EVM User's Guide: DP83826AEVM

DP83826AEVM User's Guide

Description

The DP83826AEVM is designed to evaluate the functionality and performance of the DP83826A Ethernet physical layer tranciever. The DP83826A EVM supports 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 to enable register access on the DP83826A using USB to MDIO software.

Get Started

1. Configure the board headers to fit your application.
2. Power the board with an external supply.
3. For issues, reach out to us on the TI E2E forum.

Features

- 100Base-TX, 10Base-Te with Auto-Negotiation and Force Mode
- Onboard clock and output clock
- Onboard MSP430 for easy MDIO Register Access
- Onboard MSP430 for flashing firmware
- Single supply or external power supply options
- Status LEDs
- Fiber Optic transceivers option for MDIO/MDC
- EMI/EMC Compliance Testing Completed:
  - CISPR 22 Radiated Emissions Class B
  - CISPR 22 Conducted Emissions Class B
  - IEC 61000-4-2 ESD: ±9kV contact, ±15kV air
  - IEC 61000-4-4 EFT: ±4kV

Applications

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

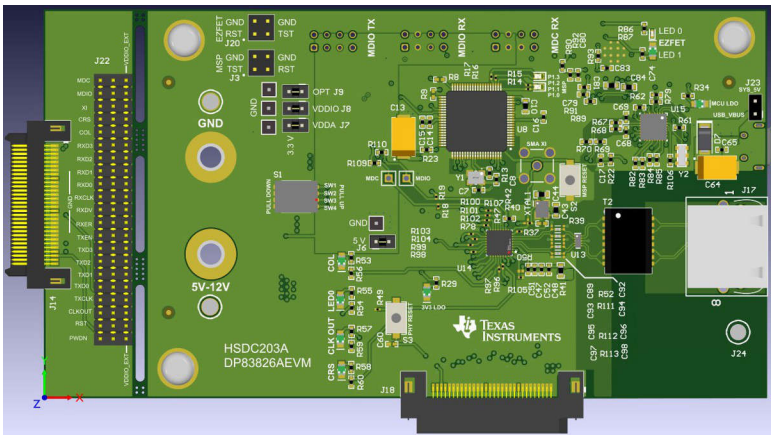

Figure 1-1. DP83826A EVM

1 Evaluation Module Overview

1.1 Introduction

The DP83826A offers low and deterministic latency, low power, robust EMC and immunity, and supports 10BASE-Te, 100BASE-TX Ethernet protocols to meet stringent requirements in real-time industrial Ethernet systems. The device includes 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 a Reduced MII (RMII) both in Master and Slave mode. The DP83826AEVM demonstrates all the features of DP83826A. The EVM supports 10BASE-Te and 100BASE-TX Ethernet protocols. The EVM includes connections to use the DP83826A MII and RMII pins through header pins.

1.2 Kit Contents

The DP83826AEVM includes:

- The DP83826A device
- (1) RJ-45 receptacle that connects to a link partner device
- (1) USB micro-B receptacle that connects to a PC running USB to MDIO
- (1) 5V - 12V banana jack receptacle and turret

1.3 Specification

The figure below shows the power and data path of the DP83826AEVM. Please note this EVM has the fiber optic transceivers depopulated by default.

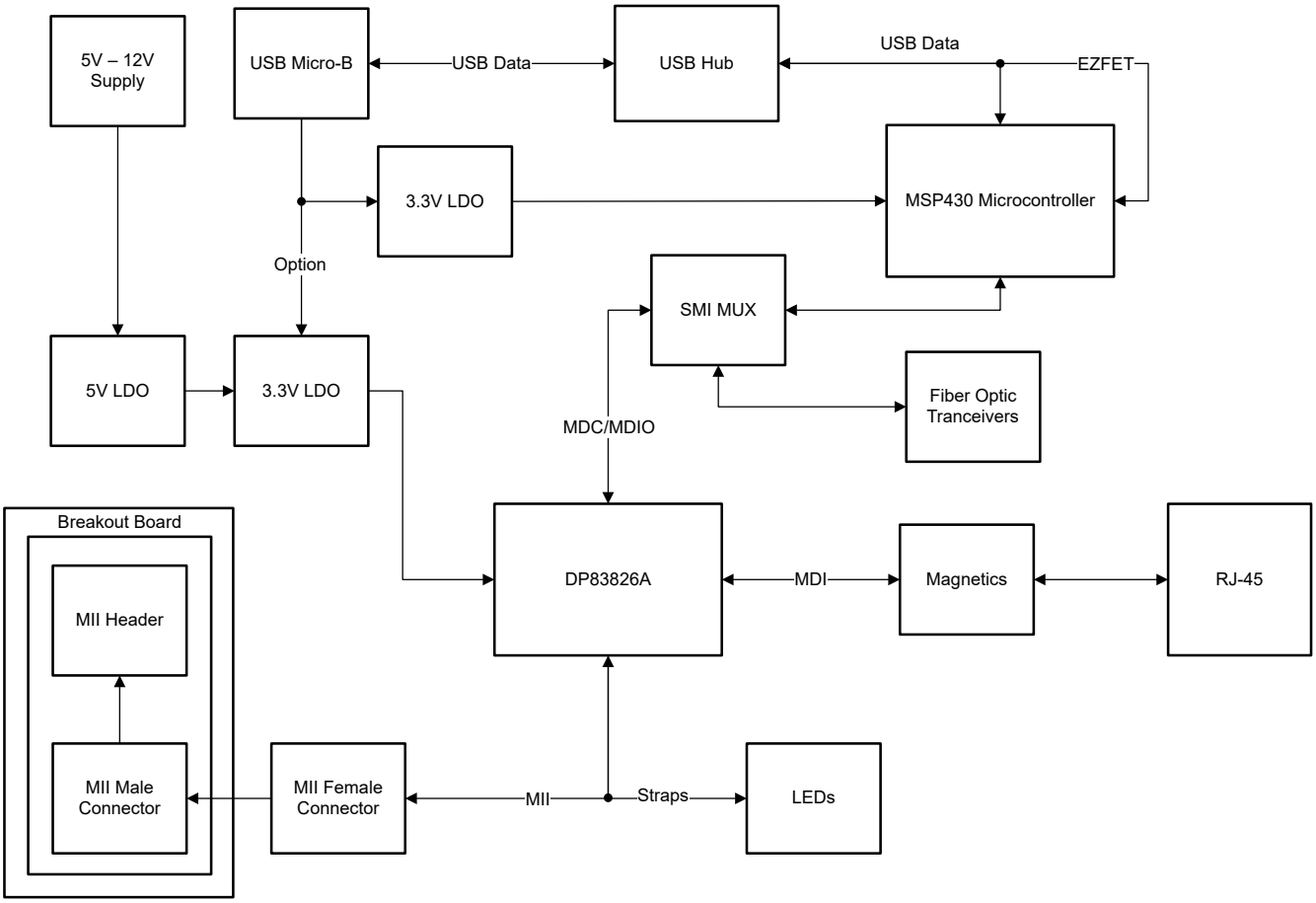

Figure 1-1. DP83826A EVM Block Diagram

1.4 Device Information

The DP83826A is a single-port physical layer transceiver designed to meet stringent Industrial fieldbus applications' needs 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. The device supports the standard MII and RMII (Master mode and Slave mode) for direct connection to the media access controller (MAC). Its dedicated CLKOUT pin can be used to clock other modules on the system. In addition, the PWRDN pin controls the DP83826A link up from power-on-reset (POR) and helps with design of asynchronous power-up of the DP83826A and host system-on-a-chip (SoC) or field-programmable-gate-array (FPGA) controller.

