TF Semiconductor Solutions

TF0579U

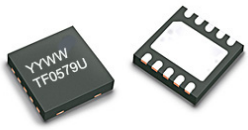
100V High Frequency High-Side and Low-Side Gate Driver with Integrated BSD

Features

- **Drives two N-channel MOSFETs in a half bridge configuration**
- **Integrated bootstrap diode (BSD) included**
- **Floating high-side driver in bootstrap operation to 100V**
- **1.5A source / 2.5A sink output current capability**
- **Undervoltage lockout for high and low side drivers**
- **Delay matching a maximum of 10ns**
- **Propagation delay a typical of 60ns**
- **Ultra low standby current (<1μA)**
- **Logic input (HIN, LIN, and EN) 3.3V capability**
- **Extended temperature range: -40°C to +125°C**
- **Space saving TDFN-10 3x3mm package**

Applications

- BLDC Motor Drivers
- Battery Powered Hand Tools
- DC/DC converters



TDFN-10

Description

The TF0579U is a high frequency gate driver capable of driving N-channel MOSFETs in a half bridge configuration. The floating high-side driver can switch to 100V in a bootstrap configuration.

The TF0579U contains an integrated bootstrap diode to greatly ease design and reduce the BOM.

The TF0579U logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with MCUs. UVLO for high side and low side will protect MOSFET with loss of supply. Also to protect MOSFETs, cross conduction prevention logic prevents the HO and LO to be on at the same time.

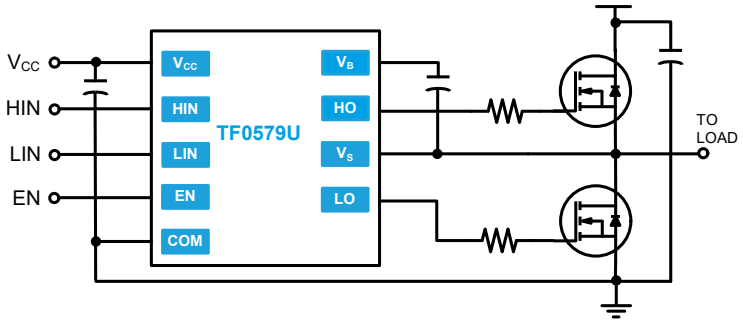
Fast and well matched propagation delays allow a higher switching frequency, enabling a smaller, more compact power switching design using smaller associated components. The TF0579U comes in a space-saving TDFN-10 package and operates over an extended -40 °C to +125 °C temperature range.

Ordering Information

Year Year Week Week

PART NUMBER	PACKAGE	PACK / Qty	MARK
TF0579U-NHS	TDFN-10	Tube / 120	YYWW TF0579U
TF0579U-NHP	TDFN-10	T&R / 3,000	

Typical Application



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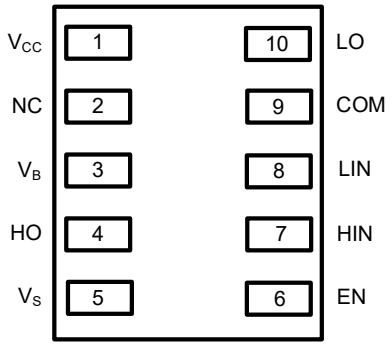
Pin Diagrams

