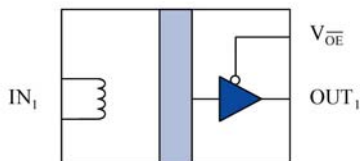# Passive Input Digital Isolators – CMOS Outputs
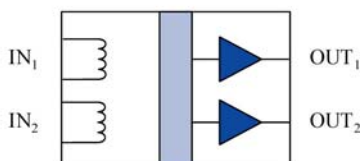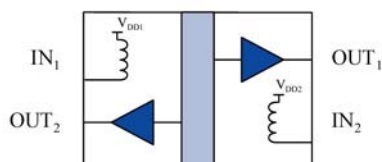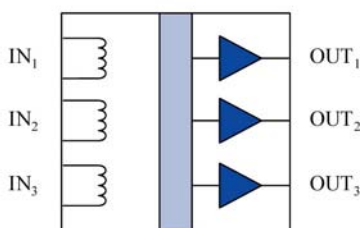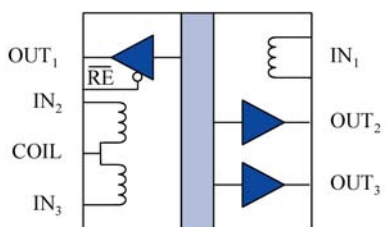
Functional Diagram

IL610

IL611

IL612

IL613

IL614

Features

- Up to 100 Mbps Data Rate
- Single-ended or Differential Input Operation
- Very Wide Input Voltage Range
- Failsafe Output (logic high output for zero coil current)
- Output Enable (IL610)
- 3.3 V or 5 V Operation / Level Translation
- 2500 V_{RMS} Isolation (1 minute)
- Low Power Dissipation
- -40°C to 85°C Temperature Range
- 20 kV/µs Minimum Common Mode Rejection
- UL1577 & IEC61010 Approval
- 8-Pin MSOP, SOIC, PDIP Packages

Applications

- CAN Bus / Device Net
- Optocoupler Replacement
- SPI interface
- RS485, RS422, RS232
- Digital Fieldbus
- Size critical multi-channel applications

Description

The IL600 series are passive input digital signal isolators with CMOS outputs and enhanced circuit performance over optocoupler solutions in most standard isolation applications. The devices are manufactured with NVE's patented IsoLoop GMR sensor technology giving exceptionally small size and low power dissipation.

A single resistor is used to set maximum input current for input voltages above 0.5 V. Improved dynamic performance is available by adding a capacitor in parallel with the current limit resistor. This versatile feature eliminates the need to hold a wide variety of optocouplers in inventory since the IsoLoop functions equally well at all data rates, edge speeds and power supply levels, enabling use in most optocoupler applications. The devices are available in the SOIC, PDIP and MSOP packages.

REV. F

Absolute Maximum Ratings[(1)]

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	-55		150	°C	
Ambient Operating Temperature	T_A	-55		125	°C	
Supply Voltage	V_{DD}	-0.5		7	V	
Input Current	I_{IN}	-25		25	mA	
Output Voltage	V_O	-0.5		V_{DD}+0.5	V	
Maximum Output Current	I_O	-10		10	mA	
ESD			2		kV	HBM

Note 1: Operating at absolute maximum ratings will not damage the device. Parametric performance is not guaranteed at absolute maximum ratings.

Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Ambient Operating Temperature	T_A	-40		85	°C	
Supply Voltage	V_{DD}	3.0		5.5	V	
Input Current	I_{IN}	0		5	mA	
Output Current	I_{OUT}	-4		4	mA	
Common Mode Input Voltage	V_{CM}			400	V_{RMS}	

Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (mm)						
MSOP		3.010			mm	
0.15" SOIC		4.026			mm	
0.30" SOIC		8.077			mm	
0.30" PDIP		7.077			mm	
Internal Isolation Distance			9		μm	
Leakage Current			0.2		μA	240 V_{RMS}, 60 Hz
Barrier Impedance			$>10^{14}\|7$		$\Omega \| pF$	
Rated Voltage (1minute), SOIC, PDIP	V_{ISO}	2500			V_{AC}	50 Hz to 60 Hz
Rated Voltage (1minute), MSOP	V_{ISO}	1000			V_{AC}	50 Hz to 60 Hz

Safety Approvals

IEC61010-2001

TUV Certificate Numbers: N1502812, N1502812-101

Classification: Reinforced Insulation

| Model	Package	Pollution Degree	Material Group	Max. Working Voltage
IL610-2E, IL611-2E, IL612-2E	PDIP	II	III	300 V_{RMS}
IL613E, IL614E	SOIC (0.3")	II	III	300 V_{RMS}
IL610-3E, IL611-3E, IL612-3E, IL613-3E, IL614-3E	SOIC (0.15")	II	III	150 V_{RMS}

UL 1577

Component Recognition program File #: E207481
Rated 2500V_{RMS} for 1 minute (SOIC, PDIP), 1000V_{RMS} for 1 minute (MSOP)

Electrostatic Discharge Sensitivity

This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to complete failure.
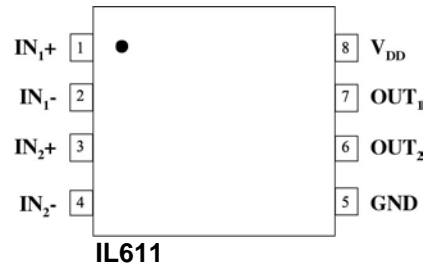
IL610 Pin Connections

1	NC	No internal connection
2	IN+	Coil connection
3	IN-	Coil connection
4	NC	No internal connection
5	GND	Ground return for V_{DD}
6	OUT	Data out
7	$V_{\overline{OE}}$	Output enable. Internally held low with 100 kΩ
8	V_{DD}	Supply Voltage

IL610
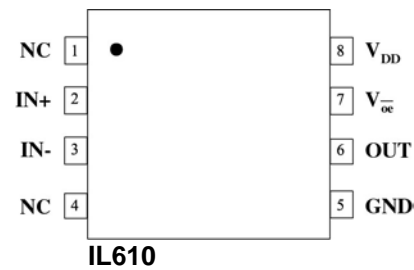
IL611 Pin Connections

1	IN_1+	Channel 1 coil connection
2	IN_1-	Channel 1 coil connection
3	IN_2+	Channel 2 coil connection
4	IN_2-	Channel 2 coil connection
5	GND	Ground return for V_{DD}
6	OUT_2	Data out, channel 2
7	OUT_1	Data out, channel 1
8	V_{DD}	Supply Voltage

IL611

IL612 Pin Connections

1	IN_1	Data in, channel 1
2	$V_{DD\,1}$	Supply Voltage 1
3	OUT_2	Data out, channel 2
4	GND_1	Ground return for V_{DD1}
5	GND_2	Ground return for V_{DD2}
6	IN_2	Data in, channel 2
7	$V_{DD\,2}$	Supply Voltage 2
8	OUT_1	Data out, channel 1

IL612
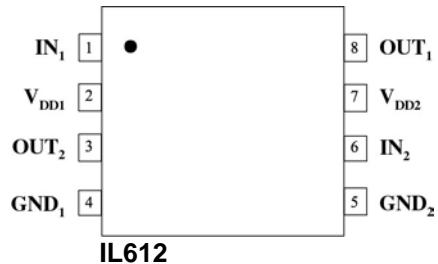
IL613 Pin Connections

| 1	IN_1+	Channel 1 coil connection
2	NC	No connection (internally connected to pin 8)
3	IN_1-	Channel 1 coil connection
4	IN_2+	Channel 2 coil connection
5	IN_2-	Channel 2 coil connection
6	IN_3+	Channel 3 coil connection
7	IN_3-	Channel 3 coil connection
8	NC	No connection (internally connected to pin 2)
9	GND	Ground return for V_{DD} (internally connected to pin 15)
10	OUT_3	Data out, channel 3
11	NC	No connection
12	V_{DD}	Supply Voltage. Pin 12 and pin 16 must be connected externally
13	OUT_2	Data out, channel 2
14	OUT_1	Data out, channel 1
15	GND	Ground return for V_{DD} (internally connected to pin 9)
16	V_{DD}	Supply Voltage. Pin 12 and pin 16 must be connected externally

IL613
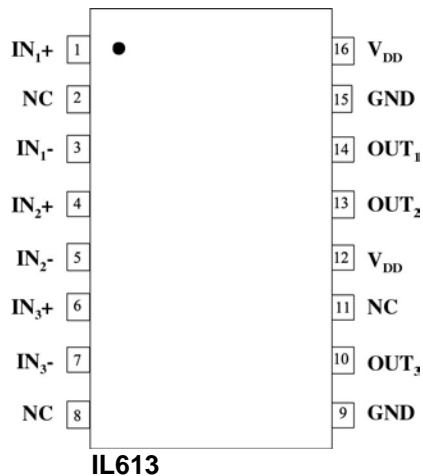
Note. Pin 12 and pin 16 must be connected externally.

