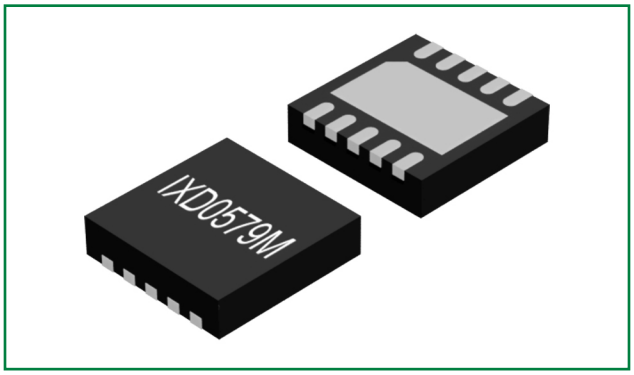
IXD0579M

100 V High-Side and Low-Side Gate Driver with Bootstrap Diode



Features

- Drives two N-channel MOSFETs in a half bridge configuration
- Integrated bootstrap diode
- Floating high-side driver potential at up to 100V in bootstrap operation
- 1.5A source/2.5A sink output current capability
- Undervoltage lockout for high- and low-side drivers
- Integrated cross-conduction protection
- 10 ns maximum propagation delay matching
- 60 ns typical propagation delay
- <1 µA ultra low standby current
- Logic inputs 3.3V compatible
- –40 °C to +125 °C ambiant temperature range
- Space saving 3 × 3 mm^2 TDFN-10 package

Applications

- Brushless DC (BLDC) Motor Drives
- Battery Powered Hand Tools
- DC/DC converters

Description

The IXD0579M gate driver is capable of driving two N-channel MOSFETs in a half-bridge configuration. An integrated diode provides the bootstrap configuration necessary to allow the floating high-side driver to operate up to 100V. Integration of the bootstrap diode along with its companion current limiting resistor simplify circuit and layout design, reduce PCB area demands, and reduce BOM count.

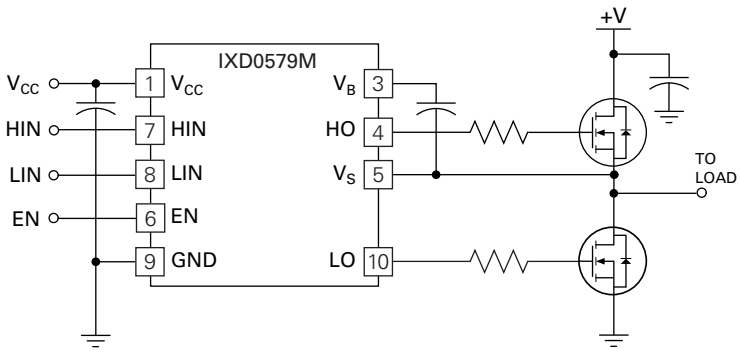
Two Undervoltage Lockout (UVLO) detectors are employed to ensure the affected low-side and high-side drivers are shut down any time their monitored voltage supply is less than their internally-set threshold. The IXD0579M has integrated cross-conduction protection logic, which prevents the high- and low- side outputs to turn on at the same time. This effectively protects the power MOSFETs from short circuit switching.

Fast and well-matched propagation delays, as provided by the IXD0579M, are crucial for the successful implementation of high frequency switching designs. To support the more compact PCB design, the IXD0579M is provided in a space saving TDFN-10 with exposed bottom pad, capable of operating over the extended temperature range of –40 °C to +125 °C.

