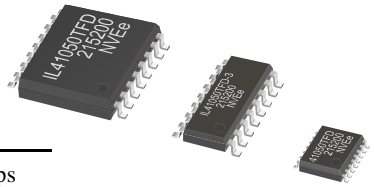
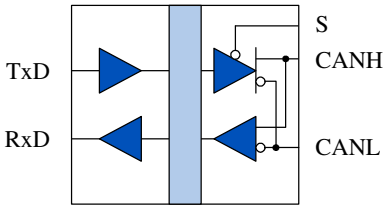
Isolated CAN FD Transceiver



Functional Diagram



IL41050TFD

V_{DD2} (V)	TxD[1]	S[2]	CANH	CANL	Bus State	RxD
4.75 to 5.25	↓	Low	High	Low	Dominant	Low
4.75 to 5.25	X	High	$V_{DD2}/2$	$V_{DD2}/2$	Recessive	High
4.75 to 5.25	↑	X	$V_{DD2}/2$	$V_{DD2}/2$	Recessive	High
<2V (no pwr)	X	X	0<V<2.5	0<V<2.5	Recessive	High
2<V_{DD2}<4.75	>2V	X	0<V<2.5	0<V<2.5	Recessive	High

Table 1. Function table.

Notes:
X = don't care.

1. TxD input is edge triggered: ↑ = Logic Lo to Hi, ↓ = Hi to Lo.

2. S-pin has an internal pull-up resistor; unconnected pin will be logic HIGH.

Features

- Flexible data rate up to 5 Mbps
- 136 ns typical loop delay
- 5 mA typ. quiescent recessive supply current
- 55 mA max. bus supply current
- −55 °C to 125 °C operating temperature
- 3 V to 5.5 V power supplies
- >110-node fan-out
- 44000 year barrier life
- No carrier or clock for low emissions and EMI susceptibility
- Silent mode to disable transmitter
- Transmit data (TxD) dominant time-out function
- Edge triggered, non-volatile input improves noise performance
- Thermal shutdown protection
- Bus power short-circuit protection
- 2500 V_{RMS} isolation voltage
- IEC 60747-17 (VDE 0884-17):2021-10 certified; UL 1577 recognized
- QSOP, 0.15" SOIC, or 0.3" True 8™ mm 16-pin packages

Applications

- Factory automation
- Battery management systems
- Noise-critical CAN
- DeviceNet

Description

The IL41050TFD is a galvanically isolated, CAN (Controller Area Network) transceiver, designed as the interface between the CAN protocol controller and the physical bus. The IL41050TFD provides the speed and signal fidelity specifications needed for CAN flexible data rate (CAN FD) up to 5 Mbps.

The wide-body version provides true 8 mm creepage. Narrow-body and QSOP packages offer unprecedented miniaturization.

The IL41050 family provides isolated differential transmit capability to the bus and isolated differential receive capability to the CAN controller via NVE's patented* spintronic Giant Magnetoresistance (GMR) technology.

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

Advanced features facilitate reliable bus operation. Unpowered nodes do not disturb the bus, and a unique non-volatile programmable power-up feature prevents unstable nodes. The devices also have a hardware-selectable silent mode that disables the transmitter.

Designed for harsh CAN and DeviceNet environments, IL41050TFD transceivers have transmit data dominant time-out, bus pin transient protection, a rugged Charged Device Model ESD rating, thermal shutdown protection, and short-circuit protection. Unique edge-triggered inputs improve noise performance.

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

Absolute Maximum Ratings[1][2]

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage temperature	T_S	−55		150	°C	
Junction temperature	T_J	−55		150	°C	
DC voltage at CANH and CANL pins	V_{CANH}, V_{CANL}	−42		42	V	0 V< V_{DD2} < 5.25 V; indefinite duration
Supply voltage	V_{DD1}, V_{DD2}	−0.3		6	V	
Digital input voltage	V_{TxD}, V_S	−0.3		V_{DD} + 0.3	V	
Digital output voltage	V_{RxD}	−0.3		V_{DD} + 0.3	V	
Transient voltage at CANH or CANL	$V_{trt(CAN)}$	−150		150	V	
Electrostatic discharge at all pins	V_{esd}	−4000		4000	V	Human body model
Electrostatic discharge at all pins	V_{esd}	−500		500	V	Machine model

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Supply voltage	V_{DD1} V_{DD2}	3.0 4.75		5.5 5.25	V	
Ambient operating temperature	T_A	−55		125	°C	
Junction temperature	T_J	−55		125	°C	
Input voltage at any bus terminal (separately or common mode)	V_{CANH} V_{CANL}	−12		12	V	
High-level digital input voltage[3][4]	V_{IH}	2 2.4 2		V_{DD1} V_{DD1} V_{DD2}	V	V_{DD1} = 3.3 V V_{DD1} = 5 V V_{DD2} = 5 V
Low-level digital input voltage[3][4]	V_{IL}	0		0.8	V	
Digital output current (RxD)	I_{OH}	−8		8	mA	V_{DD1} = 3.3V to 5V
Ambient operating temperature	T_A	−55		125	°C	
Digital input signal rise and fall times	t_{IR}, t_{IF}			1	µs	
Fanout		110			Nodes	

Notes:

1. Absolute Maximum specifications mean the device will not be damaged if operated under these conditions. It does not guarantee performance.
2. All voltages are with respect to network ground except differential I/O bus voltages.

