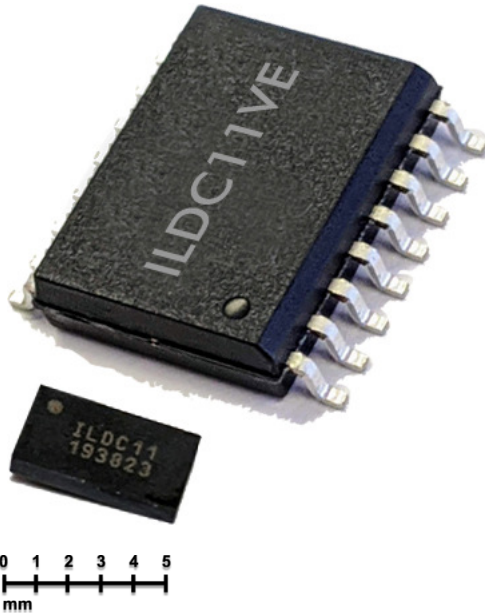


## ILDC1x Ultraminiature Isolated DC-to-DC Convertors



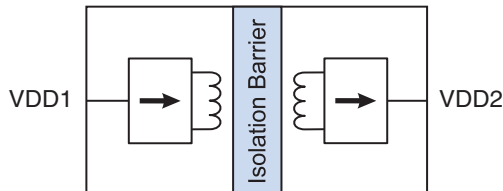
### Features

- World's smallest isolated DC-to-DC convertor
- Ultraminiature 3 x 5.5 x 0.9 mm (0.015 cm<sup>3</sup>) DFN or 8 mm creepage SOIC16-WB
- 3.3 V input; 3.3 V, 5 V, or 6 V output options
- ¼ W output
- Fully-regulated output
- Option for external regulators
- No minimum load
- Ultralow ripple
- No beads, inductors, or large stitching capacitors required
- Short-circuit and thermal protection
- 1 kV<sub>RMS</sub>, 2.5 kV<sub>RMS</sub>, and 4 kV<sub>RMS</sub> isolation versions
- UL listed under UL 1577
- EN 55032 CISPR 32 Class B fully compliant
- EU Declaration of Conformity (CE mark)
- Full -40 °C to 125 °C operating range with no derating

### Applications

- RS-485 / RS-422 bus power supplies
- Isolated ADC and DAC power supplies
- "2 x MOPP" medical systems requiring true 8 mm creepage

### Block Diagram



### Description

The ILDC1x is a family of ultraminiature one-quarter watt fully-regulated 3.3 V input DC-to-DC convertors with isolated 3.3-volt, 5-volt, or 6-volt outputs.

The two package options are the ILDC1x-15E ultraminiature 3 mm x 5.5 mm DFN6, and the ILDC1xVE SOIC16W. The DFN version is the world's smallest isolated DC-to-DC convertor at just 0.015 cm<sup>3</sup>.

A unique ceramic/polymer composite barrier provide virtually unlimited barrier life.

The device minimizes board space and parts count, requiring just three external capacitors. No additional regulation is required and there is no minimum load.

Internal shielding and frequency hopping reduce EMI. Parts are EN 55032 CISPR 32 Class B compliant with just a small amount of stitching capacitance.

A high-temperature process allows up to 175 °C junction temperature for full power up to 125 °C operating temperature with no derating. Integrated short-circuit protection avoids excessive power dissipation.



**Absolute Maximum Ratings**

Parameter	Min.	Max.	Units
Supply voltage	-0.6	6	Volts
Storage temperature	-55	180	°C
Junction temperature	-55	180	°C

**Recommended Operating Conditions**

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Ambient operating temperature	$T_{min}; T_{max}$	-40		125	°C	
Junction temperature	$T_J$	-40		175	°C	
Input supply voltage	$V_{DD1}$	3	3.3	3.6	V	
Output current	$I_{DD2}$	0		80	mA	

**Electrical Specifications**

$T_{min}$ to $T_{max}$ and $V_{DD1} = 3\text{ V}$ to $3.6\text{ V}$ unless otherwise stated						
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Output voltage ILDC11 ILDC12 ILDC13	$V_{DD2}$	3	3.3	3.45	V	$T_{min}$ to $T_{max}$ ; full $V_{DD1}$ and $I_{DD2}$ operating range
		4.5	5	5.5		
		5.75	6	6.6		
Output current ILDC11 ILDC12 ILDC13	$I_{DD2}$	80			mA	
		50				
		41				
Short-circuit protection limited current	$I_{DD2-SC}$	115	125	135	mA	
Input quiescent supply current	$I_{DD1Q}$		200	240	mA	$I_{DD2} = 0$
Input supply current ILDC11 ILDC12 ILDC13	$I_{DD1}$		380	440	mA	$I_{DD2} = \text{max.}$
			312	360		
			290	340		
Line regulation	$\Delta V_{DD2}/\Delta V_{DD1}$		32	40	mV/V	25 °C
				16		
Load regulation	$\Delta V_{DD2}/V_{DD2}$		5	6	%	$I_{DD2} = 0$ to max.
Output voltage temperature coefficient	$(\Delta V_{DD2}/V_{DD2})/\Delta T$		0.017 0.03		%/°C	$I_{DD2} = 10\text{ mA}$ $I_{DD2} = 50\text{ mA}$
Capacitive load	$C_{DD2}$			1000	µF	
Output voltage ripple	$V_{DD2RIPPLE}$		1	5	mV <sub>P-P</sub>	20 MHz bandwidth; $I_{DD2} = \text{max.}$
				1		
Start-up time	$t_{SU}$	2			ms	$I_{DD2} = 0$
						6
Convertor frequency	$f_{OSC}$	105	113	120	MHz	

**Thermal Specifications**

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions	
Junction-to-ambient thermal resistance	ILDC1x-15E	$\theta_{JA}$		46		°C/W	2s2p PCB per JESD51; leadframe pad grounded (if applicable); free air.	
	ILDC1xVE			46				
Junction-to-case (top) thermal resistance	ILDC1x-15E	$\theta_{JC}$		12				
	ILDC1xVE			9				
Junction-to-ambient thermal resistance	ILDC1x-15E	$\theta_{JA}$		52.5				2-sided PCB with 2 oz Cu and thermal vias; leadframe pad grounded.
	ILDC1xVE			67				
Junction-to-case (top) thermal resistance	ILDC1x-15E	$\theta_{JC}$		8				
	ILDC1xVE			12				
Package power dissipation	ILDC1x-15E	P			1.5	W		
	ILDC1xVE				1.5			

**Isolation Specifications**

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Isolation voltage*	ILDC1x-15E	$V_{ISO}$	1			kV <sub>RMS</sub>	Per UL 1577 and VDE 0884-17
	ILDC1xV-15E		2.5				
	ILDC1xVE		4				
Working voltage	ILDC1x-15E	$V_{IORM}$	600			V <sub>RMS</sub>	Per VDE 0884-17
	ILDC1xVE		600				
Transient overvoltage	ILDC1x-15E	$V_{IOTM}$	4			kV <sub>PK</sub>	Per VDE 0884-17
	ILDC1xVE		6				
Surge immunity			6.4			kV <sub>PK</sub>	
Creepage distance (external)	ILDC1x-15E		2.1			mm	Per IEC 60601
	ILDC1xV-15E		3.0				
	ILDC1xVE		8.03	8.3			
Comparative tracking index	ILDC1x-15E	CTI	≥175			V <sub>RMS</sub>	Per IEC 60112
	ILDC1xVE		≥600				
Total barrier thickness (internal)			0.012	0.016		mm	
Isolation barrier resistance		$R_{IO}$		$>10^{14}$		$\Omega$	500 V <sub>RMS</sub>
Isolation barrier capacitance		$C_{IO}$		7		pF	f = 1 MHz
Leakage current				0.2		$\mu A_{RMS}$	240 V <sub>RMS</sub> , 60 Hz
Barrier life				44000		Years	100°C, 1000 V <sub>RMS</sub> , 60% CL activation energy

\*UL 1577 listed under Component Recognition Program File Number E207481.

ILDC1x-15E tested at 1.2 kV<sub>RMS</sub> (1.70 kV<sub>PK</sub>) for 1 second, 5 pC partial discharge limit in accordance with UL 1577 and VDE 0884-17 Method B1.

Each lot sample tested at 1 kV<sub>RMS</sub> (1.41 kV<sub>PK</sub>) for 1 minute.

ILDC1xV-15E tested at 3 kV<sub>RMS</sub> (4.24 kV<sub>PK</sub>) for 1 second, 5 pC partial discharge limit in accordance with UL 1577 and VDE 0884-17 Method B1.

Each lot sample tested at 2.5 kV<sub>RMS</sub> (3.53 kV<sub>PK</sub>) for 1 minute.

ILDC1xVE tested at 4.8 kV<sub>RMS</sub> (6.79 kV<sub>PK</sub>) for 1 second, 5 pC partial discharge limit in accordance with UL 1577 and VDE 0884-17 Method B1.

Each lot sample tested at 4 kV<sub>RMS</sub> (5.66 kV<sub>PK</sub>) for 1 minute.

- IEC 60601-1 (medical systems)
  - ILDC1xV-15E is 1 x MOOP compliant (isolation voltage  $\geq 1.5$  kV<sub>RMS</sub>; creepage  $\geq 2.5$  mm).
  - ILDC1xVE is 2 x MOPP compliant (isolation voltage  $\geq 4$  kV<sub>RMS</sub>; creepage  $\geq 8$  mm).
- All versions compliant with IEC 60950-1 and IEC 62368-1 end equipment standards.

## **Features**

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### ***Best-in-Class Isolation***

A unique ceramic/polymer composite barrier provides virtually unlimited barrier life. The basic DFN version provides 1 kV<sub>RMS</sub> isolation; the DFN “V” version (ILDC1xV-15E) provides a full 2.5 kV<sub>RMS</sub> isolation and extended creepage, and the wide-body SOIC version provides a remarkable 4 kV<sub>RMS</sub> and true eight-millimeter creepage in accordance with IEC60601.

### ***Low Parts Count***

The only external components required are three inexpensive bypass capacitors on the VDD1, VDD2, and VF pads. This low external parts count reduces board area and cost.