2 Hardware

2.1 Power Requirements

The DP83826AEVM power is supplied by the 5-12V input connection in the image below. Single supply operation uses on-board LDOs to generate the voltages required for operating various sections of the EVM. Power can also be supplied externally to individual voltage rails. The micro-USB supplies power to the on-board LDOs that power all microcontroller related components.

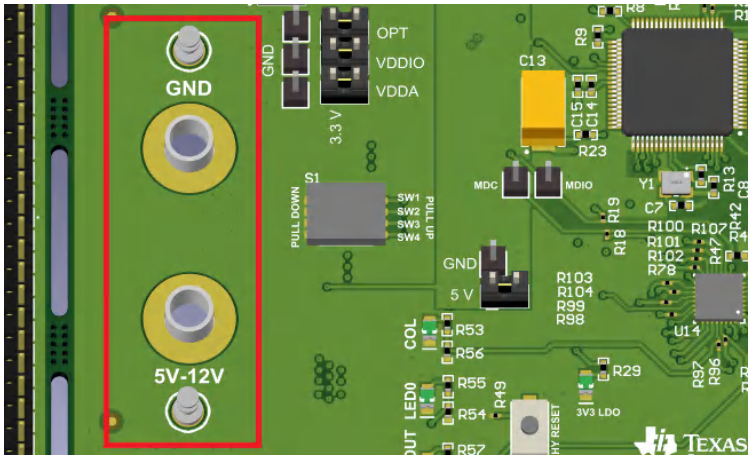

Figure 2-1. DP83826A EVM Power Headers

Note

Before supplying power at the 5-12V input, make sure the correct shunts are added to the appropriate headers to properly operate the on-board LDOs as seen in the figure below.

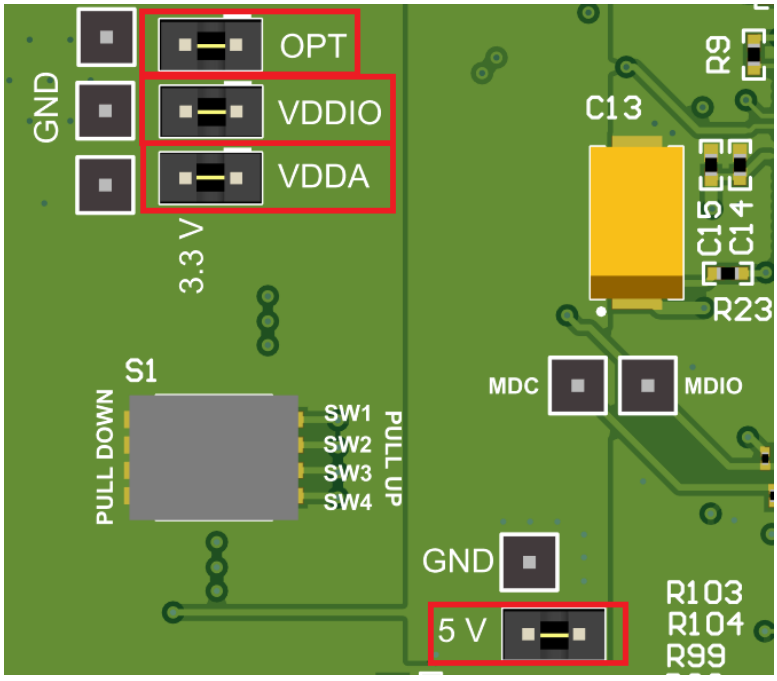

Figure 2-2. DP83826A EVM Power Headers

2.2 Setup

The DP83826AEVM default header configuration assumes the user is supplying power to the 5V-12V banana jack or turret input. If the user wants to power the EVM from external sources, power can be supplied directly to pin 2 of J7 (VDDA), J8 (VDDIO), or J9 (Fiber optic transceivers). J23 (5V) is used to supply LDO and PHY using an external 5V power supply. The on-board MSP430 is powered through the USB micro-B connector.

If standalone USB operation is desired, place a jumper on J23 (USB_VBUS). After connection, the DP83826A and MSP430 draw power from the USB micro-B receptacle without any external power supply required. Please note that standalone USB operation can cause issues with USB to MDIO register access. If register access is required, TI recommends powering the DP83826AEVM using the 5V-12V banana jack supply.

2.3 Interfaces

Table 2-1. DP83826AEVM 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 Test on EVM	Use internal PRBS and loopback. Onboard MSP430 can be used for register access.
	Measure Power Dissipation	Connect external power supplies.
	50MHz output clock	Optional Clock out SMA
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

3 Software

3.1 Software Description

The on-board MSP430 comes pre-programmed and ready to use. When using this EVM for the first time on a Windows 10 (or above) PC, MSP430 drivers and USB-2-MDIO software utility must be installed. USB-2-MDIO software can be used for accessing the PHY's registers.

3.2 Software Installation

Install the latest MSP430 driver from this website: https://software-dl.ti.com/msp430/msp430_public_sw/mcu/msp430/MSP430_FET_Drivers/latest/index_FDS.html

Download the USB-2-MDIO software from http://www.ti.com/tool/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 DP83826EVM, it is not necessary to purchase a separate MSP430 Launchpad kit. In the case the on-board MSP430 cannot be used, MDIO and MDC pins are broken out on J1 and J2, respectively. Users can connect an MSP430 launchpad using the procedure described in TI's USB2MDIO Software Tool User's Guide, or their own MDIO-MDC utility.

3.3 Programming Options

To update or read the DP83826A registers, the user can simply connect the DP83826A EVM to a computer and use the USB-2-MDIO software. The EVM is designed to enable and test strap functionality through software without the need to modify the board and hardware. This allows for simple hardware and software support for those that do not have MDIO communication capability.

More information on how to access the DP83826A MDIO status and control registers can be found in the *USB-2-MDIO Software User's Guide* .

4 Implementation Results

4.1 Performance Data and Results

This section provides details of EMI test results using the DP83826A EVM. The test results shown are based on using a shielded Ethernet cable.

