Triple- and Quad-Channel Digital Isolator EVM

CAUTION

This evaluation module (EVM) 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 a supply or digital input/output must be maintained within the 0-V to 5.5-V recommended operating range.

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

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. If there is uncertainty as to the load specification, contact a TI field representative.

During normal EVM operation, case temperatures greater than 60°C may be expected. The EVM is designed to operate properly above 60°C as long as the input and output ranges are maintained within data sheet specifications. When placing measurement probes near these devices during operation, be aware that these devices may be very warm to the touch.

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1 Introduction

This user's guide details the evaluation module (EVM) operation of a factory-installed ISO7241C quad-channel digital isolator. However, the EVM board may be reconfigured by a user for evaluation of any of TI's triple- or quad-channel digital isolators.

The EVM may be reconfigured for use with the ISO7230A, ISO7230C, ISO7230M, ISO7240A, ISO7240CF, ISO7240M and ISO7640Fx same-channel direction isolators as well as the ISO7231A, ISO7231C, ISO7231M, ISO7241A, ISO7241M, ISO7242A, ISO7242C, ISO7242M, ISO7631Fx and ISO7641Fx opposing-channel direction isolators. Contact TI for a factory installation of any of these devices.

This guide also explains the user-configurable I/O loads for both triple- and quad-channel isolator EVM configurations and presents a typical laboratory setup with output waveforms.

1.1 Overview

The ISO723x, ISO724x, ISO763x and ISO764X digital isolators have a logic input and output buffer separated by a silicon oxide (SiO^2) insulation barrier. Used with isolated power supplies, these devices block high voltage, isolate grounds, and prevent noise currents on a data bus or other circuits from entering the local ground and interfering with or damaging sensitive circuitry.

A binary input signal is conditioned, translated to a balanced signal, and then differentiated by the capacitive isolation barrier. Across the isolation barrier, a differential comparator receives the logic transition information, then sets or resets a flip-flop and the output circuit accordingly. A periodic update pulse is sent across the barrier to ensure the proper dc level of the output. If this dc-refresh pulse is not received for more than 4 µs, the input is assumed to be unpowered or not being actively driven, and a failsafe circuit drives the output to a logic-high state. For ISO7640FM, ISO7640FC, ISO7641FM, ISO7641FC, ISO7631FM and ISO7631FC failsafe is logic low state. For ISO7240CF logic low state if selected.

CAUTION

Note that although these devices provide galvanic isolation of up to 4000 V, this EVM cannot be used for isolation voltage testing. It is designed for the evaluation of device operating parameters only and may be damaged if high voltage (> 5.5 V) is applied anywhere in the circuit.

1.2 The Functional Configurations of the Triple- and Quad-Channel Digital Isolator

The pinouts of the triple-channel digital isolators are displayed in Figure 1. The EVM comes with an ISO7241C installed; however, a user may reconfigure this versatile EVM for use with any of the triple- or quad-channel footprints.

Not that ISO7231x and ISO7631Fx have the same pin out. As does ISO7240x with ISO7640Fx, and ISO7241X with ISO7641Fx.

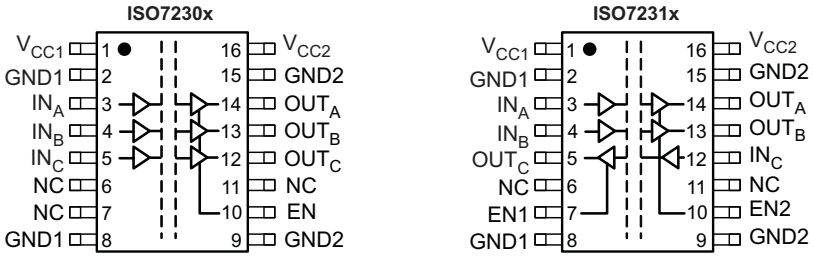

Figure 1. The ISO7230x and ISO7231x Pinout

The ISO7230A, ISO7231A, ISO7230C, and ISO7231C have TTL input thresholds and an input noise-filter that prevents transient pulses of up to 2 ns in duration from being passed to the output of the device.

The ISO7631FC has TTL input thresholds and an input noise-filter that prevents transient pulses of up to 10 ns in duration from being passed to the output of the device.

The ISO7230M and ISO7231M have a CMOS Vcc/2 input threshold and do not have the noise-filter with the additional propagation delay.

The ISO7631FM has TTL input thresholds and do not have the noise-filter or the additonal prop delay.

