EVM User's Guide: TDP142Q1-EVM

TDP142-Q1 Evaluation Model

Description

The TDP142-Q1 is a linear DisplayPort™ 1.4 redriver capable of speeds up to 8.1Gbps (HBR3). The TDP142Q1-EVM is an evaluation module used to test the signal conditioning capabilities of the TDP142-Q1. This EVM provides I^2C and GPIO control to configure the equalization of the device. Signal integrity can be tested using the DisplayPort™ connectors on the EVM.

Get Started

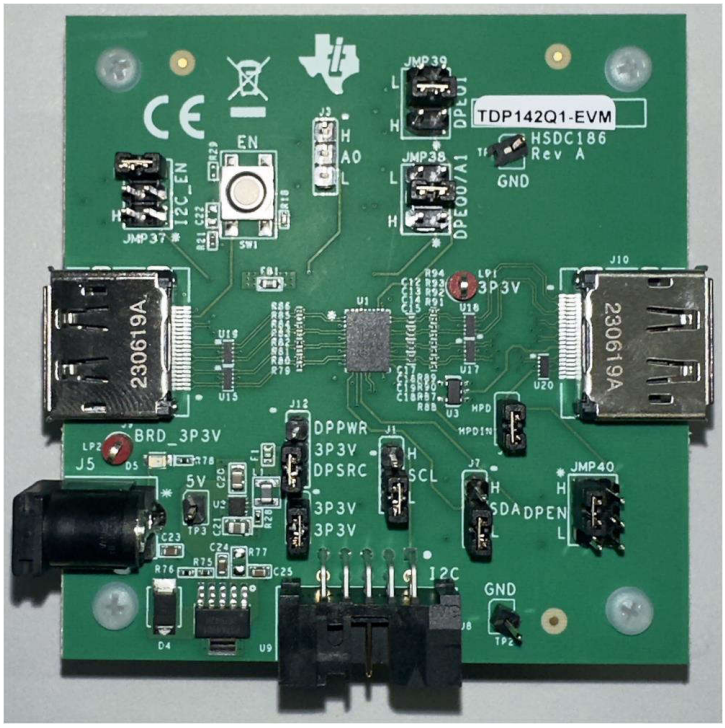
1. Order the EVM on TI.com. No software is required to use this EVM
2. Follow the default jumper settings found in the Device Configuration Table.
3. Connect DisplayPort™ source to J9.
4. Connect DisplayPort™ sink to J10.
5. Power EVM using 5V barrel jack.
6. EVM provides a signal conditioned DisplayPort™ video stream to the DisplayPort™ sink.

Features

- DisplayPort™ 1.4 up to 8.1Gbps (HBR3)
- Ultra-low-power architecture
- Linear redriver with up to 12dB at 4.05GHz equalization
- Transparent to DisplayPort™ link training
- Configurable through GPIO or I^2C
- Supports DisplayPort™ dual-mode standard version 1.1 (AC-coupled HDMI)

Applications

- Automotive head unit
- Rear seat entertainment
- Automotive infotainment and cluster
- Active cables



1 Evaluation Module Overview

1.1 Introduction

The TDP142-Q1 EVM is designed to evaluate the TDP142-Q1 device at a system level using a standard DisplayPort™ (DP) connection. The EVM provides standard DP connectors which can be used to connect to a DisplayPort™ source or sink system to evaluate the TDP142-Q1 performance. PCB design files can be provided, upon request, to aid in PCB design with the TDP142-Q1 device. The layout files can be used as a guideline to implement the device, with illustrations of the routing and placement rules. The EVM design may include test components for evaluation purposes, but not applicable for production.