IL614 Pin Connections

1	V_{DD1}	Supply Voltage 1
2	GND_1	Ground return for V_{DD1} (internally connected to pin 8)
3	OUT_1	Data out, channel 1
4	$\overline{RE}$	Channel 1 data output enable. Internally held low with 100 kΩ
5	IN_2	Data in, channel 2
6	V_{coil}	Supply connection for channel 2 and channel 3 coils
7	IN_3	Data in, channel 3
8	GND_1	Ground return for V_{DD1} (internally connected to pin 2)
9	GND_2	Ground return for V_{DD2} (internally connected to pin 15)
10	NC	No Connection
11	OUT_3	Data out, channel 3
12	V_{DD2}	Supply Voltage 2
13	OUT_2	Data out, channel 2
14	IN_1+	Coil connection
15	GND_2	Ground return for V_{DD2} (internally connected to pin 9)
16	IN_1-	Coil connection

IL614
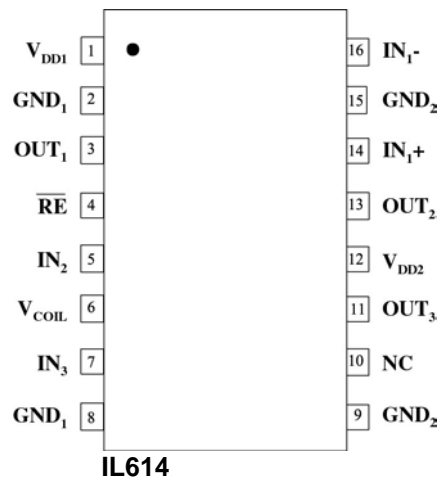
Soldering Profile
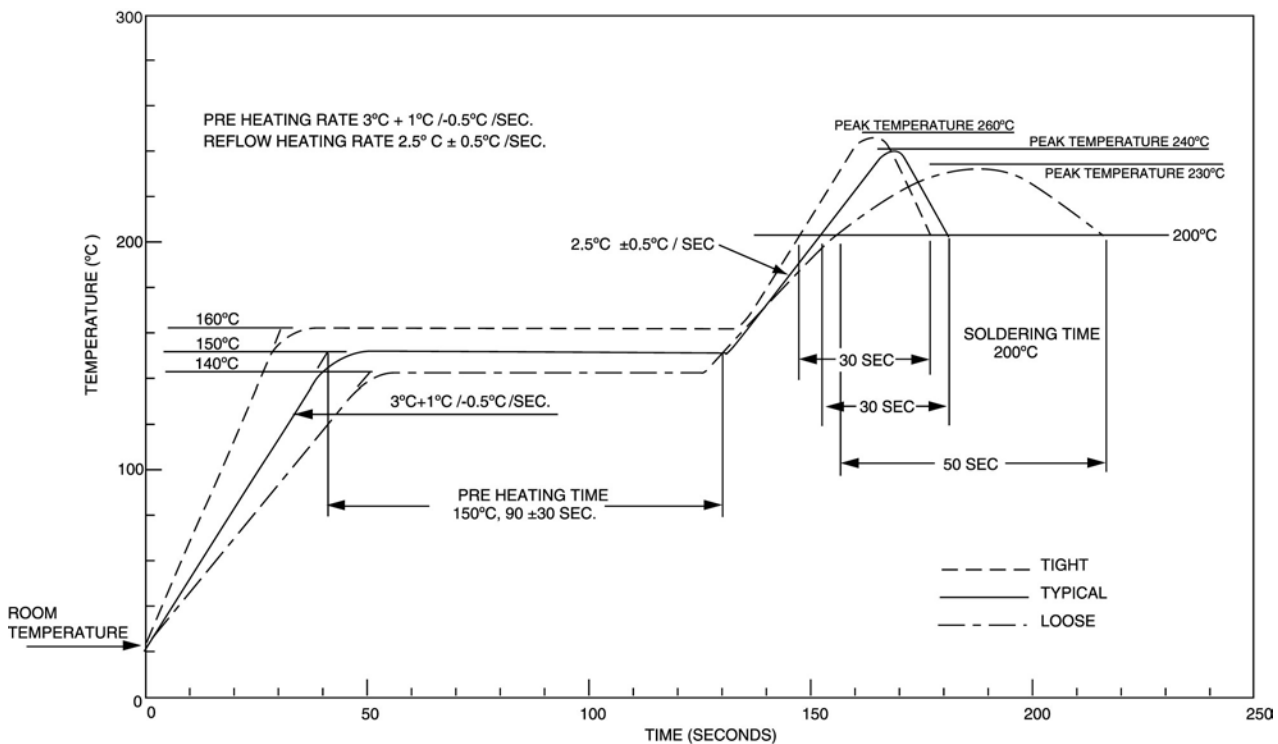
Electrical Specifications

Electrical specifications are T_{min} to T_{max} and 4.5 V to 5.5 V unless otherwise stated.

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Coil Input Impedance	Z_{COIL}	47‖8	55‖9	87‖10	Ω‖nH	$T_{AMB} = 25°C$
Temperature Coefficient of Coil Resistance	TC R_{COIL}		0.16	0.165	Ω/°C	
Input Threshold for Output Logic High	I_{INH}	0.5	1		mA	
Input Threshold for Output Logic Low	I_{INL}	5	3.5	10	mA	
Quiescent Current	IL610, I_{DD}		2	3	mA	$V_{DD} = 5$ V, $I_{IN} = 0$
	IL611, I_{DD}		4	6	mA	
	IL612, I_{DD1}		2	3	mA	
	IL612, I_{DD2}		2	3	mA	
	IL613, I_{DD}		6	9	mA	
	IL614, I_{DD1}		2	3	mA	
	IL614, I_{DD2}		4	6	mA	
Logic High Output Voltage	V_{OH}	4.9	5		V	$V_{DD} = 5$ V, $I_O = 20$ μA
		4.0	4.8			$V_{DD} = 5$ V, $I_O = 4$ mA
Logic Low Output Voltage	V_{OL}		0	0.1	V	$V_{DD} = 5$ V, $I_O = -20$ μA
			0.2	0.8		$V_{DD} = 5$ V, $I_O = -4$ mA
Logic Output Drive Current	$|I_O|$	7	10		mA	
Switching Specifications at 5V with Circuit Configuration # 1						
Input Signal Rise and Fall Times	t_{IR}, t_{IF}			1	us	See Test Circuit 1
Data Rate			100		Mbps	See Test Circuit 1
Minimum Pulse Width[1]	PW	10			ns	See Test Circuit 1
Propagation Delay Input to Output (High to Low)	t_{PHL}		8	15	ns	See Test Circuit 1
Propagation Delay Input to Output (Low to High)	t_{PLH}		8	15	ns	See Test Circuit 1
Average Propagation Delay Drift	t_{PLH}		10		ps/°C	
Pulse Width Distortion $|t_{PHL}-t_{PLH}|$ [2]	PWD		3	5	ns	See Test Circuit 1
Propagation Delay Skew [3]	t_{PSK}	-2		2	ns	See Test Circuit 1
Output Rise Time (10-90%)	t_R		2	4	ns	See Test Circuit 1
Output Fall Time (10-90%)	t_F		2	4	ns	See Test Circuit 1
Common Mode Transient Immunity	$|CM_H|,|CM_L|$	15	20		kV/μs	$V_T = 300$ V_{peak}
Switching Specifications at 5V with Circuit Configuration # 2						
Input Signal Rise and Fall Times	t_{IR}, t_{IF}			50	ms	See Test Circuit 2
Data Rate		20			Mbps	See Test Circuit 2
Minimum Pulse Width[1]	PW	50			ns	See Test Circuit 2
Propagation Delay Input to Output (High to Low)	t_{PHL}		15	40	ns	See Test Circuit 2
Propagation Delay Input to Output (Low to High)	t_{PLH}		15	40	ns	See Test Circuit 2
Average Propagation Delay Drift	t_{PLH}		10		ps/°C	
Pulse Width Distortion $|t_{PHL}-t_{PLH}|$ [2]	PWD		3.5	15	ns	See Test Circuit 2
Propagation Delay Skew [3]	t_{PSK}	-7		7	ns	See Test Circuit 2
Output Rise Time (10-90%)	t_R		2	4	ns	See Test Circuit 2
Output Fall Time (10-90%)	t_F		2	4	ns	See Test Circuit 2
Common Mode Transient Immunity	$|CM_H|,|CM_L|$	15	20		kV/μs	$V_T = 300$ V_{peak}

Notes:
1. Minimum Pulse Width is the shortest pulse width at which the specified PWD is guaranteed.
2. PWD is defined as $| t_{PHL} - t_{PLH} |$.
3. t_{PSK} is equal to the magnitude of the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units at 25°C.

Electrical specifications are T_{min} to T_{max} and 3.0V to 3.6V unless otherwise stated.

| Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Quiescent Current	IL610, I_{DD}		1.3	2	mA	V_{DD} = 3.3 V, I_{IN} = 0
	IL611, I_{DD}		2.6	4	mA	
	IL612, I_{DD1}		1.3	2	mA	
	IL612, I_{DD2}		1.3	2	mA	
	IL613, I_{DD}		4	6	mA	
	IL614, I_{DD1}		1.3	2	mA	
	IL614, I_{DD2}		2.6	4	mA	
Logic High Output Voltage	V_{OH}	3.2	3.3		V	V_{DD} = 3.3 V, I_O = 20 μA
		3.0	3.1			V_{DD} = 3.3 V, I_O = 4 mA
Logic Low Output Voltage	V_{OL}		0	0.1	V	V_{DD} = 3.3 V, I_O = -20 μA
			0.2	0.8		V_{DD} = 3.3 V, I_O = -4 mA
Logic Output Drive Current	$|I_O|$	7	10		mA	
Switching Specifications at 3.3V with Circuit Configuration # 1						
Input Signal Rise and Fall Times	t_{IR}, t_{IF}			1	μs	See Test Circuit 1
Data Rate		100			Mbps	See Test Circuit 1
Minimum Pulse Width[1]	PW	10			ns	See Test Circuit 1
Propagation Delay Input to Output (High to Low)	t_{PHL}		12	18	ns	See Test Circuit 1
Propagation Delay Input to Output (Low to High)	t_{PLH}		12	18	ns	See Test Circuit 1
Average Propagation Delay Drift	t_{PLH}		10		ps/°C	
Pulse Width Distortion $|t_{PHL}-t_{PLH}|$ [2]	PWD		3	5	ns	See Test Circuit 1
Propagation Delay Skew [3]	t_{PSK}	-2		2	ns	See Test Circuit 1
Output Rise Time (10-90%)	t_R		3	5	ns	See Test Circuit 1
Output Fall Time (10-90%)	t_F		3	5	ns	See Test Circuit 1
Common Mode Transient Immunity	$|CM_H|$,$|CM_L|$	15	20		kV/μs	V_T = 300 V_{peak}

Notes.

