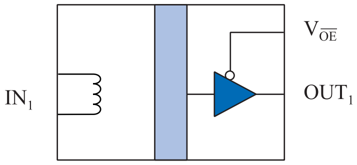
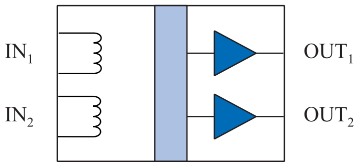
Ultrahigh CMTI Isolated MOSFET Drivers

Functional Diagrams



IL610CMTI



IL611CMTI

Features

- 200 kV/µs guaranteed CMTI; 300 kV/µs with deglitch
- 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
- Failsafe output (high output for zero coil current)
- 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. The inputs can be configured as non-inverting or inverting.

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 low power.

A unique ceramic/polymer composite barrier provides excellent isolation and virtually unlimited barrier life.

IsoLoop is a registered trademark of NVE Corporation.
*U.S. Patent number 5,831,426; 6,300,617 and others.

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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

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[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	V_{IO}	1500			V_{DC}	At maximum operating temperature
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	θ_{JA}		184		°C/W	Soldered to double-sided board; free air
	SOIC8			134			
Junction–Case (Top) Thermal Resistance	MSOP8	θ_{JT}		15		°C/W	
	SOIC8			10			
Power Dissipation	MSOP8	P_D			500	mW	
	SOIC8				675		

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

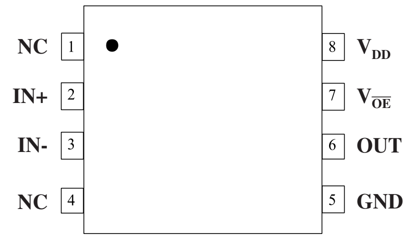
Electrostatic Discharge Sensitivity

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.

Pin Connections

IL610CMTI

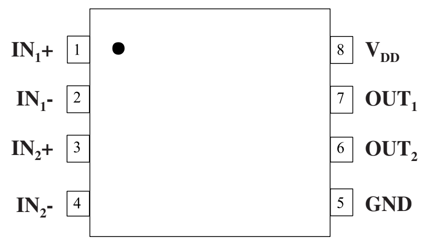
1	NC	No internal connection
2	IN+	Coil connection
3	IN–	Coil connection
4	NC	No internal connection
5	GND	Ground return for V_{DD}
6	OUT	Data out
7	$V_{\overline{OE}}$	Output enable. Internally held low with 100 kΩ
8	V_{DD}	Supply Voltage



IL610CMTI

IL611CMTI

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

Operating Specifications

Coil Specifications (V_{DD} = 3 V – 6.6 V; T = –40°C – 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 – 85°C
Coil Resistance Temperature Coefficient	TC R_{COIL}		0.2	0.25	Ω/°C	
Coil Inductance	L_{COIL}		9		nH	

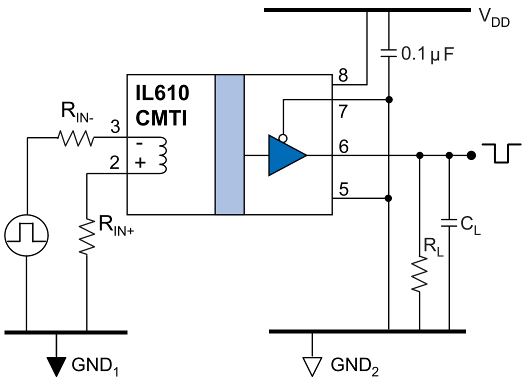


Figure 1. Test circuit.

5 V Specifications

5 V Electrical Specifications (V_{DD} = 4.5 V – 6.6 V; T = –40°C – 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Quiescent Supply Current						
IL610CMTI	I_{DD}		2	3	mA	V_{DD} = 5 V, I_{IN} = 0
IL611CMTI			4	6		
Input Threshold	$I_{INH\text{-}DC}$	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]	$I_{FS\text{-}HIGH}$	–25		0.5	mA	
	$I_{FS\text{-}LOW}$	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	$R_{DS\text{-}P}$		40		Ω	V_{DD} = 5 V
			38			V_{DD} = 6 V
Output Stage Low-Side Drain-to-Source Resistance	$R_{DS\text{-}N}$		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 – 6.6 V; T = –40°C – 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 (High-to-Low)	t_{PHL}		8	15	ns	
Propagation Delay Input to Output (Low to High)	t_{PLH}		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 Time (10–90%)	t_R		2	4	ns	
Output Fall Time (10–90%)	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 (High-to-Low)	t_{PHL}		50	70	ns	
Propagation Delay Input to 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 – 6.6 V; T = –40°C – 85°C unless otherwise stated)						
IL610CMTI (single channel)						
5 mA drive	$\lvert CM_H\rvert$,$\lvert CM_L\rvert$		165		kV/µs	I_{COIL}= 0/ +5 mA
10 mA drive[2]		200[2]	240			I_{COIL}= 0/ +10 mA
With external degliching		300	350			10 ns output deglitch

IL611CMTI (two channel)						
5 mA drive	$\lvert CM_H\rvert$,$\lvert CM_L\rvert$		145		kV/µs	I_{COIL}= 0/ +5 mA
10 mA drive[2]		200[2]	210			I_{COIL}= 0/ +10 mA
With external degliching		300	350			10 ns output deglitch

3.3 V Specifications

3.3 V Electrical Specifications (V_{DD} = 3 V − 3.6 V; T = −40°C − 85°C unless otherwise stated)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Quiescent Supply Current						
IL610	I_{DD}		1.3	2	mA	V_{DD} = 3.3 V, I_{IN} = 0
IL611	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)	$I_{FS\text{-}HIGH}$	–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 − 3.6 V; T = −40°C − 85°C unless otherwise stated)						
Minimum Pulse Width(1)	PW	10			ns	Digital Drive: Test Circuit 2; R_L = 1 KΩ; C_L = 15 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay Input to Output (High to Low)	t_{PHL}		12	18	ns	
Propagation Delay Input to 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 Time (10–90%)	t_R		3	5	ns	
Output Fall Time (10–90%)	t_F		3	5	ns	
Minimum Pulse Width(1)	PW	100			ns	MOSFET drive: Test Circuit 2; R_L = 1 MΩ; C_L = 1000 pF; t_{IR} = t_{IF} = 3 ns
Propagation Delay Input to Output (High-to-Low)	t_{PHL}		75	100	ns	
Propagation Delay Input to 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 − 3.6 V; T = −40°C – 85°C unless otherwise stated)						
IL610CMTI (single channel)						
5 mA drive	$\|CM_H\|,\|CM_L\|$		125		kV/µs	I_{COIL}= 0/ +5 mA
10 mA drive			175			I_{COIL}= 0/ +10 mA
With external degliching			300			10 ns output deglitch