Figure 1-1 shows the EVM Block Diagram

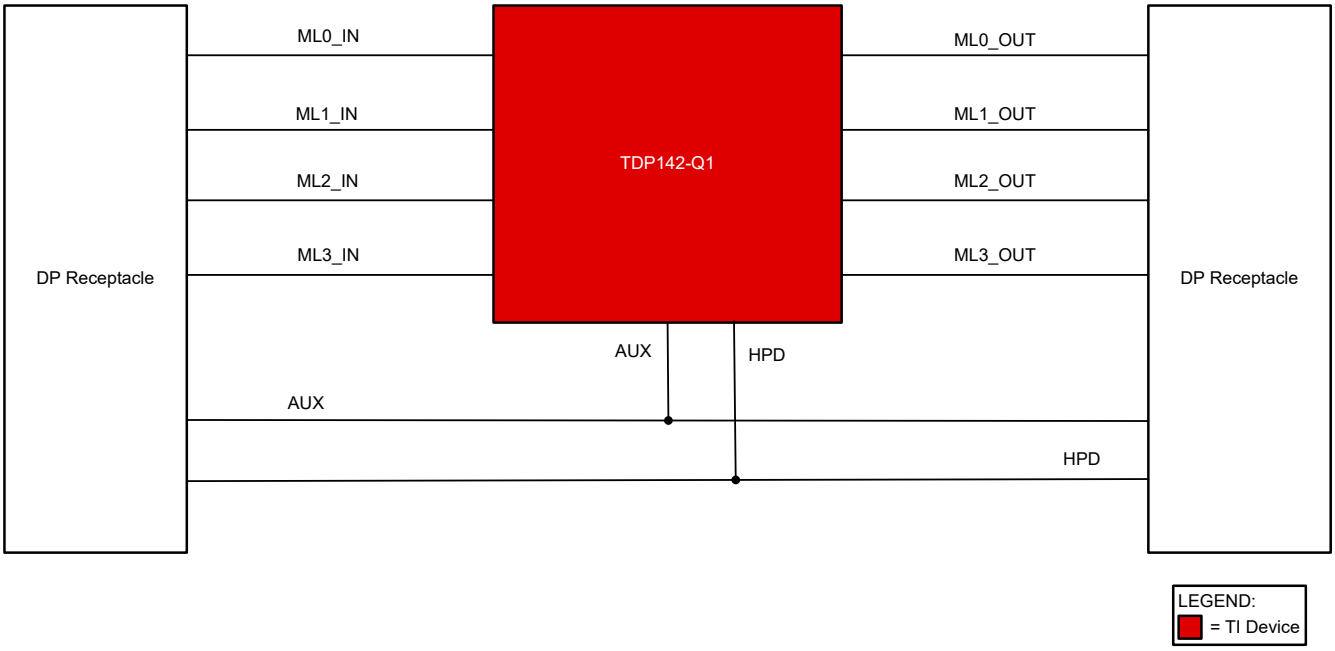


Figure 1-1. TDP142Q1-EVM Block Diagram

1.2 Kit Contents

The key components of the TDP142-Q1 EVM are as below:

- The TDP142-Q1 device
- Standard DP1.4 connector (source receptacle)
- Standard DP1.4 connector (sink receptacle)
- DC power regulators
- I^2C programming interface for external I^2C host controllers
- Standard 5V barrel jack receptacle
- Headers for configuring various TDP142-Q1 features

1.3 Device Information

The TDP142-Q1 is a DisplayPort™ (DP) linear redriver that is able to snoop AUX and HPD signals. The device complies with the VESA® DisplayPort™ standard Version 1.4, and supports a 1-lane to 4-lane Main Link interface signaling up to HBR3 (8.1Gbps per lane). Additionally, this device is position independent. The device can be placed inside source, cable or sink effectively providing a "negative loss" component to the overall link budget.

2 Hardware

2.1 Power Requirements

A DC barrel jack (J5) designed to accept a 5V wall power adapter is provided on the EVM. The DC barrel jack (CUI Inc. PJ-202AH) has an inner diameter of 2.1mm and an outer diameter of 5.5mm. The tip of the +5V power supply must be positive. A +5V power supply of at least 1.5A that meets the above requirements can be used to power the TDP142-Q1 EVM

2.2 Jumper Information

Multiple jumpers are provided on the TDP142-Q1 EVM for configuration of TDP142-Q1 and also for probe points.

