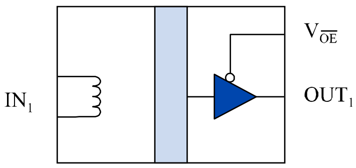
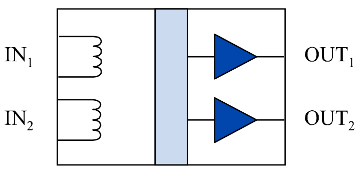
Ultrahigh CMTI Isolated FET Drivers

Functional Diagrams



IL610CMTI



IL611CMTI

Features

- 200 kV/µs guaranteed CMTI; to 350 kV/µs with deglitch
- 100% tested for CMTI
- Deterministic default LOW and default HIGH versions
- Extended 3 V to 6.6 V power supply range
- Switching frequencies up to 50 Mhz
- Flexible inputs with wide input voltage range
- Input current as low as 5 mA
- No input-side power supply needed
- No reverse input protection needed
- No carrier or clock for low EMI emissions and susceptibility
- Extremely high EMI and magnetic immunity
- 2.5 kV isolation; up to 800 V_{RMS} Working Voltage
- IEC 60747-17 (VDE 0884-17):2021-10; UL 1577
- 44000 year barrier life
- Single and dual-channel configurations
- 8-pin MSOP and SOIC packages

Applications

- H-bridges
- Floating supply applications
- Noisy environments

Description

The IL600-Series isolators are passive input digital signal isolators with CMOS outputs. The IL6xxCMTI version is optimized for driving MOSFETs either directly or with an external gate driver.

Resistors set the input current, and five milliamps guarantees switching.

CMTI-grade isolators are 100% tested to ensure each part has at least 200 kV/µs minimum Common-Mode Transient Immunity. Simple external deglitch circuitry can extend the CMTI to an extraordinary 350 kV/µs typical.

The parts also have an extended supply range of up to 6.6 volts for compatibility to directly drive a range of power MOSFETs or gate driver ICs.

The devices are manufactured with NVE's patented* IsoLoop® spintronic Giant Magnetoresistive (GMR) technology for small size, high speed, and high noise immunity. A unique ceramic/polymer composite barrier provides excellent isolation and virtually unlimited barrier life.

Absolute Maximum Ratings[1]

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	T_S	–55[2]		150	°C	
Ambient Operating Temperature	T_A	–40[3]		85	°C	
Supply Voltage	V_{DD}	–0.5		7	V	
DC Input Current	I_{IN}	–25		25	mA	
AC Input Current (Single-Ended Input)	I_{IN}	–35		35	mA	
AC Input Current (Differential Input)	I_{IN}	–75		75	mA	
Output Voltage	V_O	–0.5		V_{DD}+1.5	V	
Maximum Output Current	I_O	–10		10	mA	
ESD			2		kV	HBM

[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[3]		85	°C	
Supply Voltage	V_{DD}	3		6	V	
Input Signal Rise and Fall Times	t_{IR}, t_{IF}			1	µs	
V_{OE} Logic High Input Voltage	V_{IH}	2.4		V_{DD1}	V	
V_{OE} Logic Low Input Voltage	V_{IL}	0		0.8	V	
Common Mode Input Voltage	V_{CM}			1000	V_{RMS}	

Insulation Specifications

Parameters		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance (external)							
MSOP8			3.01			mm	
SOIC8			4.03			mm	
Total Barrier Thickness (internal)			0.012	0.013		mm	
Leakage Current				0.2		µA	240 V_{RMS}, 60 Hz
Barrier Resistance		R_{IO}		$>10^{14}$			500 V
Barrier Capacitance		C_{IO}		7		Ω ‖ pF	f = 1 MHz
Comparative Tracking Index		CTI	≥175			V	Per IEC 60112
High Voltage Endurance (maximum barrier voltage for indefinite life)	AC	V_{IO}	1000			V_{RMS}	At maximum operating temperature
	DC		1500			V_{DC}	
Barrier Life				44000		Years	100°C, 1000 V_{RMS}, 60% CL activation energy

Thermal Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	MSOP8 SOIC8	θ_{JA}		184 134		°C/W	Soldered to double-sided board; free air
Junction–Case (Top) Thermal Resistance	MSOP8 SOIC8	θ_{JT}		15 10		°C/W	
Power Dissipation	MSOP8 SOIC8	P_D			500 675	mW	

Safety and Approvals

IEC 60747-17 (VDE 0884-17):2021-10 (Basic Isolation; VDE File Number 5016933-4880-0001):

- Isolation voltage (V_{ISO}): 2500 V_{RMS}
- Transient overvoltage (V_{IOTM}): 4000 V_{PK}
- Surge rating 4000 V
- Each part tested at 1590 V_{PK} for 1 second, 5 pC partial discharge limit
- Samples tested at 4000 V_{PK} for 60 sec.; then 1358 V_{PK} for 10 sec. with 5 pC partial discharge limit

- Working Voltage (V_{IORM}; pollution degree 2):

Package	Part No. Suffix	Working Voltage
MSOP8	-1	800 V_{RMS}
SOIC8	-3	700 V_{RMS}

Safety-Limiting Values	Symbol	Value	Units
Safety rating ambient temperature	T_S	180	°C
Safety rating power (180°C)	P_S	270	mW
Supply current safety rating (total of supplies)	I_S	54	mA

UL 1577 (Component Recognition Program File Number E207481)

- 2500 V rating.
- Each part tested at 3000 V_{RMS} (4240 V_{PK}) for 1 second; each lot sample tested at2500 V_{RMS} (3530 V_{PK}) for 1 minute.

Soldering Profile

Per JEDEC J-STD-020C; MSL 1

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.

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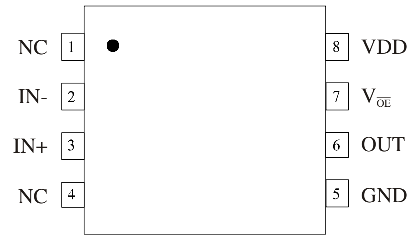
Pin Connections

IL610CMTI / IL610FCMTI

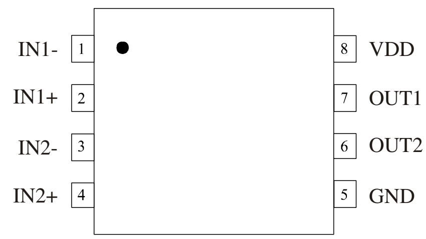
1	NC	No internal connection
2	IN–	Coil connection
3	IN+	Coil connection
4	NC	No internal connection
5	GND	Ground return for V_{DD}
6	OUT	Data out
7	$V_{\overline{OE}}$	Output enable (internally held low with approx. 100 kΩ)
8	V_{DD}	Supply Voltage



IL610CMTI / IL610FCMTI

IL611CMTI / IL611FCMTI

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



IL611CMTI
IL611FCMTI

Operating Specifications

Coil Specifications (V_{DD} = 3 V to 6.6 V; T = –40°C to 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Coil Input Resistance	R_{COIL}	47	85	112	Ω	T = 25 °C
		31	85	128	Ω	T = –40 °C to 85 °C
Coil Resistance Temperature Coefficient	TC R_{COIL}		0.2	0.25	Ω/°C	
Coil Inductance	L_{COIL}		9		nH	

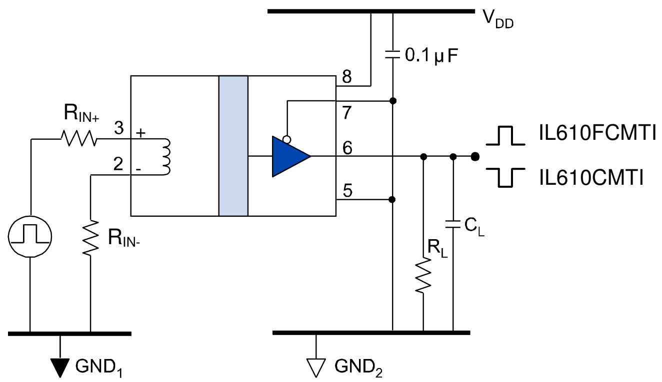


Figure 1. Test circuit.