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_{PK}
- 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
QSOP16	-1	600 V_{RMS}
Narrow-body SOIC16	-3	700 V_{RMS}
Wide-body SOIC16/True 8™	None	600 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)

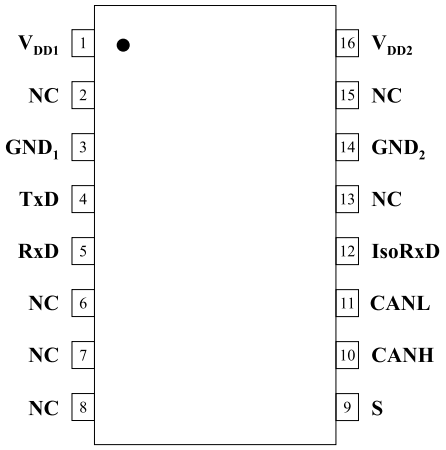
- 2500 V rating
- Each part tested at 3000 V_{RMS} (4243 V_{PK}) for 1 second
- Each lot sample tested at 2500 V_{RMS} (3536 V_{PK}) for 1 minute

Soldering Profile

Per JEDEC J-STD-020C; MSL=1

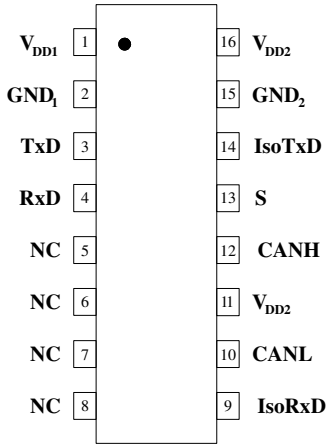
IL41050TFD-1 Pin Connections (QSOP Package)

1	V_{DD1}	V_{DD1} power supply input
2	NC	No internal connection
3	GND_1	V_{DD1} power supply ground return
4	TxD	Transmit Data input
5	RxD	Receive Data output
6	NC	No internal connection
7	NC	No internal connection
8	NC	No internal connection
9	S	Mode select input. Set low for normal operation; set high or leave open for silent mode.
10	CANH	High level CANbus line
11	CANL	Low level CANbus line
12	IsoRxD	Isolated RxD output (normally not connected).
13	NC	No internal connection
14	GND_2	Bus ground
15	NC	No internal connection
16	V_{DD2}	Bus power supply input



IL41050TFD-3 Pin Connections (0.15" SOIC Package)

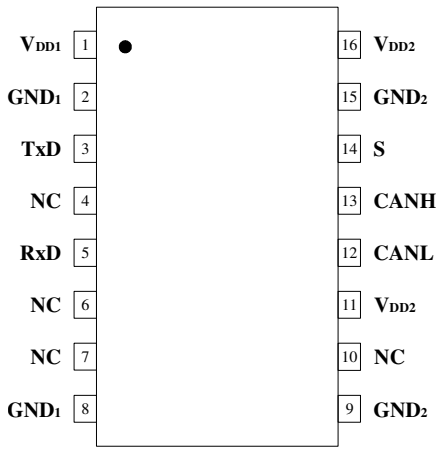
1	V_{DD1}	V_{DD1} power supply input
2	GND_1	V_{DD1} power supply ground return
3	TxD	Transmit Data input
4	RxD	Receive Data output
5	NC	No internal connection
6	NC	No internal connection
7	NC	No internal connection
8	NC	No internal connection
9	IsoRxD	Isolated RxD output (normally not connected).
10	CANL	Low level CANbus line
11	V_{DD2}	V_{DD2} CAN I/O bus circuitry power supply input*
12	CANH	High level CANbus line
13	S	Mode select input. Set low for normal operation; set high or leave open for silent mode.
14	IsoTxD	Isolated TxD output. No connection should be made to this pin.
15	GND_2	V_{DD2} power supply ground return
16	V_{DD2}	V_{DD2} isolation power supply input*



*Pin 11 is not internally connected to pin 16;
both should be connected to the V_{DD2} power supply for normal operation.

IL41050TFD Pin Connections (0.3" SOIC Package)

1	V_{DD1}	V_{DD1} power supply input
2	GND_1	V_{DD1} power supply ground return (pin 2 is internally connected to pin 8)
3	TxD	Transmit Data input
4	NC	No internal connection
5	RxD	Receive Data output
6	NC	No internal connection
7	NC	No internal connection
8	GND_1	V_{DD1} power supply ground return (pin 8 is internally connected to pin 2)
9	GND_2	V_{DD2} power supply ground return (pin 9 is internally connected to pin 15)
10	NC	No internal connection
11	V_{DD2}	V_{DD2} CAN I/O bus circuitry power supply input*
12	CANL	Low level CANbus line
13	CANH	High level CANbus line
14	S	Mode select input. Set low for normal operation; set high or leave open for silent mode.
15	GND_2	V_{DD2} power supply ground return (pin 15 is internally connected to pin 9)
16	V_{DD2}	V_{DD2} isolation power supply input*