### ***Fully Regulated with no Minimum Load***

Unlike other DC-to-DC convertors, ILDC1x devices have fully-regulated outputs specified over the full input voltage and output current operating ranges. This eliminates the need for an external regulator or load resistor.

### ***Ultralow Ripple***

An inexpensive external filter capacitor (VF) and excellent line regulation and ensures the output ripple voltage is less than 5 mV<sub>P-P</sub>.

### ***Short-Circuit Protection***

The output current is internally limited to approximately 125 mA. This provides short-circuit protection and eliminates the need for external protection circuitry.

### ***Inherently Low EMI***

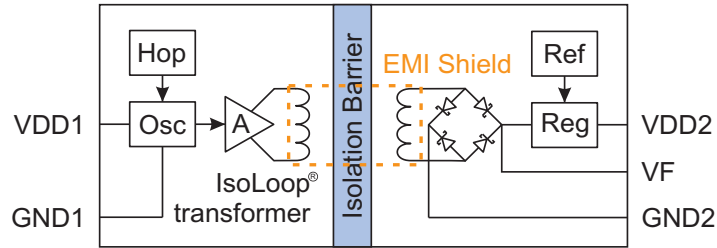
The DC-to-DC convertor oscillator operates above 88 MHz, a much higher frequency than conventional DC-to-DC convertors, where emission limits are higher since there is less risk of interference with some common commercial radio and television broadcasting.

Frequency-hopping technology dramatically reduces peak EMI, and synchronous rectification and PWM control are avoided, resulting in inherently low EMI.

This inherently low EMI allows CISPR and FCC compliance without shielding or external components such as ferrite beads. The parts are fully compliant with EN 55032 CISPR 32 Class B with just a small amount of stitching capacitance, which can be incorporated in the overlap of the inner layers of the PCB.

**Operation**

An ILDC1x block diagram is shown below:



**Figure 1. ILDC1x detailed block diagram.**

A 113 MHz oscillator drives a high-frequency power amplifier, which in turn drives an IsoLoop® microtransformer primary. Frequency hopping reduces EMI peak amplitudes, and embedded magnetic shielding further reduces radiated EMI.

On the other side of the isolation barrier, the transformer secondary output is filtered, rectified, and regulated by a low-EMI low drop-out regulator with a precision bandgap voltage reference.

A high-temperature process allows up to 175 °C junction temperature for full power up to 125 °C operating temperature with no derating.

## Application Information

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### ***Low Parts Count***

The only external components required are three inexpensive bypass capacitors: a 0.1  $\mu\text{F}$  ceramic capacitor placed as close as possible to the VDD1 pad, a 10  $\mu\text{F}$  ceramic capacitor for the VDD2 pad, and a 0.1  $\mu\text{F}/16\text{ V}$  filter capacitor near the VF pad.

### ***Fully Regulated with no Minimum Load***

The ILDC1x has a fully-regulated output specified over the full input voltage and output current operating ranges, eliminating the need for an external regulator or load resistor.

### ***Soft Start-up***

When used in MOSFET gate drivers or H-bridges, the 2 ms minimum startup time allows the control electronics to start up before the MOSFETs can be turned on to ensure high- and low-side MOSFETs on the same side are not on at the same time.

### ***Optional External Regulation***

An external regulator can be used in place of the ILDC1x's internal low drop-out regulator for voltages up to approximately 7.5 volts. The maximum output current decreases at higher regulator output voltages, but the output power capacity remains approximately 250 milliwatts.

### ***EMI Mitigation***

ILDCx parts incorporate embedded magnetic shielding to reduce radiated EMI and frequency hopping to reduce EMI peak amplitudes. This inherently low EMI generally eliminates the need for ferrite beads or other EMI mitigation. The parts are fully EN 55032 CISPR 32 Class B compliant with no EMI mitigation components and only 12 pF of input-to-output stitching capacitance. The capacitance can be created in a four-layer PCB by extending the GND1 and GND2 ground planes into the PCB isolation area. External stitching capacitor components are generally not recommended due to parasitic inductance above one gigahertz. See Fig. 13 for a typical schematic, and [Application Bulletin AB-29](#) for a recommended PCB layout.

### ***No Temperature Derating***

A double-sided, double buried power plane ("2s2p") printed-circuit board optimizes thermal performance, allowing full power up to 125 °C operating temperature with no derating. Thermal vias should be used between the power plane and the board surfaces. Both input-side ground pads and the leadframe pad (for the DFN package) should be grounded using wide traces to help cool the leadframe.

At the full output current with the recommended PCB, the ILDC1x dissipates approximately one watt and the resultant junction temperature rise is 46 °C for either package, so at 125 °C ambient the junction temperature is less than the 175 °C maximum junction temperature.

A simple double-sided PCB with thermal vias can be used rather than a 2s2p PCB with some derating (see Figure 6).

### ***Maintaining Creepage***

Creepage distances are often critical in isolated circuits. Therefore, power planes should be spaced to avoid compromising creepage or clearance, and board pads should not extend past the part pads to avoid compromising clearance.

### ***Medical Systems***

Patient-applied parts electrically connected to the patient in body-floating medical systems generally require two Means Of Patient Protection (2 x MOPP). ILDC1xVE parts meet the 2 x MOPP requirements of 4 kV<sub>RMS</sub> isolation and true 8 mm creepage. AC/DC power supplies meeting these requirements are difficult to find and expensive. An inexpensive 2 x MOPP power supply can supply the operator interface, while a 2 x MOPP compliant ILDC1xVE DC-to-DC converter can power the patient-applied electronics. The power requirements of the patient-applied electronics are generally low and can be satisfied with an ILDC1xVE. A typical circuit is shown in Figure 22.

Typical Performance Graphs

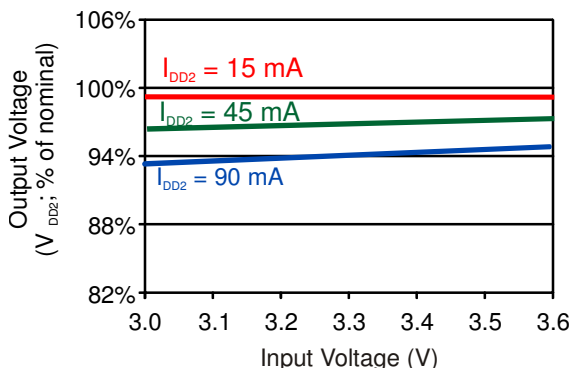


Figure 2. Typical line regulation.

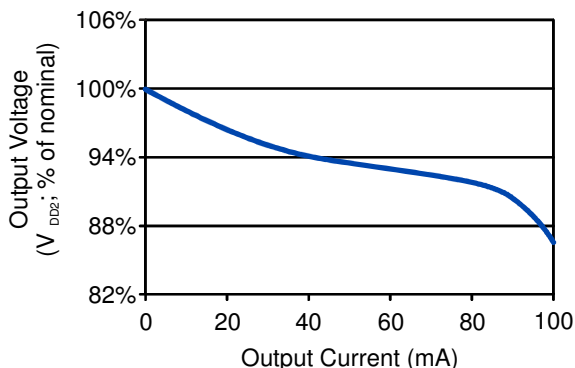


Figure 3. Typical load regulation.

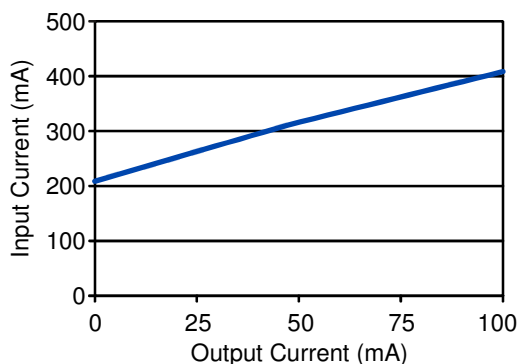


Figure 4. Typical input current versus output current.

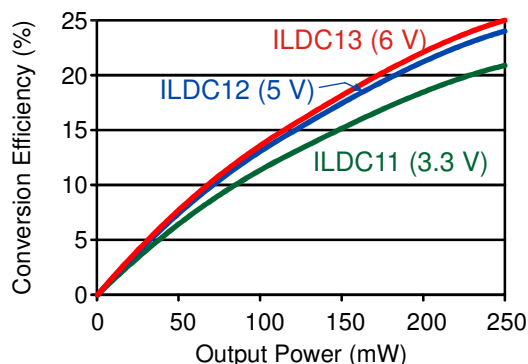


Figure 5. Conversion power efficiency.

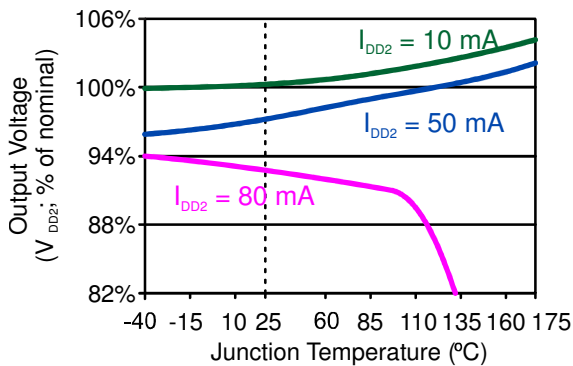


Figure 6. DC-to-DC convertor output vs. temperature and self-limiting current.

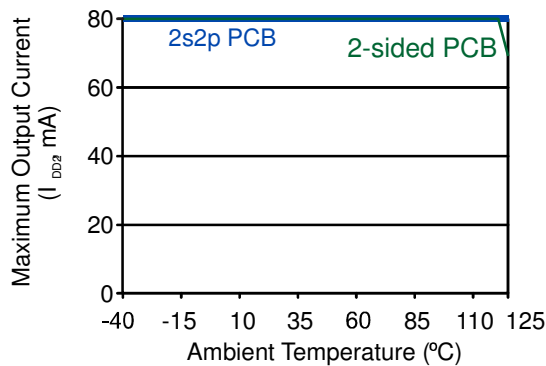


Figure 7. Temperature derating curve (ILDC11).

