Digital Isolator
I13xL1A0

Three Channel Digital Isolator

Features

- Three-channel digital isolator
  - One receive & two transmit channels
- Powered from input signal, no V_{CC} required
- Small size and low external component count reduce system complexity while preserving system power density
- Operating input voltage = 3.3 V (typ.)
- DC Isolation voltage = 4242 V_{DC}
- AC Isolation voltage = 3000 V_{RMS}
- 10 mm x 10 mm Land Grid Array (LGA) package
- 8.6 mm creepage
- Safety Regulatory Approvals
  - IEC 60950-1
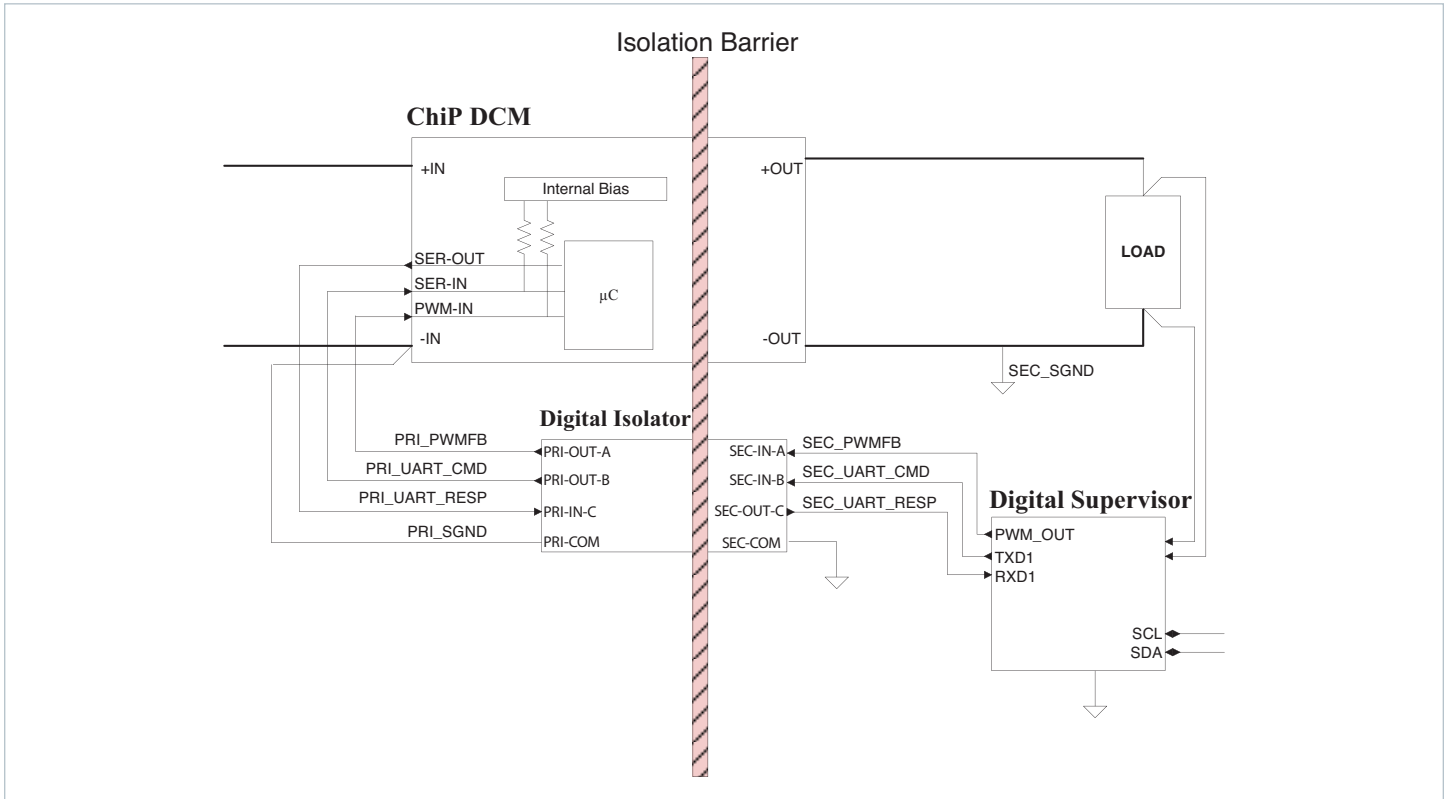 - EN 60950-1
  - UL 60950-1

Product Description

The I13xL1A0 is a three-channel passive Digital Isolator which enables secondary referenced digital power system monitoring and control when used in conjunction with Vicor's Digital Supervisor and high performance power conversion, regulation, and transformation modules.