Operating Specifications

Electrical Specifications (T_{min} to T_{max} and V_{DD1}, V_{DD2}= 4.75 V to 5.25 V unless otherwise stated)						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Power Supply Current						
Quiescent supply current (recessive)	I_{DD1}	1 0.7	1.75 1.4	3 2	mA	dr = 0 bps; V_{DD1} = 5 V dr = 0 bps;V_{DD1} = 3.3 V
Dynamic supply current (dominant)		1.2 0.9	2 1.6	3.2 2.2	mA	dr = 1 Mbps, R_L= 60Ω; V_{DD1} = 5 V dr = 1 Mbps, R_L= 60Ω; V_{DD1} = 3.3 V
Quiescent supply current (recessive) Dynamic supply current (dominant)	I_{DD2}	2 30	5 45	8 55	mA	0 bps 1 Mbps, R_L = 60Ω
Transmitter Data input (TxD)[1]						
High level input voltage ↑	V_{IH}	2.4		5.25	V	V_{DD1} = 5 V; recessive
High level input voltage ↑	V_{IH}	2		3.6	V	V_{DD1} = 3.3 V; recessive
Low level input voltage ↓	V_{IL}	−0.3		0.8	V	Output dominant
TxD input rise and fall time[2]	t_r			1	µs	10% to 90% 
High level input current	I_{IH}	−10		10	µA	V_{TxD} = V_{DD1}
Low level input current	I_{IL}	−300		−75	µA	V_{TxD} = 0 V
Mode select input (S)						
High level input voltage	V_{IH}	2		V_{DD2} + 0.3	V	Silent mode
Low level input voltage	V_{IL}	−0.3		0.8	V	Normal mode
High level input current	I_{IH}	−1	0	1	µA	V_S = V_{DD2}
Low level input current	I_{IL}	−15		−1	µA	V_S = 0 V
Receiver Data output (RxD)						
High level output current	I_{OH}	−8	−3	−1	mA	V_{RxD} = 0.8 V_{DD1}
Low level output current	I_{OL}	1	6	12	mA	V_{RxD} = 0.45 V
Failsafe supply voltage[4]	V_{DD2}	3.5	4	4.3	V	
Bus lines (CANH and CANL)						
Recessive voltage at CANH pin	$V_{O(reces)}$ CANH	2	2.5	3	V	V_{TxD} = V_{DD1}, no load
Recessive voltage at CANL pin	$V_{O(reces)}$ CANL	2	2.5	3	V	V_{TxD} = V_{DD1}, no load
Recessive current at CANH pin	$I_{O(reces)}$ CANH	−2.5		+2.5	mA	−27V < V_{CANH}< +32V; 0V < V_{DD2}<5.25V
Recessive current at CANL pin	$I_{O(reces)}$ CANL	−2.5		+2.5	mA	−27V < V_{CANL} < +32V; 0 V <V_{DD2} < 5.25V
Dominant voltage at CANH pin	$V_{O(dom)}$ CANH	3	3.6	4.25	V	V_{TxD} = 0 V
Dominant voltage at CANL pin	$V_{O(dom)}$ CANL	0.5	1.4	1.75	V	V_{TxD} = 0 V
Differential bus output voltage	$\lvert V_{CANH} - V_{CANL} \rvert$	1.5	2.25	3	V	V_{TxD} = 0 V; dominant 42.5 Ω < R_L < 60 Ω
Differential bus input voltage	$V_{CANH} - V_{CANL}$	−50	0	+50	mV	V_{TxD} = V_{DD1}; recessive; no load
Short-circuit output current at CANH	$I_{O(sc)}$ CANH	−100	−70	−1	mA	V_{CANH} = 0 V, V_{TxD} = 0
Short-circuit output current at CANL	$I_{O(sc)}$ CANL	−1	70	100	mA	V_{CANL} = 36 V, V_{TxD} = 0
Differential receiver threshold voltage	$V_{i(dif)(th)}$	0.5	0.7	0.9	V	−5 V <V_{CANL}< +10 V; −5 V <V_{CANH}< +10 V
Differential receiver input voltage hysteresis	$V_{i(dif)(hys)}$	50	70	100	mV	−5 V <V_{CANL}< +10 V; −5 V <V_{CANH}< +10 V
Common Mode input resistance at CANH	$R_{i(CM)(CANH)}$	15	25	37	kΩ	
Common Mode input resistance at CANL	$R_{i(CM)(CANL)}$	15	25	37	kΩ	
Matching between Common Mode input resistance at CANH, CANL	$R_{i(CM)(m)}$	−1	0	+1	%	V_{CANL} = V_{CANH} = 5V

Electrical Specifications (T_{min} to T_{max} and V_{DD1}, V_{DD2}= 4.5 V to 5.5 V unless otherwise stated)						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
Bus lines (….cont)						
Differential input resistance	$R_{i(diff)}$	25	50	75	kΩ	
Input capacitance, CANH	$C_{i(CANH)}$		7.5	20	pF	$V_{TxD} = V_{DD1}$
Input capacitance, CANL	$C_{i(CANL)}$		7.5	20	pF	$V_{TxD} = V_{DD1}$
Differential input capacitance	$C_{i(dif)}$		3.75	10	pF	$V_{TxD} = V_{DD1}$
Input leakage current at CANH	$I_{LI(CANH)}$	–5	0	5	µA	V_{CANH}= 5 V, V_{DD2}= 0
Input leakage current at CANL	$I_{LI(CANL)}$	–5	0	5	µA	V_{CANL}= 5 V, V_{DD2}= 0
Thermal Shutdown						
Shutdown junction temperature	$T_{j(SD)}$	155	165	180	°C	

Timing Characteristics (60 Ω / 100 pF bus loading; 20 pF RxD load; see Fig. 1)						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Conditions**
TxD to bus active delay	$t_{d(TxD-BUSon)}$		83 83	100 100	ns	V_S= 0 V; V_{DD1} = 5 V V_S = 0 V; V_{DD1} = 3.3 V
TxD to bus inactive delay	$t_{d(TxD-BUSoff)}$		67 70	100 100	ns	V_S = 0 V; V_{DD1} = 5 V V_S = 0 V; V_{DD1} = 3.3 V
Bus active to RxD delay	$t_{d(BUSon-RxD)}$		26 28	100 100	ns	V_S = 0 V; V_{DD1} = 5 V V_S = 0 V; V_{DD1} = 3.3 V
Bus inactive to RxD delay	$t_{d(BUSoff-RxD)}$		51 55	100 100	ns	V_S = 0 V; V_{DD1} = 5 V V_S = 0 V; V_{DD1} = 3.3 V
Loop delay low-to-high or high-to-low	T_{LOOP}		136	200	ns	V_S = 0 V; "Typ." at 25°C and nominal loads
TxD dominant time for timeout	$T_{dom(TxD)}$	1	-	10	ms	V_{TxD} = 0 V 3.0 V > V_{DD1} < 5.5 V
Common Mode Transient Immunity (TxD Logic High or Logic Low)	$\|CM_H\|$,$\|CM_L\|$	30	50		kV/µs	R_L = 60 Ω; V_{CM} = 1500 V_{DC}; $t_{TRANSIENT}$ = 25 ns