5 V Specifications

5 V Electrical Specifications (V_{DD} = 4.5 V to 6.6 V; T = –40°C to 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Quiescent Supply Current						
IL610CMTI / IL610FCMTI	I_{DD}		2	3	mA	V_{DD} = 5 V, I_{IN} = 0
IL611CMTI / IL611FCMTI			4	6		
Input Threshold	I_{INH-DC}	0.5	3		mA	
Input Threshold Hysteresis	$I_{INH} - I_{INL}$	0.25	1		mA	V_{DD} = 5 V
		0.25	0.5			V_{DD} = 6 V
Failsafe Input Current(1)	I_{INL-FS}	–25		0.5	mA	
	I_{INH-FS}	5		25	mA	
High Output Voltage	V_{OH}	4.9	4.999		V	V_{DD} = 5 V, I_O = 20 µA
		4.0	4.8		V	V_{DD} = 5 V, I_O = 4 mA
Low Output Voltage	V_{OL}		0.0007	0.1	V	V_{DD} = 5 V, I_O = –20 µA
			0.12	0.8	V	V_{DD} = 5 V, I_O = –4 mA
Output Stage High-Side Drain-to-Source Resistance	R_{DS-P}		40		Ω	V_{DD} = 5 V
			38			V_{DD} = 6 V
Output Stage Low-Side Drain-to-Source Resistance	R_{DS-N}		30		Ω	V_{DD} = 5 V
			28			V_{DD} = 6 V
Output Short-Circuit Current	$\lvert I_{SC} \rvert$	40	55	70	mA	V_{DD} = 5 V
		45	65	80		V_{DD} = 6 V

5 V Switching Specifications (V_{DD} = 4.5 V to 6.6 V; T = –40°C to 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Minimum Pulse Width(1)	PW	10			ns	Digital Drive: R_L = 1 kΩ; C_L = 15 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay, Input to Output	t_P		8	15	ns	
Average Propagation Delay Drift	t_{PLH}		10		ps/°C	
Pulse Width Distortion $\lvert t_{PHL}-t_{PLH} \rvert$(2)	PWD		3	5	ns	
Pulse Jitter	t_J			100	ps	
Propagation Delay Skew(3)	t_{PSK}	–2		2	ns	
Output Rise / Fall Time (10–90%)	t_R / t_F		2	4	ns	
Minimum Pulse Width(1)	PW	75			ns	Driving high-power MOSFET; R_L = 1 MΩ; C_L = 1000 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay, Input to Output (Output High-to-Low)	t_{PHL}		50	70	ns	
Propagation Delay, Input to Output (Output Low to High)	t_{PLH}		60	90		
Pulse Width Distortion $\lvert t_{PHL}-t_{PLH} \rvert$(2)	PWD		30	50		
Output Rise Time (10–90%)	t_R		130	160		
Output Fall Time (10–90%)	t_F		110	140		

5 V Common Mode Transient Immunity Specifications (V_{DD} = 4.5 V to 6.6 V; T = –40°C to 85°C unless otherwise stated)						
IL610CMTI / IL610FCMTI (single channel)						
5 mA drive	$\lvert CM_H \rvert$,$\lvert CM_L \rvert$		165		kV/µs	I_{COIL}= 0 / +5 mA
10 mA drive		200	240			I_{COIL}= 0 / +10 mA
With external deglitching		300	350			10 ns output deglitch

IL611CMTI / IL611FCMTI (two channel)						
5 mA drive	$\lvert CM_H \rvert$,$\lvert CM_L \rvert$		145		kV/µs	I_{COIL}= 0 / +5 mA
10 mA drive		200	210			I_{COIL}= 0 / +10 mA
With external deglitching		300	350			10 ns output deglitch

3.3 V Specifications

3.3 V Electrical Specifications (V_{DD} = 3 V to 3.6 V; T = –40°C to 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Quiescent Supply Current						
IL610CMTI / IL610FCMTI	I_{DD}		1.3	2	mA	V_{DD} = 3.3 V, I_{IN} = 0
IL611CMTI / IL611FCMTI	I_{DD}		2.6	4	mA	V_{DD} = 3.3 V, I_{IN} = 0
Input Threshold	$I_{INH\text{-}DC}$	0.3	1		mA	
	$I_{INL\text{-}DC}$		4	8	mA	Single-ended Unipolar
				5		Bipolar Differential
Input Threshold Hysteresis	I_{INH} - I_{INL}	0.25	3		mA	
Failsafe Input Current(1)	$I_{INL\text{-}FS}$	–25		0.3	mA	
High Output Voltage	V_{OH}	3.2	3.3		V	V_{DD} = 3.3 V, I_O = 20 µA
		3.0	3.28		V	V_{DD} = 3.3 V, I_O = 4 mA
Low Output Voltage	V_{OL}		0.0005	0.1	V	V_{DD} = 3.3 V, I_O = –20 µA
			0.15	0.8	V	V_{DD} = 3.3 V, I_O = –4 mA
Output Stage High-Side Drain-to-Source Resistance	$R_{DS\text{-}P}$		55		Ω	
Output Stage Low-Side Drain-to-Source Resistance	$R_{DS\text{-}N}$		38		Ω	
Output Short-Circuit Current	$\|I_{SC}\|$	15	25	40	mA	

3.3 V Switching Specifications (V_{DD} = 3 V to 3.6 V; T = –40°C to 85°C unless otherwise stated)						
Minimum Pulse Width(1)	PW	10			ns	Digital Drive: Figure 1 Test Circuit; R_L = 1 kΩ; C_L = 15 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay, Input to Output (Output High to Low)	t_{PHL}		12	18	ns	
Propagation Delay, Input to Output (Output Low to High)	t_{PLH}		12	18	ns	
Average Propagation Delay Drift	t_{PLH}		10		ps/°C	
Pulse Width Distortion $\|t_{PHL}–t_{PLH}\|$ (2)	PWD		3	5	ns	
Propagation Delay Skew(3)	t_{PSK}	–2		2	ns	
Output Rise / Fall Time (10–90%)	t_R / t_F		3	5	ns	
Minimum Pulse Width(1)	PW	100			ns	MOSFET drive: Figure 1 Test Circuit; R_L = 1 MΩ; C_L = 1000 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay, Input to Output (Output High-to-Low)	t_{PHL}		75	100	ns	
Propagation Delay, Input to Output (Output Low to High)	t_{PLH}		90	130	ns	
Pulse Width Distortion $\|t_{PHL}–t_{PLH}\|$(2)	PWD		45	75	ns	
Output Rise Time (10–90%)	t_R		200	240	ns	
Output Fall Time (10–90%)	t_F		165	200	ns	

3.3 V Common Mode Transient Immunity Specifications (V_{DD} = 3 V to 3.6 V; T = –40°C to 85°C unless otherwise stated)						
IL610CMTI / IL610FCMTI (single channel)						
5 mA drive	$\|CM_H\|,\|CM_L\|$		125		kV/µs	I_{COIL}= 0 / +5 mA
10 mA drive			175		kV/µs	I_{COIL}= 0 / +10 mA
With external degliching			300		kV/µs	10 ns output deglitch

IL611CMTI / IL611FCMTI (two channel)						
5 mA drive	$\|CM_H\|,\|CM_L\|$		110		kV/µs	I_{COIL}= 0 / +5 mA
10 mA drive			155		kV/µs	I_{COIL}= 0 / +10 mA
With external degliching			300		kV/µs	10 ns output deglitch

Notes:

1. "Failsafe Operation" is defined as the input current required to guarantee an output state on power-up.
   To guarantee failsafe input energization, the DC current supplied to the coil must be at least 8 mA using 3.3 V supplies versus 5 mA for 4.5 V or higher supplies.
2. Minimum Pulse Width is the shortest pulse width at which the specified PWD is guaranteed.
3. PWD is defined as | t_{PHL} – t_{PLH} |.
4. 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.
5. 100% tested.