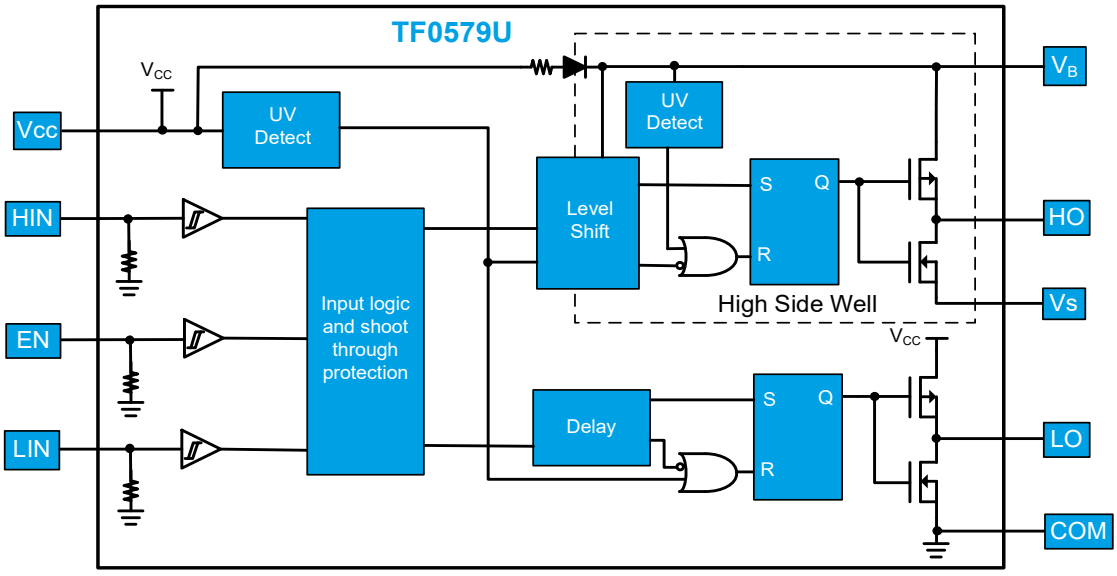


Top View

Pin Descriptions

PIN NAME	PIN NUMBER	PIN DESCRIPTION
V_{CC}	1	Low-side and logic fixed supply
NC	2	No Connect
V_B	3	High-side floating supply
HO	4	High-side gate driver output
V_S	5	High-side floating supply return
EN	6	Logic input enable, a logic low turns off gate drivers
HIN	7	Logic input for high-side gate driver, in phase with HO
LIN	8	Logic input for low-side gate driver, in phase with LO
COM	9	Low-side and logic return
LO	10	Low-side gate drive output
COM	PAD	Low-side and logic return

Functional Block Diagram



Absolute Maximum Ratings *(NOTE1)*

V_B - High side floating positive supply voltage.....0.3V to 110V
V_S - High side floating negative supply voltage..V_B-20V to V_B+0.3V
V_{HO} - High side floating output voltage.....V_S-0.3V to V_B+0.3V
dV_S/dt - Offset supply voltage transient.....50 V/ns

V_{CC} - Logic and Low-side fixed supply voltage.....-0.3V to +20V
V_{LO} - Low-side output voltage.....-0.3V to V_{CC} +0.3V
V_{IN} - Logic input voltage (HIN, LIN, and EN).....-0.3V to V_{CC} +0.3V

NOTE1 *Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

P_D - Package power dissipation at T_A = 25 °C
TDFN-10.....0.4W

TDFN-10 Thermal Resistance ***(NOTE2)***
θ_{JA}.....64°C/W
θ_{JC}..... 42°C/W

T_J - Junction operating temperature.....-40°C to +150°C
T_L - Lead Temperature (soldering, 10 seconds).....+300°C
T_{stg} - Storage temperature .....-55°C to 150°C

NOTE2 *When mounted on a standard JEDEC 2-layer FR-4 board.*

Recommended Operating Conditions

Symbol	Parameter	MIN	MAX	Unit
V_B	High side floating supply	V_S + 5.8	V_S + 18	V
V_S	High side floating supply offset voltage	***NOTE3***	100	V
V_{HO}	High side floating output voltage	V_S	V_B	V
V_{CC}	Logic and Low side fixed supply voltage	6.5	18	V
V_{LO}	Low side output voltage	0	V_{CC}	V
V_{IN}	Logic input voltage (HIN, LIN and EN)	0	5	V
T_A	Ambient temperature	-40	125	°C

