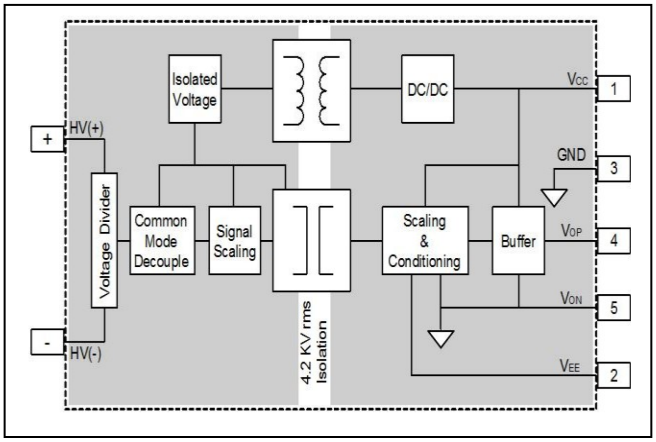
0.1% ACCURACY ±1500V HIGH BANDWIDTH ISOLATED VOLTAGE TRANSDUCER

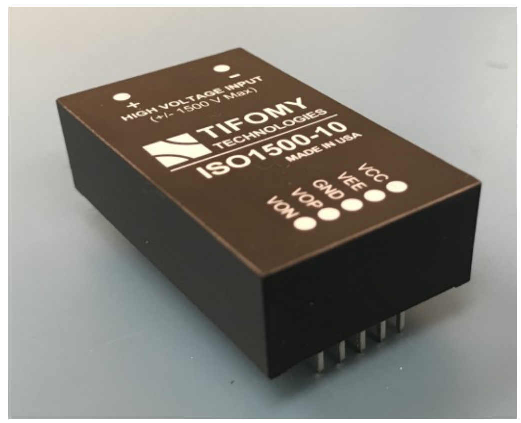
ISO1500-10

Rev A

FEATURES

- Voltage Measurement Range: 0 to ±1500V
- Output Voltage Range: 0 to ±10V
- Both AC and DC Voltage Measurement
- Galvanic Isolated Voltage Rating:4500 Vrms
- Very Low Leakage Current: < 40 uA
- Large Signal Bandwidth: 45KHz
- Overall Accuracy: ±0.1% of Full Scale
- High Capacitance Load Drive (10nF)-Long Cable
- Fast Response Time: 3μS Delay 6us Rise/Fall
- Very Low Nonlinearity: ±0.0005% Max
- High Common Mode Voltage Rejection: 112dB
- High Input Resistance: 3.0MΩ
- Operating Temperature Range: -40ºC to 85ºC
- Low Output Voltage Offset Drift: ±42μV/ ºC
- Very Low Voltage Gain Drift: ±0.0055%/ ºC
- Operating Power Supply Range: ±11V to ±16V
- Low Quiescent Current: <45mA/2.8mA V_{CC}/V_{EE}
- Built-in Isolated Power Supply
- Low Profile Footprint: 1.62”x0.95”x0.531”
- Weight: 22g (0.776 OZ)
- RoHS Compliant
- MTBF 1386 x10^3 Hrs(25ºC) 722 x10^3 Hrs(85ºC)
- Excellent Water and Thermal Shock Resistance
- Flame Retardant(UL 94 V-O)





DESCRIPTION

ISO1500-10 is a high precision high bandwidth voltage transducer that is capable of measuring AC and DC voltages up to ± 1500V with ± 0.1% accuracy. The device is rated 4.5KV rms galvanic isolation with advanced voltage sensing, common mode decoupling, and isolation technology built-in to ensure safe and accurate high voltage measurement. Excellent dynamic characteristics provide large signal bandwidth of 45 KHz and high common mode rejection of 112 dB @ 60Hz. The ISO1500-10 is ideal for high voltage sensing that requires high accuracy, fast response, high common mode rejection, wide operating temperatures (- 40 °C to 85 °C), and a small footprint.