Typical Performance Graphs

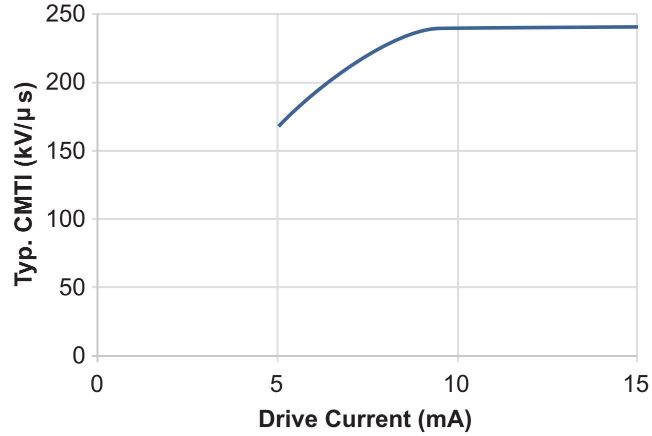


Figure 2. Typical CMTI vs. drive current (V_{DD} = 5 V).

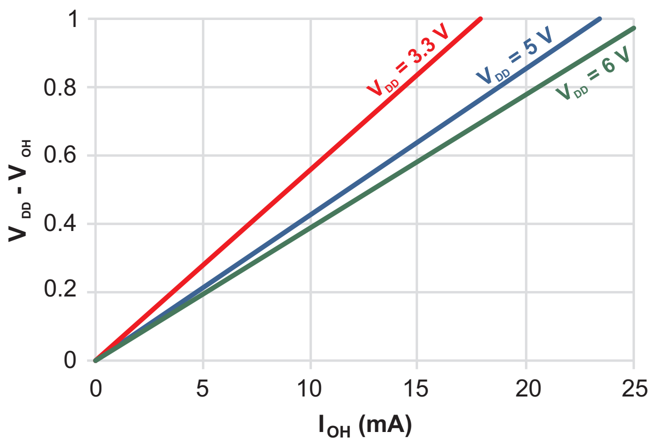


Figure 3. Typical high output voltage vs. load.

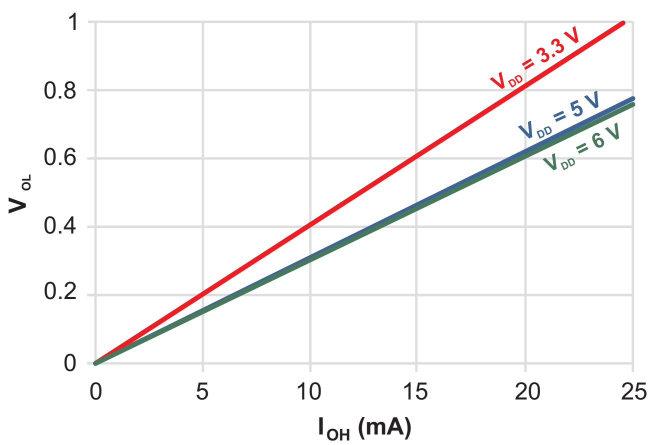


Figure 4. Typical low output voltage vs. load

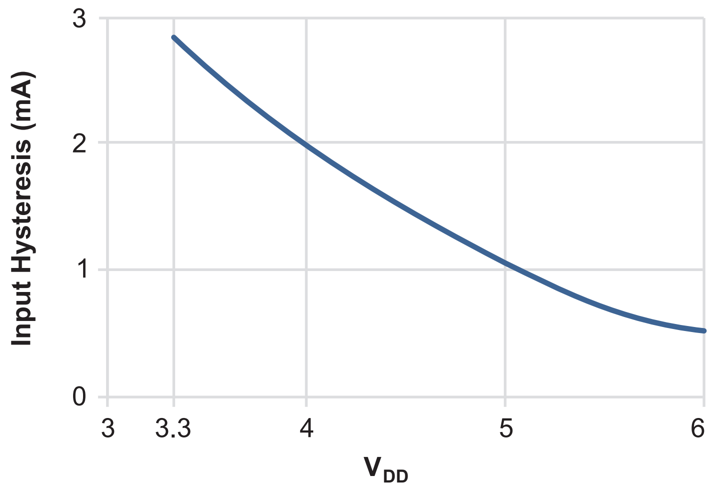


Figure 5. Typical input threshold current hysteresis.

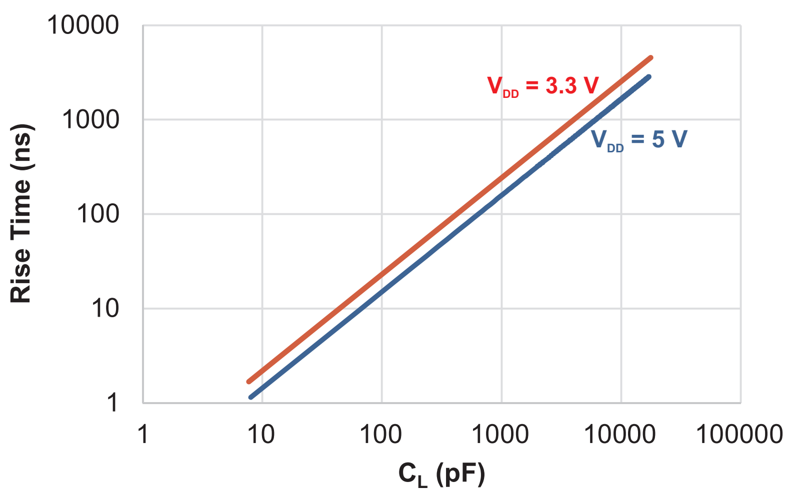


Figure 6. Typical output rise time vs. load capacitance

Applications Information

Overview

Figure 7 shows the IL600-Series block diagram. The coil, GMR, and support integrated circuitry are integrated on a single chip:

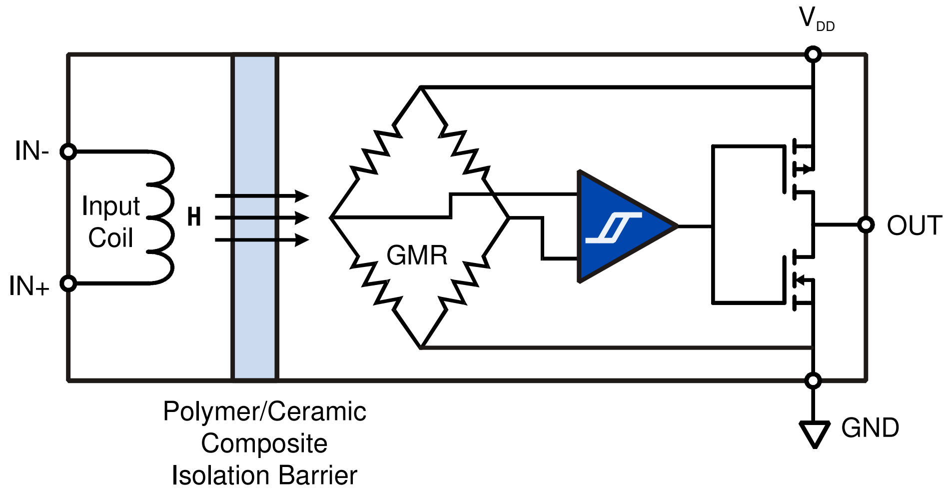


Figure 7. IL61xCMTI block diagram (each channel).