The following is a list of jumpers which are used to configure the TDP142-Q1:

- JMP37
- JMP38
- JMP39
- JMP40
- J1
- J3
- J7
- J8
- J11
- J12

The default jumper positions and all jumper configuration settings are listed out in Table 2-2.

2.2.1 Configuration Jumper Levels

The TDP142-Q1 EVM has 4-level inputs pins (I2C_EN, A0, and DPEQ[1:0]) that are used to control the equalization gain and place the TDP142-Q1 into different modes of operation. These 4-level inputs use a resistor divider to help set the four valid levels and provide a wider range of control settings. There are internal pullup and pulldown resistors that can combine with the external resistor connection to achieve the desired voltage level

Table 2-1. 4-Level Configuration Jumper Settings

LEVEL	SETTINGS
Low	Tie 1kΩ 5% to GND.
R	Tie 20kΩ 5% to GND.
F	Float (leave pin open)
High	Tie 1kΩ 5% to V_{CC}.

Note

All 4-level inputs are latched on rising edge of internal reset. After t_{cfg_hd}, the internal pullup and pulldown resistors are isolated in order to save power.

2.2.2 Default and Adjustable Jumper Settings

The TDP142 settings are configurable through the test configuration headers provided on the board. The following table summarizes the configuration settings. See the TDP142-Q1 data sheet for the details on the device operation in different settings.

Table 2-2. Device Configuration

REFERENCE NUMBER	SIGNAL NAME	DEFAULT CONFIGURATION	DESCRIPTION
JMP37	I2C_EN	Low (5-6): GPIO mode	Configures device to operate in I^2C mode or GPIO mode For I^2C mode at 1.8V connect the jumper (3-4) For I^2C mode at 3.3V connect the jumper (1-2)
JMP38	DPEQ0/ A1	R (3-4): Set EQ to level 5 of 15	Sets the EQ of the DisplayPort™ lanes/ sets the I^2C address See the *Linear EQ Configuration* section in the data sheet for more information See the *Programming* section in the data sheet for I^2C address control settings R(3-4) High (1-2) Low (5-6) F(float)
JMP39	DPEQ1	R (3-4): Set EQ to level 5 of 15	Sets the EQ of the DisplayPort™ lanes See the *Linear EQ Configuration* section in the data sheet for more information R(3-4) High (1-2) Low (5-6) F(float)
JMP40	DPEN	High (1-3): Enable DisplayPort™ functionality	When I2C_EN is Low this pin will enable and disable DisplayPort™ functionality When I2C_EN is High, this pin functions as the HPD receiver from the DisplayPort™ sink. In this mode connect the jumper (3-4)
J3	A0	F (float): No connection required	When in GPIO mode leave this pin disconnected When in I^2C mode, this pin is used to set the TDP142Q1 I^2C address. See the *Programming* section in the data sheet for I^2C address control settings High (1-2) Low (2-3) F(float)
J12	DPPWR	DPSRC (2-3): Provide 3.3V to the DisplayPort™ source through DisplayPort™ power in.	Provides 3.3V to the DisplayPort™ source or DisplayPort™ sink. To provided 3.3V to DsiplayPort™ sink connect jumper (1-2)
J11	3.3V	3.3V (1-2)	Test point for 3.3V, and ability to provide 3.3V externally
J1	SCL	SCL(2-3): Tie SCL low	This is the serial clock input for I2C communication
J7	SDA	SDA (2-3): Tie SDA low	This is the serial data input for I2C communication
J8	2x5 I2C header	F (float)	**This header is not functional as the SCL and SDA lanes are swapped. Use J7 and J1 to program this device.**

2.3 Best Practices

When handling this EVM, best practice is to use an ESD strap and maintain an ESD safe environment.