Magnetic Field Immunity(3) (V_{DD2}= 5V, 3V<V_{DD1}<5.5V)						
Power Frequency Magnetic Immunity	H_{PF}		6000		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	H_{PM}		7000		A/m	t_p = 8 µs
Damped Oscillatory Magnetic Field	H_{OSC}		7000		A/m	0.1 Hz – 1 MHz
Cross-axis Immunity Multiplier	K_X		2			See Fig. 4

Insulation Specifications

Parameter		Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage distance (external)	IL41050TFD-1E (QSOP) IL41050TFD-3E (0.15" SOIC) IL41050TFDE (0.3" SOIC)		3.2 4 8.03	 8.3		mm	 Per IEC 60601
Total barrier thickness (internal)			0.012	0.013		mm	
Barrier resistance		R_{IO}		$>10^{14}$		Ω	500 V
Barrier capacitance		C_{IO}		7		pF	f = 1 MHz
Leakage current				0.2		μA_{RMS}	240 V_{RMS}, 60 Hz
Comparative Tracking Index		CTI	≥175			V	Per IEC 60112
High voltage endurance (maximum barrier voltage for indefinite life)	AC DC	V_{IO}	1000 1500			V_{RMS} 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	QSOP 0.15" SOIC 0.3" SOIC	θ_{JA}		100 82 67		°C/W	Double-sided PCB in free air
Junction–Case (Top) Thermal Resistance	QSOP 0.15" SOIC 0.3" SOIC	θ_{JC}		9 8 12			
Junction–Ambient Thermal Resistance	0.3" SOIC	θ_{JA}		46			2s2p PCB in free air per JESD51
Junction–Case (Top) Thermal Resistance		θ_{JC}		9			
Power Dissipation	QSOP 0.15" SOIC 0.3" SOIC	P_D			675 700 1500	mW	

Notes:

1. The TxD input is edge sensitive. Voltage magnitude of the input signal is specified, but edge rate specifications must also be met.
2. The maximum time allowed for a logic transition at the TxD input is 1 µs.
3. Test and measurement methods are given in the Electromagnetic Compatibility section on p. 12.
4. If V_{DD2} falls below the specified failsafe supply voltage, RxD,TxD,S will go High-z.

Typical Performance Graphs

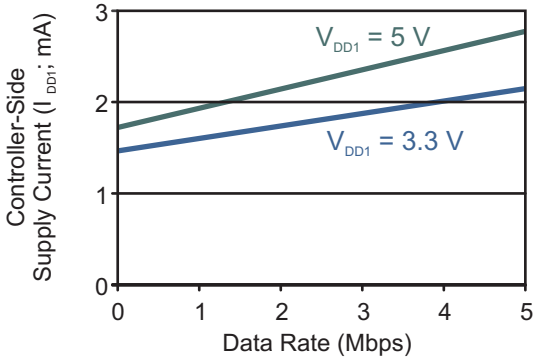


Figure 1. Controller-side supply current (I_{DD1}) vs. data rate.

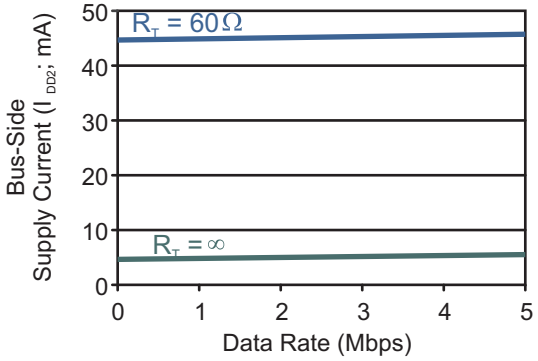


Figure 2. Bus-side supply current (I_{DD2}) vs. data rate.

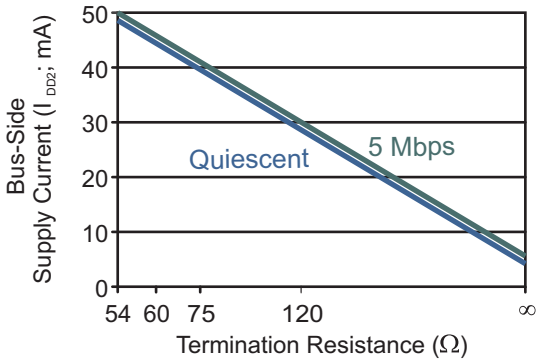


Figure 3. Bus-side supply current (I_{DD2}) vs. load.

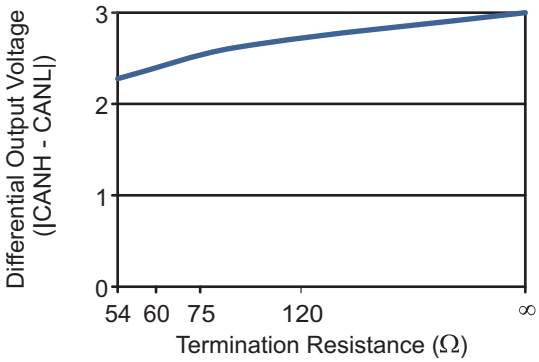


Figure 4. Differential bus output voltage (CANH - CANL) vs. load.

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

Timing Test Circuit

Timing parameters are measured with 60 Ω / 100 pF bus line loading and 20 pF on RxD as shown in Figure 1 below:

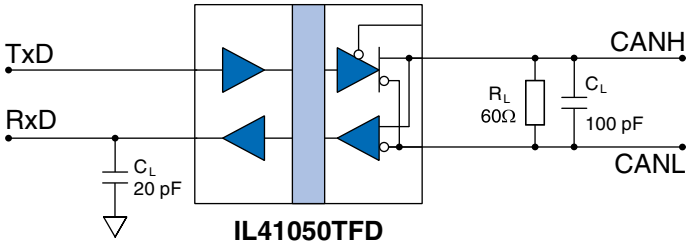


Figure 5. Timing characteristics test circuit.