Input Coil

IL600-Series Isolators' current-mode architecture avoids semiconductor structures on the inputs, allowing unprecedented transient immunity. Changes in current flow into the input coil result in logic state changes at the output. Input-stage hysteresis improves noise immunity.

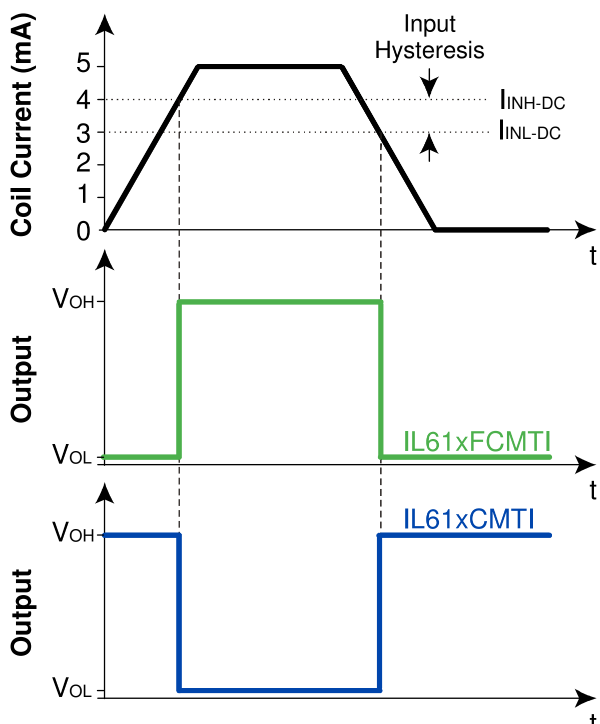


Figure 8. Typical IL600-Series transfer function.

GMR Wheatstone Bridge

The heart of the Isolator is a Wheatstone bridge constructed of GMR resistor elements. The current in the coil driven from the input side of the isolator creates a magnetic field that switches the GMR in the bridge. Thus the signal is transmitted by magnetic field.

Schmitt Trigger and Output Stage

The change in the bridge is detected by a Schmitt trigger comparator. This drives a push-pull MOSFET output stage.

The outputs have deterministic defaults when the input coil is unenergized (LOW for the IL61xFCMTI and HIGH for the IL61xCMTI).

Default-LOW versions are useful in applications such as H-bridges to avoid shoot-through by ensuring all the FETs are off when the controller starts up or in case of a loss of controller-side power.

Default-HIGH versions can be used in certain logic applications, or for electronic fusing applications to ensure the circuit in on at power-up.

Coil Polarity

Current from (In+) to (In−) energizes the coil and switches the output from its default state. Zero or negative current will cause the output to switch to the default state. The coil input is analogous to the LED in an optocoupler, with (In+) analogous to the LED anode, and (In−) analogous to the cathode.

Input Resistor Selection

Resistors set the coil input current:

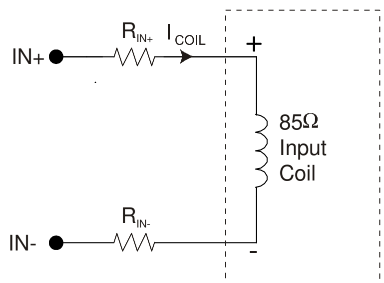


Figure 9. Input resistors.

There is no limit to input voltages because there are no semiconductor input structures.

The resistors can should be divided between the two inputs. The two resistors can be the same if necessary, although because of some inherent structural asymmetry, an R_{IN+} resistor approximately 50% larger than R_{IN-} is optimal for CMTI.
The worst-case drive current is calculated from the worst-case input voltage divided by the total series resistance plus the worst-case coil resistance. Note that coil resistance increases with temperature. Driver output impedance should also be considered if it is significant.

The following table summarizes typical input resistor values:

	5 mA min. drive current		**10 mA typical drive current**	
V_{COIL}	R_{IN+}	R_{IN-}	R_{IN+}	R_{IN-}
3.3 V	300 Ω	200 Ω	200 Ω	140 Ω
5 V	500 Ω	330 Ω	250 Ω	165 Ω

Table 1. Typical input resistor values.

The values for 5 mA drive are designed to provide a minimum of 5 mA drive current so the isolator is guaranteed to switch. The values for 10 mA drive are designed to provide 10 mA typical drive current to maximize CMTI.

The worst-case logic low threshold current is 8 mA, which is for single-ended operation with a 3 V supply. With differential drive the logic low threshold current is 5 mA for the range of supplies.

Maximum Coil Current

Absolute Maximum unipolar coil current is 25 mA, while bipolar mode allows up to ±75 mA. The difference in specifications is due to the risk of electromigration of coil metals under constant current flow. Long-term unipolar DC current flow above 25 mA can cause erosion of the coil metal. In differential mode, erosion takes place in both directions as each current cycle reverses and has no net effect up to the absolute maximum current.

An advantage over optocouplers and other high-speed couplers in differential mode is that no reverse bias protection for the input structure is required for a differential signal.

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Drive Configurations
IL600-Series Isolators can be configured with the input referenced to ground (Figure 9), referenced to a logic supply (Figure 10), or in a bipolar configuration (Figure 11).

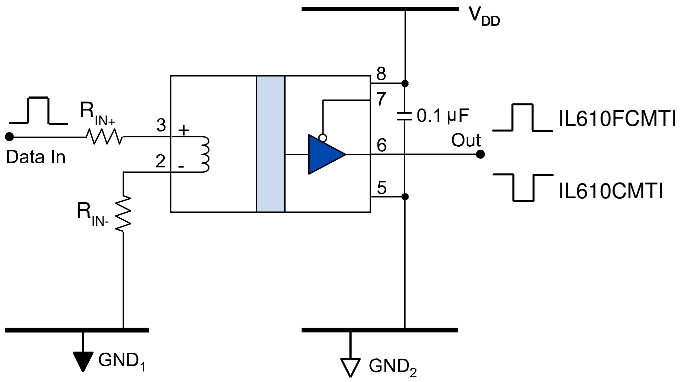


Figure 10. Input referenced to ground.

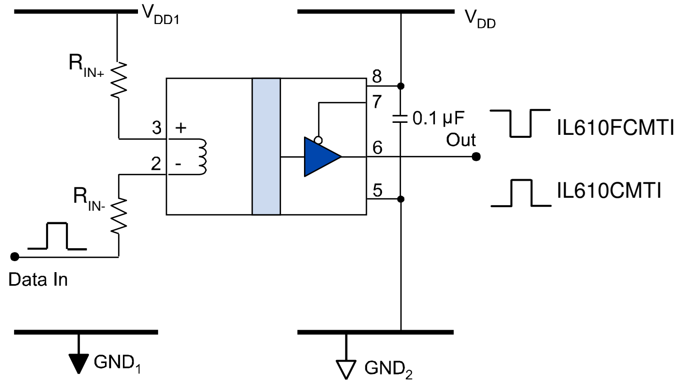


Figure 11. Input referenced to logic supply.

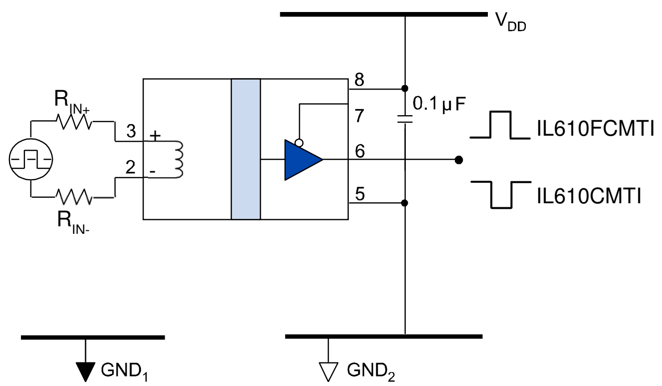


Figure 12. Bipolar drive.