Standard	Test Performed	Result
IEC 61000-4-2	ESD Direct contact	± 9kV Class A
IEC 61000-4-2	ESD Capacitor coupling	± 9kV Class A
IEC 61000-4-2	ESD Air discharge	± 15kV Class A
IEC 61000-4-3	RF electromagnetic field	10V/m Class A
IEC 61000-4-4	EFT fast transient Burst	± 4kV Class A
IEC 61000-4-5	Surge	± 2kV Class A
IEC 61000-4-6	Conducted RF (CDN)	10Vrms Class A
EN55032	Radiated Emissions	Class B
EN55032	Conducted emissions	Class B

For IEC 61000-4-3 RI testing, replacing R37 with a 100Ω resistor was shown to improve performance from 10V/m to 16V/m. Consider adjusting R37 if greater RI performance is needed.

5 Hardware Design Files

5.1 Schematics

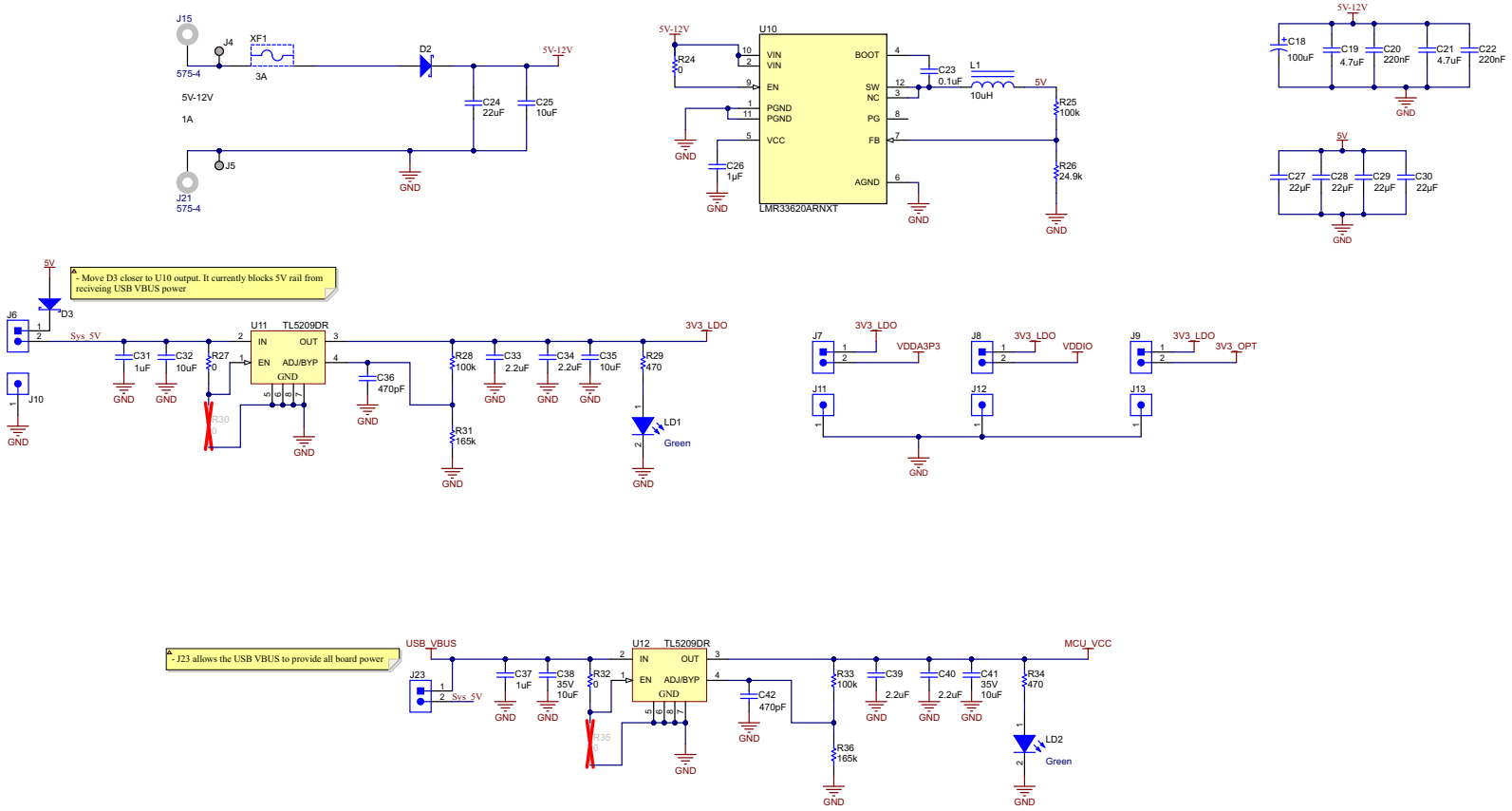

Figure 5-1. DP83826AEVM Power Schematic

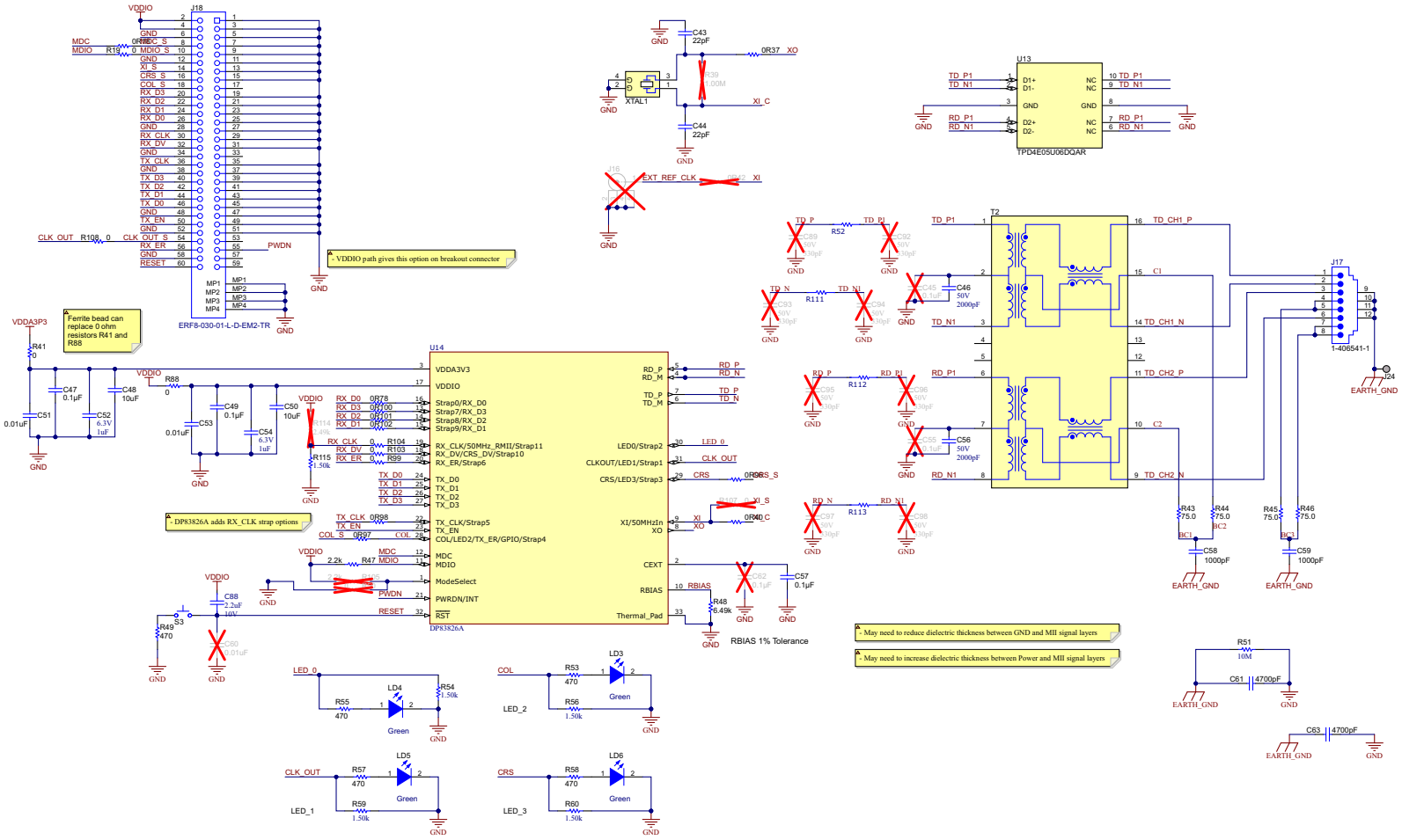

Figure 5-2. DP83826AEVM Main Schematic

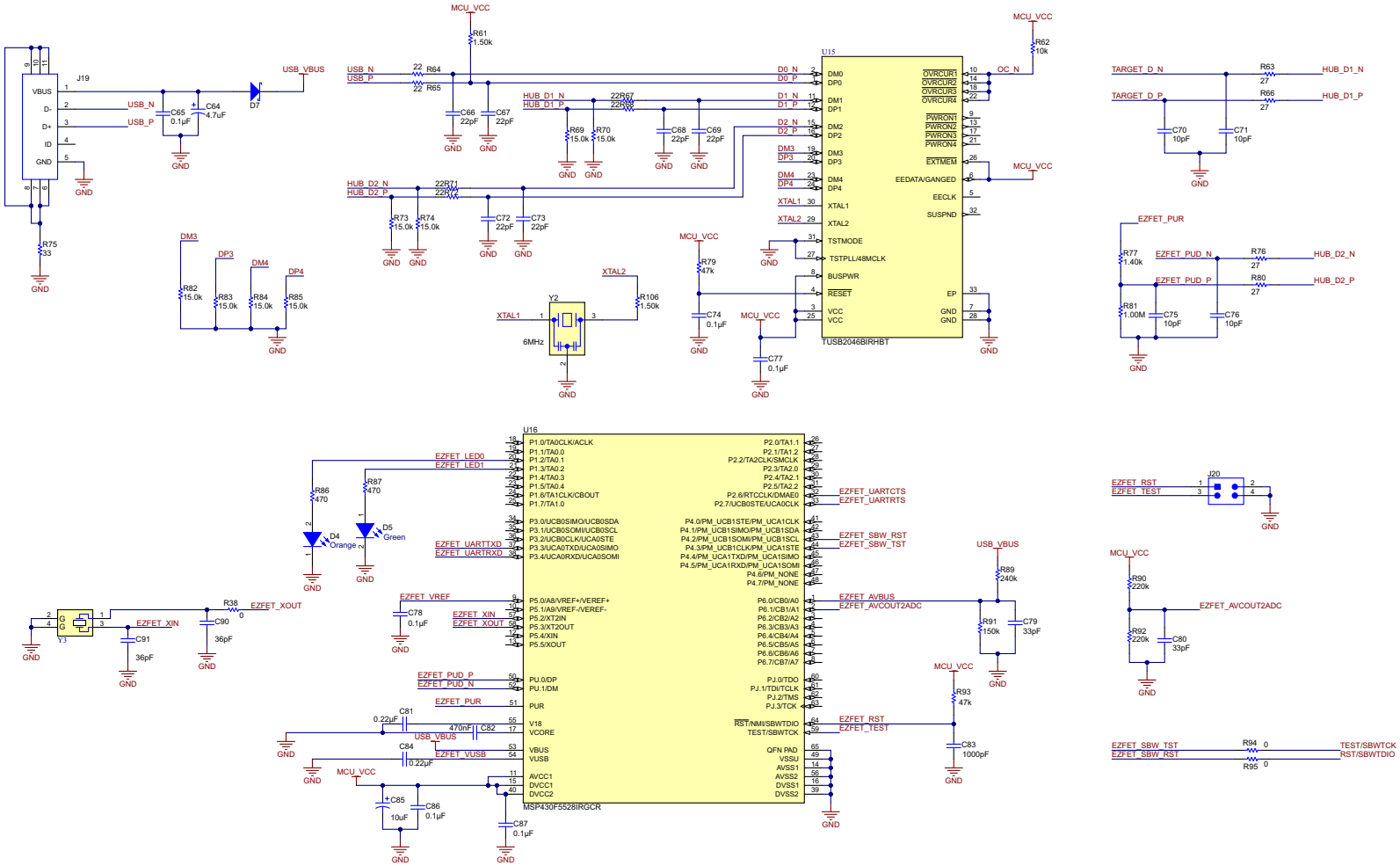

Figure 5-3. DP83826AEVM USB and MSP430 Schematic

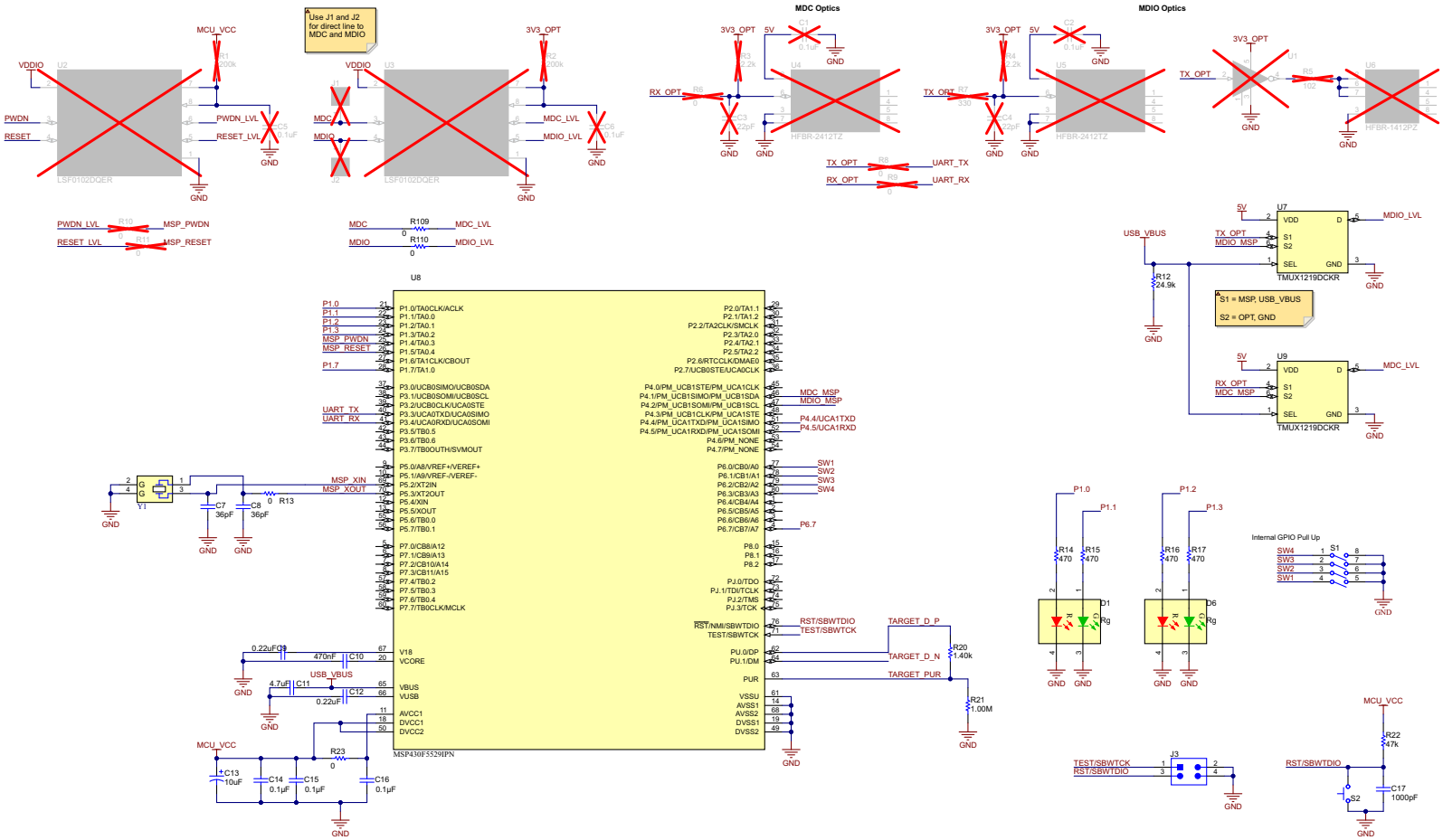

Figure 5-4. DP83826AEVM MSP430 Schematic

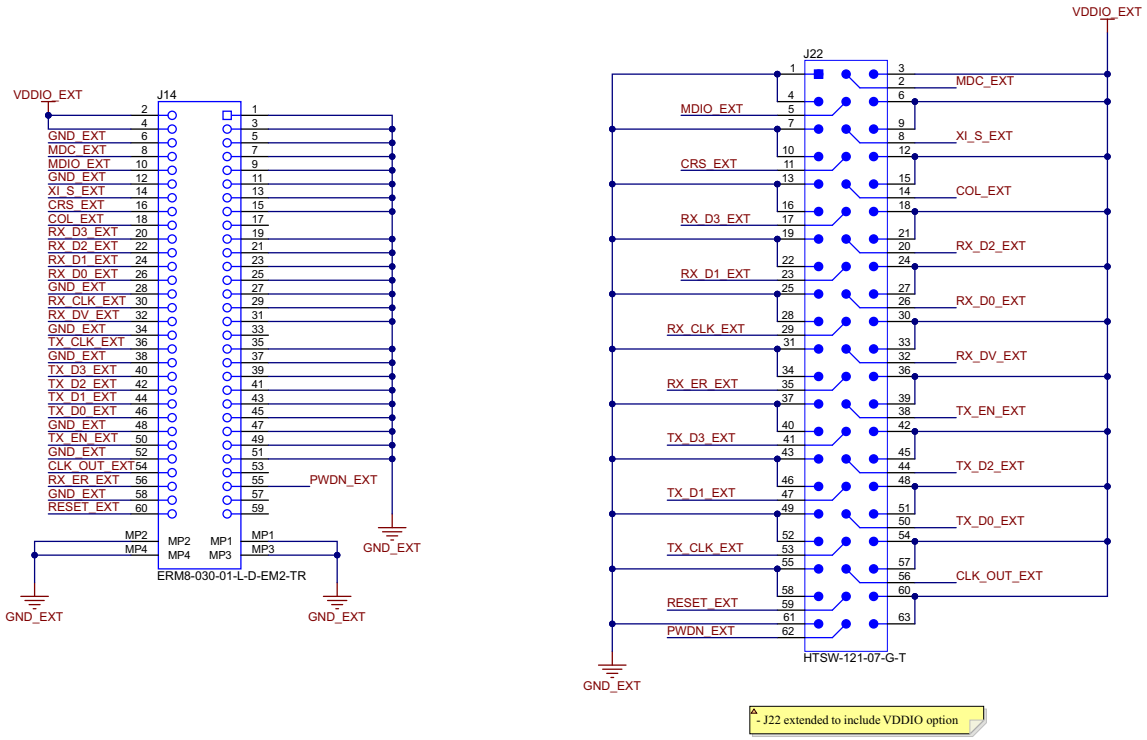

Figure 5-5. DP83826AEVM Breakout Board Schematic

5.2 PCB Layouts

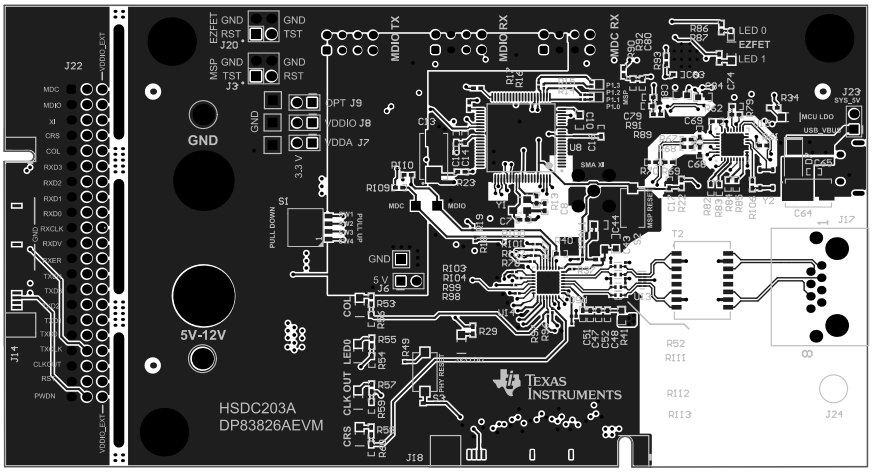