Ordering Information

Part Number	Description
IXD0579MTR	TDFN-10 with exposed bottom side pad. In Tape and Reel: (3000/Reel)

IXD0579M Typical Application



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IXD0579M_R02

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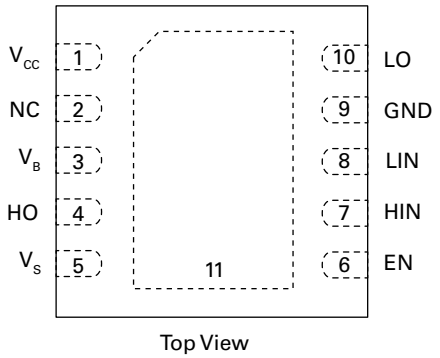
1 Specifications

1.1 Package Pinout

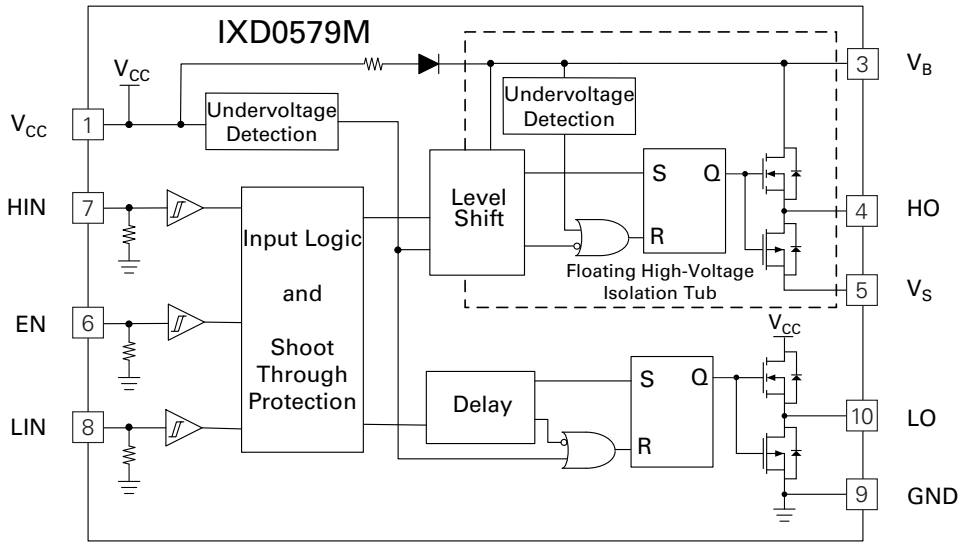


Top View

1.2 Pin Description

Pin	Name	Type	Description
1	V_{CC}	Power	Low-side and logic supply voltage
2	NC	—	No Connection
3	V_B	Power	High-side floating supply positive rail
4	HO	Output	High-side gate driver output
5	V_S	Power	High-side floating supply offset voltage
6	EN	Logic Input	Enable, a logic low turns gate drivers off
7	HIN	Logic Input	Input for high-side gate driver, in phase with HO
8	LIN	Logic Input	Input for low-side gate driver, in phase with LO
9	GND	Power	Low-side and logic return
10	LO	Output	Low-side gate driver output
11	EP	Thermal	Bottom side exposed thermal pad. Connect to Pin 9 (GND) on PCB. Exposed pad is not intended for carrying current.

Figure 1 Functional Block Diagram



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1.3 Absolute Maximum Ratings

Absolute Maximum Ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at conditions beyond those indicated in the operational sections of this data sheet is not implied.

Unless otherwise specified all voltages are with respect to GND, electrical ratings are over the operational ambient temperature range.

Parameter	Symbol	Value		Units
		Minimum	Maximum	
High-side floating supply voltage	V_B	0.3	120	V
High-side floating supply offset voltage	V_S	V_B – 20	V_B + 0.3	V
High-side floating output voltage	V_{HO}	V_S – 0.3	V_B + 0.3	V
Offset supply voltage transient	dV_S / dt	—	50	V/ns
Logic and low-side fixed supply voltage	V_{CC}	0.3	+20	V
Low-side output voltage	V_{LO}	–0.3	V_{CC} + 0.3	V
Logic input voltage (HIN, LIN, and EN)	V_{IN}	–0.3	V_{CC} + 0.3	V
Package power dissipation @ T_A = 25 °C [1]	P_D	—	2	W
Junction operating temperature	T_J	–40	+150	°C
Storage Temperature	T_{STG}	–55	+150	°C

