

## Complementary N- and P-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY			
	$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (mA)
N-Channel	20	0.70 at $V_{GS} = 4.5$ V	600
		0.85 at $V_{GS} = 2.5$ V	500
		1.25 at $V_{GS} = 1.8$ V	350
P-Channel	- 20	1.2 at $V_{GS} = - 4.5$ V	- 400
		1.6 at $V_{GS} = - 2.5$ V	- 300
		2.7 at $V_{GS} = - 1.8$ V	- 150

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFETs
- 2000 V ESD Protection
- Very Small Footprint
- High-Side Switching
- Low On-Resistance:  
N-Channel, 0.7  $\Omega$   
P-Channel, 1.2  $\Omega$
- Low Threshold:  $\pm 0.8$  V (Typ.)
- Fast Switching Speed: 14 ns
- 1.8 V Operation
- Compliant to RoHS Directive 2002/95/EC



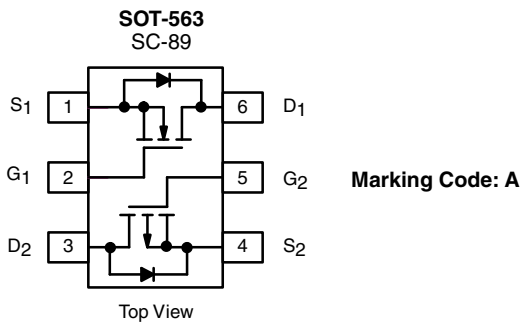
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### BENEFITS

- Ease in Driving Switches
- Low Offset (Error) Voltage
- Low-Voltage Operation
- High-Speed Circuits
- Low Battery Voltage Operation

### APPLICATIONS

- Replace Digital Transistor, Level-Shifter
- Battery Operated Systems
- Power Supply Converter Circuits



**Ordering Information:** Si1016X-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)							
Parameter	Symbol	N-Channel		P-Channel		Unit	
		5 s	Steady State	5 s	Steady State		
Drain-Source Voltage	$V_{DS}$	20		- 20		V	
Gate-Source Voltage	$V_{GS}$	$\pm 6$					
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_A = 25$ °C	515	485	- 390	- 370	mA
		$T_A = 85$ °C	370	350	- 280	- 265	
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	650		- 650			
Continuous Source Current (Diode Conduction) <sup>a</sup>	$I_S$	450	380	- 450	- 380	mW	
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25$ °C	280	250	280		250
		$T_A = 85$ °C	145	130	145		130
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150				°C	
Gate-Source ESD Rating (HBM, Method 3015)	ESD	2000				V	

Notes:

a. Surface mounted on FR4 board.

b. Pulse width limited by maximum junction temperature.

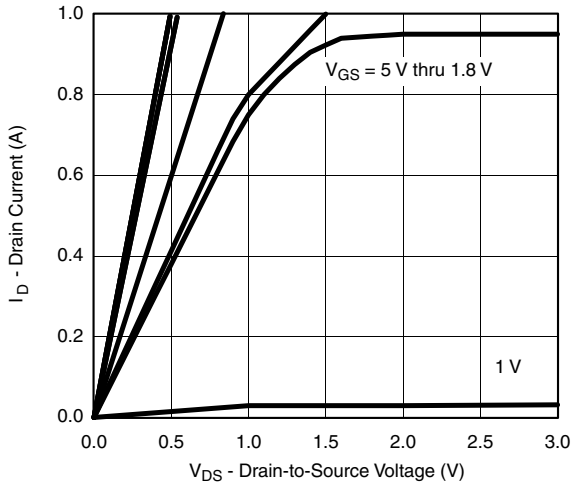
SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Static</b>							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.45		1	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.45		-1	
Gate Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$	N-Ch P-Ch		$\pm 0.5$ $\pm 1.0$	$\pm 1.0$ $\pm 2.0$	$\mu\text{A}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$	N-Ch		0.3	100	nA
		$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$	P-Ch		-0.3	-100	
		$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$	N-Ch			5	$\mu\text{A}$
		$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$	P-Ch			-5	
On State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	700			mA
		$V_{DS} = -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-700			
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 600\text{ mA}$	N-Ch		0.41	0.70	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -350\text{ mA}$	P-Ch		0.80	1.2	
		$V_{GS} = 2.5\text{ V}, I_D = 500\text{ mA}$	N-Ch		0.53	0.85	
		$V_{GS} = -2.5\text{ V}, I_D = -300\text{ mA}$	P-Ch		1.20	1.6	
		$V_{GS} = 1.8\text{ V}, I_D = 350\text{ mA}$	N-Ch		0.70	1.25	
		$V_{GS} = -1.8\text{ V}, I_D = -150\text{ mA}$	P-Ch		1.80	2.7	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 400\text{ mA}$	N-Ch		1.0		S
		$V_{DS} = -10\text{ V}, I_D = -250\text{ mA}$	P-Ch		0.4		
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = 150\text{ mA}, V_{GS} = 0\text{ V}$	N-Ch		0.8	1.2	V
		$I_S = -150\text{ mA}, V_{GS} = 0\text{ V}$	P-Ch		-0.8	-1.2	
<b>Dynamic<sup>b</sup></b>							
Total Gate Charge	$Q_g$	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 250\text{ mA}$ P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -250\text{ mA}$	N-Ch		750		pC
Gate-Source Charge	$Q_{gs}$		N-Ch		75		
			P-Ch		150		
Gate-Drain Charge	$Q_{gd}$	N-Ch		225			
		P-Ch		450			
Turn-On Time	$t_{ON}$	N-Channel $V_{DD} = 10\text{ V}, R_L = 47\text{ }\Omega$ $I_D \cong 200\text{ mA}, V_{GEN} = 4.5\text{ V}, R_g = 10\text{ }\Omega$ P-Channel $V_{DD} = -10\text{ V}, R_L = 47\text{ }\Omega$ $I_D \cong -200\text{ mA}, V_{GEN} = -4.5\text{ V}, R_g = 10\text{ }\Omega$	N-Ch		5		ns
Turn-Off Time	$t_{OFF}$		N-Ch		25		
		P-Ch		35			