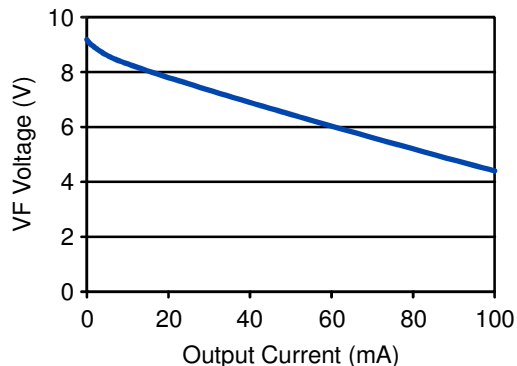


Figure 8. Typical unregulated output voltage versus output current ( $V_{DD1} = 3.3\text{ V}$ ;  $25\text{ }^\circ\text{C}$ ).

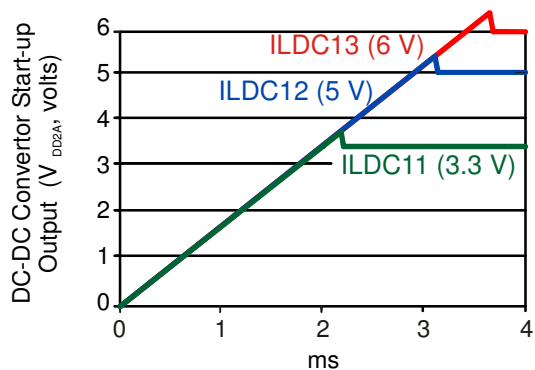


Figure 9 Typical DC-to-DC converter start-up voltage (no load).

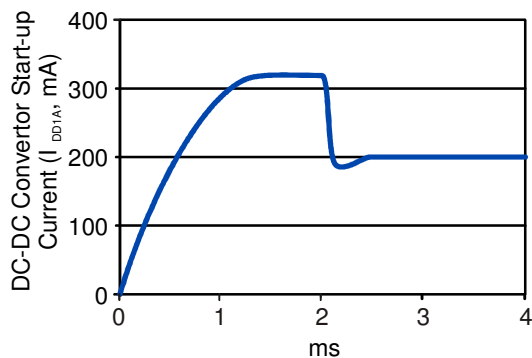


Figure 10. Typical DC-to-DC converter start-up current (no load).

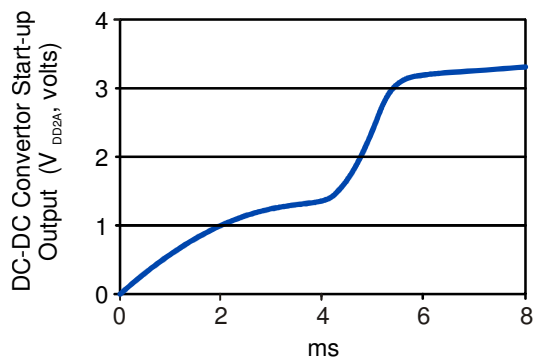


Figure 11. Typical DC-to-DC converter start-up voltage (IL46xx; maximum load).

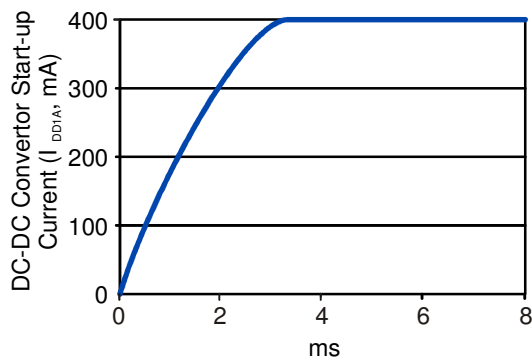
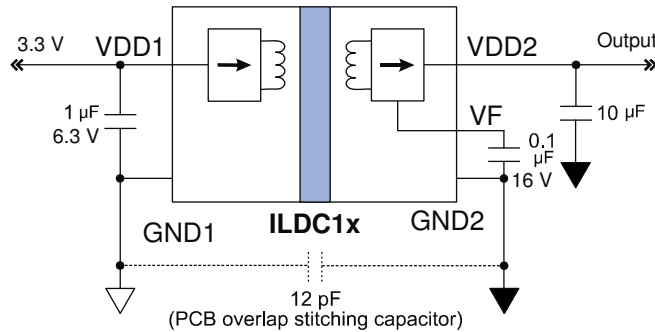


Figure 12. Typical DC-to-DC converter start-up current (maximum load).



**Application Circuits**

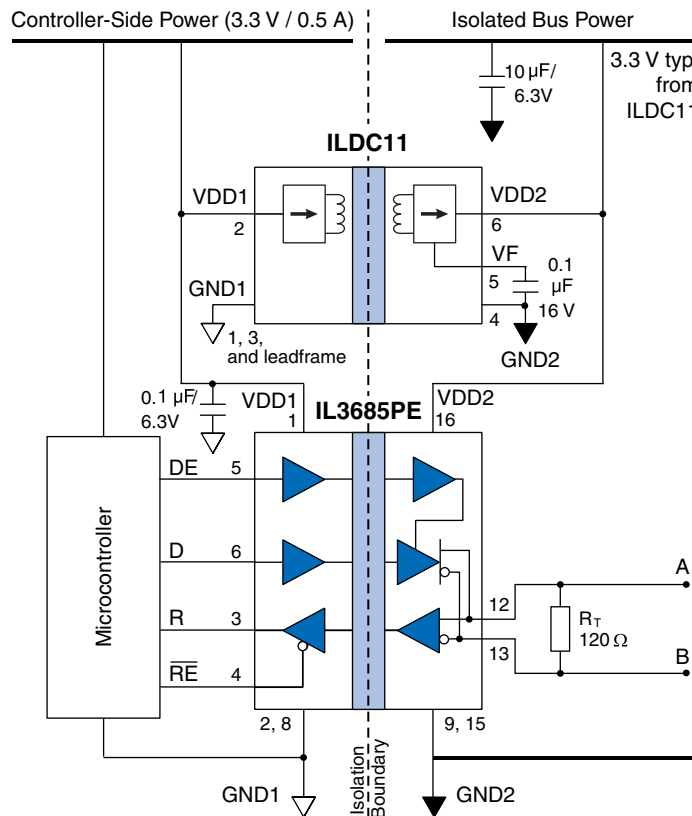
*Basic recommended circuit:*



**Figure 13. Typical circuit.**

Bypass capacitors are required on the VDD1, VDD2, and VF pins as shown. The small input-to-output ground stitching capacitance is recommended for EMI mitigation. It can be a discrete capacitor or created using PCB ground-plane overlap.

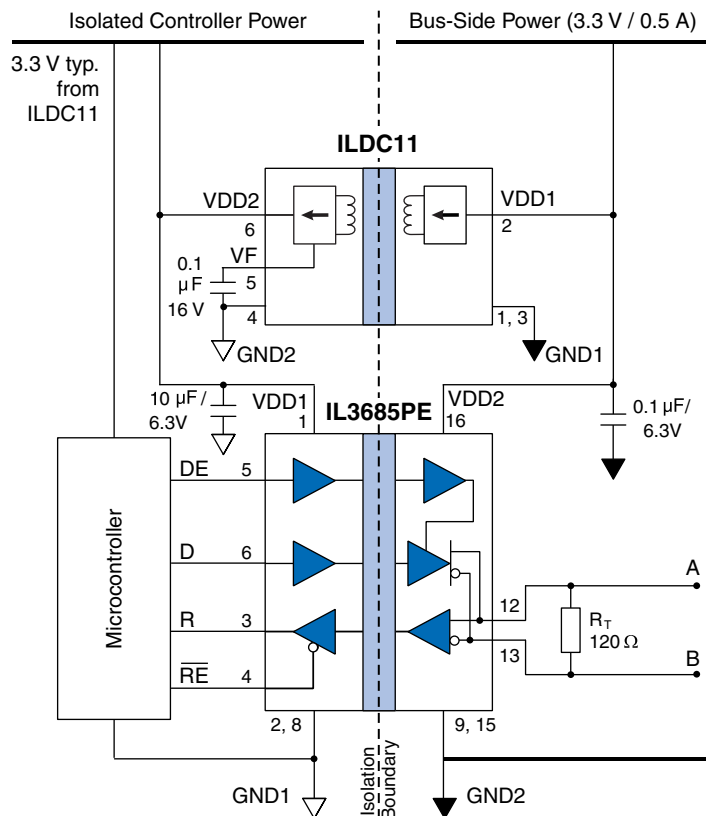
*Typical isolated RS-485 bus power supply and node:*



**Figure 14. An isolated 3.3-volt RS-485 bus power supply and node.**

An isolated 3.3 volt bus supply is generated from the controller supply. The ILDC11 generates enough power for an RS-485 bus and termination resistors.

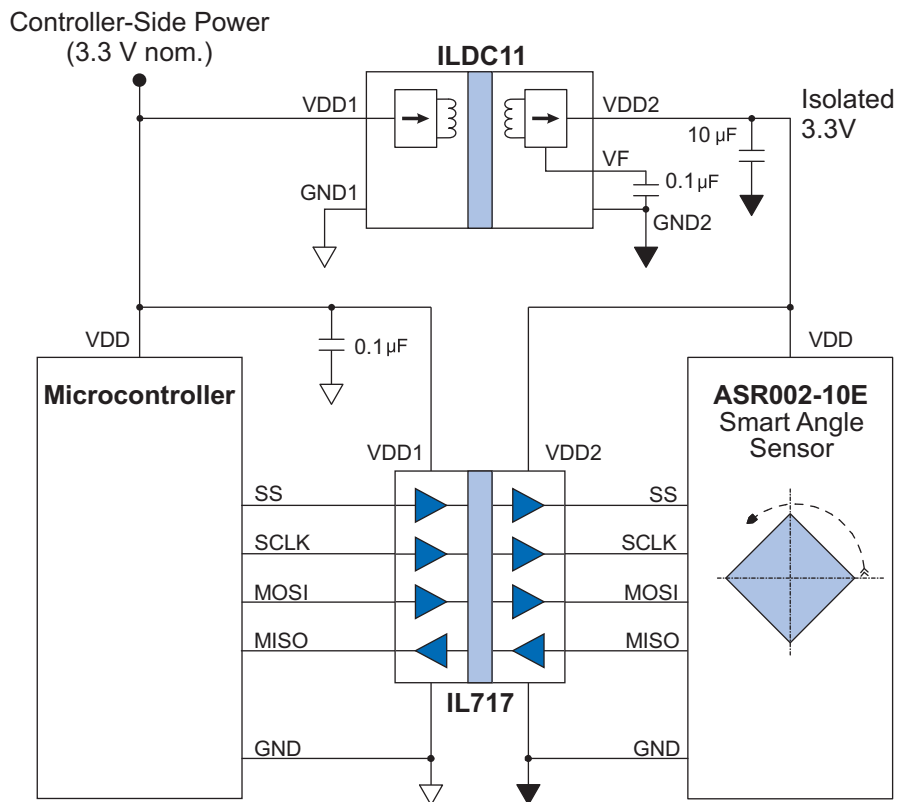
*Isolated controller supply from a 3.3-volt bus:*



**Figure 15. Reversed configuration: isolated controller supply from a 3.3-volt bus.**

Normally the bus supply is generated from the controller supply, but the reverse is also possible. An advantage of this configuration is that since the DC-to-DC convertor does not need to supply the bus-side power, the bus can have two 120Ω termination resistors with the transceiver running at maximum speed, a combination that would exceed the ILDC11's maximum output current if it were powering the bus. The ILDC11 generates enough power to supply a microcontroller and other circuitry in addition to a transceiver.

