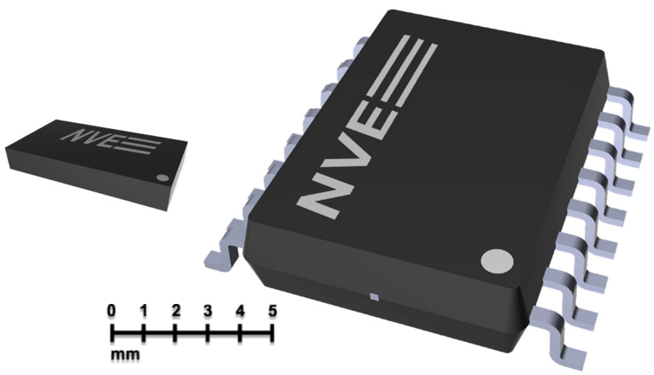
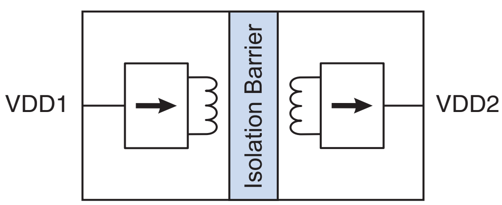
ILDC1x Ultraminiature Isolated DC-to-DC Convertors



Features

- World's smallest isolated DC-to-DC convertor
- Ultraminiature 3 x 5.5 x 0.9 mm (0.015 cm³) 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
- 2.5 kV_{RMS} (DFN) and 6 kV_{RMS} (SOIC) isolation
- UL1577 approved
- 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

Block Diagram



Applications

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

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.

Parts are available in an ultraminiature 3 mm x 5.5 mm DFN6 or a True-8 mm creepage SOIC16. The DFN versions are the world's smallest isolated DC-to-DC convertor at just 0.015 cm³.

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.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 Fax: (952) 829-9189 www.IsoLoop.com

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

Thermal Specifications

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction-to-ambient thermal resistance	ILDC1xV-15E	θ_{JA}		46		°C/W	2s2p PCB per JESD51; leadframe pad grounded (if applicable); free air.
	ILDC1xVE			46			
Junction-to-case (top) thermal resistance	ILDC1xV-15E	θ_{JC}		12			
	ILDC1xVE			9			
Junction-to-ambient thermal resistance	ILDC1xV-15E	θ_{JA}		52.5			2-sided PCB with 2 oz Cu and thermal vias; leadframe pad grounded.
	ILDC1xVE			67			
Junction-to-case (top) thermal resistance	ILDC1xV-15E	θ_{JC}		8			
	ILDC1xVE			12			
Package power dissipation	ILDC1xV-15E	P			1.5	W	
	ILDC1xVE				1.5		

Isolation Specifications

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
	ILDC1xV-15E		2.5				
	ILDC1xVE		6				
Working voltage		V_{iorm}	600			V_{RMS}	Per VDE 0884-17
Transient overvoltage	ILDC1xV-15E	V_{IOTM}	4			kV_{PK}	Per VDE 0884-17
	ILDC1xVE		6				
Surge immunity			6.4			kV_{PK}	
	ILDC1xV-15E		3.5				
	ILDC1xVE		8.03	8.3			
Comparative tracking index	ILDC1xV-15E	CTI	≥175			V_{RMS}	Per IEC 60112
	ILDC1xVE		≥600				
Total barrier thickness (internal)			0.012	0.016		mm	
Isolation barrier resistance		R_{IO}		$>10^{14}$		Ω	500 V_{RMS}
Isolation barrier capacitance		C_{IO}		7		pF	f = 1 MHz
Leakage current				0.2		μA_{RMS}	240 V_{RMS}, 60 Hz
Barrier life				44000		Years	100°C, 1000 V_{RMS}, 60% CL activation energy

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

ILDC1xV-15E tested at 3 kV_{RMS} (4.24 kV_{PK}) 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_{RMS} (3.53 kV_{PK}) for 1 minute.

ILDC1xVE tested at 7.2 kV_{RMS} (10.2 kV_{PK}) for 1 second, 5 pC partial discharge limit in accordance with UL 1577 and VDE 0884-17 Method B1.
Each lot sample tested at 6 kV_{RMS} (8.5 kV_{PK}) for 1 minute.

- IEC 60601-1 (medical systems)
  - ILDC1xV-15E is 1xMOOP compliant (isolation voltage ≥1.5 kV_{RMS}; creepage ≥2.5 mm).
  - ILDC1xVE is 2xMOPP compliant (isolation voltage ≥4 kV_{RMS}; creepage ≥8 mm).

- All versions compliant with IEC 60950-1 and IEC 62368-1 end equipment standards.

Features

Best-in-Class Isolation

A unique ceramic/polymer composite barrier provides virtually unlimited barrier life. The DFN version (ILDC1xV-15E) provides a full 2.5 kV_{RMS} isolation and extended creepage, and the wide-body SOIC version provides a remarkable 6 kV_{RMS} and true eight-millimeter creepage in accordance with IEC60601.

Low Parts Count

The only external components required are three inexpensive bypass capacitors on the V_{DD1}, V_{DD2}, 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_{P-P}.

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:

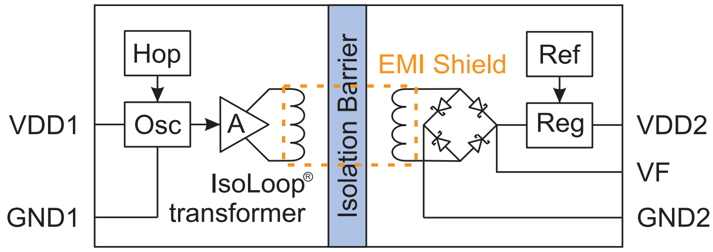


Figure 1. ILDC1x detailed block diagram.

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.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Application Information

Low Parts Count
The only external components required are three inexpensive bypass capacitors: a 0.1 µF ceramic capacitor placed as close as possible to the VDD1 pad, a 10 µF ceramic capacitor for the VDD2 pad, and a 0.1 µF/16 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 two milliseconds 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 (2xMOPP). ILDC1xVE parts meet the 2xMOPP requirements of 4 kV_{RMS} isolation and true 8 mm creepage. AC/DC power supplies meeting these requirements are difficult to find and expensive. An inexpensive 2xMOOP power supply can supply the operator interface, while a 2xMOPP 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.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Typical Performance Graphs

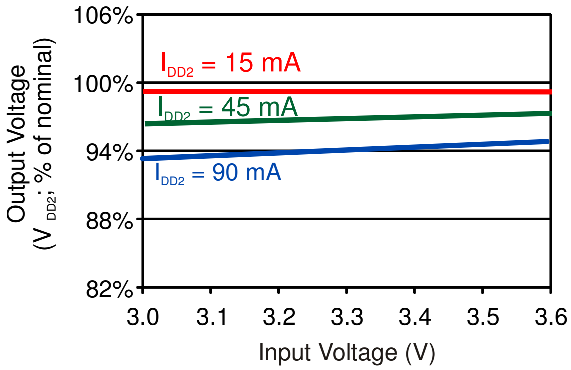


Figure 2. Typical line regulation.

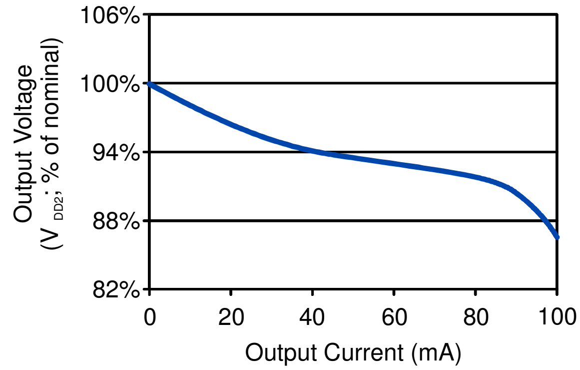


Figure 3. Typical load regulation.

