

## 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

### Typical Applications

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

### Product Description

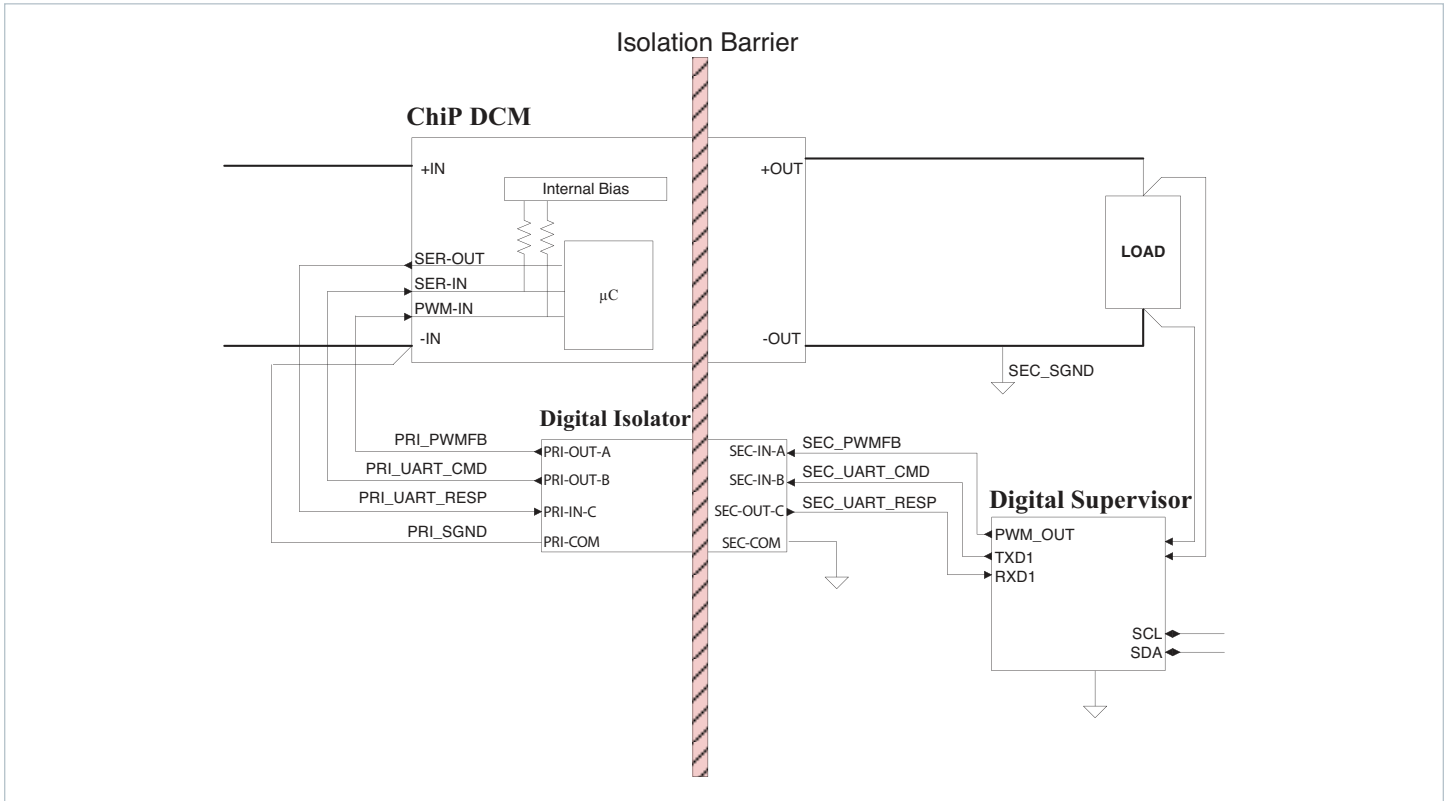
The I13xL1A0 is a three-channel passive Digital Isolator which enables secondary referenced digital power system monitoring and control when used in conjunction with Vicor's Digital Supervisor and high performance power conversion, regulation, and transformation modules.

