

ISO1176T/35T/3086T Evaluation Module

This document describes the ISO1176T/35T/3086T Evaluation Module (EVM). It is used to evaluate the ISO1176T PROFIBUS™ Transceiver, the ISO35T RS-485 Transceiver, or the ISO3086T RS-485 Transceiver. Because the devices are similar transceivers, and the printed-circuit board is the same for all three EVMs, this manual can be used for all three devices.

The EVM can be used to evaluate device parameters while acting as a guide for board layout. The board allows for the connection of 50-Ω coaxial cables via QuietZone connectors. It also provides easy connection points for oscilloscope probes. Banana jacks are provided for connection of a dc power supply. These features provide the designer with a tool for evaluation and the successful design of an end-product.

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1 Overview

This EVM allows for evaluation of either the ISO1176T PROFIBUS™ or ISO35T or ISO3086T RS-485 transceivers. The EVM comes with a single transceiver installed on the circuit board (U1), but any of the three devices can be evaluated using this single printed-circuit board (PCB). The PCB also contains a transformer and voltage regulator that is used to provide dc power to the right (bus) side of the device. Because all three devices contain the output oscillator signals used to drive the transformer, any of the three devices can be evaluated using this single PCB. Note that two different transformers and voltage regulators can be installed on the PCB. One set is used to generate +3.3 Vdc for the ISO35T device, which is specified for 3.3-Vdc operation. The other set is installed on the ISO1176TEVM and ISO3086TEVM to generate +5-Vdc power required for those two devices. These three integrated circuits (ISO1176T, ISO35T, and ISO3086T) all contain the integrated transformer driver and are footprint compatible. The major difference is the +5-Vdc or +3.3-Vdc operation.

Care needs to be taken regarding the isolated power and ground, as this is an isolating device. Power and ground for the Data/Control side of the device (pins D, R, DE, RE, D1, and D2) can be completely isolated from power and ground for the Bus side of the device (pins A, B, etc.). Although these devices are designed to operate with an isolation voltage up to 4000 V, this PCB is not. To ensure user safety while using the EVM, the PCB has been designed to support an isolation voltage of approximately 500 V. The user must be careful when using the EVM to test isolation voltage.

Finally, the ISO1176TEVM allows half-duplex operation, whereas the ISO35T and ISO3086T are full-duplex devices. The PCBs are configured for either half- or full-duplex operation in their as-shipped configuration. Changes between configurations can easily be done using the notes provided on the schematic. The EVMs allow the user to evaluate half-duplex point-to-point or multidrop (PROFIBUS) systems, or multipoint (RS-485) applications using multiple EVMs.

The ISO1176T meets or exceeds the requirements of EN50170 and the ISO35T and ISO3086T meet or exceed the requirements of TIA/EIA RS-485 while providing 4000 V of isolation between the Data/Control and Bus sides of the device. Each device has specific features, such as receiver hysteresis, low bus capacitance, and failsafe receiver output for bus open, short, or idle conditions. These devices also support extremely fast data rates or 1 Mbps (ISO35T), 20 Mbps (ISO3086T), or 40 Mbps (ISO1176T). These features all contribute to making the ISO1176T, ISO35T, or ISO3086T an excellent choice for use in industrial and factory environments.

CAUTION

Note that although the device provides galvanic isolation of up to 4000 V, this EVM cannot be used for isolation voltage testing. It is designed for the examination of device operating parameters only and may be damaged if high voltage (>500 V) is applied across the isolation barrier or if a voltage >5.5 V is applied to any device pin.

The data sheet for three devices is available on the TI Web site. A pinout of each device and functional block diagram are in [Figure 1](#) through [Figure 3](#).

