

## Bi-Directional N-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY		
V <sub>S1S2</sub> (V)	R <sub>S1S2(on)</sub> (Ω)	I <sub>S1S2</sub> (A)
20	0.024 at V <sub>GS</sub> = 4.5 V	7
	0.026 at V <sub>GS</sub> = 3.7 V	6.8
	0.034 at V <sub>GS</sub> = 2.5 V	5.0
	0.040 at V <sub>GS</sub> = 1.8 V	5.5

### FEATURES

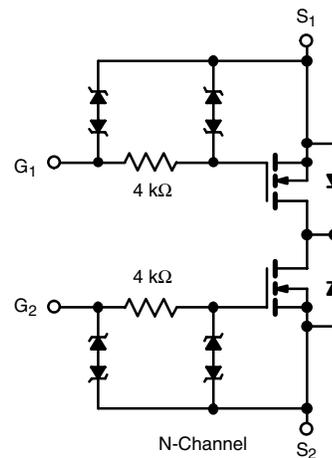
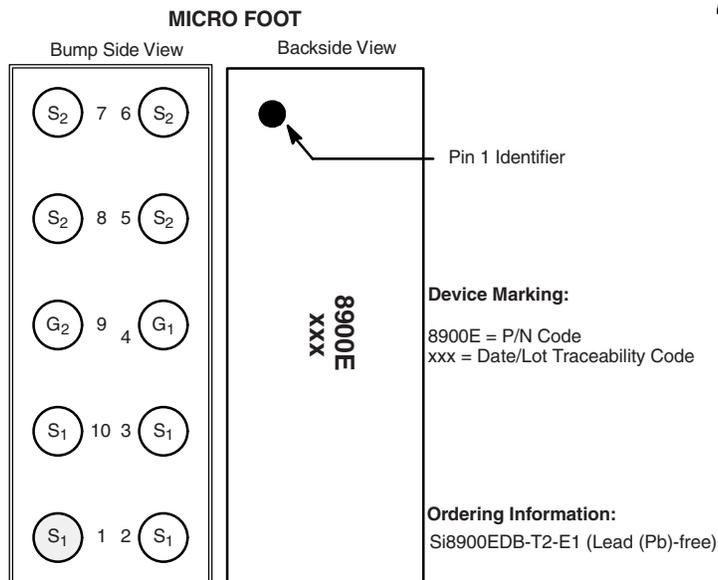
- TrenchFET® Power MOSFET
- Ultra-Low R<sub>SS(on)</sub>
- ESD Protected: 4000 V
- MICRO FOOT® Chipscale Packaging  
Reduces Footprint Area Profile (0.62 mm)  
and On-Resistance Per Footprint Area



**RoHS**  
COMPLIANT

### APPLICATIONS

- Battery Protection Circuit  
- 1-2 Cell Li+/LiP Battery Pack for Portable Devices



ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted					
Parameter	Symbol	5 s	Steady State	Unit	
Source1- Source2 Voltage	V <sub>S1S2</sub>	20		V	
Gate-Source Voltage	V <sub>GS</sub>	± 12			
Continuous Source1- Source2 Current (T <sub>J</sub> = 150 °C) <sup>a</sup>	I <sub>S1S2</sub>	T <sub>A</sub> = 25 °C	7	5.4	A
		T <sub>A</sub> = 85 °C	5.1	3.9	
Pulsed Source1- Source2 Current	I <sub>SM</sub>	50			
Maximum Power Dissipation <sup>a</sup>	P <sub>D</sub>	T <sub>A</sub> = 25 °C	1.8	1	W
		T <sub>A</sub> = 85 °C	0.9	0.5	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C	
Package Reflow Conditions <sup>c</sup>	IR/Convection	260			

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>a</sup>	R <sub>thJA</sub>	t ≤ 5 s	55	70	°C/W
		Steady State	95	120	
Maximum Junction-to-Foot <sup>b</sup>	R <sub>thJF</sub>	12	15		

Notes:

- Surface Mounted on 1" x 1" FR4 board.
- The foot is defined as the top surface of the package.
- Refer to IPC/JEDEC (J-STD-020C), no manual or hand soldering.