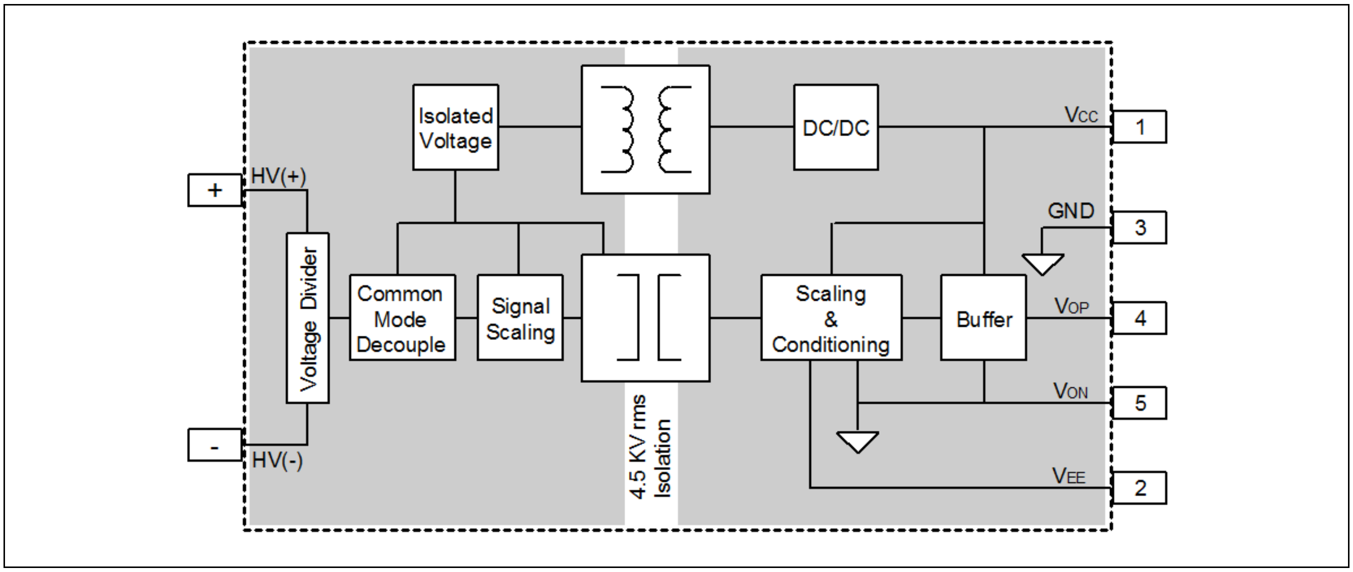
The ISO1500-10 is easy to use and does not require additional components. The device has an internal integrated isolation power supply and circuitry for direct high voltage sensing. Just apply nominal ± 12Vdc power and high voltage to be sensed, the device will output a galvanic isolated voltage signal with voltage attenuation gain of 150. High voltage input pins are “+” and “-” with maximum differential voltage of ± 1500V and voltage rated 4.5KV rms with respect to ground. Operating power supply requirement is ± 12Vdc nominal (range: ± 11V to ± 16V). Pin “VCC” is +12V input, Pin “VEE” is -12V input, and pin “GND” is ± 12V return or GND. Pin “VOP” (reference to Pin “VON”) is the output with full scale output voltage of ± 10V. Pins “+”, “-” and Pins “VCC”, “VEE”, “GND”, “VOP”, “VON” are isolated with reinforced insulation of 4.5KVrms isolation rating.