Block Diagram

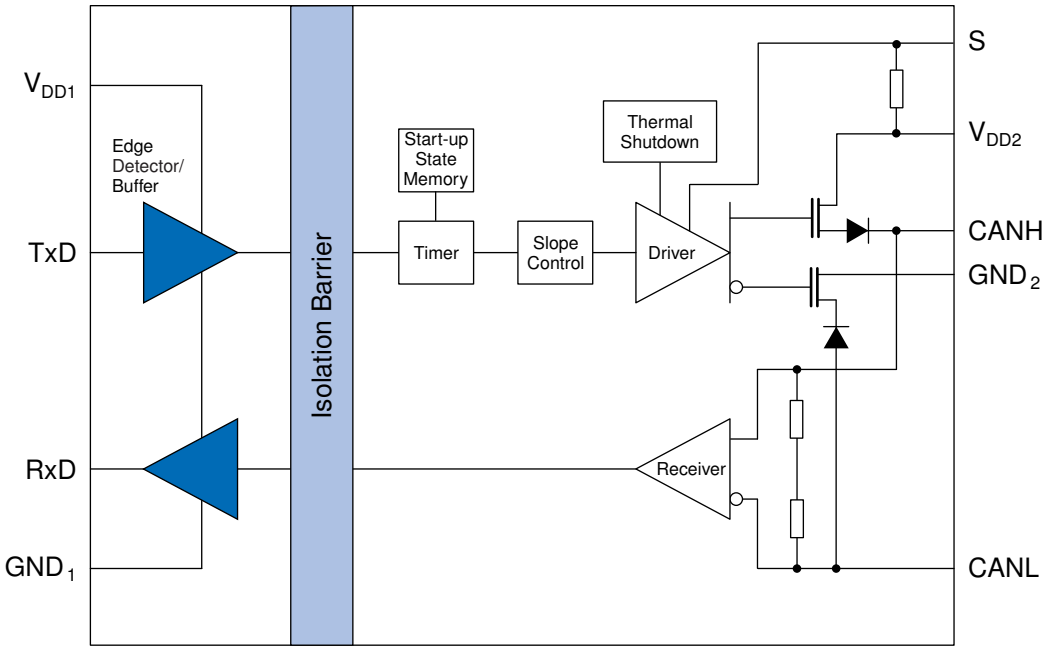


Figure 6. IL41050TFD detailed functional diagram.

GMR Isolator Operation

An equivalent circuit for each of the Giant Magnetoresistor (GMR) isolator channels is shown in Figure 3:

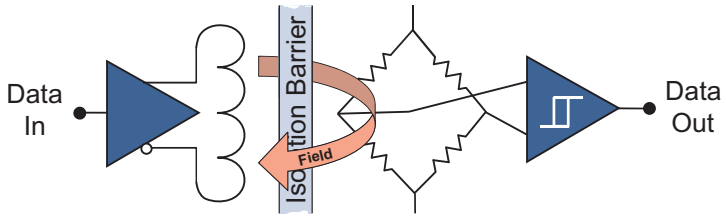


Figure 7. Isolator model signal path.

Isolator Signal Path

The GMR isolator signal path starts with a buffered input signal that is driven through an ultraminiature coil. This generates a small magnetic field that changes the electron spin polarization of GMR resistors, which are configured as a Wheatstone bridge. The change in spin polarization of the resistors creates a bridge voltage which drives an output comparator to construct an isolated version of the input signal.

Small Size, High Speed, and Low EMI

The coil, GMR, and circuitry are integrated to allow small packages. GMR is inherently high speed and low distortion, and unlike transformers, does not rely on energy transfer, so power is low and EMI emissions are minimal.

High Magnetic Immunity

GMR provides large signals which improve magnetic immunity, and the Wheatstone bridge configuration cancels ambient common-mode magnetic fields, further enhancing immunity to external magnetic fields.

Application Information

As Figure 3 shows, the IL41050TFD can provide isolation and level shifting between a five-volt CAN bus and a 3.3-volt microcontrollers:

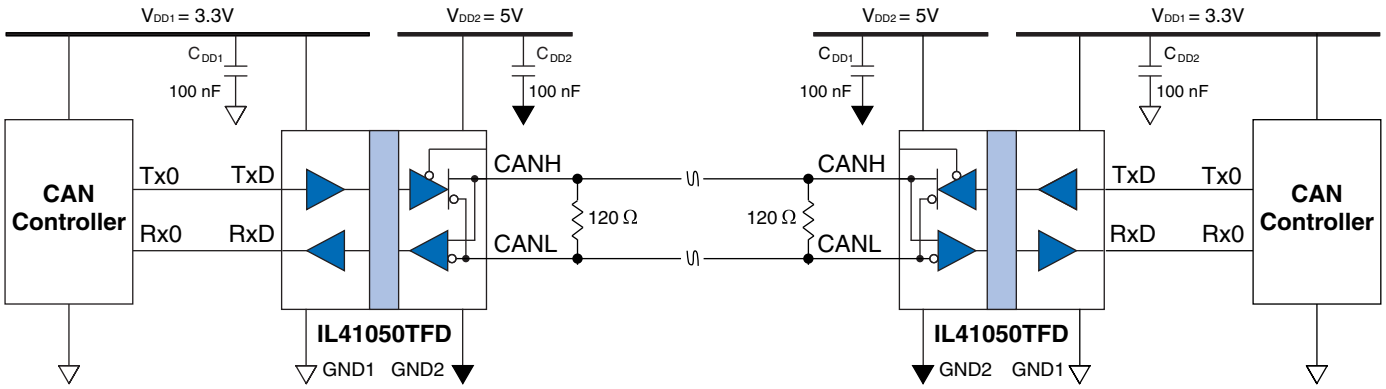


Figure 8. An isolated CAN network using two IL41050TFD's.