The I13xL1A0's passive design reduces system complexity, while its small footprint increases system power density.
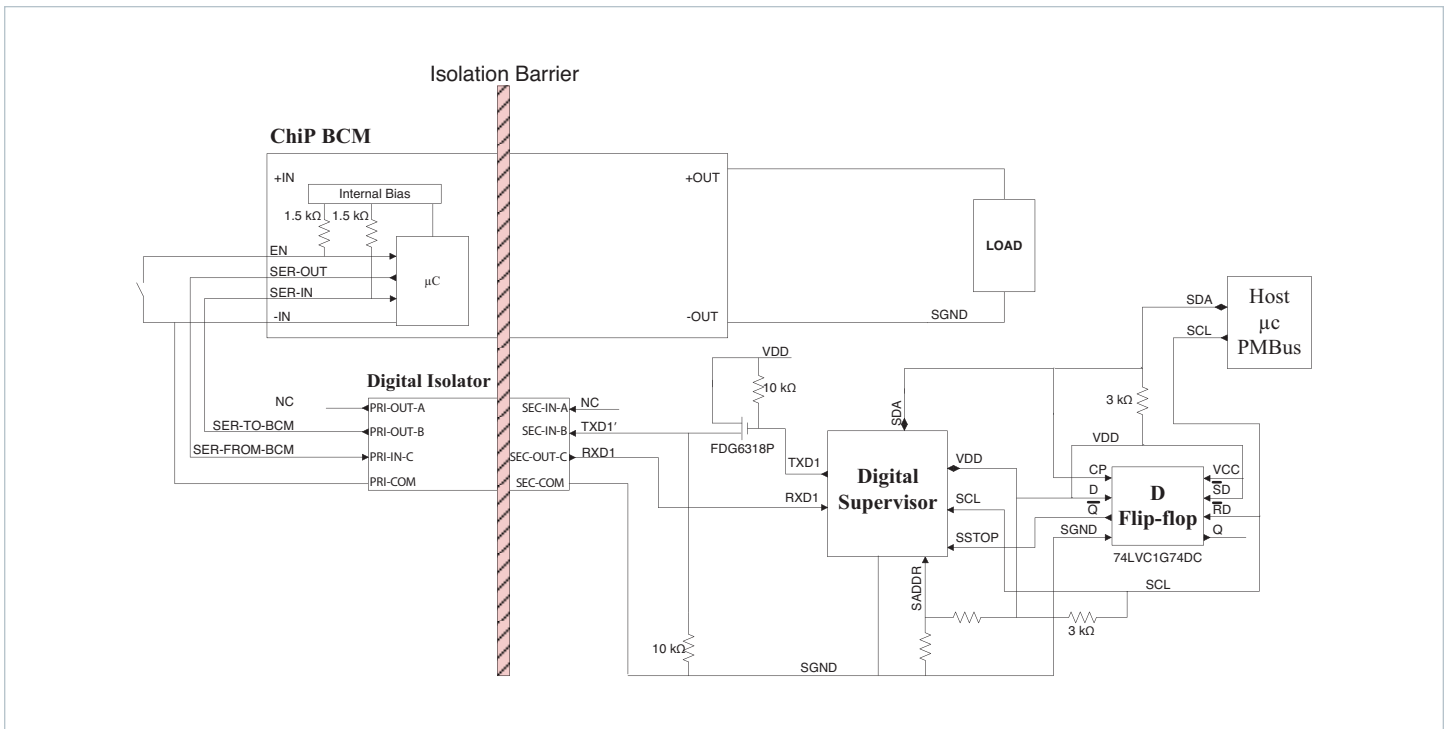
Standard Models

Part Number	Package Type	Temperature
I13**T**L1A0	LGA (10 x 10 mm)	T-Grade (-40°C to 125°C)
I13**M**L1A0	LGA (10 x 10 mm)	M-Grade (-55°C to 125°C)

Typical Applications

- 380 VDC Power Distribution
- High End Computing Systems
- Automated Test Equipment
- Industrial Systems
- High Density Power Supplies
- Communications Systems
- Transportation