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

Notes:

1. Failsafe Operation is defined as the guaranteed output state which will be achieved if the DC input current falls between the input levels specified.
   Note if Failsafe to Logic Low is required, 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

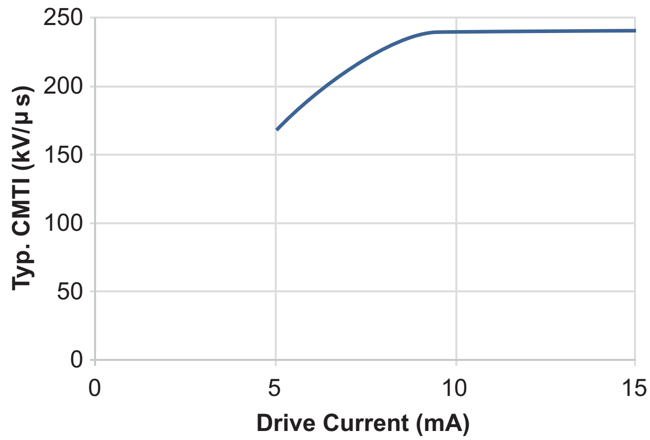


Figure 2. Typical CMTI vs. drive current (V_{DD} = 5 V).

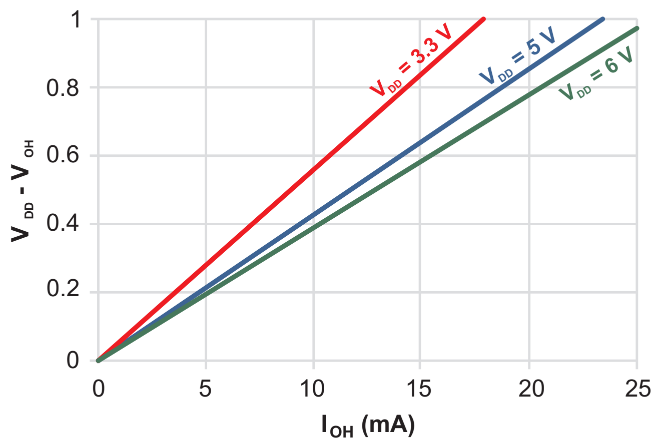


Figure 3. Typical high output voltage vs. load.

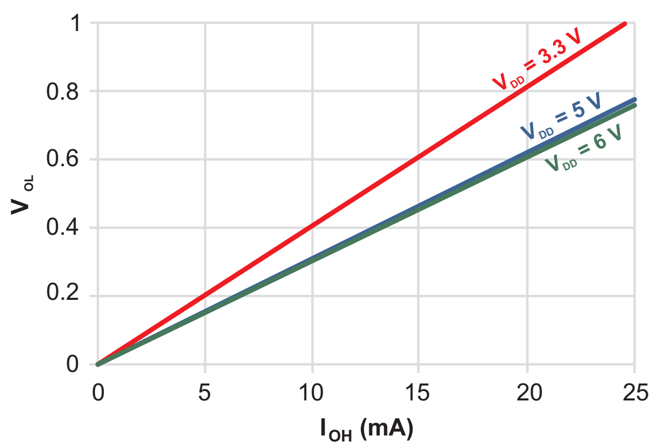


Figure 4. Typical low output voltage vs. load

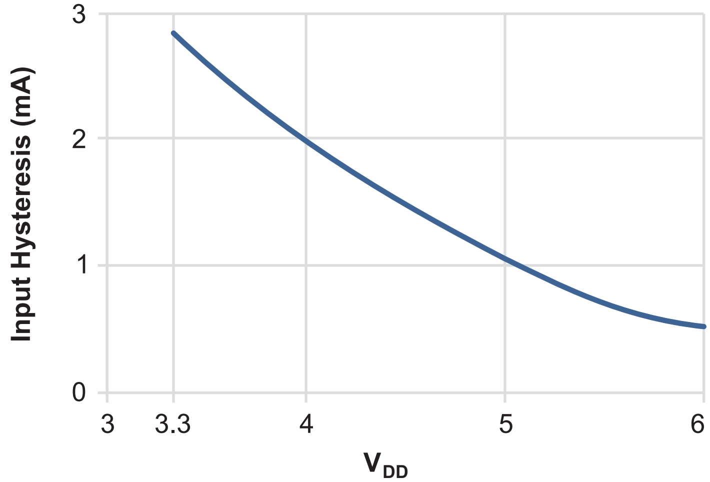


Figure 5. Typical input threshold current hysteresis.

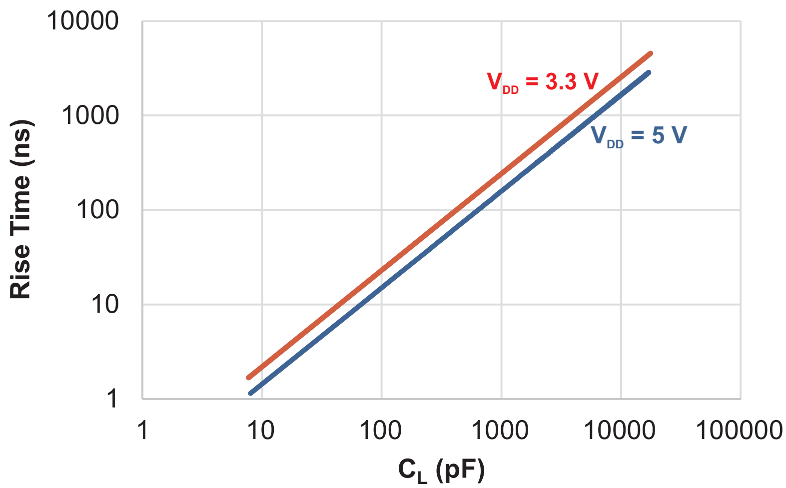


Figure 6. Typical output rise time vs. load capacitance

Applications Information

Overview

Figure 7 shows a block diagram of the IL61xCMTI. The coil, GMR, and support integrated circuitry are integrated on a single chip:

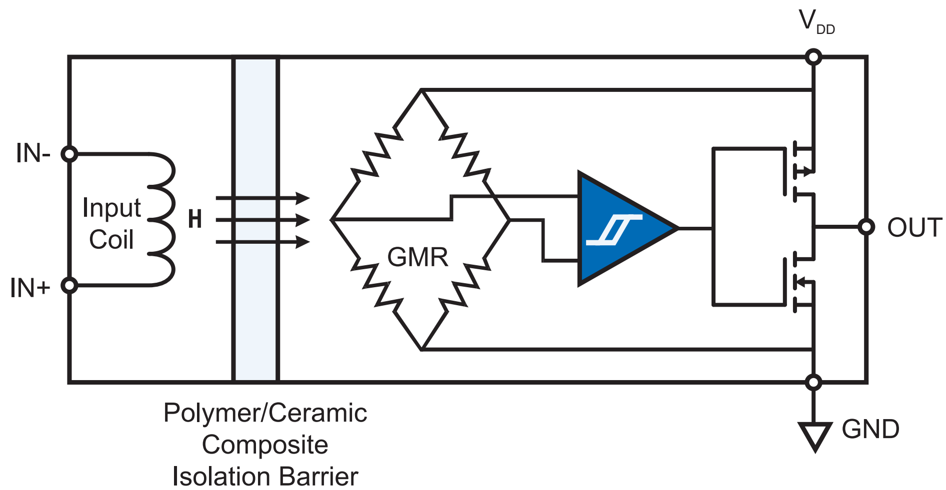


Figure 7. IL61xCMTI block diagram (each channel).

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.

Input Coil

IL600-Series Isolators are current mode devices. Changes in current flow into the input coil result in logic state changes at the output. Input-stage hysteresis improves noise immunity. Output logic high is the zero input current state:

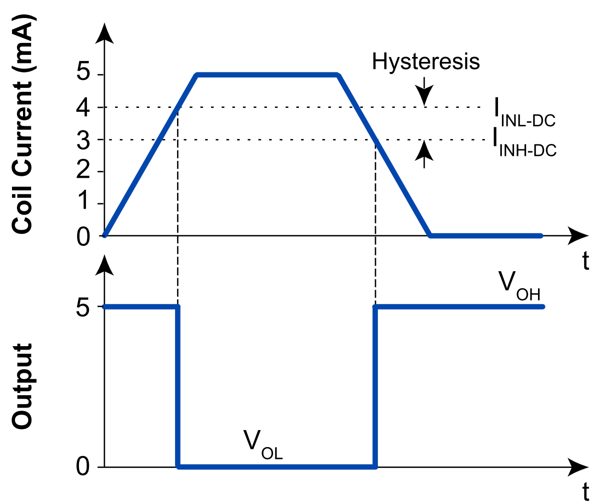


Figure 8. Typical IL600-Series transfer function.

Coil Polarity

The device switches to low if current flows from (In–) to (In+). ***Note that the designations "In–" and "In+" refer to logic levels, not current flow.*** Positive values of current mean current flow into the In– input.

Input Resistor Selection

Resistors set the coil input current:

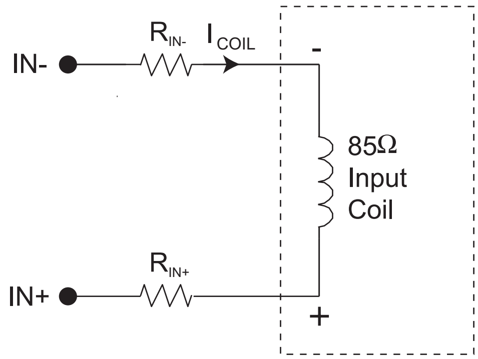


Figure 9. Input resistors.

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.

Drive Configurations
IL600-Series Isolators can be configured in inverting (Figure 9) non-inverting (Figure 10) or bipolar (Figure 11) configurations.

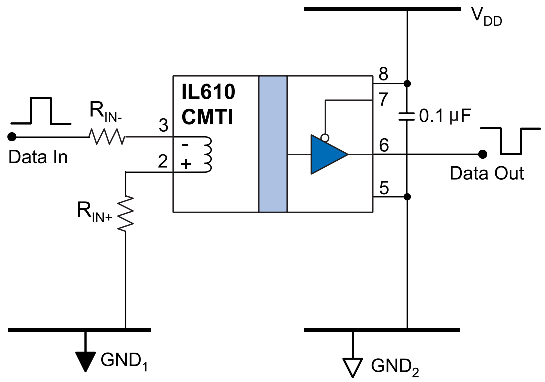


Figure 10. Inverting drive configuration.

This configuration is similar to standard logic. The output is high when the coil current is less than 0.5 mA, and low when the current is more than 5 mA.

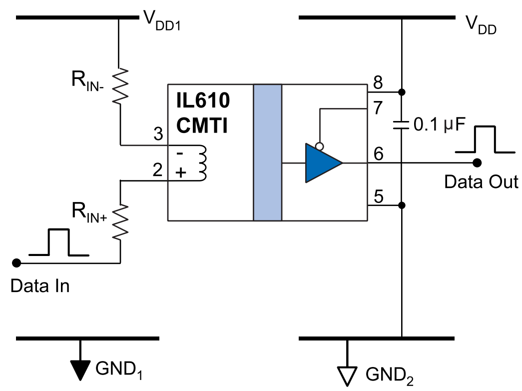


Figure 11. Non-inverting drive configuration.

When a logic high is applied to the input, the current through the coil is zero. When the input is a logic low (0 V), at least 5 mA flows through the coil from the In– side to the In+ side.