An inexpensive separate isolator can be added to the mode select (S) line to allow the bus to be disabled by the CAN controller without compromising isolation:

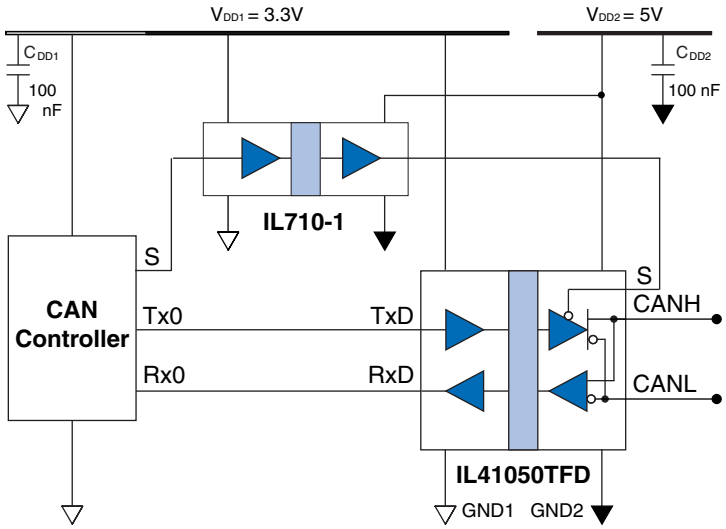


Figure 9. Isolated "S" circuit.

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

Flexible Data Rate

The IL41050TFD provides the speed and signal fidelity specifications needed for CAN flexible data rate (CAN FD) up to 5 Mbps.

Bus-Side Power Supply Pins

On the 0.3" SOIC version, both V_{DD2} power supply inputs (pins 11 and 16) must be connected to the bus-side power supply. On some parts the CAN I/O circuitry and bus-side isolation circuitry power are separated for testing purposes. The part may not operate without both pins powered, and operation without both pins powered can cause damage.

Power Supply Decoupling

V_{DD1} and V_{DD2} should be bypassed with 0.1 µF capacitors as close as possible to the V_{DD} pins.

Maintaining Creepage

Creepage distances are often critical in isolated circuits. In addition to meeting JEDEC standards, NVE isolator packages have unique creepage specifications. 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.

Input Configurations

The TxD input should not be left open as the state will be indeterminate. If connected to an open-drain or open collector output, a pull-up resistor (typically 16 kΩ) should be connected from the input to V_{DD1}.

Dominant Mode Time-out and Failsafe Receiver Functions

CAN bus latch up is prevented by an integrated Dominant mode timeout function. If the TxD pin is forced permanently low by hardware or software application failure, the time-out returns the RxD output to the high state no more than 10 ms after TxD is asserted dominant. The timer is triggered by a negative edge on TxD. If the duration of the low is longer than the internal timer value, the transmitter is disabled, driving the bus to the recessive state. The timer is reset by a positive edge on pin TxD.

If power is lost on Vdd2, the IL41050TFD asserts the RxD output high when the supply voltage falls below 3.8 V. RxD will return to normal operation when Vdd2 rises above approximately 4.2 V.

Programmable Power-Up

A unique non-volatile programmable power-up feature prevents unstable nodes. A state that needs to be present at node power up can be programmed at the last power down. For example if a CAN node is required to "pulse" dominant at power up, TxD can be sent low by the controller immediately prior to power down. When power is resumed, the node will immediately go dominant allowing self-check code in the microcontroller to verify node operation. If desired, the node can also power up silently by presetting the TxD line high at power down. At the next power on, the IL41050TFD will remain silent, awaiting a dominant state from the bus.

The microcontroller can check that the CAN node powered down correctly before applying power at the next "power on" request. If the node powered down as intended, RxD will be set high and stored in the IL41050TFD's non-volatile memory. The level stored in the RxD bit can be read before isolated node power is enabled, avoiding possible CAN bus disruption due to an unstable node.

Replacing Non-Isolated Transceivers

The IL41050TFD is designed to replace common non-isolated CAN transceivers such as the NXP TJF1051 with minimal circuit changes. Some notable differences:

- Some non-isolated CAN transceivers have internal TxD pull-up resistors, but the IL41050TFD TxD input should not be left open. If connected to an open-drain or open collector output, a pull-up resistor (typically 16 kΩ) should be connected from the input to V_{DD1}.

- Initialization behavior varies between CAN transceivers. To ensure the desired power-up state, the IL41050TFD should be initialized with a TxD pulse (low-to-high for recessive initialization), or shut down the transceiver in the desired power-up state (the "programmable power-up feature").

- Some non-isolated CAN transceivers have a V_{REF} output. Such a reference can be replaced with an external voltage divider if needed.

IsoRxD / IsoTxD Outputs

The IsoRxD and IsoTxD outputs are isolated versions of the RxD and TxD signals. These outputs are provided for troubleshooting on the QSOP and narrow-body versions, but normally no connections should be made to the pins.

The Isolation Advantage

Battery fire caused by over or under charging of individual lithium ion cells is a major concern in multi-cell high voltage electric and hybrid vehicle batteries. To combat this, each cell is monitored for current flow, cell voltage, and in some advanced batteries, magnetic susceptibility. The IL41050TFD allows seamless connection of the monitoring electronics of every cell to a common CAN bus by electrically isolating inputs

from outputs, effectively isolating each cell from all other cells. Cell status is then monitored via the CAN controller in the Battery Management System (BMS).

Another major advantage of isolation is the tremendous increase in noise immunity it affords the CAN node, even if the power source is a battery. Inductive drives and inverters can produce transient swings in excess of 20 kV/µs. The traditional, non-isolated CAN node provides some protection due to differential signaling and symmetrical driver/receiver pairs, but the IL41050TFD typically provides more than twice the dV/dt protection of a traditional CAN node.

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.

Electromagnetic Compatibility

The IL41050TFD is fully compliant with IEC 61000-6-1 and IEC 61000-6-2 standards for immunity, and IEC 61000-6-3, IEC 61000-6-4, CISPR, and FCC Class A standards for emissions.