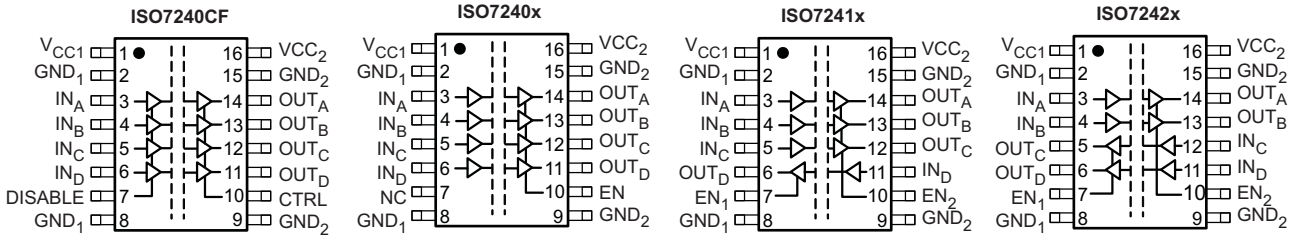

Figure 2. The ISO7240CF, ISO7240x, ISO7241x, and ISO7242x Pinout

The ISO7240A, ISO7240C, ISO7241A, ISO7241C, ISO7242A, and ISO7242C have TTL input thresholds and an input noise-filter that prevents transient pulses of up to 2 ns in duration from being passed to the output of the device.

The ISO7640FC and ISO7641FC have TTL input thresholds and an input noise-filter that prevents transient pulses of up to 10 ns in duration from being passed to the output of the device.

The ISO7240M, ISO7241M, and ISO7242M have a CMOS Vcc/2 input threshold and do not have the noise-filter with the additional propagation delay.

The ISO7640FM and ISO7641FM have TTL input thresholds and do not have the noise-filter or the additonal prop delay

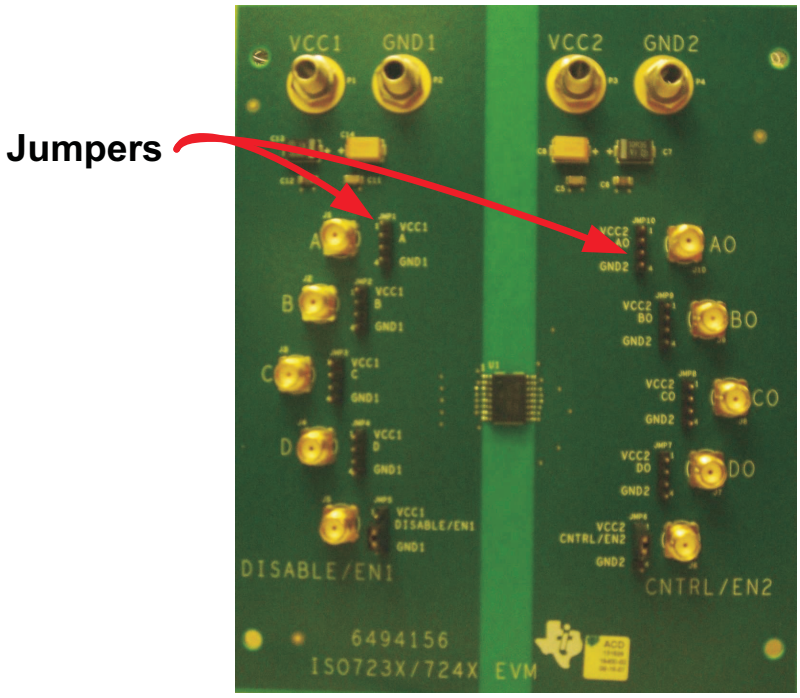

Figure 3. The EVM Top Photograph

The 4-pin jumpers on top of the EVM provide for an input or output pin to be tied to either Vcc or ground. The jumper also provides scope probe access to each pin.