NOTE3 *Logic operational for VS of -5V to +100V.*

DC Electrical Characteristics *(NOTE4)*

V_{CC} = V_{BS} = 12V, COM=V_S=0V, T_A = 25 °C , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
V_{IH}	Logic "1" input voltage	HIN and LIN, ***NOTE5***	2.4			V
V_{IL}	Logic "0" input voltage				0.8	
V_{EIH}	Enable logic "1" input voltage	EN	1.5			
V_{EIL}	Enable logic "0" input voltage				0.5	
V_{INHYS}	Input voltage hysteresis			0.7		
V_{OH}	High level output voltage, V_{BIAS} - V_O	I_{O+} = 10mA		0.05	0.3	
V_{OL}	Low level output voltage, V_O	I_{O-} = 10mA		0.02	0.1	
I_{LK}	Offset supply leakage current	VB = VS = 100V		0.1	1	µA
I_{CCSD}	V_{CC} shutdown supply current	V_{IN} = 0V or 5V, V_{EN} = 0V		0	1	
I_{CCQ}	V_{CC} quiescent supply current	V_{IN} = 0V or 5V		80	150	
I_{CCOP}	V_{CC} operating supply current	fs = 500kHz, C_L = 1nF		8.2		mA
I_{BSQ}	V_{BS} quiescent supply current	V_{IN} = 0V or 5V		50	100	µA
I_{BSOP}	V_{BS} operating supply current	fs = 500kHz, C_L = 1nF		8.0		mA
I_{IN+}	Logic "1" input bias current	V_{IN} = 5V			50	µA
I_{IN-}	Logic "0" input bias current	V_{IN} = 0V			5	
V_{BSUV+}	V_{BS} supply under-voltage positive going threshold		3.8	4.9	5.8	V
V_{BSUV-}	V_{BS} supply under-voltage negative going threshold		3.3	4.5	5.3	
V_{CCUV+}	V_{CC} supply under-voltage positive going threshold		4.0	5.2	6.0	
V_{CCUV-}	V_{CC} supply under-voltage negative going threshold		3.5	4.7	5.5	
I_{O+}	Output high short circuit pulsed current	V_O = 0V, PW ≤ 10 µs	1.0	1.5		A
I_{O-}	Output low short circuit pulsed current	V_O = 12V, PW ≤ 10 µs	1.5	2.5		
V_{F1}	Forward voltage of boostrap diode	I_F = 100µA		0.6	0.75	V
V_{F2}	Forward voltage of boostrap diode	I_F = 100mA		1.4	1.75	

NOTE4 *The V_{IN} and I_{IN} parameters are applicable to the logic input pins: HIN, LIN, and EN. The V_0 and I_0 parameters are applicable to the respective output pins: HO and LO*

NOTE5 *For optimal operation, it is recommended that the input pulse (to HIN, LIN, and EN) should have an amplitude of 2.4V minimum with a pulse width of 140ns minimum.*

AC Electrical Characteristics

V_{CC} = V_{BS} = 12V, COM=V_S=0V, C_L = 1000pF, T_A = 25 °C , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
t_{on}	Turn-on propogation delay			65		ns
t_{off}	Turn-off propogation delay	V_S = 100V		58		
t_{DM}	Delay matching, HS & LS turn-on			1	10	
t_r	Turn-on rise time			27		
t_f	Turn-off fall time			20		