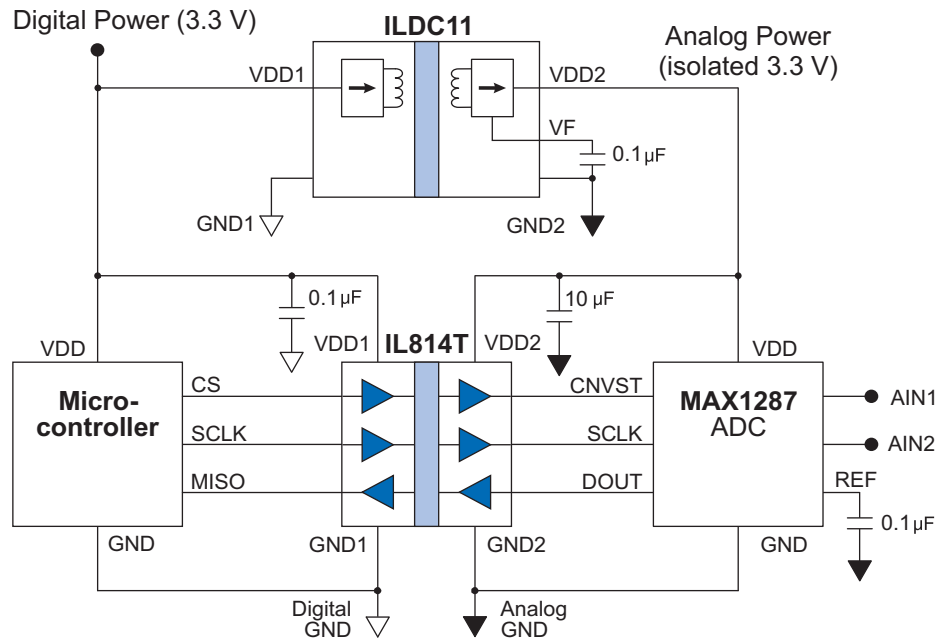
*Isolated SPI sensor interface:*



**Figure 16. An isolated SPI sensor interface.**

Isolation reduces noise by eliminating ground loops, and improves safety by providing another insulation level. The ILDC11 generates an isolated power supply to independently power the sensor. The four-channel IL717 isolator transmits the SPI signals while maintaining galvanic isolation. A five-channel IL261 isolator can be used to select between two sensors. A similar circuit can be used for a variety of four-wire interface sensors, including angle, magnetic field, current, temperature, or pressure sensors.

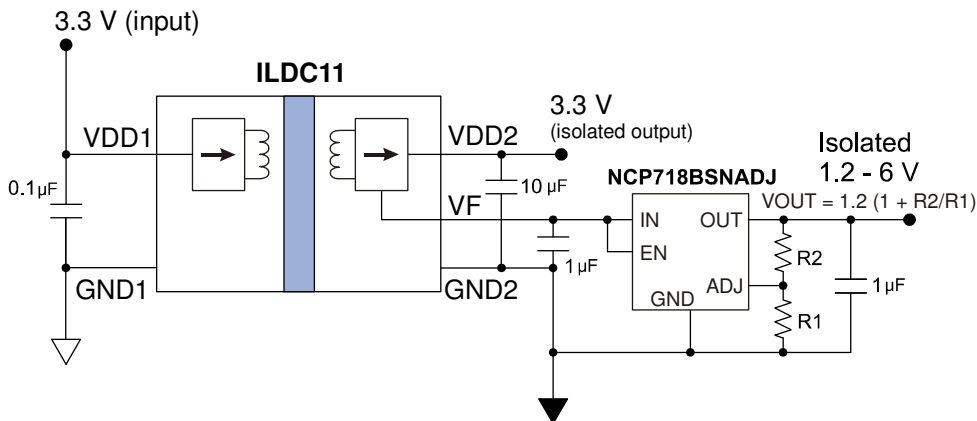
*Isolated SPI / MICROWIRE ADC interface:*



**Figure 17. Isolated ADC serial interface.**

An isolated analog power supply generated by the ILDC11 significantly improves the noise performance of a successive-approximation ADC. The three-channel IL814TE isolates the ADC's serial interface. A similar circuit can be used for other three-wire SPI or MICROWIRE peripherals such as DACs or sensors.

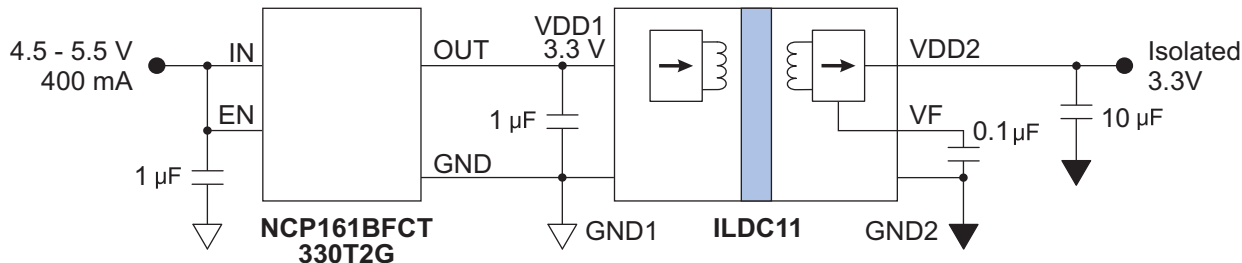
**External regulator for dual outputs or nonstandard voltages:**



**Figure 18. A 3.3-volt input, fixed plus adjustable output isolated supply using an external regulator.**

An inexpensive adjustable regulator can be added to the ILDC11's VF output as shown above to provide nonstandard output voltages.

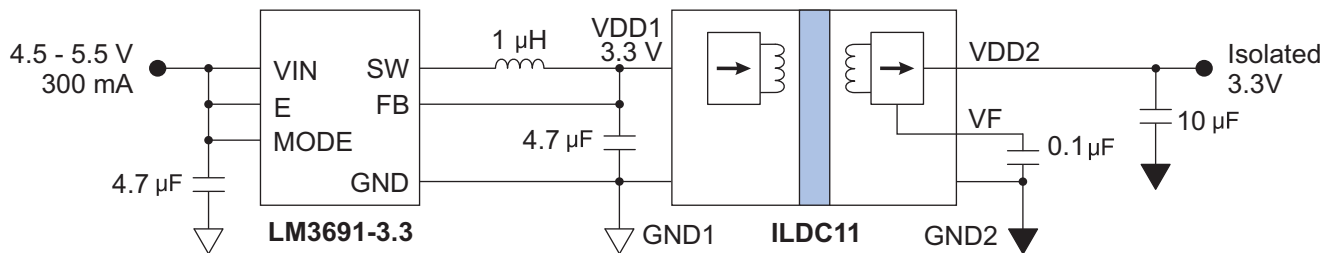
**5-volt input:**



**Figure 19. A 5-volt input / 3.3-volt output isolated supply.**

An inexpensive chip-scale linear regulator such as an NCP161 can be used for a 5-volt input.

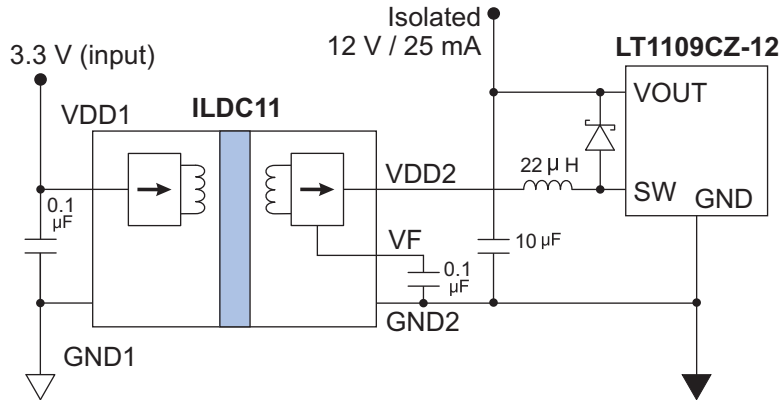
**High-efficiency 5-volt input:**



**Figure 20. A 5-volt input / 3.3-volt with a buck regulator.**

A step-down (buck) switching regulator can be used with a 5-volt input for higher efficiency than a linear regulator.

