EVM User's Guide: DP83CX-M-EVM

DP83Cx Evaluation Module

Description

The DP83CX-M, DP83CX-RL, and DP83CX-RF evaluation modules (EVMs) evaluate the functionality and performance of DP83CX-M, DP83CX-RL, and DP83CX-RF Ethernet physical layer transceivers. The DP83CXEVMs support both 10BASE-Te and 100BASE-TX Ethernet protocols on the media dependent interface through an RJ-45 connection. This EVM is equipped with an onboard MSP430™ microcontroller to enable register access on DP83CX devices using USB to MDIO software.

Get Started

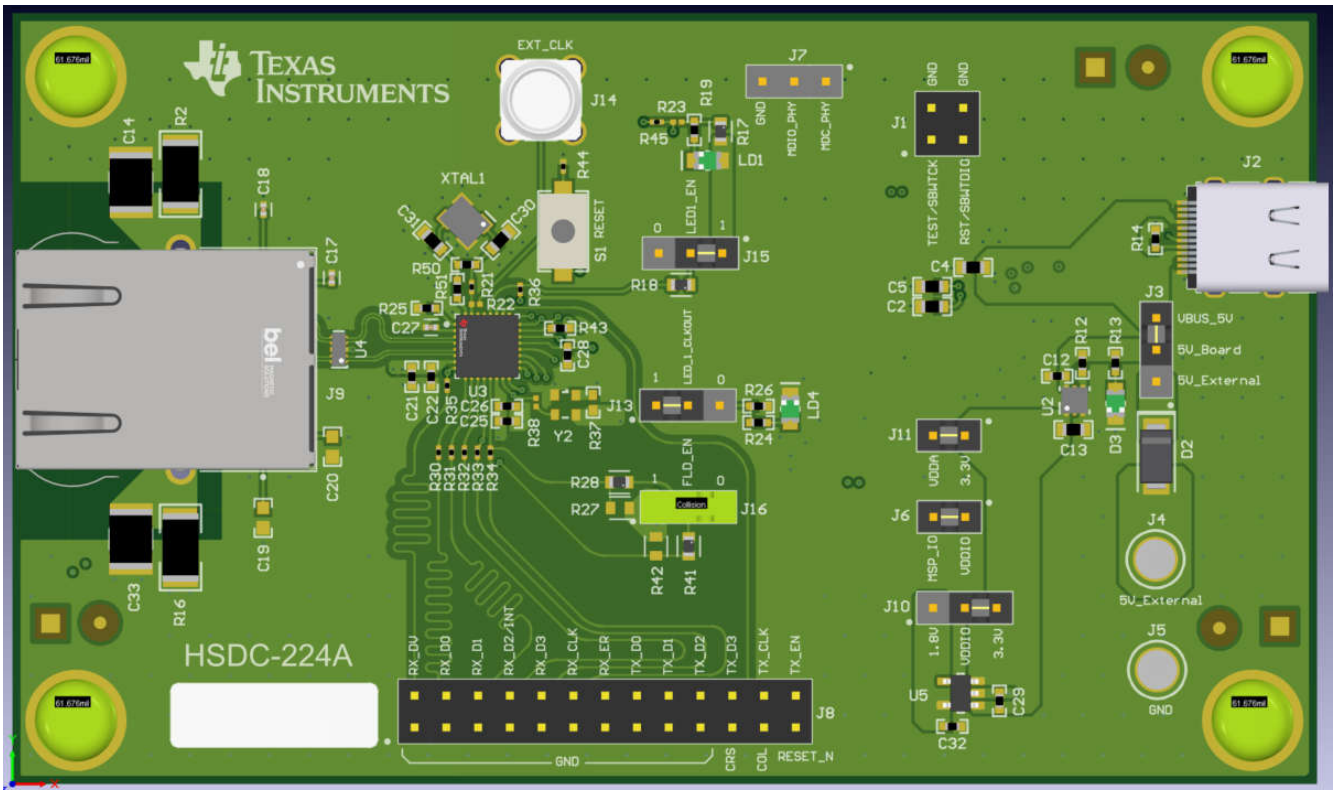
1. Configure the board headers to fit the application.
2. Power the board through USB or an external supply.
3. For issues, reach out on the TI E2E™ forum.

Features

- 100Base-TX, 10Base-Te with auto-negotiation and force mode
- Onboard and external clock options
- Onboard MSP430 for MDIO register access
- USB-C® or external power supply options
- Status LEDs

Applications

- Factory automation
- Robotics and motion control
- Motor drives
- Grid infrastructure
- Building automation
- Industrial Ethernet fieldbus



DP83CX-M-EVM

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1 Evaluation Module Overview

1.1 Introduction

DP83CX PHYs offer low and deterministic latency, low power, robust EMC and immunity, and support 10BASE-Te, 100BASE-TX Ethernet protocols. DP83CX PHYs include hardware bootstraps to achieve fast link-up time, fast link-drop detection modes and dedicated reference CLKOUT to clock synchronize other modules on the systems. The device interfaces to the MAC layer through a media independent interface (MII) or reduced media independent interface (RMII). DP83CX EVMs demonstrate all the features of DP83CX-M, DP83CX-RL, and DP83CX-RF PHYs.

Table 1-1. Supported PHYs

EVM	PHYs supported
DP83CX-M-EVM (MII)	DP83C8201F-M
	DP83C8512-M
	DP83C8522-M
	DP83C1111-M
DP83CX-RL-EVM (RMII Leader)	DP83C8201F-RL
	DP83C8512-RL
	DP83C8522-RL
	DP83C1111-RL
DP83CX-RF-EVM (RMII Follower)	DP83C8201F-RF
	DP83C8512-RF
	DP83C8522-RF
	DP83C1111-RF

All DP83CX EVMs use the same PCB design, yet come with different default components based on the core device being evaluated. By default, the DP83CX-M-EVM supports devices that use the MII MAC interface, the DP83CX-RL-EVM supports devices that use the RMII leader MAC interface, and the DP83CX-RF-EVM supports devices that use the RMII follower MAC interface. TI recommends to order the EVM that aligns with the end-application MAC interface.

1.2 Kit Contents

DP83CX-EVMs include:

- The DP83CX device
- (1) RJ-45 receptacle with integrated magnetics that connects to a link partner device
- (1) USB C receptacle that connects to a PC running USB to MDIO
- (1) 5V turret for external power

1.3 Specification

Figure 1-1 shows the power and data path of DP83CX-EVMs.