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

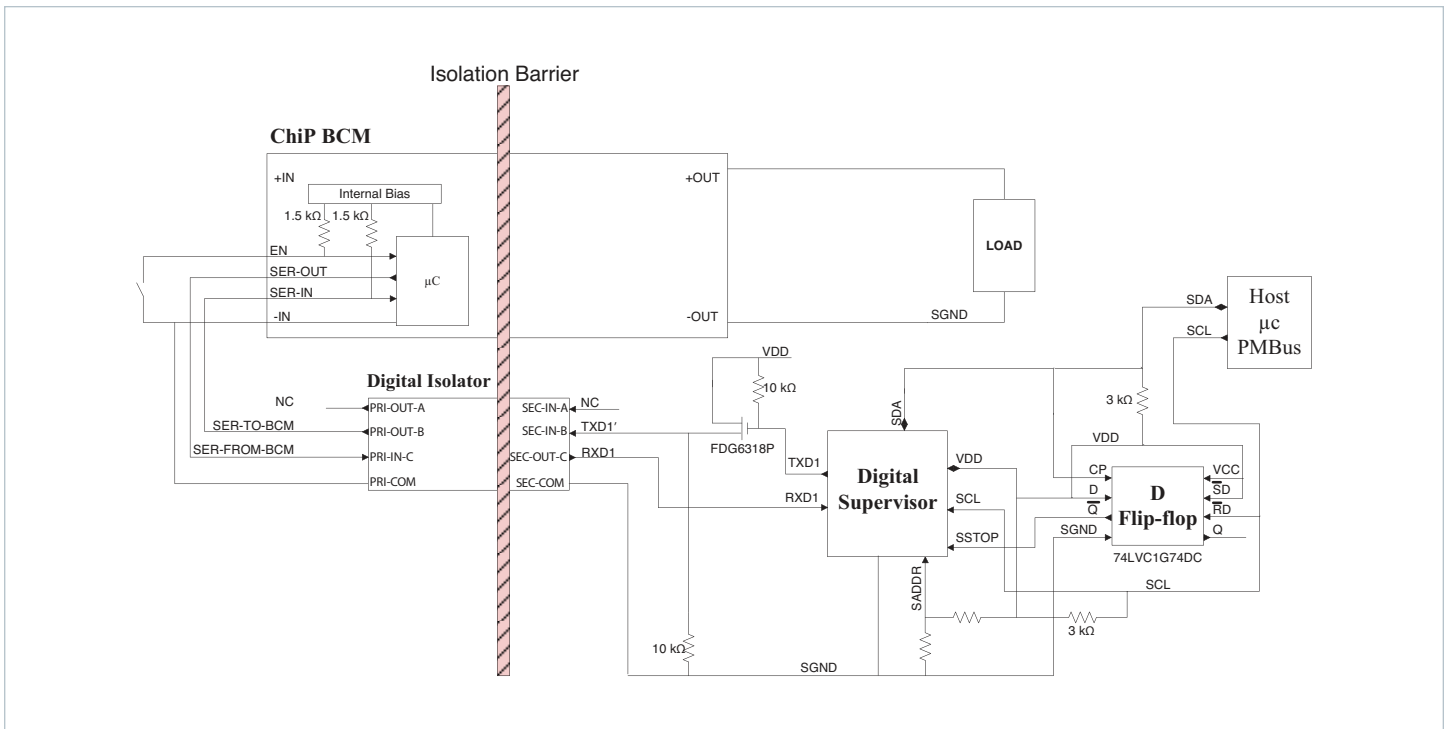
### Standard Models

Part Number	Package Type	Temperature
I13TL1A0	LGA (10 x 10 mm)	T-Grade (-40°C to 125°C)
I13ML1A0	LGA (10 x 10 mm)	M-Grade (-55°C to 125°C)