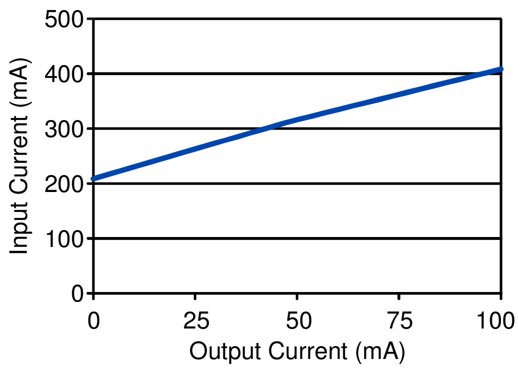


Figure 4. Typical input current versus output current.

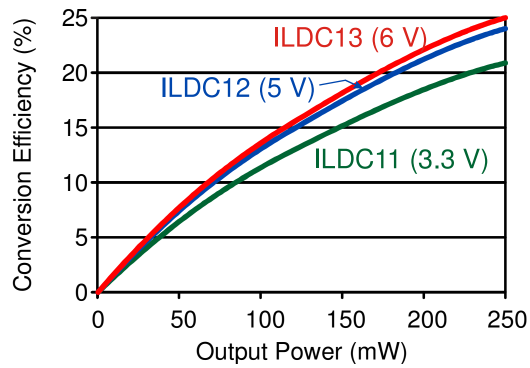


Figure 5. Conversion power efficiency.

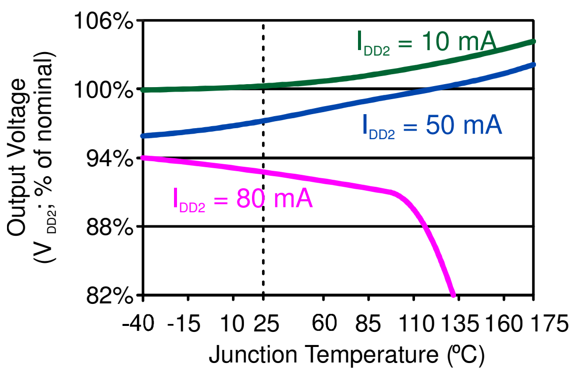


Figure 6. DC-to-DC convertor output vs. temperature and self-limiting current.

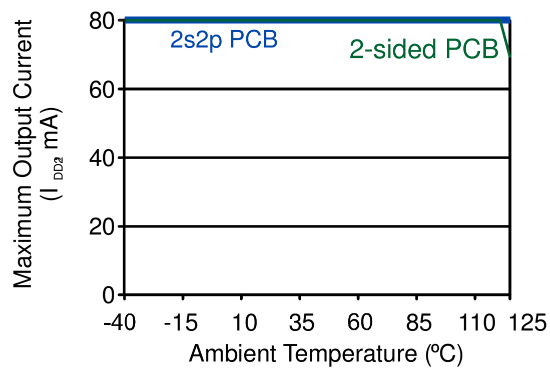


Figure 7. Temperature derating curve (ILDC11).

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

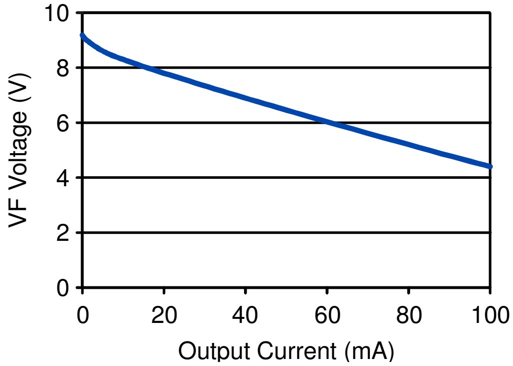


Figure 8. Typical unregulated output voltage versus output current (V_{DD1} = 3.3 V; 25 °C).

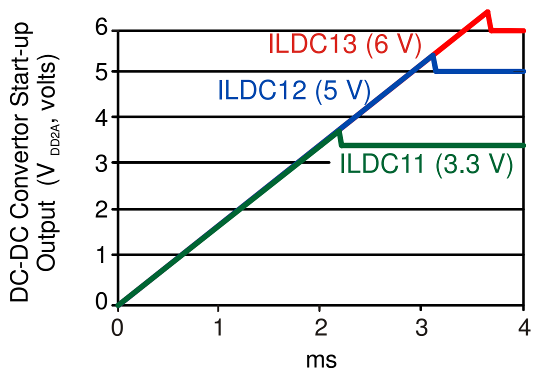


Figure 9 Typical DC-to-DC convertor start-up voltage (no load).

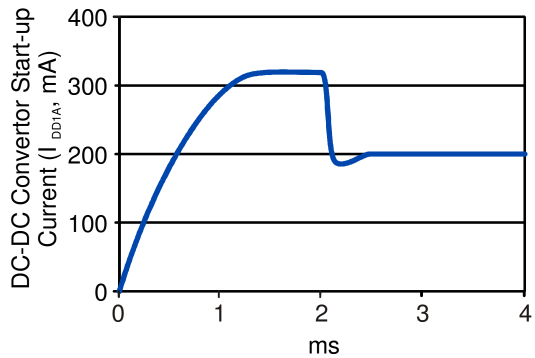


Figure 10. Typical DC-to-DC convertor start-up current (no load).

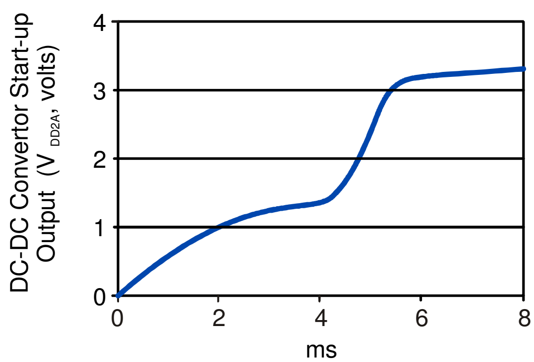


Figure 11. Typical DC-to-DC convertor start-up voltage (IL46xx; maximum load).

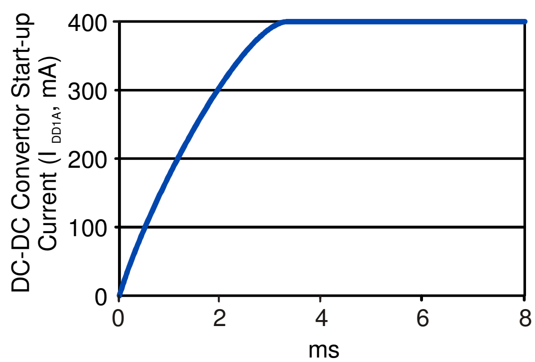


Figure 12. Typical DC-to-DC convertor start-up current (maximum load).

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Application Circuits

Basic recommended circuit:

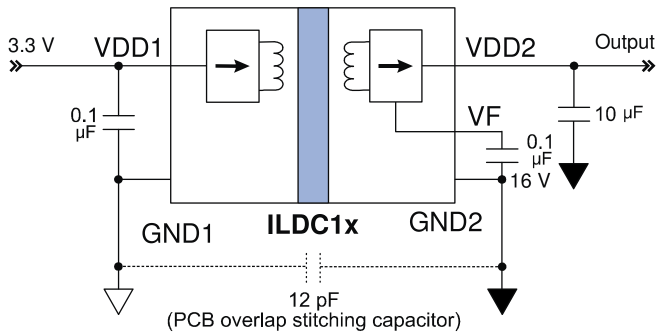


Figure 13. Typical circuit.