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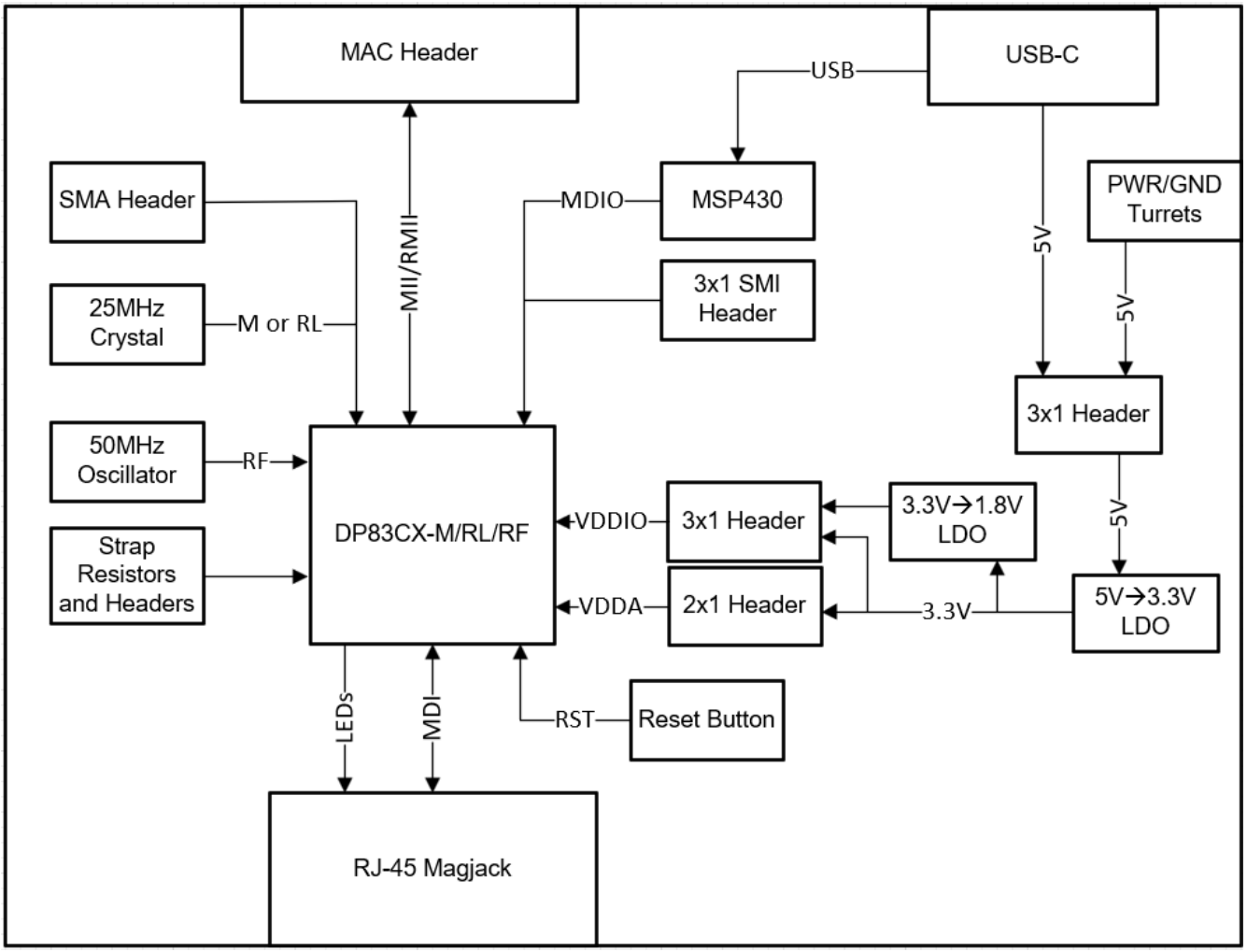


Figure 1-1. DP83CX-EVM Block Diagram

1.4 Device Information

DP83CX Ethernet PHYs are single-port physical layer transceivers designed to meet the stringent needs of industrial fieldbuses and offers very low latency, deterministic variation in latency (across reset, power cycle), fixed phase between XI and TX_CLK, low power, and configuration using hardware bootstraps to achieve fast link up. DP83CX PHYs support either MII, RMII leader, or RMII follower for connection to the media access controller (MAC) and can use the dedicated CLKOUT pin to clock other modules on the system.

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2 Hardware

2.1 Power Requirements

Either the 5V turret or the USB-C connector in Figure 2-1 supply power to the DP83CX-EVMs. On-board LDOs generate the voltages required for operating various sections of the EVM. Alternatively, external power can be supplied to individual voltage rails.

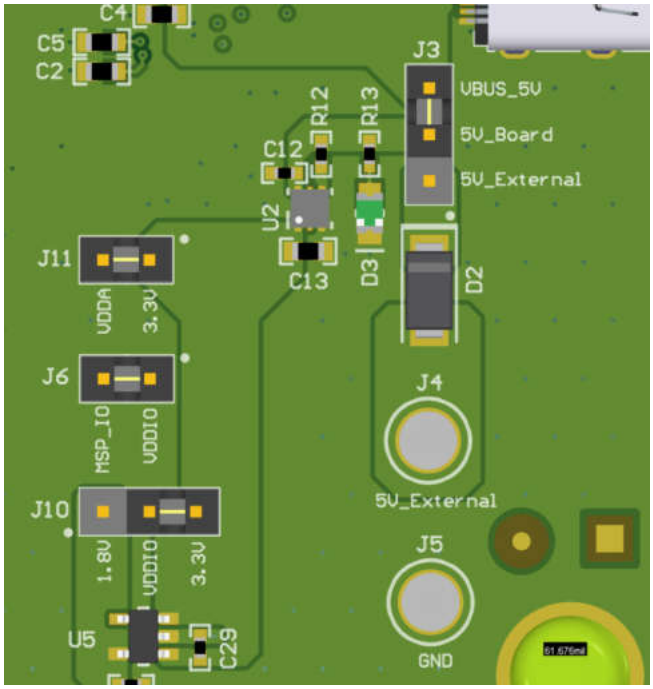


Figure 2-1. DP83CX EVM Power Headers

Note

Before supplying power at the 5V input or USB-C, add the correct shunts to J6, J10, and J11 to properly operate the on-board LDOs.