Figure 5-6. Layer 1, Top

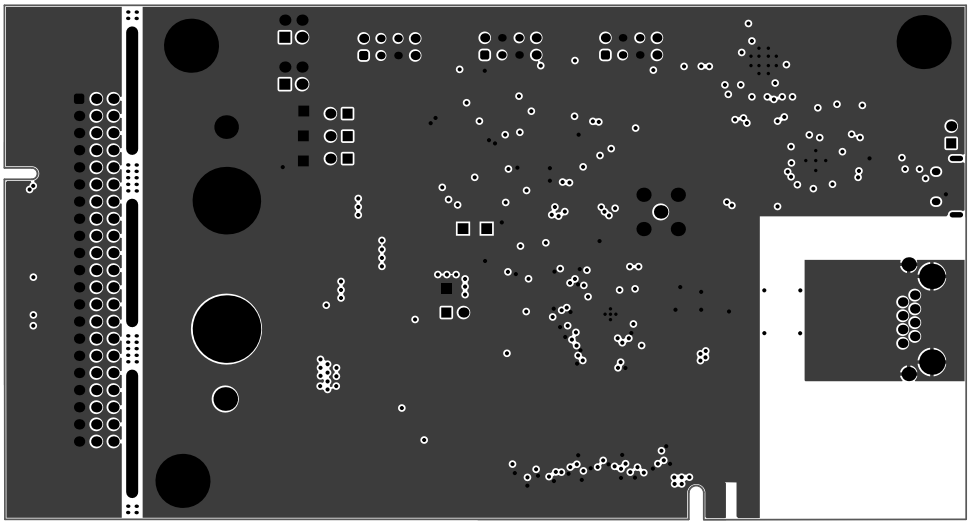

Figure 5-7. Layer 2, GND

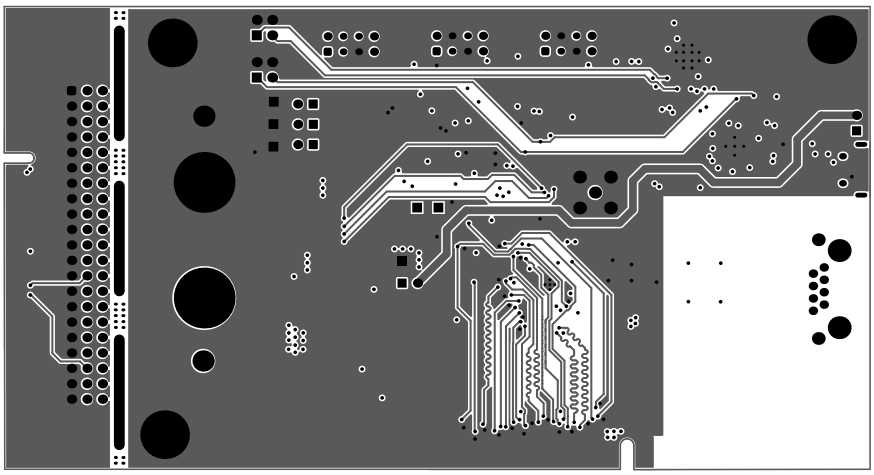

Figure 5-8. Layer 3, Signal

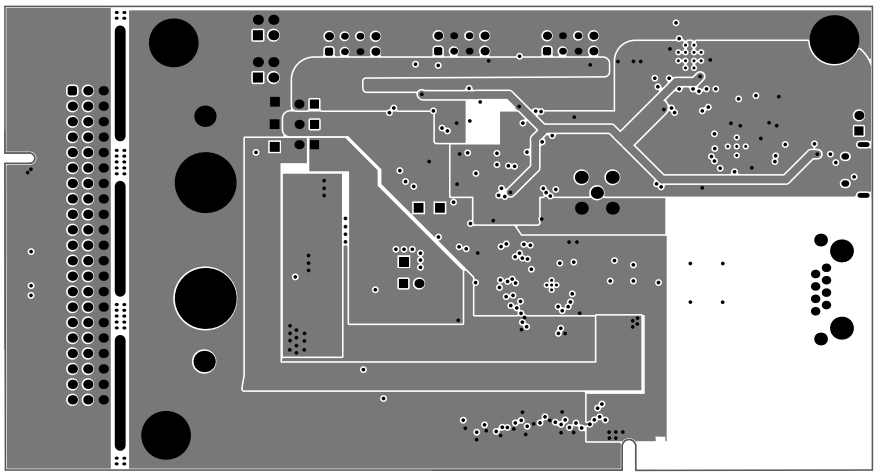

Figure 5-9. Layer 4, Power

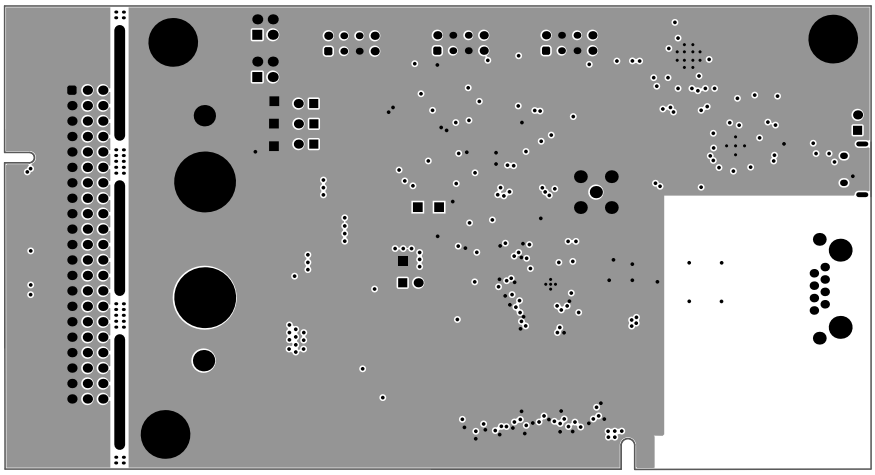

Figure 5-10. Layer 5, GND

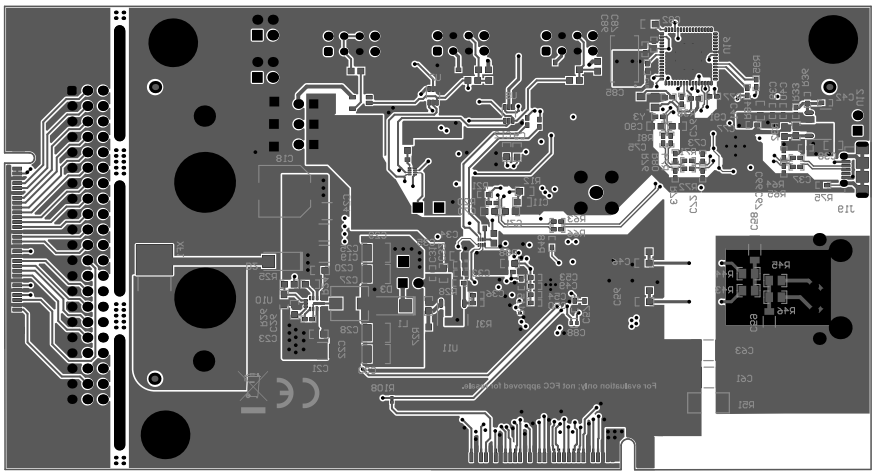

Figure 5-11. Layer 6, Bottom

5.3 Bill of Materials (BOM)

Table 5-1. Bill of Materials

Quantity	Designator	Description	Part Number	Manufacturer
1	!PCB1	Printed Circuit Board	Printed Circuit Board	
4	C7, C8, C90, C91	CAP, CERM, 36pF, 50V,+/- 5%, C0G/NP0, 0402	CL05C360JB5NNNC	Samsung
2	C9, C12	CAP, CERM, 0.22uF, 16V, +80/-20%, Y5V, 0603	C0603C224Z4VACTU	KEMET
1	C10	CAP, CERM, 0.47uF, 16V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	GCM188R71C474KA55D	Murata
1	C11	CAP, CERM, 4.7uF, 35V, +/- 10%, X5R, 0603	C1608X5R1V475K080AC	TDK
2	C13, C85	CAP, TA, 10uF, 35V, +/- 10%, 0.125 ohm, SMD	TPSD106K035R0125	AVX
7	C14, C15, C16, C47, C49, C57, C65	CAP, CERM, 0.1µF, 10V,+/- 10%, X7R, 0402	C0402C104K8RACTU	
2	C17, C83	CAP, CERM, 1000pF, 50V, +/- 5%, C0G/NP0, 0402	C1005NP01H102J050BA	TDK
