

# ISOW1412 Isolated RS-485/RS-422 Transceiver With Integrated DC-DC Converter Evaluation Module



## ABSTRACT

This user's guide describes the evaluation module (EVM) for an isolated RS-485 transceiver with integrated DC-DC converter. This EVM helps designers evaluate the device performance for fast development and analysis of data transmission systems using the ISOW1412 device in a 20-pin DFM package.

## CAUTION

This evaluation module is made available for isolator parameter performance evaluation only and is not intended for isolation voltage testing. To prevent damage to the EVM, any voltage applied as supply to LDO inputs must be maintained within 0V to 12V range and voltage applied to device supply or data input/output pins must be maintained within 0V to 5.5V range as specified in datasheet section "Recommended Operating Conditions".

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## 1 Introduction

ISOW1412 is a galvanically-isolated differential line transceiver with a built-in isolated DC-DC converter for TIA/EIA RS-485 and RS-422 applications. Both signal and power paths are isolated per UL1577 and are qualified for reinforced isolation per VDE, CSA and CQC. These devices do not require any external components other than bypass capacitors to realize an isolated RS-485 port. The low-emissions, isolated DC/DC converter ensures the final system is capable of meeting CISPR 32 radiated emissions limit lines with just two ferrite beads.

The device is ideal for long distance communications. Isolation breaks the ground loop between the communicating nodes, allowing for a much larger common-mode voltage range. It supports a maximum data rate of 500 kbps. It can operate from a single supply voltage of 3 V to 5.5 V by connecting  $V_{IO}$  and  $V_{DD}$  together on PCB. If lower logic levels are required, these devices support 1.71 V to 5.5 V logic supply ( $V_{IO}$ ) that can be independent from the power converter supply ( $V_{DD}$ ) of 3 V to 5.5 V. These devices support a wide operating ambient temperature range from  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  and are available in 20-pin DFM (SOIC footprint compatible package) offering a minimum of 8 mm creepage and clearance.

ISOW1412DFMEVM can be used to evaluate different system parameters of the devices. Test signals and sequences can be applied to the device and different performance characteristics can be observed such as propagation delay, power consumption, and different bus and driver conditions. Users can evaluate these parameters in their own lab environment.

The EVM has footprints named *DNI* for additional components that are not needed to test the standard functionality. Add components to these footprints for evaluation and to get specific system requirements. Refer to this users guide for the basic functionality that can be assessed with the EVM.

## 2 Functional Block Diagram and Device Pin Configuration of ISOW1412

### 2.1 Functional Block Diagram and Device Pin Configuration

Figure 2-1 shows functional block diagram of isolated full-duplex RS-485 transceiver with integrated DC-DC converter, ISOW1412. Figure 2-2 shows the pin configuration of the ISOW1412 in the 20-pin DFM package.