4. The Minimum Pulse Width is the shortest pulse width at which the specified PWD is guaranteed.

5. PWD is defined as $|t_{PHL} - t_{PLH}|$.

6. t_{PSK} is equal to the magnitude of the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between units at 25°C.

Test Circuits

These circuits show the configurations used to obtain the specifications on the previous pages. All applications should follow these circuits closely. The circuits shown use the IL610. However, the input configuration applies to all the devices in the IL600 series. A bypass capacitor should be placed across the current limit resistor to achieve the enhanced timing specifications. This capacitor must be in all 3.3V applications unless true differential signalling is used.

The circuits shown are in the non-inverting configuration. The same technique must also be used for inverting configurations.

Test Circuit #1	Test Circuit #2
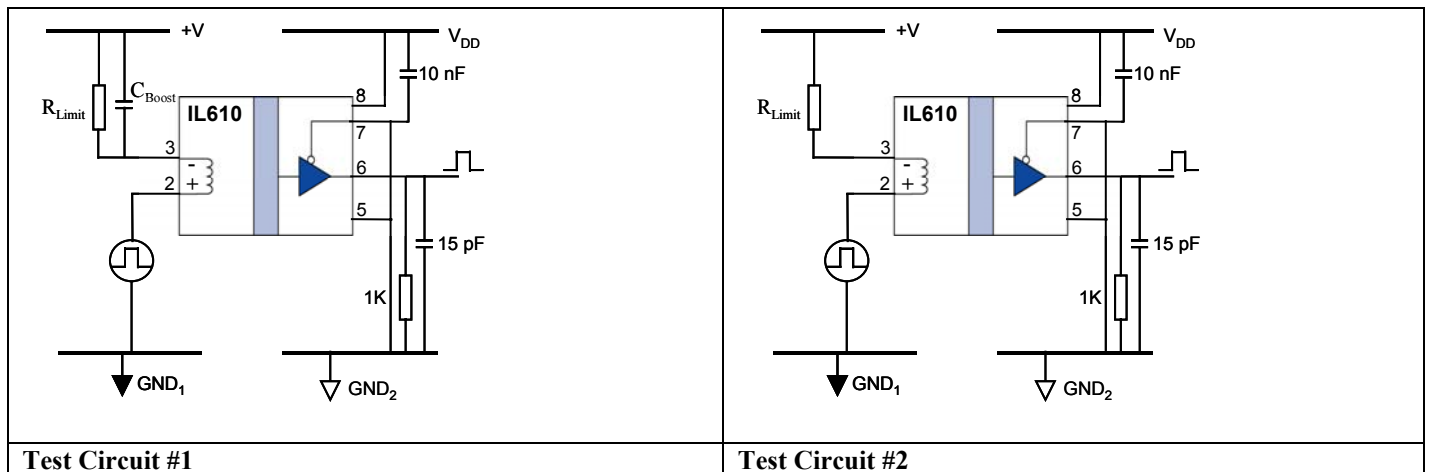
Select a bypass capacitor value based on the rise and fall times of the input signal to be isolated. The value chosen is not critical and can vary +/- 50% with little noticeable difference in device performance. This chart is shown as a guide.

For standard logic signals (t_r, t_f < 10 ns) a 16pF capacitor is recommended.

C_{boost} Selector
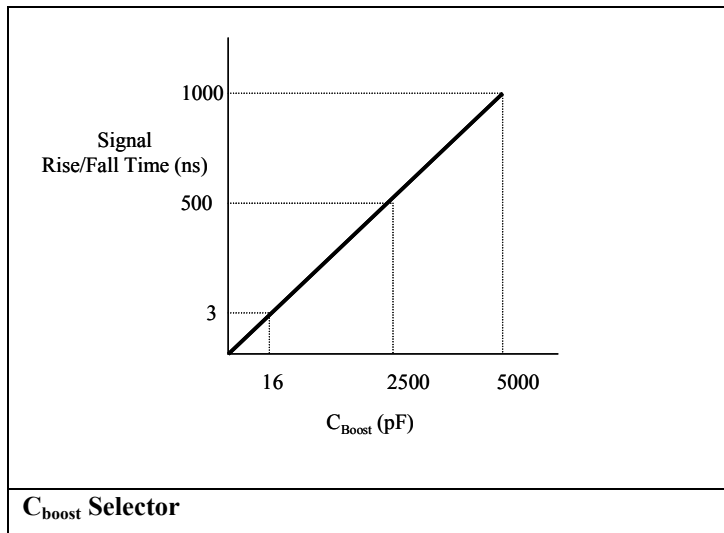
Operation

The IL600 series are current mode devices. Changes in current flow into the input coil result in logic state changes at the output. One of the great advantages of the passive coil input is that both single ended and differential inputs can be handled without the need for reverse bias protection. The internal GMR sensor switches the output to logic low if current flows from (In-) to (In+). Only a single resistor is required to limit the input coil to the recommended 5 mA. This allows large input voltages to be used since there is no semiconductor structure on the input.

The absolute maximum current through the coil of the IL600 series is 25 mA DC. The worst case logic threshold current is 5 mA. While typical threshold currents are actually less than this, NVE recommends designing a 5 mA logic threshold current in each application. In all cases, the current must flow from In- to In+ in the coil to switch the output low. This is the case for true or inverted data, or single ended or differential configurations. Output logic high is the zero input current state.

Figure 1 shows the response of the IL600 series. The GMR bridge structure is designed such that the output of the isolator is logic high when no field signal is present. The output will switch to the low state with approximately 3.5 mA of coil current, and switch back to the high state when the input current falls below 1.5 mA. This allows glitch-free interface with low slew rate signals.

To calculate the value of the protection resistor (R1) required, use Ohm's law as shown in the examples below. It should be noted that we are concerned only with the magnitude of the voltage across the coil. The absolute values of V_{INH} and V_{INL} are arbitrary.
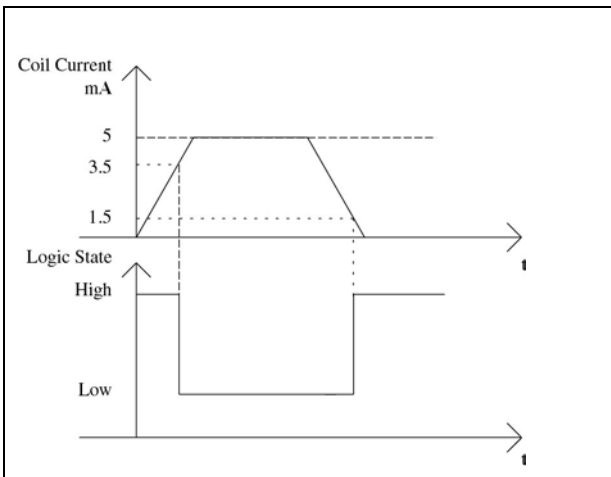

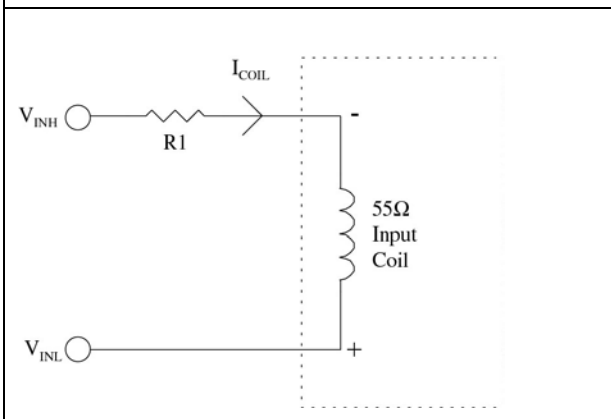**Figure 1. IL600 Series Transfer Function**

Figure 2. Series Resistor Calculation Equivalent Circuit

Example 1. In this case, $T_{NOM} = 25ºC$, V_{IN} High is 24 V, V_{IN} Low is 1.8 V, and I_{COIL} minimum is specified as 5 mA. Total loop resistance is:

$$(R1 + R_{COIL}) = \frac{(V_{INH} - V_{INL})}{I_{COIL}} = \frac{22.2\ \Omega}{0.005} = 4440\ \Omega$$

Therefore,
R1 = (4440-55) Ω = 4385 Ω

Example 2. At a maximum operating temperature of 85°C, $T_{MAX} = 85ºC$, $T_{NOM} = 25ºC$, V_{IN} High = 5 V, V_{IN} Low = 0 V, and nominal $R_{COIL} = 55\ \Omega$. At $T_{MAX} = 85ºC$

$$R_{COIL} = 55 + (T_{MAX} - T_{MIN}) \times TCR_{COIL}$$
$$= 55 + (85 - 25) \times 0.165 = 55 + 9.9 = 65\ \Omega$$

Therefore, the recommended series resistor is

$$R1 = \frac{(V_{INH} - V_{INL})}{I_{COIL}} - R_{COIL}$$

$$R1 = \frac{(5-0)}{0.005} - 5 = 935\ \Omega$$

Allowance should also be made for the temperature coefficient of the current limiting resistor to ensure that I_{COIL} is at least 5 mA at the maximum operating temperature.

Typical Resistor Values

The table shows typical values for the external resistor in 5 V and 3 V logic systems. As usual, use these values as approximate

V_{COIL}	0.125W, 10% Resistor
3.3 V	665 Ω
5 V	1 kΩ

and factor in application specifics such as temperature range required. If the expected temperature range is large, the designer may wish to use 5% or even 1% tolerance resistors to provide extra design latitude. Alternately, see the *Applications* section for circuit ideas which allow more generalized resistor selection.