Timing Waveforms

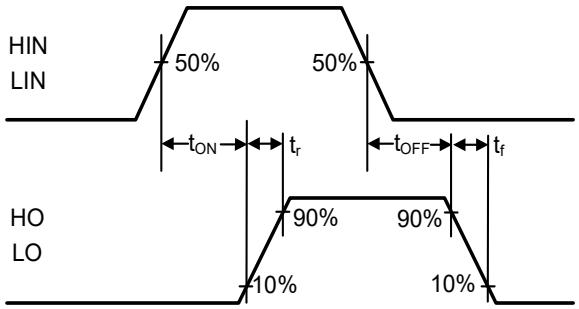


Figure 1. Switching Time Waveform Definitions

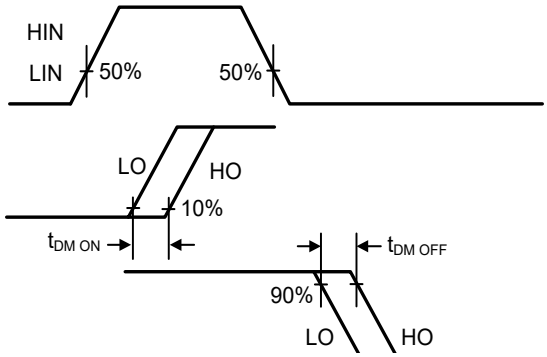


Figure 2. Delay Matching Waveform Definitions

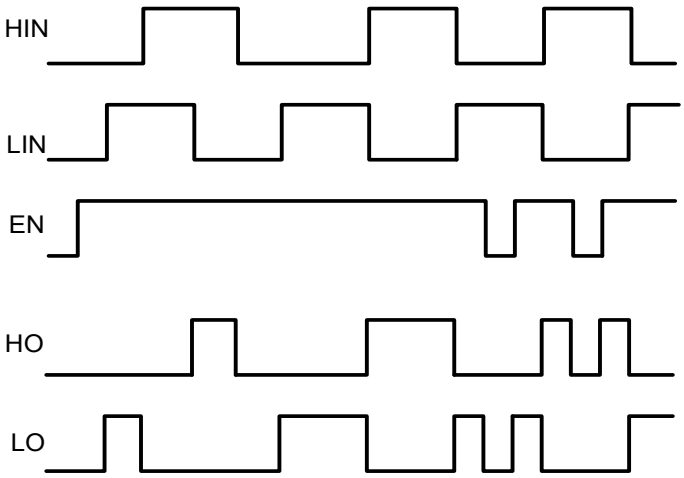


Figure 3. Input / Output Timing Diagram

Typical Characteristics

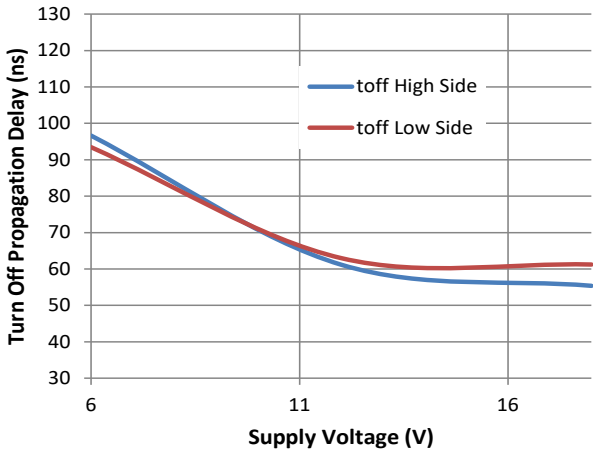


Figure 1. Turn-off Propagation Delay vs. Supply Voltage

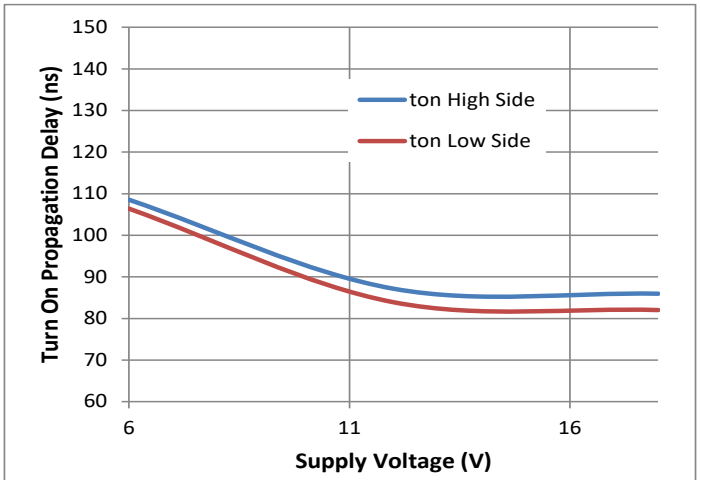