Bypass capacitors are required on the V_{DD1}, V_{DD2}, and VF pins as shown. The small input-to-output ground stitching capacitance is recommended for EMI mitigation. The capacitance can be created using PCB ground-plane overlap.

Typical isolated RS-485 bus power supply and node:

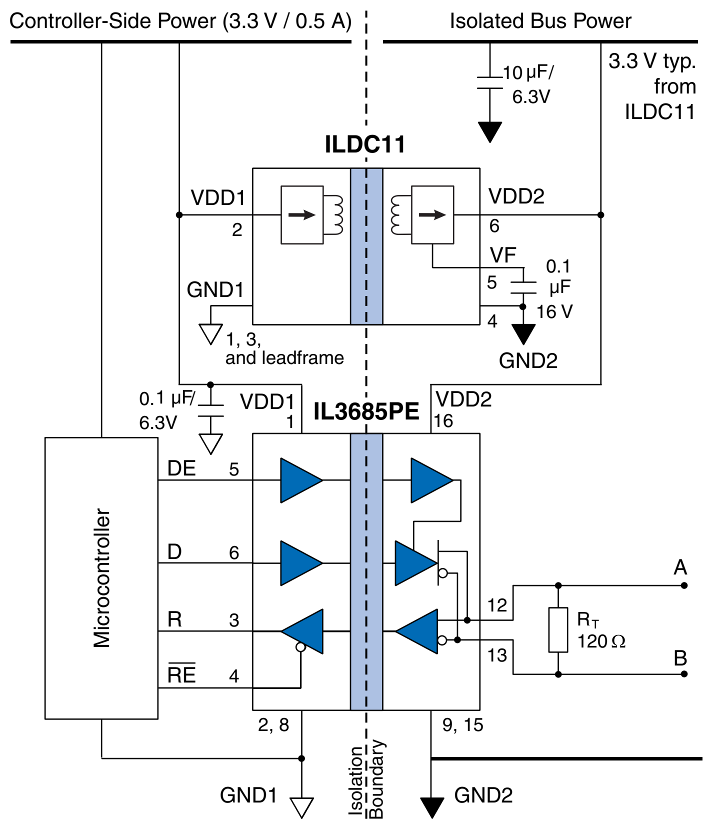


Figure 14. An isolated 3.3-volt RS-485 bus supply and node.

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:

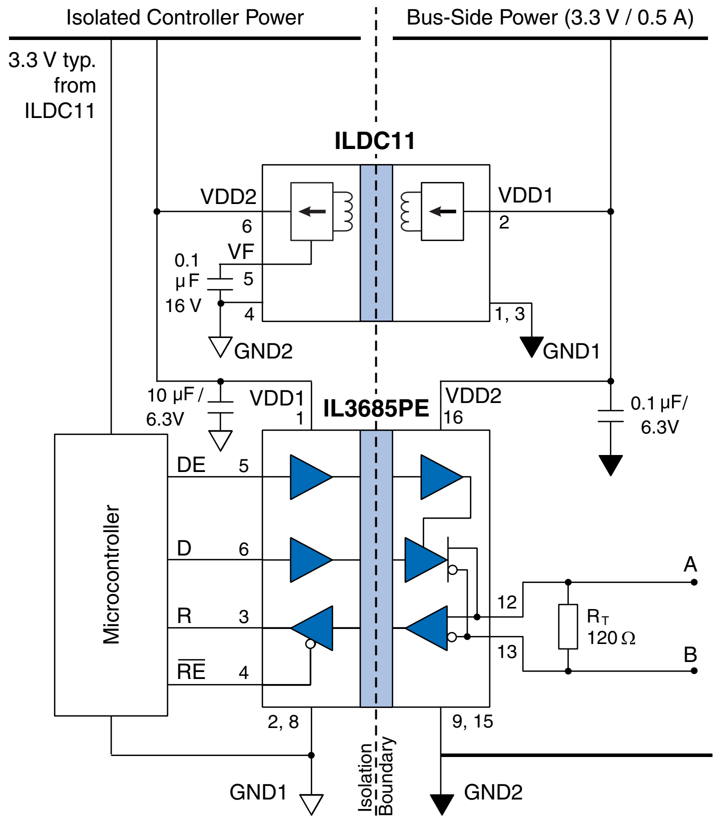


Figure 15. Reversed configuration: isolated controller supply from a 3.3-volt bus.

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.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Isolated SPI sensor interface:

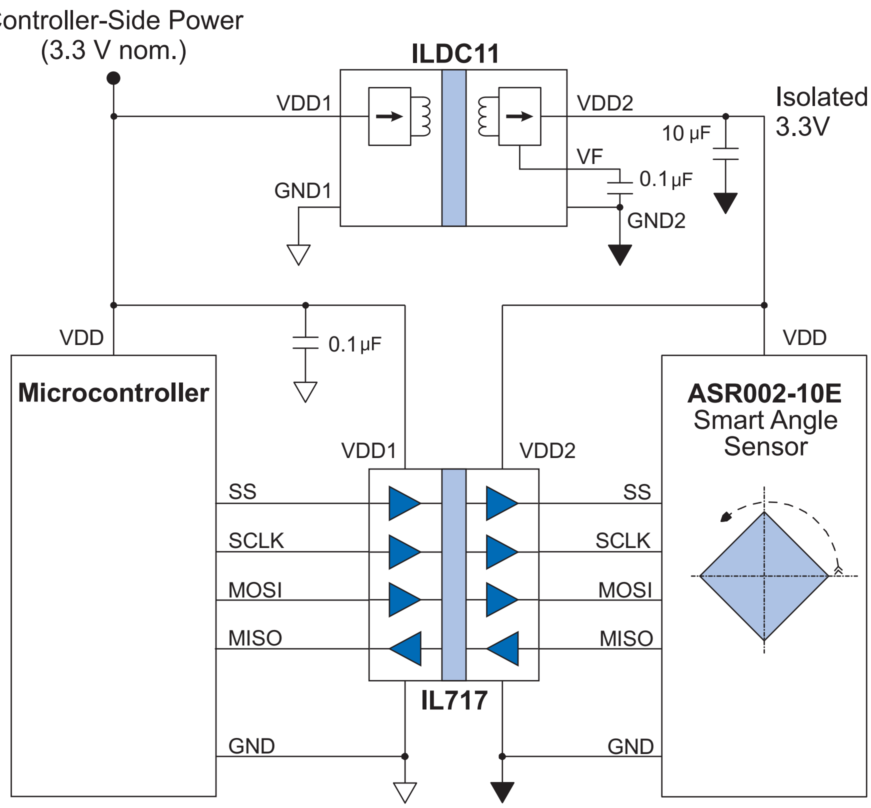


Figure 16. An isolated SPI sensor interface.

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:

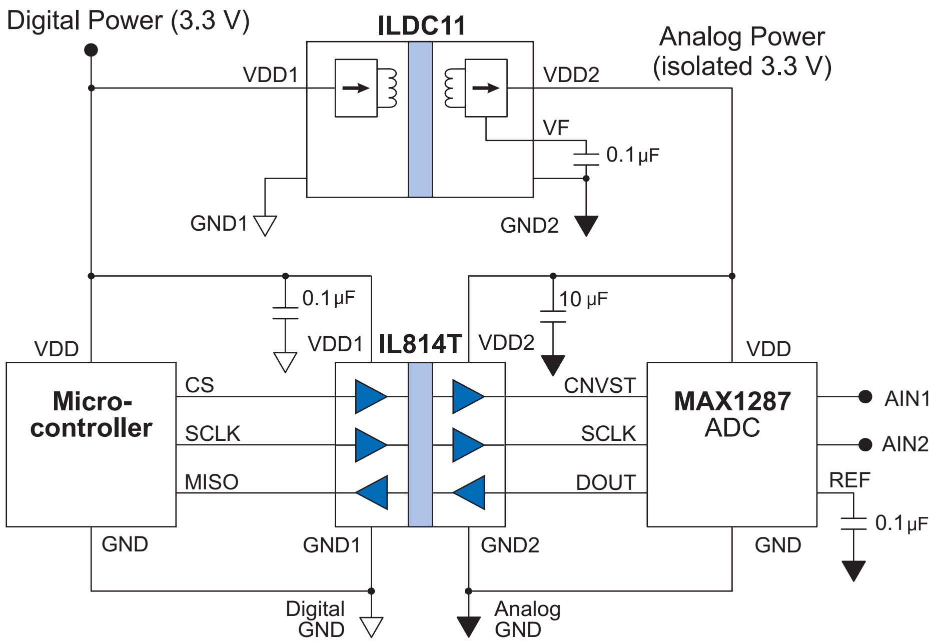


Figure 17. Isolated ADC serial interface.