1	C18	CAP, AL, 100uF, 50V, +/- 20%, SMD	EMVE500ADA101MHA0G	Chemi-Con
2	C19, C21	CAP, CERM, 4.7uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 1210	CGA6P3X7R1H475K250AB	TDK
2	C20, C22	CAP, CERM, 0.22uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E3X7R1H224K080AB	TDK
1	C23	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	GCM155R71H104KE02D	Murata
1	C24	CAP, CERM, 22uF, 16V, +/- 20%, X7R, AEC-Q200 Grade 1, 1210	CGA6P1X7R1C226M250AC	TDK
1	C25	CAP, CERM, 10uF, 25V, +/- 20%, X7R, AEC-Q200 Grade 1, 1210	CGA6P1X7R1E106M250AC	TDK
1	C26	CAP, CERM, 1uF, 35V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E1X7R1V105K080AC	TDK
4	C27, C28, C29, C30	CAP, CERM, 22µF, 25V,+/- 10%, X7R, AEC-Q200 Grade 1, 1210	TMK325B7226KMHP	
2	C31, C37	CAP, CERM, 1uF, 35V, +/- 20%, X5R, 0402	GRM155R6YA105ME11D	Murata
4	C32, C35, C38, C41	CAP, CERM, 10uF, 35V, +/- 20%, X5R, 0603	GRM188R6YA106MA73D	Murata
4	C33, C34, C39, C40	CAP, CERM, 2.2uF, 16V, +/- 10%, X6S, 0402	GRM155C81C225KE11D	Murata
2	C36, C42	CAP, CERM, 470pF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	GCM155R71H471KA37D	Murata