Notes:

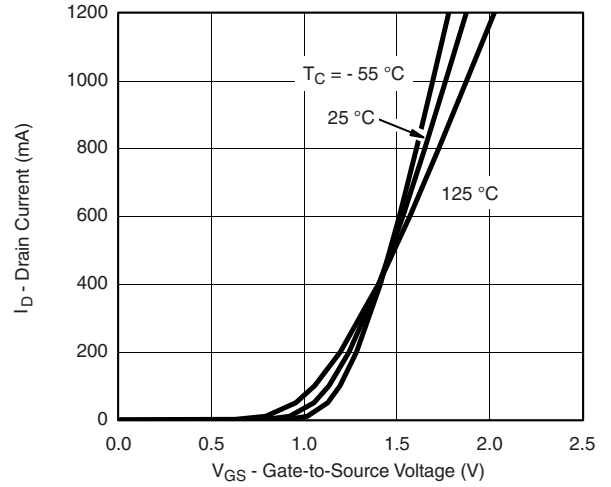
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

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.

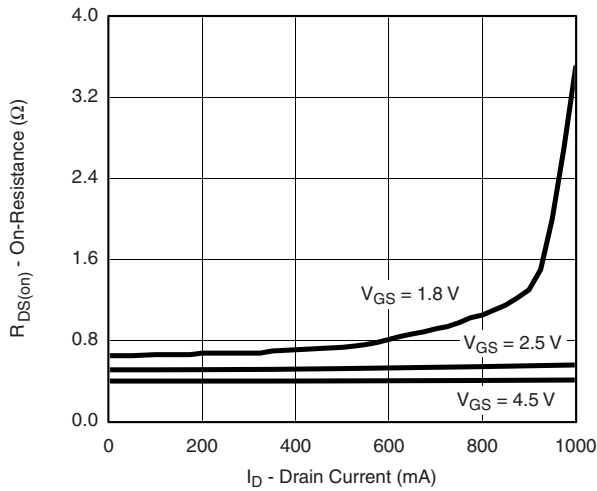
**N-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