Figure 2. Turn-on Propagation Delay vs. Supply Voltage

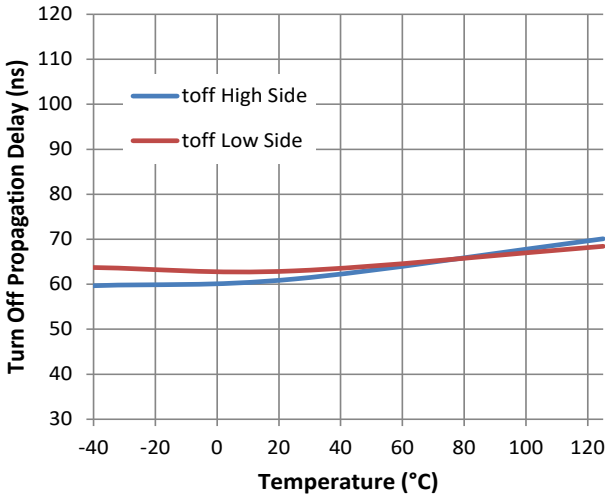


Figure 3. Turn-off Propagation Delay vs. Temperature

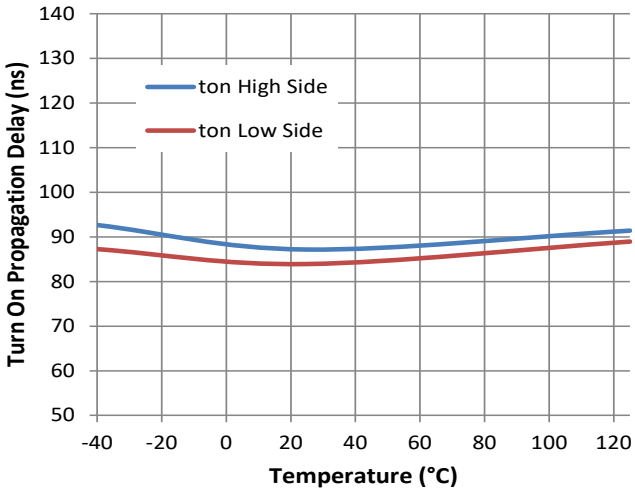


Figure 4. Turn-on Propagation Delay vs. Temperature

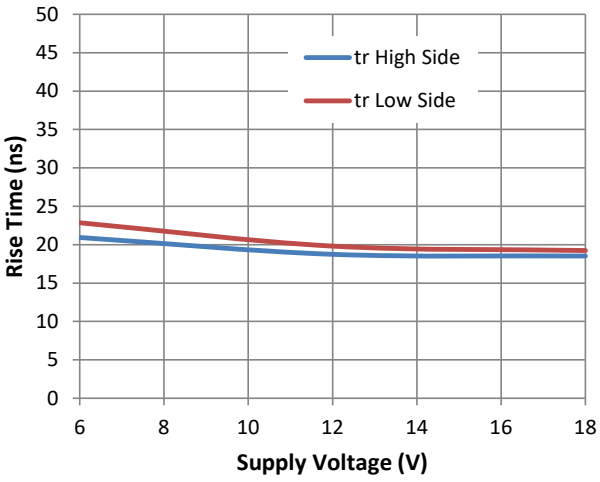


Figure 5. Rise Time vs. Supply Voltage

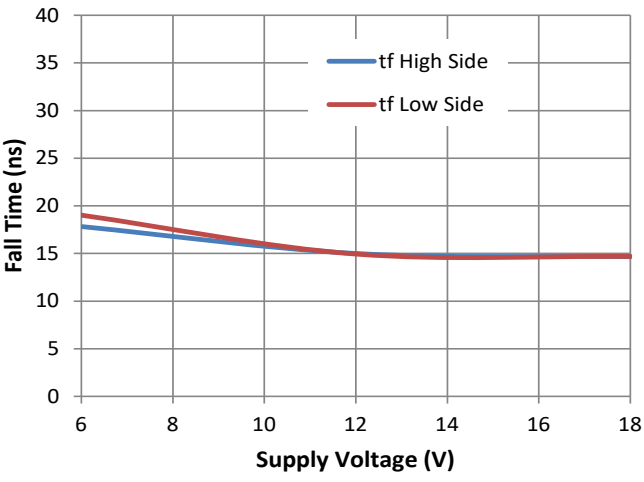


Figure 6. Fall Time vs. Supply Voltage

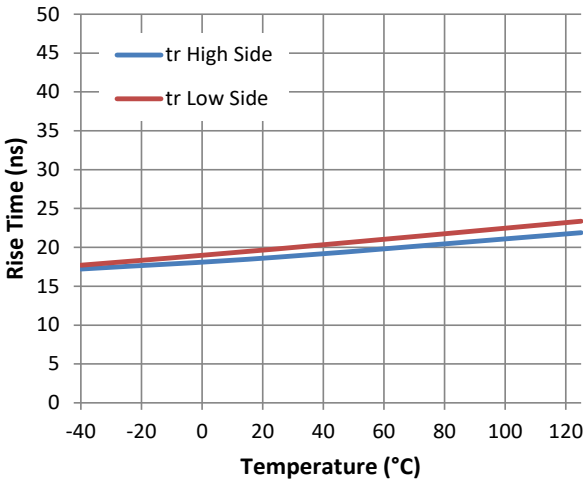


Figure 7. Rise Time vs. Temperature