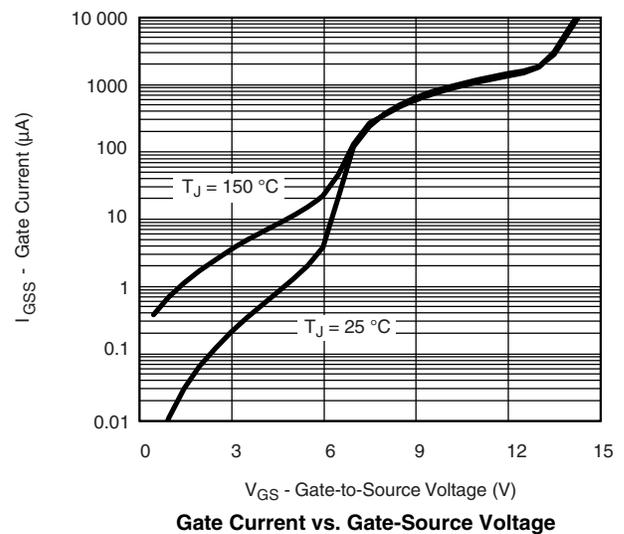
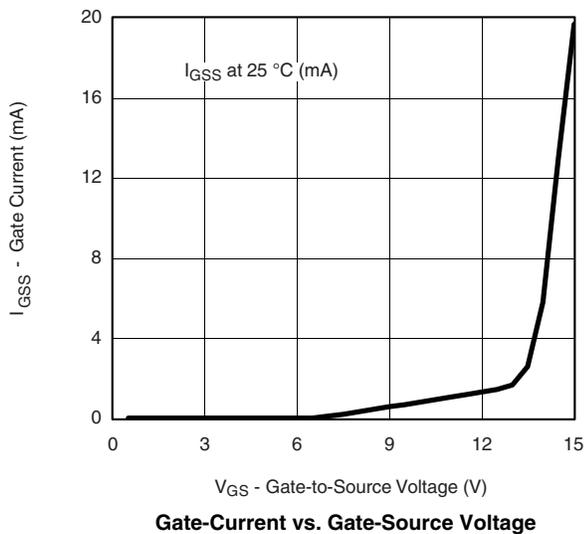
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{SS} = V_{GS}, I_D = 1.1\text{ mA}$	0.45		1.0	V
Gate-Body Leakage	$I_{GSS}$	$V_{SS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$			$\pm 4$	$\mu\text{A}$
		$V_{SS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$			$\pm 10$	mA
Zero Gate Voltage Drain Current	$I_{S1S2}$	$V_{SS} = 20\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
		$V_{SS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$			5	
On-State Drain Current <sup>a</sup>	$I_{S(on)}$	$V_{SS} = 5\text{ V}, V_{GS} = 4.5\text{ V}$	5			A
Source1- Source2 On State Resistance <sup>a</sup>	$R_{S1S2(on)}$	$V_{GS} = 4.5\text{ V}, I_{SS} = 1\text{ A}$		0.020	0.024	$\Omega$
		$V_{GS} = 3.7\text{ V}, I_{SS} = 1\text{ A}$		0.022	0.026	
		$V_{GS} = 2.5\text{ V}, I_{SS} = 1\text{ A}$		0.026	0.034	
		$V_{GS} = 1.8\text{ V}, I_{SS} = 1\text{ A}$		0.032	0.040	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{SS} = 10\text{ V}, I_{SS} = 1\text{ A}$		31		S
<b>Dynamic<sup>b</sup></b>						
Turn-On Delay Time	$t_{d(on)}$	$V_{SS} = 10\text{ V}, R_L = 10\text{ }\Omega$ $I_{SS} \cong 1\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 6\text{ }\Omega$		3	5	$\mu\text{s}$
Rise Time	$t_r$			4.5	7	
Turn-Off Delay Time	$t_{d(off)}$			55	85	
Fall Time	$t_f$			15	25	