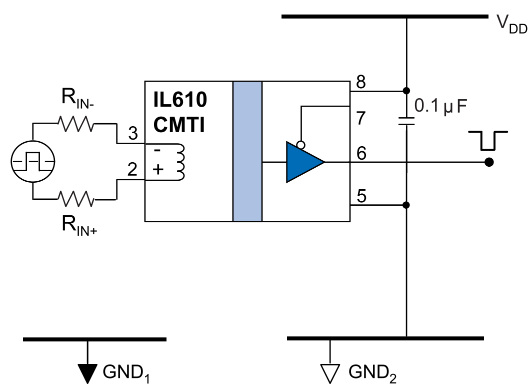


Figure 12. Bipolar drive configuration.

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 12.

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.

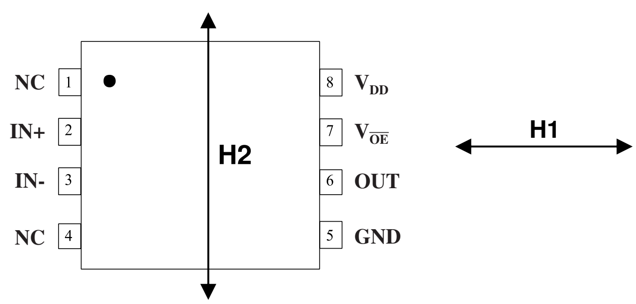
Maintaining Creepage
Standard pad libraries often extend under the package, compromising creepage and clearance. Similarly, ground planes, if used, should be spaced to avoid compromising clearance. Package drawings and recommended pad layouts are included in this datasheet.

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 have the lowest emitted noise of any non-optical isolators.

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 inputs.

1. Orientation of the device with respect to the field direction
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 the applied internal field. In one direction it will tend to help switching; in the other it will hinder switching. This can cause unpredictable operation.
An applied field in direction "H2" has considerably less effect and results in higher magnetic immunity.



2. Bipolar input
Regardless of orientation, a bipolar input improves magnetic immunity. This is because the logic high state is driven by an applied field instead of zero field, as is the case with single-ended operation. The higher the coil current, the higher the internal field, and the higher the immunity to external fields.

Method	Approximate Immunity	Immunity Description
Field applied in H1 direction	±20 Gauss	A DC current of 16 A flowing in a conductor 1 cm from the device could cause disturbance.
Field applied in H2 direction	±70 Gauss	A DC current of 56 A flowing in a conductor 1 cm from the device could cause disturbance.
Field applied in any direction but with a bipolar input	±250 Gauss	A DC current of 200 A flowing in a conductor 1 cm from the device could cause disturbance.

Illustrative Applications

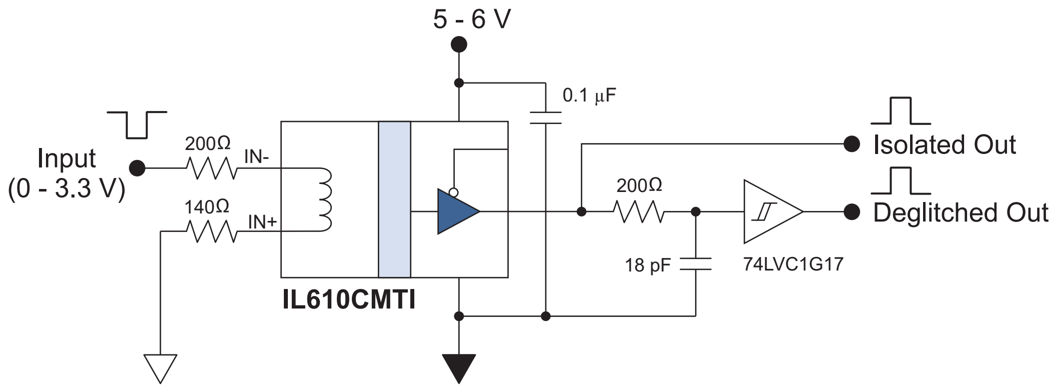


Figure 13. A simple deglitch circuit.

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.

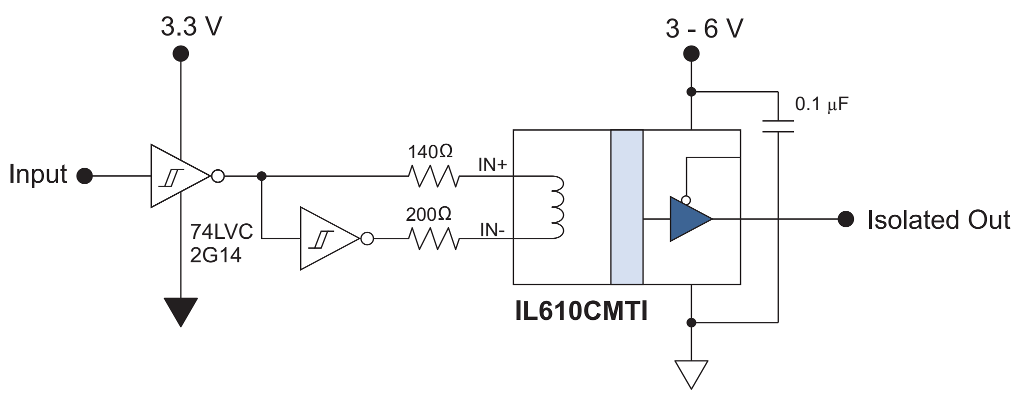


Figure 14. Bipolar driver.

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.

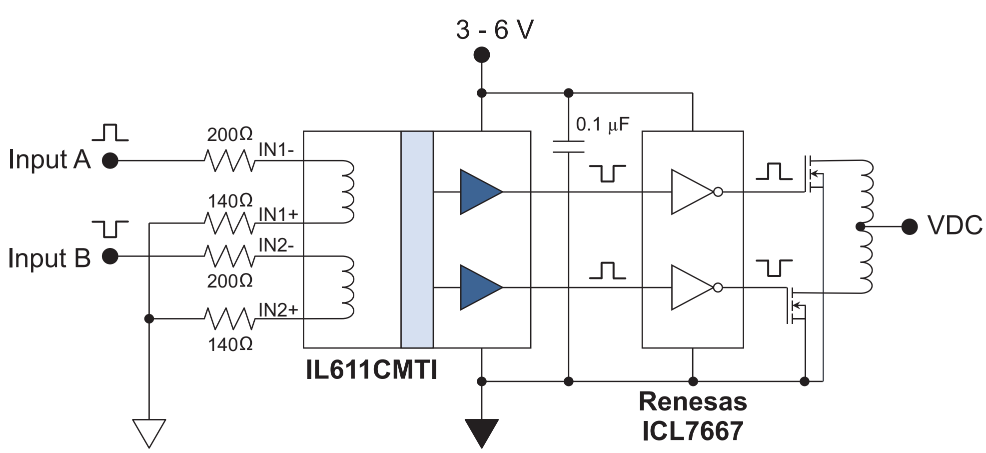


Figure 15. Isolated gate-driver interface.