Power Supplies

It is recommended that 47 nF ceramic capacitors be used to decouple the power supplies. The capacitors should be placed as close as possible to the appropriate V_{DD} pin for optimum output wave shaping.

Applications Information

The IL600 series devices are current mode isolators. This means that a current of a certain magnitude and direction must flow in the input coil to change the output logic state. Figure 3 shows a simplified transfer curve for a typical IL600 series data channel.

Figure 3. IL600 Series Transfer Function
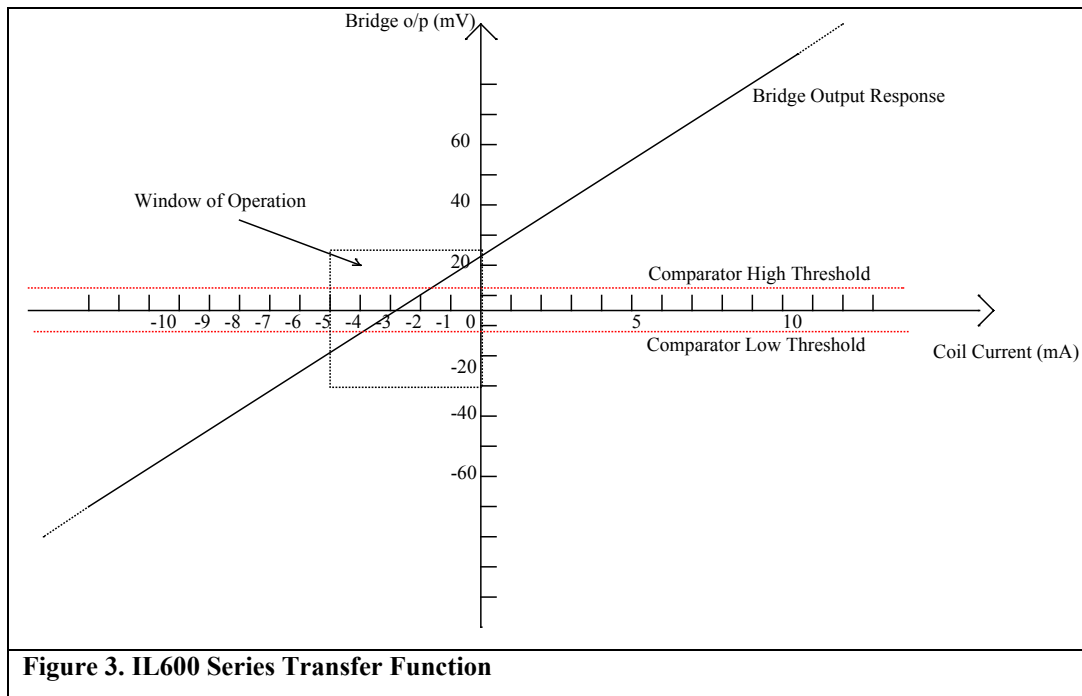
The transfer function for this device is essentially linear in nature. An applied coil input current creates a magnetic field which causes the GMR bridge output to change in proportion to the applied field. The GMR bridge is connected to a comparator. When the bridge output is greater than the comparator high threshold level the output will go high. Similarly, when the bridge output is less than the comparator low threshold, the output will go low. The Window of Operation shown in Figure 3 highlights the specified corners of operation of the device. An input current of approximately -3.5 mA or -1.5 mA will cause the device to hover around the comparator switching thresholds and will produce an unstable output response. The recommendation for single-ended operation across the entire temperature range and power supply range is that the magnitude of the coil current for a logic low is at least -5 mA and the magnitude of the coil current for a logic high is between -0.8 mA and 0 mA. At this point it should be noted that the stated direction of the current is negative in Figure 3 since we are creating a negative magnetic field with respect to Earth Field. Current is always fed into the In- terminal of an IL6xx device. Since these currents are actually sourced, not sunk by the user, the specified currents are quoted as positive values in the *Electrical Specifications* section of this data sheet.

When designing circuits using digital logic, most designers are aware that the input to a logic gate is differential with respect to ground. The importance of the ground signal is such that separate ground layers, star points or planes usually need to be designed into circuit boards with fast switching currents to reduce ground voltage bounce caused by inductance in ground returns. Ground error voltages can be responsible for transmitted data errors in high speed circuits because of their impact on the effective logic threshold voltage at any given instant. Similarly, when using the IL600 series devices, the designer should be aware that it is the magnitude of the voltage across the coil which creates the current and not just the value of the input voltage. To illustrate this point consider the following cases.

The In- terminal I is connected via a 1 kΩ current limiting resistor to the supply rail and the input is connected to the In+ terminal. Assume the supply voltage is +5 V and the input signal is a 5 V CMOS signal. A 1 kΩ resistor is selected to limit the current into the coil to 5 mA. For the purpose of this illustration we will ignore the coil resistance. When a logic high (+5 V) is applied to the input, the current through the coil is zero. When the input is a logic low (0 V), approximately 5 mA flows from the In- side through the coil to the In+ side. Figure 3 shows that the device will transition to both logic states easily under these conditions. Assume that the 5 V rail is now sitting at 5.5 V and the CMOS input signal is loaded so that its high level is only 4.5 V. When a logic high (4.5 V) now appears on the input, there is still a current of -1mA flowing through the coil. Referring to Figure 3 shows that the device is getting close to the off-state threshold of -1.5 mA and actually exceeds the specification of -0.8 mA for this logic level. Some intermittent operation may be expected in this case. The designer must ensure that the difference between the logic high voltage and the power supply voltage is such that the residual current in the coil is lower than 0.8 mA.

In the inverting configuration the design problem is the same as the standard logic problem. The signal into the coil is now differential with respect to ground. The designer must ensure that the difference between the logic low voltage and the ground point to which the coil is connected is such that the residual current in the coil is lower than 0.8 mA. The usual design precautions regarding ground bounce should also be taken into consideration.

Inverting Circuit   Note. C_1 is 47 nF ceramic.

Non-Inverting Circuit   Note. C_1 is 47 nF ceramic.

Figure 4. Inverting and Non-Inverting circuits

The IL612 and IL614 devices have some inputs which do not offer non-inverting operation. The power supply to the device is hardwired internally to the coil In- input. Therefore it is important to make sure that the power supply to the isolator is at the same voltage as the power supply to the source of the input logic signal.

The IL600 devices are simple to use as long as it is remembered that the application must allow sufficient current (-5 mA) to flow in the coil for an output logic low state, and close to zero current (-0.8 mA to 0 mA) to flow for an output logic high state.

Magnetic Field Booster

In all applications, it is possible to boost the signal seen by the GMR sensor. This can be of benefit in high temperature applications or in cases where differential currents of 5mA can not always be guaranteed. A small capacitor (see page 5) placed across the current limiting resistor will effectively boost instantaneous current through the coil at the point of signal transition. The resultant magnetic field has the effect of pushing the GMR bridge output through the comparator threshold voltage with reduced propagation delay and improved pulse width distortion. Figure 5 shows how the capacitor is connected in the case of the IL610. Note that the capacitor can be used in both inverting and non-inverting modes of operation. The use of the capacitor gives a great deal of design headroom and can usually eliminate design concerns related to temperature range and power supply fluctuation. In 3.3 V applications the capacitor must be used. In 5 V applications where t_r, t_f < 1 μs use of the capacitor is highly recommended.
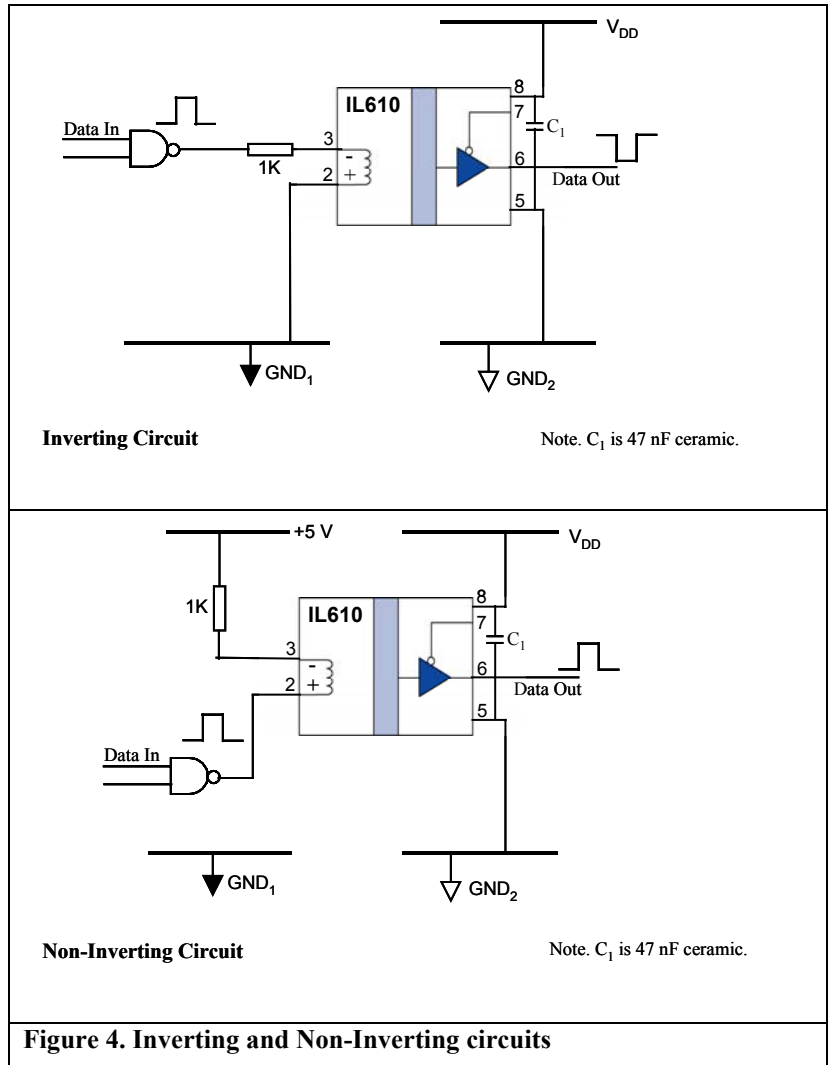
Differential or Single Ended Input

The IL610, IL611, IL613 and channel 1 of the IL614 can be run with differential or single-ended inputs. In the differential mode current will flow through the coil in both directions. This is not a problem for the device. Figure 3 shows that current flowing from In+ to In- (positive values of current in the graph) will simply push the device into the high state quicker than if the current was allowed to passively return to zero. There are many applications where the differential option can be very useful. The most obvious advantage of the devices over optocouplers and other high-speed couplers in this regard is that no reverse bias protection for the input structure is required when it is subjected to a differential signal. This reduces cost and complexity. One of the more common applications is an isolated Differential Line Receiver. RS485 and RS422 signals can be terminated on the IL610 at a fraction of the cost of an isolated RS485 node.