Typical Application

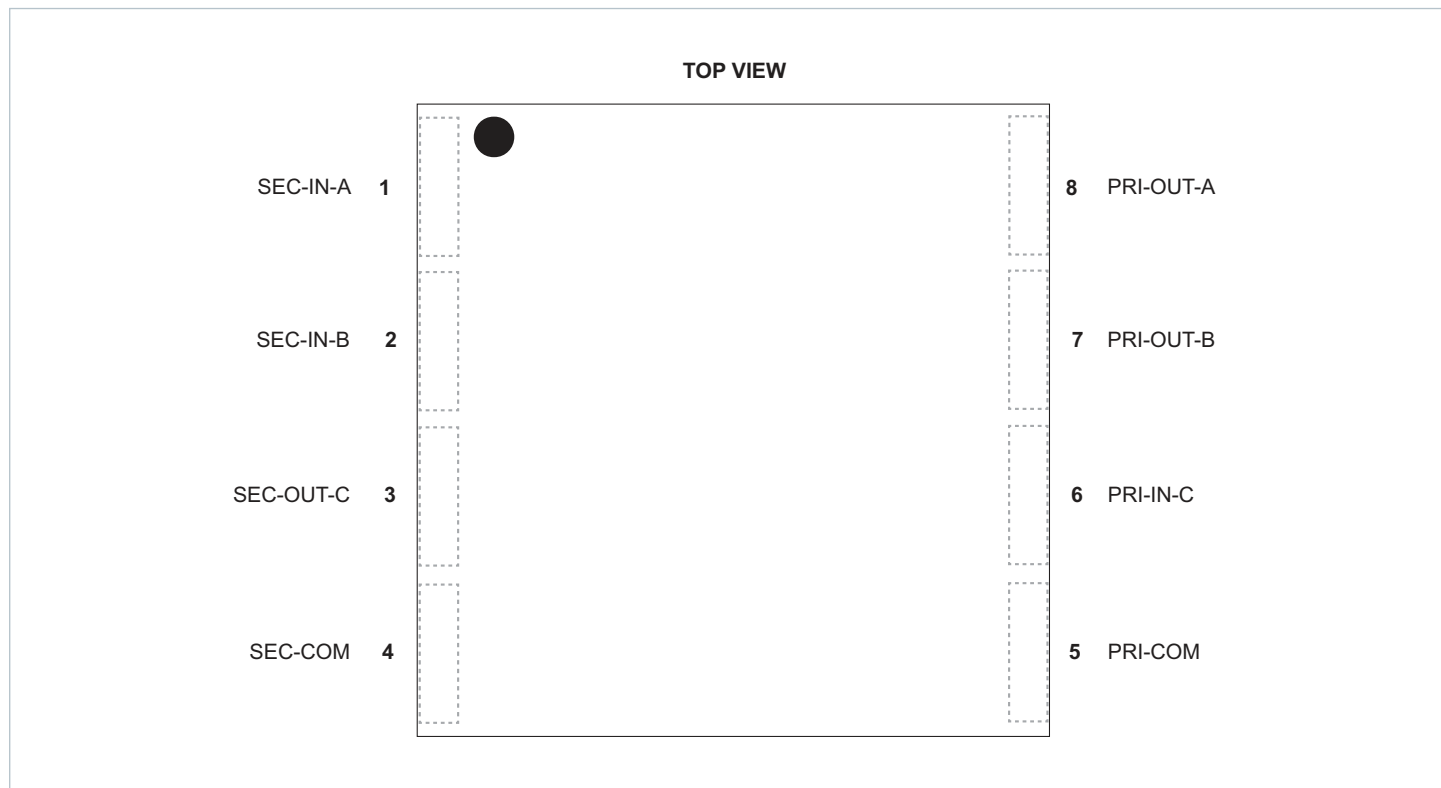


I13xL1A0 + Isolated Regulated DC/DC Converter Module and Digital Supervisor



I13xL1A0 + Offline BCM and Digital Supervisor

## Pin Configuration



## 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

## 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 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  $T_{INT} = 25^{\circ}\text{C}$  unless otherwise noted. **Boldface** specifications apply over the temperature range of  $-40^{\circ}\text{C} \leq T_{INT} \leq +125^{\circ}\text{C}$  (T-Grade), or  $-55^{\circ}\text{C} \leq T_{INT} \leq +125^{\circ}\text{C}$  (M-Grade).