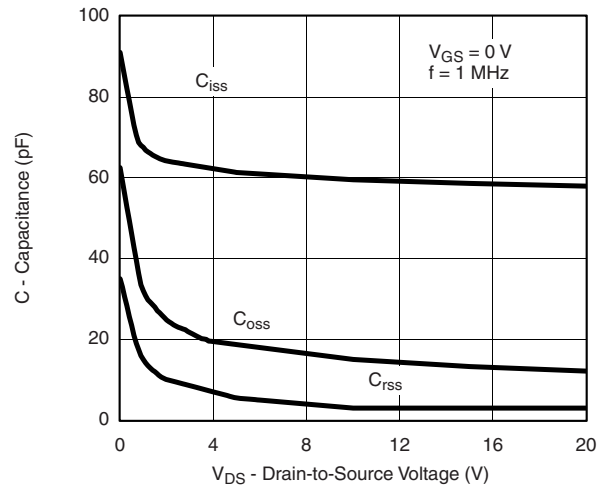
**Output Characteristics**



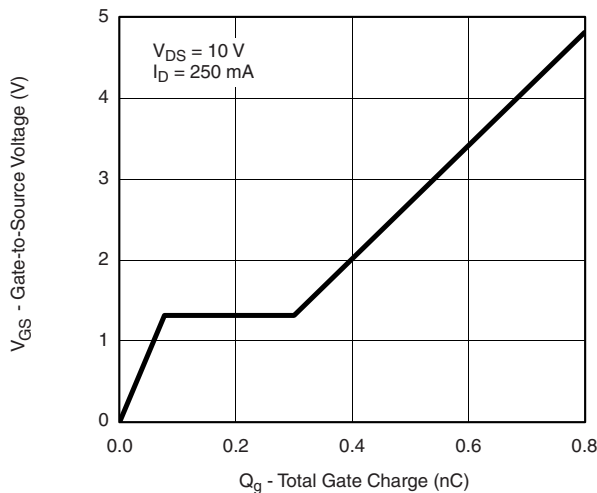
**Transfer Characteristics**



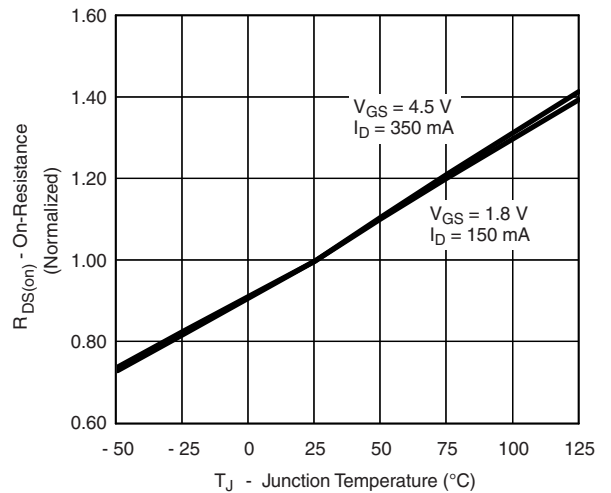
**On-Resistance vs. Drain Current**



**Capacitance**

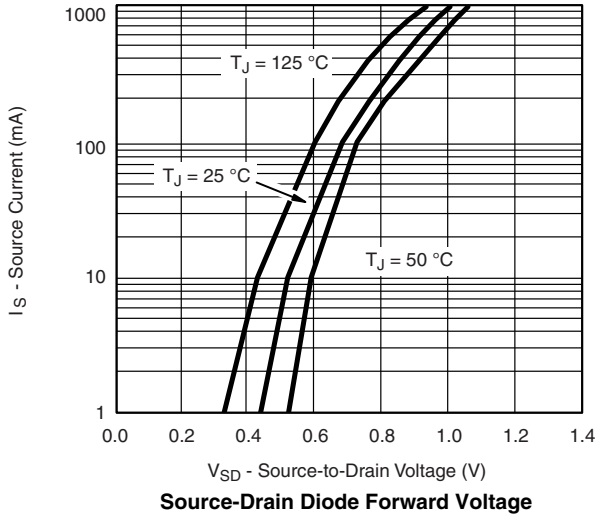


**Gate Charge**

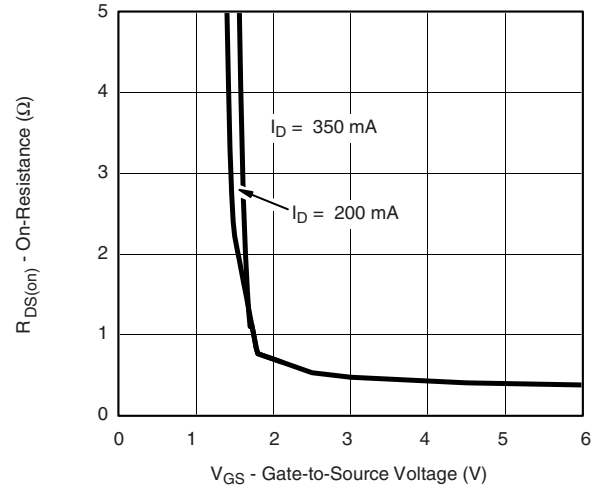


**On-Resistance vs. Junction Temperature**

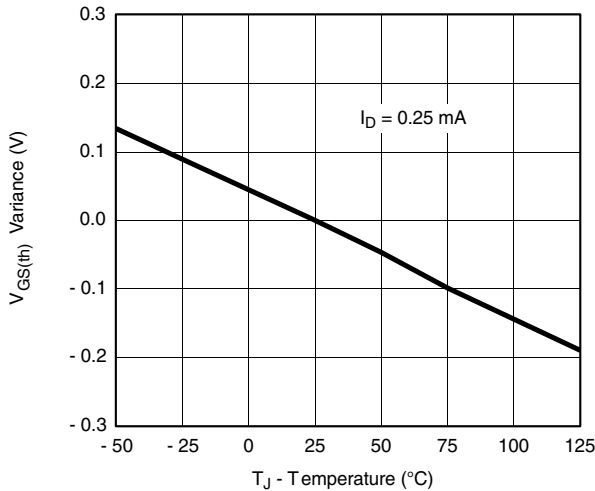
## N-CHANNEL TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