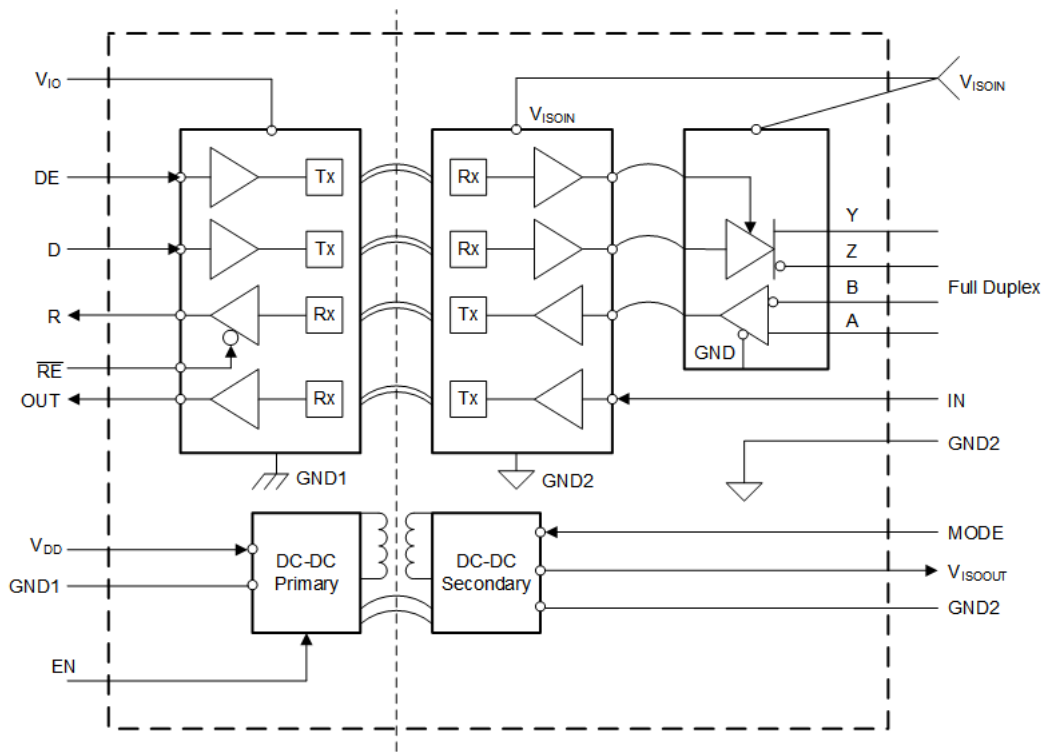


Figure 2-1. ISOW1412 Functional Block Diagram

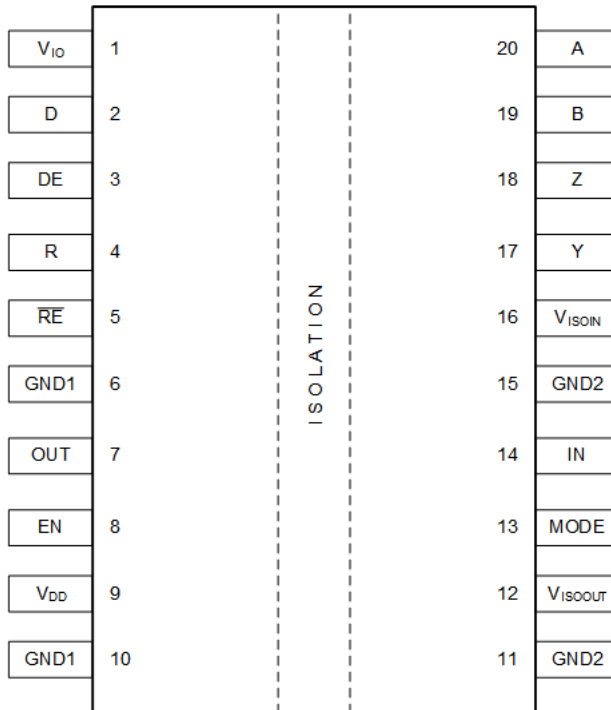


Figure 2-2. ISOW1412 Pin Configuration

### 3 EVM Schematic

Figure 3-1, Figure 3-2 and Figure 3-3 show the ISOW1412DFMEVM schematic.