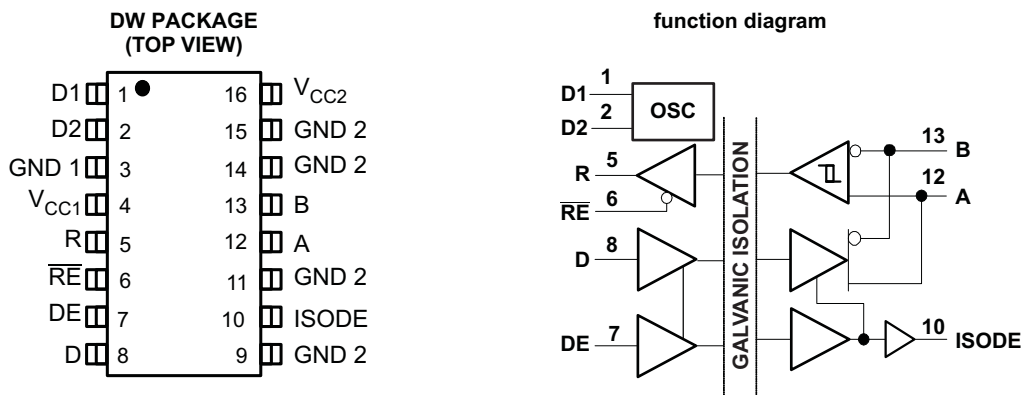


Figure 1. ISO1176T Device Pinout and Block Diagram

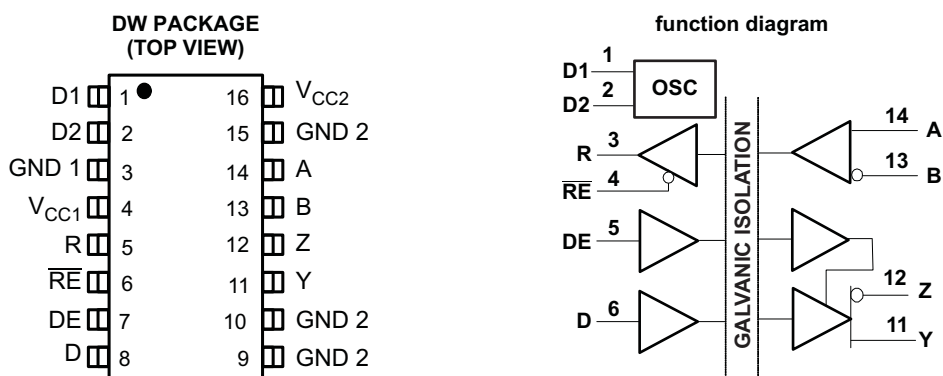


Figure 2. ISO35T Device Pinout and Block Diagram

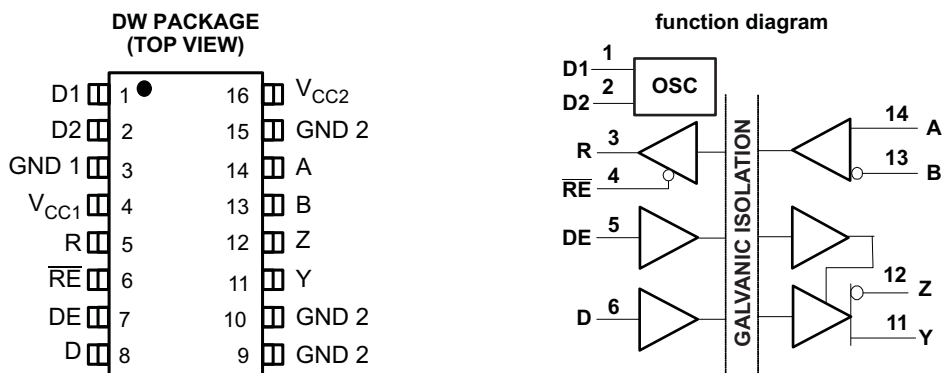


Figure 3. ISO3086T Device Pinout and Block Diagram

1.1 PROFIBUS/RS-485

The TIA/EIA-485 (also known as RS-485) standard was created in response to a demand from the data communications community for a general-purpose, high-speed balanced interface standard for multipoint applications. The standard, *Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*, specifies differential signaling drivers and receivers for data interchange across half-duplex or multipoint data bus structures. Although TIA/EIA-485 specifies requirements for drivers and receivers operating at a signaling rate up to 10 Mbps, the standard also states that devices meeting the electrical characteristics of the standard:

...."need not operate over the entire data signaling rate range specified nor be limited to 10Mbps. They may be specified to operate at data rates to satisfy specific applications. The upper bound is application dependent and beyond the scope of this standard. Maximum signaling rate is typically limited by the following: ratio of signal transition time to the unit interval, maximum allowable stub length, and the bandwidth of the interconnecting media."

PROFIBUS (Process Field Bus), developed subsequently, had several impacts on the electrical (physical) layer including an increase in the receiver noise margin, to allow the bus to be used in an extremely noisy (i.e., EMI-rich) environment. This was accomplished by increasing the minimum differential voltage on the bus. The ISO1176T has been designed specifically for these types of environments. The two standards are indeed very similar.

1.2 EVM Kit Contents

1.2.1 ISO1176TEVM Kit Contents

ISO1176TEVM circuit board with ISO1176TDW installed - (6510416-1)

This PCB is configured with a DA2304-AL transformer and LP2985A-50DBVR LDO for 3-V to 5-V operation on the logic side of the device and 5-V operation on the bus side.

1.2.2 ISO35TEVM Kit Contents

ISO35TEVM circuit board with ISO35TDW installed – (6510416-2)

This PCB is configured with a DA2303-AL transformer and LP2985A-33DBVR for 3-V operation on the logic and bus sides of the device.