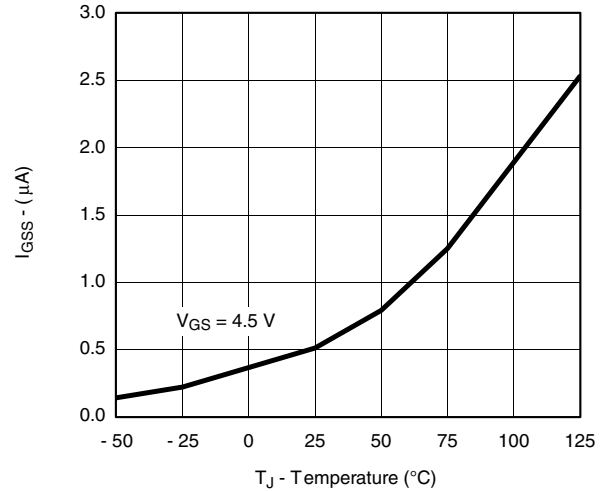
Source-Drain Diode Forward Voltage



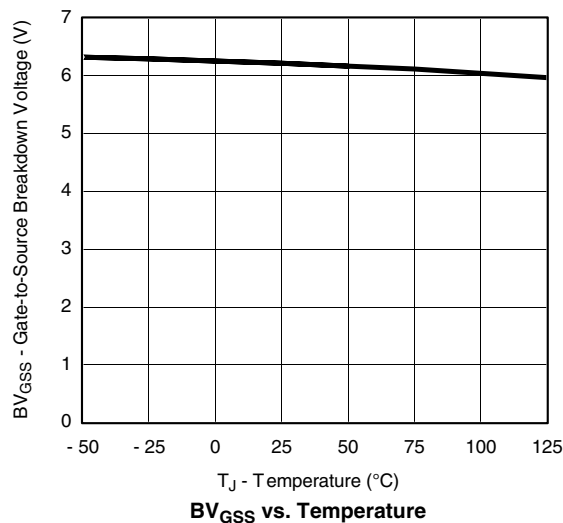
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage Variance vs. Temperature