[1] *When mounted on a standard JEDEC 2-layer FR-4 board.*

1.4 Recommended Operating Conditions

Parameter	Symbol	Value		Units
		Minimum	Maximum	
High-side floating supply voltage	V_B	V_S + 5.8	V_S + 18	V
High-side floating supply offset voltage	V_S	–5	+100	V
High-side floating output voltage	V_{HO}	V_S	V_B	V
Logic and low-side fixed supply voltage	V_{CC}	6.5	18	V
Low-side output voltage	V_{LO}	0	V_{CC}	V
Logic input voltage (HIN, LIN and EN)	V_{IN}	0	5	V
Ambient temperature	T_A	–40	+125	°C

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1.5 DC Electrical Characteristics

Typical values are characteristics of the device at T_A = 25°C and are the result of engineering evaluations. They are provided for informational purposes only and are not part of the manufacturing testing requirements.

V_{BIAS} (V_{CC}, V_{BS}) = 12V, GND = V_S = 0V, T_A = 25°C, unless otherwise specified. V_{BS} = Bootstrap Voltage

The V_{IN} and I_{IN} parameters are applicable to the logic input pins: HIN, LIN, and EN. The V_O and I_O parameters are applicable to the respective output pins: HO and LO are referenced to GND.

1.5.1 Power Supplies

Parameter	Conditions	Symbol	Value			Units
			Minimum	Typical	Maximum	
Offset supply leakage current	V_B = V_S = 100V	I_{LK}	—	0.1	1	µA
V_{CC} shutdown supply current	V_{IN} = 0V or 5V, V_{EN} = 0V	I_{CCSD}	—	0	1	
V_{CC} quiescent supply current	V_{IN} = 0V or 5V	I_{CCQ}	—	80	150	
V_{CC} operating supply current	fs = 500 kHz, C_L = 1 nF	I_{CCOP}	—	8.2	—	mA
V_{BS} quiescent supply current	V_{IN} = 0V or 5V	I_{BSQ}	—	50	100	µA
V_{BS} operating supply current	fs = 500 kHz, C_L = 1 nF	I_{BSOP}	—	8	—	mA
V_{BS} supply under-voltage positive going threshold	—	V_{BSUV+}	3.8	4.9	5.8	V
V_{BS} supply under-voltage negative going threshold	—	$V_{BSUV–}$	3.3	4.5	5.3	
V_{CC} supply under-voltage positive going threshold	—	V_{CCUV+}	4	5.2	6	
V_{CC} supply under-voltage negative going threshold	—	$V_{CCUV–}$	3.5	4.7	5.5	

1.5.2 Inputs

Parameter	Conditions	Symbol	Value			Units
			Minimum	Typical	Maximum	
Logic "1" input voltage, HIN and LIN	—	V_{IH}	2.5	—	—	V
Logic "0" input voltage, HIN and LIN	—	V_{IL}	—	—	0.8	
Enable logic "1" input voltage, EN	—	V_{EIH}	1.6	—	—	
Enable logic "0" input voltage, EN	—	V_{EIL}	—	—	0.5	
Input voltage hysteresis	—	V_{INHYS}	—	0.7	—	
Logic "1" input bias current	V_{IN} = 5V	I_{IN+}	—	—	50	µA
Logic "0" input bias current	V_{IN} = 0V	$I_{IN–}$	—	—	5	

1.5.3 Outputs

Parameter	Conditions	Symbol	Value			Units
			Minimum	Typical	Maximum	
High level output voltage, V_{BIAS} – V_O	I_{O+} = 10 mA	V_{OH}	—	0.05	0.3	V
Low level output voltage, V_O	$I_{O–}$ = 10 mA	V_{OL}	—	0.02	0.1	
Output high short circuit pulsed current	V_O = 0V, PW ≤ 10 µs	I_{O+}	1	1.5	—	A
Output low short circuit pulsed current	V_O = 12V, PW ≤ 10 µs	$I_{O–}$	1.5	2.5	—	