2	C43, C44	CAP, CERM, 22pF, 50V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0603	CGA3E2C0G1H220J080AA	TDK
2	C46, C56	CAP, CERM, 2000pF, 50V, +/- 5%, C0G/NP0, 0603	GRM1885C1H202JA01D	Murata

Table 5-1. Bill of Materials (continued)

Quantity	Designator	Description	Part Number	Manufacturer
2	C48, C50	CAP, CERM, 10uF, 6.3V, +/- 20%, X5R, 0402	CL05A106MQ5NUNC	Samsung
2	C51, C53	CAP, CERM, 0.01uF, 16V, +/- 10%, X7R, 0402	885012205031	Wurth Elektronik
2	C52, C54	CAP, CERM, 1uF, 6.3V,+/- 10%, X7R, 0402	GRM155R70J105KA12D	Murata
2	C58, C59	CAP, CERM, 1000pF, 2000V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	C1206C102KGRACAUTO	KEMET
2	C61, C63	CAP, CERM, 4700pF, 2000V, +/- 10%, X7R, 1812	1812GC472KAT1A	AVX
1	C64	CAP, TA, 4.7uF, 35V, +/- 10%, 1.3 ohm, SMD	293D475X9035D2TE3	Vishay/Sprague
6	C66, C67, C68, C69, C72, C73	CAP, CERM, 22pF, 50V,+/- 5%, C0G/NP0, 0402	C1005NP01H220J050BA	TDK
4	C70, C71, C75, C76	CAP, CERM, 10pF, 50V, +/- 5%, C0G/NP0, 0603	CGA3E2NP01H100D080AA	TDK
5	C74, C77, C78, C86, C87	CAP, CERM, 0.1µF, 16V,+/- 10%, X7R, 0402	CL05B104KO5NNNC	Walsin