Output to input voltage gain is 1:150. The ISO1500-10 has excellent gain linearity with typical ± 0.0002% nonlinearity (±100V to ±1500V) and maximum ± 0.0005% nonlinearity at low voltage range (< ±100V). Gain deviation as a function of temperature is typically ± 0.0055% /°C. Output voltage offset drift is typically ±42µV /°C.

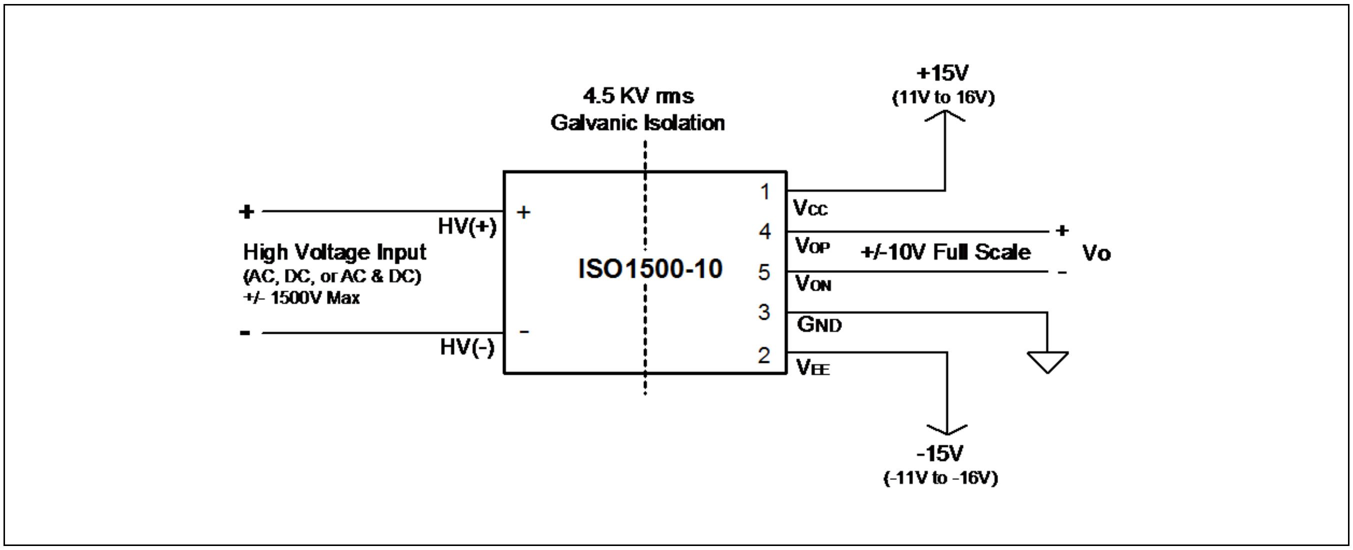
High voltage input resistance is typical 3.0 MΩ and it requires very small power from high voltage bus circuit being sensed. For example, power drawn from a 1500Vdc high voltage bus is 0.75 watts. The input resistance is optimized with dynamic characteristics, DC characteristics, and thermal performance of the device.