3 Hardware Design Files

3.1 Schematics

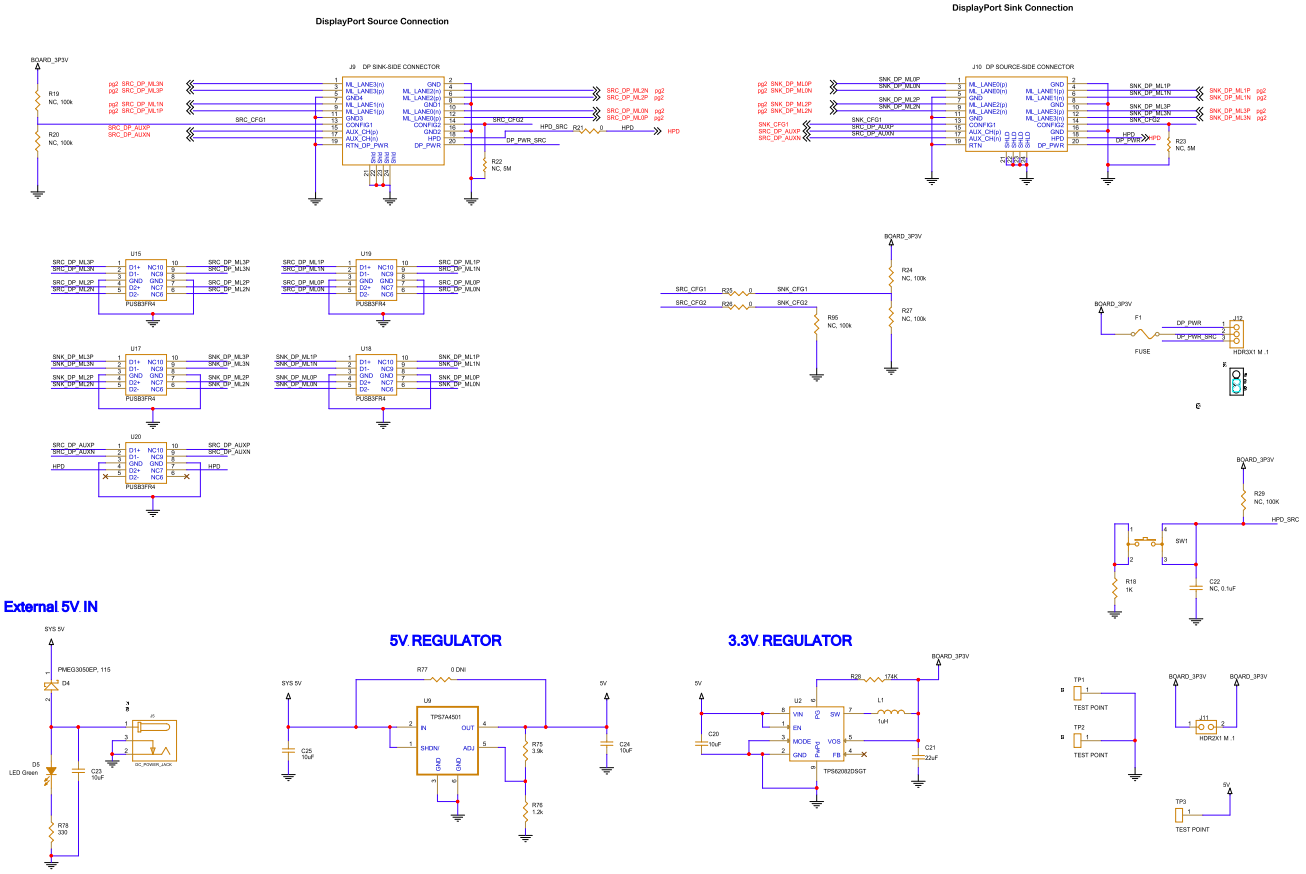


Figure 3-1. TDP142-Q1 EVM Schematic 1

