluation only.

Features

- Sitara MCU's Programmable Realtime Unit (PRU) re-purposed as a direct drive interface to emulate the DMD's DDR2 timing specification.
- eMMC flash memory used to store uncompressed bitplane and DMD control signal data to fully offload the Sitara MCU from having to perform any additional processing or manipulation of the bitplane data.
- Single LED driver available to support monochromatic/white LED and RGB LED illumination sources.
- DMD interposer and mounting holes allow the DLP2021LEWQ1EVM optical light engine to be attached to create a fully operational projector system.
- SPI is the primary host interface, Ethernet, CAN, UART, I2C, and LIN interface options are also accessible.

Applications

- Automotive Dynamic Ground Projection (DGP)
- Interior Projection



DLP2021AM263Q1EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide presents an overview of the DLP2021AM263Q1EVM, a general description of the main features and functions, and quick start procedure for out-of-box evaluation. TI recommends users to first read the *Dynamic Ground Projection Application Requirements* (DLPA116) and *DLP3021-Q1 Dynamic Ground Projection System Design* (DLPA086) reports to become familiar with the terminology, variables, application considerations, and system design requirements for dynamic ground projection as the reports relate to the DLP2021AM263Q1EVM.

This document defines the interfaces and functionality of the DLP® Automotive Dynamic Ground Projection Sitara MCU design implemented for the AM263x-Q1. Some specifications are based on the AM263x-Q1 hardware blocks and non-design-specific constraints. In these cases, AM263x-Q1 documentation are considered the more accurate source of information if there are conflicting values.

1.2 Kit Contents

Table 1-1. Kit Contents

Quantity	Description	Part Number
1	DLP2021AM263Q1EVM; Circuit Board	DLP096
1	DLP2021-Q1 DMD	DLP2021AFQUQ1
1	DMD S249 mounting interface, aluminum plate, 6061-T6	2518081
4	Interface screws, M1.6 x 0.35, 5 mm	90116A003

1.3 Specification

Table 1-2. Recommended Operating Conditions

PARAMETER	MIN	NOM	MAX	UNIT
INPUT				
Voltage	10.5	12	18	V
Supply current (PWM enabled)(1)		0.3		A
Supply current (PWM disabled)		0.2		A
Power (PWM enabled)		3.6		W
Power (PWM disabled)		2.4		W
LED Driver				
Light engine efficiency(2)		29.5		%
LED power		1.31		W
Efficacy(3)		30.1		Lm/W
TEMPERATURE				
Operating DMD temperature	-40	25	105	°C

(1) Luminus SFT-03X-W, White LED, LED PWM Configuration = 450 of 1023, duty cycles: R0%, G100%, B0%. Any RGB channel can be used for monochromatic operation, but the green channel is used as the TI default.
(2) Efficiency defined as: (Luminous Flux x 100%)/Calculated Raw Lumens.
(3) Efficacy defined as: White ANSI Lumen/LED Power.

WARNING

When choosing the LED component (not included with this EVM), the 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 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.

The block diagram is shown in Figure 1-1.

In this application, the Sitara MCU reads video data directly from a flash memory to display on the DMD. The Sitara MCU also coordinates the illumination timing to coordinate with the displayed video content.