The ISO1500-10 requires small quiescent current (41 mA @ +12V) from its VCC input power supply and 2.7 mA max from VEE. The internal integrated isolation power supply is derived from the VCC input to power up high voltage side circuitry.

FUNCTIONAL BLOCK DIAGRAM



TYPICAL APPLICATION WIRING DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Minimum	Maximum	Units
Storage Temperature		TS	-45	+ 95	°C
Ambient Operating Temperature		TA	-40	+ 85	°C
Supply Voltages		VCC [Pin 1]	11	16	V
		VEE [Pin 2]	-11	-16	V
		GND [Pin 3]	0	0.2	V
Steady State Input Voltage		[Pin +] - [Pin -]	-1500	+ 1500	V
Transient Input Voltage (30 Seconds)		[Pin +] - [Pin -]	-1650	+ 1650	V
Output Voltage		Vo [Pin 4]-[Pin 5]	-16	16	V
Pins Soldering	Temperature			260	°C
	Time Duration			15	S

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Minimum	Maximum	Units
Ambient Operating Temperature	TA	-40	+ 85	°C
Supply Voltages	VCC [Pin 1]	12	15	V
	VEE [Pin 2]	-12	-15	V
Input Voltage Range	[Pin +] - [Pin -]	-1500	1500	V

ELECTRICAL CHARACTERISTICS

At T_A = +25°C, Vcc = +12V VEE=-12V, and RL = 10kΩ, unless otherwise noted

PARAMETER	CONDITIONS	Fig	Note	ISO1000-10			UNITS
				MIN	TYP	MAX	
ISOLATION							
Isolation Voltage Rating	Input to Output, 60Hz AC, 60sec 100% Tested	17	1	4500			Vrms
Leakage Current	Input to Output, 4500 Vrms @ 60Hz				28	40	µA rms
GAIN							
Nominal Gain	Output to Input Voltage Ratio	1-2	2		1/150		V/V
Overall Accuracy		3	3			±0.1	%
Gain Vs Temperature	-40 °C to 85 °C	6	4			±0.0055	% / ºC
Nonlinearity		4	5		±0.0002	±0.0005	%
COMMON MODE REJECTION							
Frequency Response	60Hz 10KHz 500KHz	16,19	6		112 79 56		dB dB dB
Transient Immunity	1000V Step Excitation	15,20	7		1		V
INPUT VOLTAGE							
Voltage Range	Continuous Operation	18	8			±1500	V
Resistance	Between Pin “+” and Pin “-“				3.0		MΩ
OUTPUT VOLTAGE							
Voltage Range						± 10	V
Offset Voltage						± 5	mV
Voltage Offset Drift	Deviation from offset @ 25ºC	18	9		± 42		µV / ºC
Current Drive					±10		mA
Capacitive Load	In parallel with 2KΩ				10		nF
Ripple Voltage	Vin=0V with 2K 1nF RC Filter				±10		mV
DYNAMIC RESPONSE	**DYNAMIC RESPONSE**						
Large Signal Bandwidth	Vin Amplitude:1000V	7-12	10		45		KHz
Propagation Delay	Pulse Transient Test	13-14 22	11		3		µS
Slew Rate			11		2.5		V / µS
POWER SUPPLY							
Supply Voltage	Rated Input Voltage Range			±11	±12	±15	V
Quiescent Current (VCC)				40.1	40.7	42.2	mA
Quiescent Current (VEE)				2.7	2.7	2.7	mA
Temperature Range							
Operating	Continuous Full Input Voltage			- 40		85	ºC
Storage	Non-Power			- 45		95	ºC