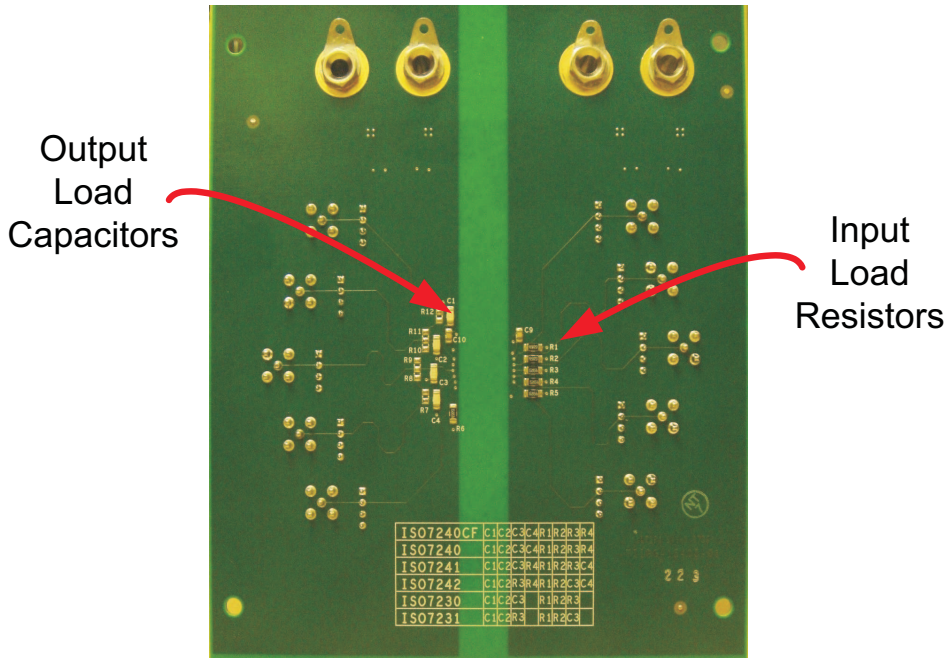

Figure 4. The EVM Bottom Photograph

Each channel is configured with a 50-Ω load resistor on each input, labeled R1 through R4, and a 4.7-pF load on each channel output labeled C1 through C4. Note that each channel may be configured for operation in either direction by simply switching the input load resistor with the output load capacitor.

For example, in Figure 6, because the ISO7231 has the bottom channel configured in the opposing direction, R3 and C3 have changed place from that in Figure 5. This is all that is required to reconfigure a channel direction.

A user may also evaluate varied input and output loading conditions by replacing the factory-installed 1203 footprint loads.

1.3 The EVM Schematics of the Triple and Quad Isolators

This multifunctional EVM is designed with the signal paths displayed in Figure 1, Figure 5, and Figure 6 for the evaluation of the ISO7230x, ISO7231x and ISO7631Fx triple-channel isolators.

The functional signal path schematics of the ISO7240CF, ISO7240x and ISO7640Fx are presented in Figure 2 and Figure 7, whereas the ISO7241x, ISO7641Fx and ISO7242x are displayed in Figure 2, Figure 8, and Figure 9.

Note that each input channel has a 50-Ω load resistor to ground. Each output channel has a 4.7-pF load capacitor to ground that when added to the parallel capacitance of the trace to the SMA connector brings the total capacitive load to 15 pF.

When a channel direction is reversed, the 50-Ω resistor and 4.7-pF capacitor change place, each to the other side of the isolation barrier as displayed in Figure 6 for the opposing channel.

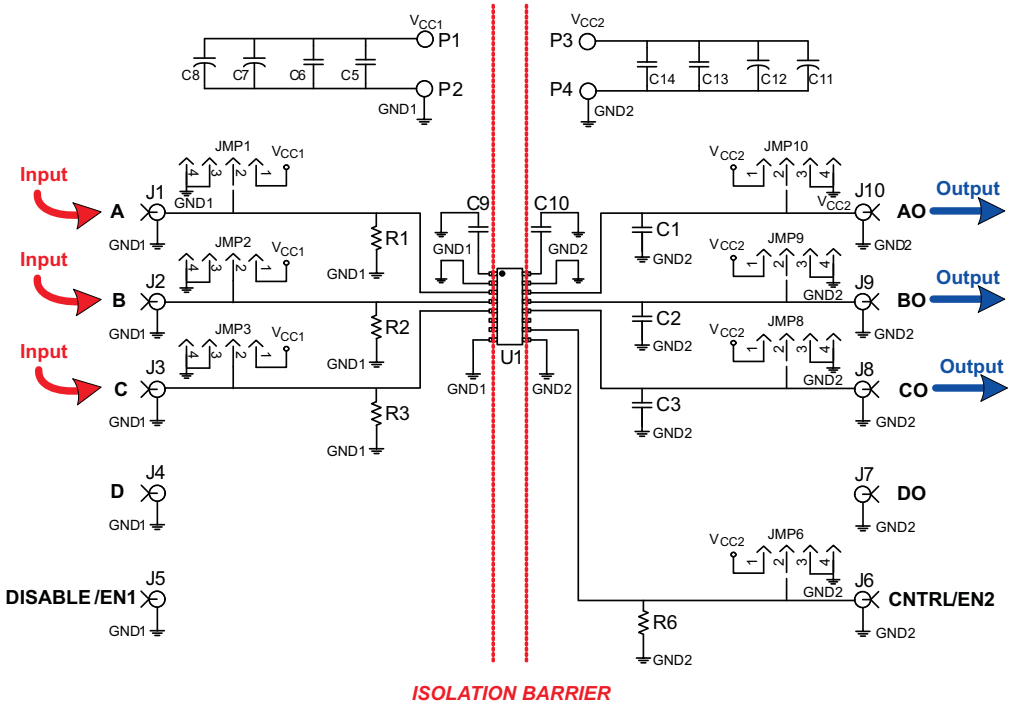

Figure 5. The ISO7230x Same-Channel Direction EVM Schematic

Table 1. ISO7230x EVM

Connection	Label	Description
A	J1	SMA connector to the A input, pin 3
B	J2	SMA connector to the B input, pin 4
C	J3	SMA connector to the C input, pin 5
D	J4	SMA connector (**not used**)
DISABLE/EN1	J5	SMA connector (**not used**)
CNTRL/EN2	J6	SMA connector to the output enable input, pin 10
DO	J7	SMA connector (**not used**)