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:

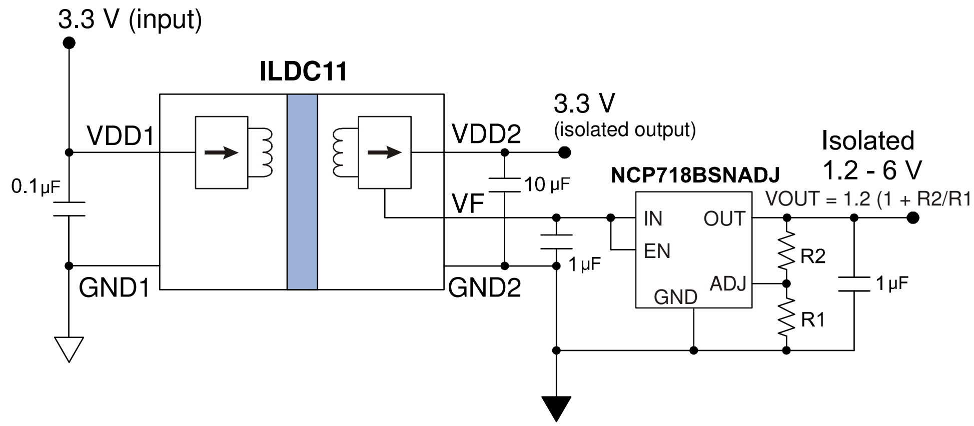


Figure 18. A 3.3-volt input, fixed plus adjustable output isolated supply using an external regulator.

An inexpensive adjustable regulator can be added to a ILDC1x VF output as shown above to provide nonstandard output voltages.

5-volt input:

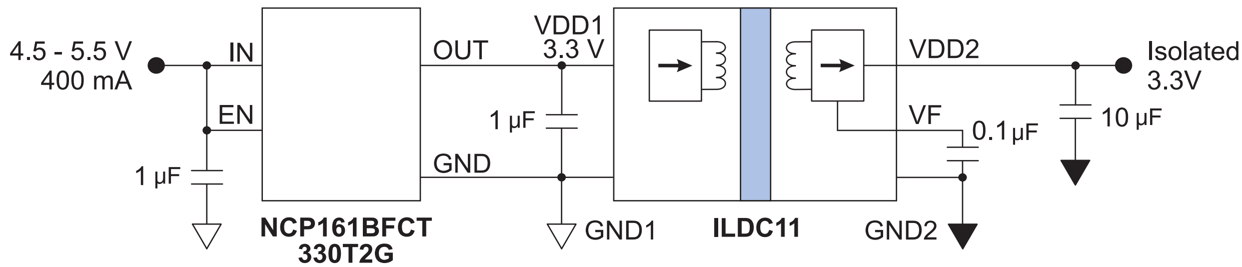


Figure 19. A 5-volt input / 3.3-volt output isolated supply.

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

High-efficiency 5-volt input:

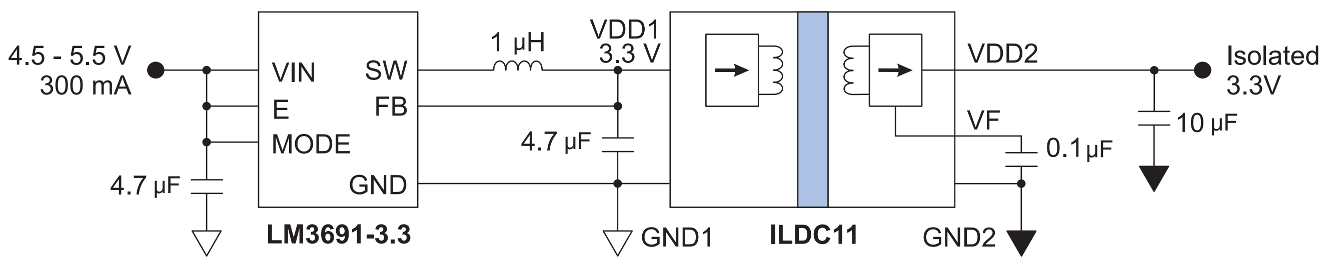


Figure 20. A 5-volt input / 3.3-volt with a buck regulator.

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

Isolated 12-volt output:

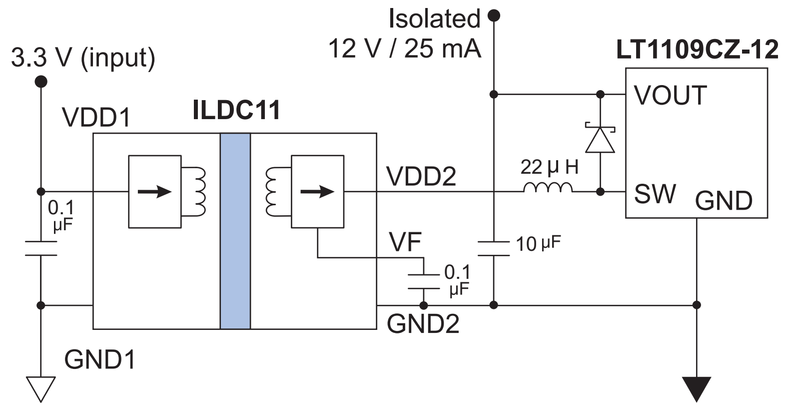
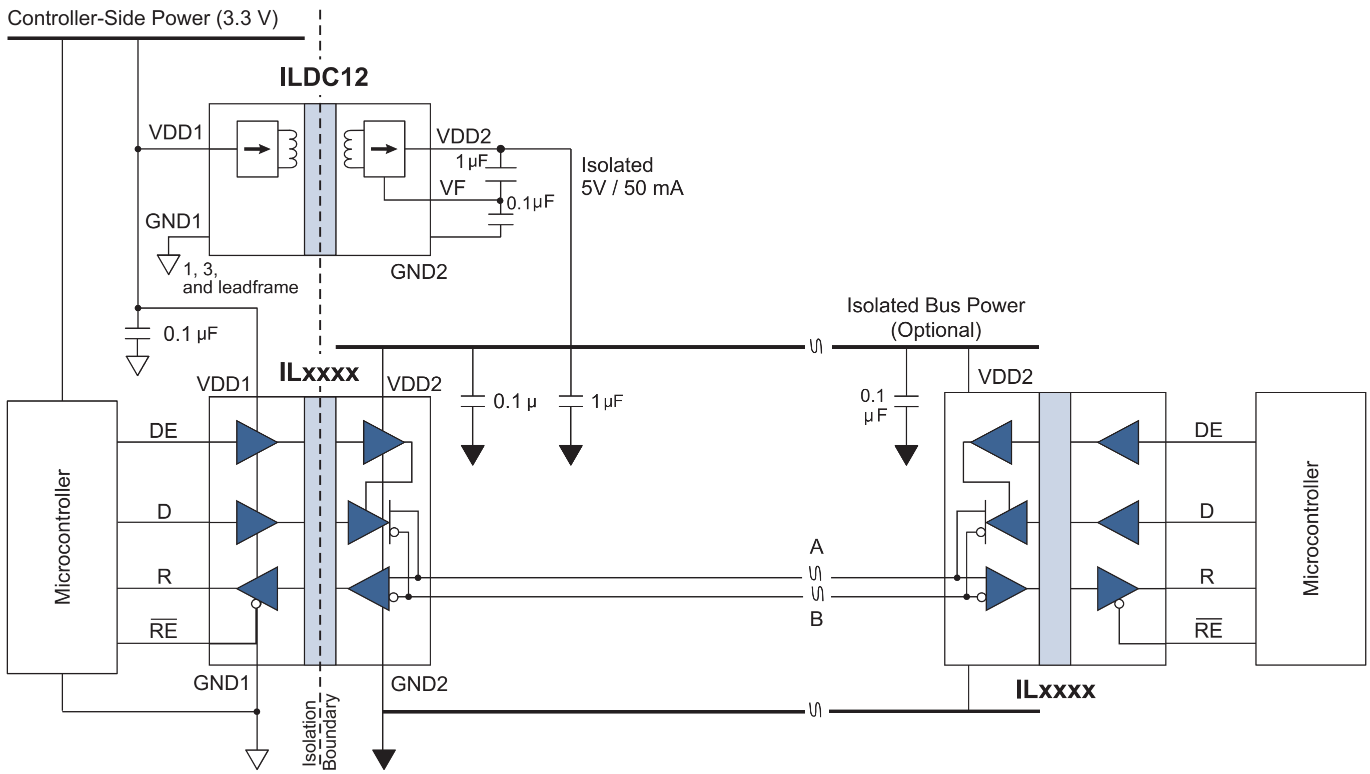