PERFORMANCE CHARACTERISTICS

At TA = +25°C, Vcc = +12V VEE=-12V, and RL = 10kΩ, unless otherwise noted

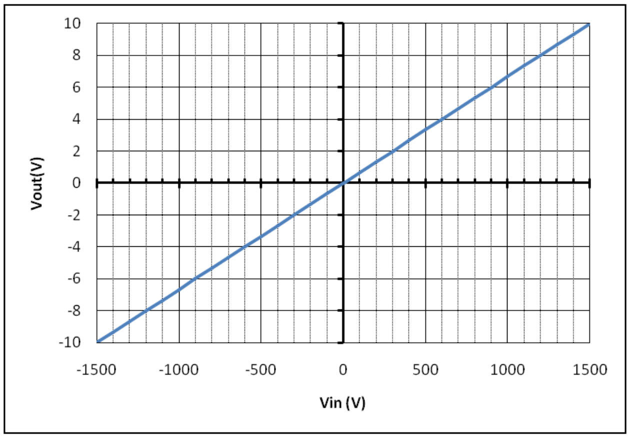


Figure 1: Input to Output Voltage

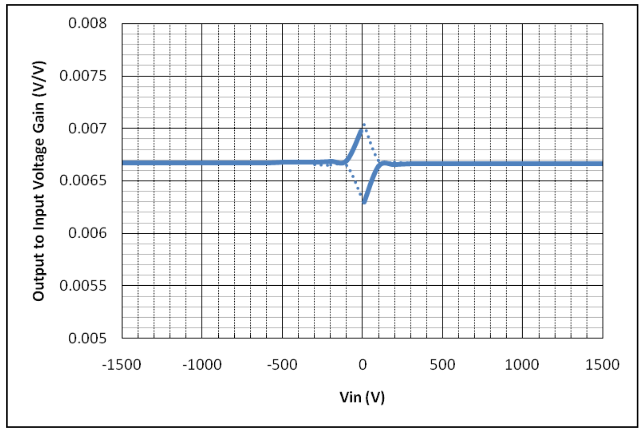


Figure 2: Output to Input Voltage Gain

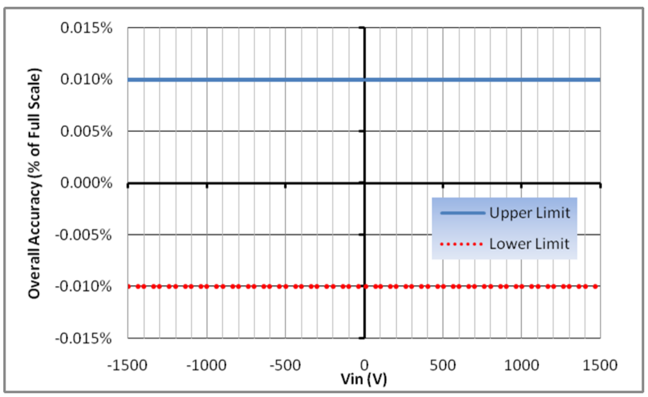


Figure 3: Voltage Sensing Overall Accuracy

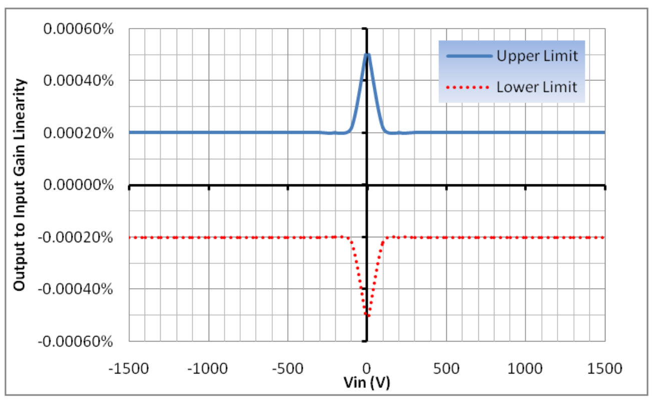


Figure 4: Gain Nonlinearity

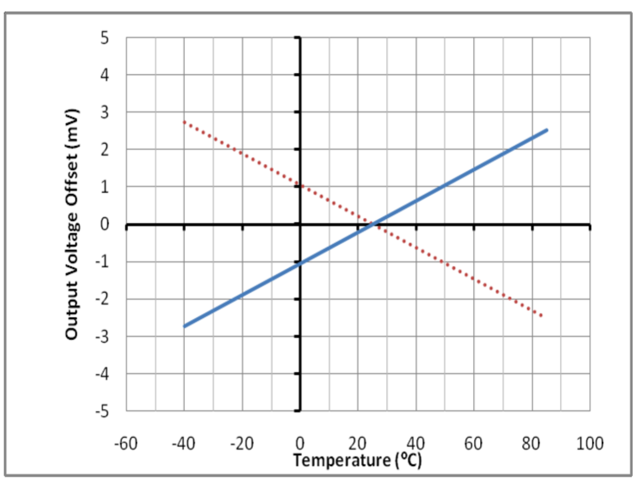


Figure 5: Output Voltage Drift vs. Temperature

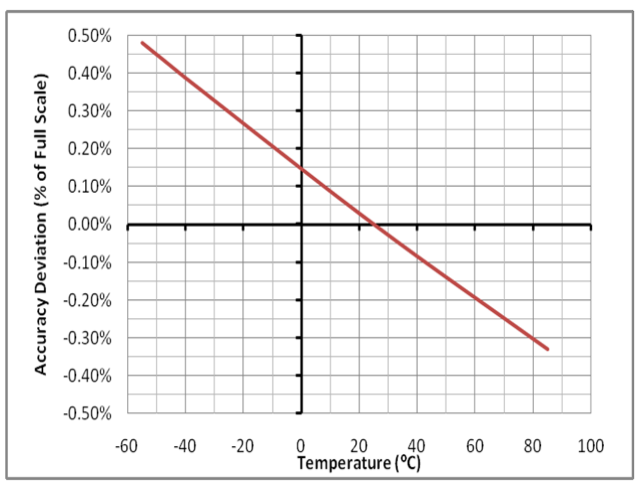


Figure 6: Gain Percentage Deviation vs. Temperature

PERFORMANCE CHARACTERISTICS (-Continue)