Table 1. ISO7230x EVM (continued)

Connection	Label	Description
CO	J8	SMA connector to the CO output, pin 12
BO	J9	SMA connector to the BO output, pin 13
AO	J10	SMA connector to the AO output, pin 14
P1	VCC1	Left-side power supply banana jack
P2	GND1	Left-side power ground connection banana jack
P3	VCC2	Right-side power supply banana jack
P4	GND2	Right-side power ground connection banana jack
	JMP1	4-pin jumper to V_{CC1}, input A, GND1
	JMP2	4-pin jumper to V_{CC1}, input B, GND1
	JMP3	4-pin jumper to V_{CC1}, input C, GND1
	JMP4	4-pin jumper (**not used**)
	JMP5	4-pin jumper (**not used**)
	JMP6	4-pin jumper to V_{CC2}, EN2, GND2
	JMP7	4-pin jumper (**not used**)
	JMP8	4-pin jumper to V_{CC2}, output CO, GND2
	JMP9	4-pin jumper to V_{CC2}, output BO, GND2
	JMP10	4-pin jumper to V_{CC2}, output AO, GND2
	R1, R2, R3, R4, R5, R6	50\-Ω ±1% 1203 footprint input load resistor
	C1, C2, C3, C4	4.7-pF 1203 footprint output load capacitor
	C5, C11	0.1-µF filter capacitor
	C6, C12	1.0-µF filter capacitor
	C7, C13	10-µF electrolytic filter capacitor
	C8, C14	68-µF electrolytic filter capacitor
	C9, C10	0.01-µF filter capacitor
	R7, R8, R9, R10, R11, R12	open, not populated