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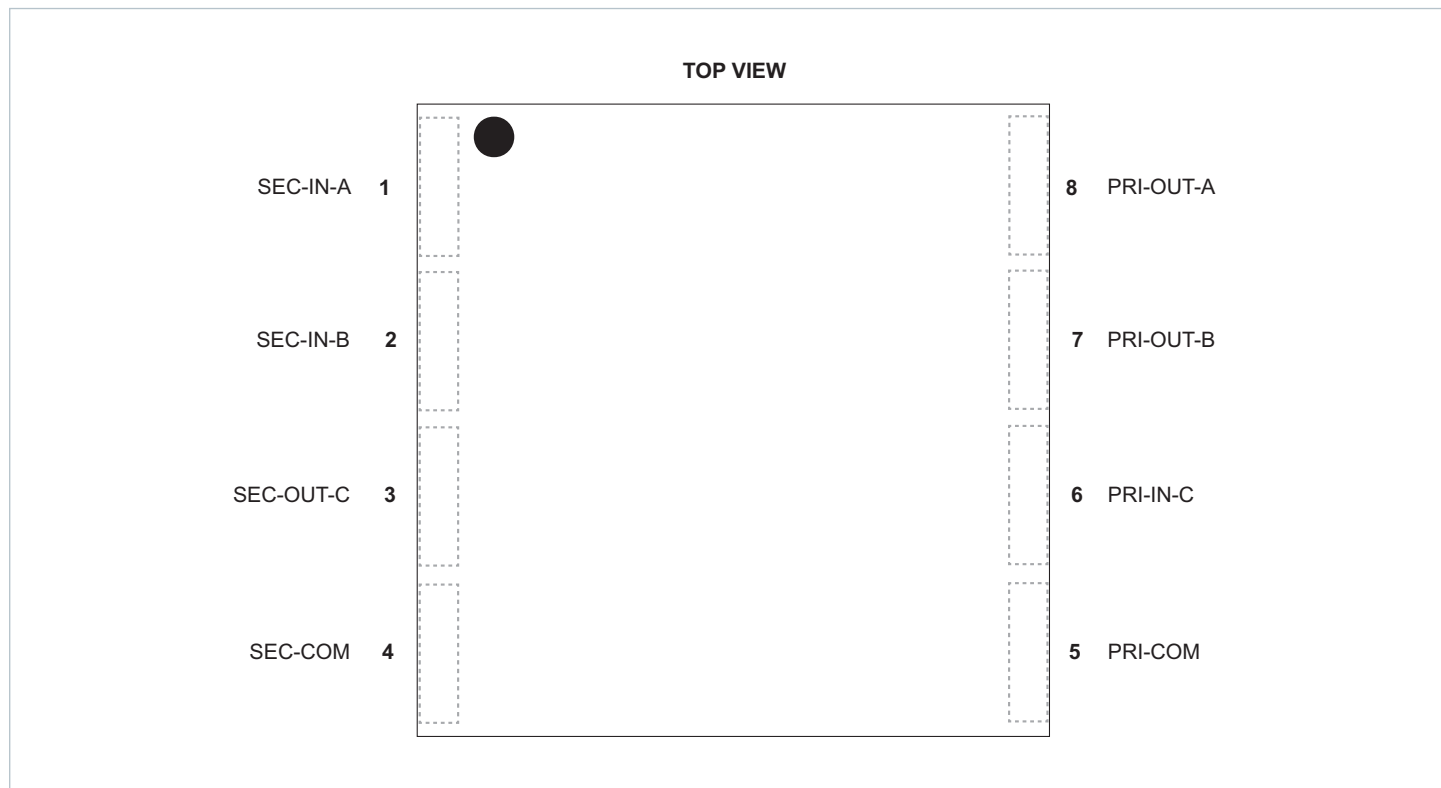800 927.9474

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Typical Application

I13xL1A0 + Isolated Regulated DC/DC Converter Module and Digital Supervisor

I13xL1A0 + Offline BCM and Digital Supervisor

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Pin Configuration

TOP VIEW

SEC-IN-A **1**

SEC-IN-B **2**

SEC-OUT-C **3**

SEC-COM **4**

8 PRI-OUT-A

7 PRI-OUT-B

6 PRI-IN-C

5 PRI-COM

Pin Description

PIN Number	Signal Name	PIN Type	Function
1	SEC-IN-A	INPUT	A channel input on secondary
2	SEC-IN-B	INPUT	B channel input on secondary
3	SEC-OUT-C	OUTPUT	C channel output on secondary
4	SEC-COM	COMMON (secondary side)	Reference for secondary side signals
5	PRI-COM	COMMON (primary side)	Reference for primary side signals
6	PRI-IN-C	INPUT	C channel input on primary
7	PRI-OUT-B	OUTPUT	B channel output on primary
8	PRI-OUT-A	OUTPUT	A channel output on primary

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Absolute Maximum Ratings

ABSOLUTE MAXIMUM ratings are stress ratings only. Operation at or beyond these maximum ratings can cause permanent damage to the device. Electrical specifications do not apply when operating beyond rated operating conditions. Operating beyond rated operating conditions for extended period of time may affect device reliability. All voltages are specified are relative to the associated COMMON pin unless otherwise noted. Positive pin current represents current flowing out of the pin.