Figure 21. A 3.3-volt input / 12-volt output isolated supply.

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 five-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 five-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:

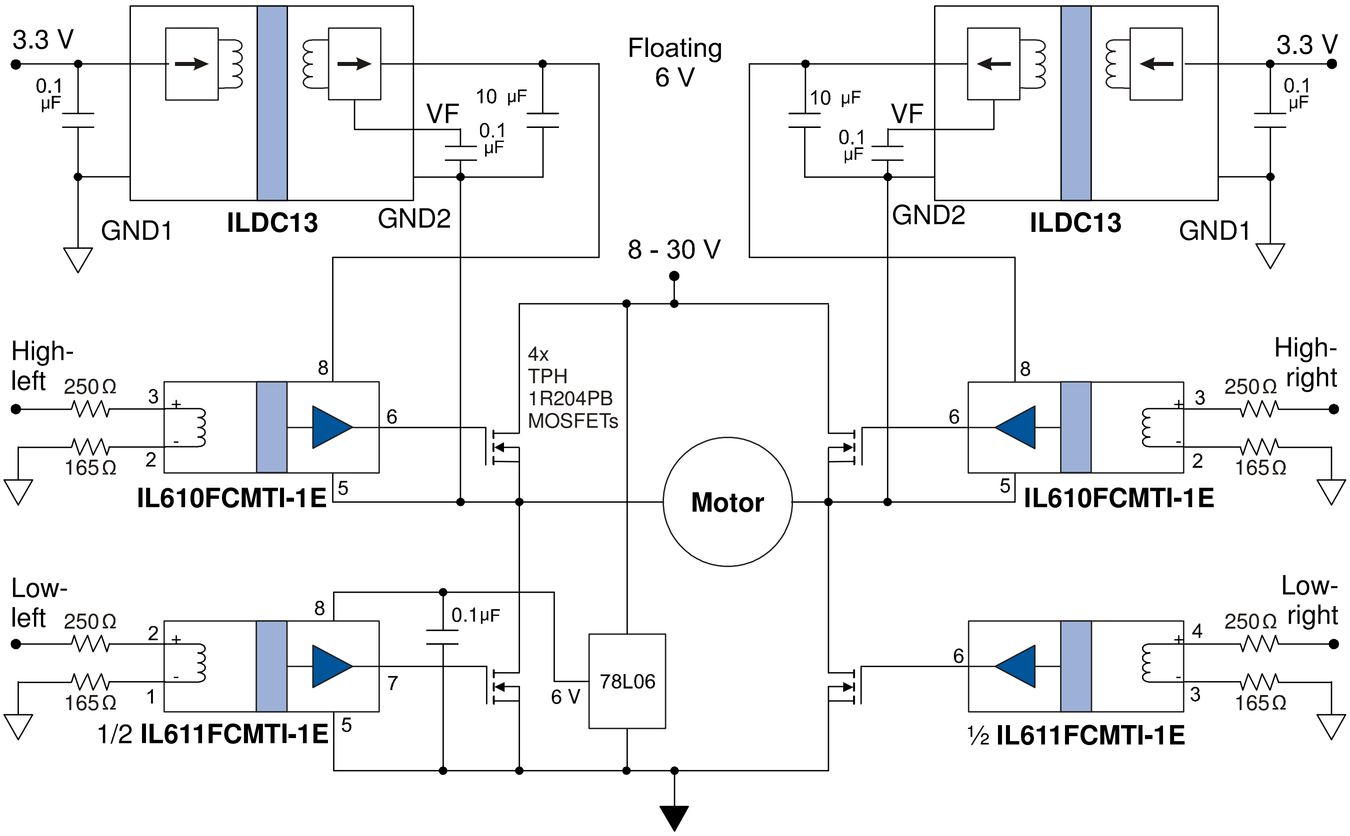


Figure 23a. Simple isolated H-bridge.

Two ILDC13 DC-to-DC-convertors provide isolated floating high-side gate power for this isolated H-bridge circuit.

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. The default-LOW IL6xxFCMTI versions 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. These isolators have low-impedance outputs to directly drive low- to medium-power MOSFETs, so separate MOSFET drivers are not required. The isolators are the world's smallest, with the highest common-mode transient immunity in the industry. With up to 350 kV/µs transient immunity, the IL610CMTIs prevent spurious isolator switching when the high-side MOSFETs switch.