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

## Signal Characteristics

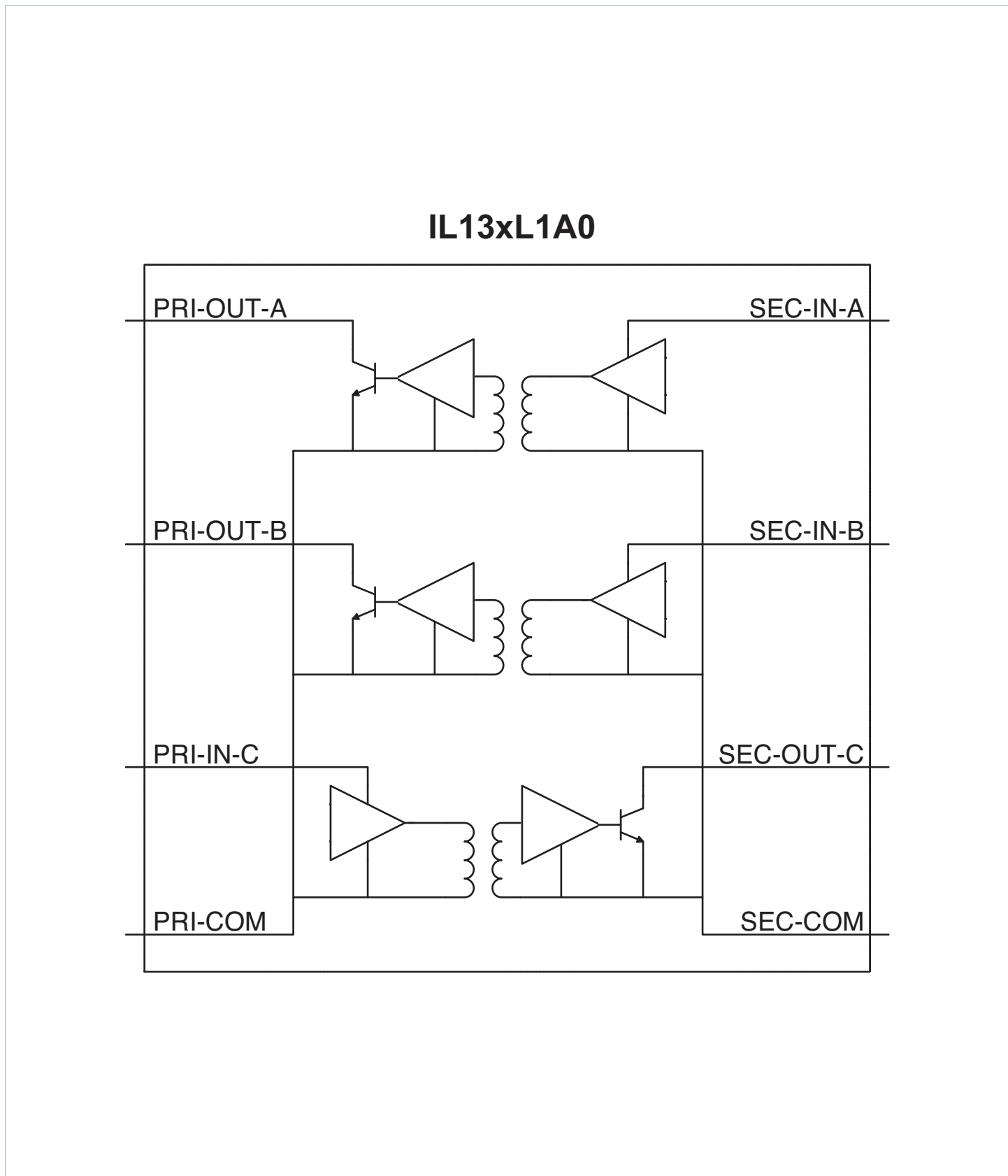
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PRI-COM, SEC-COM								
• PRI-COM and SEC-COM serve as the return current node for any channel inputs or outputs on each side of the Digital Isolator's isolation boundary.								
SIGNAL TYPE	STATE	ATTRIBUTE	SYMBOL	CONDITIONS / NOTES	MIN	TYP	MAX	UNIT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