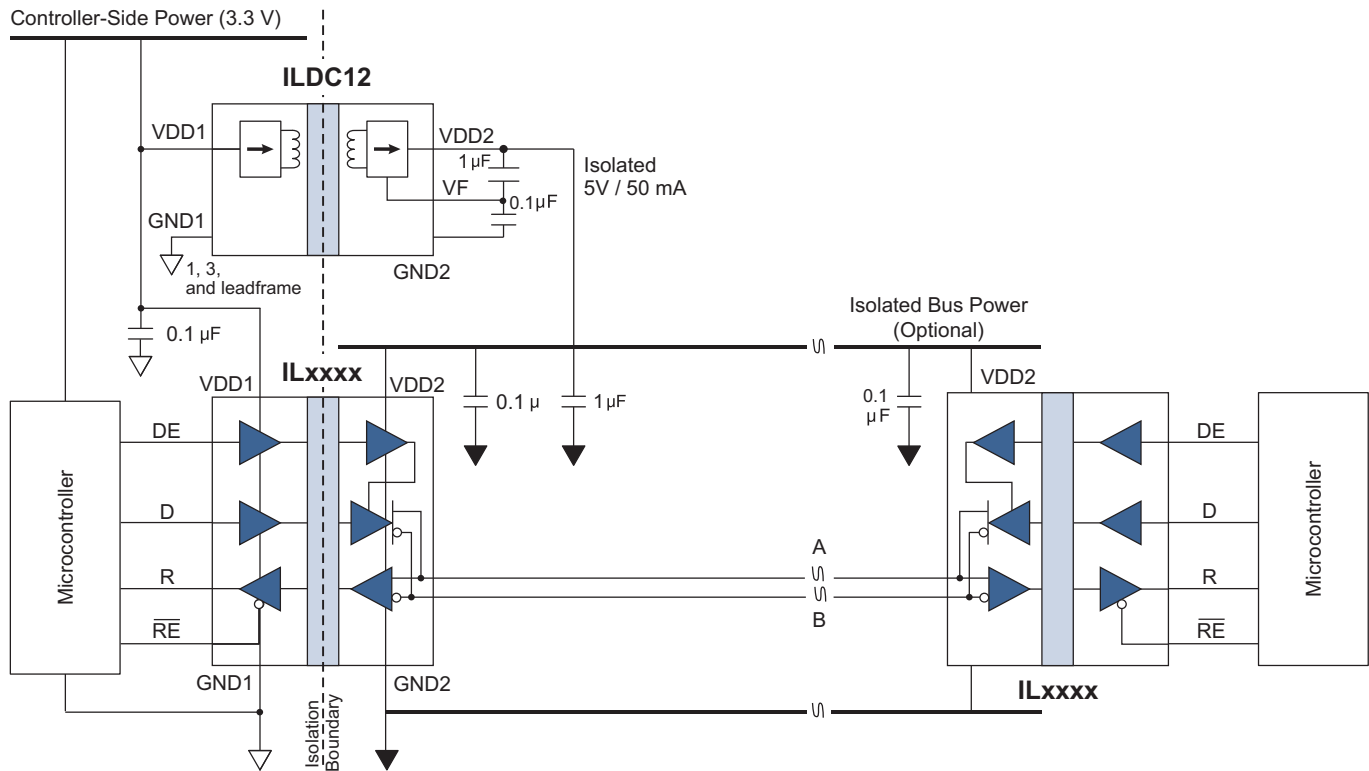
*Isolated 12-volt output:*



**Figure 21. A 3.3-volt input / 12-volt output isolated supply.**

An inexpensive boost regulator can be added to an ILDC1x to provide an isolated 12-volt output. The ILDC1x's inherent stability allows it to directly drive the inductive load required for the boost regulator.

Isolated 5-volt bus system:

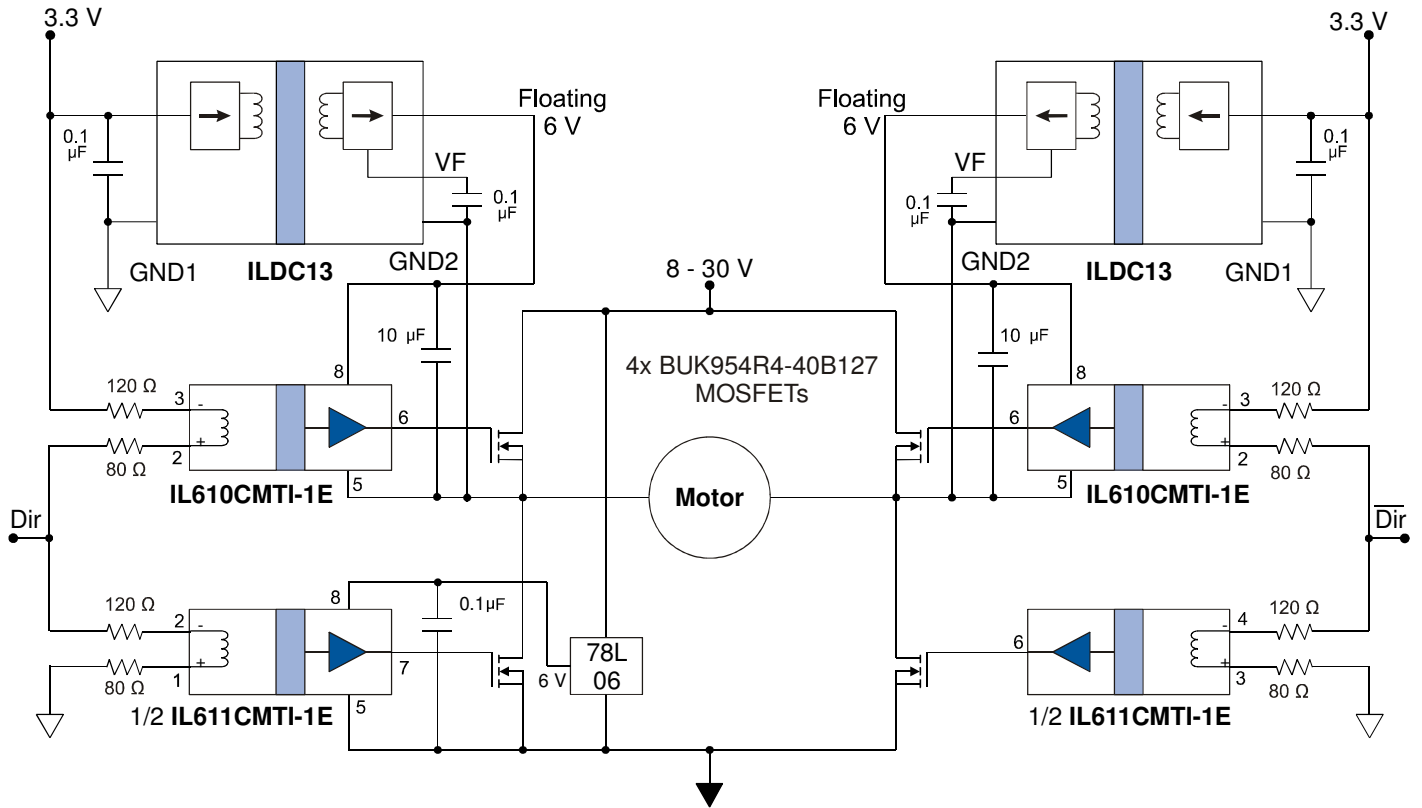


5-Volt Isolated Transceivers							
Model	Duplex	Inputs	Mbps	Nodes	Bus ESD	Key Features	Available Packages
IL3022	Full	Digital	4	32	7.5 kV	Low Cost	0.3" SOIC16
IL2985	Half	Digital	4	32	15 kV	Low Power	0.3" SOIC16
IL3085	Half	Digital	4	32	15 kV	Low Cost	QSOP16; 0.15" SOIC16; 0.3" SOIC16
IL3522	Full	Digital	40	50	15 kV	Very High Speed	0.3" SOIC16
IL3585	Half	Digital	40	50	15 kV	Very High Speed	0.15" SOIC16; 0.3" SOIC16
IL3685	Half	Digital	40	50	15 kV	PROFIBUS	QSOP16; 0.15" SOIC16; 0.3" SOIC16

Figure 22. An isolated 5-volt RS-485 bus system.

An ILDC12 provides isolated five volts for a traditional RS-485 bus. The ILDC12’s output capacity is 50 mA, which is enough to power an RS-485 transceiver without termination resistors. It can also power a number of additional low-power nodes if desired. Low-power IL2985 transceivers have a maximum bus-side quiescent supply current of less than 2 mA. Other 5-volt isolated transceiver options include the 40 Mbps IL3585, the 40 Mbps PROFIBUS IL3685, the low-cost IL3085, and the full-duplex IL3522 or IL3022. Ultraminiature IL3685-1E or IL3085-1E QSOP16 versions are available to minimize board area.

**Isolated H-Bridge Drivers:**



**Figure 23a. 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.

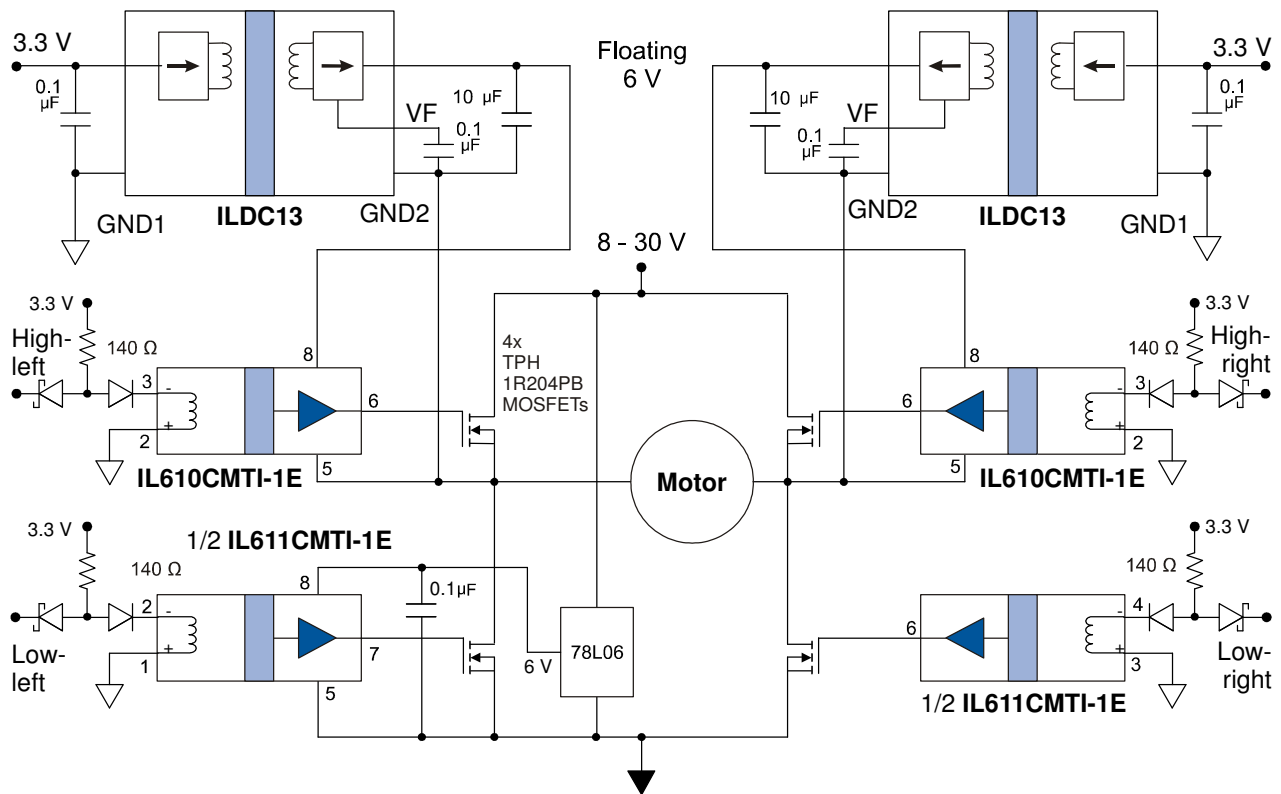
The IL600CMTI isolators are the world's smallest isolators, with the highest common-mode transient immunity in the industry. With up to 350 kV/μs guaranteed transient immunity, the IL610CMTIs prevent spurious isolator switching when the high-side MOSFETs switch.

