

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

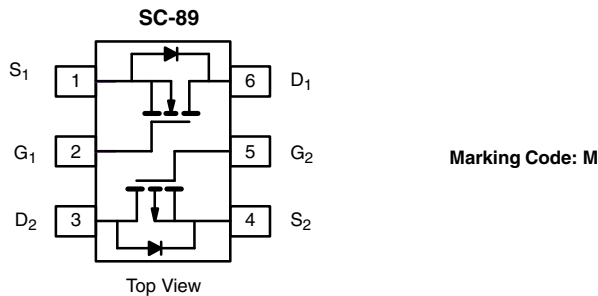
PRODUCT SUMMARY			
	$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (mA)
N-Channel	20	5 at $V_{GS} = 4.5$ V	200
		7 at $V_{GS} = 2.5$ V	175
		9 at $V_{GS} = 1.8$ V	150
		10 at $V_{GS} = 1.5$ V	50
P-Channel	- 20	8 at $V_{GS} = - 4.5$ V	- 150
		12 at $V_{GS} = - 2.5$ V	- 125
		15 at $V_{GS} = - 1.8$ V	- 100
		20 at $V_{GS} = - 1.5$ V	- 30

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET: 1.5 V Rated
- Very Small Footprint
- High-Side Switching
- Low On-Resistance:  
N-Channel, 5  $\Omega$   
P-Channel, 8  $\Omega$
- Low Threshold:  $\pm 0.9$  V (typ.)
- Fast Switching Speed: 45 ns (typ.)
- 1.5 V Operation
- Gate-Source ESD Protected: 2000 V
- Compliant to RoHS Directive 2002/95/EC



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



**Ordering Information:** Si1035X-T1-GE3 (Lead (Pb)-free and 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
- Load/Power Switching Cell Phones, Pagers

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	$V_{GS}$	$\pm 5$					
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_A = 25$ °C	190	180	- 155	- 145	mA
		$T_A = 85$ °C	140	130	- 110	- 105	
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	650		- 650			
Continuous Source Current (Diode Conduction)	$I_S$	450	380	- 450	- 380		
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25$ °C	280	250	280	250	mW
		$T_A = 85$ °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.