Note. C_1 is 200 pF to 1 nF ceramic.
C_2 is 47 nF ceramic.
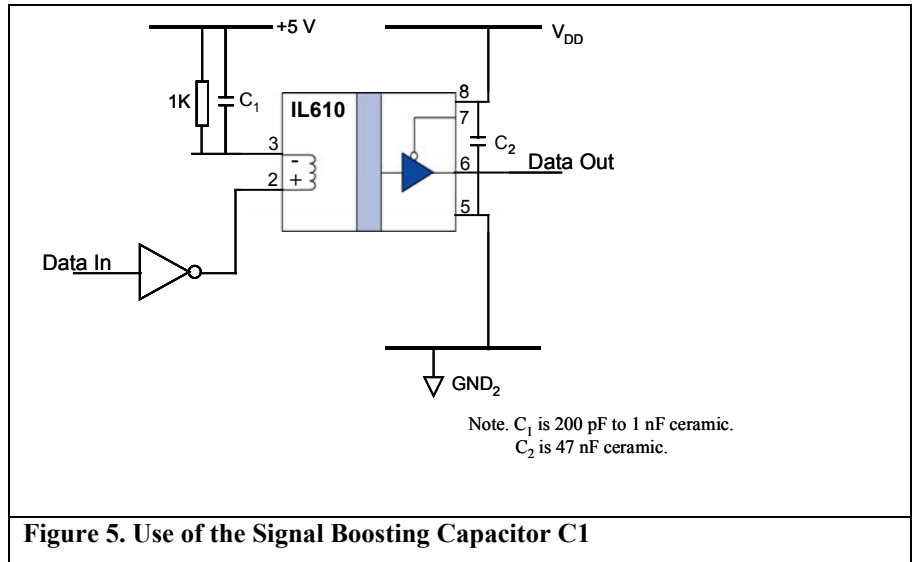
Figure 5. Use of the Signal Boosting Capacitor C1

Magnetic Field Immunity

All IsoLoop devices operate by imposing a magnetic field on a GMR sensor which then translates the change in field into a change in output logic state. The devices are manufactured with a magnetic shield above the sensor. This shield acts as a flux concentrator to boost the magnetic signal from the internal coil and as a shield against externally generated magnetic fields. The shield will absorb surrounding stray flux until it becomes saturated. At saturation the shield is transparent to an external applied field and the GMR sensor may react to the field. To compensate for this effect, IsoLoop devices use Wheatstone Bridge structures which are only sensitive to differential magnetic fields. In addition, the IL600 series allows several ways of enhancing magnetic field immunity. In general, applying a larger internal field will reduce the effect of an external field on the GMR sensor.
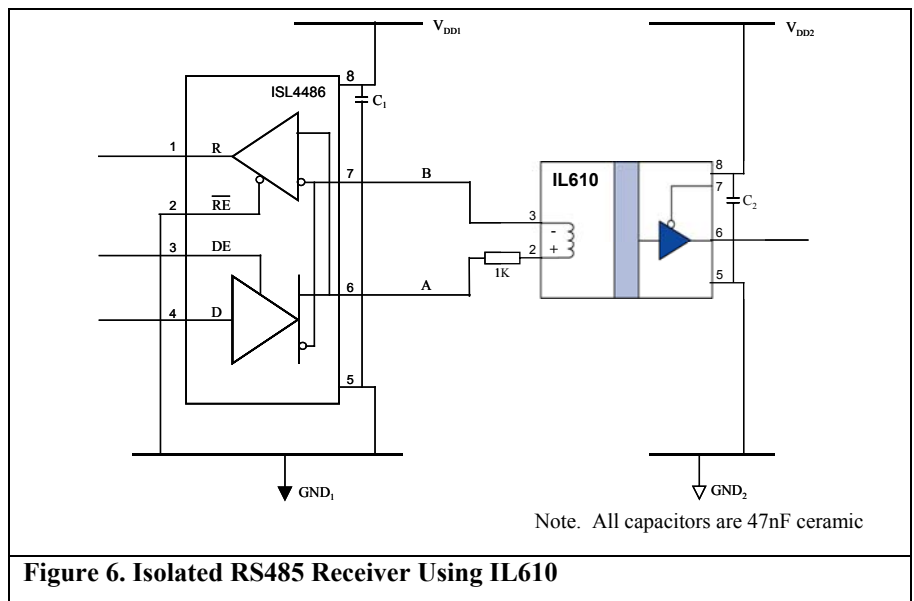

Note. All capacitors are 47nF ceramic

Figure 6. Isolated RS485 Receiver Using IL610

Two main options for enhancing external magnetic field immunity are shown below.

1. Orientation of the device with respect to the field direction

An applied field in the direction of "H1" with respect to the orientation of the device will result in worst case immunity. In this case the external field is operating in the same direction as the applied internal field. In one direction it will tend to help switching while in the other it will tend to hinder it. This can result in unpredictable switching due to external magnetic fields.

An applied field in the direction of "H2" has considerably less effect on the sensor and will result in significantly higher immunity levels as shown below.
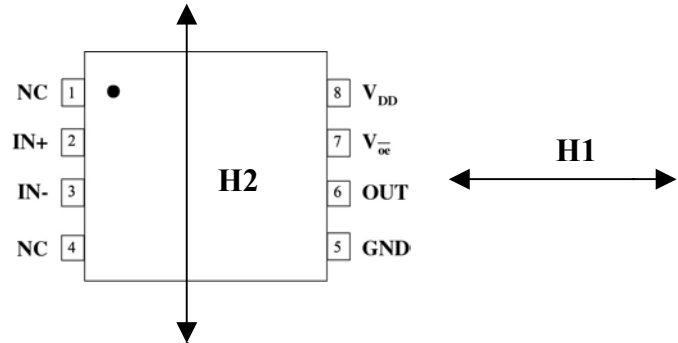
2. Differential Signaling and Current Boosting.

In all cases driving the coil differentially will result in improved immunity. This is because the logic high state is now driven by an applied field instead of the zero field as is the case with single ended operation. The more current present in the coil, the more internal field is generated and the more immunity the device will have to external fields. The device may be safely driven with ±10 mA dc coil current.

Greatest magnetic immunity is achieved by adding the current boost capacitor shown in Figure 5. Very high immunity figures can be achieved with this method.

Method	Immunity Expected	Immunity Description
Field applied in direction H1	±20 Gauss	A DC current of 16 A flowing in a conductor 1 cm away from the device could cause disturbance
Field applied in direction H2	±70 Gauss	A DC current of 56 A flowing in a conductor 1 cm away from the device could cause disturbance
Field applied in any direction but with current booster capacitor (1 nF) in circuit	±250 Gauss	A DC current of 200 A flowing in a conductor 1 cm away from the device could cause disturbance