The ILDC13 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 time that two MOSFETs on the same side are both ON (“shoot-through”). When the DIR and DIR inputs are high impedance, such as when a controller is starting up, all of the MOSFETs will be off.

If the DIR and DIR inputs are both set low, the motor is grounded to shunt the back EMF and stop the motor.

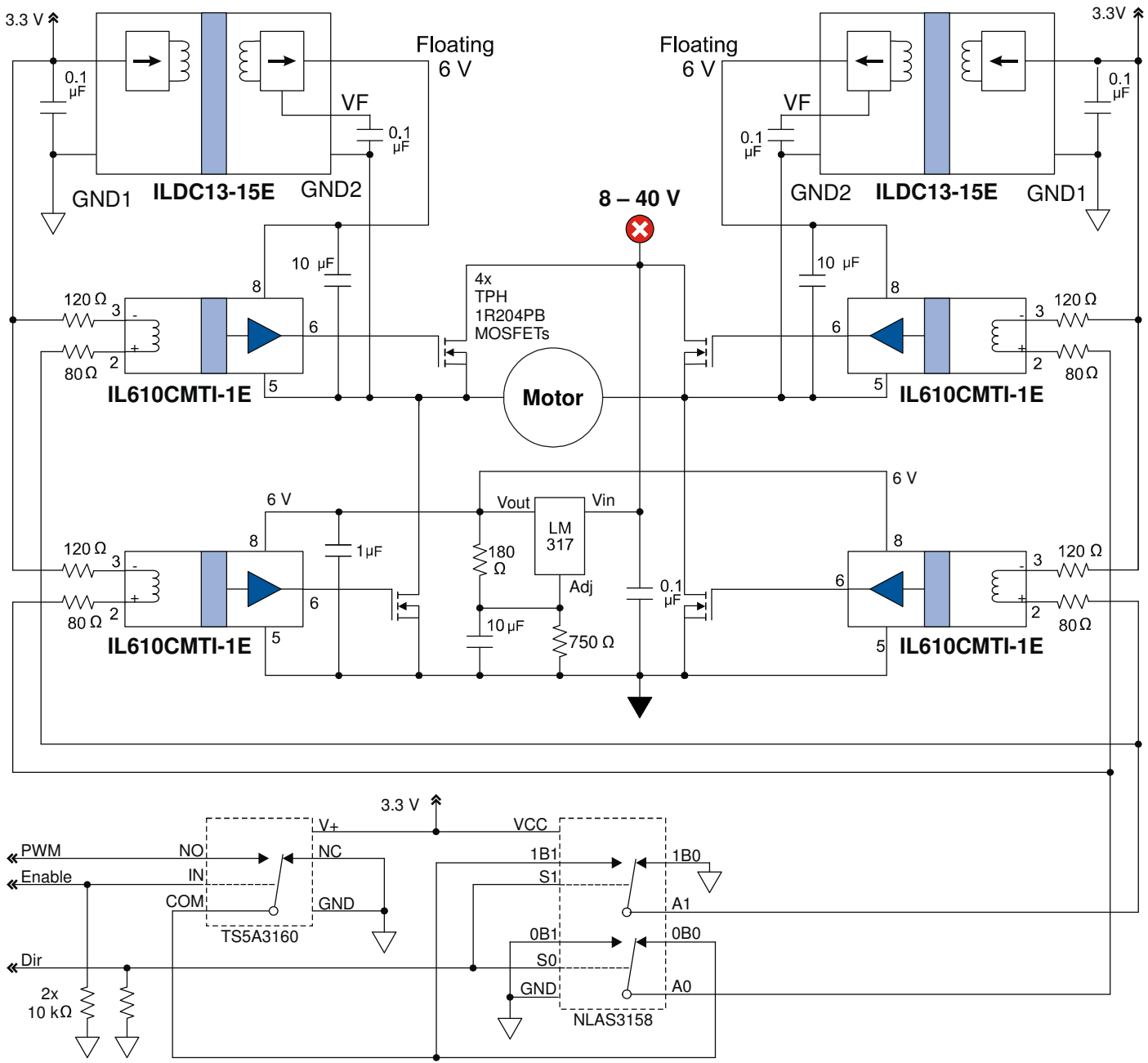




**Figure 23b. Isolated H-bridge with separate MOSFET control inputs.**

The circuit above 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 23c. Isolated H-bridge with enhanced controller interface.**

The addition of analog switches to the circuit in Figure 23c provides PWM, Enable, and Direction inputs for a simple controller interface.

The NLAS3158's short break-before-make time prevents shoot-through. The TS5A3160 analog switch provides an Enable line, allowing all four MOSFETs to be disabled such as during a reversal. The 10 kΩ pull-down resistors ensure the load is disabled until the controller powers up and provides outputs.

The LM317 regulator allows the isolators to be powered from a motor supply up to the 40-volt MOSFET maximum.

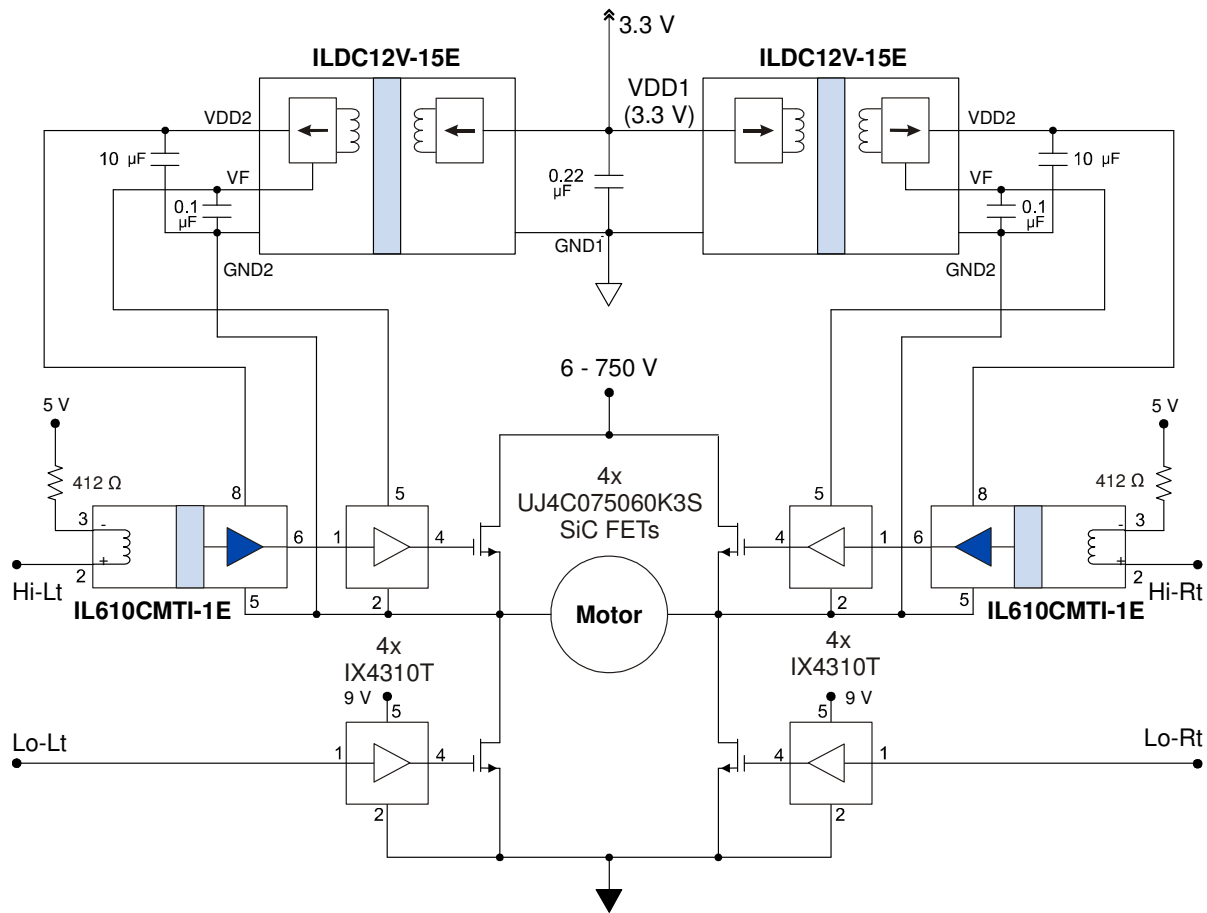
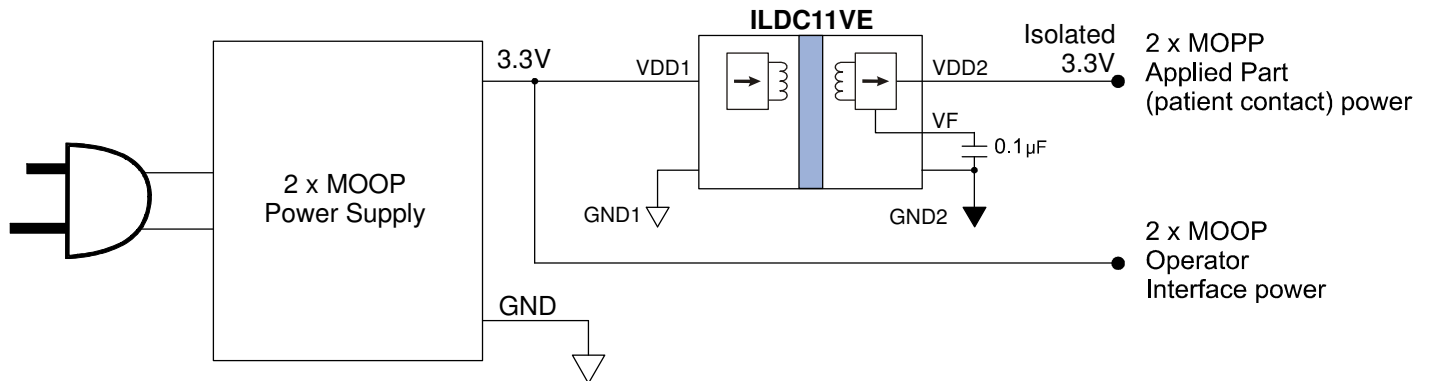


Figure 23d. Isolated high-power silicon-carbide H-bridge.