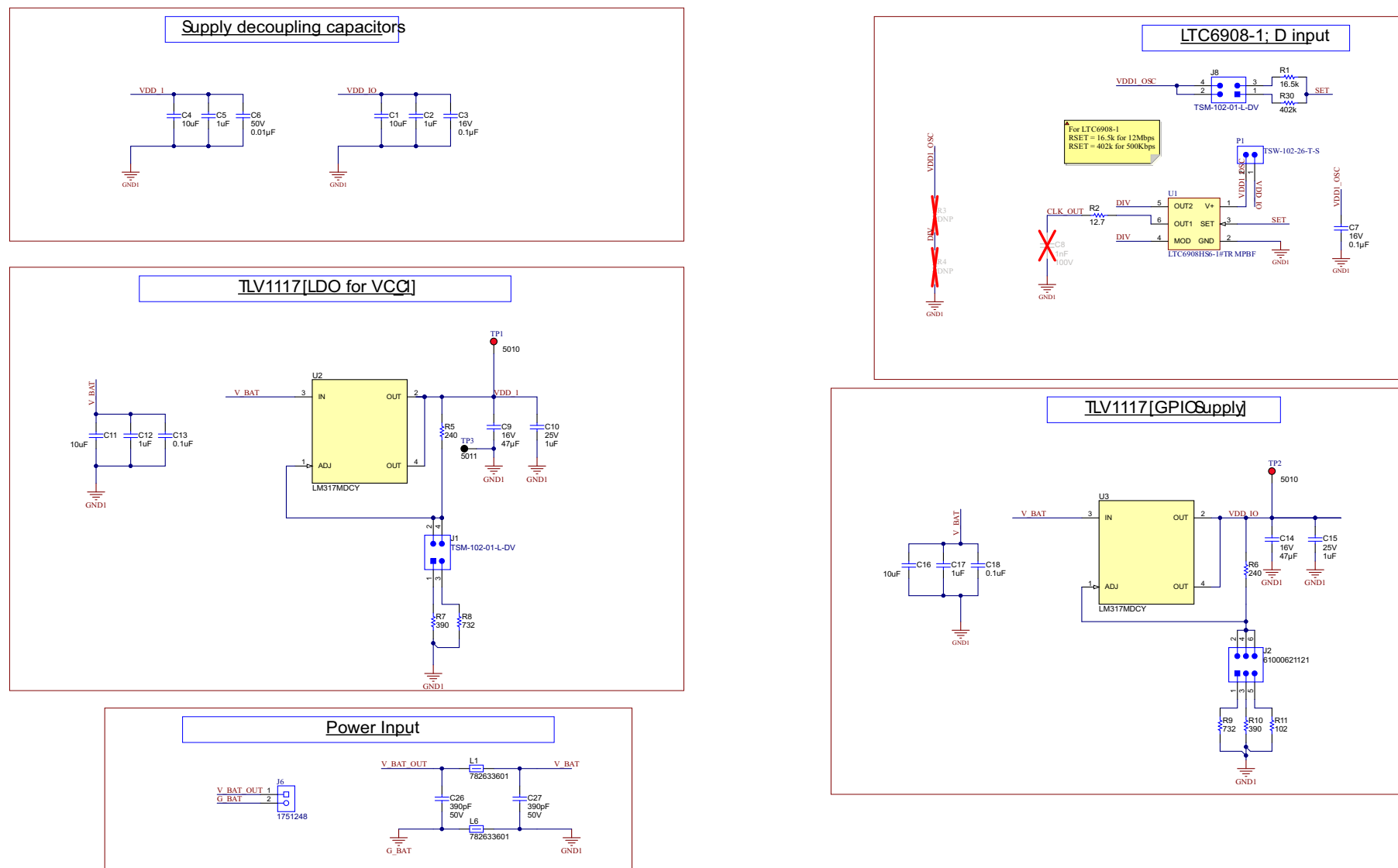


Figure 3-1. ISOW1412DFMEVM Schematic - Power

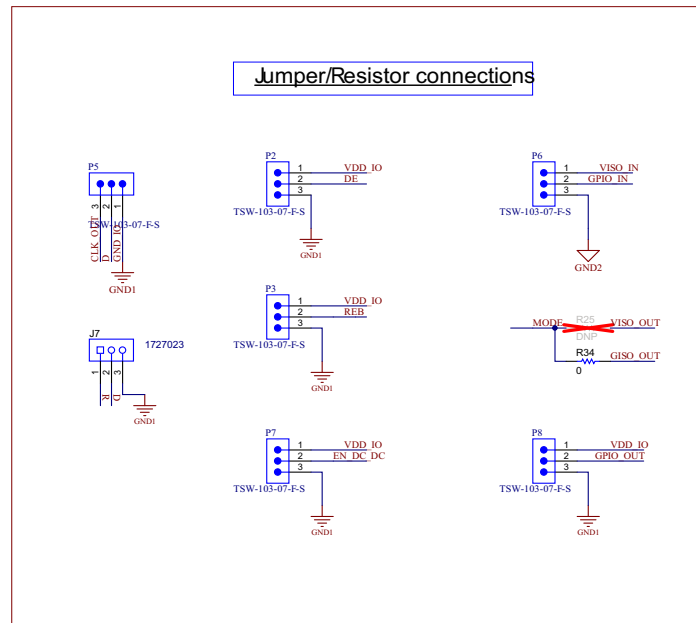
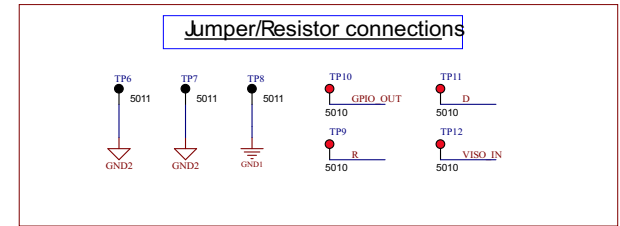
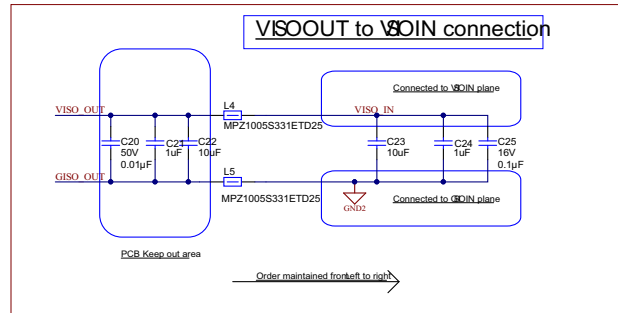
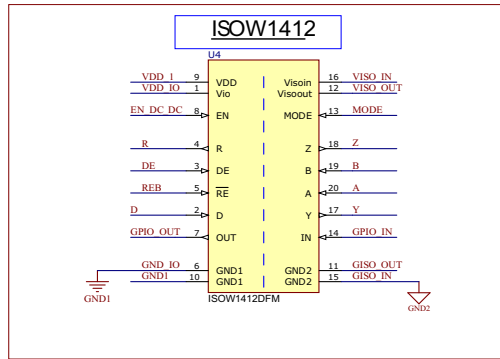