1.2.3 ISO3086TEVM Kit Contents

ISO3086TEVM circuit board with ISO3086TDW installed - (6510416-3)

This PCB is configured with a DA2304-AL transformer and LP2985A-50DBVR LDO for 3-V to 5-V operation on the logic side of the device and 5-V operation on the bus side.

The ISO1176T/35T/3086TEVM is shown in [Figure 4](#).

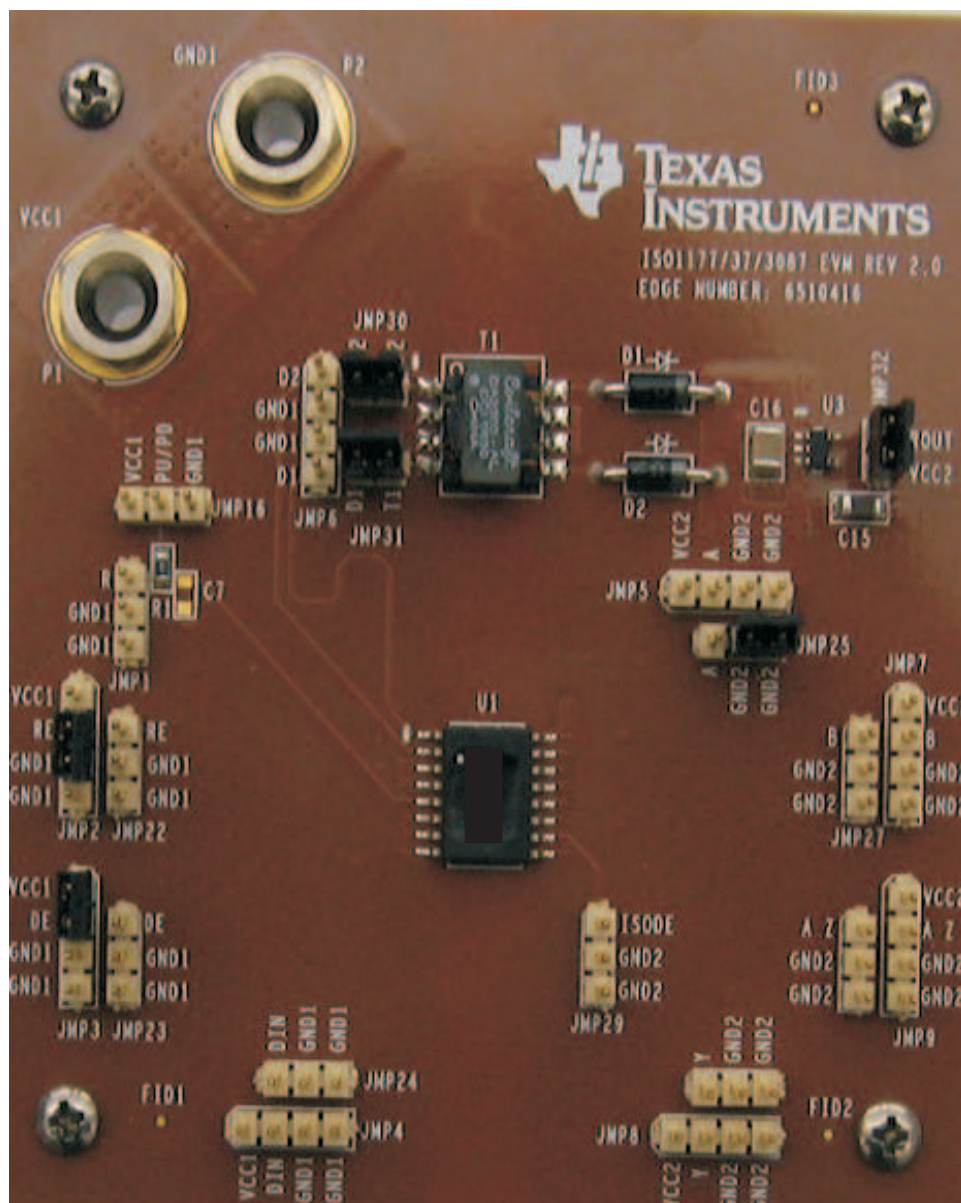


Figure 4. ISO1176T/35T/3086TEVM Board

1.3 Configurations

The ISO1176T/35T/3086TEVM board allows the user to evaluate performance of any of the three devices, or to connect easily to an existing PROFIBUS or RS-485 bus to evaluate system performance in an existing system. Also, multiple EVMs can be obtained to allow the user to construct various bus configurations. With just two EVMs, the user may evaluate performance of a point-to-point simplex, parallel-terminated point-to-point simplex, and two-node multipoint operation. When using multiple EVMs, all of these modes of operation can be configured through onboard jumpers, external cabling, and the R7–R10 resistors.