Parameter	Comments	Min	Max	Unit
Any input		−0.5	4.6	V
Any output	Off state voltage	−0.5	6	V
	On state current	−10		mA
Dielectric withstand (PRI-COM to SEC-COM)	Reinforced insulation 1 min.	4,242		Vdc
		3,000		Vrms
Operating Internal Temperature	T grade	-40	125	°C
	M grade	-55	125	°C
Storage Temperature	T grade	-40	125	°C
	M grade	-65	125	°C

Electrical Specifications

Specifications apply with T_{INT} = 25°C unless otherwise noted. **Boldface** specifications apply over the temperature range of -40°C ≤ T_{INT} ≤ +125°C (T-Grade), or -55°C ≤ T_{INT} ≤ +125°C (M-Grade).

Attribute	Symbol	Conditions / Notes	Min	Typ	Max	Unit
Minimum pulse width	t_{PW-MIN}	V_{IN} = 3.3 V	**84**			ns
Turn-on time	t_{ON}	V_{IN} = 3.3 V	**35**	45	**58**	ns
Output fall time at turn-on	t_{FALL}	Output with 1.5 kΩ to 3.3 V		22	**26**	ns
Turn-off time	t_{OFF}	V_{IN} = 0.0 V	**30**	55	**84**	ns
Output rise time at turn-off	t_{RISE}	Output with 1.5 kΩ to 3.3 V		65	**95**	ns
Common mode Transient Immunity	V_{CMTI}	V_{IN} = 0.0 V or 3.3 V, output = 1.5 kΩ to 3.3 V	**3.0**			kV/μs

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Signal Characteristics
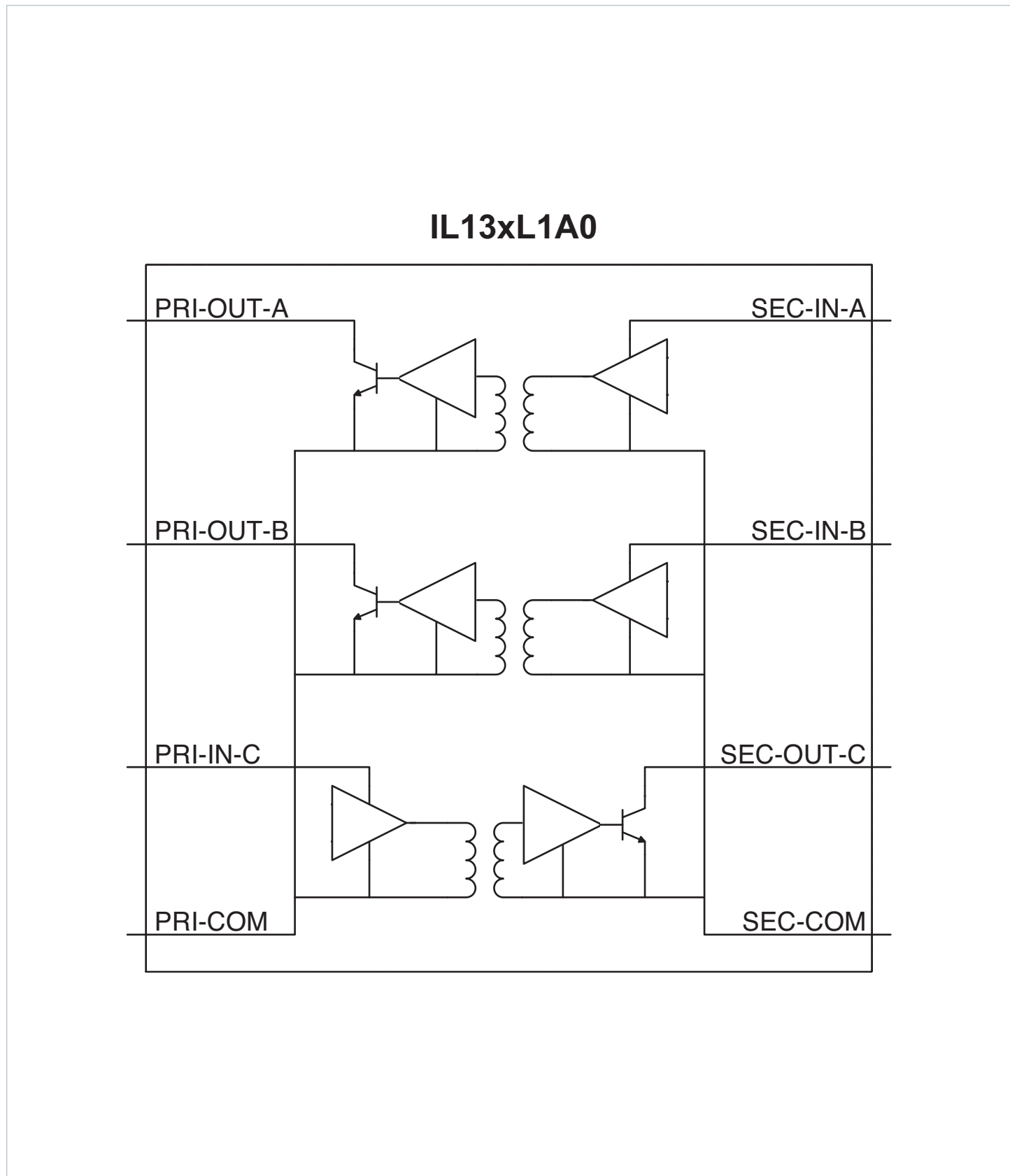
Specifications apply with T_{INT} = 25°C unless otherwise noted. **Boldface** specifications apply over the temperature range of -40°C ≤ T_{INT} ≤ +125°C (T-Grade), or -55°C ≤ T_{INT} ≤ +125°C (M-Grade).