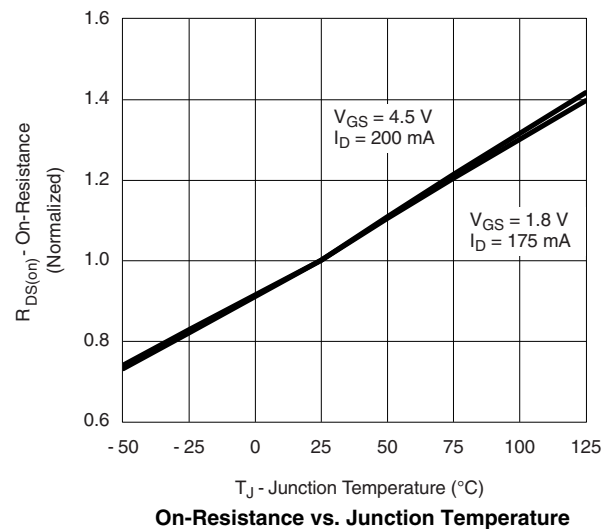
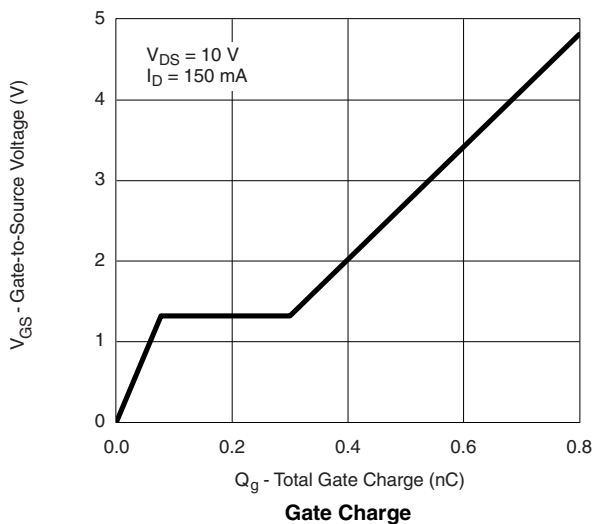
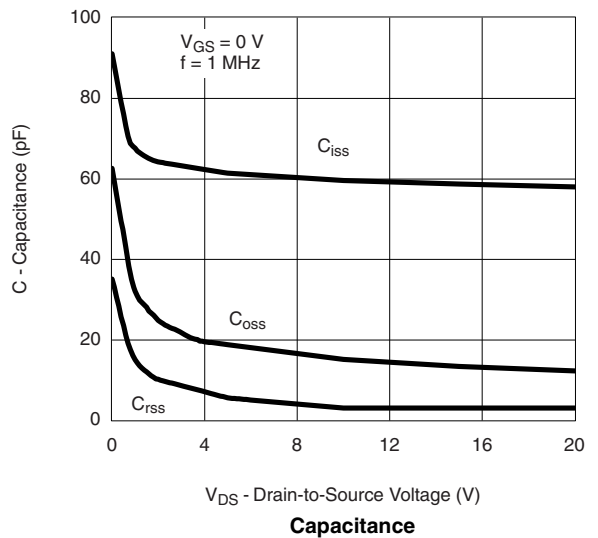
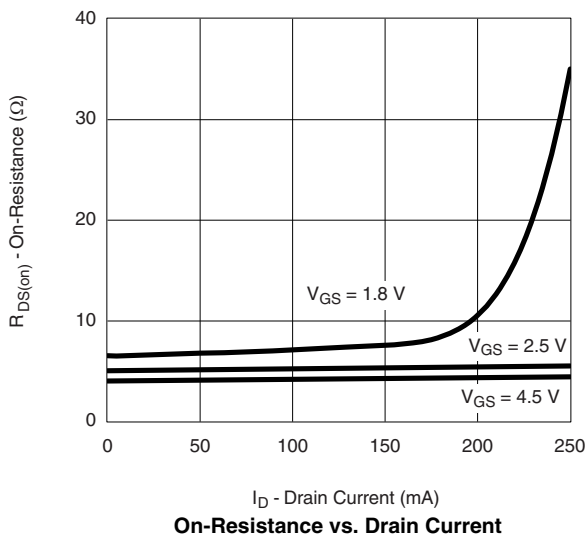
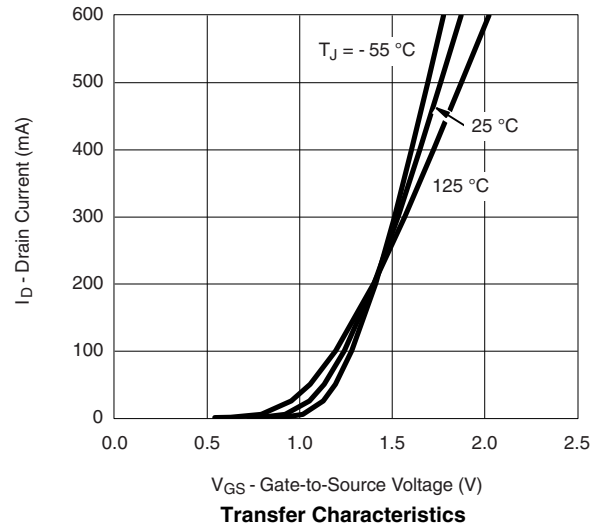
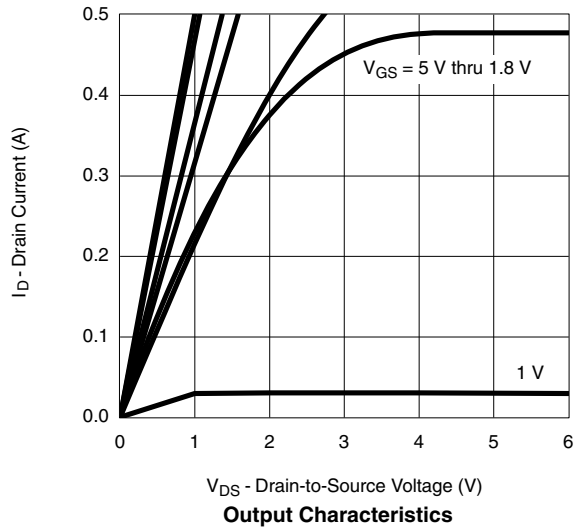
SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Static</b>							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.40		V	
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.40			
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 2.8\text{ V}$	N-Ch	$\pm 0.5$	$\pm 1.0$	$\mu\text{A}$	
			P-Ch	$\pm 0.5$	$\pm 1.0$		
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$	N-Ch	$\pm 1.5$	$\pm 3.0$		
			P-Ch	$\pm 1.0$	$\pm 3.0$		
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$	N-Ch	1	500	nA	
		$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$	P-Ch	-1	-500		
		$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$	N-Ch		10	$\mu\text{A}$	
		$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$	P-Ch		-10		
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	250		mA	
		$V_{DS} = -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-200			
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 200\text{ mA}$	N-Ch		5	$\Omega$	
		$V_{GS} = -4.5\text{ V}, I_D = -150\text{ mA}$	P-Ch		8		