Figure 3-2. ISOW1412DFMEVM Schematic - Isolator

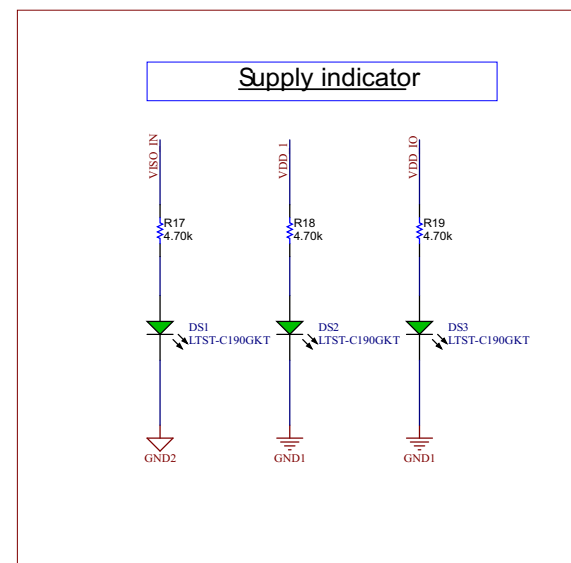
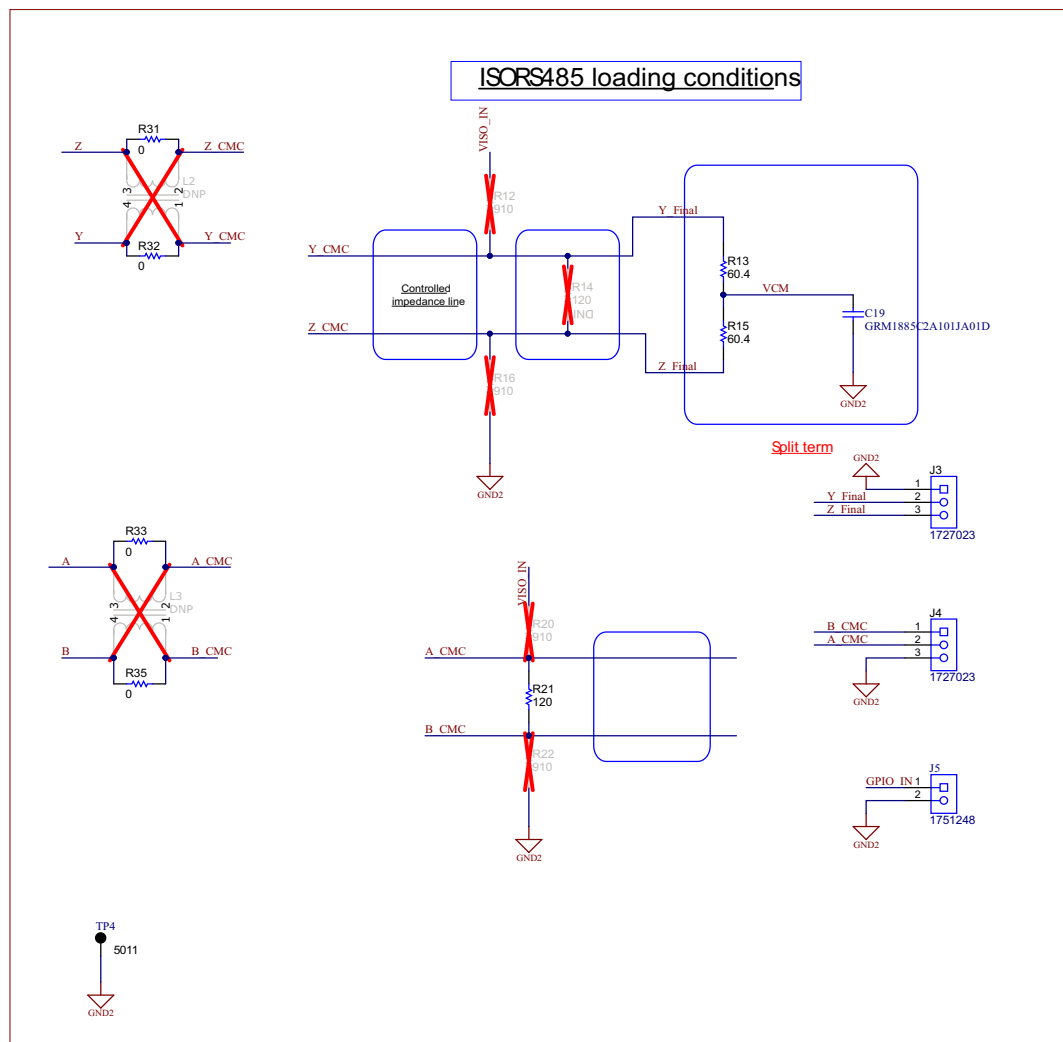


Figure 3-3. ISOW1412DFMEVM Schematic - RS-485 Bus

## 4 EVM 3D Diagram and PCB Layout

Figure 4-1 shows 3D diagram of ISOW1412DFMEVM. Figure 4-2 and Figure 4-3 show the PCB layout of ISOW1412DFMEVM, respectively.