Notes:

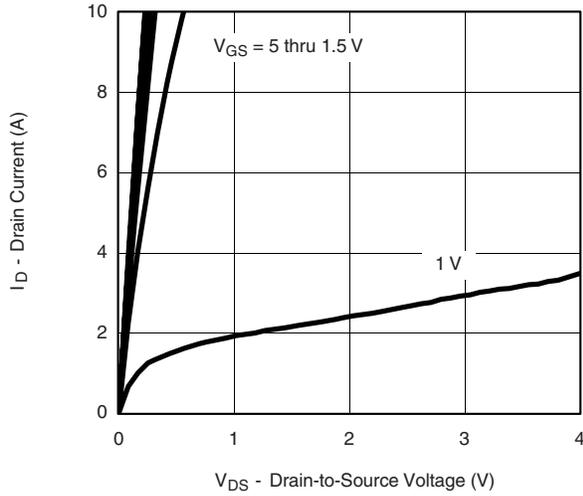
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.

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.

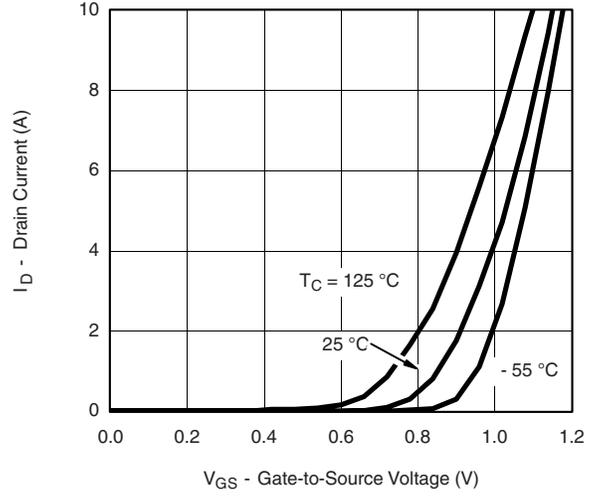
**TYPICAL CHARACTERISTICS**  $25\text{ }^\circ\text{C}$ , unless otherwise noted



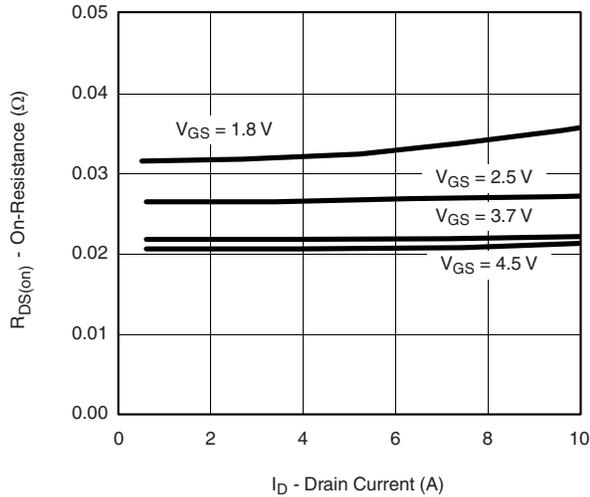
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