		$V_{GS} = 2.5\text{ V}, I_D = 175\text{ mA}$	N-Ch		7		
		$V_{GS} = -2.5\text{ V}, I_D = 125\text{ mA}$	P-Ch		12		
		$V_{GS} = 1.8\text{ V}, I_D = 150\text{ mA}$	N-Ch		9		
		$V_{GS} = -1.8\text{ V}, I_D = -100\text{ mA}$	P-Ch		15		
		$V_{DS} = 1.5\text{ V}, I_D = 40\text{ mA}$	N-Ch		10		
		$V_{DS} = -1.5\text{ V}, I_D = -30\text{ mA}$	P-Ch		20		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 200\text{ mA}$	N-Ch		0.5	S	
		$V_{DS} = -10\text{ V}, I_D = -150\text{ mA}$	P-Ch		0.4		
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = 150\text{ mA}, V_{GS} = 0\text{ V}$	N-Ch		1.2	V	
		$I_S = -150\text{ mA}, V_{GS} = 0\text{ V}$	P-Ch		-1.2		
<b>Dynamic<sup>b</sup></b>							
Total Gate Charge	$Q_g$	$V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 150\text{ mA}$  $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -150\text{ mA}$	N-Ch		750	pC	
Gate-Source Charge	$Q_{gs}$		P-Ch		1500		
			N-Ch		75		
Gate-Drain Charge	$Q_{gd}$		P-Ch		150		
		N-Ch		225			
Turn-On Time	$t_{ON}$	$V_{DD} = 10\text{ V}, R_L = 47\text{ }\Omega$ $I_D \cong 250\text{ mA}, V_{GEN} = 4.5\text{ V}, R_g = 10\text{ }\Omega$	N-Ch		75	ns	
			P-Ch		80		
Turn-Off Time	$t_{OFF}$		$V_{DD} = -10\text{ V}, R_L = 65\text{ }\Omega$ $I_D \cong -150\text{ mA}, V_{GEN} = -4.5\text{ V}, R_g = 10\text{ }\Omega$	N-Ch			75
				P-Ch			90