Data Rate and Magnetic Field Immunity

In all IL600 series applications it is easier to disrupt an isolated dc signal with an external magnetic field than it is to disrupt an isolated AC signal. Similarly, a DC magnetic field will have a greater effect on the device than an ac magnetic field of the same effective magnitude. For example, signals with pulses greater than 100 μs in duration are more susceptible to the effects of magnetic fields than those where the pulse width is shorter. For input signals greater than 1 MHz, a 1 nF current boost capacitor will provide as much as 400 Gauss immunity, while the same input capacitor might only provide 70 Gauss of immunity on a 50 kHz signal.
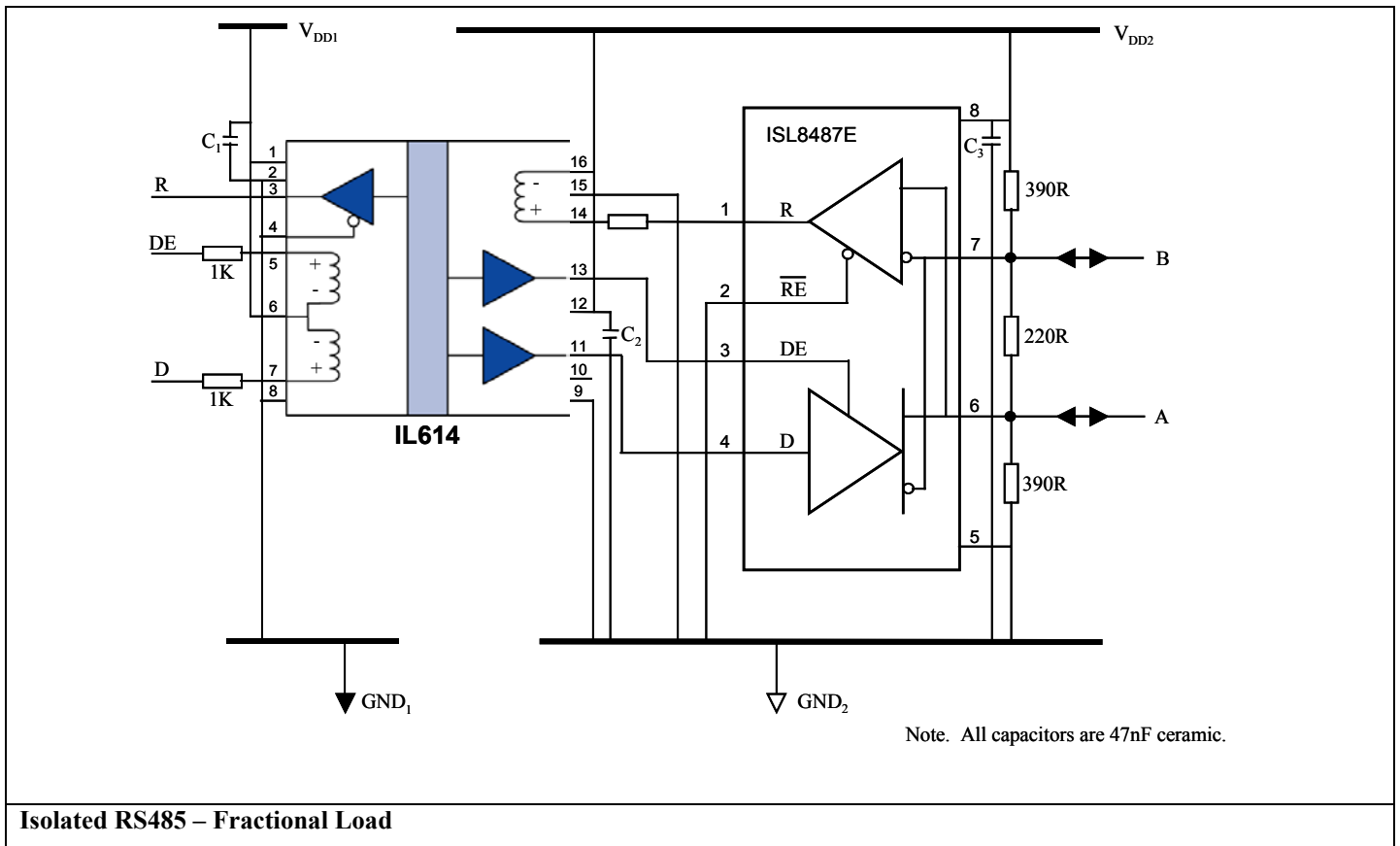
Application Diagrams

Note: In all applications if V_{DD} is 3.3 V C_{Boost} must be used. (See Test Circuit #1)
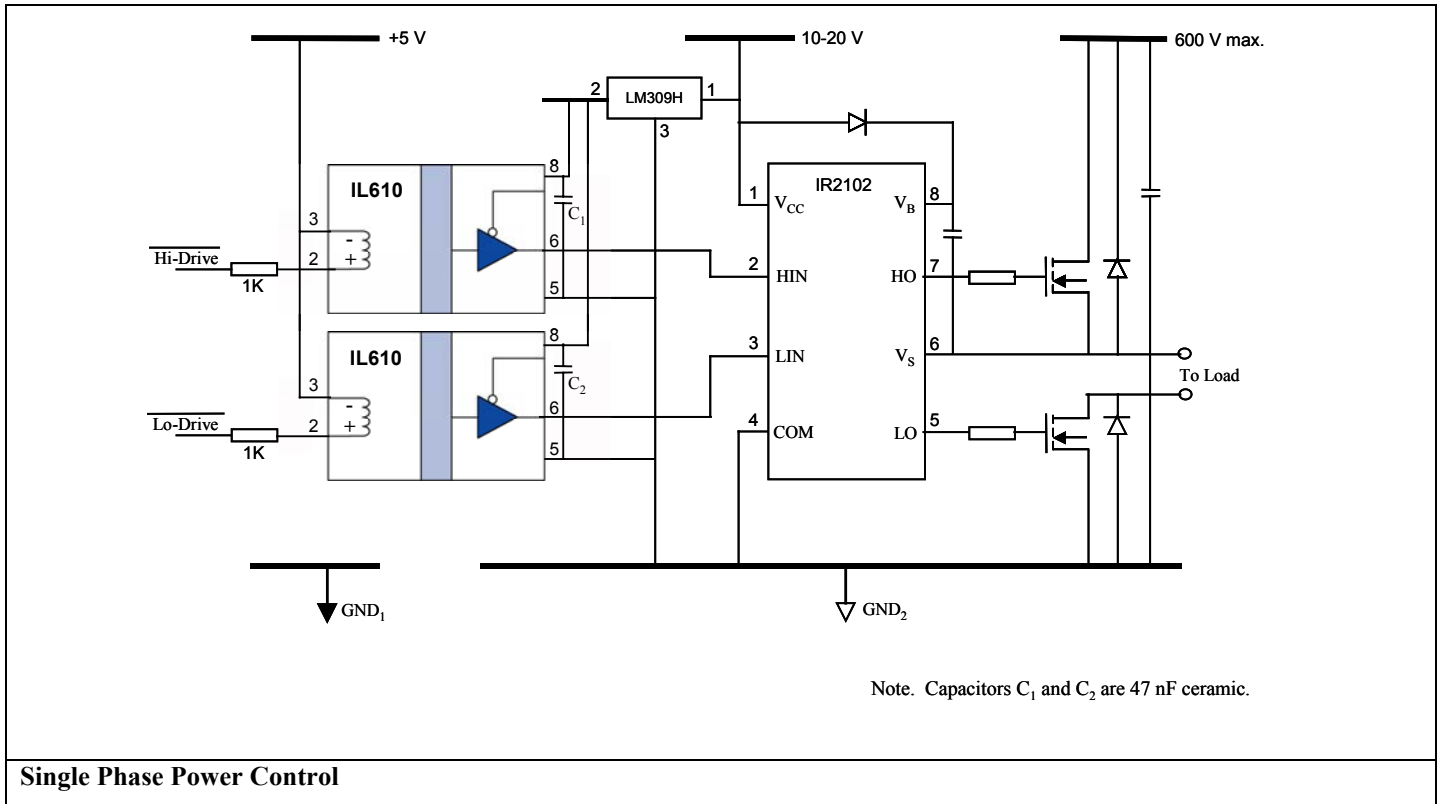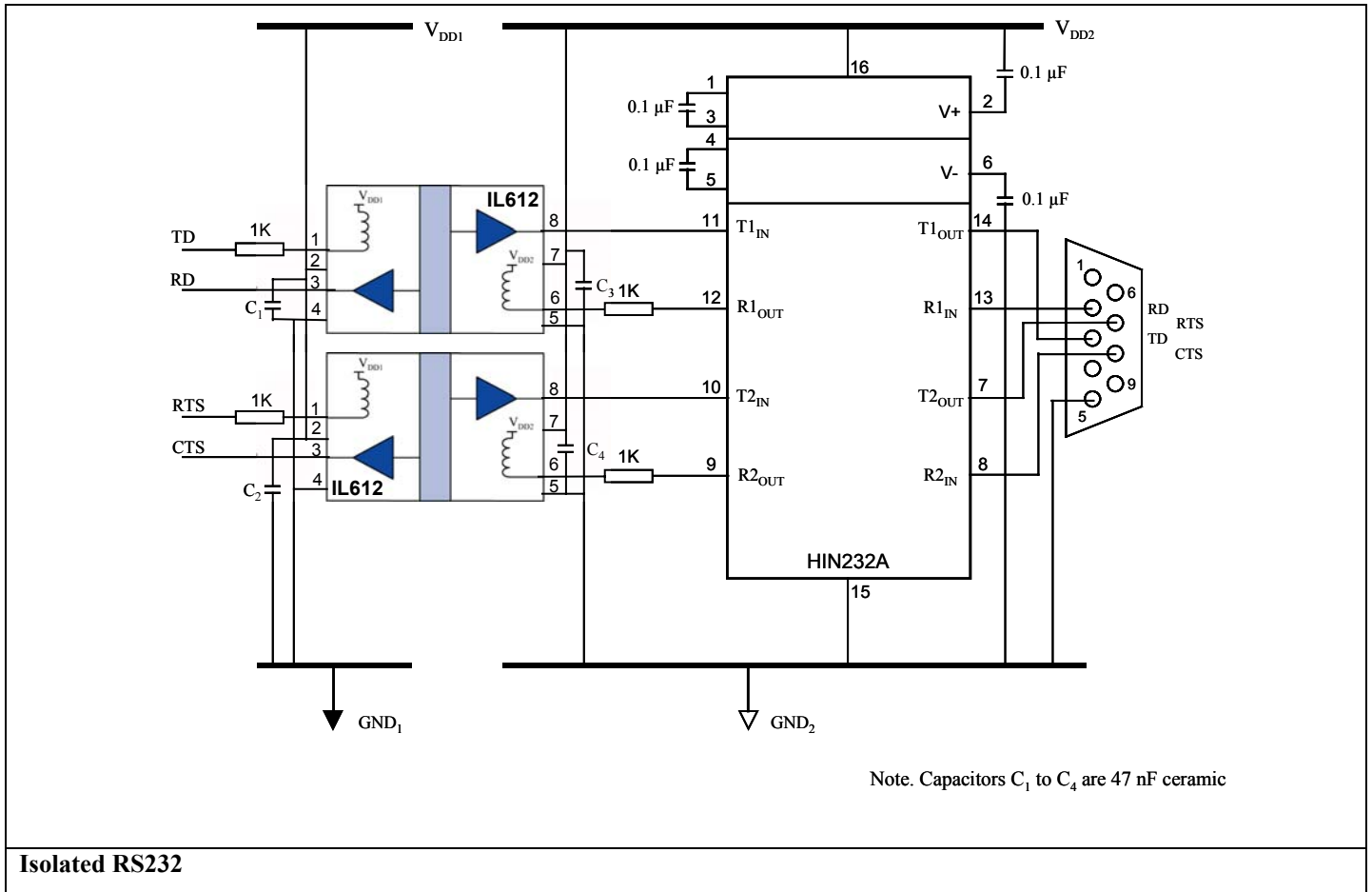