PRI-COM, SEC-COM								
• PRI-COM and SEC-COM serve as the return current node for any channel inputs or outputs on each side of the Digital Isolator's isolation boundry.								
SIGNAL TYPE	STATE	ATTRIBUTE	SYMBOL	CONDITIONS / NOTES	MIN	TYP	MAX	UNIT
COMMON MODE	Any	Coupling Capacitance	C_{IN-OUT}	V_{CM} = 0 V, f = 1 MHz		7.5		pF

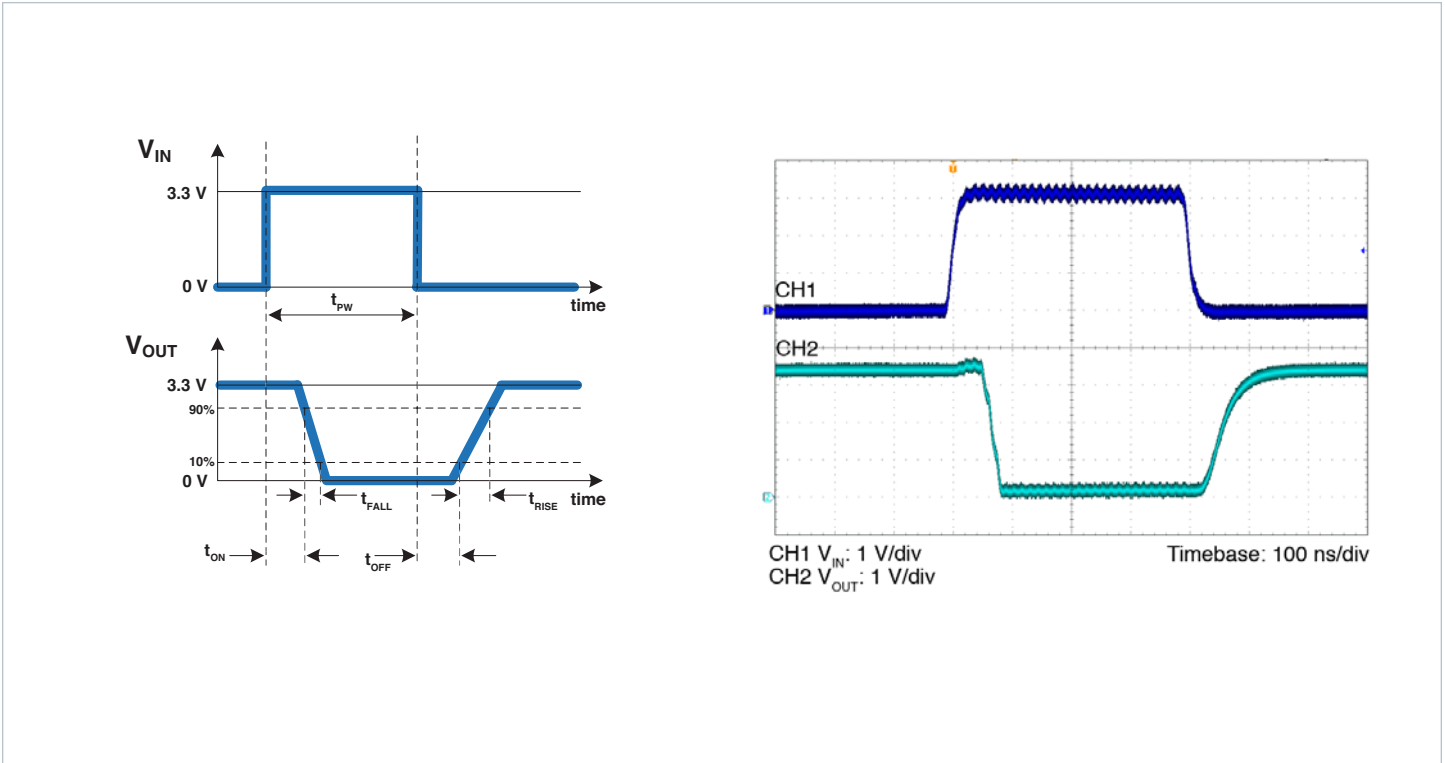| PRI-IN-*n*, SEC-IN-*n*								
• PRI-IN-*n* and SEC-IN-*n* are the drive sides of each channel. The input charateristics are the same for each of the three channels.								
SIGNAL TYPE	STATE	ATTRIBUTE	SYMBOL	CONDITIONS / NOTES	MIN	TYP	MAX	UNIT
INPUT	OFF	Input voltage	V_{IL}		**0.00**		**1.96**	V
		Input capacitance	C_{IN}			200	**210**	pF
	ON	Input voltage	V_{IH}		**2.5**	3.3	**3.6**	V
		Input current	I_{IH}	V_{IN} = 3.3 V		5.06	**5.7**	mA