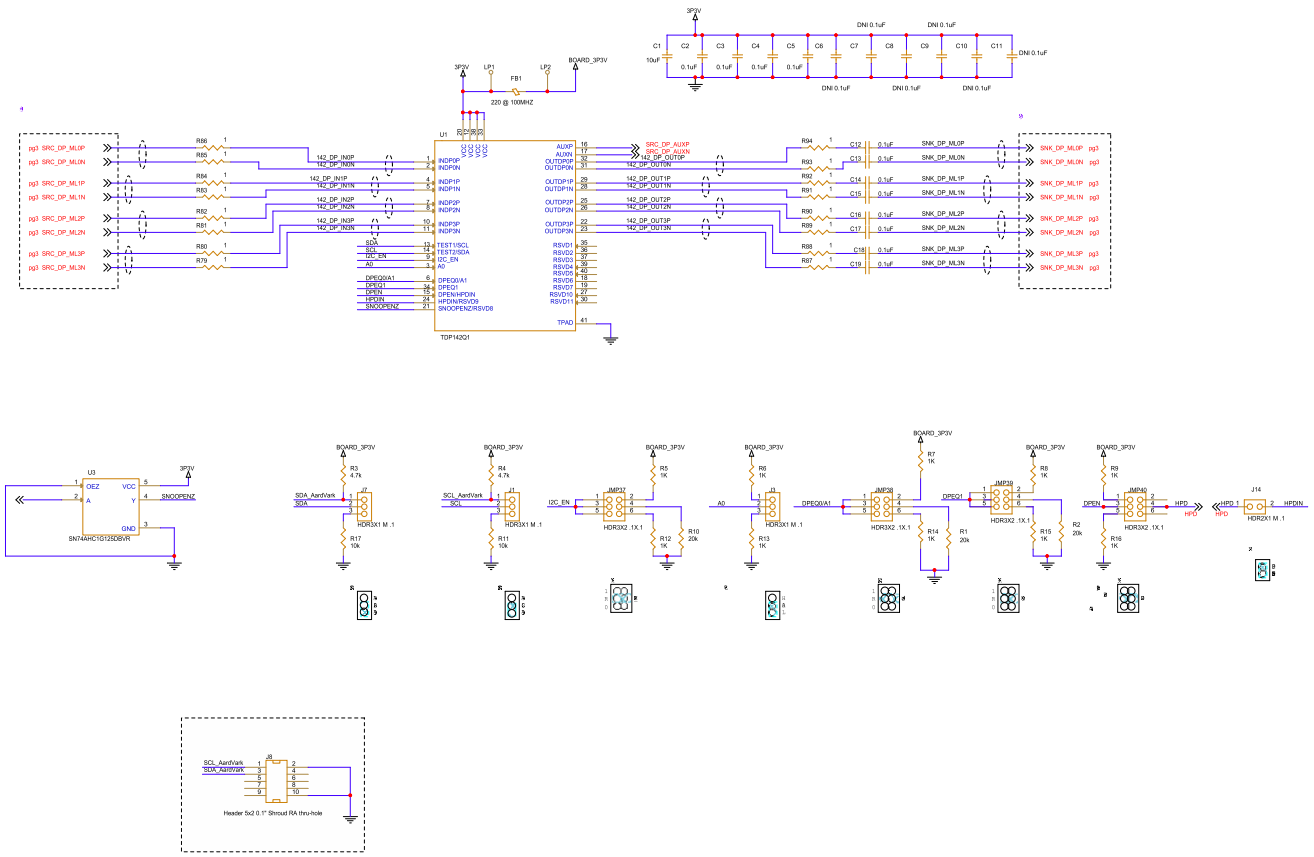


Figure 3-2. TDP142-Q1 EVM Schematic 2

3.2 PCB Layouts

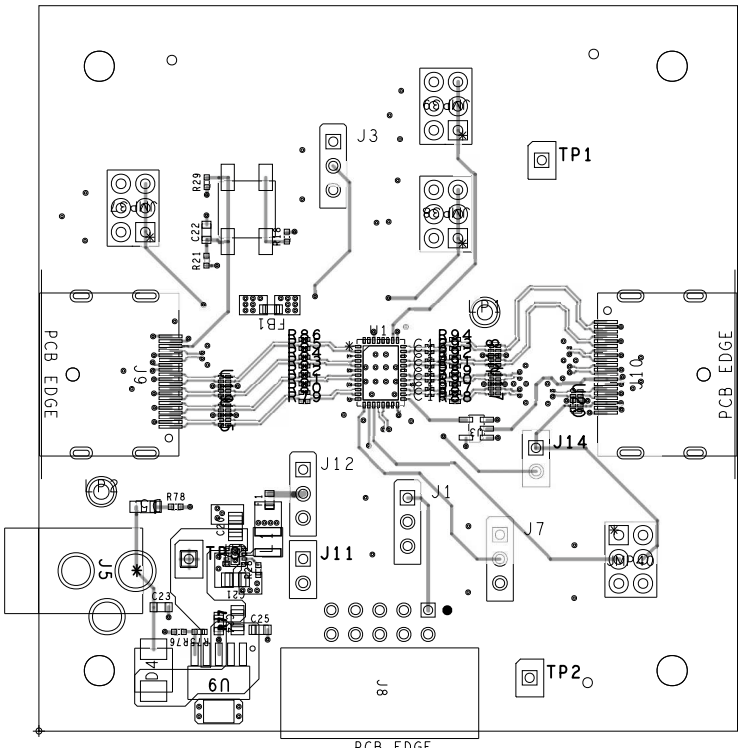