2.2 Setup

The DP83CX EVM default header configuration assumes power is supplied through the USB-C input. Alternatively, 5V can be supplied to J4 for board power so long as J3(1-2) is shunted. A third option is to provide 3.3V directly to of J11 (VDDA) and the VDDIO voltage to J10 (VDDIO). The USB-C connector powers the on-board MSP430.

If using standalone USB operation, place a jumper on pins 2 and 3 of J3 (VBUS_5V). After connection, the DP83CX PHY and MSP430 draw power from the USB-C receptacle. The VDDIO can be set to either 3.3V or 1.8V through J10. The MSP430 IO voltage follows the VDDIO setting by default, and the MSP430 IO rail can be disconnected from VDDIO by removing the shunt on J6.

Note

If VDDIO is set to 1.8V, the LEDs on the RJ-45 connector does not light. This is because the forward voltage of these LEDs exceeds the 1.8V VDDIO voltage.

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2.3 Interfaces

Table 2-1. DP83CX EVM Applications

Test Cases	Applications	How to Use
MII/RMII to Copper	Perform IEEE and UNH compliance testing	Using onboard MSP430 and software.
	Run EMI/EMC Tests on EVM	Use internal PRBS and loopback. Onboard MSP430 can be used for register access.
	Measure Power Dissipation	Connect external power supplies.
	25MHz output clock	Optional Clock out on LED_1
MDI (Reverse) Loopback	Data received by the PHY can be looped back through the MDI interface without needing a MAC.	Use onboard MSP430 to enable loopback.
Low Power modes	Demonstrate Sleep and Power down mode	Use onboard MSP430 to activate low power mode

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3 Software

3.1 Software Description

The on-board MSP430 comes programmed and ready to use with USB-2-MDIO. When using this EVM on a Windows® PC, install MSP430 drivers and the USB-2-MDIO software application. Use USB-2-MDIO on a connected PC to access registers on the PHY.

3.2 Software Installation

Download the USB-2-MDIO software from USB-2-MDIO

The USB-2-MDIO webpage contains a user's guide for installing and using the software. Because the MSP430 is on-board the DP83CX EVM, it is not necessary to purchase a separate MSP430 Launchpad kit. If the on-board MSP430 cannot be used, MDIO and MDC pins are broken out on J7. Users can optionally connect an MSP430 launchpad using the procedure described in TI's *USB-2-MDIO Software Tool* user's guide.

3.3 Programming Options

To update or read the DP83CX PHY registers, the user can connect the EVM to a computer and use USB-2-MDIO software. The EVM enables both strap and register functionality without the need to modify hardware.

More information on how to access the DP83CX MDIO status and control registers can be found in the *USB-2-MDIO Software Tool* user's guide.

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4 Implementation Results

4.1 Performance Data and Results

This section provides details of EMI test results using DP83CX EVMs. The test results shown in #unique_21/unique_21_Connect_42_GUID-3A8CC17E-9B63-4007-BE56-027FBDC1B256 are based on using a shielded Ethernet cable.

Standard	Test Performed	Result
IEC 61000-4-2	ESD Direct contact	±8kV Class A
IEC 61000-4-2	ESD Capacitor coupling	TBD
IEC 61000-4-2	ESD Air discharge	±15kV Class A
IEC 61000-4-3	RF electromagnetic field	TBD
IEC 61000-4-4	EFT fast transient Burst	TBD
IEC 61000-4-5	Surge	TBD
IEC 61000-4-6	Conducted RF (CDN)	TBD
EN55032	Radiated Emissions	Class B
EN55032	Conducted emissions	TBD