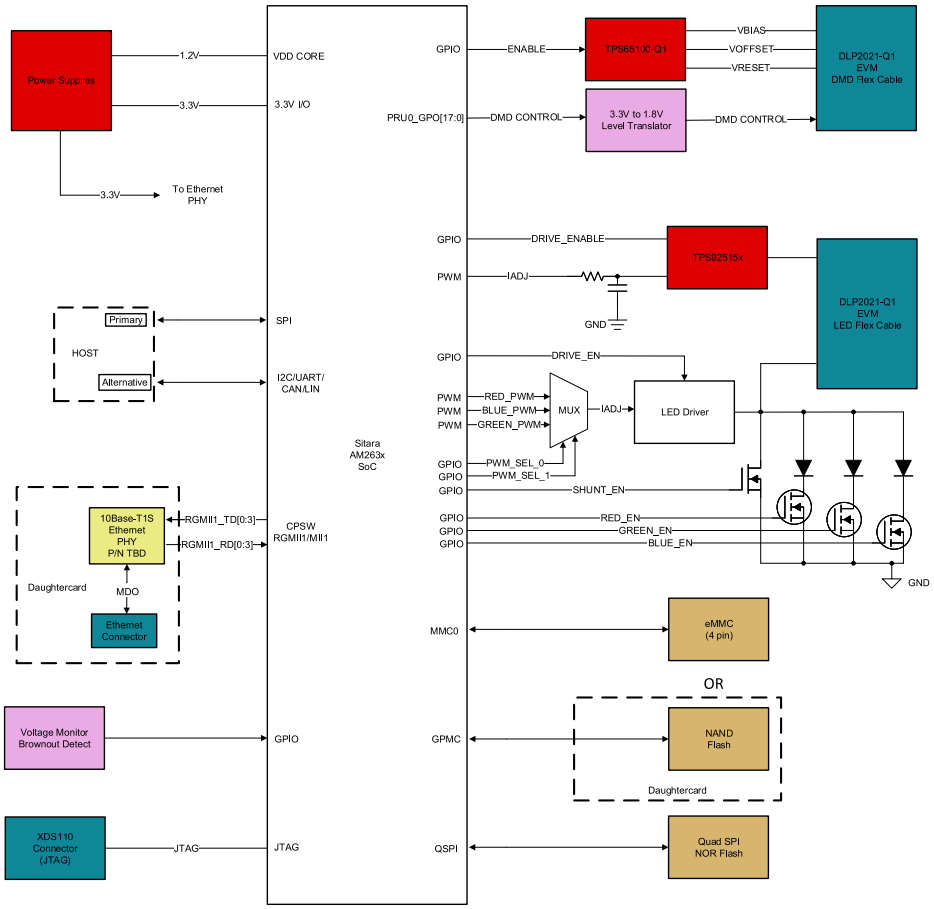


Figure 1-1. Dynamic Ground Projection Electronics Block Diagram

1.4 Device Information

DLP2021-Q1: The DLP2021-Q1 automotive digital micromirror device (DMD) is designed for automotive exterior light control and display applications. Applications include ground projection that displays full color and animated and dynamic content. Ground projections help to facilitate vehicle-to-pedestrian (V2P) communication, such as back-up and door-open warnings, and orchestrate vehicle communication systems and vehicle personalization options. Due to their small form factor and low power operation, projectors with the DLP2021-Q1 chipset can support many projection applications. The projectors can be placed in many locations in the car, including inside the side mirror, door panel, tail light, front grill, and more.

AM2632-Q1: The AM263x Sitara™ Arm® Microcontrollers are built to meet the complex real-time processing needs of next generation industrial and automotive embedded products. The AM263x MCU family consists of multiple pin-to-pin compatible devices with up to four 400 MHz Arm® Cortex®-R5F cores. As an option, the Arm® R5F subsystem can be programmed to run in lockstep or dual-core mode for a multiple functional safety configurations. The industrial communications subsystem (PRU-ICSS) enables integrated industrial Ethernet communication protocols such as PROFINET®, TSN, Ethernet/IP™, EtherCAT® (among many others), standard Ethernet connectivity, and even custom I/O interfaces. The family is designed for the future of motor control and digital power applications with advanced analog sensing and digital actuation modules. The multiple R5F cores are arranged in cluster subsystems with 256KB of shared tightly coupled memory (TCM) along with 2MB of shared SRAM, greatly reducing the need for external memory. Extensive ECC is included for on-chip memories, peripherals, and interconnects for enhanced reliability. Granular firewalls managed by the Hardware Security Manager (HSM) enable developers to implement stringent security-minded system design requirements. Cryptographic acceleration and secure boot are also available on AM263x devices. TI provides a complete set of microcontroller software and development tools for the AM263x family of microcontrollers.

2 Hardware

2.1 Additional Image

Figure 2-1 shows the overview of the DLP2021AM263Q1EVM.