Note. All capacitors are 47 nF ceramic
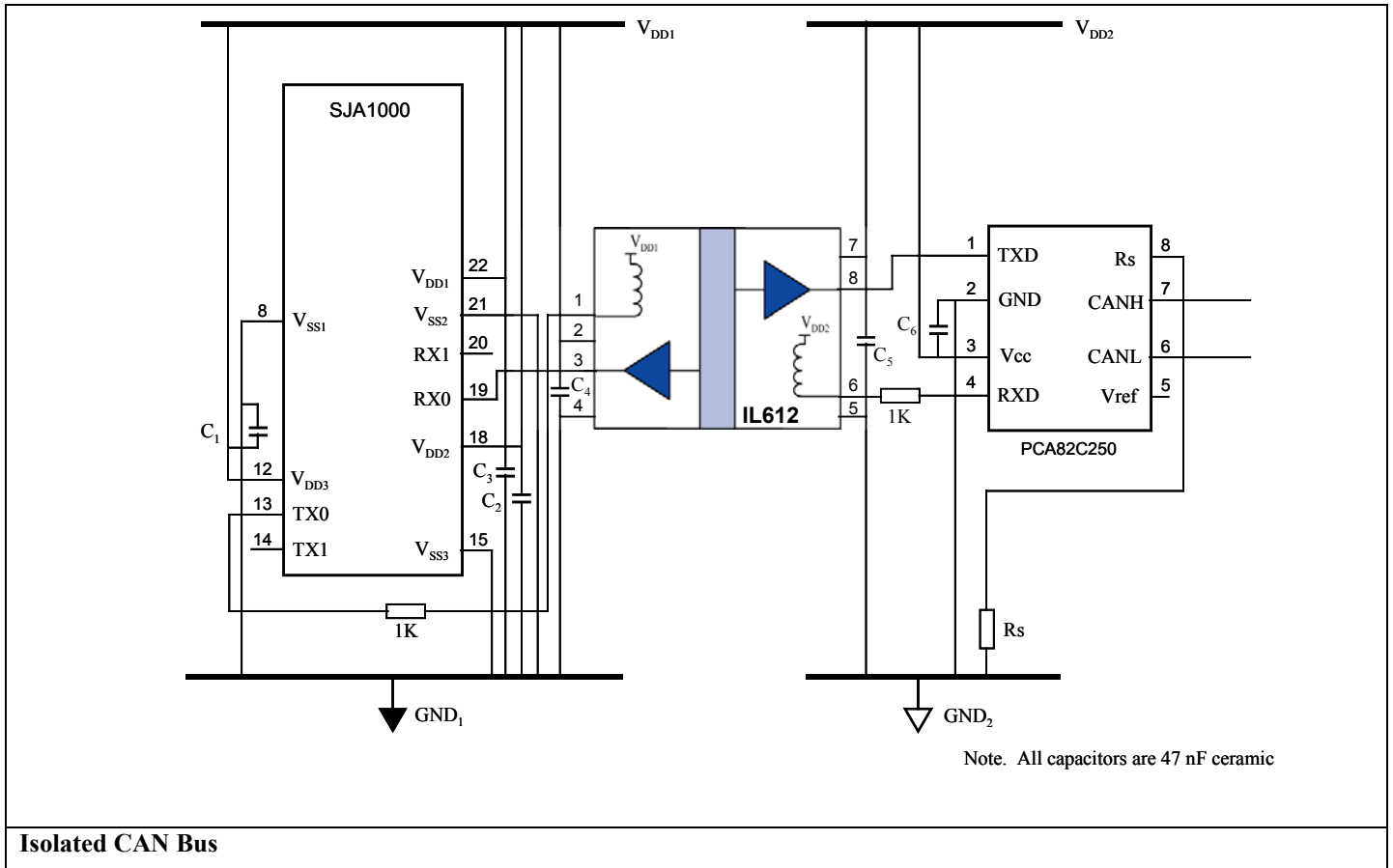
Isolated CAN Bus

Note: In all applications if V_{DD} is 3.3 V C_{Boost} must be used. (See Test Circuit #1)

Note. All capacitors are 47nF ceramic.

Isolated RS485 – Fractional Load

Note: In all applications if V_{DD} is 3.3 V C_{Boost} must be used. (See Test Circuit #1)

Note. Capacitors C_1 and C_2 are 47 nF ceramic.

Single Phase Power Control

Note: In all applications if V_{DD} is 3.3 V C_{Boost} must be used. (See Test Circuit #1)

Note. Capacitors C_1 to C_4 are 47 nF ceramic

Isolated RS232

Package Drawings, Dimensions and Specifications
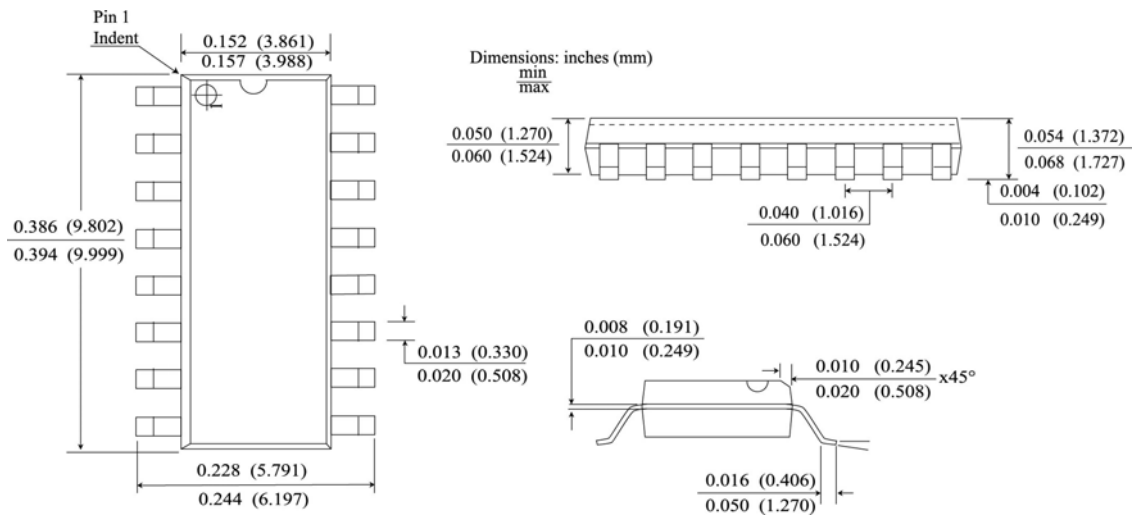
8-pin MSOP Package
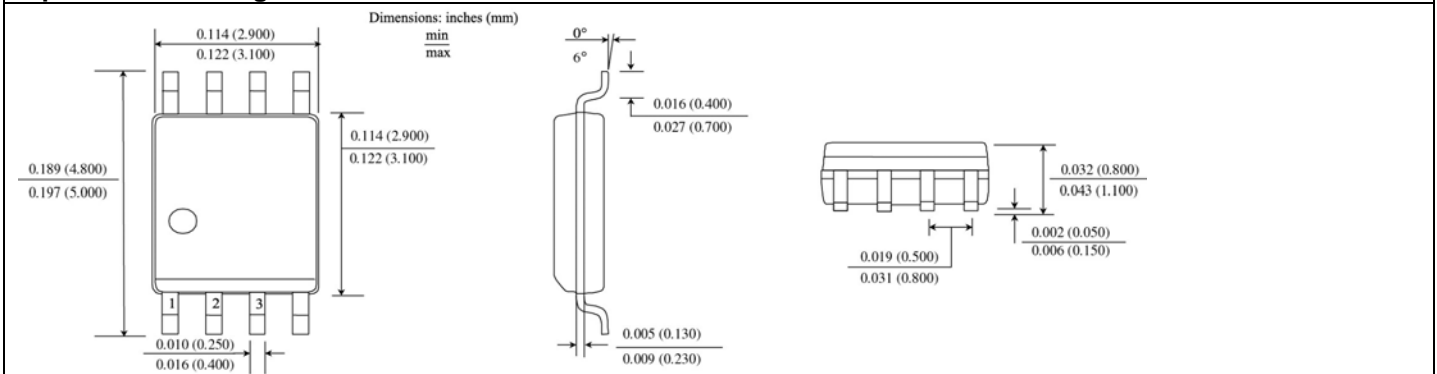
8-pin SOIC Package
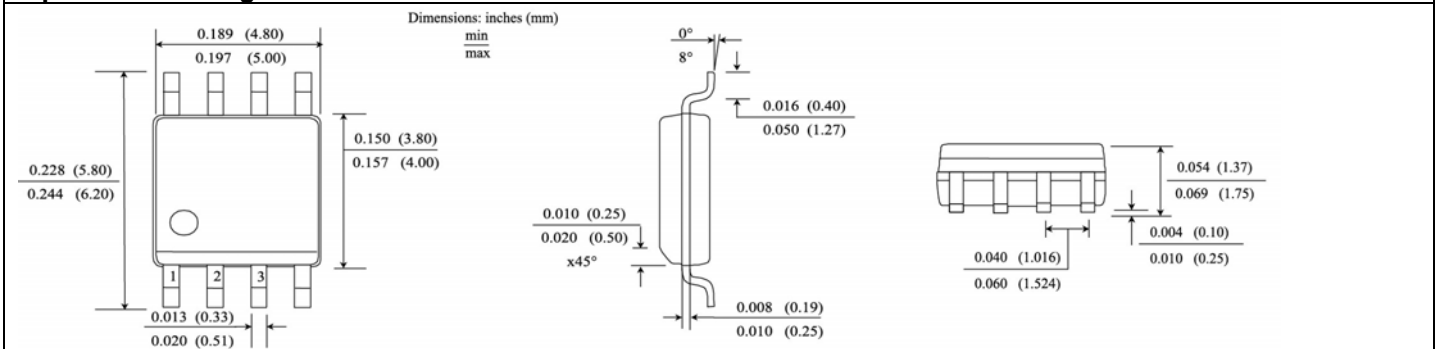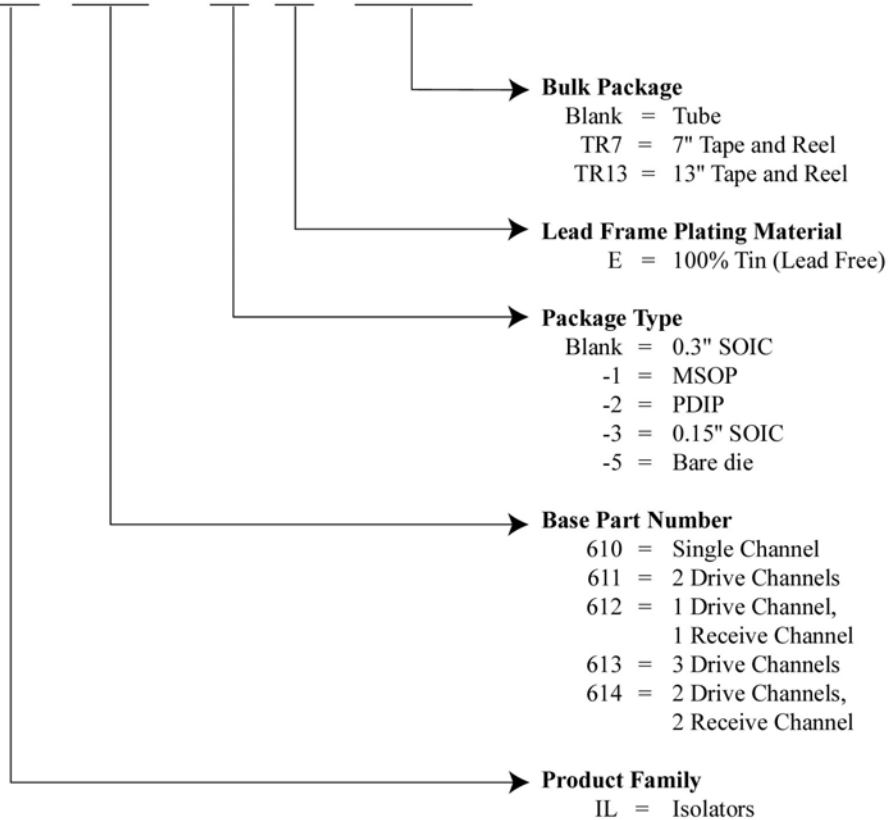