The differential coil current is negative for a high output and positive for a low output. Bipolar drive increases the absolute maximum coil current, minimizes the required input current with a 3.3-volt supply, and maximizes immunity to external magnetic fields. No reverse bias protection for the input structure is required for a bipolar signal.

Maximizing CMTI

10 mA coil current
CMTI increases with coil current, up to approximately 10 mA. More than 10 mA does not significantly improve CMTI.

Output Deglitching
Deglitching significantly increases CMTI. Some MOSFET drivers have built-in degliching, or a simple deglitch circuit is shown in Figure 13.

Power Supply Decoupling
A 0.1 µF ceramic capacitor is recommended to decouple the output-side power supply (V_{DD2}). The capacitor should be as close as possible to the V_{DD} pin.

Maintaining Creepage
Standard pad libraries often extend under the package, compromising creepage and clearance. Similarly, ground planes, if used, should be spaced to avoid compromising clearance. Package drawings and recommended pad layouts are included in this datasheet.

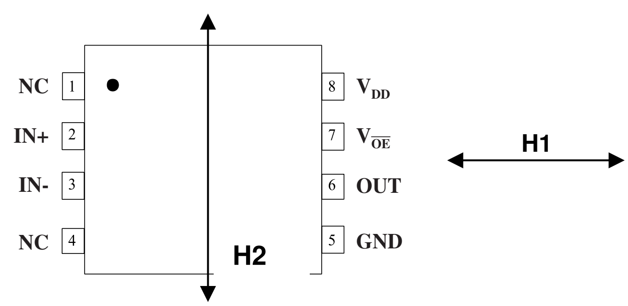
Electromagnetic Compatibility and Magnetic Field Immunity
IL600-Series isolators are ideal for harsh industrial environments with low emitted fields and very high external magnetic field immunity. Because IL600-Series Isolators are completely static, they do no emitted any EMI.

Internal shielding and inherent common-mode field immunity
IsoLoop Isolators operate by imposing a magnetic field on a GMR sensor, which translates the change in field into a change in logic state. A magnetic shield and a Wheatstone Bridge configuration provide superb immunity to external magnetic fields.

Inherent AC magnetic field immunity
Unlike inductive or capacitive which transmit and detect high-frequency carriers, IsoLoop Isolators do not rely on AC signals, and are inherently insensitive to AC magnetic fields. It is harder to disrupt an isolated AC signal with an external magnetic field than a DC signal. This enhances the IL6xxCMTI magnetic immunity in switch-mode power control applications. Immunity to external magnetic fields can be enhanced by (1) optimal orientation of the device with respect to the field direction and (2) the use of bipolar coil inputs.

1. *Orientation of the device with respect to the external field*
   An applied field in the "H1" direction is the worst case for magnetic immunity. In this case, the external field is in the same direction as fields generated on-chip. An applied field in direction "H2" has considerably less effect and results in higher magnetic immunity.

2. *Bipolar coil input*
   Regardless of orientation, a bipolar input on the coil improves magnetic immunity. The higher the coil current, the higher the on-chip fields, and the higher the immunity to external fields.



Method	Approximate Immunity	Immunity Description
Field applied in H1 direction	±2 mT	A DC current of 100 A flowing in a conductor 1 cm from the device could cause disturbance.
Field applied in H2 direction	±7 mT	A DC current of 140 A flowing in a conductor 1 cm from the device could cause disturbance.
Field applied in any direction but with a bipolar input to the coil	±25 mT	A DC current of 1250 A flowing in a conductor 1 cm from the device could cause disturbance.

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Illustrative Applications

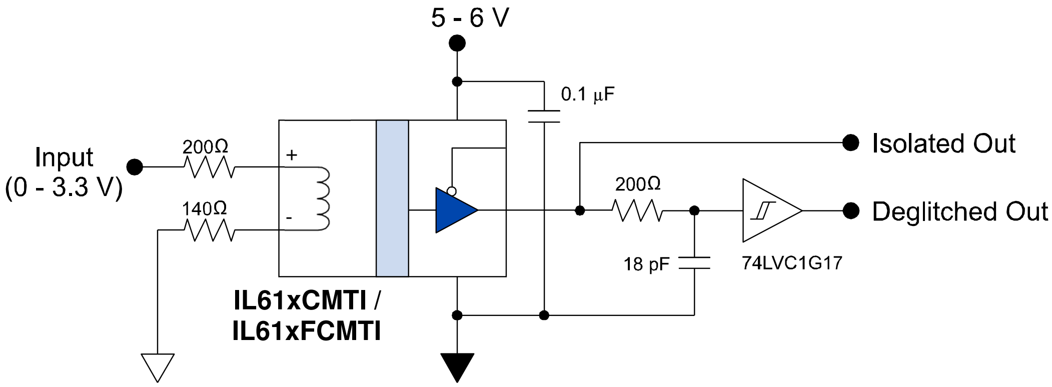

Figure 13. A simple deglitch circuit.

Deglitching provides a minimum of 300 kV/µs transient immunity. In this circuit, the RC delay filters out pulses less than approximately 10 ns, and an inexpensive Schmitt-trigger provides a digital output.

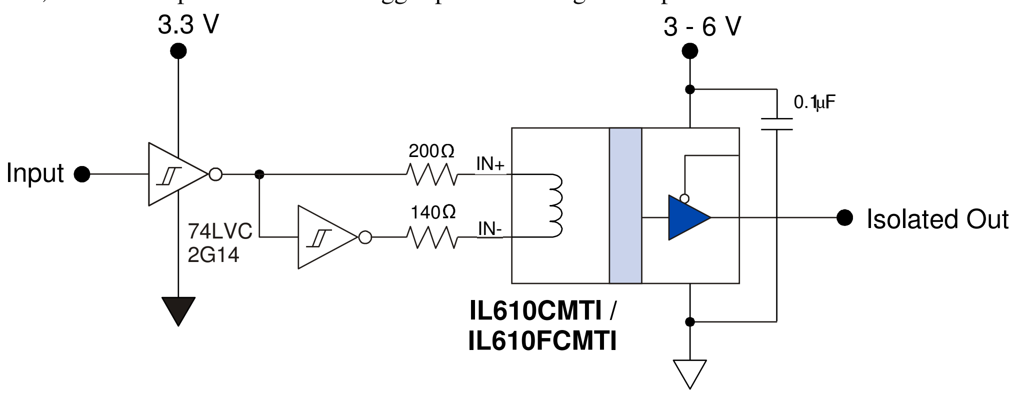

Figure 14. Bipolar driver.

A simple ±10 mA bipolar differential coil driver using an inexpensive dual Schmitt trigger. Bipolar drive increases the absolute maximum coil current, minimizes the required input current with a 3.3-volt supply, and maximizes immunity to external magnetic fields.

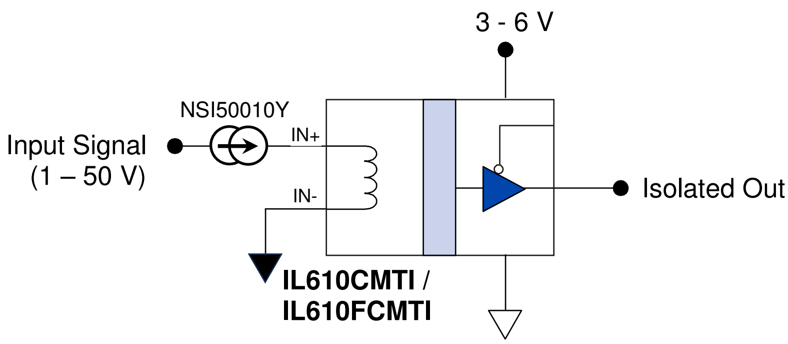

Figure 15. Wide input voltage range with a constant current regulator.