Figure 3-3. TDP142-Q1 EVM Layer 1 (Top Side)

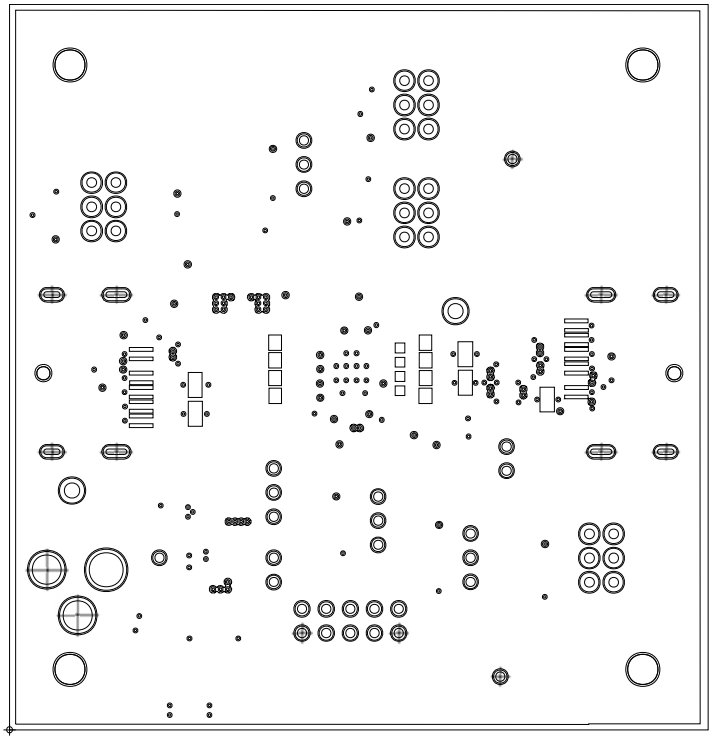


Figure 3-4. TDP142-Q1 EVM Layer 2 (GND Plane)