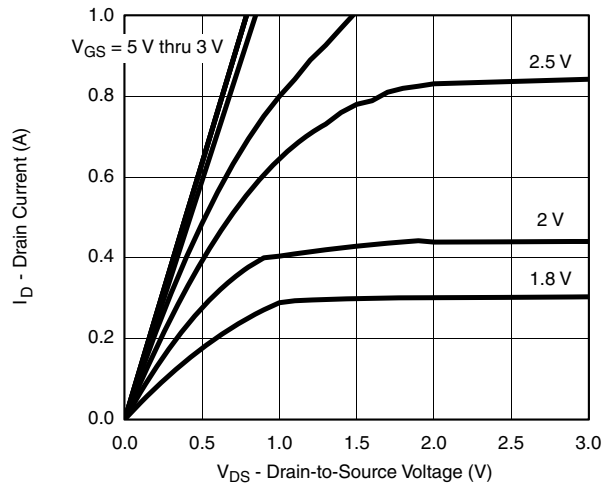


$I_{GSS}$  vs. Temperature

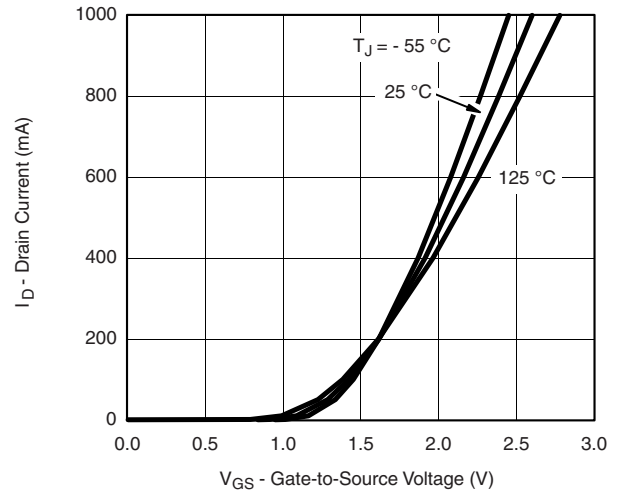


$BV_{GSS}$  vs. Temperature

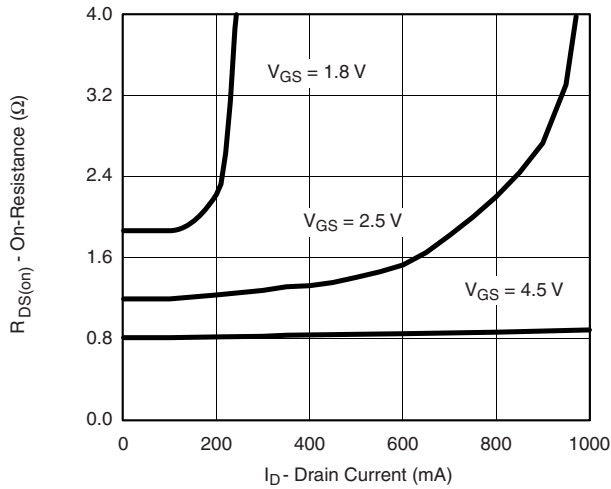
## P-CHANNEL TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