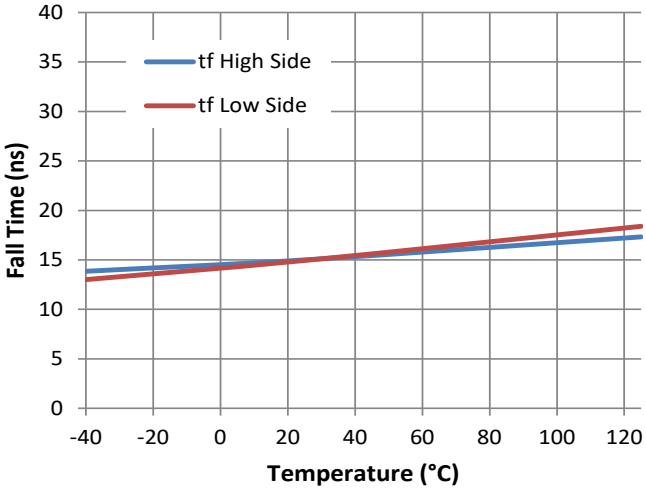


Figure 8. Fall Time vs. Temperature

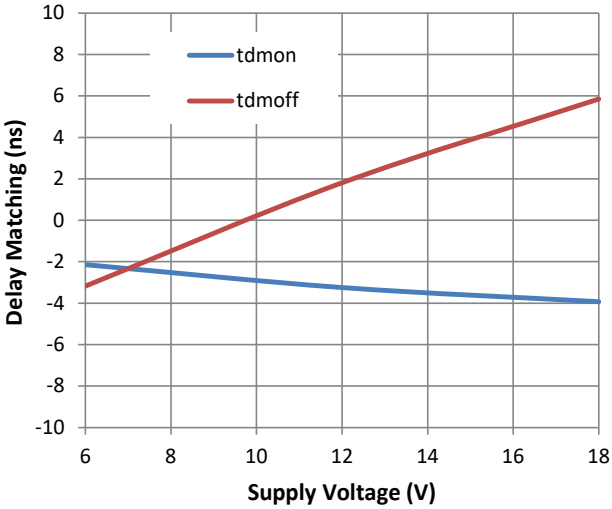


Figure 9. Delay Matching vs. Supply Voltage

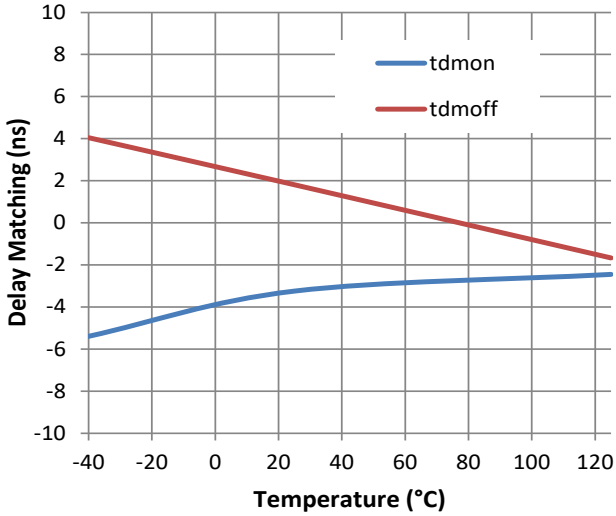


Figure 10. Delay Matching vs. Temperature

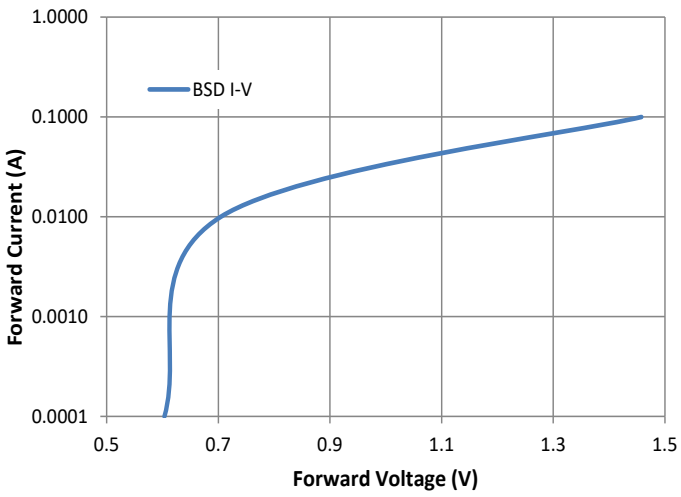
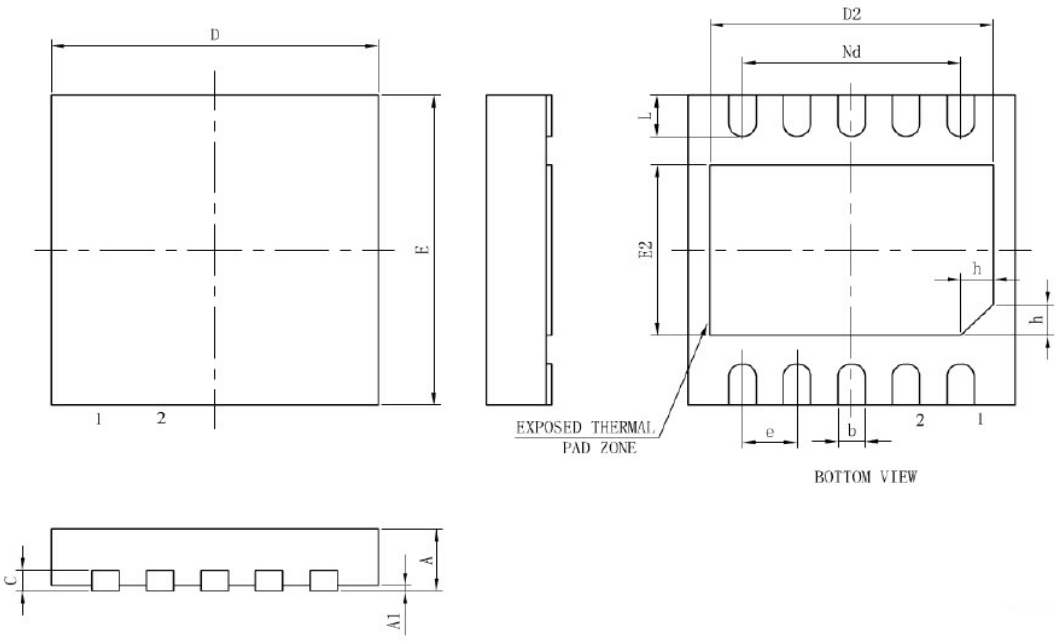


Figure 11 . Bootstrap Diode I-V Characteristics

Package Dimensions (TDFN-10)

Please contact support@tfsemi.com for package availability.



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
e	0.50BSC		
Nd	2.00BSC		
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

Revision History

Rev.	Change	Owner	Date
1.0	First release	Keith Spaulding	4/14/2020
1.1	Add Enable logic input threshold specification	Keith Spaulding	6/10/2020
1.2	Electrical specs changed to match early production data, and some graphs added.	Keith Spaulding	8/1/2020

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