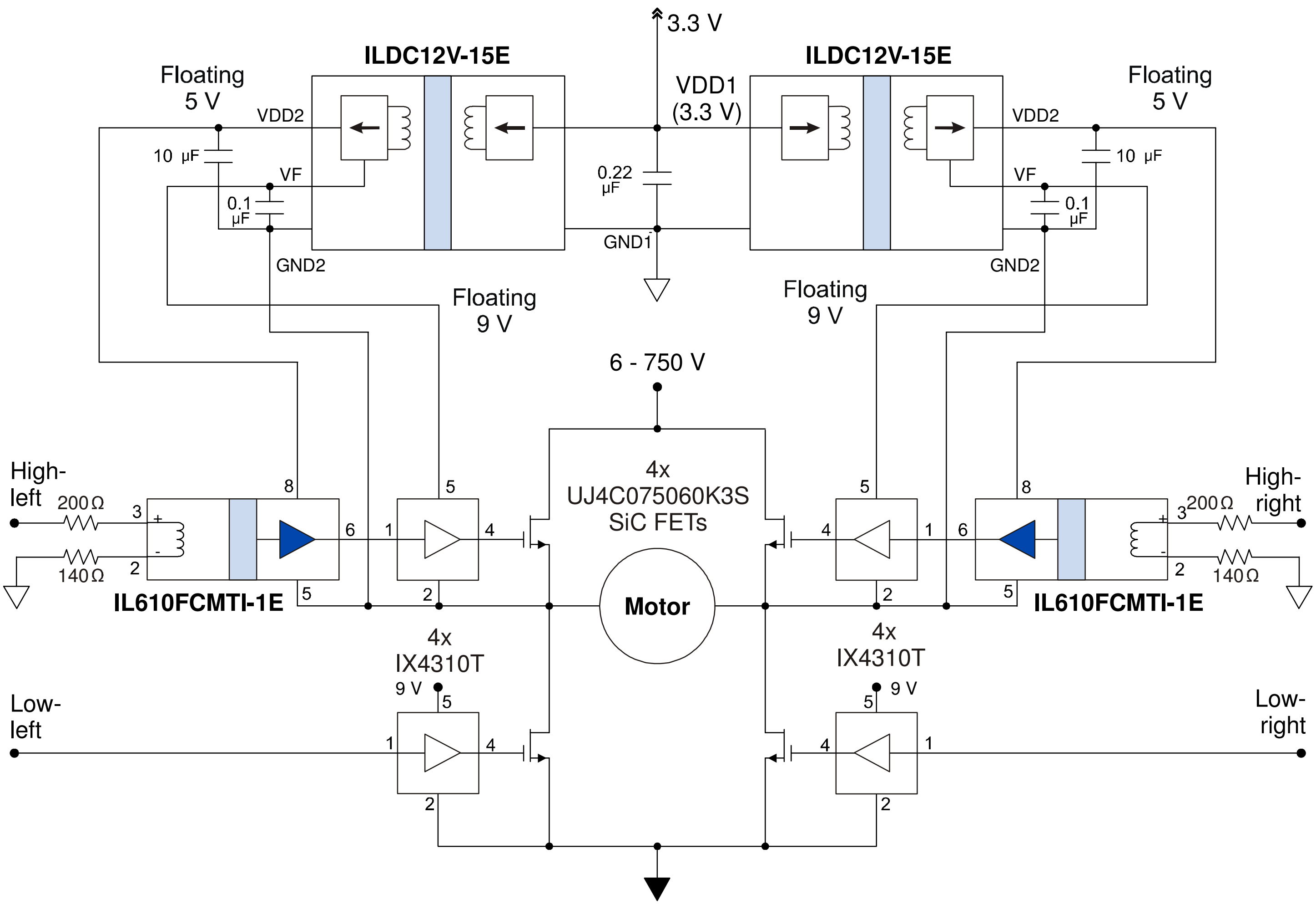


Figure 23b. Isolated high-power silicon-carbide H-bridge.

Silicon-carbide FETs usually require more than six-volt gate drive and lower-impedance drivers. For these applications, the ILDC12s' unregulated VF outputs provide approximately nine volts of isolated power for the high-side gates.

IL610FCMTI isolators can be combined with external drivers such as the IX4310T as shown in Figure 18. 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 DC-to-DC convertors provide failsafe protection, since their "soft-start" feature allows time for the controller to start up before the high-side gate supplies are available. The default-LOW IL6xxFCMTI isolators on the high side provide an additional layer of failsafe protection by ensuring that all the FETs are off when the controller starts up or in case of a loss of controller-side power.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Medical System Isolation:

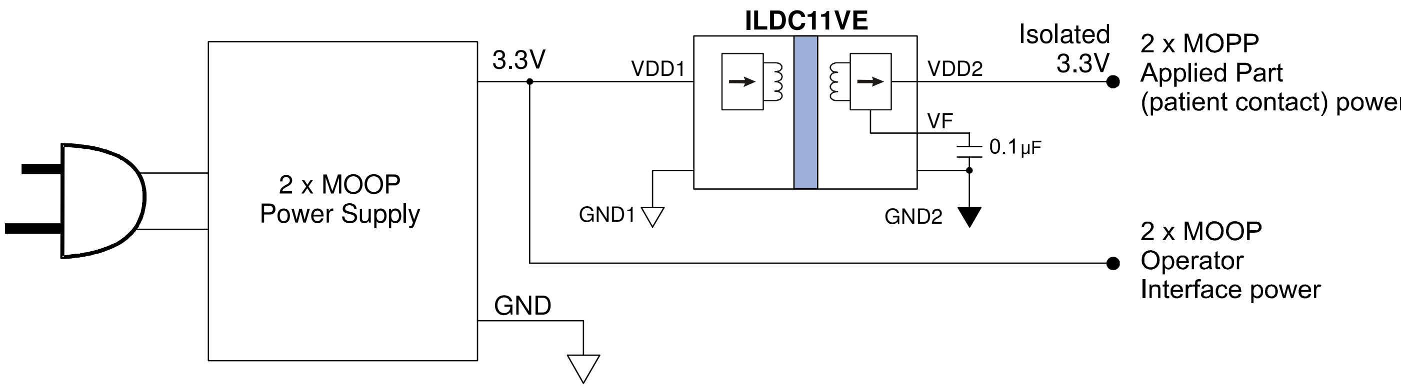
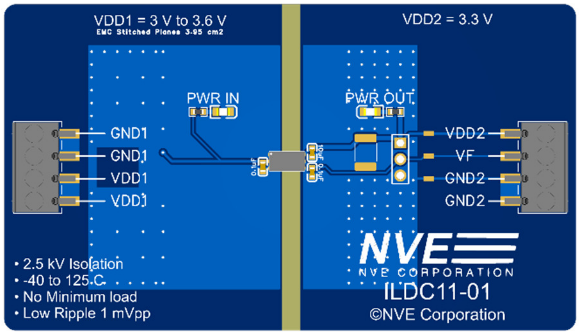


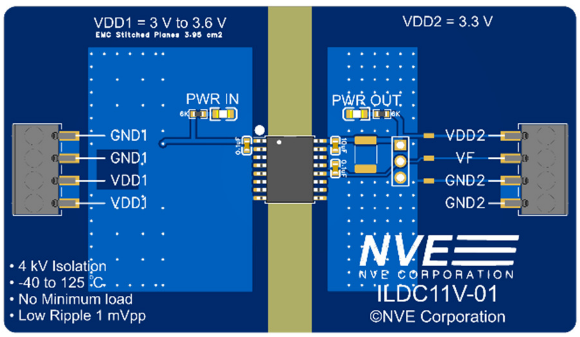
Figure 24. Medical system isolation.

Combining a double Means Of Operator Protection (2xMOOP) power supply with a double Means of Patient Protection (2xMOPP) 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



ILDC1xV-15E-01 Series Evaluation Board.



ILDC1xVE-01 Series Evaluation Board.