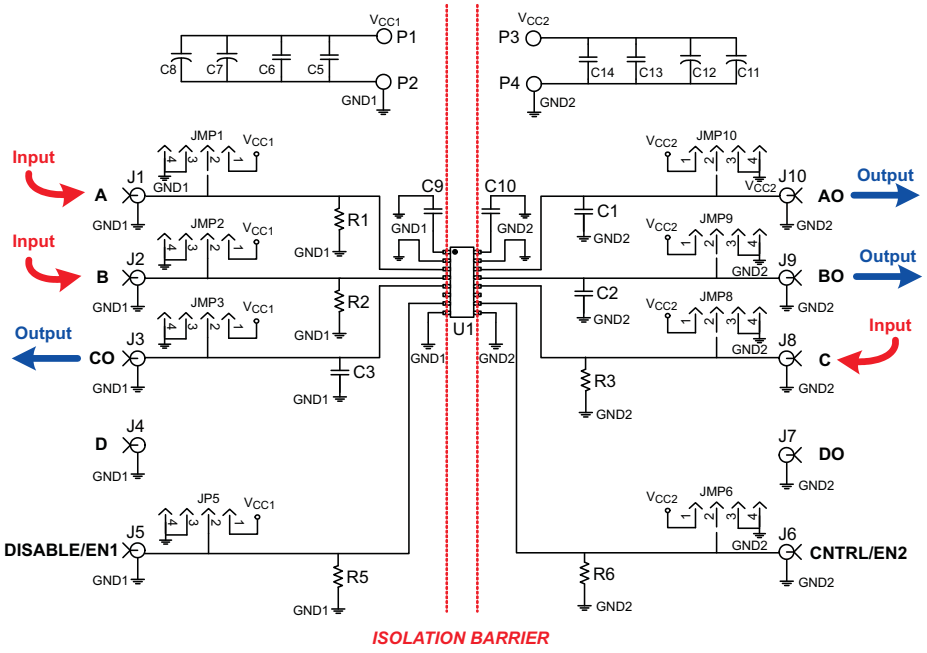

Figure 6. The ISO7231x and ISO7631Fx Opposing-Channel Direction Schematic

Table 2. ISO7231x and ISO7631Fx EVM

Connection	Label	Description
A	J1	SMA connector to the A input, pin 3
B	J2	SMA connector to the B input, pin 4
CO	J3	SMA connector to the C0 output, pin 5
D	J4	SMA connector (**not used**)
DISABLE/EN1	J5	SMA connector to the EN1 output enable, pin 7
CNTRL/EN2	J6	SMA connector to the EN2 output enable, pin 10
DO	J7	SMA connector (**not used**)
C	J8	SMA connector to the C input, pin 12
BO	J9	SMA connector to the BO output, pin 13
AO	J10	SMA connector to the AO output, pin 14
P1	VCC1	Left-side power supply banana jack
P2	GND1	Left-side power ground connection banana jack
P3	VCC2	Right-side power supply banana jack
P4	GND2	Right-side power ground connection banana jack
	JMP1	4-pin jumper to V_{CC1}, input A, GND1
	JMP2	4-pin jumper to V_{CC1}, input B, GND1
	JMP3	4-pin jumper – VCC1, output CO, GND1
	JMP4	4-pin jumper (not used)
	JMP5	4-pin jumper to V_{CC1}, EN1, GND1
	JMP6	4-pin jumper to V_{CC2}, EN2, GND2
	JMP7	4-pin jumper (not used)
	JMP8	4-pin jumper to V_{CC2}, input C, GND2
	JMP9	4-pin jumper to V_{CC2}, output BO, GND2
	JMP10	4-pin jumper to V_{CC2}, output AO, GND2
	R1, R2, R3, R4, R5, R6	50-Ω ±1% 1203 footprint input load resistor
	C1, C2, C3, C4	4.7-pF 1203 footprint output load capacitor
	C5, C11	0.1-µF filter capacitor
	C6, C12	1-µF filter capacitor
	C7, C13	10-µF electrolytic filter capacitor
	C8, C14	68-µF electrolytic filter capacitor
	C9, C10	0.01-µF filter capacitor
	R7, R8, R9, R10, R11, R12	open, not populated

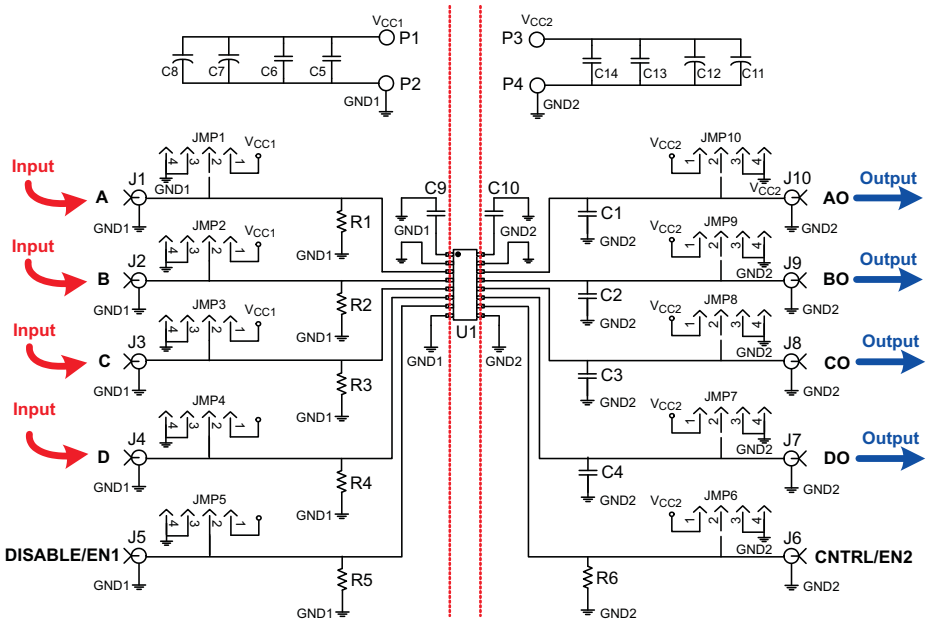

Figure 7. The ISO7240CF, ISO7240x and ISO7640Fx Same Channel Direction EVM Schematic

Table 3. ISO7240CF, ISO7240x and ISO7640Fx EVM

Connection	Label		Description
A	J1		SMA connector to the A input, pin 3
B	J2		SMA connector to the B input, pin 4
C	J3		SMA connector to the C input, pin 5
D	J4		SMA connector to the D input, pin 6
DISABLE/EN1	J5	ISO7240x	SMA (**not connected**)
		ISO7240CF	SMA connector to the DISABLE, pin 7
CNTRL/EN2	J6	ISO7240x	SMA connector to the EN2 output enable, pin 10
		ISO7240CF	SMA connector to the CNTRL failsafe select, pin 10
DO	J7		SMA connector to the DO output, pin 11
CO	J8		SMA connector to the CO output, pin 12
BO	J9		SMA connector to the BO output, pin 13
AO	J10		SMA connector to the AO output, pin 14
P1	VCC1		Left-side power supply banana jack
P2	GND1		Left-side power ground connection banana jack
P3	VCC2		Right-side power supply banana jack
P4	GND2		Right-side power ground connection banana jack
	JMP1		4-pin jumper to V_{CC1}, input A, GND1
	JMP2		4-pin jumper to V_{CC1}, input B, GND1
	JMP3		4-pin jumper to V_{CC1}, input C, GND1
	JMP4		4-pin jumper to V_{CC1}, input D, GND1
	JMP5		4-pin jumper to V_{CC1}, DISABLE/EN1, GND1
	JMP6		4-pin jumper to V_{CC2}, CNTRL/EN2, GND2
	JMP7		4-pin jumper to V_{CC2}, output DO, GND2
	JMP8		4-pin jumper to V_{CC2}, output CO, GND2
	JMP9		4-pin jumper to V_{CC2}, output BO, GND2
	JMP10		4-pin jumper to V_{CC2}, output AO, GND2
	R1, R2, R3, R4, R5, R6		50-Ω ±1% 1203 footprint input load resistor