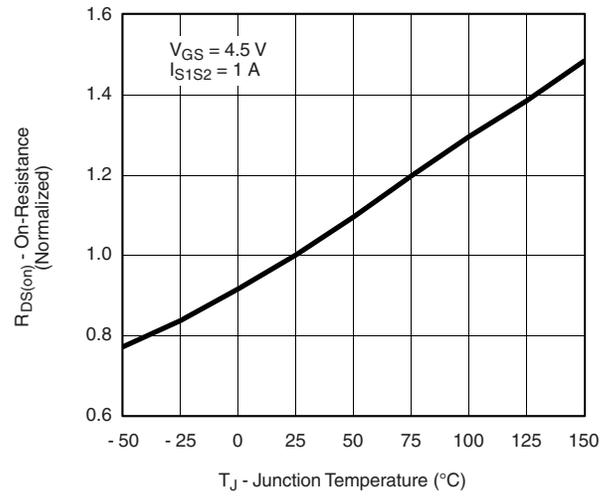
**Output Characteristics**



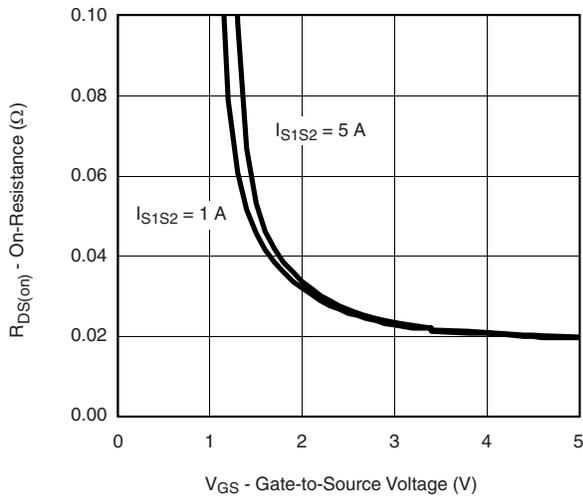
**Transfer Characteristics**



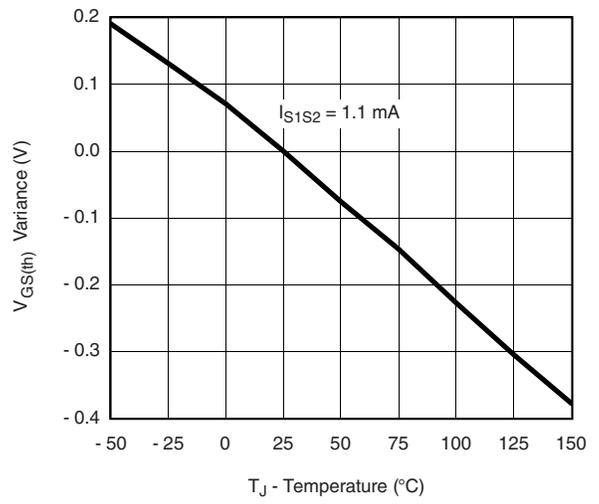
**On-Resistance vs. Drain Current**



**On-Resistance vs. Junction