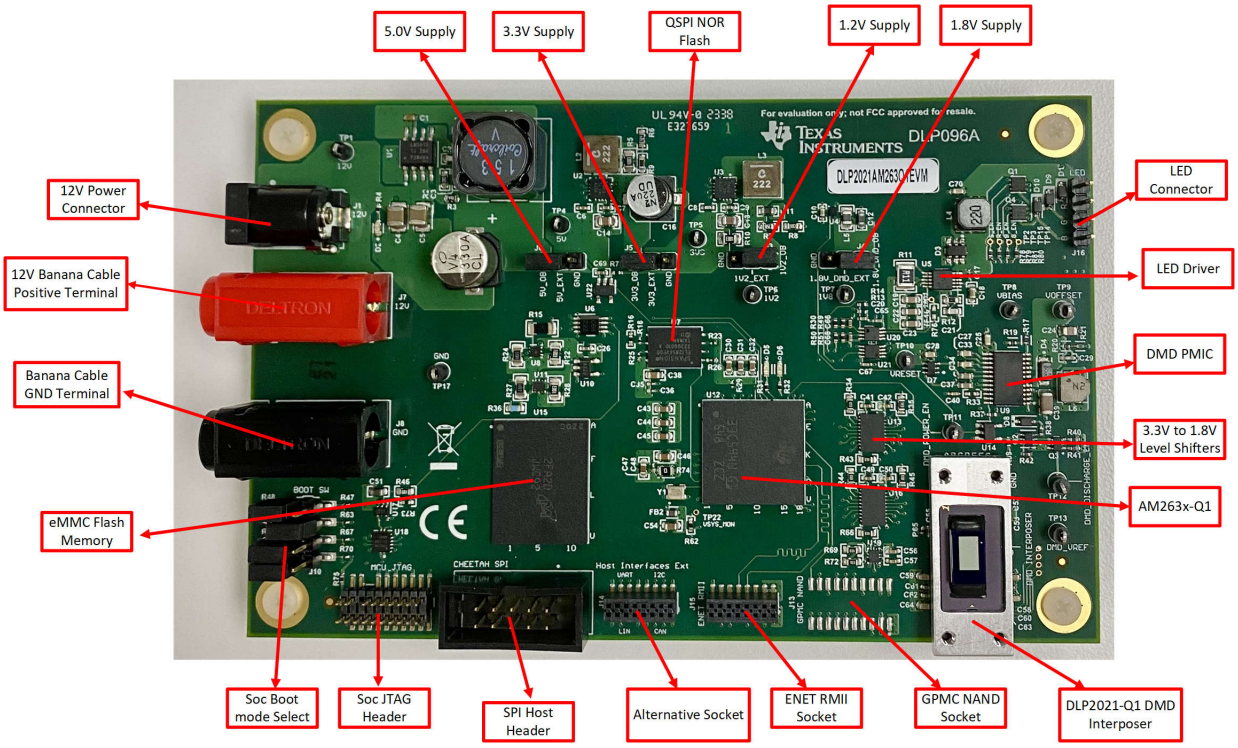


Figure 2-1. DLP2021AM263Q1EVM

Note

The DLP2021AM263Q1EVM does not include the optical engine.

2.2 Power Requirements

Follow the following steps to properly supply power to the EVM:

1. Connect the barrel jack (J1) or banana cable connectors (J7 and J8) to a power supply that meets input power specification defined in Specification. A 12-V supply with a 0.5-A limit is recommended for out-of-box evaluation.
2. Turn on the supply power.
3. When power is supplied correctly, the red LED (D2) illuminates.

2.3 Connector/Header Information

Table 2-1. Installed Connectors/Headers

INSTALLED CONNECTORS/ HEADERS	DESCRIPTION
J1	Connector for 12 V external power supply interface.
J3	Header for the 1.2V supply. Install jumper on Pin 1 and Pin 2 to use on-board regulator for 1.2V.
J4	Header for the 1.8V supply. Install jumper on Pin 1 and Pin 2 to use on-board regulator for 1.8V.
J5	Header for the 3.3V supply. Install jumper on Pin 1 and Pin 2 to use on-board regulator for 3.3V.
J6	Header for the 5.0V supply. Install jumper on Pin 1 and Pin 2 to use on-board regulator for 5.0V.
J7	Connector for 12 V banana cable positive terminal.
J8	Connector for banana cable ground terminal.
J10	Header for Sitara MCU boot mode select. Refer to Section 2.4.
J11	Total Phase Cheetah USB to SPI adapter.
J12	JTAG Programming/Debug interface.
J14	CAN/LIN/I2C/UART daughtercard socket.
J15	Ethernet RMII daughtercard socket.
J16	LED connector.

2.4 Boot Mode Pin Mapping

Table 2-2. J10-Boot Mode Pin Mapping

BOOT MODE	SPI0_D0_pad (SOP3)	SPI0_CLK_pad (SOP2)	QSPI_D1 (SOP1)	QSPI_D0 (SOP0)
QSPI (4S) - Quad Read Mode	0	0	0	0
UART	0	0	0	1
QSPI (1S) - Single Read Mode	0	0	1	0
QSPI (4S) - Quad Read UART Fallback Mode	0	1	0	0
QSPI (1S) - Single Read UART Fallback Mode	0	1	0	1
DevBoot	1	0	1	1
Unsupported Bood Mode	All other combinations not defined above			

2.5 Debug Information

The user can use the J12 JTAG header to connect a XDS110 JTAG Debug Probe (TMDSEMU110-U) for flash programming and debugging the Sitara MCU on the DLP2021AM263Q1EVM.

3 Software

3.1 Software Installation

Download and install the following software from TI:

- DLP Control Program (*DLPC136*): DLPC136.
- DLP Composer for DGP (*DLPC137*): DLPC137.
- Code Composer Studio (Version 12.2.0.00009 as minimum requirement): CCSTUDIO.
- MCU-PLUS-SDK-AM263X (Version 08.06.00.34 as minimum requirement): MCU-PLUS-SDK-AM263X.

Example host interface from third-parties:

- The C232HM MPSSE cable requires USB device drivers, available free from FTDICHIP. The D2XX driver is used with application software to directly access the FT232H in the cable though a DLL.
- Total Phase Cheetah™ USB adapter: USB-DRIVERSWINDOWS.

4 Hardware Design Files

4.1 Schematics

Please see design files referenced on the product page of DLP2021AM263Q1EVM.

4.2 PCB Layouts

Please see design files referenced on the product page of DLP2021AM263Q1EVM.

4.3 Bill of Materials (BOM)

Please see design files referenced on the product page of DLP2021AM263Q1EVM.

5 Additional Information

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NOTE:

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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

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

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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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