1.3.1 Point-to-Point

The point-to-point configuration is shown in Figure 5. This configuration requires two EVMs, and although this is not the intended mode of operation for PROFIBUS/RS-485 devices, it is used for high noise or longer (higher loss) transmission lines. Due to the increased drive current, a single 100-Ω termination resistor on the EVM results in a differential bus voltage (V_{od}) twice as large as the normally doubled terminated line. This practice is acceptable as long as the combination of input voltage and common-mode voltage does not exceed absolute maximum ratings of the line circuits.

This configuration is shown in Figure 5. It consists of a single driver on the left, and a single receiver on the right. Note that the termination resistors (R9 and R10) have been removed from the driver EVM.

This configuration shows the receiver disabled on the driver (JUMP2 connected to Vcc) EVM and the driver disabled on the receiver EVM (JMP4 tied to GND1). Note that with only a single termination, the differential bus voltage is higher than normal.



Figure 5. Point-to-Point Simplex Circuit

This configuration also can have a termination at the source and load (parallel terminated as shown Figure 6) thereby, keeping nominal PROFIBUS/RS-485 signal levels.

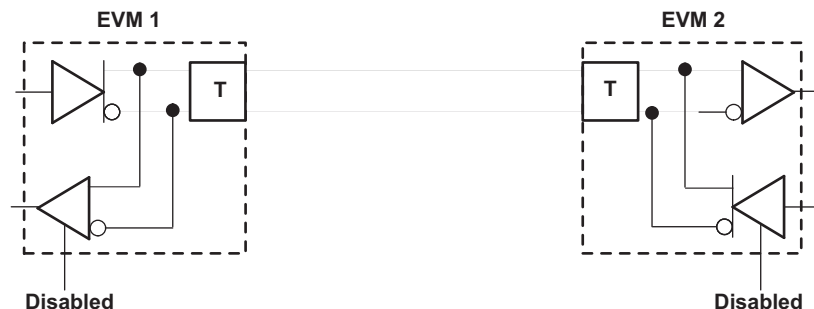


Figure 6. Parallel Terminated Simplex Circuit

1.3.2 Multipoint

The multipoint configuration is the primary application of PROFIBUS/RS-485. The RS-485 standard allows for any combination of drivers, receivers, or transceivers up to a total of 32 unit loads on the line. The ISO1176T device allows the total number of nodes to be increased because ISO1176T represents just 1/5 of a unit load. This allows up to 160 nodes to be connected onto a single bus. Figure 7 shows a representation of a five-node multipoint configuration using five ISO1176T transceivers. Increased drive current in addition to the wide common-mode input, allows this ISO1176T PROFIBUS transceiver to drive multiple receivers over longer line lengths. Notice that the termination resistors (R9 and R10) are only installed on the EVMs at each end of the bus.

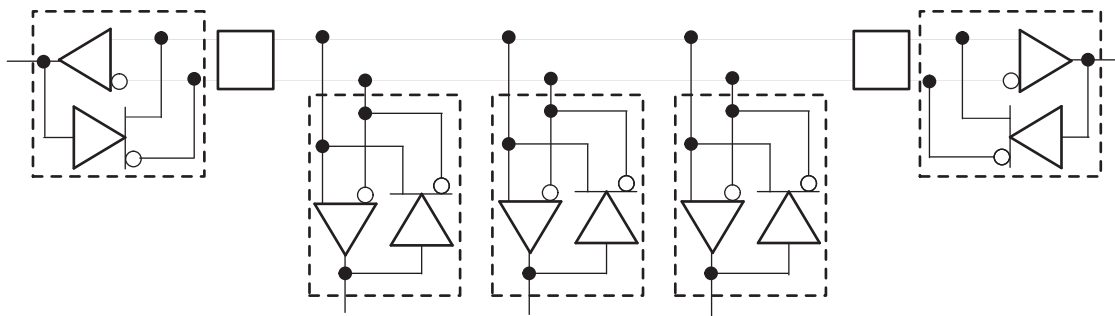


Figure 7. Five-Node Multipoint Circuit

Notice that the bus configuration shown in [Figure 7](#) can be redrawn as shown in [Figure 8](#). Additional EVMs can be obtained and connected to the bus, but the termination resistors on those EVMs need to be removed so that the bus is terminated only at each end.