The isolators can drive general-purpose gate drivers for applications requiring high speed or high gate capacitance MOSFETs. An 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.

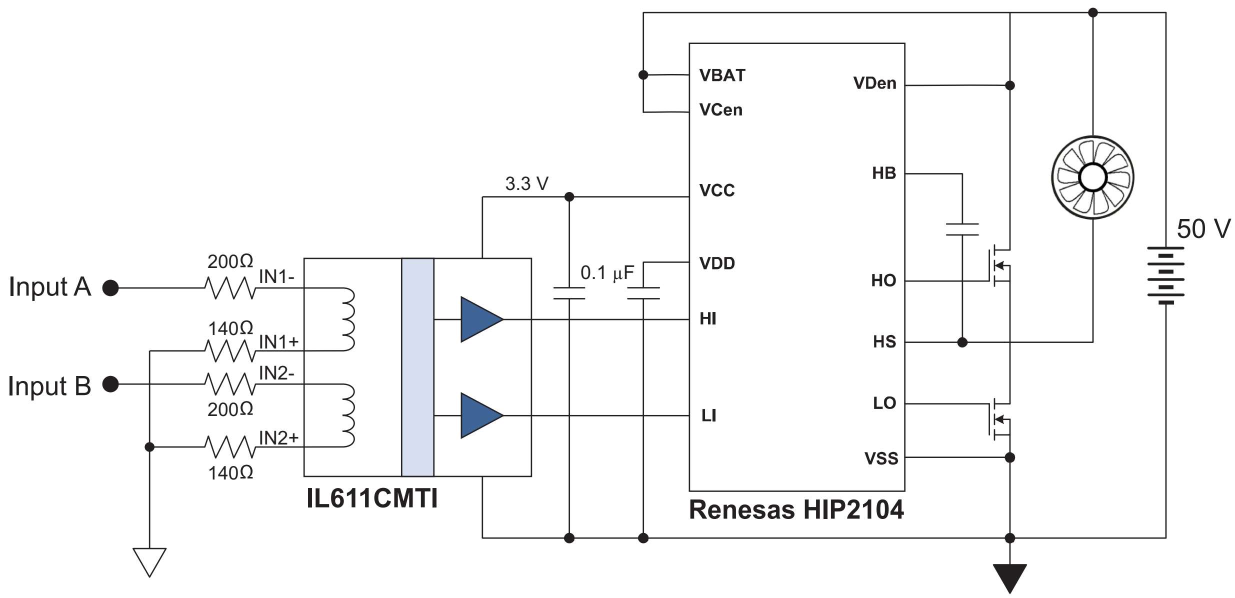


Figure 16. Isolated half-bridge motor drive.

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.

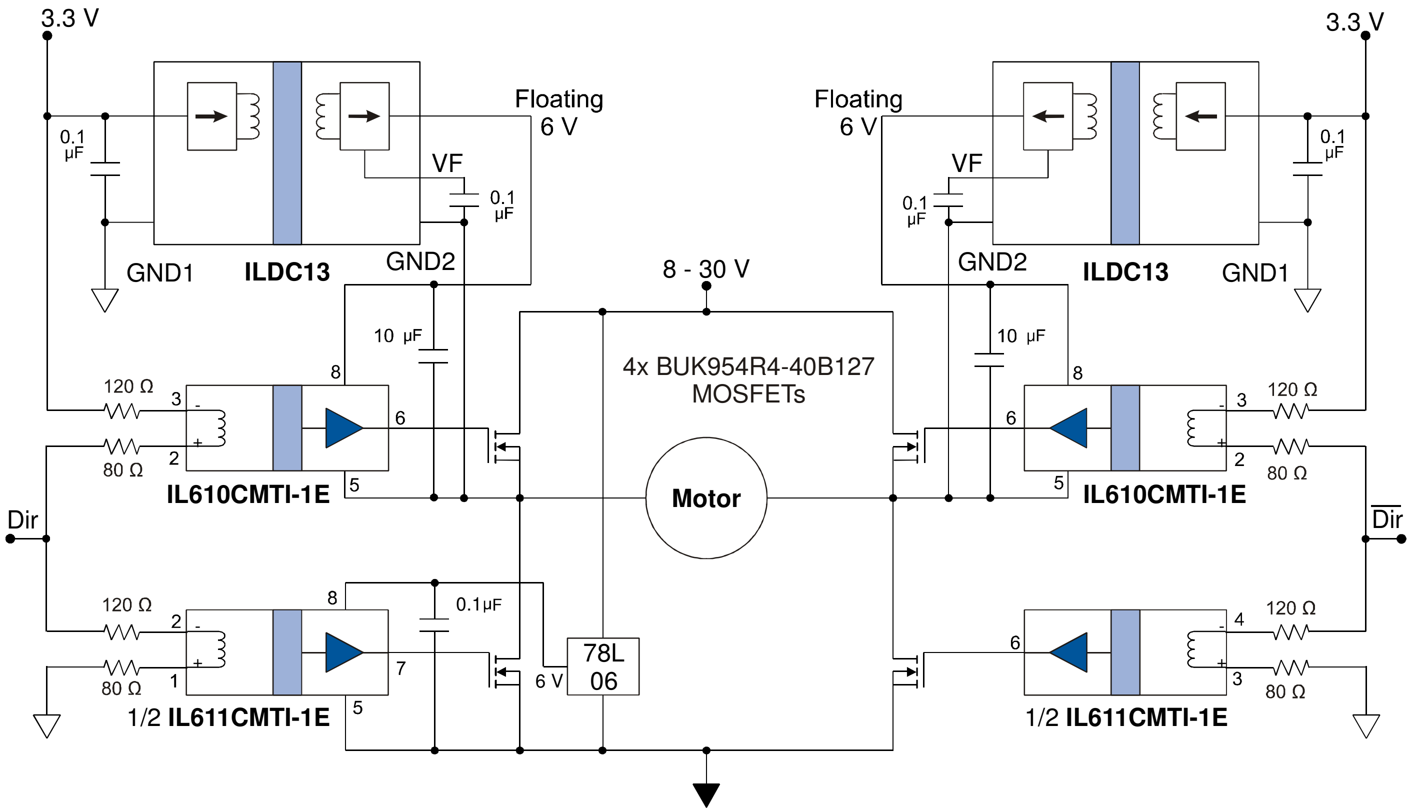


Figure 17. Simple isolated H-bridge.