A Self-Biased Transistor (SBT) Constant Current Regulator (CCR) can be used to regulate the coil current to approximately 10 mA over a very wide voltage range. This may have slightly less CMTI performance than the recommended resistors, but it maximizes input signal flexibility. In the circuit above, the maximum continuous input voltage will be limited by the CCR's 208 mW total device dissipation.

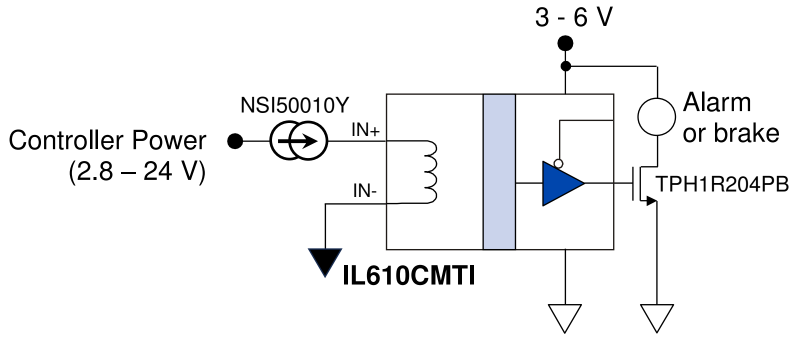

Figure 16. A failsafe-HIGH alarm application circuit.

Failsafe-HIGH isolators are useful when a high output is needed to indicate a fault or to ensure safe start-up. The circuit above can be used to activate an alarm or motor brake to shut down power-side devices safely if the controller power fails.

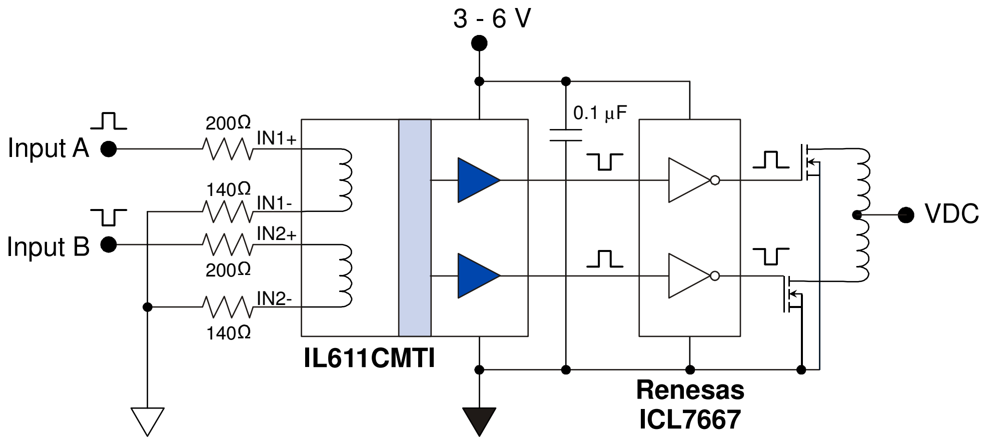

Figure 17. Isolated gate-driver interface.

The isolators can drive general-purpose gate drivers for applications requiring high speed or high gate capacitance MOSFETs. A Renesas ICL7667 dual high-speed monolithic driver is used in the circuit above to drive the primary of an isolated DC-DC convertor transformer. The resistor values shown are typical for a 3.3-volt supply.

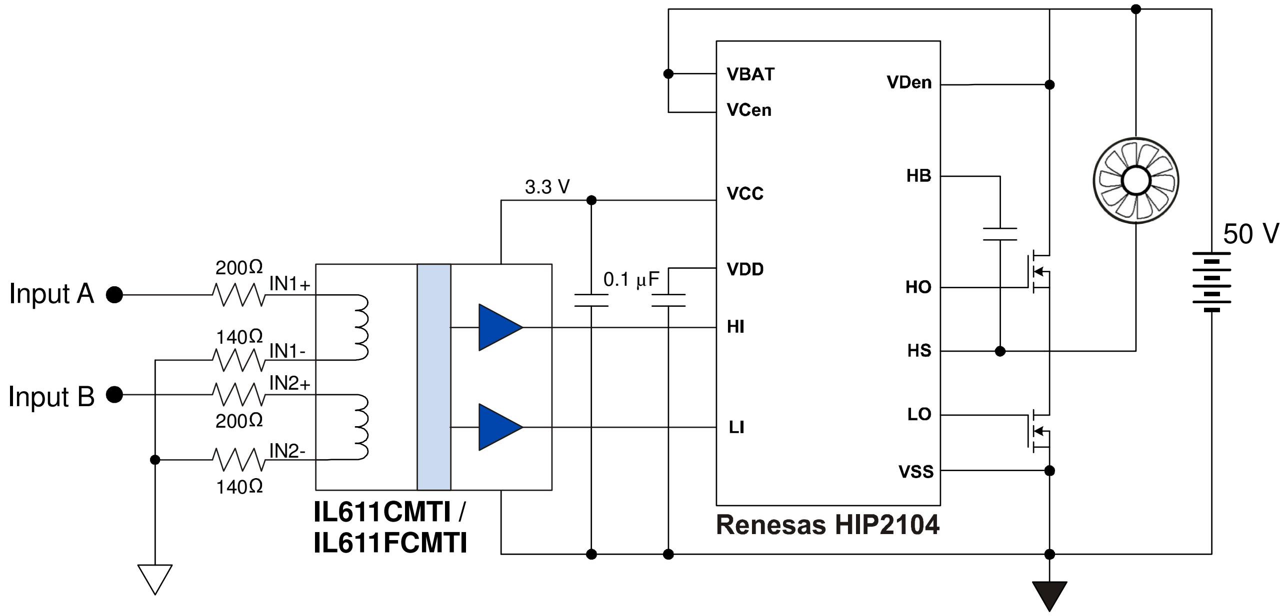

Figure 18. Isolated half-bridge motor drive.

The isolators can be used in conjunction with a half-bridge driver to create an isolated driver for motors or power-drive circuits. The HIP2104 IC provides fast drive of high gate-capacitance MOSFETs and powers the bridge side of the isolator. The resistor values shown are typical for a 3.3 volt input.