Immunity to external magnetic fields is higher if the field direction is “end-to-end” (rather than to “pin-to-pin”) as shown in the diagram below:

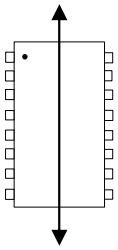
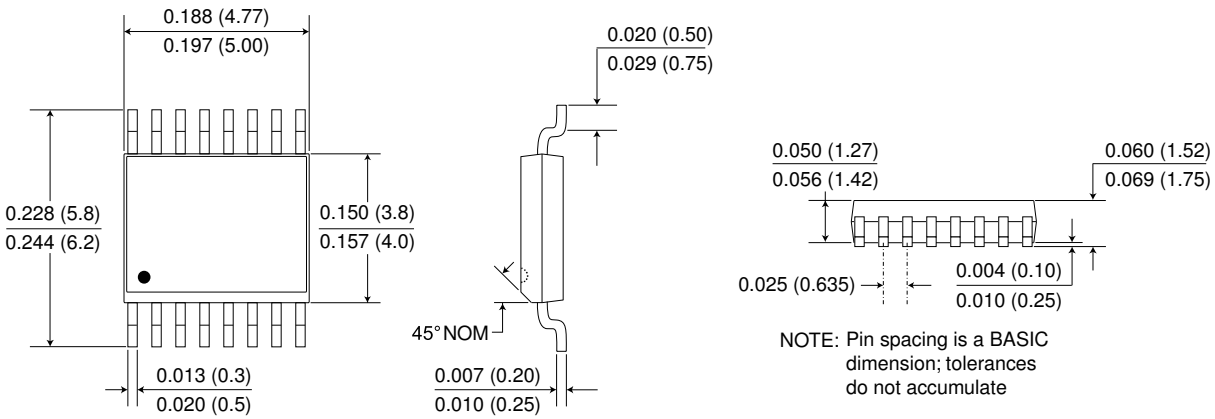


Figure 4. Orientation for high field immunity.

Package Drawings

Ultraminiature 16-pin QSOP Package (-1 suffix)

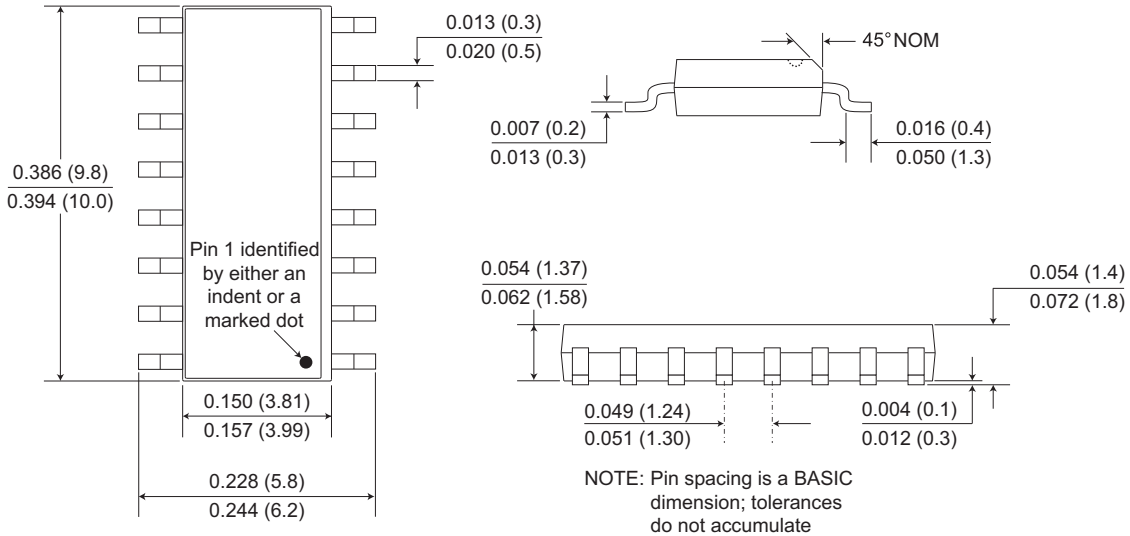
Dimensions in inches (mm); scale = approx. 5X



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

0.15" 16-pin SOIC Package (-3 suffix)