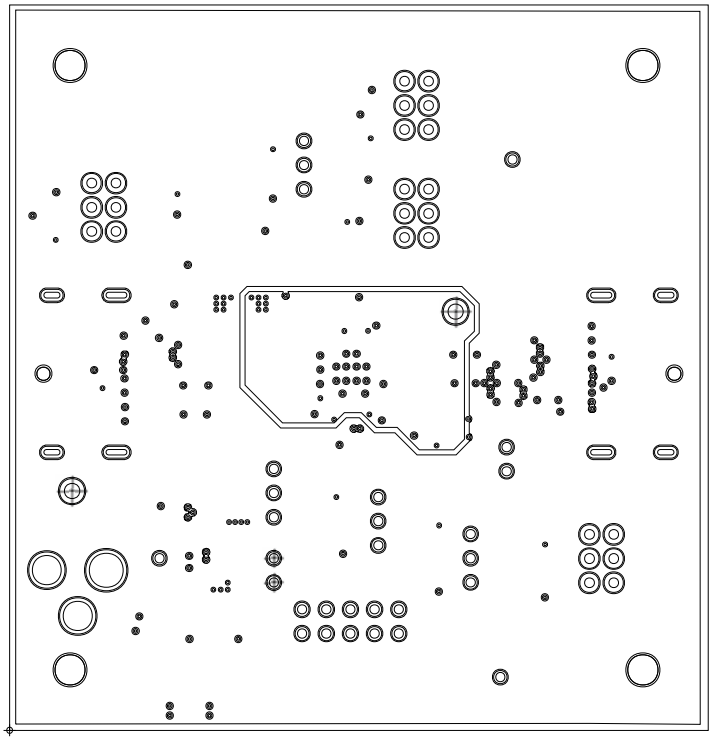


Figure 3-5. TDP142-Q1 EVM Layer 3 (PWR Plane)

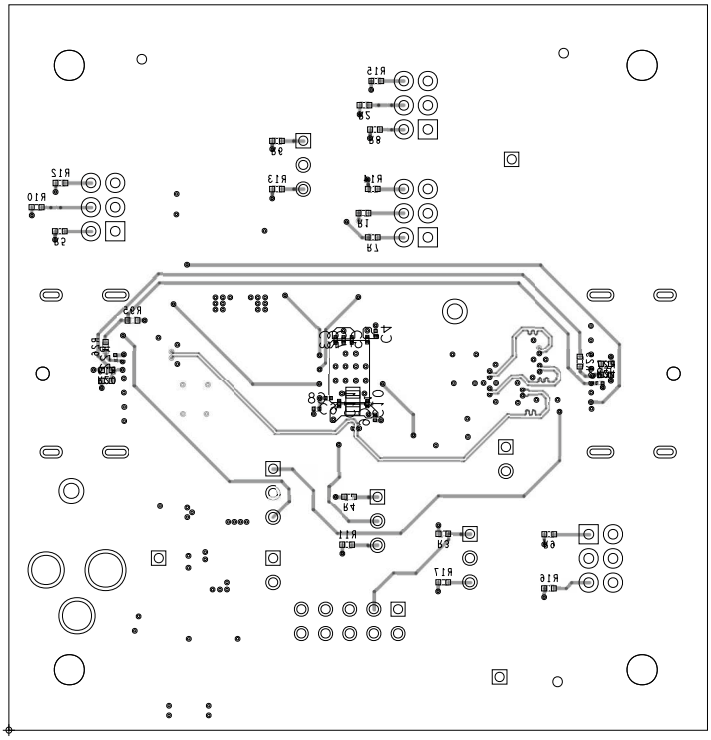


Figure 3-6. TDP142-Q1 EVM Layer 4 (Bottom Side)

3.3 Bill of Materials (BOM)

Table 3-1. Bill of Materials (BOM)