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5 Hardware Design Files

5.1 Schematics

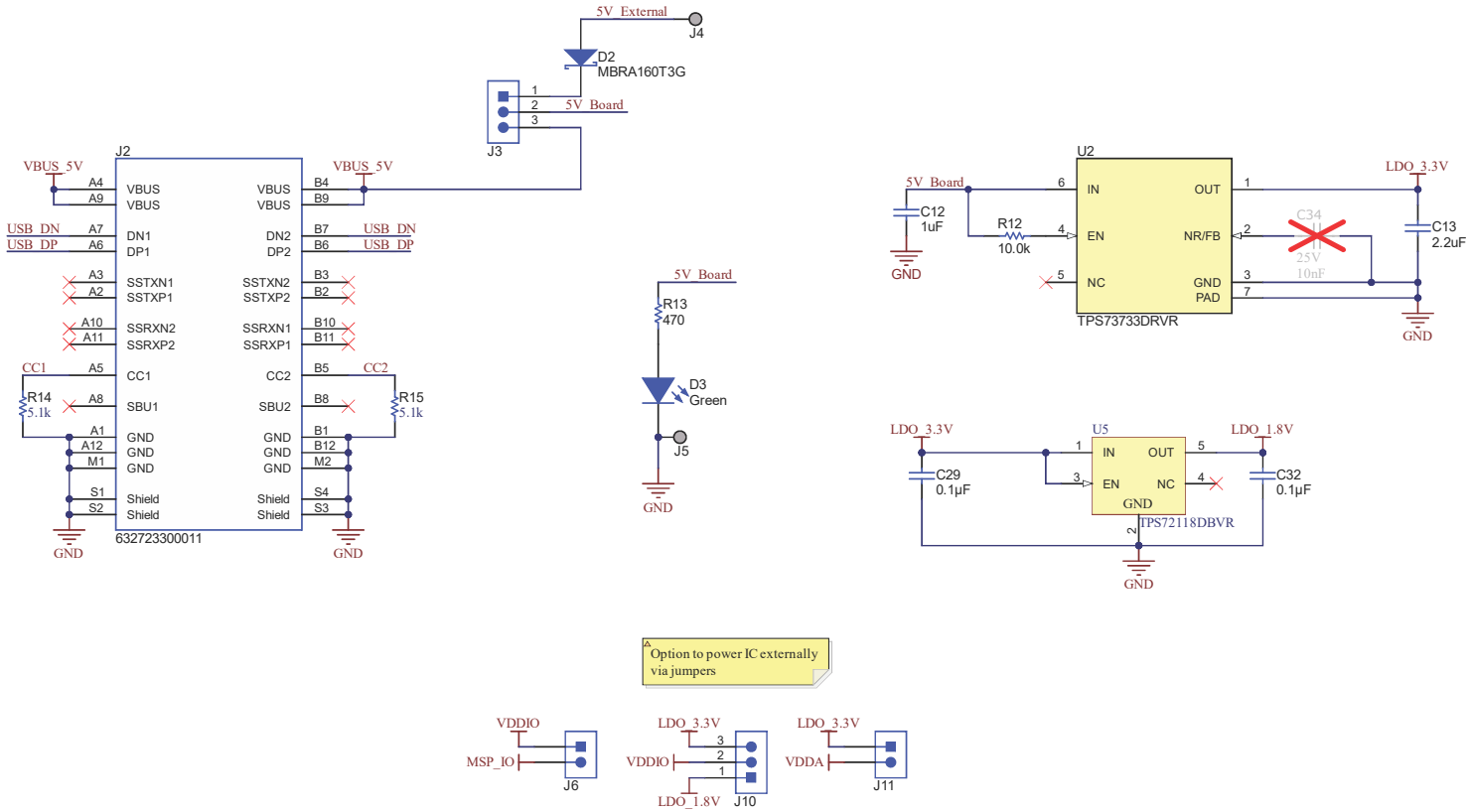


Figure 5-1. DP83CX EVM Power Schematic

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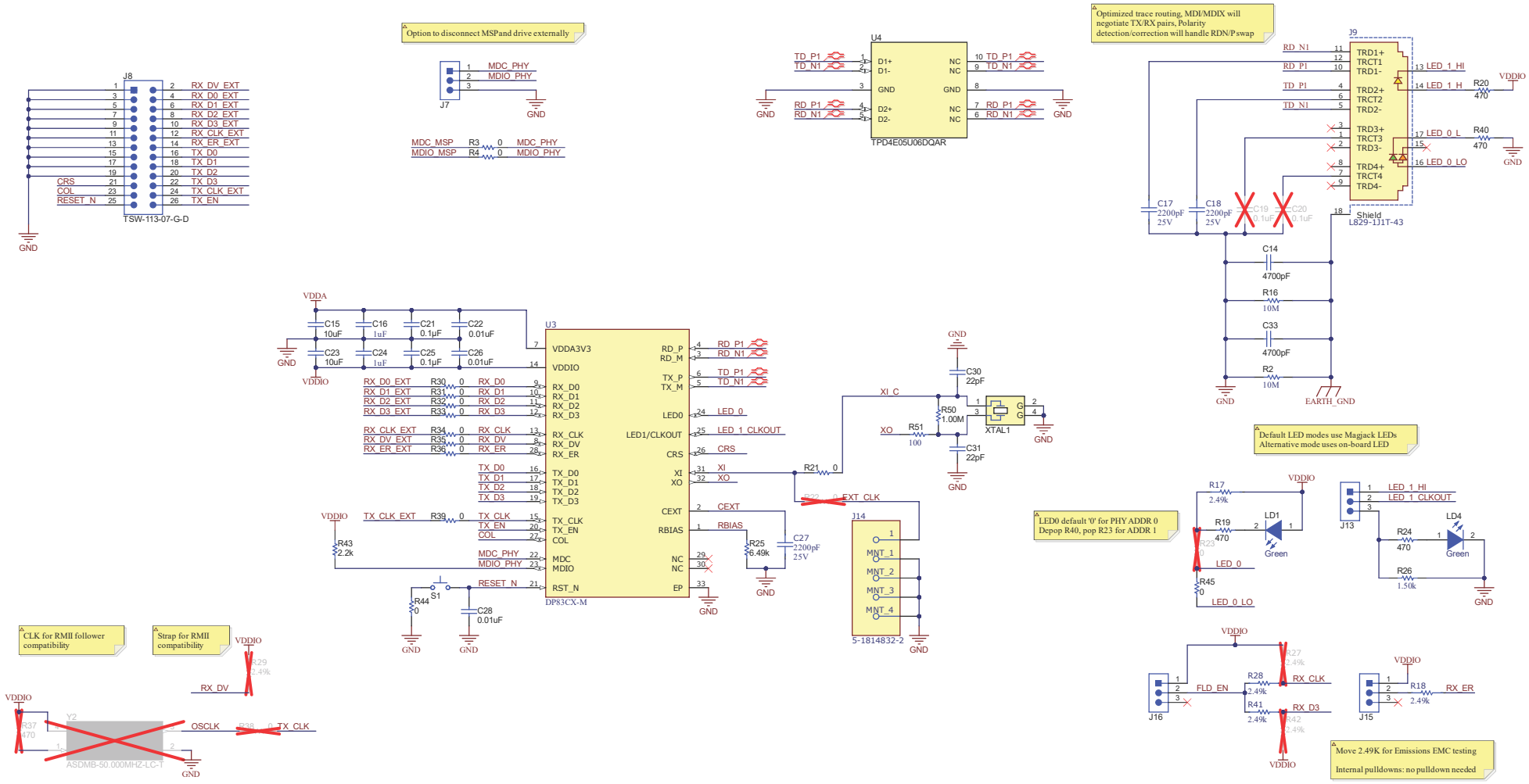