Four channels of isolation in three IL6xxCMTI isolators allow referencing the high-side gate signals to the floating MOSFET 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 low- to medium-power MOSFETs, so separate MOSFET drivers are not required.

With their ultrahigh transient immunity, the IL610CMTIs prevent spurious isolator switching when the high-side MOSFETs switch.

The ILDC13 ultraminiature DC-DC convertor isolates and floats the high-side gate power.

The isolator inputs on each side of the H-bridge are connected in series, which minimizes the times that two MOSFETs on the same side are both ON (“shoot-through”).

The isolator inputs on each side of the H-bridge are connected in series, which minimizes the time that two MOSFETs on the same side are both ON (“shoot-through”). When the DIR and $\overline{\text{DIR}}$ inputs are high impedance, such as when a controller is starting up, all of the MOSFETs will be off.

If the DIR and $\overline{\text{DIR}}$ inputs are both set low, the motor is grounded to shunt the back EMF and stop the motor.

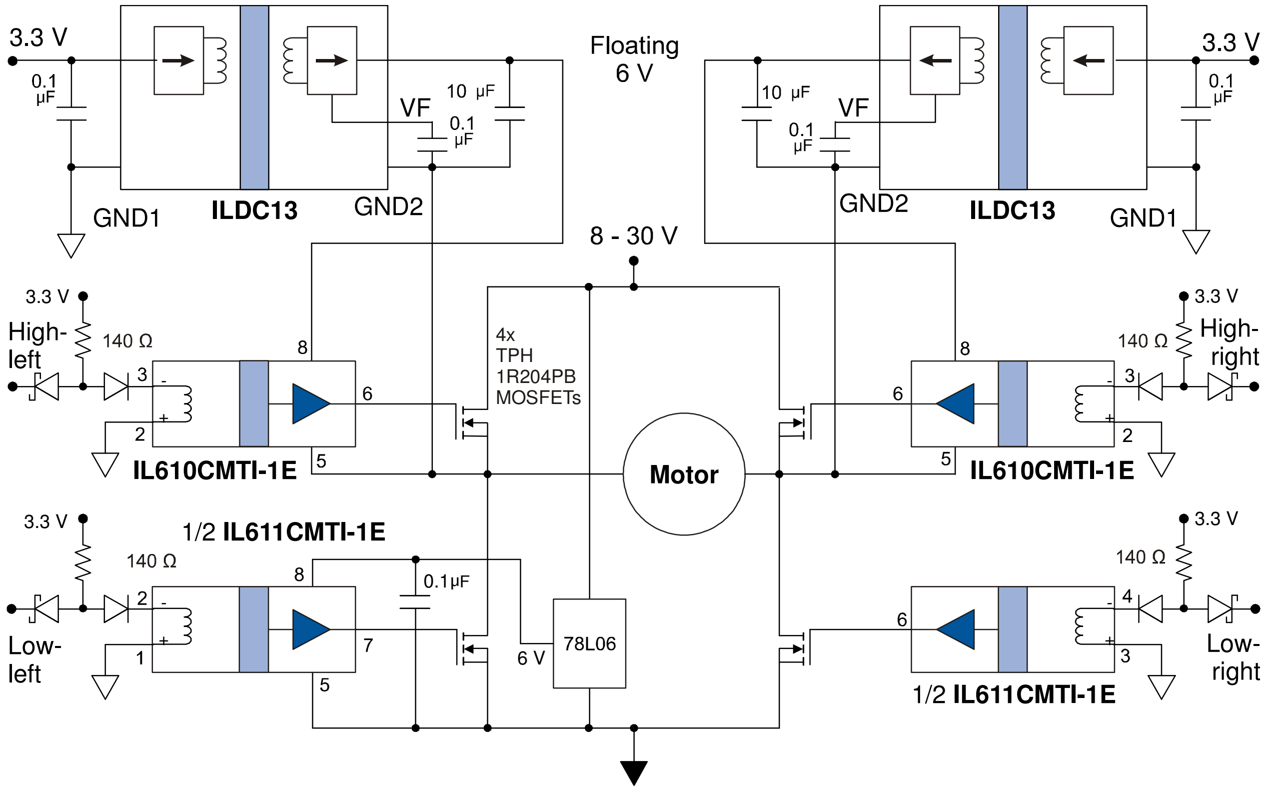


Figure 18. Isolated H-bridge with separate MOSFET control inputs.

This circuit provides separate inputs for each MOSFET to maximize flexibility, and allows all MOSFETS to be turned off while changing direction to prevent shoot-through.

The Schottky /conventional diode pairs ensure all MOSFETs are off when the MOSFET control inputs are tristate as the controller powers up.