At T_A = +25°C, Vcc = +12V VEE=-12V, and RL = 10kΩ, unless otherwise noted

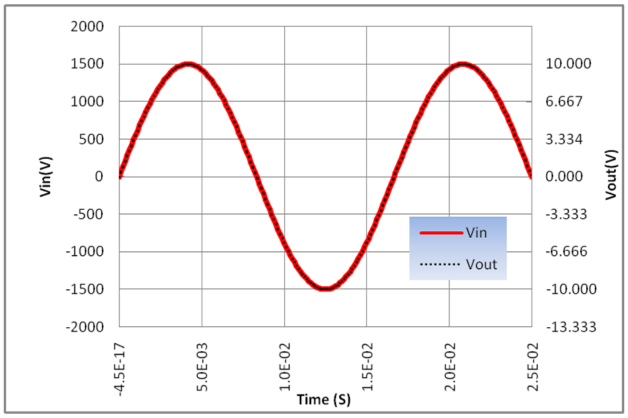


Figure 7: 60Hz Response

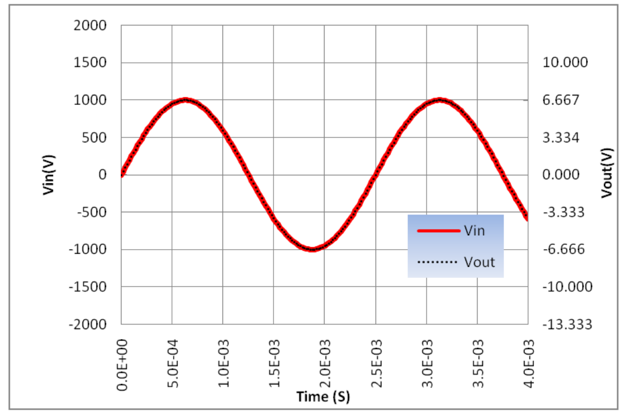


Figure 8: 400Hz Response

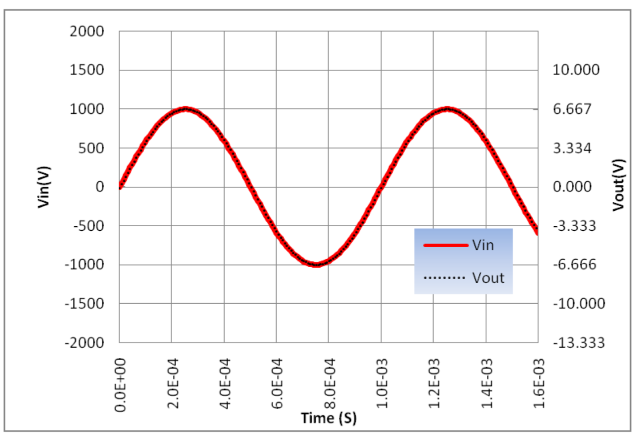


Figure 9: 1KHz Response

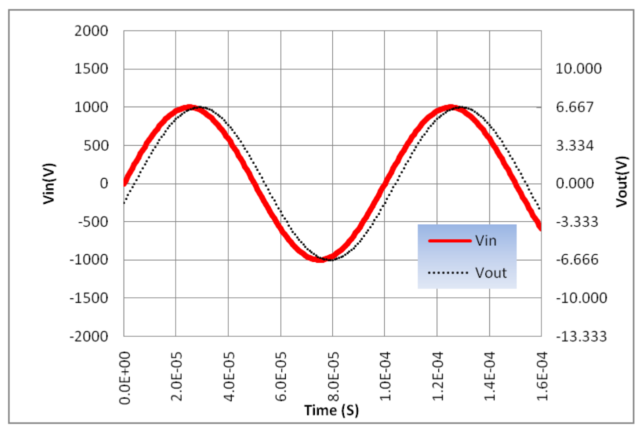


Figure 10: 10KHz Response

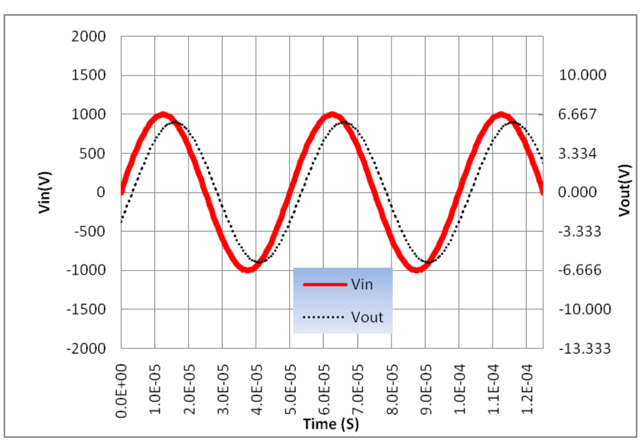


Figure 11: 20KHz Response

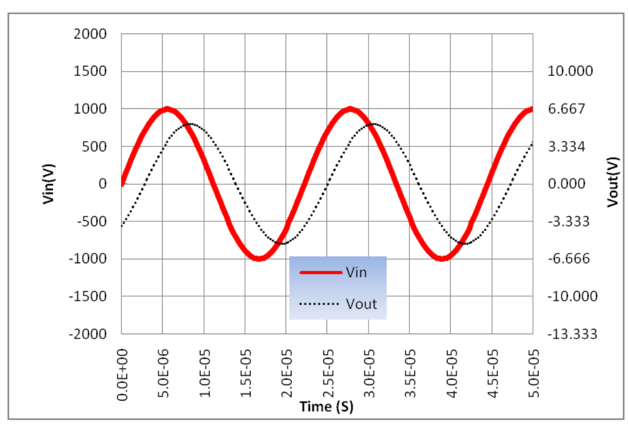


Figure 12: 45KHz Response

PERFORMANCE CHARACTERISTICS (-Continue)