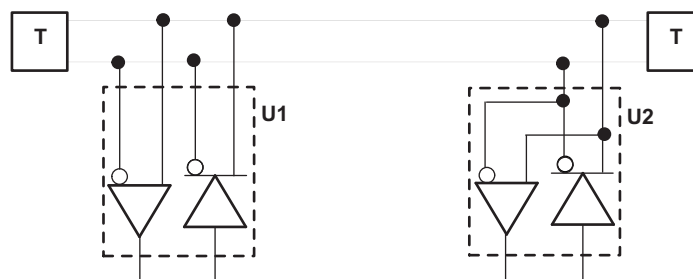


Figure 8. Two-Node Multipoint Circuit

1.4 Operation Over Extended Common-Mode Voltage Range

One of the features of the three ISO devices is their operation over an extremely wide common-mode voltage range or -7 Vdc to $+12\text{ Vdc}$. This can be evaluated using two EVMs, each powered from a separate independent power supply. This extended common-mode range is important because communications between equipment located hundreds of meters apart usually means a voltage offset exists between the grounds of each node. The EVMs can be configured with three power supplies with isolated outputs in such a way as to input a fixed offset between the grounds (see [Figure 7](#)). This induces a ground potential difference voltage (VGPD) between EVM#1 and EVM#2. To demonstrate this capability, the following steps are presented.

1. Adjust PS1 and PS2 to the supply voltage (+5 V) and current limit to 200 mA.
2. Set PS3 to 0 V.
3. Induce a ground offset by varying the output of PS3.

WARNING

PS3 output must not exceed +12 V to -7 V to remain within the device ratings.

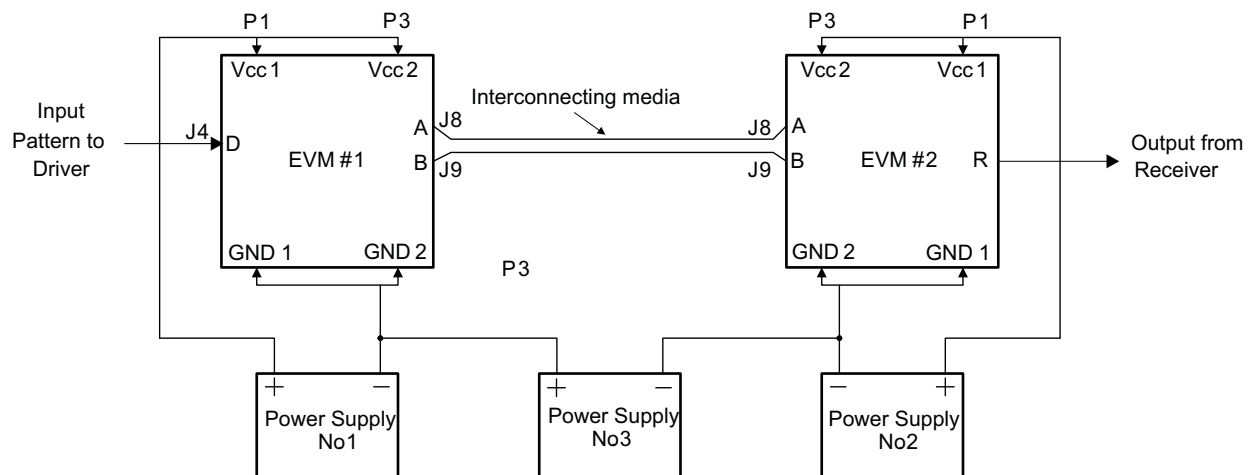


Figure 9. EVM Configuration for Inducing a Ground Potential Difference Voltage Between Nodes

2 Recommended Equipment

- 5-Vdc at 0.5 A power supply
- A pattern generator capable of supplying single-ended signals at the desired signaling rate and input levels
- A multiple-channel, high-bandwidth oscilloscope, preferably above the 100-MHz range. Differential and single-ended oscilloscope probes
- When using two or more EVMs, a 100-Ω transmission medium between transceivers (twisted-pair cable recommended, CAT5 cable for example) made be used using JMP7 and JMP9 (half duplex) between EVMs. Full-duplex connections can be made using JMP5/JMP7 and JMP8/JMP9. The termination resistors need to be configured for each case.

2.1 EVM Configurations

The schematic for the ISO1176TEVM appears on the last page of this manual.

[Table 1](#) contains a list of the onboard jumpers and their function as well as the input and output loading installed on the board for the half-duplex ISO1176TEVM. [Table 2](#) contains the same information for the full-duplex ISO35TEVM and ISO3086TEVM.

Table 1. EVM Configuration Options for ISO1176T

Jumper Function	Configuration	I/O Load
DATA/CONTROL		
SIDE JUMPERS		
JMP1 – Receiver Output		R1 (see JMP16)
JMP2 – Receiver Enable		R2 – 50 Ω ⁽¹⁾
JMP3 – Driver Enable		R3 – 50 Ω ⁽¹⁾
JMP4 – Driver Input		R4 – 50 Ω ⁽¹⁾
		R7 – Uninstalled
JMP6 – D1/D2 Test Point		R8 – Uninstalled
JMP16 – Rout Load	Jumper short allows Rout to be pulled up to Vcc or to GND through a 1-kΩ resistor.	R10 – Uninstalled

⁽¹⁾ These resistors are provided as impedance-matching terminations to be used when driving these signals with 50-Ω source impedance test/measurement equipment. When not driving these signals with a 50-Ω source, the components must be removed.