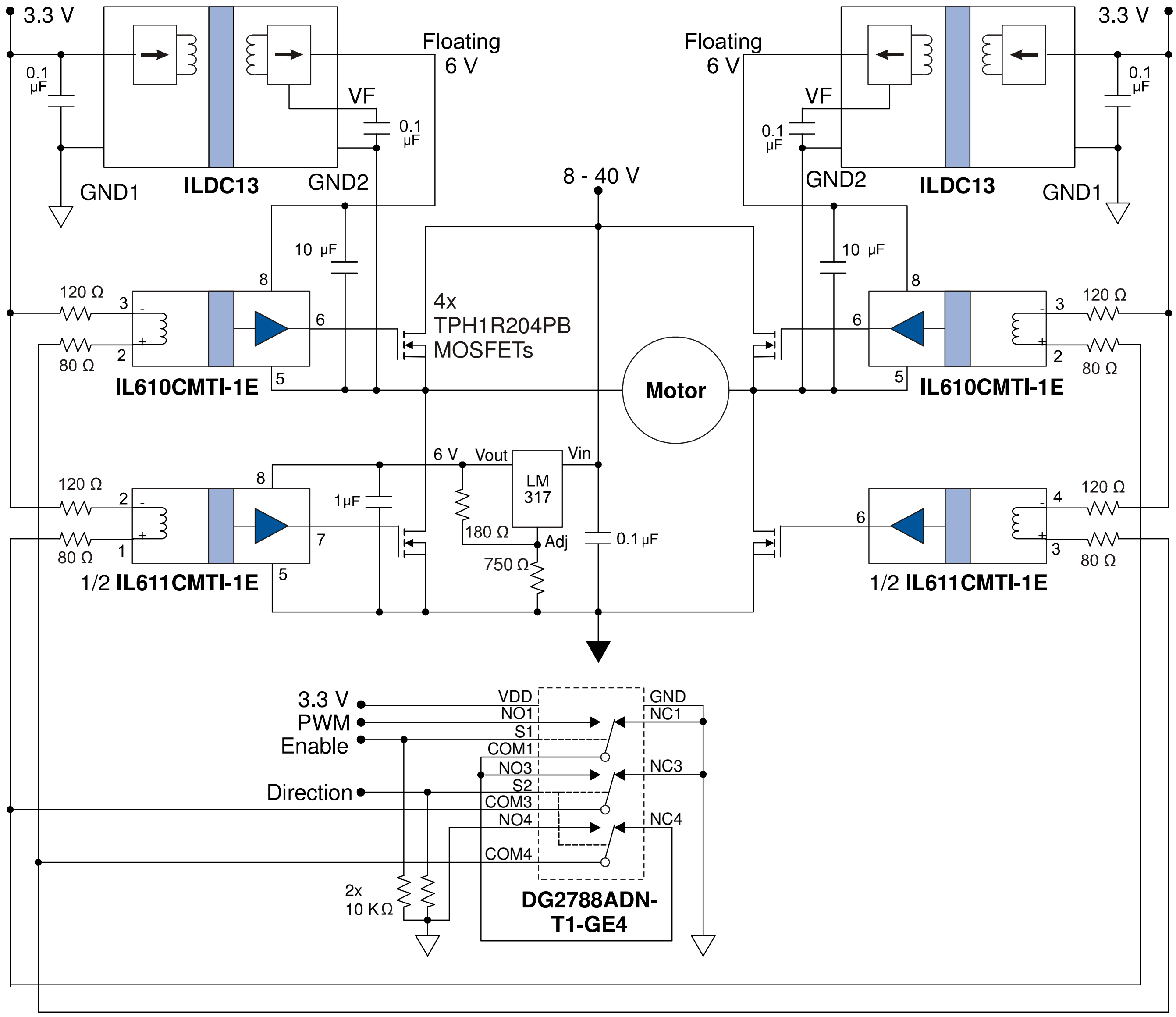


Figure 19. Isolated H-bridge with enhanced controller interface.

The addition of the DG2788 analog switch in Figure 19 provides PWM, Enable, and Direction inputs for a simple interface to the controller. It also allows the MOSFETs to be disabled during a reversal to prevent MOSFET shoot-through.

The LM317 regulator allows the isolators to be powered from a motor supply of up to 40 volts.