Temperature**

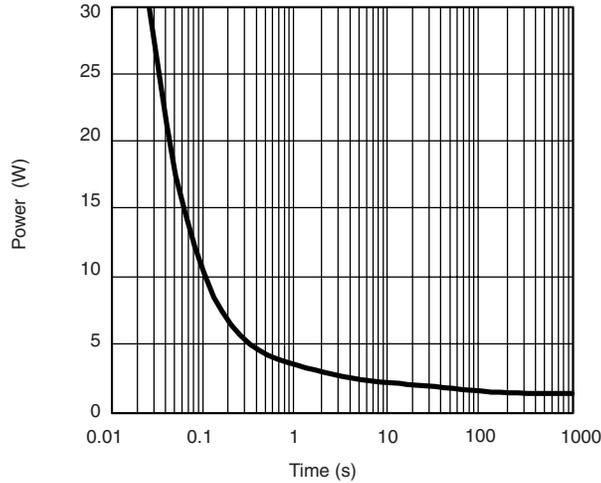


**On-Resistance vs. Gate-to-Source Voltage**

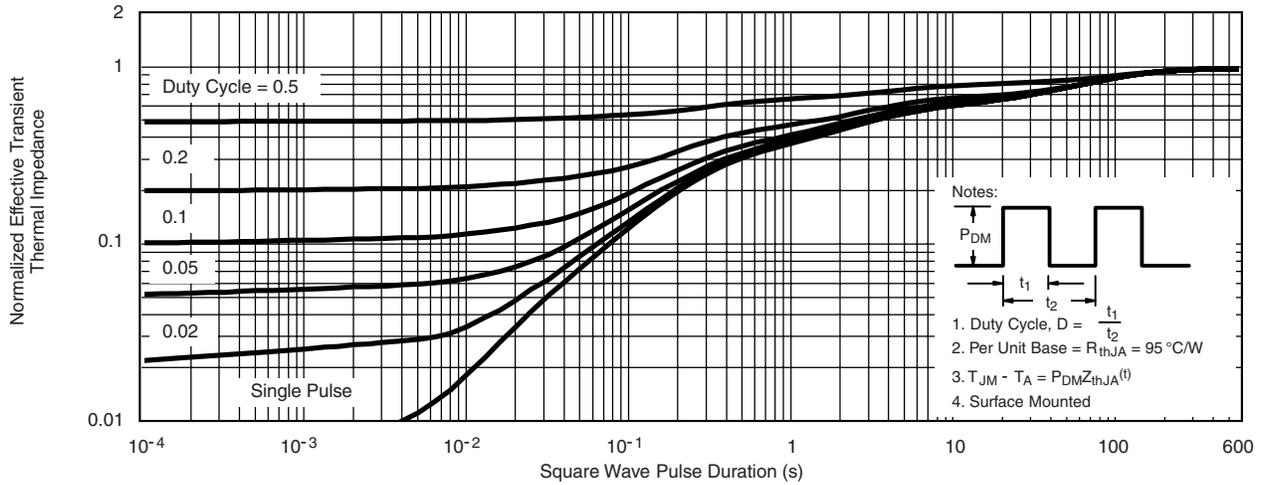


**Threshold Voltage**

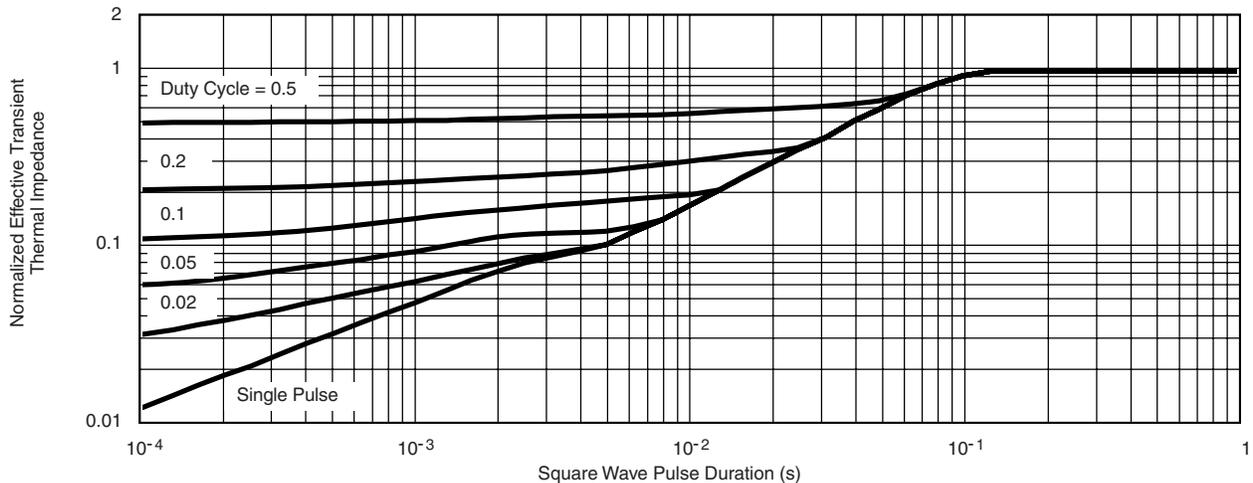
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