Table 1. EVM Configuration Options for ISO1176T (continued)

Jumper Function	Configuration	I/O Load
JMP22 – RE Test Point		R11 – Uninstalled
JMP23 – DE Test Point		
JMP24 – D Test Point		
JMP30 – D2	Connects D2 output to transformer pin 1	Jumper short installed
JMP31 – D1	Connects D1 output to transformer pin 4	Jumper short installed
BUS SIDE JUMPERS		
JMP5 – GND2	Jumper installed from pin 2 to pin 3	Ground U1-14
JMP7 – Bus Pin B		R8,R10 – Uninstalled
JMP8 – GND2	Jumper installed from pin 2 to pin 3	Ground U1-11
JMP9 – Bus Pin A	Bus termination A to B	Install R9 – 54 Ω
JMP25	Not used on half-duplex device	
JMP26 – A Test Point		
JMP27 – B Test Point		
JMP28	Not used on half-duplex device	
JMP29 – ISODE Test Point	ISO1176T only	
JMP32 – Regulator Output	Jumper installed from pin 1 to pin 2	Connects regulator output to Vcc2. Remove this jumper when connecting power externally (regulator not in use)
NOTE: For half-duplex operation R9 (54 Ω) only; R7, R8, AND R10 are uninstalled.	R9 for half-duplex ISO1176T device; R7, R8, and R10 for full-duplex device.	

Table 2. EVM Configuration Options for ISO35T and ISO3086T

Jumper Function	Configuration	I/O Load
DATA/CONTROL		
SIDE JUMPERS		
JMP1 – Receiver Output		R1 (see JMP16)
JMP2 – Receiver Enable		R2 – 50 Ω ⁽¹⁾
JMP3 – Driver Enable		R3 – 50 Ω ⁽¹⁾
JMP4 – Driver Input		R4 – 50 Ω ⁽¹⁾
		R7 – Uninstalled
JMP6 – D1/D2 Test Point		
JMP16 – Rout Load	Jumper short allows Rout to be pulled up to Vcc or to GND through a 1-k Ω resistor.	
JMP22 – RE Test Point		
JMP23 – DE Test Point		
JMP24 – D Test Point		
JMP30 – D2	Connects D2 output to transformer pin 1	Jumper Short Installed
JMP31 – D1	Connects D1 output to transformer pin 4	Jumper Short Installed
BUS SIDE JUMPERS		
JMP5 – A Input	R7 and R8 for bus termination	R7 – 50 Ω
JMP7 – B Input	Across A and B inputs	R8 – 50 Ω

⁽¹⁾ These resistors are provided as impedance-matching terminations to be used when driving these signals with 50- Ω source impedance test/measurement equipment. When not driving these signals with a 50- Ω source, the components must be removed.

Table 2. EVM Configuration Options for ISO35T and ISO3086T (continued)

Jumper Function	Configuration	I/O Load
JMP8 – Y Output JMP9 – Z Output JMP25 – A Test Point JMP26 – Z Test Point JMP27 – B Test Point JMP28 – Y Test Point JMP29 – GND2 JMP32 – Regulator Output	R10 set source termination across Driver pins Y and Z Jumper installed from pin 1 to pin 2	R10 – 54 Ω R10 – 54 Ω Jumper short installed to short U1-10 to GND2 Connects regulator output to Vcc2. Remove this jumper when connecting power externally (regulator not In use)

2.2 Bill of Materials

The items used in the ISO1176T/35T/3086TEVM are listed in the bill of materials in [Table 3](#), [Table 4](#), and [Table 5](#).

Table 3. ISO1176TEVM Bill of Material

Item	Qty	Reference	Value	Footprint	Manufacturer	Part Number
1	1	C2	68 μ F	cc7260	SPRAGUE	592D68X0010R2T
2	1	C3	10 μ F	cc7343	SPRAGUE	293D106X0035D2W
3	1	C4	1 μ F	cc1206	AVX	12063G105ZATRA
4	1	C5	0.1 μ F	cc1206	AVX	12065C104JATMA
5	1	C6	0.01 μ F	cc0805	AVX	06033G102JATMA
6	1	C7	DNI	cc0805		
7	2	C15, C17	10 μ F	cc1206		
8	1	C16	22 μ F	cc1210		
9	2	D1,D2	1N5817			
10	10	JMP1, JMP16, JMP22–JMP29	Header 3x1			
11	8	JMP2–JMP9	Header 4x1			
12	3	JMP30–JMP32	Header 2x1			
13	2	P1, P2	Banana-Jack	bjack	ITT-POMONA	3267
14	1	R1	1K	r0805		
15	5	R2, R3, R4	49.9	r0805		
16	2	R7, R8, R10, R11	DNI	r0805		
17	1	R9	54	r0805		
18	1	T1	DA2304-AL		Coil Craft	DA2304-AL
19	1	U1	ISO1176T	16 pin DW	TI	ISO1176T
20	1	U3	LP2985A-50DBVR	SOT23-5	TI	LP2985A-50DBVR