Figure 5-2. DP83CX-M-EVM Main Schematic

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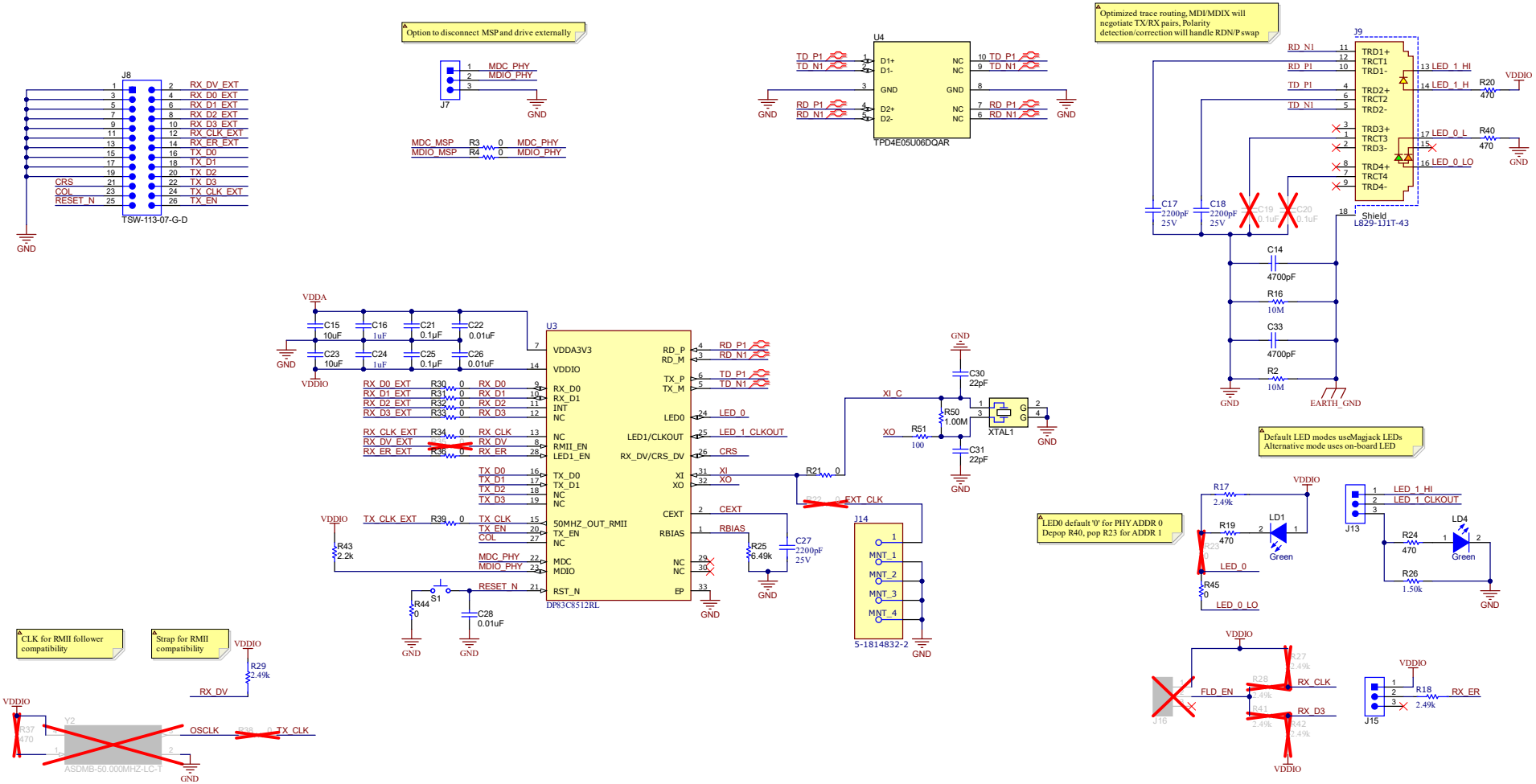


Figure 5-3. DP83CX-RL-EVM Main Schematic

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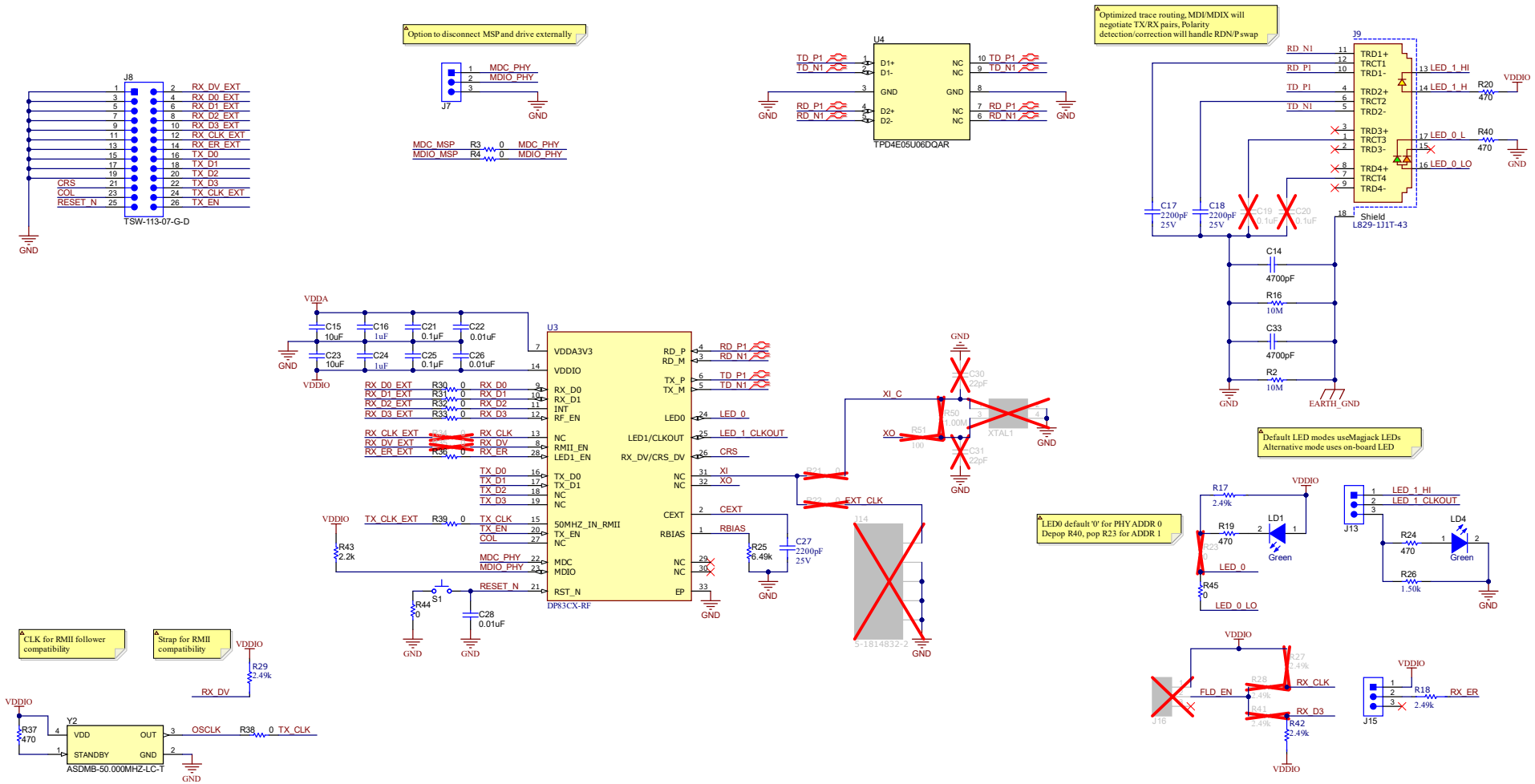