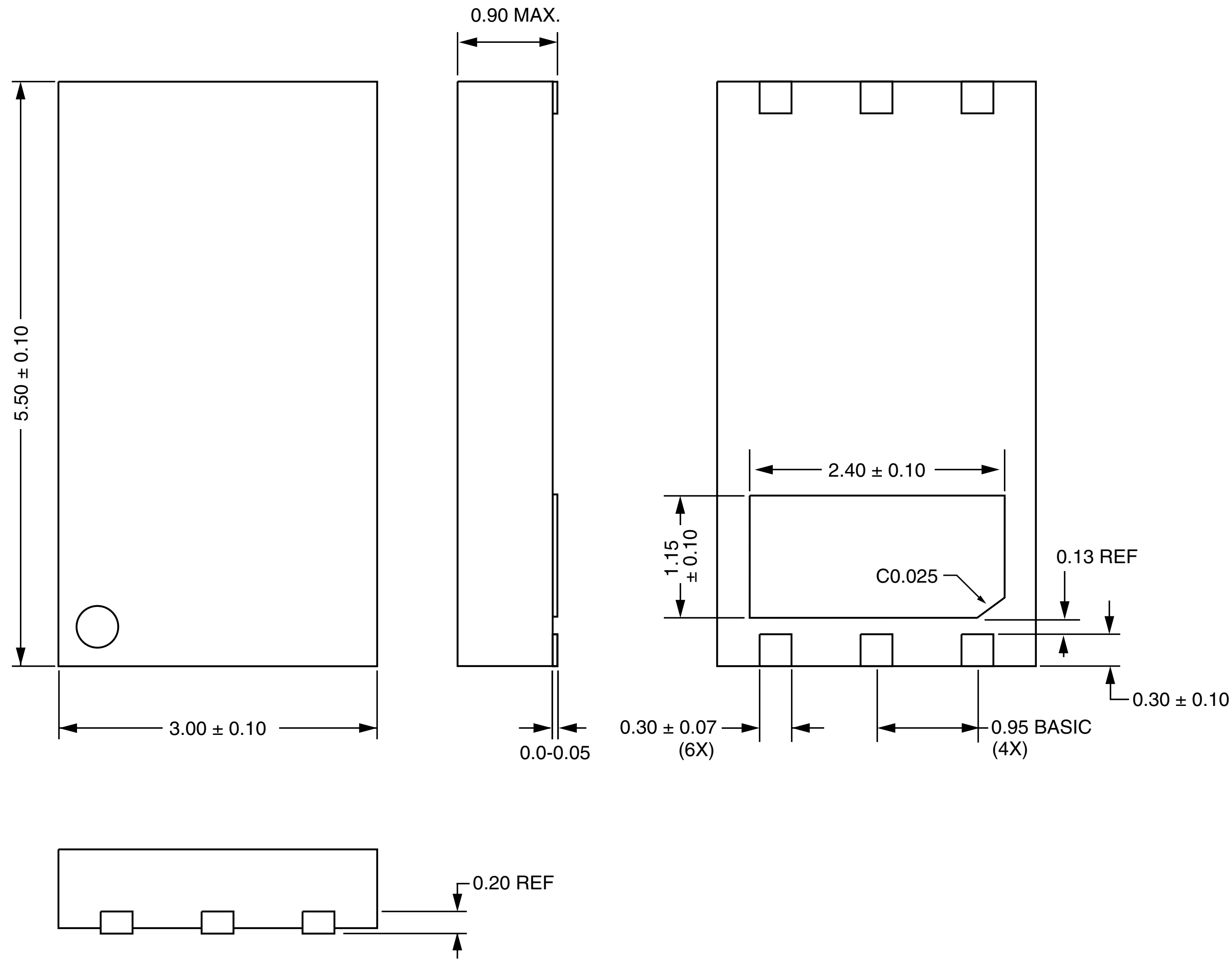
ILDC1xV-15E-01 and ILDC1xVE-01 Series Evaluation Boards
These 2 x 3.5-inch (50 x 90 mm) boards have an ILDC-Series part, LEDs to show the DC-to-DC convertor is operating, and the three required external bypass capacitors.

There are screw connections, test pads, and provisions for header pins.

The boards follow best practices including 2s2p with thermal vias for optimal thermal performance, and stitched ground planes to provide CISPR 32-compliant EMC mitigation with no external components. The boards have provisions for external components if additional EMC mitigation is desired.

Versions are available for all ILDC-Series parts.

ILDC1xV-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 µF 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 µF / 16 V external capacitor; can be used with an optional external regulator for multiple outputs or nonstandard voltages)
6	VDD2	Output (bypass with 10 µF)
Leadframe pad	GND1	Input-side leadframe connection (connect to GND1 to optimize thermal performance)

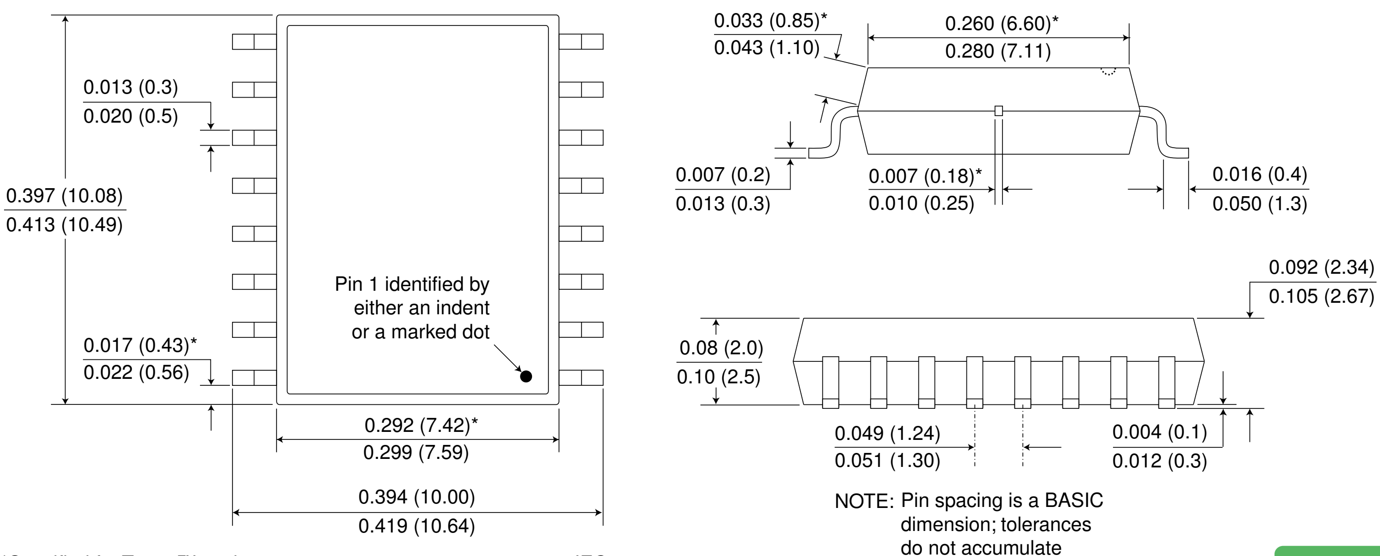
Notes:
- Dimensions in millimeters.
- Soldering profile per JEDEC J-STD-020C, MSL 1.

RoHS COMPLIANT

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

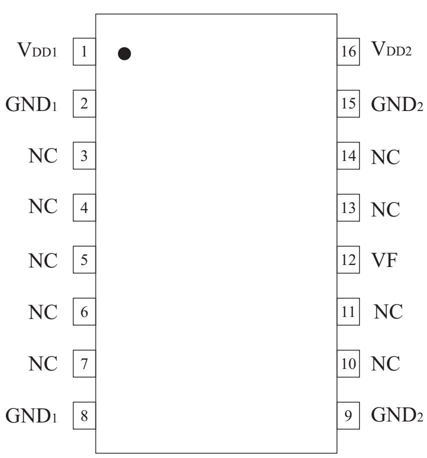
ILDC1xVE (SOIC16 Wide-Body Package)

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



*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.