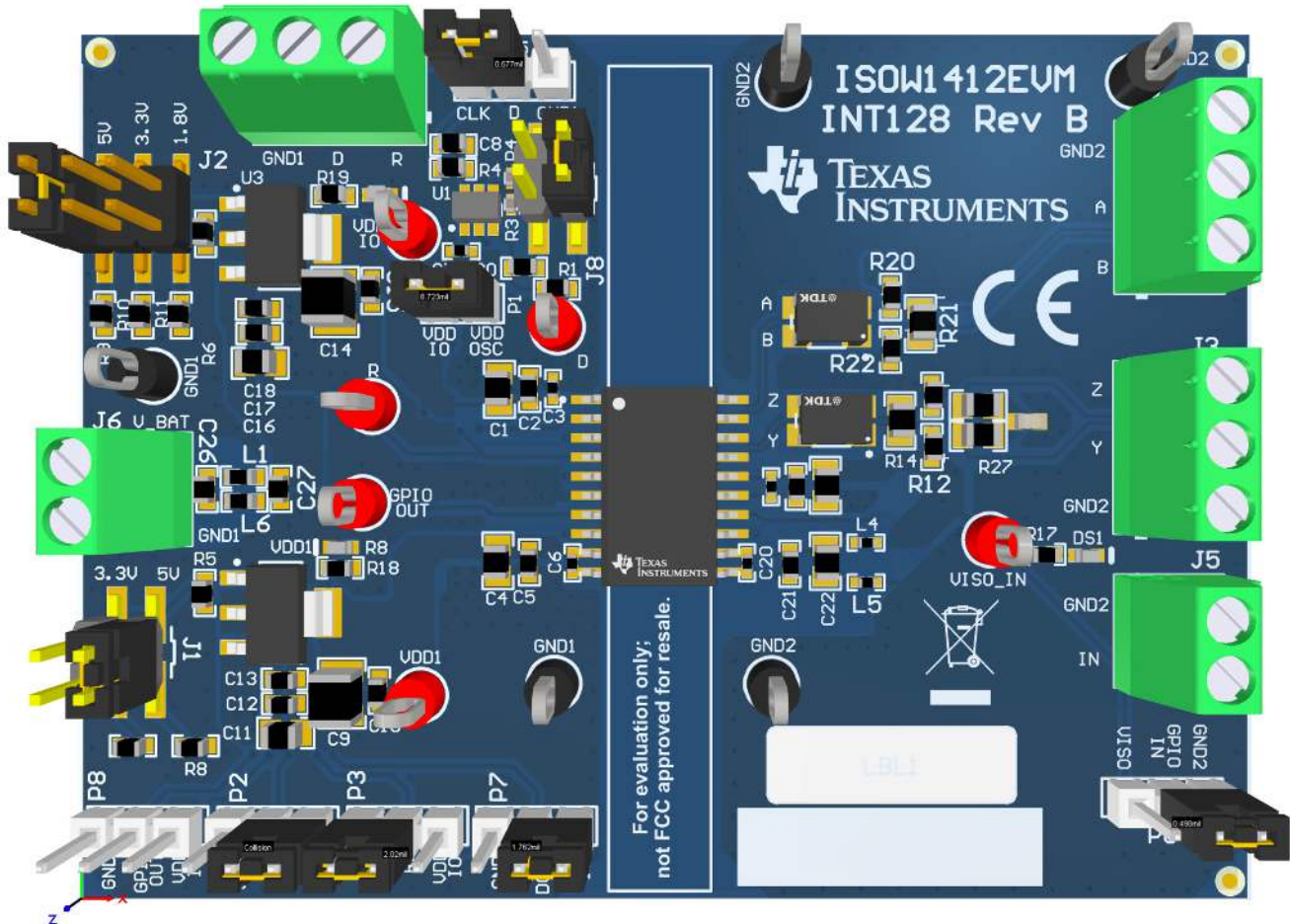


Figure 4-1. ISOW1412DFMEVM PCB 3D diagram

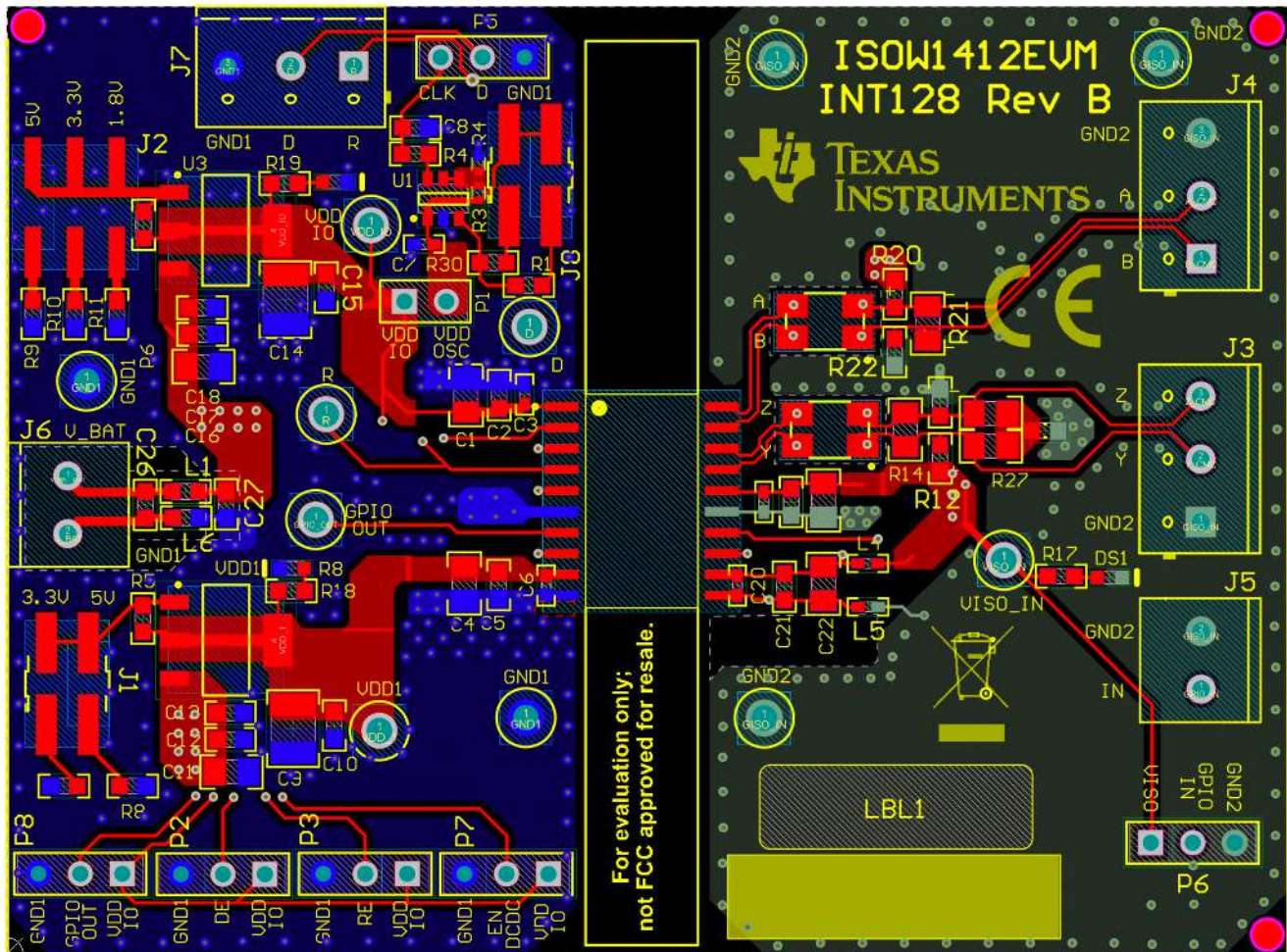


Figure 4-2. ISOW1412DFMEVM PCB Layout - Top Layer