Table 3. ISO7240CF, ISO7240x and ISO7640Fx EVM (continued)

Connection	Label	Description
	C1, C2, C3, C4	4.7-pF 1203 footprint load capacitor
	C5, C11	0.1-µF filter capacitor
	C6, C12	1- µF filter capacitor
	C7, C13	10-µF electrolytic filter capacitor
	C8, C14	68-µF electrolytic filter capacitor
	C9, C10	0.01- µF filter capacitor
	R7, R8, R9, R10, R11, R12	open, not populated

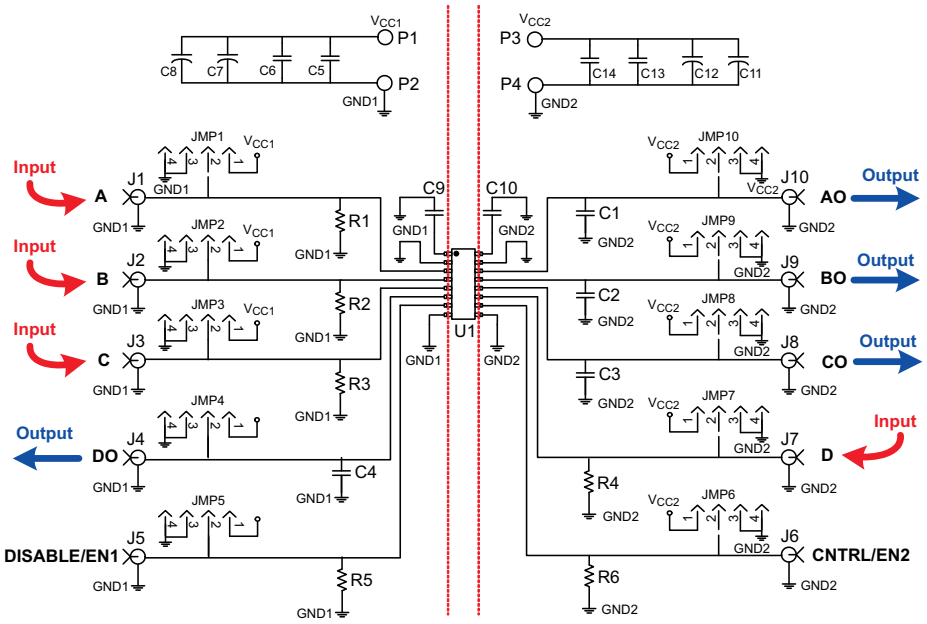

Figure 8. The ISO7241x and ISO7641Fx Single Opposing-Channel Direction Schematic

Table 4. ISO7241x and ISO7641Fx EVM

Connection	Label	Description
A	J1	SMA connector to the A input, pin 3
B	J2	SMA connector to the B input, pin 4
C	J3	SMA connector to the C input, pin 5
DO	J4	SMA connector to the DO output, pin 6
DISABLE/EN1	J5	SMA connector to the EN1 output enable, pin 7
CNTRL/EN2	J6	SMA connector to the EN2 output enable, pin 10
D	J7	SMA connector to the D input, pin 11
CO	J8	SMA connector to the CO output, pin 12
BO	J9	SMA connector to the BO output, pin 13
AO	J10	SMA connector to the AO output, pin 14
P1	VCC1	Left-side power supply banana jack
P2	GND1	Left-side power ground connection banana jack
P3	VCC2	Right-side power supply banana jack
P4	GND2	Right-side power ground connection banana jack
	JMP1	4-pin jumper to V_{CC1}, input A, GND1
	JMP2	4-pin jumper to V_{CC1}, input B, GND1

Table 4. ISO7241x and ISO7641Fx EVM (continued)