1.5.4 Bootstrap Diode

Parameter	Conditions	Symbol	Value			Units
			Minimum	Typical	Maximum	
Forward voltage of boostrap diode	I_F = 100 µA	V_{F1}	—	0.6	0.75	V
Forward voltage of boostrap diode	I_F = 100 mA	V_{F2}	—	1.4	1.75	

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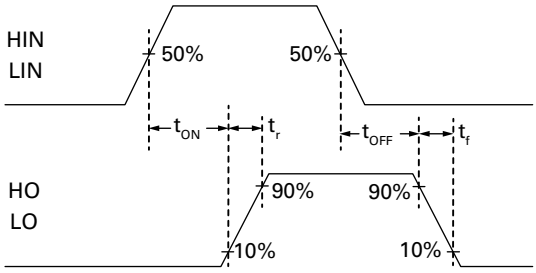
1.6 AC Electrical Characteristics

$V_{CC} = V_{BS} = 12V$, GND = $V_S = 0V$, $C_L = 1\,nF$, $T_A = 25\,°C$, unless otherwise specified.

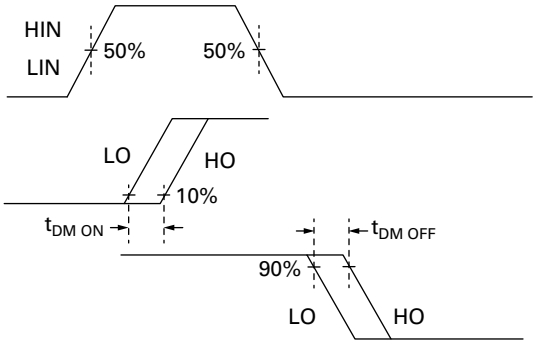
Parameter	Conditions	Symbol	Value			Units
			Minimum	Typical	Maximum	
Turn-on propagation delay	—	t_{on}	—	65	—	ns
Turn-off propagation delay	$V_S = 100V$	t_{off}	—	58	—	
Delay matching, HS and LS turn-on	—	t_{DM}	—	—	10	
Turn-on rise time	—	t_r	—	19	—	
Turn-off fall time	—	t_f	—	15	—	

1.7 Timing Waveforms

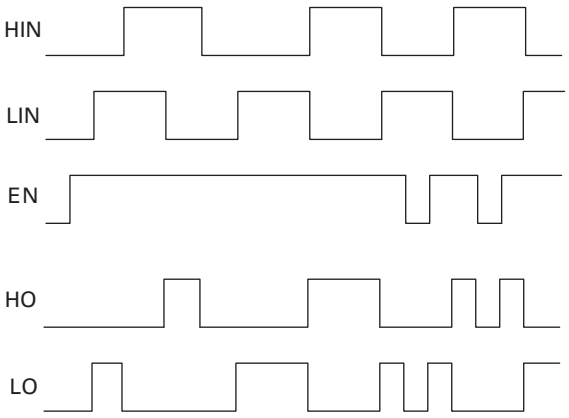
1.7.1 Switching Time Waveform Definitions



1.7.2 Delay Matching Waveform Definitions



1.7.3 Input / Output Timing Diagram



1.8 Thermal Characteristics

Parameter	Symbol	Rating	Units
Thermal Impedance, Junction to Ambient	θ_{JA}	62	K/W
Thermal Impedance, Junction to Case	θ_{JC}	42	K/W

Note: When mounted on a standard JEDEC 2-layer FR-4 board.