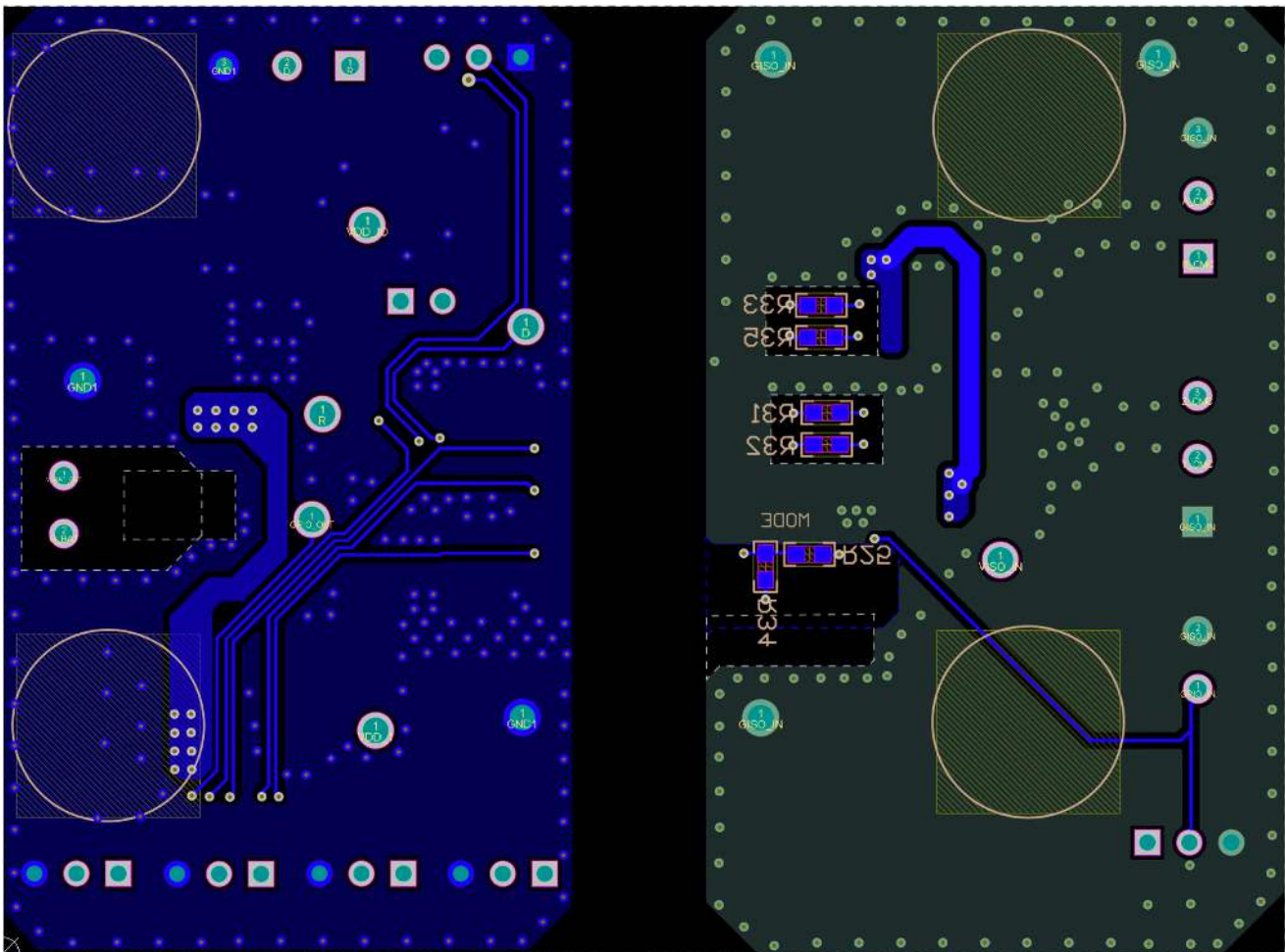


Figure 4-3. ISOW1412DFMEVM PCB Layout - Bottom Layer

## 5 Bill of Materials

Section 5 shows the bill of materials for ISOW1412DFMEVM.