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 23d. The ILDC12's unregulated VF output provides approximately nine volts to power the high-side MOSFETs gates. The separate gate drivers translate the IL610CMTI isolator outputs to nine volts and provide instantaneous high gate-drive currents for fast switching speeds with large MOSFETs.

An ILDC12V-15E, with 2.5 kV<sub>RMS</sub> isolation, provides plenty of margin for a 750 volt motor supply.

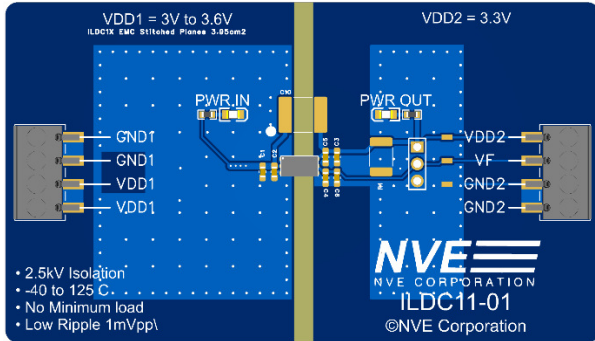
*Medical System Isolation:*



**Figure 24. Medical system isolation.**

Combining a double Means Of Operator Protection (2 x MOOP) power supply with a double Means of Patient Protection (2 x MOOP) ILDC1xVE provides cost-effective compliance with IEC 60601 for body-floating medical systems. The power requirements of the patient-applied electronics are generally low and can be satisfied with an ILDC1xVE.

**Evaluation Boards**



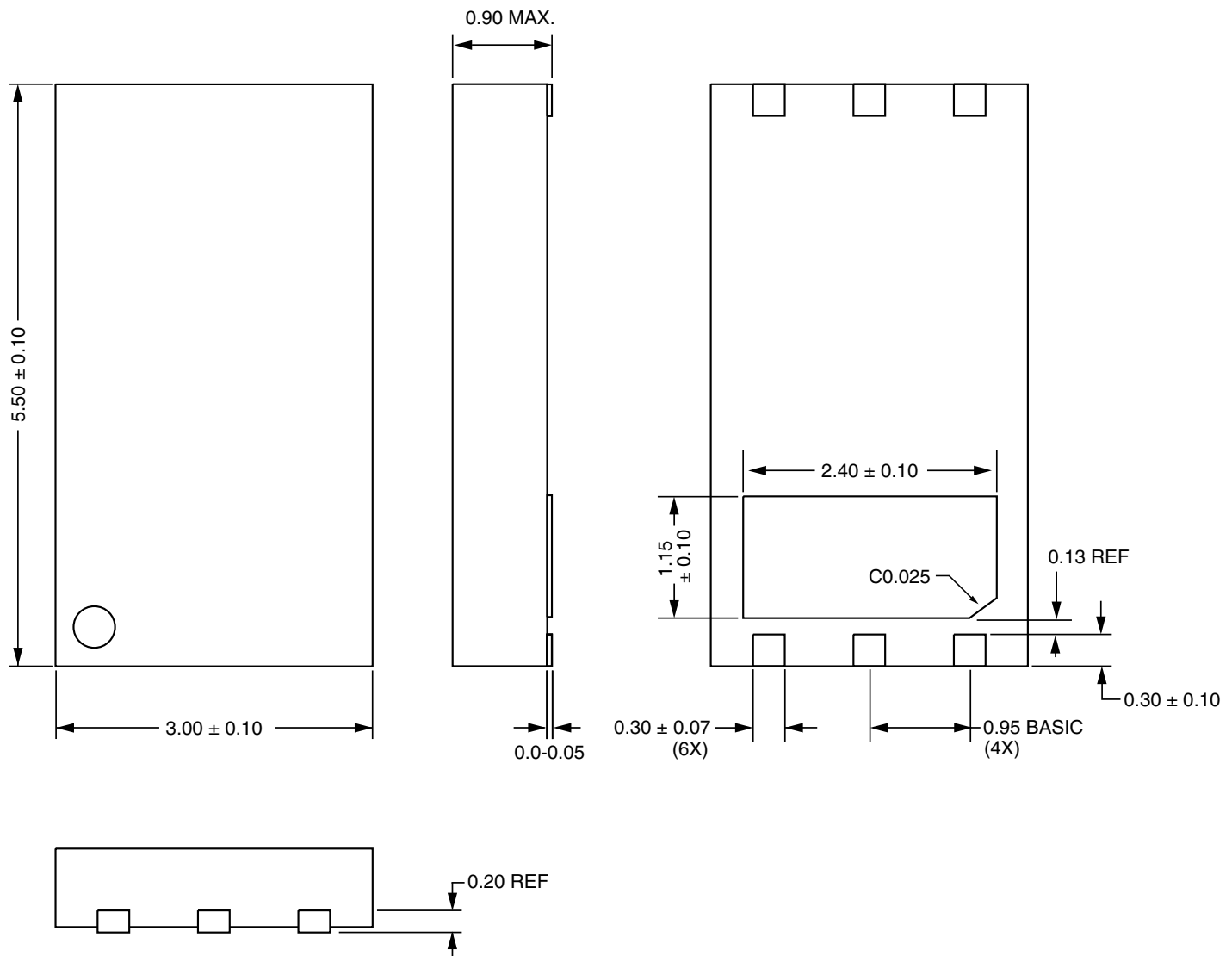
**Evaluation Boards**

The evaluation boards use four-layer PCBs with ground-plane overlap stitching capacitance for EMI mitigation and thermal vias to optimize thermal performance.

These 2 x 3.5-inch (50 x 90 mm) boards have an ILDC-Series part, LEDs to show the DC-to-DC converter is operating, the three required external bypass capacitors, screw connections, test pads, and provisions for header pins.

Versions are available for all ILDC-Series parts.

**ILDC1x-15E (3 mm x 5.5 mm DFN6 Package)**



Pad	Symbol	Description
1	GND1	Input-Side Ground (internally connected to pad 3)
2	VDD1	Input Supply (bypass with a $0.1 \mu\text{F}$ capacitor)
3	GND1	Input-Side Ground (internally connected to pad 1)
4	GND2	Output-Side Ground
5	VF	Filter capacitor / external regulator (connect to a $0.1 \mu\text{F}$ / 16 V external capacitor; can be used with an optional external regulator for multiple outputs or nonstandard voltages)
6	VDD2	Output (bypass with $10 \mu\text{F}$ )
Leadframe pad	GND1	Input-side leadframe connection (connect to GND1 to optimize thermal performance)

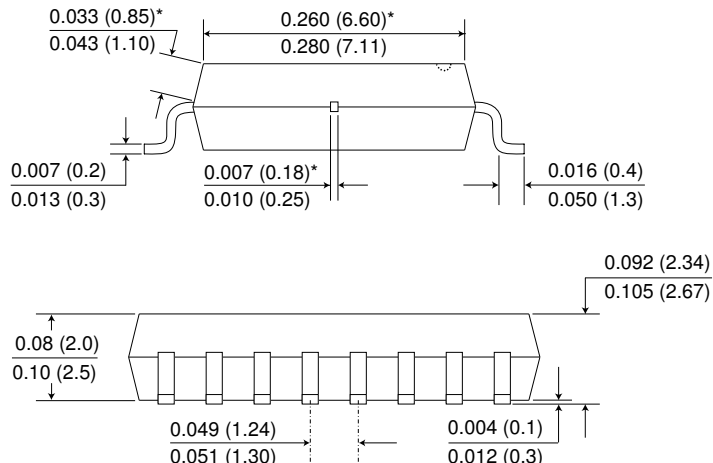
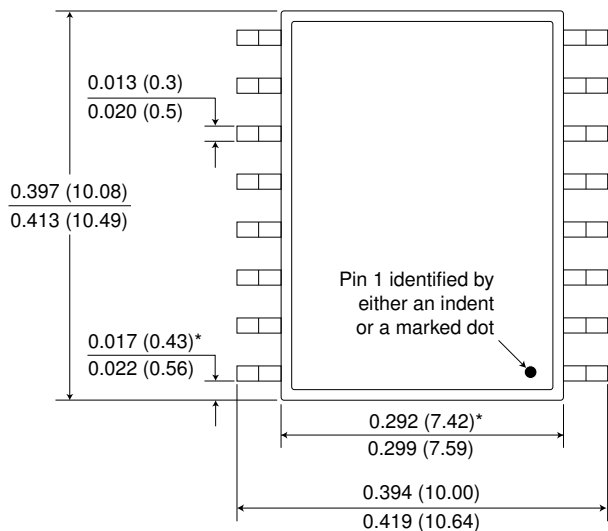
**Notes:**

- Dimensions in millimeters.
- Soldering profile per JEDEC J-STD-020C, MSL 1.