Notes:

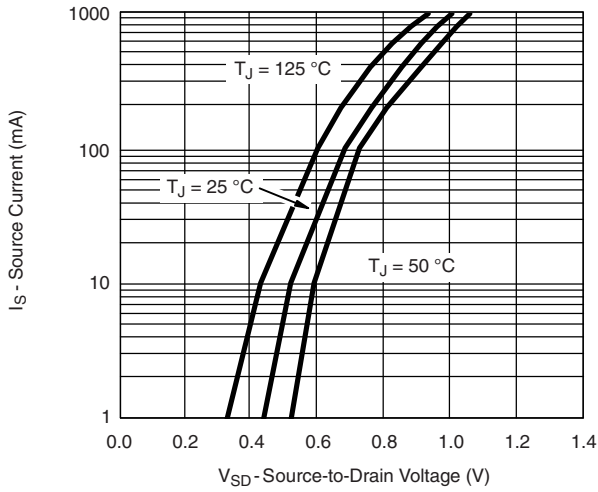
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

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.

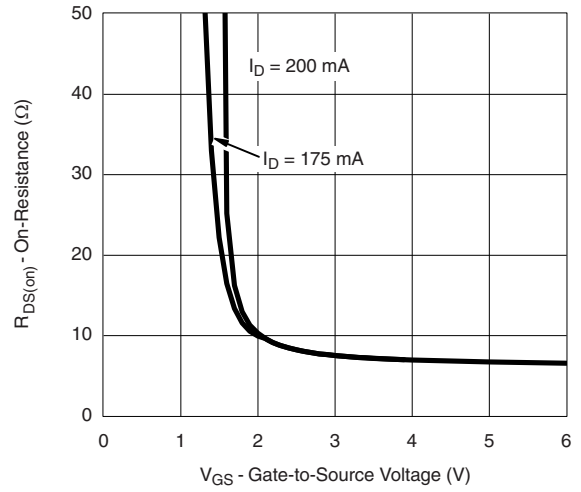
**N-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



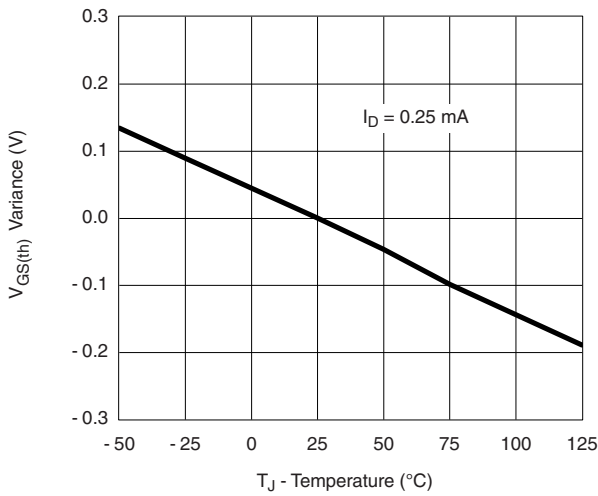
## N-CHANNEL TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



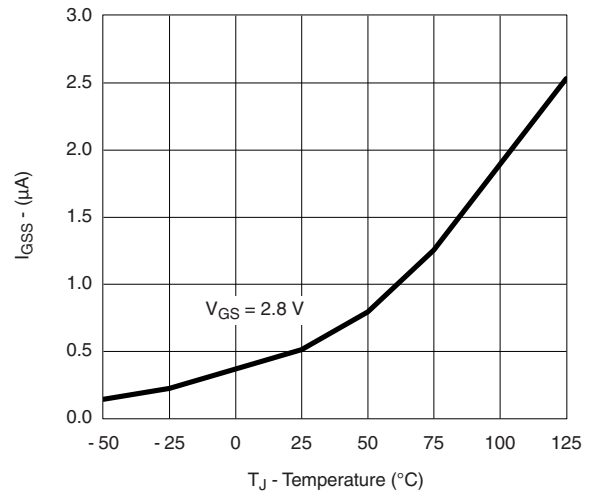
**Source-Drain Diode Forward Voltage**



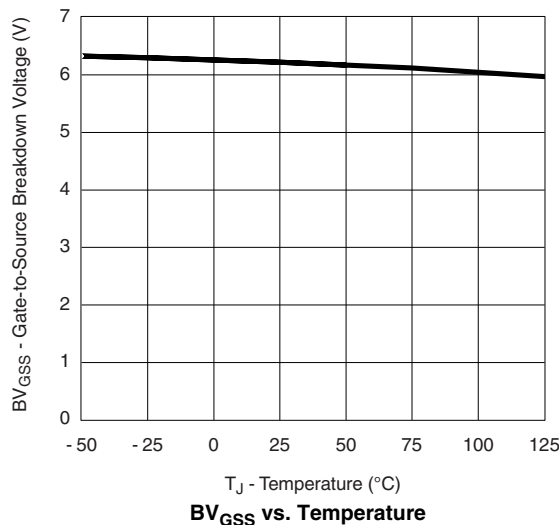
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage Variance vs. Temperature**