Figure 5-4. DP83CX-RF-EVM Main Schematic

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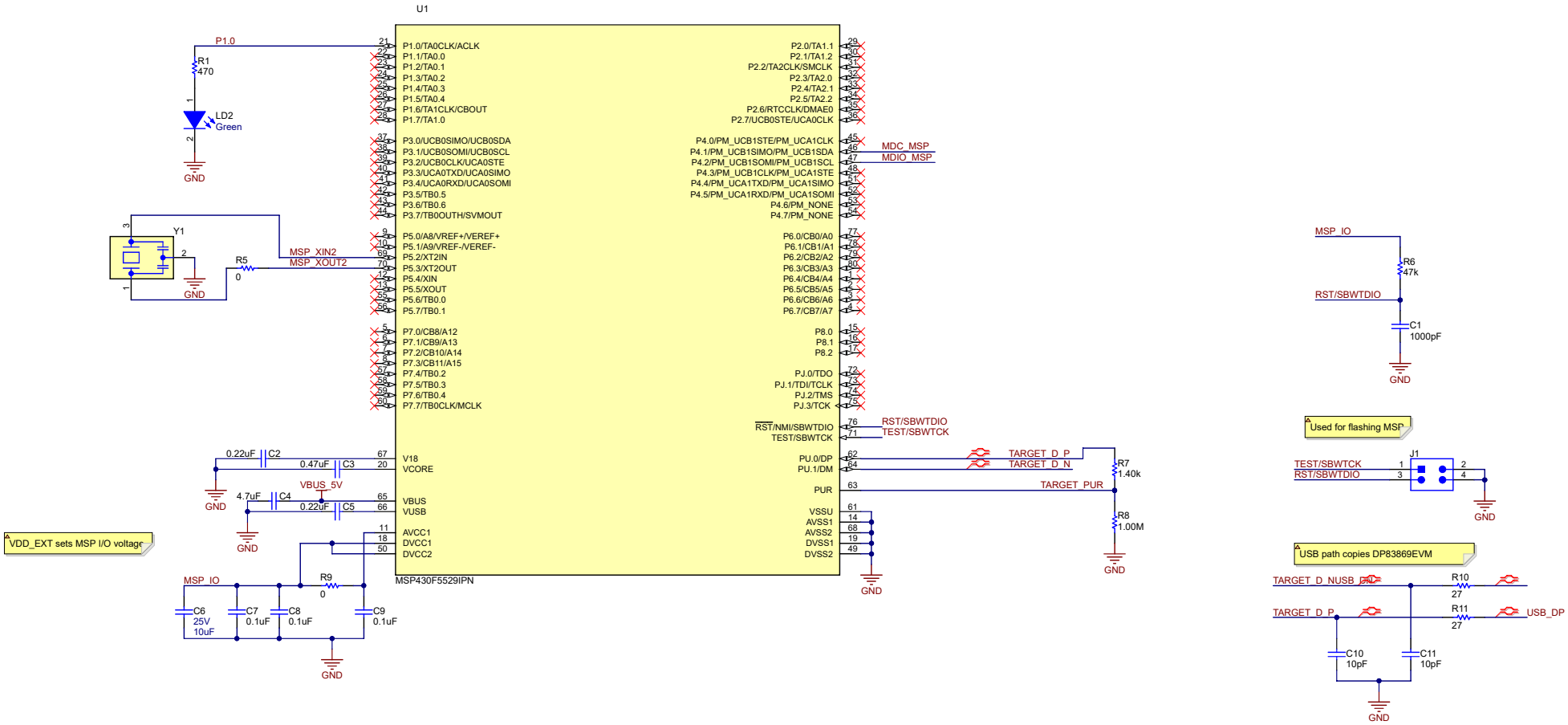