Connection	Label	Description
	JMP3	4-pin jumper – V_{CC1}, input C, GND1
	JMP4	4-pin jumper – V_{CC1}, output DO, GND1
	JMP5	4-pin jumper – V_{CC1}, EN1, GND1
	JMP6	4-pin jumper to V_{CC2}, EN2, GND2
	JMP7	4-pin jumper – V_{CC2}, input D, GND2
	JMP8	4-pin jumper – V_{CC2}, output CO, GND2
	JMP9	4-pin jumper to V_{CC2}, output BO, GND2
	JMP10	4-pin jumper to V_{CC2}, output AO, GND2
	R1, R2, R3, R4, R5, R6	50-Ω ±1% 1203 footprint input load resistor
	C1, C2, C3, C4	4.7-pF 1203 footprint output load capacitor
	C5, C11	0.1-µF filter capacitor
	C6, C12	1- µF filter capacitor
	C7, C13	10-µF electrolytic filter capacitor
	C8, C14	68-µF electrolytic filter capacitor
	C9, C10	0.01-µF filter capacitor
	R7, R8, R9, R10, R11, R12	open, not populated

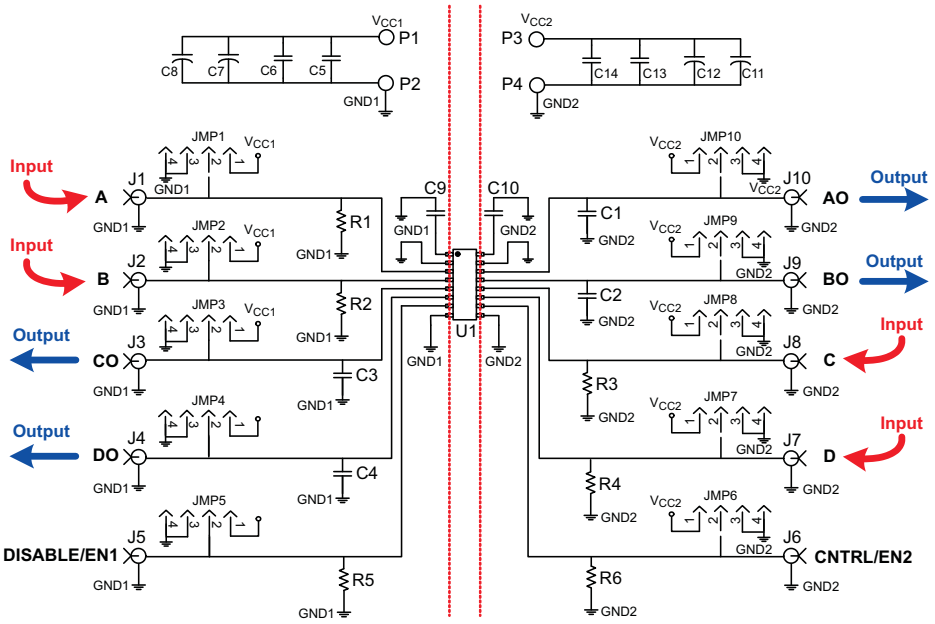

Figure 9. The ISO7242x Dual Opposing-Channel Direction Schematic

Table 5. ISO7242x EVM

Connection	Label	Description
A	J1	SMA connector to the A input, pin 3
B	J2	SMA connector to the B input, pin 4
CO	J3	SMA connector to the CO output, pin 5
DO	J4	SMA connector to the DO output, pin 6
DISABLE/EN1	J5	SMA connector to the EN1 output enable, pin 7
CNTRL/EN2	J6	SMA connector to the EN2 output enable, pin 10
D	J7	SMA connector to the D input, pin 11

Table 5. ISO7242x EVM (continued)

Connection	Label	Description
C	J8	SMA connector to the C input, pin 12
BO	J9	SMA connector to the BO output, pin 13
AO	J10	SMA connector to the AO output, pin 14
P1	VCC1	Left-side power supply banana jack
P2	GND1	Left-side power ground connection banana jack
P3	VCC2	Right-side power supply banana jack
P4	GND2	Right-side power ground connection banana jack
	JMP1	4-pin jumper to V_{CC1}, input A, GND1
	JMP2	4-pin jumper to V_{CC1}, input B, GND1
	JMP3	4-pin jumper – V_{CC1}, output CO, GND1
	JMP4	4-pin jumper – V_{CC1}, output DO, GND1
	JMP5	4-pin jumper – V_{CC1}, EN1, GND1
	JMP6	4-pin jumper to V_{CC2}, EN2, GND2
	JMP7	4-pin jumper – V_{CC2}, input D, GND2
	JMP8	4-pin jumper – V_{CC2}, input C, GND2
	JMP9	4-pin jumper to V_{CC2}, output B, GND2
	JMP10	4-pin jumper to V_{CC2}, output A, GND2
	R1, R2, R3, R4, R5, R6	50-Ω ±1% 1203 footprint input load resistor
	C1, C2, C3, C4	4.7-pF 1203 footprint output load capacitor
	C5, C11	0.1-µF filter capacitor
	C6, C12	1-µF filter capacitor
	C7, C13	10-µF electrolytic filter capacitor
	C8, C14	68-µF electrolytic filter capacitor
	C9, C10	0.01-µF filter capacitor
	R7, R8, R9, R10, R11, R12	open, not populated