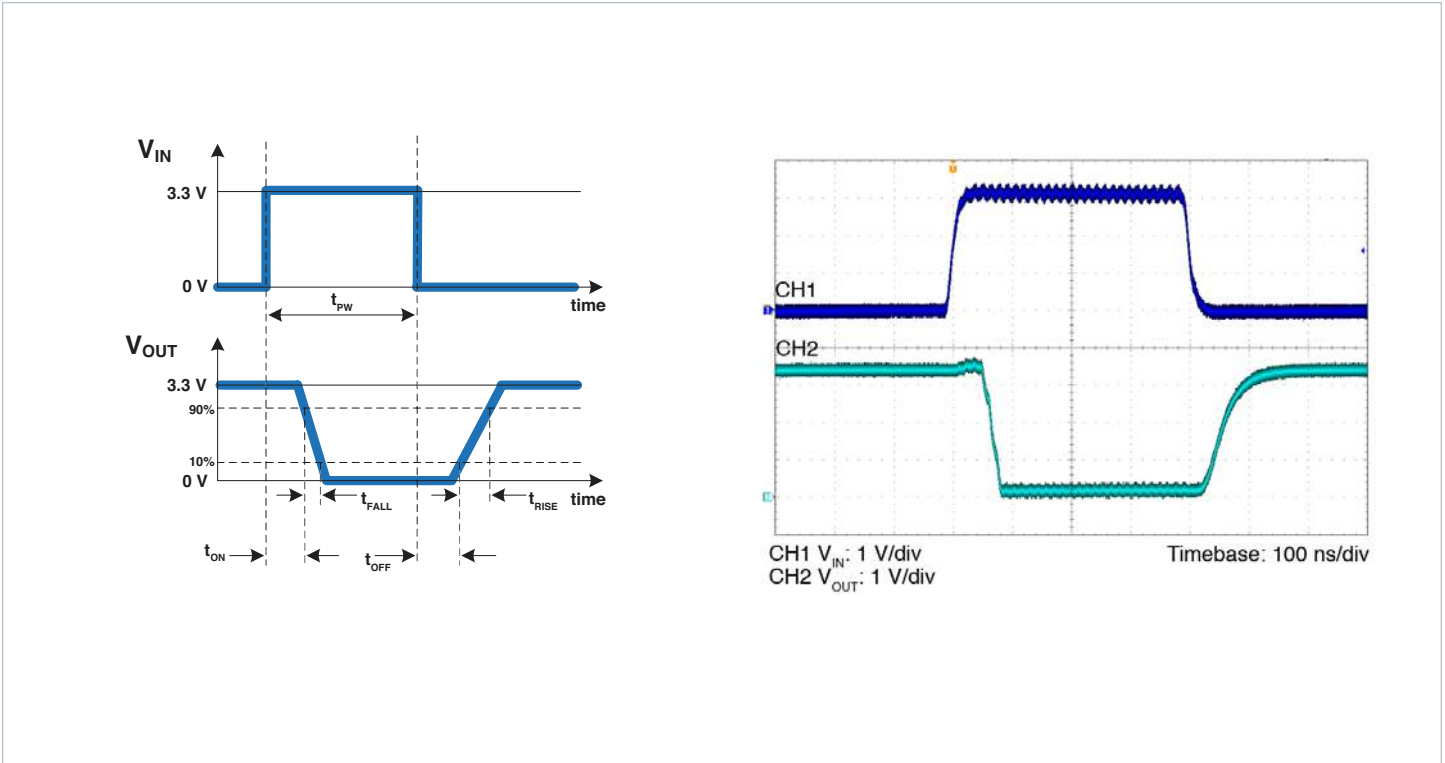
PRI-IN- <i>n</i> , SEC-IN- <i>n</i>								
• PRI-IN- <i>n</i> and SEC-IN- <i>n</i> are the drive sides of each channel. The input characteristics are the same for each of the three channels.								
SIGNAL TYPE	STATE	ATTRIBUTE	SYMBOL	CONDITIONS / NOTES	MIN	TYP	MAX	UNIT
INPUT	OFF	Input voltage	$V_{IL}$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