Figure 5-5. DP83CX EVM MSP430 Schematic

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5.2 PCB Layouts

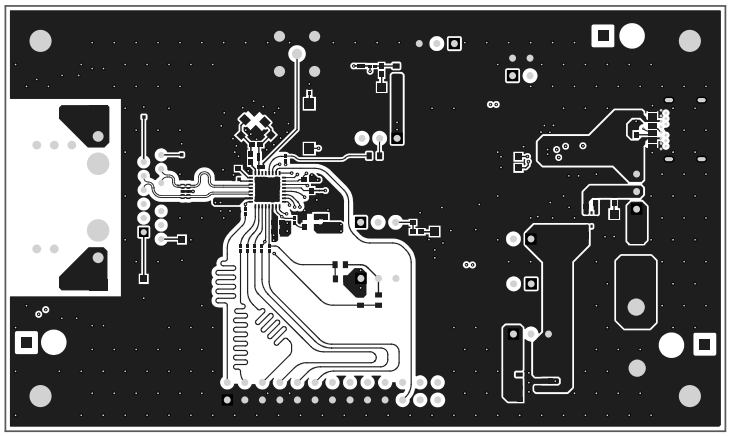


Figure 5-6. Layer 1, Top

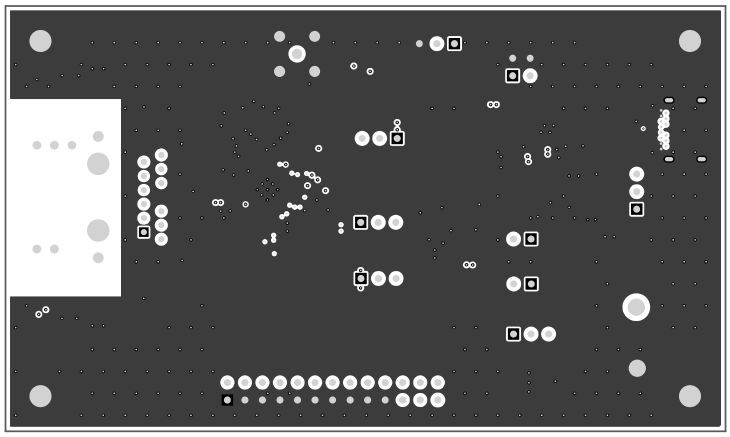


Figure 5-7. Layer 2, GND

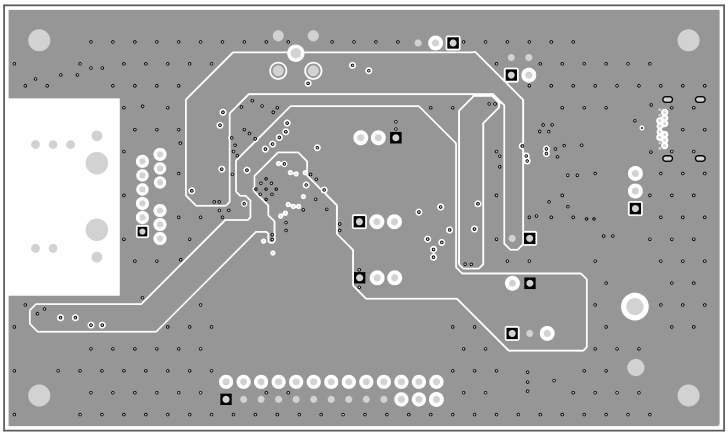


Figure 5-8. Layer 3, Power

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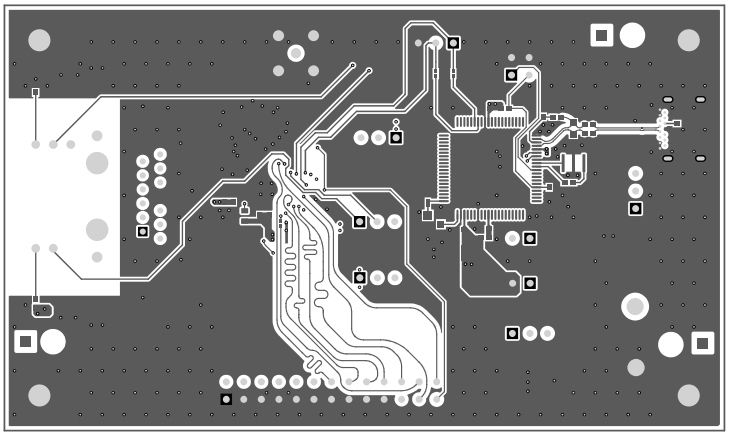


Figure 5-9. Layer 4, Bottom

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5.3 Bill of Materials (BOM)

Name	Description	Designator	Quantity	Manufacturer
Printed Circuit Board	Printed Circuit Board	!PCB1	1	Any
C1005NP01H102J050BA	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, 0402	C1	1	TDK
C1608X5R1H224K080AB	CAP, CERM, 0.22 uF, 50 V, +/- 10%, X5R, 0603	C2, C5	2	TDK
C1608X6S1H474K080AB	CAP, CERM, 0.47 uF, 50 V, +/- 10%, X6S, 0603	C3	1	TDK
GRM188R6YA475KE15J	CAP, CERM, 4.7 uF, 35 V, +/- 10%, X5R, 0603	C4	1	TDK
C1210C106K3RACTU	CAP, CERM, 10 uF, 25 V, +/- 10%, X7R, 1210	C6	1	Kemet
GRM155R71C104KA88D	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	C7, C8, C9	3	MuRata
CGA3E2NP01H100D080AA	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	C10, C11	2	TDK
GRM155R61E105KA12D	CAP, CERM, 1 uF, 35 V, +/- 20%, X5R, 0402	C12	1	MuRata
CGA3E1X7S1C225M080AC	CAP, CERM, 2.2 uF, 16 V, +/- 20%, X7S, AEC-Q200 Grade 1, 0603	C13	1	TDK
1812GC472KAT1A	CAP, CERM, 4700 pF, 2000 V, +/- 10%, X7R, 1812	C14, C33	2	AVX
CL05A106MQ5NUNC	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0402	C15, C23	2	Samsung Electro-Mechanics
GRM155R70J105KA12D	CAP, CERM, 1 uF, 6.3 V,+/- 10%, X7R, 0402	C16, C24	2	MuRata
C0402C222F3GACTU	2200 pF ±1% 25V Ceramic Capacitor C0G, NP0 0402 (1005 Metric)	C17, C18, C27	3	KEMET
C0603C104K8RACTU	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0603	C19, C20	2	Kemet
C0402C104K8RACTU	CAP, CERM, 0.1 µF, 10 V,+/- 10%, X7R, 0402	C21, C25, C29, C32	4	Kemet

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Name	Description	Designator	Quantity	Manufacturer
885012205031	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X7R, 0402	C22, C26, C28	3	Wurth Elektronik
CGA3E2C0G1H220J080AA	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0603	C30, C31	2	TDK
GRT155R71E103KE01J	Multi-Layer Ceramic Capacitor 10nF 25V X7R ±10% 0402 Paper T/R	C34	1	Murata
MBRA160T3G	Diode, Schottky, 60 V, 1 A, AEC-Q101, SMA	D2	1	ON Semiconductor
QTLP630C4TR/FC17-21SYGC/S530-E2/TR8	LED, Green, SMD	D3, LD1, LD2, LD4	4	Everlight
NY PMS 440 0025 PH	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	H1, H2, H3, H4	4	B&F Fastener Supply
1902E	Standoff, Hex, 1"L #4-40 Nylon	H5, H6, H7, H8	4	Keystone
TSW-102-07-G-D	Header, 100mil, 2x2, Gold, TH	J1	1	Samtec
632723300011	Connector, Receptacle, USB Type C, R/A	J2	1	Wurth Elektronik
HTSW-103-07-G-S	Header, 100mil, 3x1, Gold, TH	J3, J7, J10, J13, J15, J16	6	Samtec
1502-2	Terminal, Turret, TH, Double	J4, J5	2	Keystone
HTSW-102-07-G-S	Header, 100mil, 2x1, Gold, TH	J6, J11	2	Samtec
TSW-113-07-G-D	Header, 100mil, 13x2, Gold, TH	J8	1	Samtec
L829-1J1T-43	Conn RJ-45 F 8 POS 2.03mm Solder RA Thru-Hole 17 Terminal 1 Port MagJack® T/R/Tray	J9	1	Bel Fuse
5-1814832-2	SMA Connector Jack, Female Socket 50Ohm Through Hole Solder	J14	1	TE Connectivity
RC0201JR-07470RL	RES, 470, 5%, 0.05 W, 0201	R1	1	Yageo America
HVC2010-10MJT3	RES, 10 M, 5%, 0.5 W, 2010	R2, R16	2	TT Electronics/IRC
CRCW02010000Z0ED	RES, 0, 5%, 0.05 W, 0201	R3, R4, R21, R22, R23, R30, R31, R32, R33, R34, R35, R36, R38, R39, R44, R45	16	Vishay-Dale
CRCW04020000Z0ED	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R5, R9	2	Vishay-Dale