QUANTITY	REFERENCE DESIGNATOR	VALUE	MANUFACTURER	PART NUMBER
2	C1,C20	10uF	Kemet	C0805C106K8PAC7800
12	C2,C3,C4,C5,C12,C13,C14,C15,C16,C17,C18,C19	0.1uF	Murata	GRM033R61A104KE15D
6	C6,C7,C8,C9,C10,C11	DNI 0.1uF	TDK	GRM033R61A104KE15D
1	C21	22uF	Murata	GRM21BR60J226ME39L
1	C22	NC, 0.1uF	Murata	GCJ188R71E104KA12D
3	C23,C24,C25	10uF	Murata	GRM188R61C106MA73D
1	D4	SCHOTTKY	NXP	PMEG3050EP,115
1	D5	LED Green	LITE-ON TECHNOLOGY CORPORATION	LTST-C170KGKT
1	FB1	220 @ 100MHZ	MuRata	BLM18EG221SN1D
1	F1	FUSE	Bel Fuse	0ZCM0010FF2G
4	JMP37,JMP38,JMP39,JMP40	HDR3X2 .1X.1	Harwin	M22-2020305
4	J1,J3,J7,J12	HDR3X1 M .1	Harwin	HTSW-150-07-G-S
1	J5	DC_PWR_JACK	CUI Inc.	PJ-202AH
1	J8	Header 5x2 0.1	3M	D2510-5002-AR
1	J9	DP SINK-SIDE CONNECTOR	Molex Inc	0472720001
1	J10	DP SOURCE-SIDE CONNECTOR	Molex	0472720001
2	J11,J14	HDR2X1 M .1	Harwin	M22-2510205
1	LB1	THD-47-478-10	Brady	THT-14-423-10
2	LP1,LP2	LP	Keystone Electronics	36-5000-ND
1	L1	1uH	Murata	LQM21PZ1R0NGRD
1	PCB1	HSDC186	Any	HSDC069
3	R1,R2,R10	20k	Yageo	RC0402JR-0720KL
2	R3,R4	4.7k	Yageo	RC0402JR-074K7L
11	R5,R6,R7,R8,R9,R12,R13,R14,R15,R16,R18	1K	Yageo	RC0402JR-071KL
2	R11,R17	10k	Yageo	RC0402JR-0710KL

Table 3-1. Bill of Materials (BOM) (continued)

QUANTITY	REFERENCE DESIGNATOR	VALUE	MANUFACTURER	PART NUMBER
6	R19,R20,R24,R27,R29,R95	NC, 100k	Yageo	RC0402JR-07100KL
3	R21,R25,R26	0	Panasonic	ERJ-2GE0R00X
2	R22,R23	NC, 5M	Yageo	RC0201FR-075M1L
1	R28	174K	Stackpole Electronics Inc.	RMCF0402FT174K
1	R75	3.9k	Panasonic Electronic Components	ERJ-2GEJ392X
1	R76	1.2k	Panasonic Electronic Components	ERJ-2GEJ122X
1	R77	0 DNI	Panasonic Electronic Components	ERJ-6GEY0R00V
1	R78	330	Panasonic Electronic Components	ERJ-2GEJ331X
16	R79,R80,R81,R82,R83,R84,R85,R86,R87,R88,R89,R90,R91,R92,R93,R94	1	Panasonic Electronic Components	ERJ-1GNJ1R0C
4	SCRW1,SCRW2,SCRW3,SCRW4	NY PMS 440 005 PH	B & F Fastener	NY PMS 440 0050 PH
9	SHNT1,SHNT2,SHNT3,SHNT4,SHNT5,SHNT6,SHNT7,SHNT8,SHNT9,SHNT10	QPC02SXGN-RC	Sullins Connector Solutions	QPC02SXGN-RC
4	STDOFF1,STDOFF2,STDOFF3,STDOFF4	1902E	Keystone	1902E
1	SW1	B3SN-3012	Omron Electronics Inc-EMC Div	B3SN-3012P
3	TP1,TP2,TP3	TEST POINT	Samtec	HTSW-101-07-G-S
1	U1	TDP142Q1	Texas Instruments	TDP142Q1
1	U2	TPS62082DSGT	Texas Instruments	TPS62082DSGT
1	U3	SN74AHC1G125DBVR	Texas Instruments	SN74AHC1G125DBVR
1	U9	TPS7A4501	Texas Instruments	TPS7A4501DCQR
5	U15,U17,U18,U19,U20	PUSB3FR4	Nexperia USA	PUSB3FR4Z

4 Additional Information

4.1 Trademarks

DisplayPort™ is a trademark of VESA.
All trademarks are the property of their respective owners.

4.2 Related Documentation

For related documentation, see the following:

- Texas Instruments, *TDP142-Q1 DisplayPort™ 8.1Gbps Linear Redriver* data sheet

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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 DEGREDATION 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/lsds/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.

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

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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/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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