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

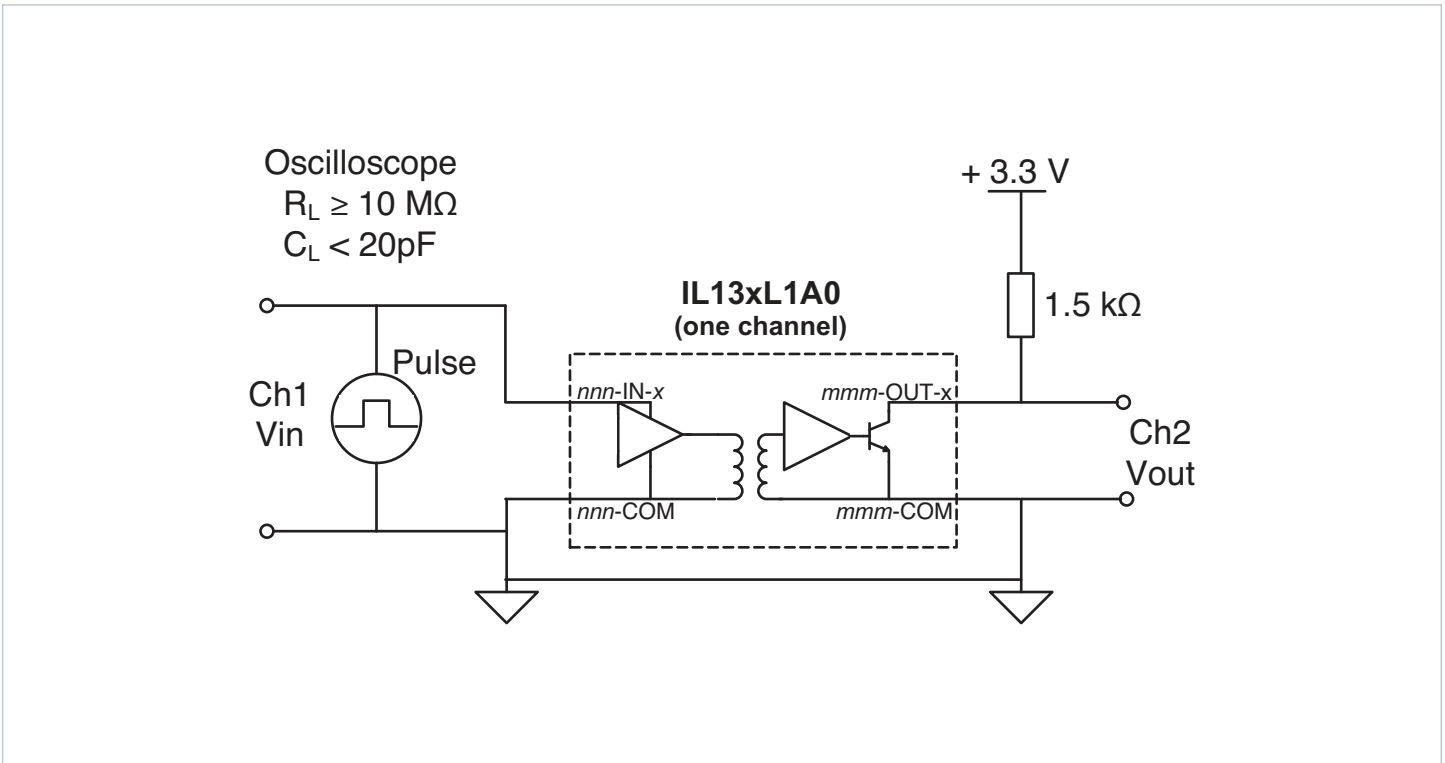
Block Diagram



Timing Definition and Typical Performance Characteristics



Test Circuit



## Safety and Insulation Ratings, General Characteristics

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

Attribute	Symbol	Conditions / Notes	Min	Typ	Max	Unit
<b>Safety and Insulation Ratings</b>						
Insulation resistance		$T_{amb} = 25^{\circ}\text{C}$ , VDC = 500 Vdc	500			M $\Omega$
Creepage distance			<b>8.6</b>			mm
Clearance distance			<b>8.6</b>			mm
Insulation thickness (DTI)			0.4			mm
<b>Mechanical</b>						
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]		cm <sup>3</sup> / [in <sup>3</sup> ]
Weight	W			0.54 / [0.0019]		g / [oz]
Pad finish		Nickel	5.0			$\mu\text{m}$
		Palladium	0.3			
		Gold	0.03			
<b>Thermal</b>						
Power dissipation	$P_D$	All three channels ON, $V_{IN} = 3.6\text{ V}$ , $I_{OUT} = 5\text{ mA}$			<b>100</b>	mW
Thermal resistance	$\theta_{INT-PADS}$			<b>38</b>		$^{\circ}\text{C/W}$
Operating internal temperature $T_{INT}$ is the hottest junction under any specified operating condition	$T_{INT}$	T grade	-40		125	$^{\circ}\text{C}$
		M grade	-55		125	$^{\circ}\text{C}$