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Name	Description	Designator	Quantity	Manufacturer
CRCW040247K0JNED	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R6	1	Vishay-Dale
CRCW04021K40FKED	RES, 1.40 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	R7	1	Vishay-Dale
CRCW04021M00FKED	RES, 1.00 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	R8	1	Vishay-Dale
CRCW040227R0JNED	RES, 27, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R10, R11	2	Vishay-Dale
CRCW040210K0FKED	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	R12	1	Vishay-Dale
CRCW0402470RJNED	RES, 470, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R13, R19, R20, R24, R37, R40	6	Vishay-Dale
CRCW04025K10JNED	RES, 5.1 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R14, R15	2	Vishay-Dale
CRCW06032K49FKEAHP	RES Thick Film, 2.49kΩ, 1%, 0.33W, 100ppm/°C, 0603	R17, R18, R27, R28, R29, R41, R42	7	Vishay
CRCW04026K49FKED	RES, 6.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	R25	1	Vishay-Dale
RMCF0402FT1K50	RES, 1.50 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	R26	1	Stackpole Electronics Inc
CRCW04022K20JNED	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	R43	1	Vishay-Dale
RC0402FR-071ML	RES, 1.00 M, 1%, 0.063 W, 0402	R50	1	Yageo America
ERJ-2RKF1000X	RES, 100, 1%, 0.1 W, 0402	R51	1	Panasonic
KSR221GLFS	Switch, Normally open, 2.3N force, 200k operations, SMD	S1	1	C&K Components
M7582-05	Single Operation 2.54mm Pitch Open Top Jumper Socket	SH-J3, SH-J6, SH-J10, SH-J11, SH-J13, SH-J15, SH-J16	7	Harwin
MSP430F5529IPN	25 MHz Mixed Signal Microcontroller with 128 KB Flash, 8192 B SRAM and 63 GPIOs, -40 to 85 degC, 80-pin QFP (PN), Green (RoHS & no Sb/Br)	U1	1	Texas Instruments

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Name	Description	Designator	Quantity	Manufacturer
TPS73733DRVR	Single Output LDO, 1A, Adj. (1.2 to 5.0V), Reverse Current Protection, DRV0006A (WSON-6)	U2	1	Texas Instruments
DP83C8512-M	Deterministic, Low-Latency, Low-Power, Multisource, 10/100Mbps, Industrial Ethernet PHY	U3	1	Texas Instruments
TPD4E05U06DQAR	4-Channel Ultra-Low-Capacitance IEC ESD Protection Diode, DQA0010A (USON-10)	U4	1	Texas Instruments
TPS72118DBVR	Single Output Low Input Voltage Requirement LDO, 150 mA, Fixed 1.8 V Output, 1.8 to 5.5 V Input, with Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	U5	1	Texas Instruments
ECS-250-12-33Q-JES-TR	Crystal, 25 MHz, 20 ppm, AEC-Q200 Grade 1, SMD	XTAL1	1	ECS Inc.
CSTNR4M00GH5L000R0	Oscillator, 4 MHz, 700 ppm, 39 pF, SMD	Y1	1	MuRata
ASDMB-50.000MHZ-LC-T	OSC, 50 MHz, 1.8 to 3.3V, SMD	Y2	1	Abracon Corporation

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6 Additional Information

6.1 Trademarks

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USB-C® is a registered trademark of USB Implementers Forum.
Windows® is a registered trademark of Microsoft Corporation.
All trademarks are the property of their respective owners.

6.2 Terminology

Table 6-1. Terminology

ACRONYM	DEFINITION
PHY	Physical Layer Transceiver
MAC	Media Access Controller
SMI	Serial Management Interface
MDIO	Management Data I/O
MDC	Management Data Clock
MII	Media Independent Interface
VDDA	Analog Core Supply Rail
VDDIO	Digital Supply Rail
PD	Pulldown
PU	Pullup
MCU	Microcontroller
PRBS	Pseudo Random Binary Sequence

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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.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   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.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   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.

STANDARD TERMS FOR EVALUATION MODULES (continued)

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

1. 電波法施行規則第 6 条第 1 項第 1 号に基づく平成 18 年 3 月 28 日総務省告示第 173 号で定められた電波暗室等の試験設備でご使用いただく。
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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東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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.

STANDARD TERMS FOR EVALUATION MODULES (continued)

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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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STANDARD TERMS FOR EVALUATION MODULES (continued)

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.

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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.

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2. Unless otherwise indicated, EVMs are not finished products and not intended for consumer use. EVMs are intended solely for use by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.
3. User agrees that EVMs shall not be used as, or incorporated into, all or any part of a finished product.
4. User agrees and acknowledges that certain EVMs may not be designed or manufactured by TI.
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6. User assumes all responsibility, obligation, and any corresponding liability for proper and safe handling and use of EVMs.
7. Should any EVM not meet the specifications indicated in the user’s guide or other documentation accompanying such EVM, the EVM may be returned to TI within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY TI TO USER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. TI SHALL NOT BE LIABLE TO USER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATED TO THE HANDLING OR USE OF ANY EVM.
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10. User has sole responsibility to ensure the safety of any activities to be conducted by it and its employees, affiliates, contractors or designees, with respect to handling and using EVMs. Further, user is responsible to ensure that any interfaces (electronic and/or mechanical) between EVMs 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.
11. User shall employ reasonable safeguards to ensure that user’s use of EVMs will not result in any property damage, injury or death, even if EVMs should fail to perform as described or expected.
12. User shall be solely responsible for proper disposal and recycling of EVMs consistent with all applicable federal, state, and local requirements.

ADDITIONAL TERMS AND CONDITIONS, WARNINGS, RESTRICTIONS, AND DISCLAIMERS FOR EVALUATION MODULES (continued)

Certain Instructions. User shall operate EVMs within TI's recommended specifications and environmental considerations per the user's guide, accompanying documentation, and any other applicable requirements. Exceeding the specified ratings (including but not limited to input and output voltage, current, power, and environmental ranges) for EVMs may cause property damage, personal injury or death. If there are questions concerning these ratings, 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the applicable EVM user's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using EVMs' schematics located in the applicable EVM user's guide. When placing measurement probes near EVMs during normal operation, please be aware that EVMs may become very warm. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use EVMs.

Agreement to Defend, Indemnify and Hold Harmless. User agrees to defend, indemnify, and hold TI, its directors, officers, employees, agents, representatives, affiliates, licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of, or in connection with, any handling and/or use of EVMs. User's indemnity shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if EVMs fail to perform as described or expected.

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Last updated 10/2025