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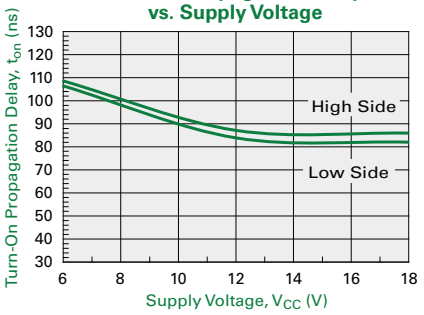
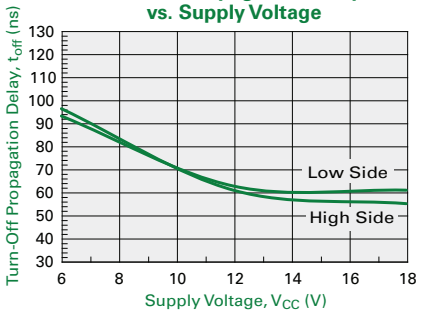
2 Performance Data

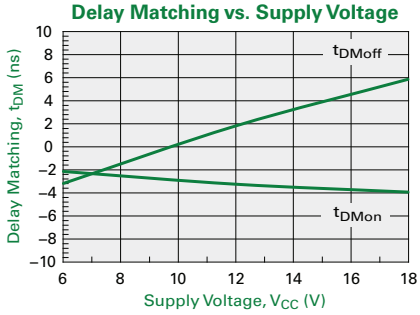
Turn-On Propagation Delay vs. Supply Voltage



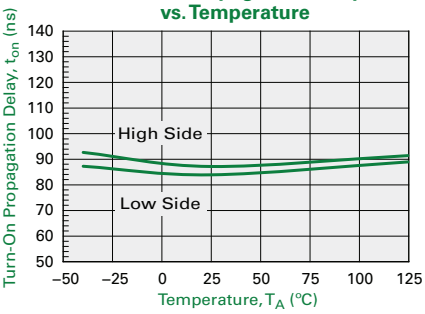
Turn-Off Propagation Delay vs. Supply Voltage



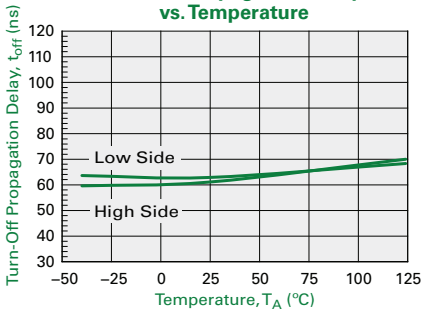
Delay Matching vs. Supply Voltage



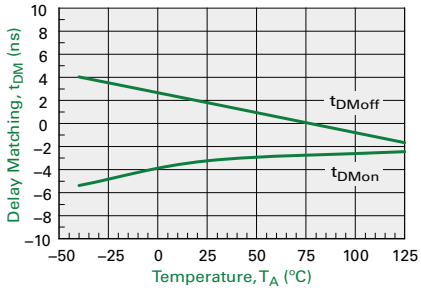
Turn-On Propagation Delay vs. Temperature



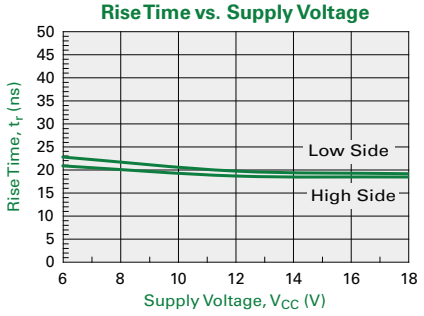
Turn-Off Propagation Delay vs. Temperature