PRI-OUT-*n*, SEC-OUT-*n*								
• PRI-OUT-*n* and SEC-OUT-*n* are the receive sides of each channel. The output charateristics are the same for each of the three channels.								
SIGNAL TYPE	STATE	ATTRIBUTE	SYMBOL	CONDITIONS / NOTES	MIN	TYP	MAX	UNIT
OUTPUT	OFF	Voltage level	V_{OH}	$R_{PULL-UP}$ = 1.5 kΩ to 3.3 V	**3.0**	3.3		V
		Leakage current	$I_{OUT-LEAKAGE}$	$R_{PULL-UP}$ = 1.5 kΩ to 3.3 V		700	**870**	µA
		Capacitance	C_{OUT}	with V_{OUT} = 3.3 V		9	**13**	pF
		External trace capacitance	$C_{OUT-EXT}$				**TBD**	pF
	ON	Voltage level	V_{OL}	V_{IN} = 3.3 V, $R_{PULL-UP}$ = 1.5 kΩ to 3.3 V		0.2	**0.3**	V
		Drive current	I_{OL}	V_{IN} = 3.3 V, $R_{PULL-UP}$ = 1.5 kΩ to 3.3 V, for V_{OUT} < 0.3 V	**2.00**	2.07		mA
		Ripple voltage	V_{RIPPLE}	V_{IN} = 3.3 V, $R_{PULL-UP}$ = 1.5 kΩ to 3.3 V		75	120	mVpp
		Ripple frequency	f_{RIPPLE}	V_{IN} = 3.3 V, $R_{PULL-UP}$ = 1.5 kΩ to 3.3 V	**75**	85	**95**	MHz

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Block Diagram

IL13xL1A0

PRI-OUT-A

SEC-IN-A

PRI-OUT-B

SEC-IN-B

PRI-IN-C

SEC-OUT-C

PRI-COM

SEC-COM

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Timing Definition and Typical Performance Characteristics

CH1 V_{IN}: 1 V/div
CH2 V_{OUT}: 1 V/div
Timebase: 100 ns/div

Test Circuit

Oscilloscope
$R_L \geq 10 \text{ M}\Omega$
$C_L < 20\text{pF}$

Ch1 Vin

Pulse

IL13xL1A0
(one channel)

nnn-IN-*x*

nnn-COM

mmm-OUT-*x*

mmm-COM

+ 3.3 V

1.5 kΩ

Ch2 Vout

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Safety and Insulation Ratings, General Characteristics