## Safety and Insulation Ratings, General Characteristics (Cont.)

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

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

## 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

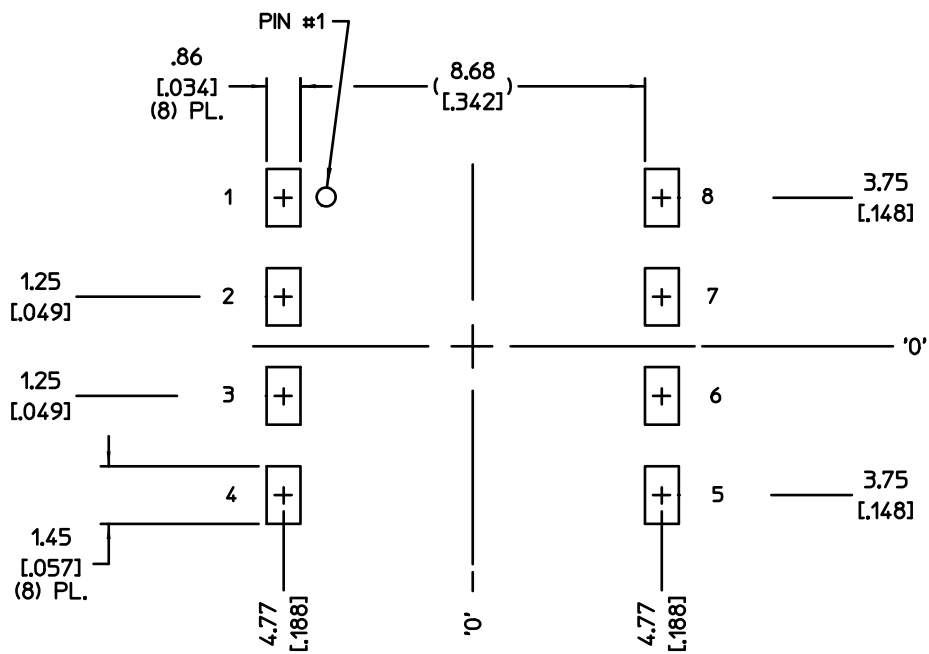
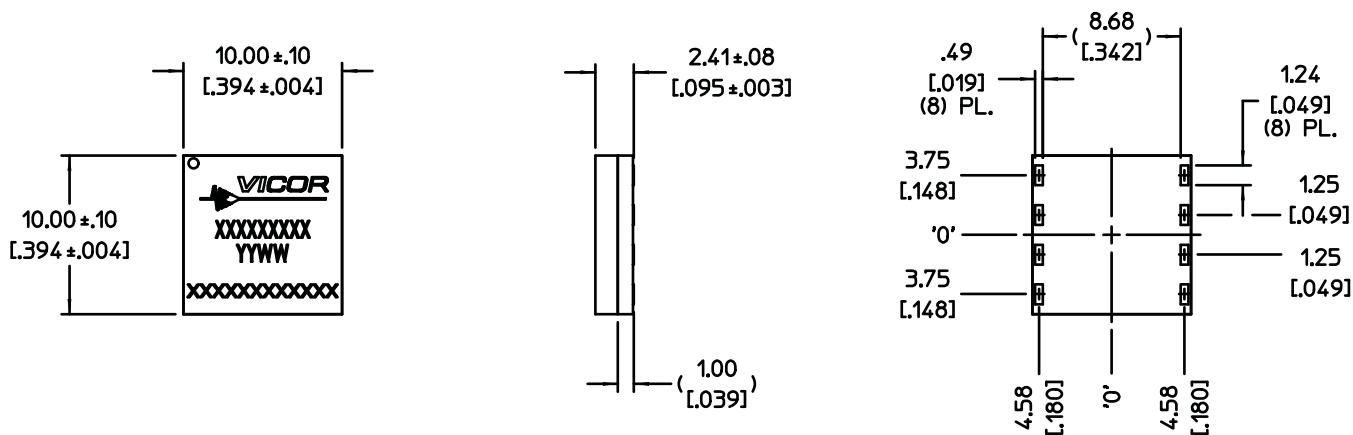
The Digital Isolator should be physically placed near its associated powertrain, across the isolation barrier of PCB. The maximum recommended trace length between any of the Digital Isolator (primary side) transmit and receive channels and the primary referenced control pins of the powertrain is 6".

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.

Product Outline Drawing and Recommended Land Pattern

10 mm x 10 mm LGA (Land Grid Array)



RECOMMENDED LAND PATTERN

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