2	C79, C80	CAP, CERM, 33pF, 50V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	GCM1555C1H330JA16D	Murata
2	C81, C84	CAP, CERM, 0.22µF, 50V,+/- 10%, X5R, 0603	CL10A224KB8NNNC	Samsung
1	C82	CAP, CERM, 0.47uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E3X7R1H474K080AB	TDK
1	C88	Chip Multilayer Ceramic Capacitors for General Purpose, 0402, 2.2uF, X7R, 15%, 10%, 10V	GRM155Z71A225KE01D	Murata
2	D1, D6	LED, Rg, SMD	HSMF-C165	Avago
3	D2, D3, D7	Diode, Schottky, 60V, 1A, AEC-Q101, SMA	NRVBA160NT3G	ON Semiconductor
1	D4	LED, Orange, SMD	APHHS1005SECK	
7	D5, LD1, LD2, LD3, LD4, LD5, LD6	LED, Green, SMD	QTLP630C4TR/FC17-21SYGC/S530-E2/TR8	Everlight
1	F1	Fuse, 3A, 63VAC/VDC, SMD	3402.0014.11	Schurter
3	H1, H2, H3	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener
4	H5, H6, H7, H8	Standoff, Hex, 1"L #4-40 Nylon	1902E	
2	J3, J20	Header, 100mil, 2x2, Gold, TH	TSW-102-07-G-D	
3	J4, J5, J24	Terminal, Turret, TH, Double	1502-2	
5	J6, J7, J8, J9, J23	Header, 100mil, 2x1, Tin, TH	PEC02SAAN	
4	J10, J11, J12, J13	Header, 1x1, Tin, TH	PEC01SAAN	
1	J14	Receptacle, 0.8mm, 30x2, Tin, Edge mount	ERM8-030-01-L-D-EM2-TR	

Table 5-1. Bill of Materials (continued)