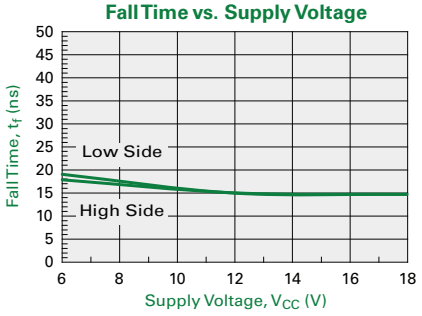
Delay Matching vs. Temperature



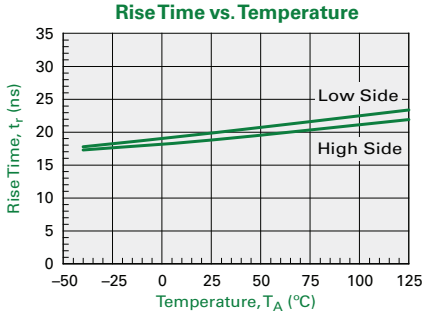
Rise Time vs. Supply Voltage



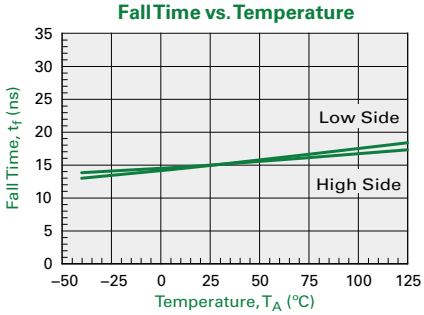
Fall Time vs. Supply Voltage



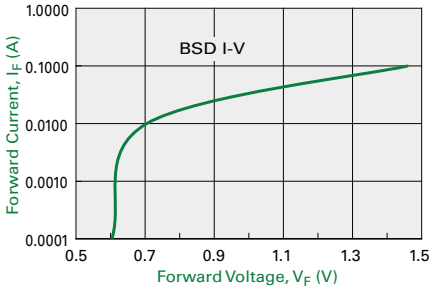
Rise Time vs. Temperature



Fall Time vs. Temperature



Integrated Diode Forward Current vs. Forward Voltage



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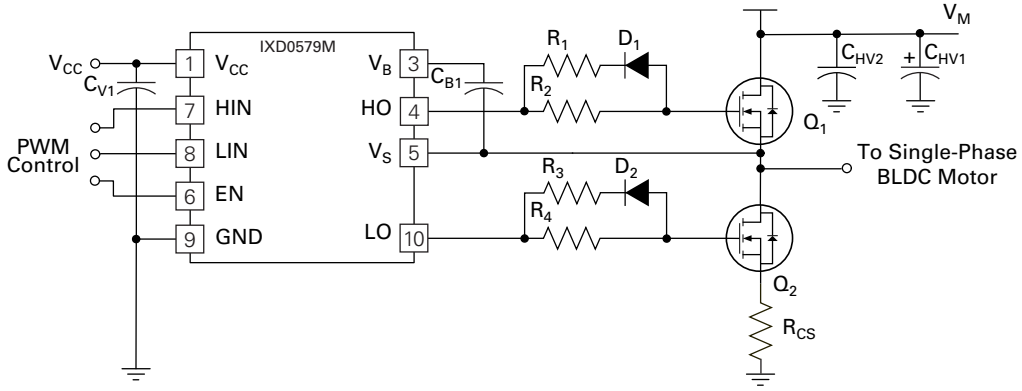
3 Application Information

Figure 2 Single phase (of three) for BLDC motor drive application using the IXD0579M



- R_2 and R_4 values are typically between 10 Ω and 50 Ω, optimal value is selected based on MOSFET gate capacitance and drive source current of gate driver. Gate resistor values are increased to decrease system noise, minimize ringing, and hence lower EMI.
- R_1 and R_3 values are typically between 5 Ω and 20 Ω, optimal value is selected based on MOSFET gate capacitance and drive sink current of gate driver. Also, sink current gate resistance values are increased to decrease system noise, minimize ringing, and hence lower EMI.
- C_{V1} is the decoupling capacitor for V_{CC} and is typically between 0.1 µF and 2.2 µF. Also, C_{B1} is a decoupling capacitor for the high-side power supply voltage (V_{BS}). It provides a low impedance path to source high peak currents to charge the high-side MOSFET. Typical value range from 0.1 uF to 2.2 uF.
- It is recommended that the input pulse (to HIN and LIN) should have an amplitude of 2.5V minimum (for V_{CC} = 12V) with a minimum pulse width of 140 ns.

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4 Manufacturing Information

4.1 Moisture Sensitivity

All plastic encapsulated semiconductor packages are susceptible to moisture ingression. Littelfuse classifies its plastic encapsulated devices for moisture sensitivity according to the latest version of the joint industry standard, **IPC/JEDEC J-STD-020**, in force at the time of product evaluation. We test all of our products to the maximum conditions set forth in the standard, and guarantee proper operation of our devices when handled according to the limitations and information in that standard as well as to any limitations set forth in the information or standards referenced below.