At T_A = +25°C, Vcc = +12V VEE=-12V, and RL = 10kΩ, unless otherwise noted

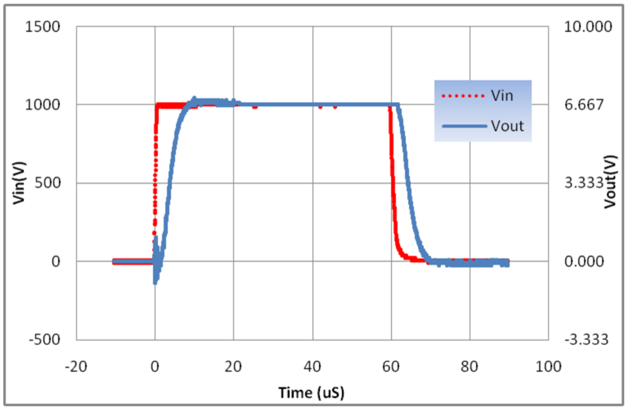


Figure 13: 1000V Input Step Response

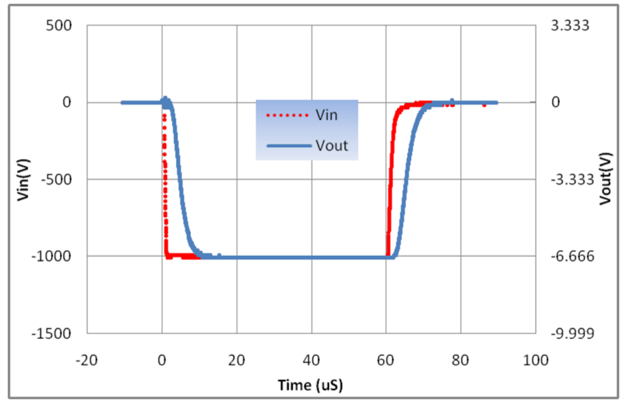


Figure 14: -1000V Input Step Response

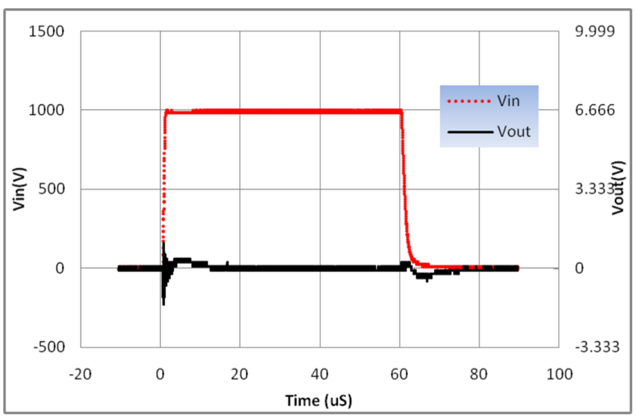


Figure 15: 1000V Common Mode Rejection Response

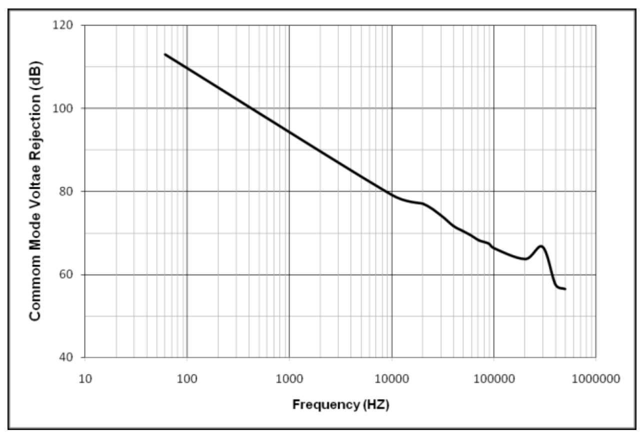


Figure 16: Common Mode Frequency Response

Note:

1. The 4500Vrms 60Hz is applied between shorted high voltage pins (“+” and “-“) and shorted low voltage pins (VCC, VEE, GND,VOP and VON) for a duration of 60 seconds at room temperature. Passing criteria is less than 40 μA. Each device is 100% tested by this test.
2. Isolated output voltage (pin “VOP” - pin “VON”) is plotted as a function of high voltage input (pin “+”- pin “-“). Gain is defined as the ratio of output voltage (pin “VOP” – pin “VON”) and input voltage (pin “+” - pin “-“).
3. Overall accuracy is defined as voltage error between measured output voltage and actual input voltage divided by 150, expressed as a percentage of the full-scale differential output voltage.
4. Gain vs. temperature is defined as gain deviation from the gain at 25°C, expressed as a percentage per degree C over the operating temperature range of -40°C to 85°C.
5. Nonlinearity is defined as gain deviation from the best-fit gain line, expressed as a percentage of the full-scale differential output voltage.

6. See figure 19 for common mode rejection frequency response test setup.

7. See figure 20 for common mode rejection transient immunity test setup.

8. This is continuous voltage operation range. Maximum DC voltage operation is ± 1500V. Maximum AC voltage operation is 1060.5 Vrms. The amplitude of the AC voltage is 1.414*1060.5=1500V for 1060.5 Vrms.

9. The output voltage offset drift is defined as voltage deviation from the offset measured at 25 °C with zero input voltage, expressed as per degree C over the operating temperature range of -40°C to 85°C.

10. This is the output voltage response for a sinusoidal input voltage with (1) fixed amplitude of 1500V and frequency 60Hz (2) fixed amplitude of 1000V and frequency from 10KHz to 45 KHz.

11. The propagation delay is the time delay between input voltage applied and output voltage starts to respond. Slew rate is the output voltage linearly increased in volts per micro second when a voltage input step is applied.