8-pin PDIP Package
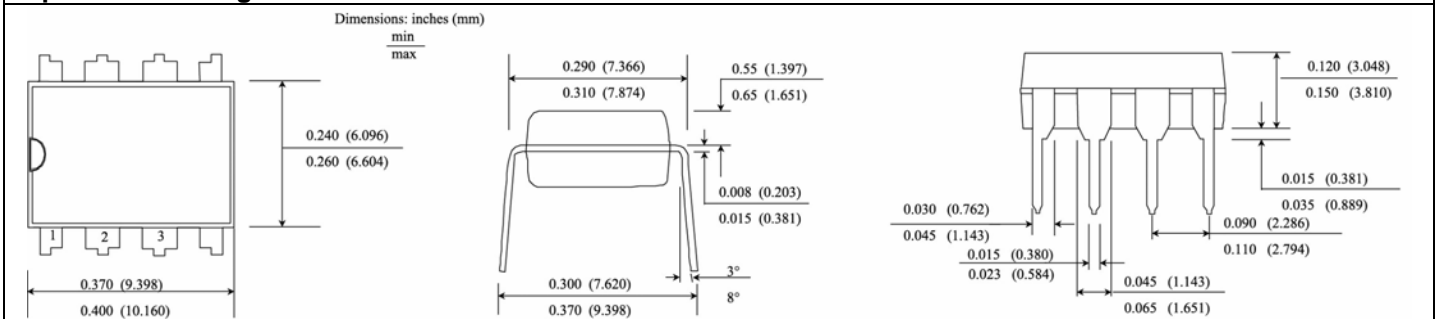
0.15" 16-pin SOIC

0.3" 16-pin SOIC
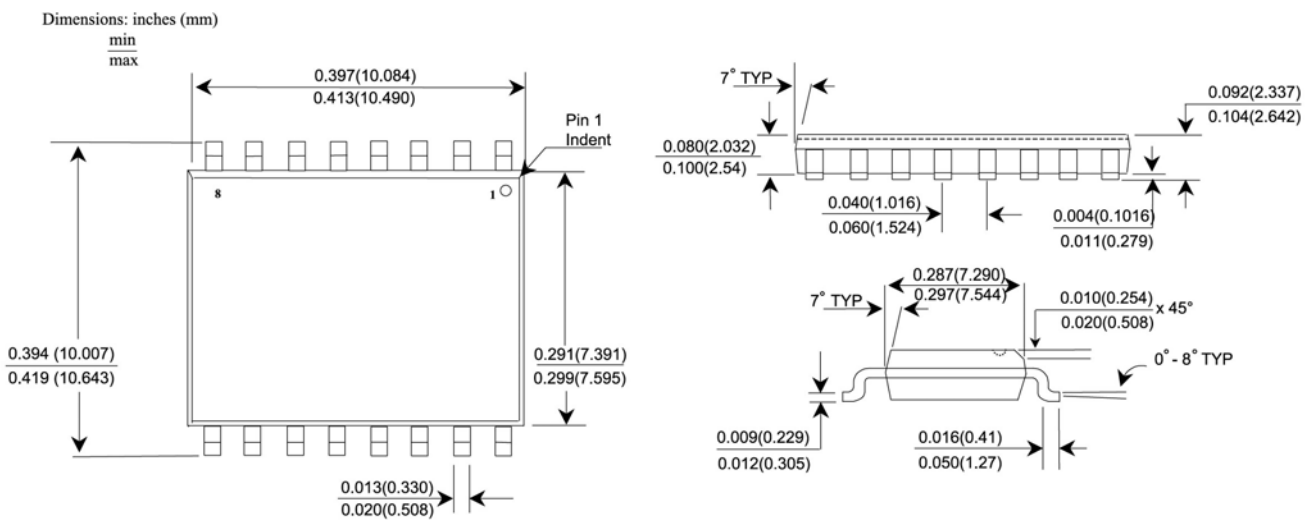
Ordering Information and Valid Part Numbers

IL 610 - 1 E TR13

Bulk Package
Blank = Tube
TR7 = 7" Tape and Reel
TR13 = 13" Tape and Reel

Lead Frame Plating Material
E = 100% Tin (Lead Free)

Package Type
Blank = 0.3" SOIC
-1 = MSOP
-2 = PDIP
-3 = 0.15" SOIC
-5 = Bare die

Base Part Number
610 = Single Channel
611 = 2 Drive Channels
612 = 1 Drive Channel,
        1 Receive Channel
613 = 3 Drive Channels
614 = 2 Drive Channels,
        2 Receive Channel

Product Family
IL = Isolators

IL610 Valid Part Numbers

IL610-1E
IL610-2E
IL610-3E
IL610-5E
IL610-1ETR7
IL610-3ETR7
IL610-1ETR13
IL610-3ETR13

IL611 Valid Part Numbers

IL611-1E
IL611-2E
IL611-3E
IL611-5E
IL611-1ETR7
IL611-3ETR7
IL611-1ETR13
IL611-3ETR13

IL612 Valid Part Numbers

IL612-2E
IL612-3E
IL612-3ETR7
IL612-3ETR13

IL613 Valid Part Numbers

IL613E
IL613ETR13
IL613-3E
IL613-3ETR13

IL614 Valid Part Numbers

IL614E
IL614ETR13
IL614-3E
IL614-3ETR13

Revision History

ISB-DS-001-IL600-F	**Changes**

1. Data rate increased to 100 Mbps

2. Boost Capacitor information added for 5 V and 3.3 V applications.

3. Input threshold for logic low changed to 0.5 mA

4. Test circuits added

5. Boost capacitor selection graph added.

6. Note that boost capacitor must be used on all 3.3 V applications added to all application diagrams.

ISB-DS-001-IL600-E   **Changes**

7. UL File Number and TUV Certificate numbers added to page two

8. Soldering profile added to page four.

ISB-DS-001-IL600-D   **Changes**

9. IL600 Series data sheet has been created from the division of ISB-DS-001-IL600-B into separate IL600A and IL600 data sheets. Revision C was not published.

10. Leaded parts option removed.

11. Applications added.

About NVE

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine leading edge Giant Magnetoresistive (GMR) materials with integrated circuits to make high performance electronic components. Products include Magnetic Field Sensors, Magnetic Field Gradient Sensors (Gradiometer), Digital Magnetic Field Sensors, Digital Signal Isolators and Isolated Bus Transceivers.

NVE is a leader in GMR research and in 1994 introduced the world's first products using GMR material, a line of GMR magnetic field sensors that can be used for position, magnetic media, wheel speed and current sensing.

NVE is located in Eden Prairie, Minnesota, a suburb of Minneapolis. Please visit our Web site at www.nve.com or call 952-829-9217 for information on products, sales or distribution.

NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617 USA
Telephone: (952) 829-9217
Fax: (952) 829-9189
Internet: www.nve.com
e-mail: isoinfo@nve.com

Specifications shown are subject to change without notice.

ISB-DS-001-IL600-F
January 19, 2005