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

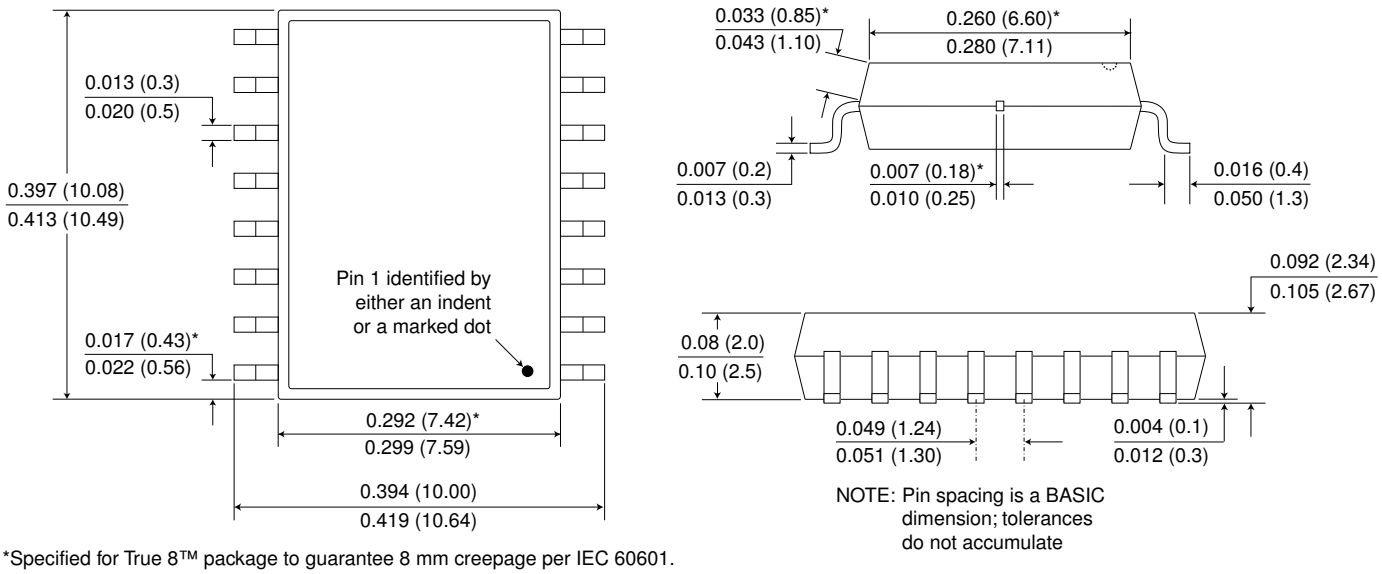


NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

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

0.3" 16-pin SOIC Package (no suffix)

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



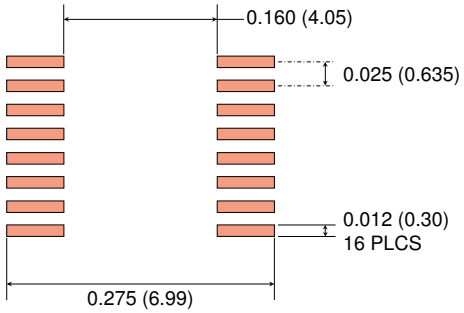
NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

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

Recommended Pad Layouts

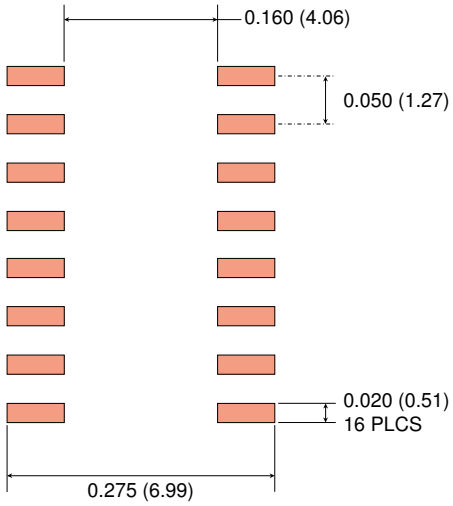
4 mm x 5 mm 16-pin QSOP Pad Layout

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



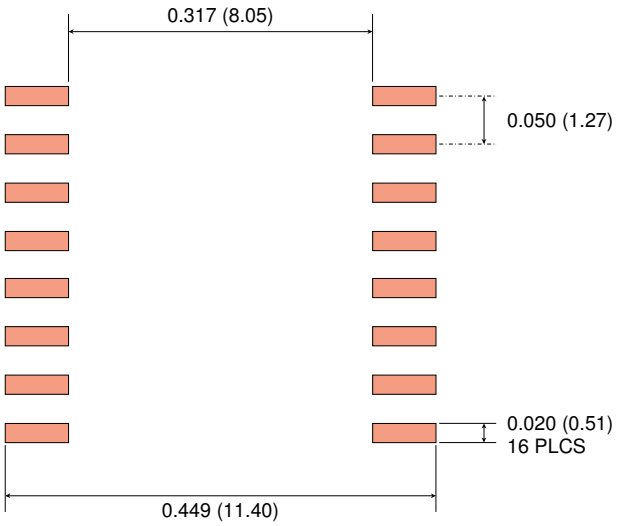
0.15" 16-pin SOIC Pad Layout

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



0.3" 16-pin SOIC Pad Layout

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



Ordering Information and Valid Part Numbers

IL 4 1050 T FD-3 E TR13

Bulk Packaging
Blank = Tube (50 pcs)

TR7 = 7" Tape and Reel
(800 pcs 0.15" SOIC or
1000 pcs QSOP)

TR13 = 13" Tape and Reel
(1500 pcs 0.3" SOIC,
3000 pcs 0.15" SOIC, or
5000 pcs QSOP)

Package
E = RoHS Compliant

Package Type
Blank = 0.3" SOIC
-3 = 0.15" SOIC
-1 = 0.15" QSOP

Part Subtype
FD = Flexible data rate (to 5 Mbps)

Temperature Range
T = Extended
(-55 °C to +125 °C)

Channel Configuration
1050 = CAN Transceiver

Base Part Number
4 = Isolated Transceiver

Product Family
IL = Isolators

Valid Part Numbers
IL41050TFDE
IL41050TFDETR13
IL41050TFD-3E
IL41050TFD-3E TR7
IL41050TFD-3E TR13
IL41050TFD-1E
IL41050TFD-1E TR7
IL41050TFD-1E TR13

RoHS COMPLIANT

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

Revision History

ISB-DS-001-IL41050TFD-RevC
October 2022

Changes

- Added CAN FD description (pp. 1 and 13).
- Upgraded VDE certification to VDE 0884-17 (p. 3).
- Increased Working Voltage ratings based on latest VDE testing (p. 3).
- Corrected wide-body pinout diagram (p. 5).
- Added GMR description (p. 10).
- Added typical performance graphs (p. 9).
- Added “S” input to detailed block diagram (p. 10).
- Added multiple nodes to application diagram (p. 12).
- Added isolated “S” application circuit (p. 12).
- Clarified replacement of V_{REF} function in nonisolated transceivers (p. 13).
- Corrected “Valid Part Numbers” list (p. 19).

ISB-DS-001-IL41050TFD-RevB
March 2020

Changes

- VDE certification and UL listing granted.
- Changed 0.3" SOIC Pin 11 to NC (p. 5).
- Updated thermal specifications (p. 8).
- Added description of GMR isolation (p. 9).

ISB-DS-001-IL41050TFD-RevA
August 2019

Changes

- Initial release.

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-IL41050TFD-C

October 2022