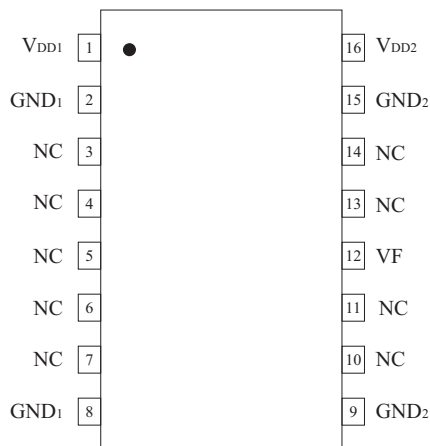
**ILDC1xVE (SOIC16 Wide-Body Package)**

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



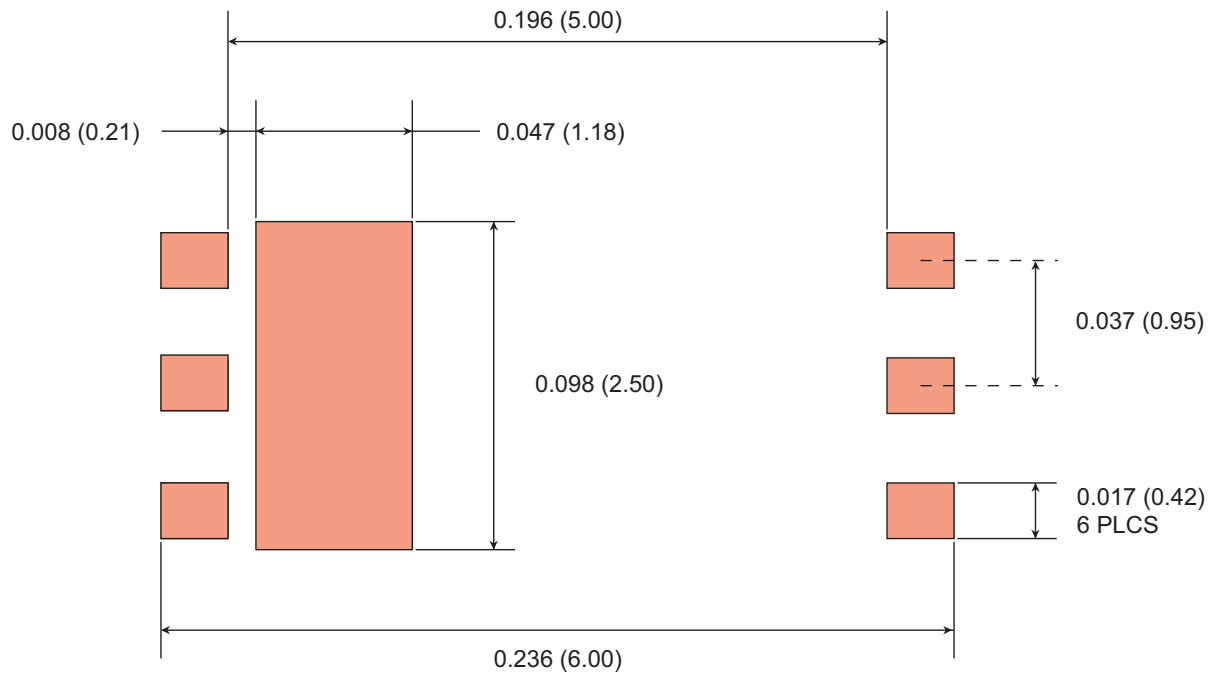
NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

\*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.  
Soldering profile per JEDEC J-STD-020C, MSL 1.



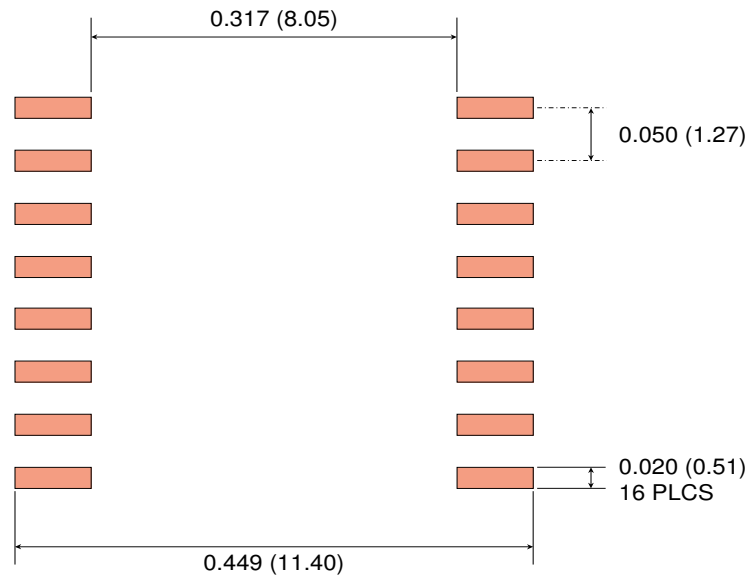
Pin	Symbol	Description
1	V <sub>DD1</sub>	Input Supply (bypass with a 0.1 μF capacitor)
2	GND <sub>1</sub>	Input-Side Ground (internally connected to pin 8)
8	GND <sub>1</sub>	Input-Side Ground (internally connected to pin 2)
9	GND <sub>2</sub>	Output-Side Ground (internally connected to pin 15)
12	VF	Filter capacitor / external regulator (connect to a 0.1 μF / 16 V external capacitor; can be used with an optional external regulator for multiple outputs or nonstandard voltages)
16	V <sub>DD2</sub>	Output (bypass with 10 μF)
3, 4, 5, 6, 7, 10, 11, 13, 14	NC	No internal connection

**ILDC1x-15E Recommended Layout Footprint**



**ILDC1xVE Recommended Layout Footprint**

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



Dimensions in inches (millimeters)



**Ordering Information**

# ILDC1xV-15E TR7

**Product Line**

IL = Isolation products

**Product Family**

DC = DC-to-DC convertor

**Part Numbers**

11 = 3.3 V in / 3.3 V out

12 = 3.3 V in / 5 V out

13 = 3.3 V in / 6 V out

Part Number	Package	Input Voltage	Output Voltage	Isolation Voltage
ILDC11-15E	DFN6	3.3 V	3.3 V	1 kV <sub>RMS</sub>
ILDC11V-15E	DFN6			2.5 kV <sub>RMS</sub>
ILDC11VE	SOIC16W			4 kV <sub>RMS</sub>
ILDC12-15E	DFN6	3.3 V	5 V	1 kV <sub>RMS</sub>
ILDC12V-15E	DFN6			2.5 kV <sub>RMS</sub>
ILDC12VE	SOIC16W			4 kV <sub>RMS</sub>
ILDC13-15E	DFN6	3.3 V	6 V	1 kV <sub>RMS</sub>
ILDC13V-15E	DFN6			2.5 kV <sub>RMS</sub>
ILDC13VE	SOIC16W			4 kV <sub>RMS</sub>

**Part Package**

15 = 3 x 5.5 mm DFN package

V = Extended creepage versions

**RoHS-compliance**

E = RoHS-compliant

**Bulk Packaging**

Blank = Bulk (tubes)

TR7 = 7" Tape and Reel

TR13 = 13" Tape and Reel

**Available Parts.**

**Revision History**

**ISB-DS-001-ILDC1x-RevJ**

Feb. 2024

**Changes**

- Added ILDC1xV-15E high-isolation DFN version.
- Updated evaluation board description.

**ISB-DS-001-ILDC1x-RevI**

Sept. 2023

**Changes**

- Added EU declaration of conformity and CE mark (p. 1).
- Tightened ILDC13 output voltage min. spec to 5.75 volts (p. 2).
- Changed ILDC1x-15E external creepage distance from 3.5 to 2.1 mm (p. 3).
- Added CISPR 32 Class B compliance and stitching capacitor recommendation (p. 6).
- Added basic circuit (Fig. 13, p. 9).
- Revised Fig. 18 (p. 13).
- Revised H-bridge application circuit (Fig. 23c, p. 18).
- New eval boards have four layers and ground-plane overlap stitching capacitance (p. 21).

**ISB-DS-001-ILDC1x-RevH**

March 2023

**Change**

- Updated H-bridge application circuits (Figs. 22a – 22d).

**ISB-DS-001-ILDC1x-RevG**

Sept. 2022

**Changes**

- Reduced startup current (p. 2).
- Received UL approval (p. 3).
- Changed isolation voltage from 5 kV to 4 kV under the more stringent IEC60747-17 standard.
- Added IEC 60601 medical equipment standards (p. 3).
- Added equipment-level safety standards such as IEC 62368-1 (p. 3).
- Added section on EMI mitigation (p. 6).
- Added section on medical systems (p. 6).
- Changed start-up description with soft-start on lot numbers 22xxxx and higher.
- Changed Fig. 9 for soft-start.
- Added diagram for medical system isolation (Fig. 22).

**ISB-DS-001-ILDC1x-RevF**

April 2021

**Changes**

- Added 5 V and 6 V output options (ILDC12 and ILDC13).
- Added a wide-body SOIC16 version with 5 kV<sub>RMS</sub> isolation (ILDC1xVE).
- Updated isolation specifications (p. 3).
- Discontinued the 5 V bus demo board with an external regulator since we now offer a 5 V output DC-to-DC convertor version.

**ISB-DS-001-ILDC11-RevE**

Oct. 2020

**Changes**

- Added VF vs. output current typical performance graph (Figure 8).
- Added descriptions of external regulator options.
- Revised external regulator reference designs and isolated H-bridge driver.

**ISB-DS-001-ILDC11-RevD**

Sept. 2020

**Change**

- More detailed Figure 18 (isolated H-bridge driver).

**ISB-DS-001-ILDC11-RevC**

July 2020

**Changes**

- Added start-up current specification (p. 2) and typical graph (Figure 10).
- Added thermal protection description (p. 2) and typical graph (Figure 10).
- Updated step-down regulator reference design with higher-current regulator (Figure 16).

**ISB-DS-001-ILDC11-RevB**

June 2020

**Change**

- Added efficiency performance graph (Figure 5).

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NVE Corporation  
11409 Valley View Road  
Eden Prairie, MN 55344-3617 USA  
Telephone: (952) 829-9217  
[www.nve.com](http://www.nve.com)  
e-mail: [iso-info@nve.com](mailto:iso-info@nve.com)

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ISB-DS-001-ILDC1x

*February 2024*