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Attribute	Symbol	Conditions / Notes	Min	Typ	Max	Unit
Safety and Insulation Ratings						
Insulation resistance		Tamb = 25 C, VDC = 500 Vdc	500			MΩ
Creepage distance			**8.6**			mm
Clearance distance			**8.6**			mm
Insulation thickness (DTI)			0.4			mm
Mechanical						
Length	L		9.90 / [0.390]	10.00 / [0.394]	10.10 / [0.398]	mm / [in]
Width	W		9.90 / [0.390]	10.00 / [0.394]	10.10 / [0.398]	mm / [in]
Height	H		2.23 / [0.0917]	2.41 / [0.0949]	2.49 / [0.0980]	mm / [in]
Volume	Vol			0.241 / [0.0147]		cm³/ [in³]
Weight	W			0.54 / [0.0019]		g / [oz]
Pad finish		Nickel	5.0			μm
		Palladium	0.3			
		Gold	0.03			
Thermal						
Power dissipation	P_D	All three channels ON, V_{IN} = 3.6 V, I_{OUT} = 5 mA			**100**	mW
Thermal resistance	$\theta_{INT\text{-}PADS}$			**38**		°C/W
Operating internal temperature T_{INT} is the hottest junction under any specifed operating condition	T_{INT}	T grade	-40		125	°C
		M grade	-55		125	°C

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Safety and Insulation Ratings, General Characteristics (Cont.)

Specifications apply with T_{INT} = 25°C unless otherwise noted. **Boldface** specifications apply over the temperature range of -40°C ≤ T_{INT} ≤ +125°C (T-Grade), or -55°C ≤ T_{INT} ≤ +125°C (M-Grade).

Attribute	Symbol	Conditions / Notes	Min	Typ	Max	Unit
Assembly						
Storage temperature	T_{ST}	T grade	-40		125	°C
		M grade	-65		125	°C
Moisture sensitivity level	MSL	MSL 4, 72 hours out of bag				
ESD rating	ESD_{HBM}	Human Body Model, "JEDEC JESD 22-A114C.01"				
	ESD_{CDM}	Charged Device Model, "JEDEC JESD 22-C101D"				
Soldering						
Peak temperature during reflow		Under MSL 4 conditions above	235	245	260	°C
Maximum time above 217°C			30	60	90	s
Peak heating rate during reflow			0.5	1.5	3.0	°C/s
Peak cooling rate post reflow			0.5	2.0	6.0	°C/s
Reliability						
MTBF		Telcordia Issue 2 - Method I Case 3 25°C; GB, GC, 100%		17.24		MHrs
		MIL-HDBK-217 Plus Parts Count - 25°C Ground Benign		13.83		MHrs
Agency Approvals						
Agency Approvals / Standards		cURus, cTÜVus, UL60950-1, EN/IEC 60950-1				
		CE Marked for Low Voltage Directive and RoHS Recast Directive				

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Product Description

The Digital Isolator is a three channel, signal powered logic isolator. It uses an air core magnetic structure to couple power from the input of each channel to the receiver in the channel's output. The inputs are driven from a voltage driver source and require no series current limiting resistors; the outputs are open-collector, and perform a logical inversion of the input signal.

Digital Isolators are an effective alternative to optocouplers. Their low profile is valuable in high density power systems, their channel count is optimized for Vicor BCM and DCM converters.

Digital Isolators offer improved system reliability as there is no LED emitter to degrade with use, and no optical barrier to degrade with time.