Failure to adhere to the warnings or limitations as established by the listed specifications could result in reduced product performance, reduction of operable life, and/or reduction of overall reliability.

This product carries a Moisture Sensitivity Level (MSL) classification as shown below, and should be handled according to the requirements of the latest version of the joint industry standard **IPC/JEDEC J-STD-033**.

Device	Moisture Sensitivity Level (MSL) Classification
IXD0579M	MSL 1

4.2 ESD Sensitivity

This product is ESD Sensitive, and should be handled according to the industry standard **JESD-625**.

4.3 Soldering Profile

Provided in the table below is the **IPC/JEDEC J-STD-020** Classification Temperature (T_C) and the maximum dwell time (T_C – 5 °C). The Classification Temperature sets the Maximum Body Temperature allowed for these devices during reflow soldering processes.

Device	Classification Temperature (T_C)	Dwell Time (t_P)	Maximum Reflow Cycles
IXD0579M	260 °C	30 seconds	3

4.4 Board Wash

Littelfuse recommends the use of no-clean flux formulations. Board washing to reduce, or remove flux residue following the solder reflow process is acceptable, provided proper precautions are taken to prevent damage to the device. These precautions include, but are not limited to: Using a low pressure wash and providing a follow-up bake cycle sufficient to remove any moisture trapped within the device, due to the washing process. Due to the variability of the wash parameters used to clean the board, determination of the bake temperature and duration necessary to remove the moisture trapped within the package is the responsibility of the user (assembler). Cleaning, or drying methods that employ ultrasonic energy may damage the device and should not be used. Additionally, the device must not be exposed to halide flux or solvents.

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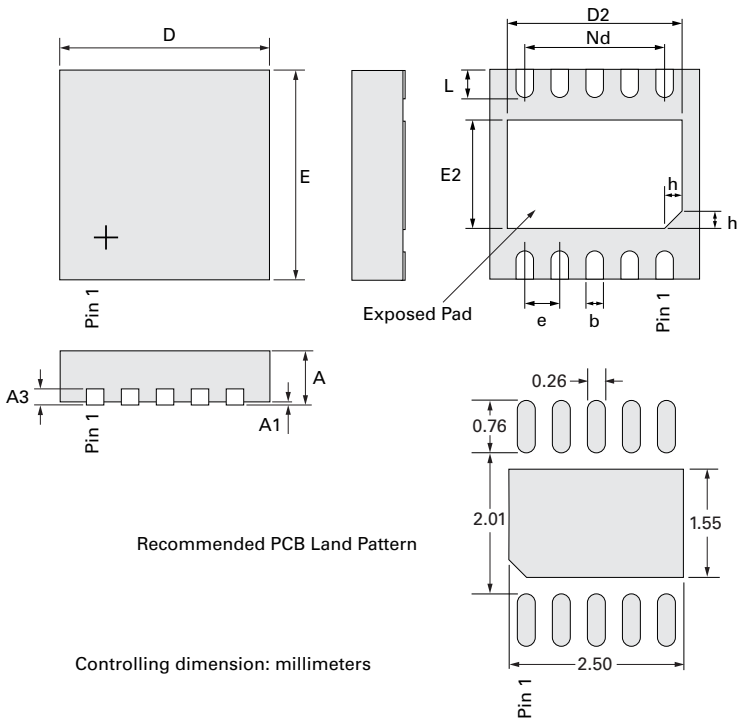
4.5 Mechanical Dimensions