Table 4. ISO35TEVM Bill of Materials

Item	QTY	Reference	Value	Footprint	Manufacturer	Part Number
1	1	C2	68 μ F	cc7260	SPRAGUE	592D68X0010R2T
2	1	C3	10 μ F	cc7343	SPRAGUE	293D106X0035D2W
3	1	C4	1 μ F	cc1206	AVX	12063G105ZATRA
4	1	C5	0.1 μ F	cc1206	AVX	12065C104JATMA
5	1	C6	0.01 μ F	cc0805	AVX	06033G102JATMA
6	1	C7	DNI	cc0805		
7	2	C15, C17	10 μ F	cc1206		
8	1	C16	22 μ F	cc1210		
9	2	D1, D2	1N5817			
10	10	JMP1, JMP16, JMP22–JMP29	Header 3x1			
11	8	JMP2–JMP9	Header 4x1			
12	3	JMP30–JMP32	Header 2x1			
13	2	P1, P2	Banana-Jack	bjack	ITT-POMONA	3267
14	1	R1	1K	r0805		
15	3	R2, R3, R4, R7, R8	49.9	r0805		
16	1	R10	54	r0805		
17	4	R9, R11	DN!	r0805		
18	1	T1	DA2303-AL		Coil Craft	DA2303-AL
19	1	U1	ISO35T	16 pin DW	TI	ISO35T
20	1	U3	LP2985A-33DBVR	SOT23-5	TI	LP2985A-33DBVR

Table 5. ISO3086TEVM Bill of Materials

Item	QTY	Reference	Value	Footprint	Manufacturer	Part Number
1	1	C2	68 μ F	cc7260	SPRAGUE	592D68X0010R2T
2	1	C3	10 μ F	cc7343	SPRAGUE	293D106X0035D2W
3	1	C4	1 μ F	cc1206	AVX	12063G105ZATRA
4	1	C5	0.1 μ F	cc1206	AVX	12065C104JATMA
5	1	C6	0.01 μ F	cc0805	AVX	06033G102JATMA
6	1	C7	DNI	cc0805		
7	2	C15, C17	10 μ F	cc1206		
8	1	C16	22 μ F	cc1210		
9	2	D1, D2	1N5817			
10	10	JMP1, JMP16, JMP22–JMP29	Header 3x1			
11	8	JMP2–JMP9	Header 4x1			
12	3	JMP30–JMP32	Header 2x1			
13	2	P1, P2	Banana-Jack	bjack	ITT-POMONA	3267
14	1	R1	1K	r0805		
15	3	R2, R3, R4, R7, R8	49.9	r0805		
16	1	R10	54	r0805		
17	4	R9, R11	DN!	r0805		
18	1	T1	DA2304_AL		Coil Craft	DA2304-AL
19	1	U1	ISO3086T	16 pin DW	TI	ISO3086T
20	1	U3	LP2985A-50DBVR	SOT23-5	TI	LP2985A-50DBVR

2.3 PCB Layout and Construction

The ISO1176/35T/3086TEVM PCB is a 4-layer board. The top and bottom layers (Figure 10 and Figure 12) contain signal routing. The remaining layers (Figure 11 and Figure 13) are power and ground planes. These are split planes to keep the Vcc1/GND1 separate from Vcc2/GND2. The I/O traces are designed to have a characteristic impedance of 50 Ω .