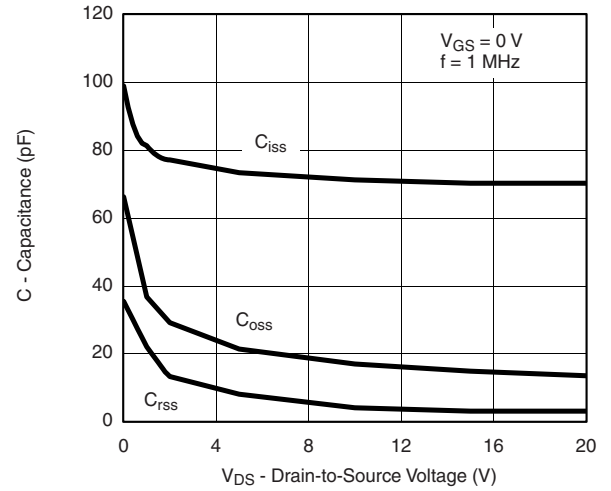
**Output Characteristics**



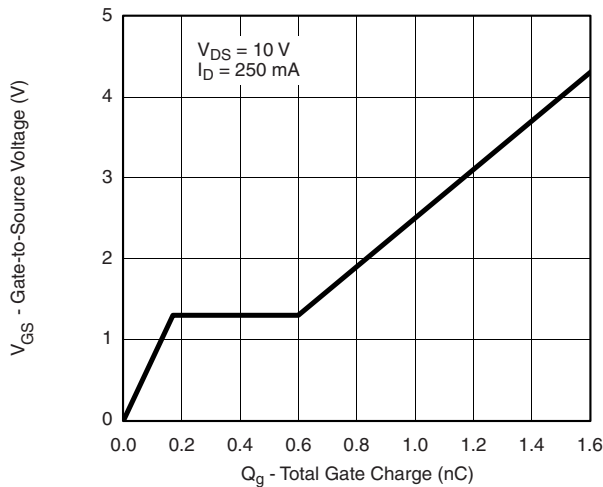
**Transfer Characteristics**



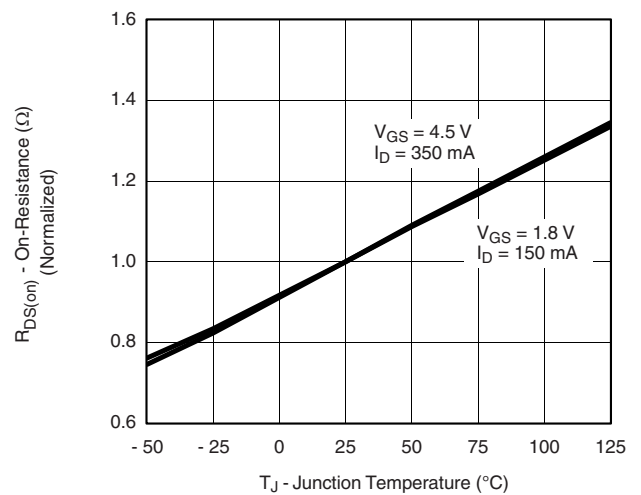
**On-Resistance vs. Drain Current**



**Capacitance**

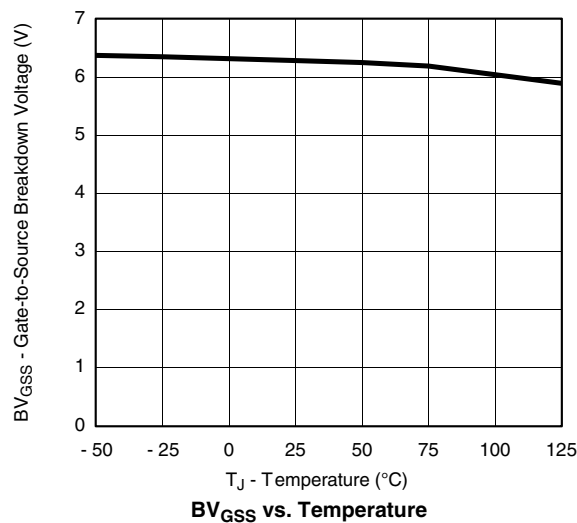
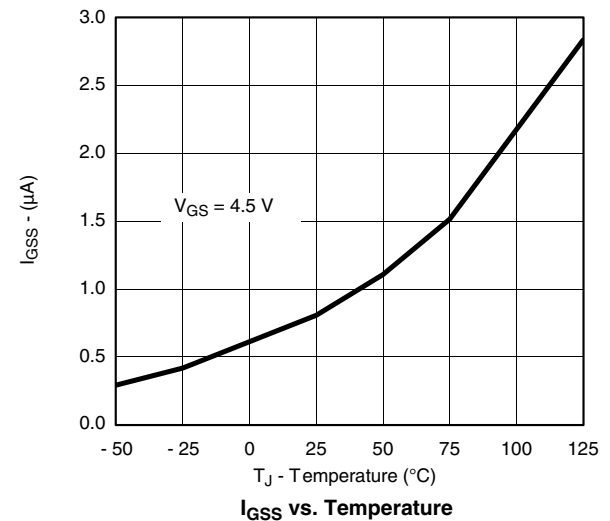
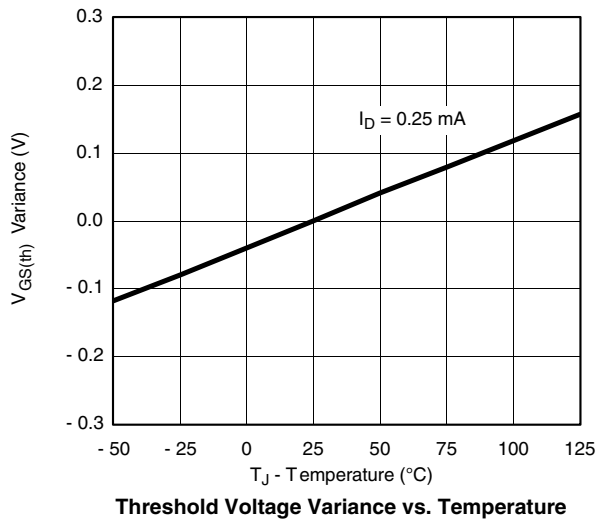
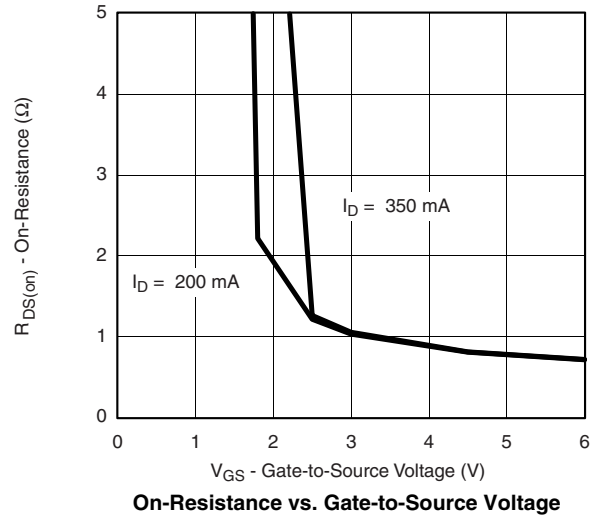
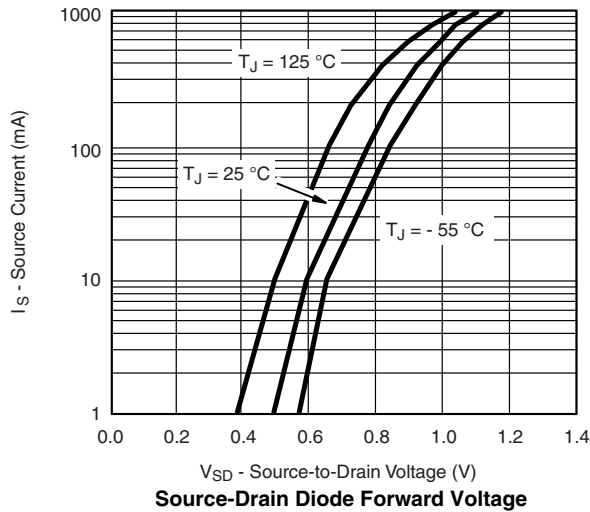