4.5.1 IXD0579M TDFN-10 Package

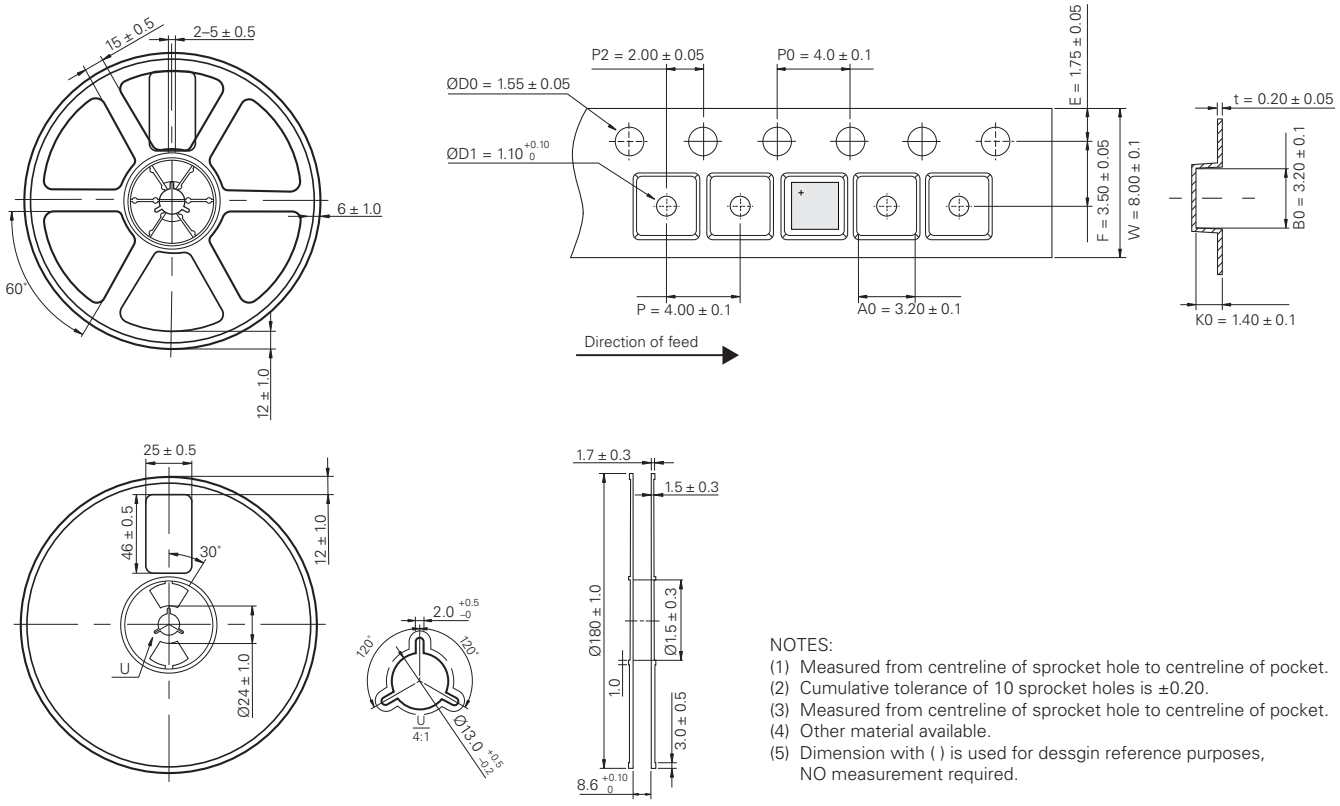


Symbol	MIN	NOM	MAX
	mm		
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
A3	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
e	0.50 BSC		
Nd	2.00 BSC		
E	2.90	3.00	3.10
E2	1.45	1.55	1.65
L	0.30	0.40	0.50
h	0.20	0.25	0.30

Recommended PCB Land Pattern

Controlling dimension: millimeters

4.5.2 IXD0579M TDFN-10 Package Tape and Reel



NOTES:
(1) Measured from centreline of sprocket hole to centreline of pocket.
(2) Cumulative tolerance of 10 sprocket holes is ±0.20.
(3) Measured from centreline of sprocket hole to centreline of pocket.
(4) Other material available.
(5) Dimension with ( ) is used for dessgin reference purposes, NO measurement required.

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