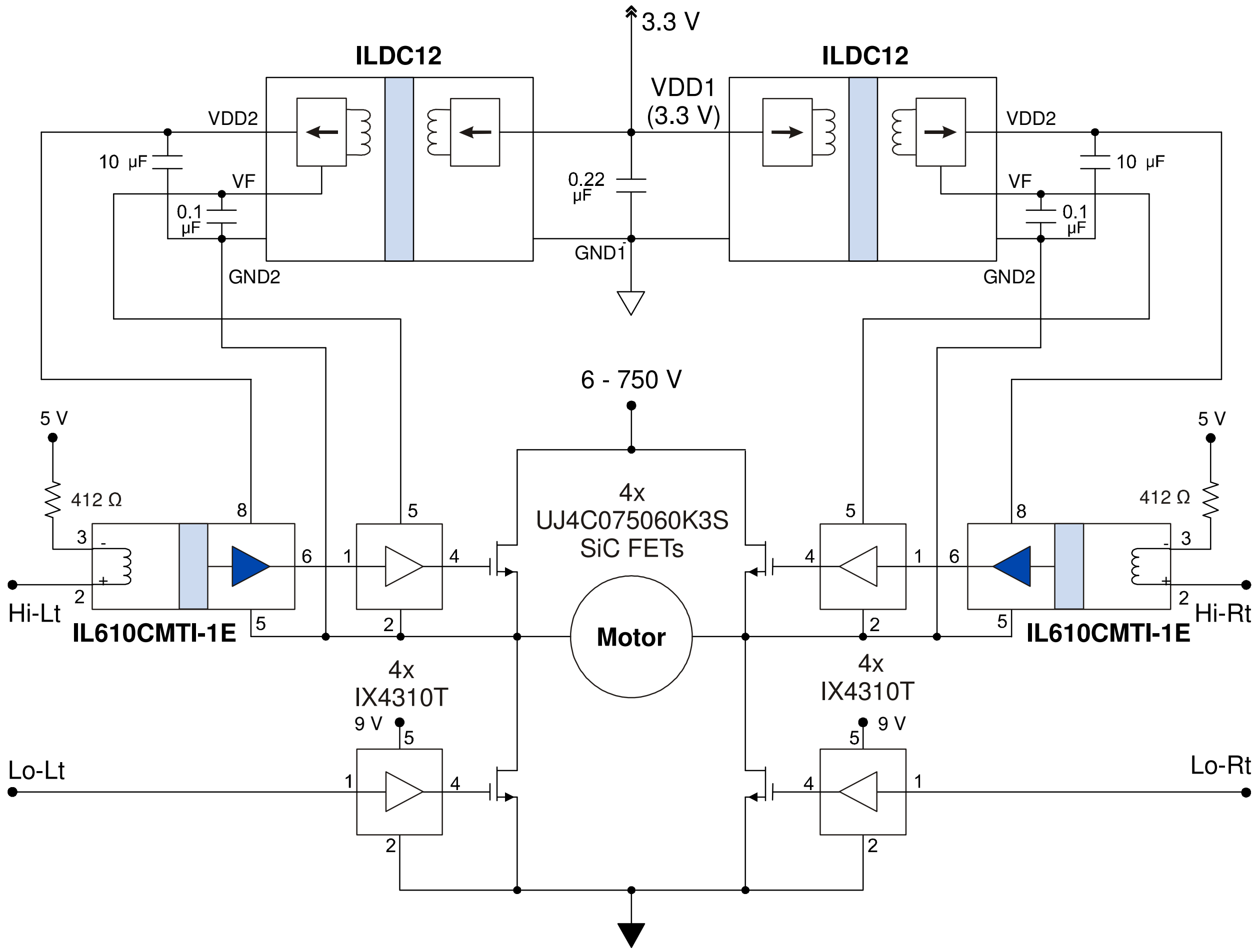


Figure 20. Isolated high-power silicon-carbide H-bridge.

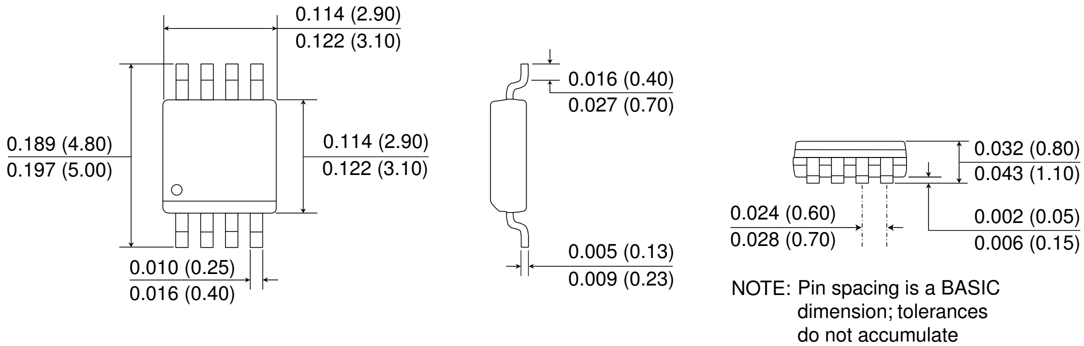
Silicon-carbide MOSFETs usually require more than six-volt gate drive and lower-impedance drivers. For these applications, IL610CMTI isolators can be combined with external drivers such as the IX4310T as shown in Figure 19. The separate gate drivers translate the IL611CMTI isolator outputs to nine volts and provide instantaneous high gate-drive currents for fast switching speeds with large MOSFETs.

The ILDC12's unregulated VF output provides approximately nine volts to power the high-side MOSFETs.

Package Drawings

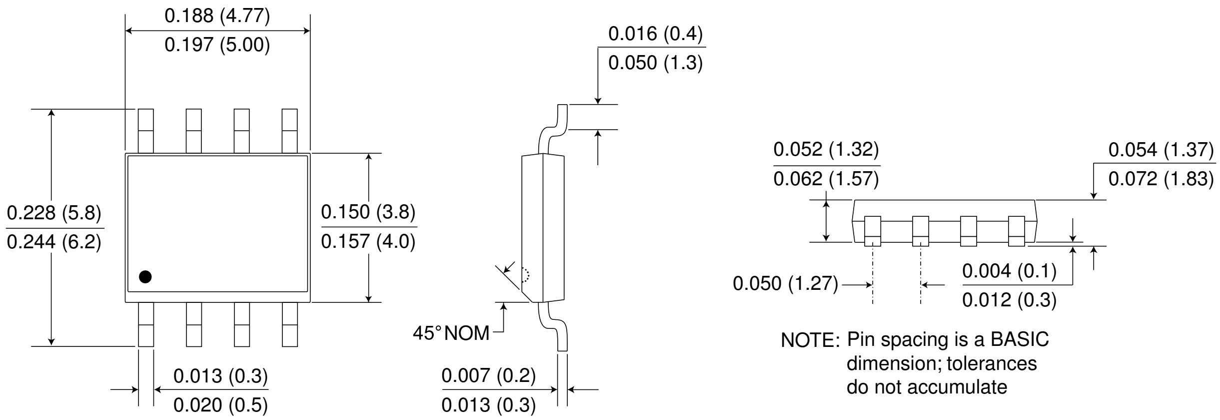
8-pin MSOP (-1 suffix)

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



8-pin SOIC Package (-3 suffix)

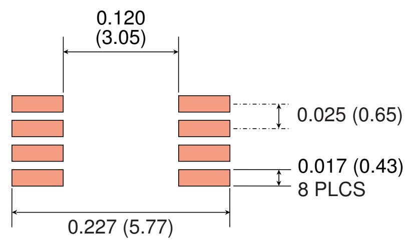
Dimensions in inches (mm); scale = approx. 5X



Recommended Pad Layouts

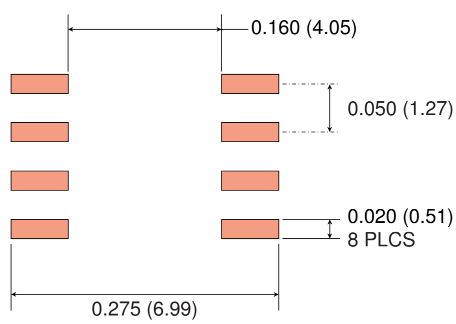
8-pin MSOP Pad Layout

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



8-pin SOIC Pad Layout

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



Ordering Information and Valid Part Numbers

IL 6xx 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

Base Part Number
610 = Single Channel
611 = Dual Channel

Product Family
IL = Isolators

Available Parts:

Part Number	Channels	Package
IL610CMTI-1E	1	MSOP8
IL610CMTI-3E	1	SOIC8
IL611CMTI-1E	2	MSOP8

RoHS COMPLIANT

Revision History

ISB-DS-001-IL6xxCMTI-RevF
March 2023

Changes
- Updated simple H-bridge application circuit with ILDC13 (Fig. 17).
- Added more sophisticated H-bridge application circuits (Figs. 18 – 20).

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

March 2023