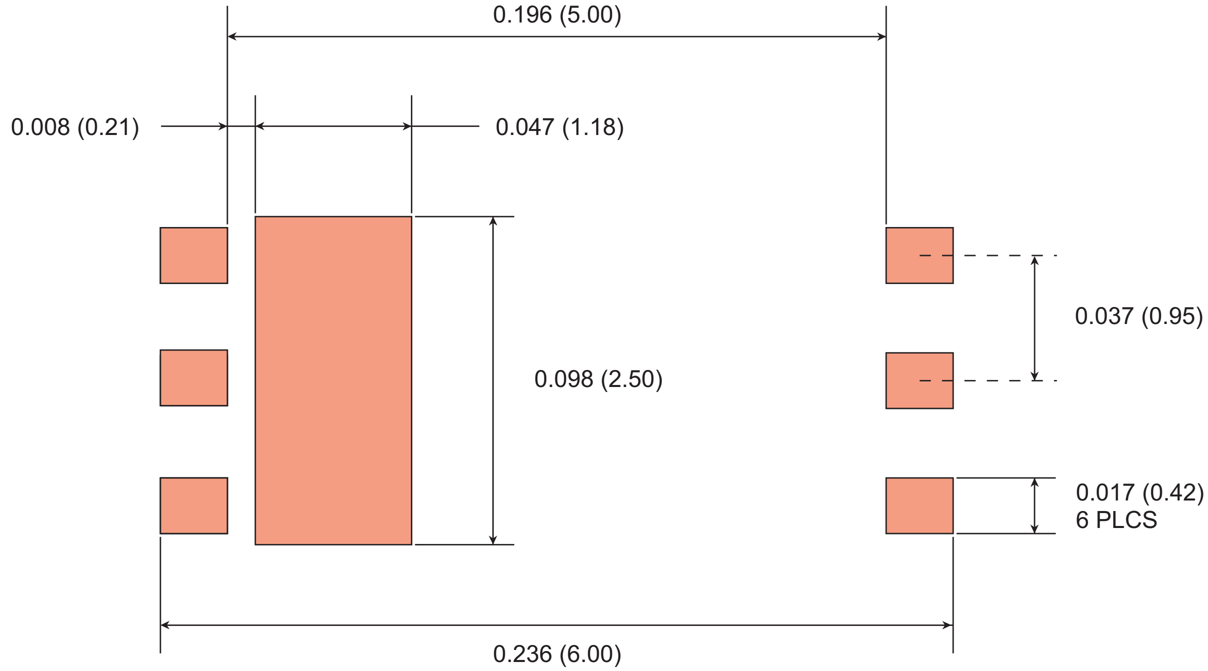
Soldering profile per JEDEC J-STD-020C, MSL 1.



Pin	Symbol	Description
1	VDD1	Input Supply (bypass with a 0.1 µF capacitor)
2	GND1	Input-Side Ground (internally connected to pin 8)
8	GND1	Input-Side Ground (internally connected to pin 2)
9	GND2	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	VDD2	Output (bypass with 10 µF)
3, 4, 5, 6, 7, 10, 11, 13, 14	NC	No internal connection

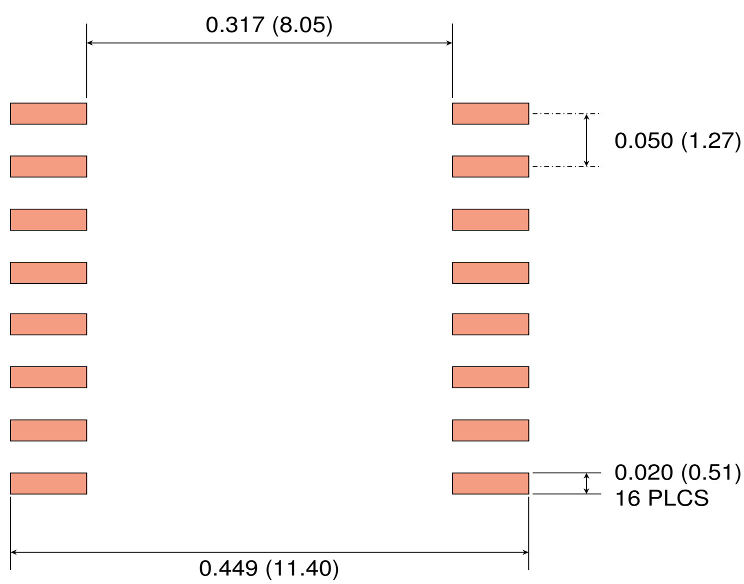
•

ILDC1xV-15E Recommended Layout Footprint



ILDC1xVE Recommended Layout Footprint

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



Dimensions in inches (millimeters)

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Ordering Information

Available Parts

Part Number	Package	Nominal Input Voltage	Nominal Output Voltage	Isolation Voltage
ILDC11V-15E	DFN6	3.3 V	3.3 V	2.5 kV_{RMS}
ILDC11VE	SOIC16W			6 kV_{RMS}
ILDC12V-15E	DFN6		5 V	2.5 kV_{RMS}
ILDC12VE	SOIC16W			6 kV_{RMS}
ILDC13V-15E	DFN6		6 V	2.5 kV_{RMS}
ILDC13VE	SOIC16W			6 kV_{RMS}

Product Line

IL = Isolation products

Product Family

DC = DC-to-DC convertors

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

V = Extended creepage

Part Package

Blank = SOIC16

-15 = 3 x 5.5 mm DFN

RoHS Compliance

E = RoHS compliant

Bulk Packaging

Blank = Bulk (tubes)
TR7 = 7'' Tape and Reel
TR13 = 13'' Tape and Reel

Revision History

ISB-DS-001-ILDC1x-RevK
January 2025

Changes
- Updated package images (p. 1).
- Revised H-bridge application circuits to use new failsafe-LOW isolators (Fig. 23a and 23b, pp. 16 and 17).
- Deleted 1 kV isolation versions (obsoleted by the 2.5 kV ILDC1xV-15E).

ISB-DS-001-ILDC1x-RevJ
April 2024

Changes
- Increased ILDC1xVE isolation spec from 4 kV_{RMS} to 6 kV_{RMS}, lot codes ≥240000.
- Added ILDC1xV-15E extended-creepage DFN version with 2.5 kV_{RMS} isolation.
- Updated evaluation board images and description (p. 21).

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_{RMS} 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).

ISB-DS-001-ILDC11-RevA
June 2020

Changes
- Finalized performance graphs.
- Changed package description from QFN to DFN.
- Additional application circuits.
- Initial release.

ISB-DS-001-ILDC11-PRELIM3
February 2020

Changes
- Updated and expanded thermal resistance specifications.
- Added a derating curve for a double-sided PCB.
- Added application circuits.
- Added Evaluation Boards.

ISB-DS-001-ILDC11-PRELIM2
January 2020

Changes
- Updated and expanded thermal resistance specifications.
- Added application circuits with external regulators.
- Added recommended pad footprint layout (p. 12).

ISB-DS-001-ILDC11-PRELIM
December 2019

Change
- Preliminary release.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 www.nve.com YouTube.com/NveCorporation iso-apps@nve.com

Datasheet Limitations
The information and data provided in datasheets shall define the specification of the product as agreed between NVE and its customer, unless NVE and customer have explicitly agreed otherwise in writing. All specifications are based on NVE test protocols. In no event however, shall an agreement be valid in which the NVE product is deemed to offer functions and qualities beyond those described in the datasheet.

Limited Warranty and Liability
Information in this document is believed to be accurate and reliable. However, NVE does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NVE be liable for any indirect, incidental, punitive, special or consequential damages (including, without limitation, lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Right to Make Changes
NVE reserves the right to make changes to information published in this document including, without limitation, specifications and product descriptions at any time and without notice. This document supersedes and replaces all information supplied prior to its publication.

Use in Life-Critical or Safety-Critical Applications
Unless NVE and a customer explicitly agree otherwise in writing, NVE products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical devices or equipment. NVE accepts no liability for inclusion or use of NVE products in such applications and such inclusion or use is at the customer's own risk. Should the customer use NVE products for such application whether authorized by NVE or not, the customer shall indemnify and hold NVE harmless against all claims and damages.

Applications
Applications described in this datasheet are illustrative only. NVE makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NVE products, and NVE accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NVE product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customers. Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NVE does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customers. The customer is responsible for all necessary testing for the customer's applications and products using NVE products in order to avoid a default of the applications and the products or of the application or use by customer's third party customers. NVE accepts no liability in this respect.

Limiting Values
Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the recommended operating conditions of the datasheet is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and Conditions of Sale
In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NVE hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NVE products by customer.

No Offer to Sell or License
Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export Control
This document as well as the items described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Automotive Qualified Products
Unless the datasheet expressly states that a specific NVE product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NVE accepts no liability for inclusion or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NVE's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NVE's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NVE for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NVE's standard warranty and NVE's product specifications.

An ISO 9001 Certified Company

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

ISB-DS-001-ILDC1x

January 2025