2 EVM Setup and Operation

This section includes the setup and operation of the EVM for parameter performance evaluation. Typical output waveforms are included

2.1 Overview

The basic setup in Figure 10 has the two power supplies required to evaluate isolator performance with any combination of 3.3

V or 5

V on either side. If both sides are to be evaluated at the same supply voltage, only one power supply is required and can be used to power both sides of the EVM.

CAUTION

Note that this EVM is for operating parameter performance evaluation only and not designed for isolation voltage testing. Any voltage applied above the 5.5-V maximum recommended operating voltage of the isolators will damage the EVM.

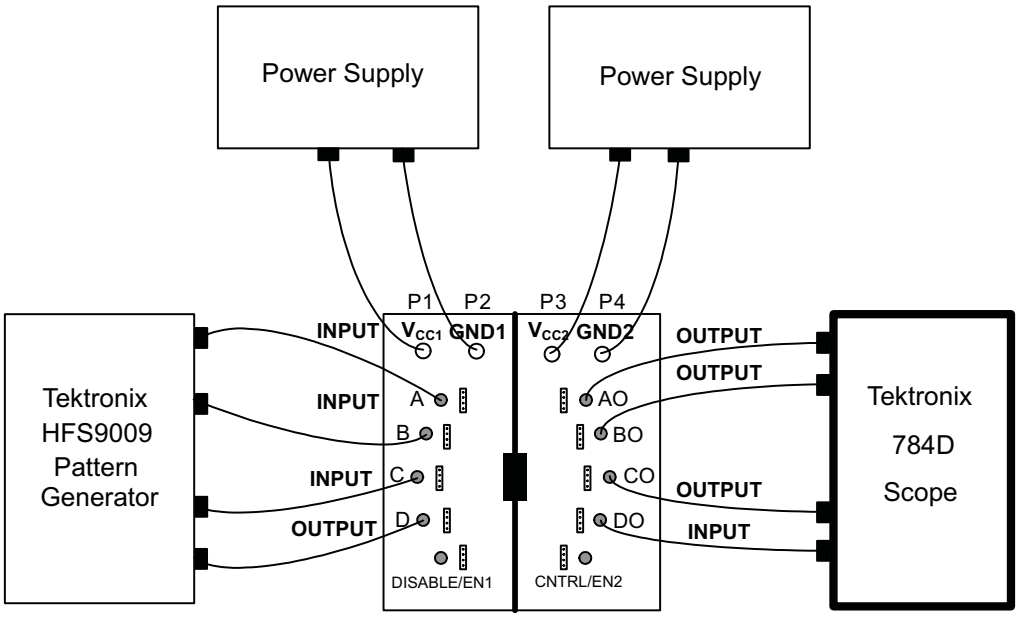

Figure 10. Basic EVM Operation with a ISO7241C

The J1, J2, J3, and J7 inputs to the EVM is a 12.5-MHz pulse displayed on channels 1, 2, 3, and 4 in Figure 11. Note that because the ISO7241C is being used, the DISABLE/EN1 and CNTRL/EN2 inputs are tied to Vcc with the jumpers JMP5 and JMP6 to enable the outputs on each side of the device.

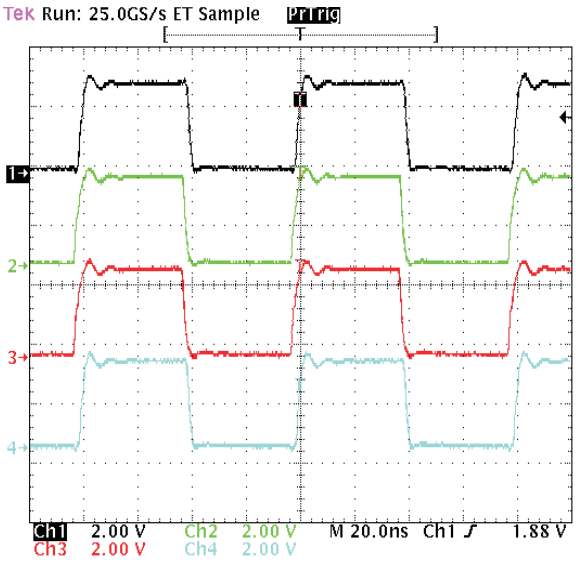

Figure 11. Typical Output Waveforms

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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 5.5 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 60°C. The EVM is designed to operate properly with certain components above 60°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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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265