**Table 5-1. Bill of Materials**

Item	Designator	Description	Manufacturer	Part Number
1	C1, C4, C11, C16, C22, C23	CAP, CERM, 10 $\mu$ F, 35 V, $\pm$ 10%, X5R, 0805	MuRata	GRM21BR6YA106KE43L
2	C2, C5, C12, C17, C21, C24	CAP, CERM, 1 $\mu$ F, 50 V, $\pm$ 10%, X5R, 0603	MuRata	GRM188R61H105KAALD
3	C3, C7, C25	CAP, CERM, 0.1 $\mu$ F, 16 V, $\pm$ 10%, X7R, 0402	Walsin	CL05B104KO5NNNC
4	C6, C20	CAP, CERM, 0.01 $\mu$ F, 50 V, $\pm$ 10%, X7R, 0402	Walsin	0402B103K500CT
5	C8	CAP, CERM, 1000 pF, 100 V, $\pm$ 10%, X7R, 0603	MuRata	GRM188R72A102KA01D
6	C9, C14	CAP, CERM, 47 $\mu$ F, 16 V, $\pm$ 10%, X5R, 1210	MuRata	GRM32ER61C476KE15K
7	C10, C15	CAP, CERM, 1 $\mu$ F, 25 V, $\pm$ 10%, X5R, 0603	MuRata	GRM188R61E105KA12D
8	C13, C18	CAP, CERM, 0.1 $\mu$ F, 25 V, $\pm$ 5%, X7R, 0603	AVX	06033C104JAT2A
9	C19	CAP 100pF 16V $\pm$ 1% 0603 (1608 Metric) Thickness 1mm SMD		06033C101KAT2A
10	C26, C27	CAP, CERM, 390 pF, 50 V, $\pm$ 10%, X7R, 0603	MuRata	GRM188R71H391KA01D
11	DS1, DS2, DS3	LED Uni-Color Green, 100 mW, 5 V, -55 to 85 degC, 2-Pin SMD, RoHS, Tape and Reel		LTST-C190GKT
12	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)
13	J1, J8	Header, 2.54mm, 2x2, Gold, SMT	Samtec	TSM-102-01-L-DV
14	J2	Header, 2.54mm, 3x2, Gold, SMT	Würth Elektronik	61000621121
15	J3, J4, J7	Terminal Block Receptacle, 3x1, 3.81mm, TH	Phoenix Contact	1727023
16	J5, J6	Conn Term Block, 2POS, 3.5mm, TH	Phoenix Contact	1751248
17	L1, L6	Ferrite Bead, 600 ohm @ 100 MHz, 1 A, 0603	Würth Elektronik	782633601
18	L4, L5	Ferrite Bead, 330 ohm @ 100 MHz, 0.7 A, 0402	TDK	MPZ1005S331ETD25
19	LBL1	Thermal Transfer Printable Labels, 0.650	Brady	THT-14-423-10
20	P1		Samtec	TSW-102-26-T-S
21	P2, P3, P5, P6, P7, P8		Samtec	TSW-103-07-F-S
22	R1	RES, 16.5 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0716K5L
23	R2	RES, 12.7, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060312R7FKEA
24	R5, R6	RES SMD 240 OHM 1% 1/10W 0603	Yageo	RC0603FR-07240RL
25	R8, R9	RES SMD 732 OHM 1% 1/10W 0603	Yageo	RC0603FR-07732RL
26	R7, R10	RES SMD 390 OHM 1% 1/10W 0603	Yageo	RC0603FR-07390RL
27	R11	RES SMD 100 OHM 1% 1/10W 0603	Yageo	RC0603FR-07100RL
28	R12, R16, R20, R22	RES, 910, 1%, 0.1 W, 0603	Yageo	RC0603FR-07910RL
29	R21,	RES, 120, 1%, 0.4 W, 0805	Rohm	ESR10EZPF1200
30	R27	RES, 120, 1%, 0.4 W, 0805	DNI	DNI
31	R13, R15,	RES, 59, 1%, 0.1 W, 0603	Yageo	RC0603FR-0759RL
32	R17, R18, R19	RES, 4.7k, 1%, 0.1 W, 0603	Yageo	RC0603FR-074K7L
33	R23, R24, R25, R28, R29	RES, 49.9, 1%, 0.1 W, 0603	DNI	DNI
34	R30	RES, 200 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-07200KL

**Table 5-1. Bill of Materials (continued)**

Item	Designator	Description	Manufacturer	Part Number
35	R31, R32, R33, R34, R35	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00
36	SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G
37	TP1, TP2, TP9, TP10, TP11, TP12	Test Point, Red, Through Hole, RoHS, Bulk		5010
38	TP3, TP4, TP6, TP7, TP8	Test Point, Multipurpose, Black, TH	Keystone	5011
39	U1		Linear Technology	LTC6908IS6-1#TRMPBF
40	U2, U3	3/4 Pin 500mA Adjustable Positive Voltage Regulator, DCY0004A (SOT-223-4)	Texas Instruments	LM317MDCY
41	U4	Reinforced 5-kVRMS Isolated RS-485/RS-422 Transceiver With Integrated Low Emissions DC-DC Converter	Texas Instruments	ISOW1412DF