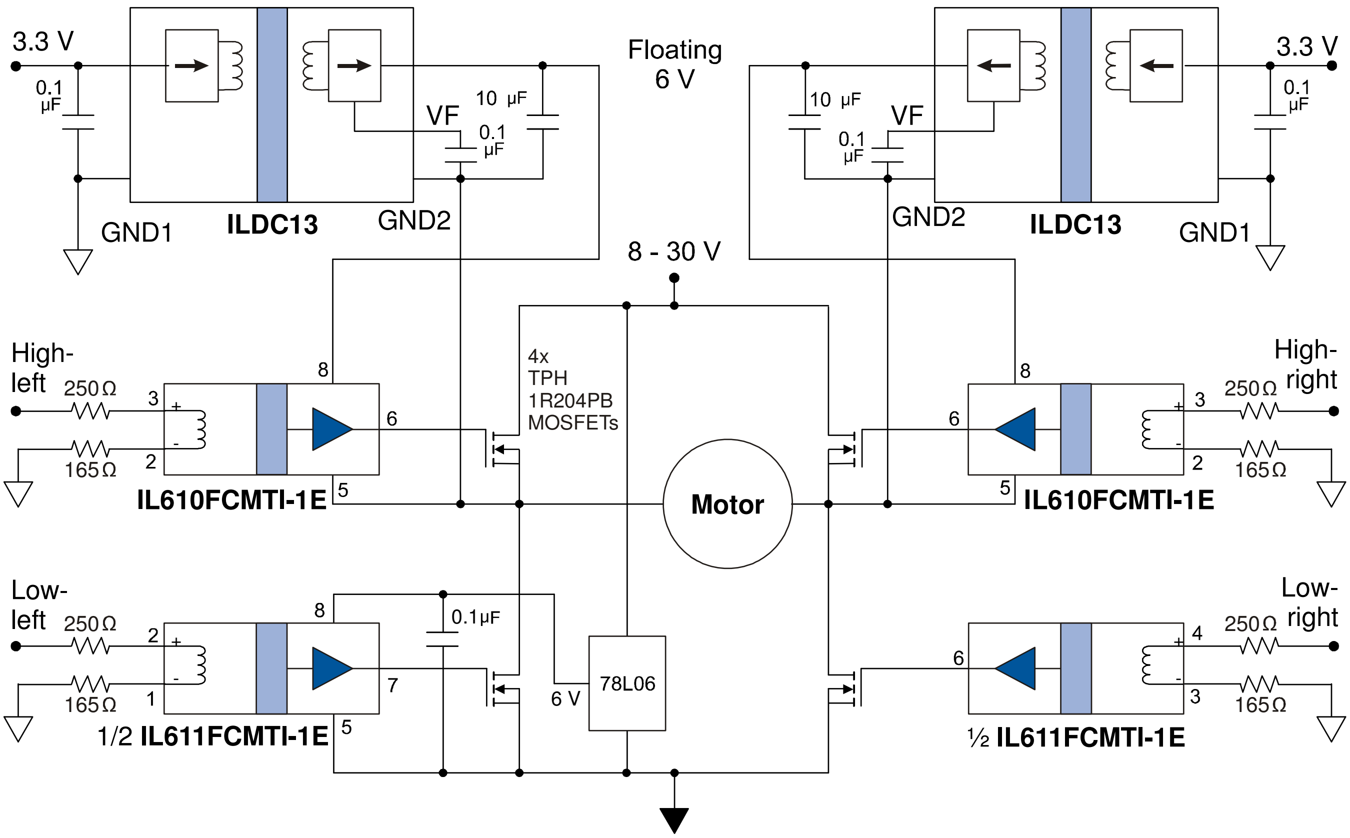

Figure 19. Simple Isolated H-Bridge.

Four channels of isolation in three IL6xxFCMTI isolators allow referencing the high-side gate signals to the floating FET source pins, plus they level-shift low-voltage controller inputs to six volts to drive MOSFET gates. These isolators have low-impedance outputs to directly drive FETs, so separate drivers are not required.

The 250 Ω and 165 Ω isolator input resistors are scaled for five-volt control inputs and maximum transient immunity. See Table 1 for other typical resistor values.

The default-LOW IL6xxFCMTI isolators prevent shoot-through and ensure all the FETs are off when the controller starts up or in case of a loss of controller-side power.

The ILDC13 ultraminiature DC-DC convertor isolates and floats the high-side gate power. The DC-to-DC convertors powered by the controller-side provide an additional layer of failsafe protection. The DC-to-DC convertors have a “soft-start” feature that allows time for the controller to start up before the high-side gate supplies are available.

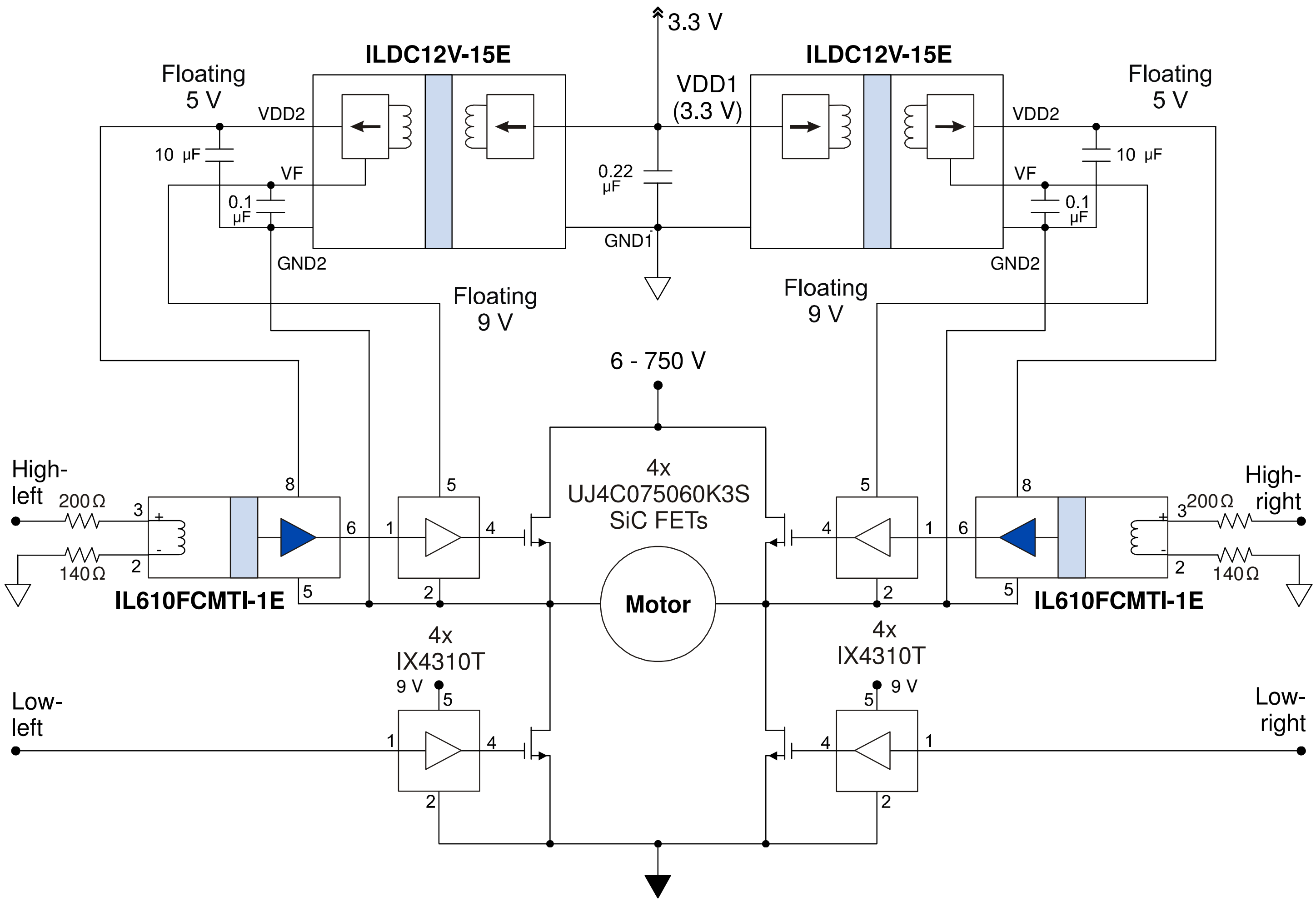

Figure 20. Isolated high-power silicon-carbide H-bridge.

Silicon-carbide FETs usually require more than six-volt gate drive and lower-impedance drivers. For these applications, IL610FCMTI isolators can be combined with external drivers such as the IX4310T as shown in Figure 20. The separate gate drivers translate the IL611FCMTI isolator outputs to nine volts and provide instantaneous high gate-drive currents for fast switching speeds with large FETs. The ILDC12s' unregulated VF outputs provide approximately nine volts of isolated power for the high-side gates

The 200 Ω and 140 Ω isolator input resistors are scaled for 3.3-volt control inputs and maximum transient immunity. See Table 1 for other typical resistor values.

The default-LOW IL6xxFCMTI isolators on the high side prevent ensure all the FETs are off when the controller starts up or in case of a loss of controller-side power. The DC-to-DC convertors powered by the controller-side provide an additional layer of failsafe protection. The DC-to-DC convertors have a "soft-start" feature that allows time for the controller to start up before the high-side gate supplies are available.