12. Calculation of MTBF (Mean Time Between Failure) is based on Mil-HDBK-217F Notice 2.

TEST SETUP

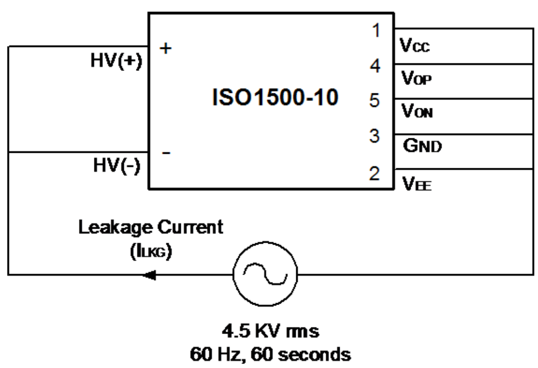


Figure 17: Isolation (Hi-Pot) Test Setup

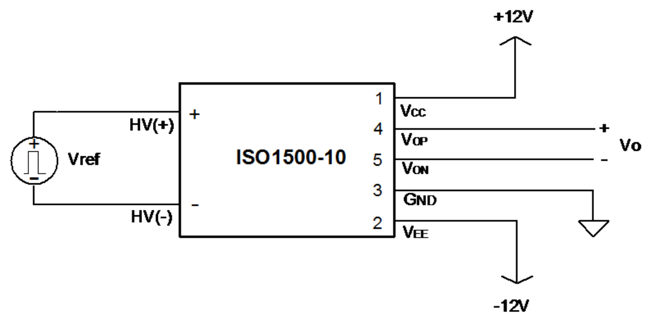


Figure 18: Voltage Step Response Test Setup

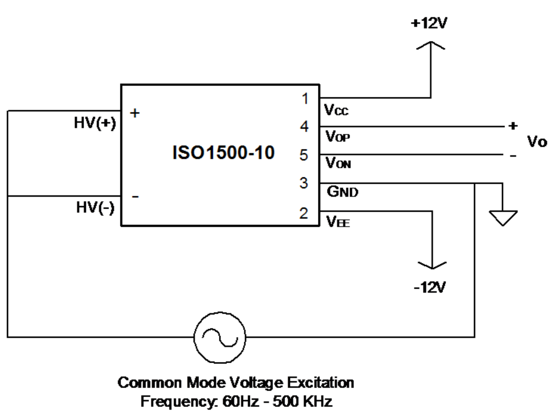


Figure 19: Common Mode Rejection Frequency Response Test Setup

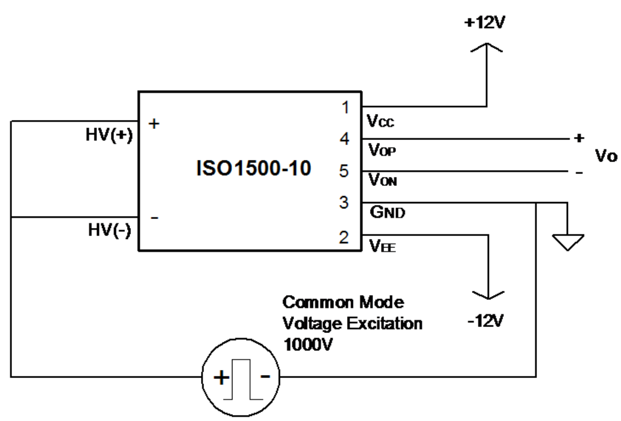
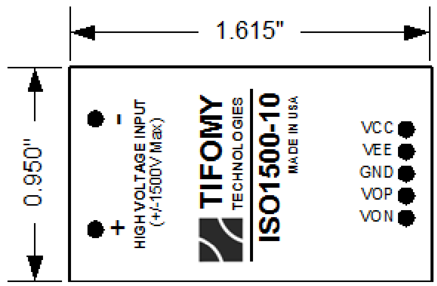
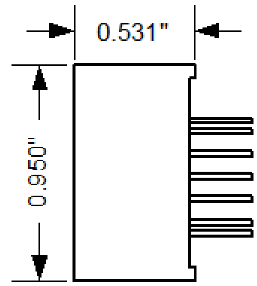


Figure 20: Common Mode Rejection Transient Immunity Test Setup

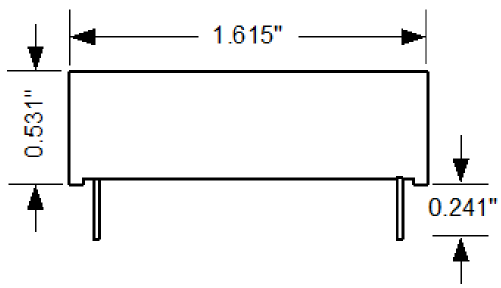
PACKAGE OUTLINE



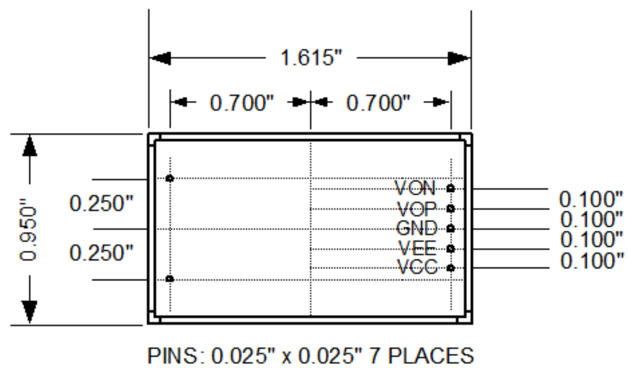
Top View



Right View



Front View



Bottom View

PACKAGE WEIGHT

0.776 OZ (22 g)

WARNING!

 Danger! Electrical Shock Risk	The exposed pins of the voltage transducer can carry hazardous voltage. The device must be used in a protective housing and the conducting parts must be inaccessible after installation. Ignoring this warning can lead to injury and/or serious damage.

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