## 6 EVM Setup and Operation

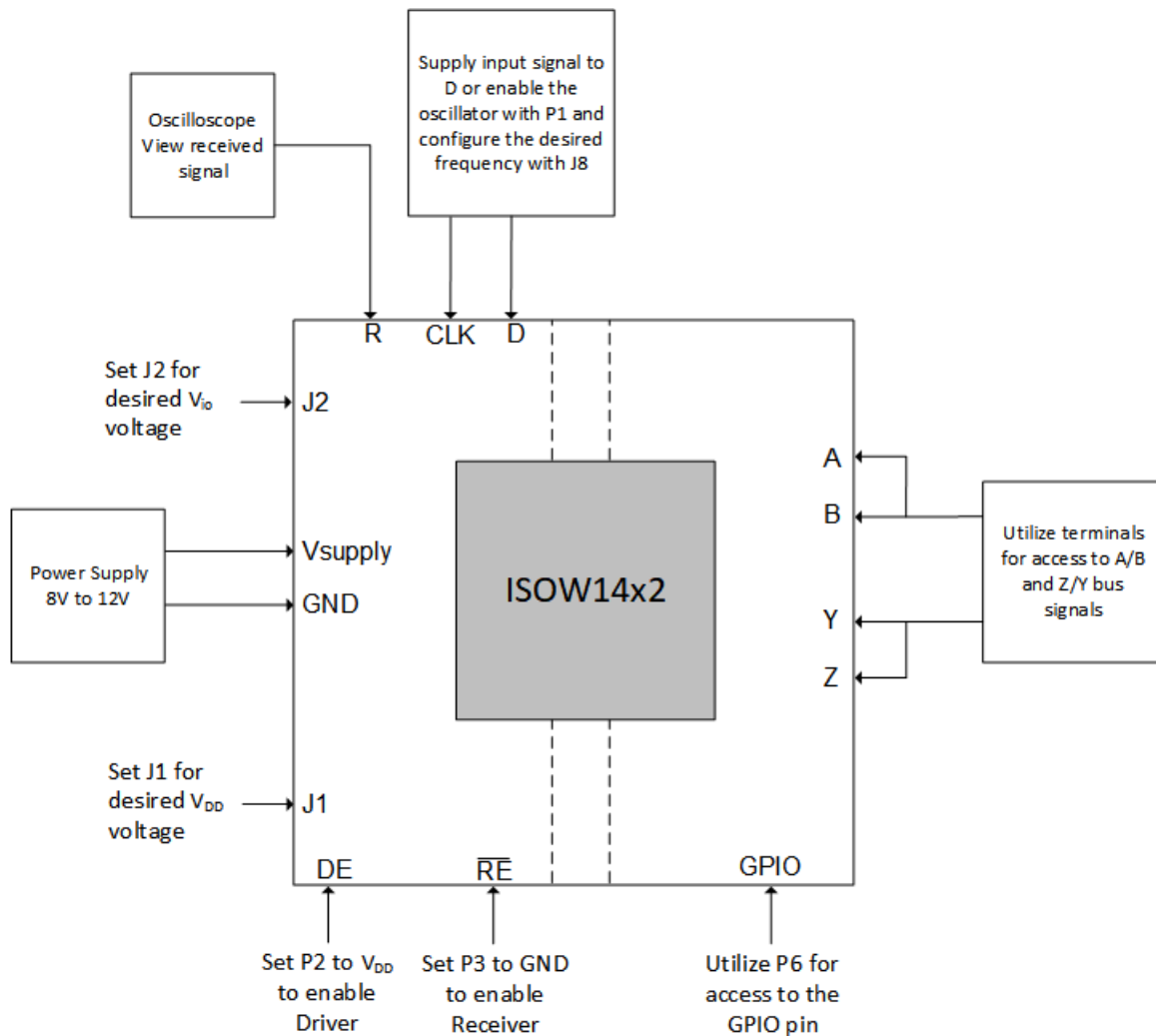
Figure 6-1 shows the basic setup of the EVM with only a single power supply needed to evaluate isolator performance.

Use voltages that are within the range given in the device data sheet. The LDOs on the EVM will provide  $V_{DD}$  as configured by their jumpers. The supply voltage to the EVM should ideally be between 8 V and 12 V. ISOW1412 will generate the isolated power for  $V_{ISOOUT}$  that is connected to  $V_{ISOIN}$  on the EVM.

The EVM features an on-board oscillator device that can be used to provide a clock signal to D pin of ISOW1412. The oscillator is bridged to the D input through the Jumper P1 and can be configured to output 12 Mbps or 500 kbps by changing the configuration of J8. Utilizing the on-board oscillator is recommended if conducting any emissions testing on the EVM.

There are two LDOs on the EVM to provide  $V_{DD}$  and  $V_{IO}$  voltages separately. One can change the LDO output voltage by reconfiguring the jumpers on J1 and J2. J1 controls the output voltage of the LDO supplying  $V_{DD}$  and can be 3.3 V or 5 V. J2 controls the output voltage of the LDO supplying  $V_{IO}$  and can be 1.8 V, 3.3 V, or 5 V.

J4 and J3 are the terminals that provide access to the A/B and Z/Y bus lines, respectively. These can be used to connect to other RS-485 devices.



- A. Normal transceiver operation requires both the driver and the receiver sections to be active. Set the receiver enable pin ( $\overline{RE}$ ) to logic low and the driver enable pin (DE) to logic high to enable both the driver and receiver.

**Figure 6-1. Basic EVM Setup**

Table 6-1 shows the information on jumper configuration for basic tests.

**Table 6-1. Jumper Configuration**

Connection	Label	Description
J1	3.3 V, 5 V	Connect this jumper to choose the desired $V_{DD}$ voltage of either 3.3 V or 5 V.
J2	1.8 V, 3.3 V, 5 V	Connect this jumper to choose the desired $V_{IO}$ voltage of 1.8 V, 3.3 V, or 5 V.
J8	J8	Connect this jumper to choose the desired oscillator switching frequency
P1	VDD IO, VDD OSC	Connect this jumper to power on and enable the oscillator.
P2	VDD IO, DE, GND1	Connect this jumper between the middle pin and GND1 to tie the DE pin low. The driver input is disabled when the DE pin is low. Connect this jumper between the middle pin and VDD IO to tie the DE pin high. The driver input is enabled when the DE pin is high. Tie the DE pin to VDD IO for full operation tests.
P3	VDD IO, $\overline{RE}$ , GND1	Connect this jumper between the middle pin and GND1 to tie the $\overline{RE}$ pin low. The receiver is enabled when the $\overline{RE}$ pin is low. Tie the $\overline{RE}$ pin to GND1 for full operation tests. Connect this jumper between the middle pin and VDD IO to tie the $\overline{RE}$ pin high. The receiver is disabled when the $\overline{RE}$ pin is high.
P7	VDD IO, EN, GND1	Connect this jumper between the middle pin and GND1 to disable the DC-DC converter. Leave jumper off or connected to VDD IO to enable DC-DC converter.

## 7 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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