Quantity	Designator	Description	Part Number	Manufacturer
2	J15, J21	Standard Banana Jack, Uninsulated, 5.5mm	575-4	Keystone Electronics
1	J17	RJ45, No LED, tab up, R/A, TH	1-406541-1	
1	J18	Receptacle, 0.8mm, 30x2, Gold, Edge Mount	ERF8-030-01-L-D-EM2-TR	
1	J19	Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	475890001	
1	J22	Header, 2.54mm, 21x3, Gold, TH	HTSW-121-07-G-T	Samtec
1	L1	Inductor, Shielded, Ferrite, 10 uH, 2.75A, 0.128 ohm, SMD	SRP5030T-100M	
2	R12, R26	RES, 24.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060324K9FKEA	Vishay/Dale
2	R13, R23	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04020000Z0ED	Vishay / Dale
5	R14, R15, R16, R17, R49	RES, 470, 5%, 0.05 W, 0201	RC0201JR-07470RL	
15	R18, R19, R37, R40, R78, R96, R97, R98, R99, R100, R101, R102, R103, R104, R108	RES, 0, 5%, 0.05 W, 0201	CRCW02010000Z0ED	Vishay / Dale
2	R20, R77	RES, 1.40 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021K40FKED	Vishay / Dale
2	R21, R81	RES, 1.00M, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW04021M00FKED	
3	R22, R79, R93	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040247K0JNED	Vishay / Dale
1	R24	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	RMCF0603ZT0R00	Stackpole Electronics Inc
1	R25	RES, 100 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603100KFKEA	Vishay/Dale
2	R27, R32	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	ERJ-3GEY0R00V	Panasonic
2	R28, R33	RES, 100 k, 0.5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402100KDHEDP	
8	R29, R34, R53, R55, R57, R58, R86, R87	RES, 470, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402470RJNED	Vishay / Dale
2	R31, R36	RES, 165 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402165KFKED	Vishay / Dale
3	R38, R94, R95	RES, 0, 5%, 0.063 W, 0402	RC0402JR-070RL	Yageo America
2	R41, R88	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06030000Z0EA	Vishay-Dale
4	R43, R44, R45, R46	RES, 75.0, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	CRCW080575R0FKEA	Vishay

Table 5-1. Bill of Materials (continued)

Quantity	Designator	Description	Part Number	Manufacturer
1	R47	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04022K20JNED	Vishay / Dale
1	R48	RES, 6.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04026K49FKED	
0	R50	RES, 0, 5%, .05 W, AEC-Q200 Grade 0, 0201	ERJ-1GN0R00C	
1	R51	RES, 10M, 1%, 0.5W, 2010	HVC2010-10MFT3	TT Electronics/IRC
4	R52, R111, R112, R113	0 Ohms Jumper Chip Resistor 0402 (1005 Metric) Metal Element	5113	Keystone Electronics
5	R54, R56, R59, R60, R115	RES, 1.50 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	RMCF0402FT1K50	
2	R61, R106	RES, 1.50 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW04021K50FKED	Vishay / Dale
1	R62	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040210K0JNED	Vishay / Dale
4	R63, R66, R76, R80	RES, 27, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040227R0JNED	Vishay / Dale
6	R64, R65, R67, R68, R71, R72	RES, 22, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040222R0JNED	Vishay / Dale
8	R69, R70, R73, R74, R82, R83, R84, R85	RES, 15.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040215K0FKED	Vishay / Dale
1	R75	RES, 33, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW040233R0JNED	Vishay / Dale
1	R89	RES, 240 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402240KJNED	
2	R90, R92	RES, 220 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402220KJNED	
1	R91	RES, 150 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	CRCW0402150KJNED	
2	R109, R110	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	ERJ-2GE0R00X	Panasonic
1	S1	Switch, Slide, SPST 4 poles, SMT	218-4LPST	CTS Electrocomponents
2	S2, S3	Switch, Normally open, 2.3N force, 200k operations, SMD	KSR221GLFS	C&K Components
4	SH-J1, SH-J2, SH-J3, SH-J4	Single Operation 2.54mm Pitch Open Top Jumper Socket	M7582-05	
1	T2	Transformer, 350 uH, SMT	HX1188FNLT	Pulse Engineering
2	U7, U9	1-ch, 2:1 general-purpose analog multiplexer with 1.8V logic control, DCK0006A (SOT-SC70-6)	TMUX1219DCKR	
1	U8	25MHz 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)	MSP430F5529IPN	

Table 5-1. Bill of Materials (continued)

Quantity	Designator	Description	Part Number	Manufacturer
1	U10	3.8V to 36V 2A Synchronous Step-Down Voltage Regulator, RNX0012B (VQFN-HR-12)	LMR33620ARNXT	
2	U11, U12	Single Output Low Noise LDO, 500mA, Adjustable 1.3 to 6.5V Output, 2.5 to 16V Input, 8-pin SOIC (D), -40 to 125°C, Green (RoHS & no Sb/Br)	TL5209DR	
1	U13	4-Channel Ultra-Low-Capacitance IEC ESD Protection Diode, DQA0010A (USON-10)	TPD4E05U06DQAR	Texas Instruments
1	U14	Deterministic, Low-Latency, Low-Power, 10/100 Mbps, Industrial Ethernet PHY	DP83826A	Texas Instruments
1	U15	4-Port Full-Speed USB Hub, 3.3V, -40 to 85 degC, 32-Pin QFN (RHB), Green (RoHS & no Sb/Br)	TUSB2046BIRHBT	
1	U16	16-Bit Ultra-Low-Power Microcontroller, 128KB Flash, 8KB RAM, USB, 12Bit ADC, 2 USCIs, 32Bit HW MPY, RGC0064B (VQFN-64)	MSP430F5528IRGCR	Texas Instruments
1	XF1	FUSE HLDR CARTRIDGE 125V 5A SMD	0031.7701.11	
1	XTAL1	Crystal, 25MHz, 20ppm, AEC-Q200 Grade 1, SMD	ECS-250-12-33Q-JES-TR	
2	Y1, Y3	Crystal, 24MHz, 20pF, SMD	ECS-240-20-33-DU-TR	ECS Inc.
1	Y2	Resonator, 6MHz, 15pF SMD	CSTCR6M00G53Z-R0	Murata

6 Additional Information

6.1 Known Hardware or Software Issues

In Rev A of the DP83826A EVM (HSDC203A) there is a known issue with USB-2-MDIO register access when powering the board over USB only. If powering this EVM with USB only, the MDIO interface can become unstable. This is because the USB VBUS is unable to power the on board MDIO/MDC MUXes U7 and U9. TI recommends powering the board with an external supply if register access is needed.

6.2 Trademarks

All trademarks are the property of their respective owners.

6.3 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
RMII	Reduced Media Independent Interface
SFD	Start-of-Frame Detection
VDDA	Analog Core Supply Rail
VDDIO	Digital Supply Rail
PD	Pulldown
PU	Pullup
MCU	Microcontroller
PMD	Physical Medium Dependent
PRBS	Pseudo Random Binary Sequence

7 Related Documentation

7.1 Supplemental Content

8 References

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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.

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.

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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.

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