**Gate Charge**

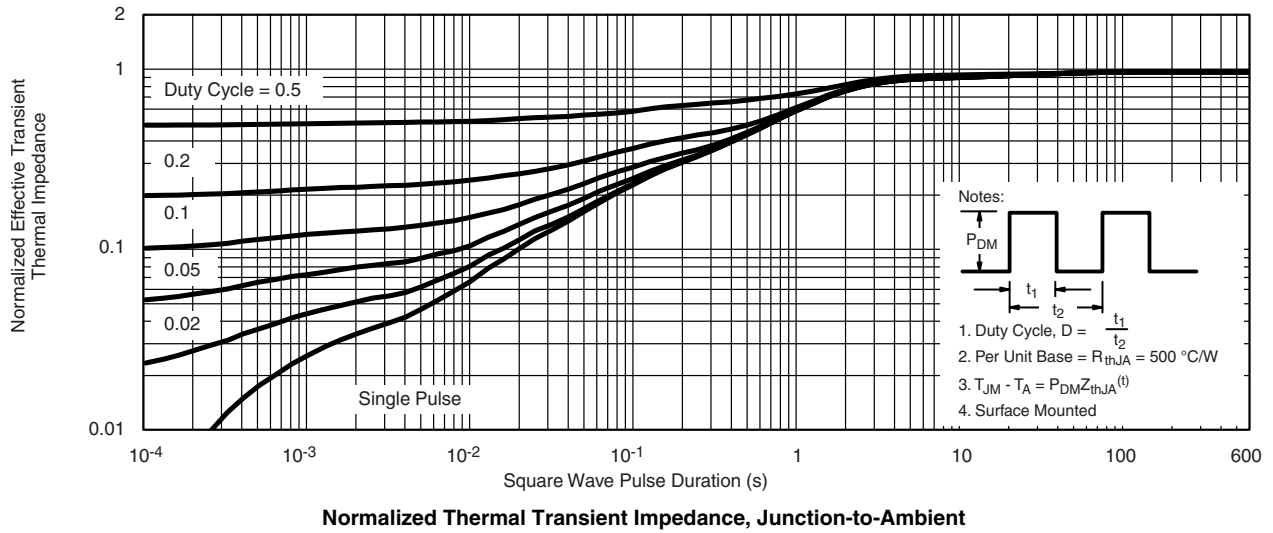


**On-Resistance vs. Junction Temperature**

## P-CHANNEL TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

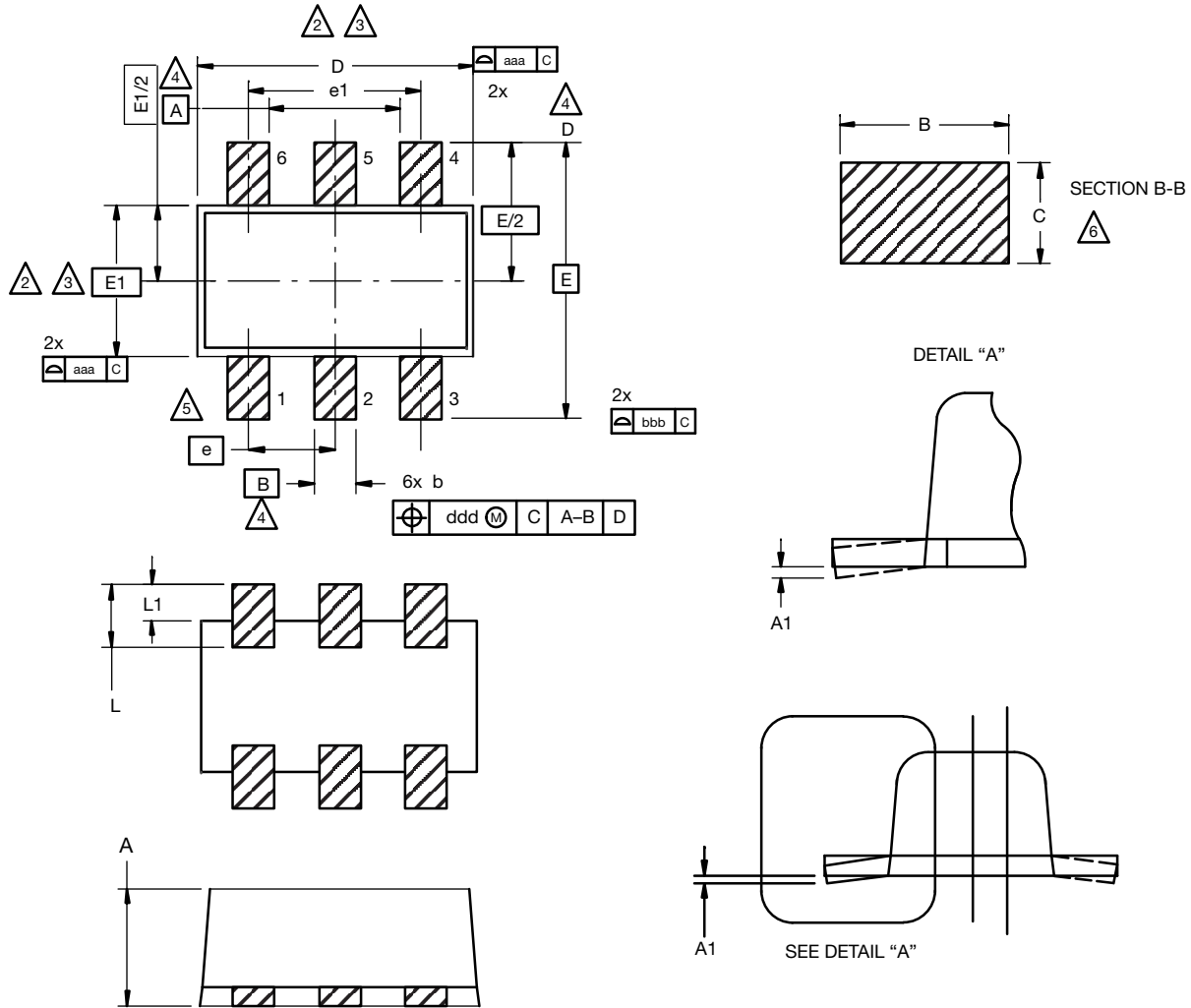


**N- OR P-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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### SC-89 6-Leads (SOT-563F)



**Notes**

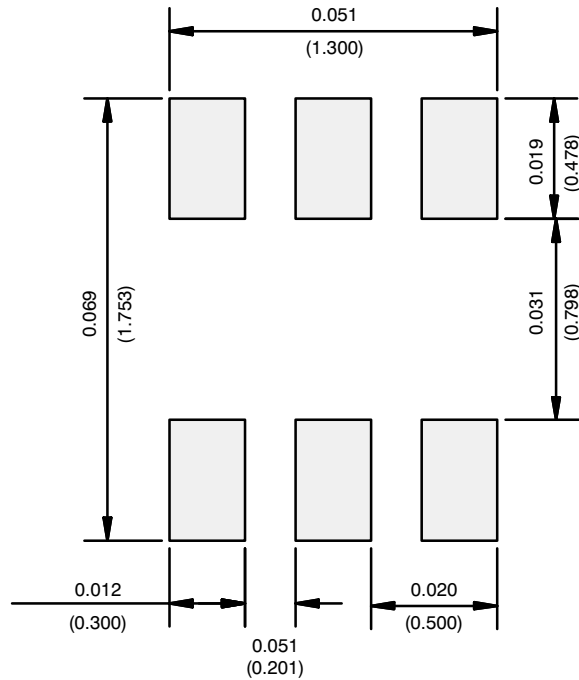
- 1. Dimensions in millimeters.
- ⚠ Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per dimension E1 does not include interlead flash or protrusion, interlead flash or protrusion shall not exceed 0.15 mm per side.
- ⚠ Dimensions D and E1 are determined at the outmost extremes of the plastic body exclusive of mold flash, the bar burrs, gate burrs and interlead flash, but including any mismatch between the top and the bottom of the plastic body.
- ⚠ Datums A, B and D to be determined 0.10 mm from the lead tip.
- ⚠ Terminal numbers are shown for reference only.
- ⚠ These dimensions apply to the flat section of the lead between 0.08 mm and 0.15 mm from the lead tip.

DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.56	0.58	0.60
A1	0	0.02	0.10
b	0.15	0.22	0.30
c	0.10	0.14	0.18
D	1.50	1.60	1.70
E	1.50	1.60	1.70
E1	1.15	1.20	1.25
e	0.45	0.50	0.55
e1	0.95	1.00	1.05
L	0.25	0.35	0.50
L1	0.10	0.20	0.30

C14-0439-Rev. C, 11-Aug-14  
DWG: 5880



## RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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