Evaluation Support

An Arduino Shield with H-bridge circuitry similar to Figure 19 is available. The Shield uses two IL610CMTI isolators and an IL611CMTI dual isolator to drive a MOSFET H-bridge:

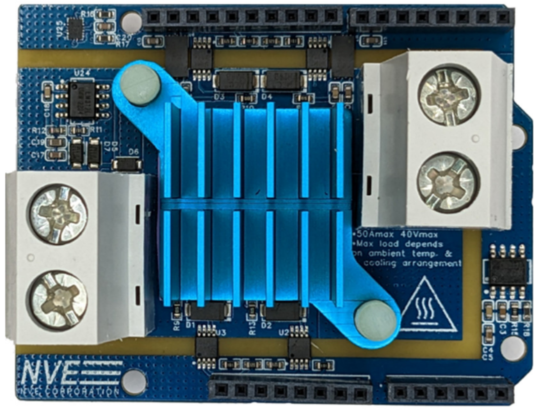

Figure 21. Shield01 H-bridge Arduino Shield (actual size).
2.7" x 2.1" (53 mm x 69 mm)

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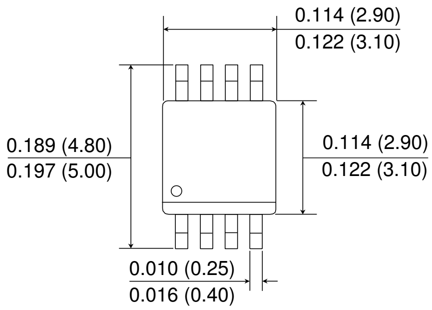
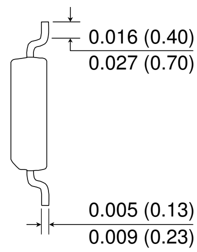
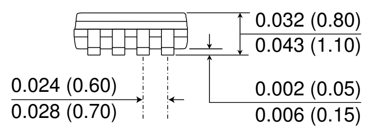
Package Drawings

8-pin MSOP (-1 suffix)

Dimensions in inches (mm); scale = approx. 5X



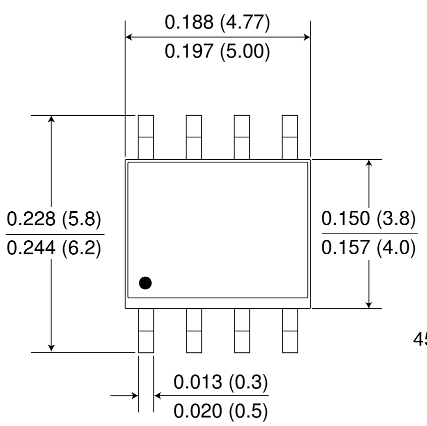


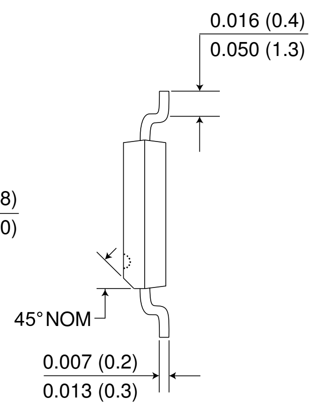


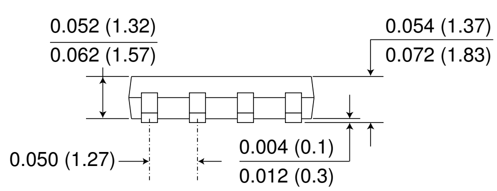
NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

8-pin SOIC Package (-3 suffix)

Dimensions in inches (mm); scale = approx. 5X



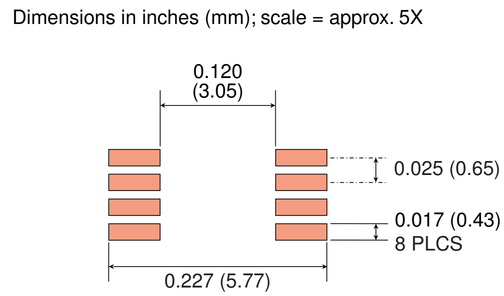




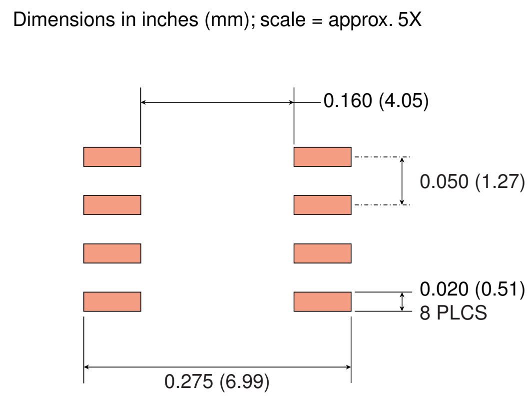
NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

Recommended Pad Layouts

8-pin MSOP Pad Layout



8-pin SOIC Pad Layout



Ordering Information and Valid Part Numbers

IL 6xx F CMTI - 1 E TR13

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

Package
E = RoHS Compliant

Package Type
-1 = MSOP8
-3 = SOIC8

Grade
Blank = Standard
CMTI = Ultrahigh Transient Immunity

Default Output
Blank = HIGH
F = LOW

Base Part Number
610 = Single Channel
611 = Dual Channel

Product Family
IL = Isolators

Available Parts:

Part Number	Channels	Default Output	Package
IL610CMTI-1E	1	HIGH	MSOP8
IL610FCMTI-1E		LOW	
IL611CMTI-1E	2	HIGH	
IL611FCMTI-1E		LOW	
IL610CMTI-3E	1	HIGH	SOIC8

Revision History

ISB-DS-001-IL6xxCMTI-RevG
February 2025

Changes

- Added default-LOW versions (IL6xxFCMTI).
- Reversed coil polarity labeling for applicability to both default-HIGH and default-LOW versions.
- Changed magnetic immunity units from G to mT (SI units); clarified "Immunity Descriptions" (p. 13).
- Added constant current regulator and failsafe-HIGH alarm application circuits (Figs. 15 and 16, pp. 15 and 16).
- Added Arduino Shield demo board (p. 18).

ISB-DS-001-IL6xxCMTI-RevF
September 2023

Changes

- Updated simple H-bridge application circuit with ILDC13.
- Added more sophisticated H-bridge application circuits.

ISB-DS-001-IL6xxCMTI-RevE
October 2022

Changes

- Added V_{OE} logic high and low input voltage specifications (p. 2).
- Upgraded to VDE 0884-17 (p. 3).
- Increased Working Voltage ratings based on latest VDE testing (p. 3).

ISB-DS-001-IL6xxCMTI-RevD
September 2020

Change

- More detailed Figure 15 (isolated H-bridge driver).

ISB-DS-001-IL6xxCMTI-RevC
March 2020

Change

- Dropped IL6xxCMTI-3 part type.

ISB-DS-001-IL6xxCMTI-RevB
February 2020

Changes

- Increased SOIC Working Voltage to 1000 V_{RMS} (p. 3).
- Added drain-source resistance and more detailed output voltage specs.
- Separated 3.3 V and 5 V CMTI specification tables and separated one- and two-channel models.
- Added detailed block diagram.
- Dropped boost capacitor recommendation because it degrades CMTI.
- Added several performance graphs.
- Recommended two coil resistors and imbalanced resistors.
- VDE and UL approval.

ISB-DS-001-IL6xxCMTI-RevA
November 22, 2019

Changes

- Added thermal characteristics (p. 2).
- Increased supply voltage range from 6 V to 6.6 V.
- Additional application circuits.
- Initial release.

ISB-DS-001-IL6xxCMTI-PRELIM2
November 1, 2019

Changes

- Updated CMTI specs.
- Additional application circuits.

ISB-DS-001-IL6xxCMTI-PRELIM
September 2019

Change

- Preliminary release.

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ISB-DS-001-IL6xxCMTI

February 2025