**Single Pulse Power, Junction-to-Ambient**



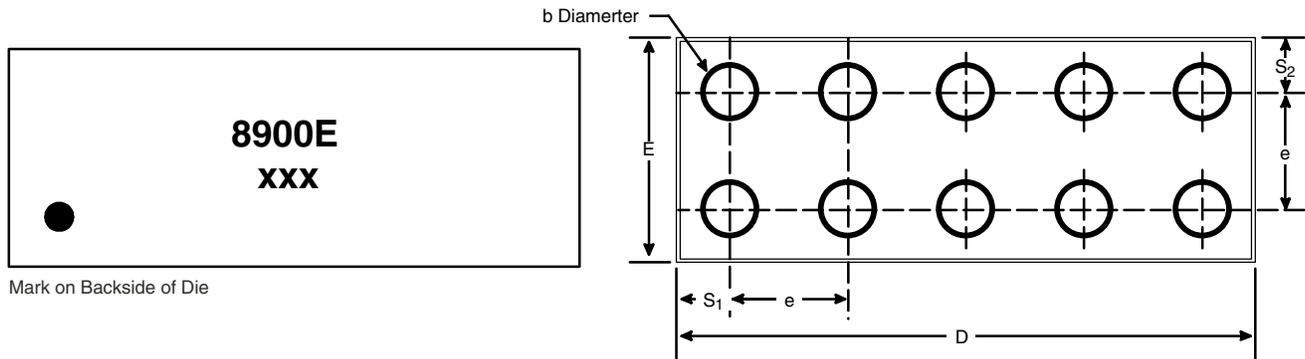
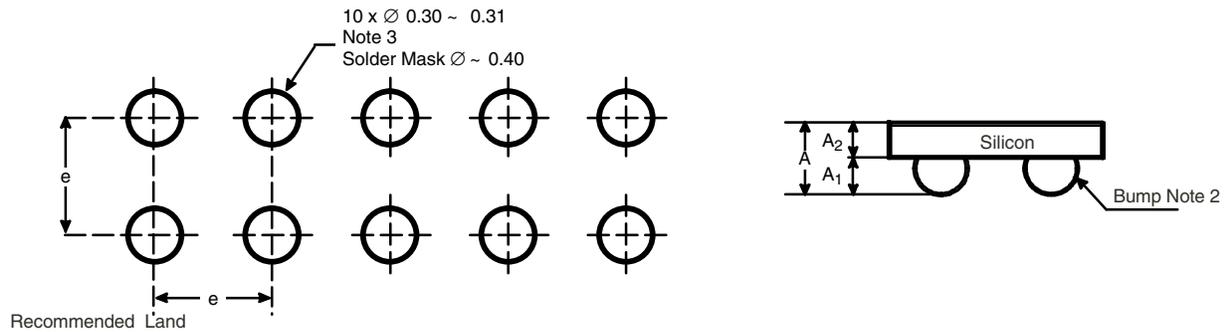
**Normalized Thermal Transient Impedance, Junction-to-Ambient**



**Normalized Thermal Transient Impedance, Junction-to-Foot**

**PACKAGE OUTLINE**

**MICRO FOOT: 10-BUMP (2 x 5, 0.8 mm PITCH)**



Notes (Unless Otherwise Specified):

1. Laser mark on the silicon die back, coated with a thin metal.
2. Bumps are 95.5Sn/3.8Ag/0.7Cu.
3. Non-solder mask defined copper landing pad.

Dim.	Millimeters <sup>a</sup>		Inches	
	Min.	Max.	Min.	Max.
A	0.600	0.650	0.0236	0.0256
A <sub>1</sub>	0.260	0.290	0.102	0.0114
A <sub>2</sub>	0.340	0.360	0.0134	0.0142
b	0.370	0.410	0.0146	0.0161
D	4.050	4.060	0.1594	0.1598
E	1.980	2.000	0.0780	0.0787
e	0.750	0.850	0.0295	0.0335
S <sub>1</sub>	0.430	0.450	0.0169	0.0177
S <sub>2</sub>	0.580	0.600	0.0228	0.0236

Notes:

- a. Use millimeters as the primary measurement.

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