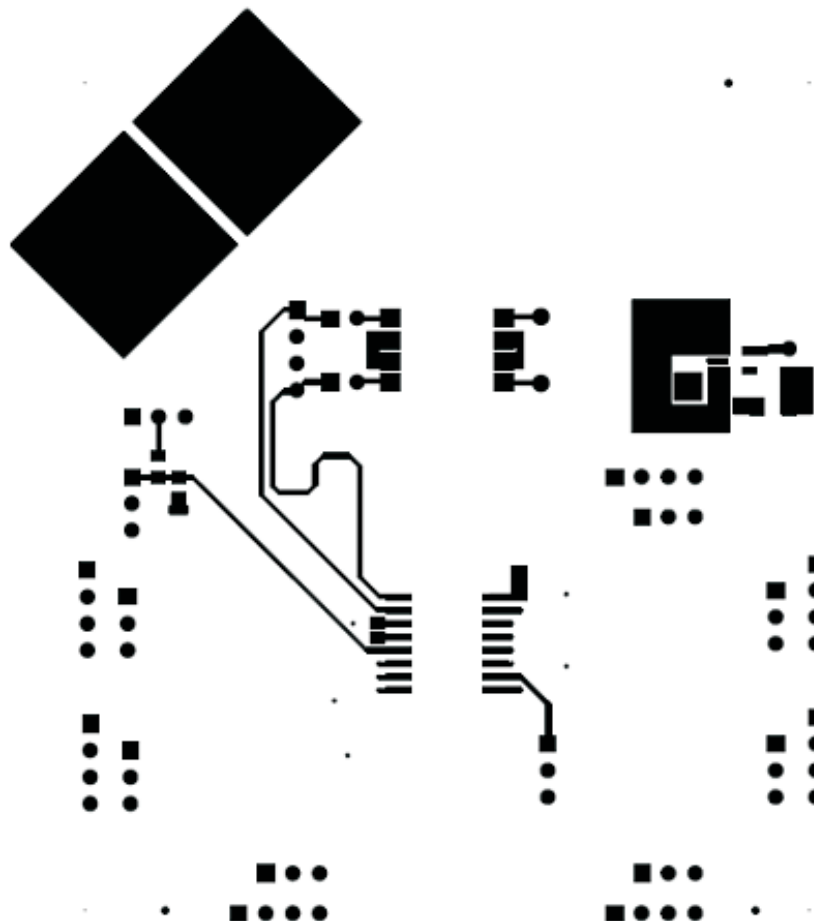


Figure 10. PCB Top Layer



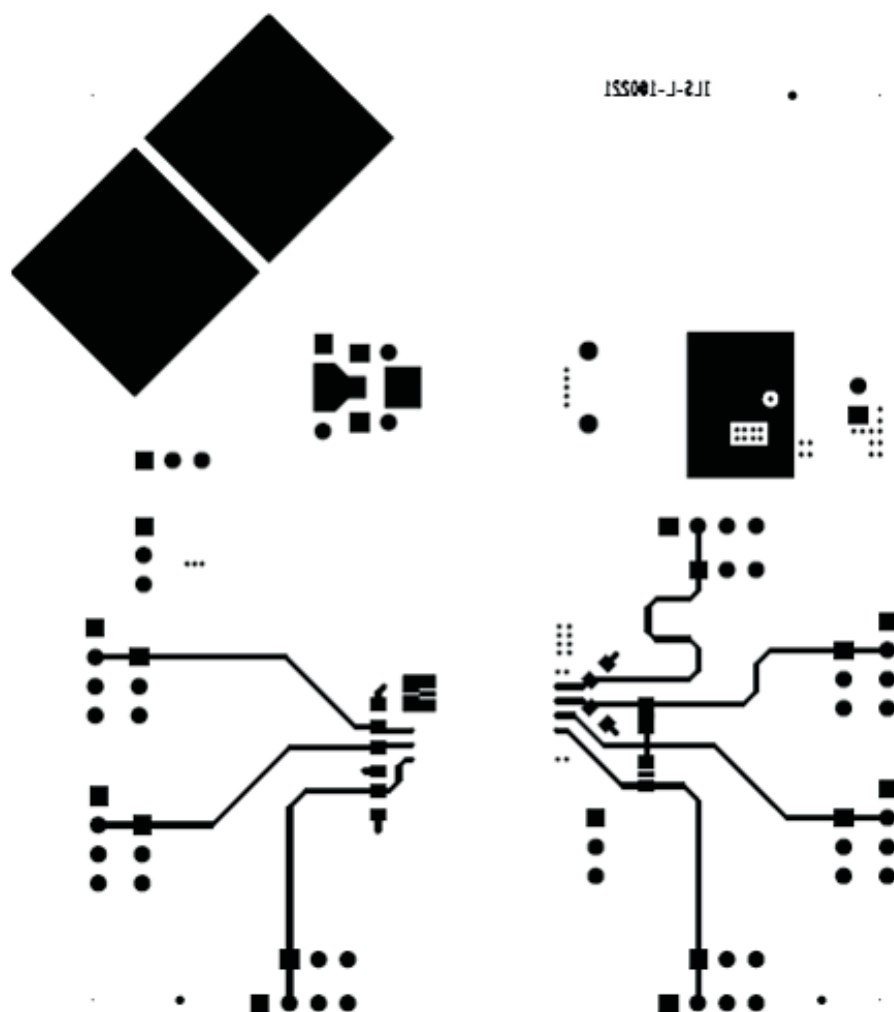


Figure 12. Signal Traces – Bottom Layer



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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 5.5 V and the output voltage range of 0 V to 6 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the 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 85° C. The EVM is designed to operate properly with certain components above 85° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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