All three channels have the same internal structure and nominal performance, but are grouped in a 2 transmit/ 1 receive configuration so that data can be transferred to and from the power converters in the system. A Digital Isolator channel performs a logical inversion on the data as it is transferred to the open collector output. The transmit and receive ports on each side of the isolation boundary have a common low side, to optimize package pin utilization.
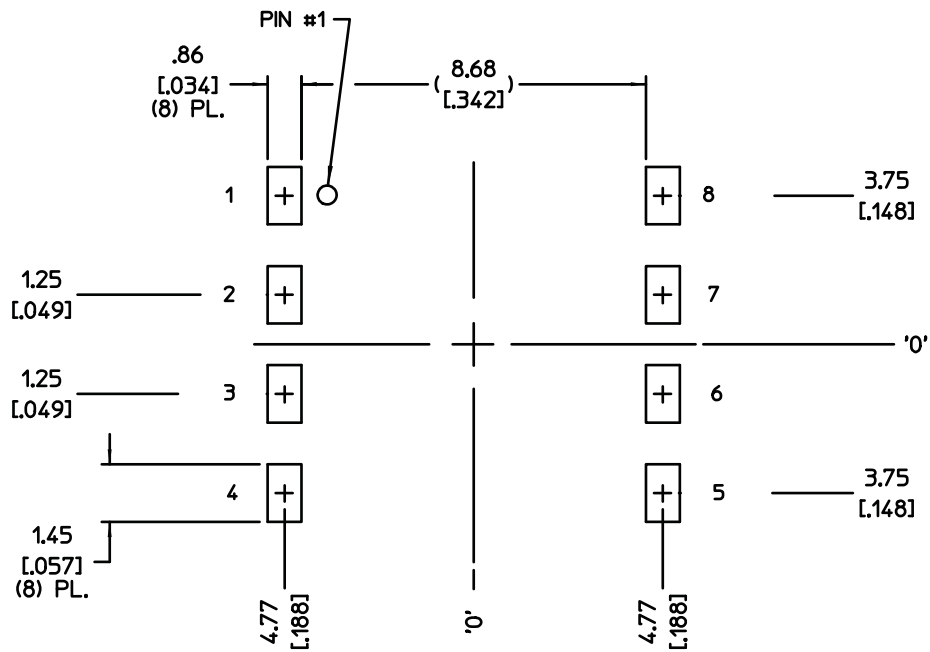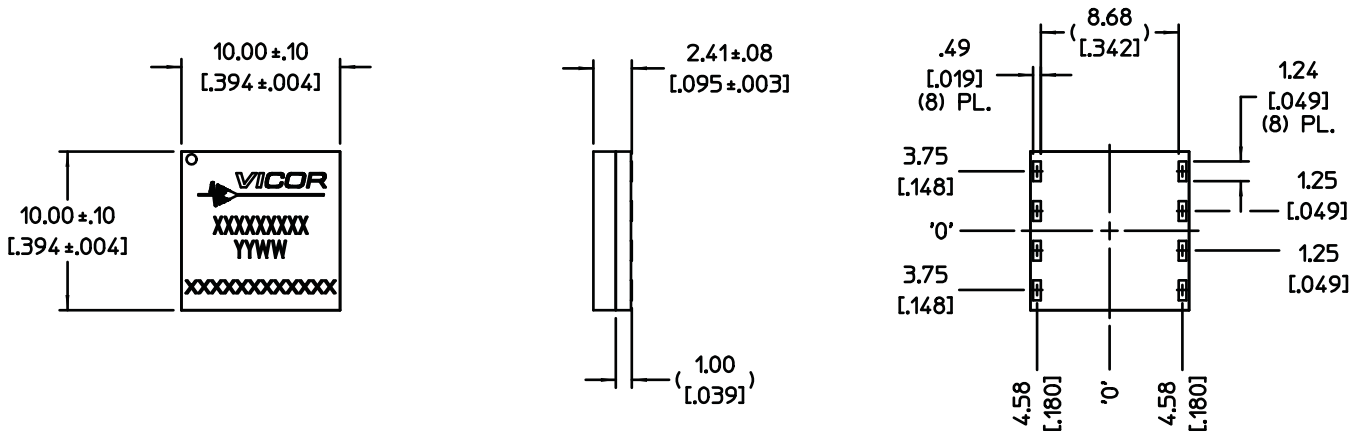
Design Guidelines

The Digital Isolator should be physically placed near its associated powertrain, across the isolation barrier of PCB. The maximum recommended trace length between any of the Digital Isolator (primary side) transmit and receive channels and the primary referenced control pins of the powertrain is 6".

The maximum recommended trace length between any of the Digital Isolator secondary referenced transmit and receive channels and the system Digital Supervisor i/o pin is 18".

All traces should be 8 mil wide, ½ oz. copper, or equivalent for series resistance purposes. While strict impedance control is not required for proper operation, the three channel signals on each side of the Digital Isolator should be routed in such a way as to minimize the likelihood of interference or stray noise pickup. A stripline or microstrip structure is recommended, with the common pin run as the shield or reference.

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Product Outline Drawing and Recommended Land Pattern

10 mm x 10 mm LGA (Land Grid Array)

10.00 ±.10 [.394 ±.004]

10.00 ±.10 [.394 ±.004]

2.41±.08 [.095 ±.003]

1.00 ([.039])

8.68 ([.342])

.49 [.019] (8) PL.

1.24 [.049] (8) PL.

3.75 [.148]

1.25 [.049]

'0'

1.25 [.049]

3.75 [.148]

4.58 [.180]

'0'

4.58 [.180]

PIN #1

.86 [.034] (8) PL.

8.68 ([.342])

1   8

3.75 [.148]

1.25 [.049]   2   7

1.25 [.049]   3   6

'0'

4   5

3.75 [.148]

1.45 [.057] (8) PL.

4.77 [.188]

'0'

4.77 [.188]

RECOMMENDED LAND PATTERN

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