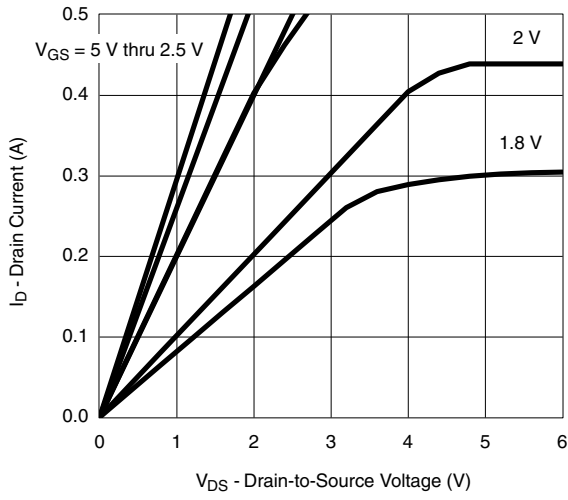


**$I_{GSS}$  vs. Temperature**

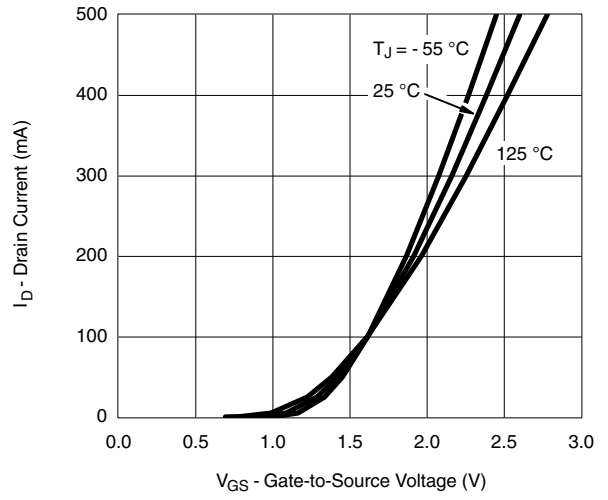


**$BV_{GSS}$  vs. Temperature**

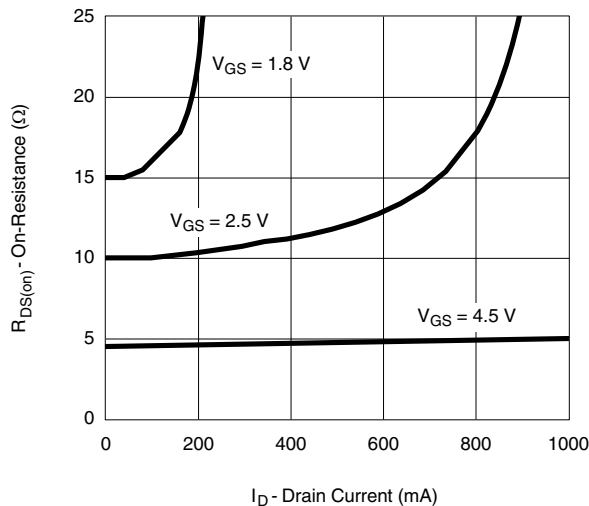
**P-CHANNEL TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



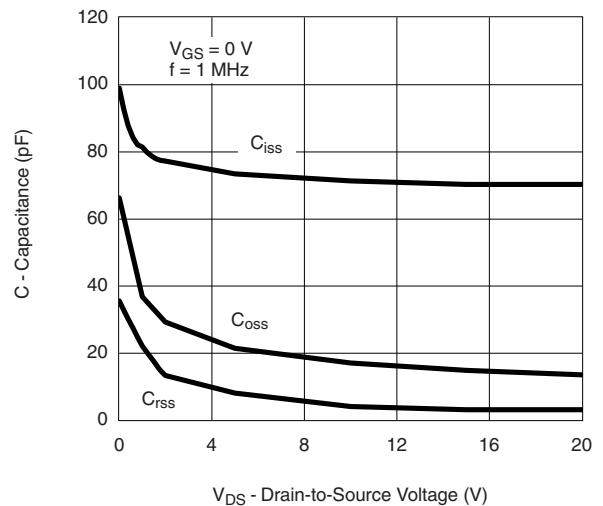
**Output Characteristics**



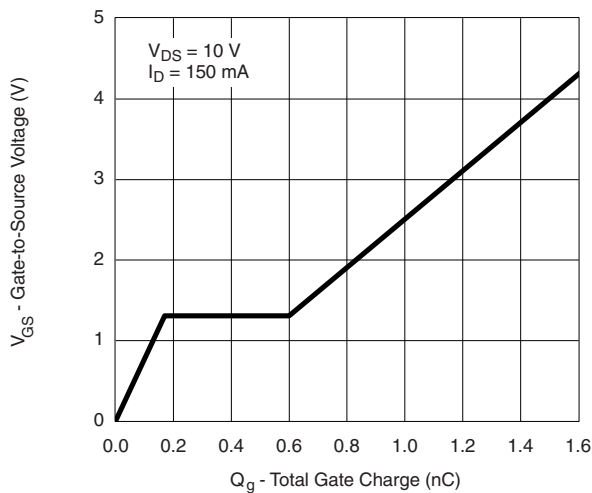
**Transfer Characteristics**



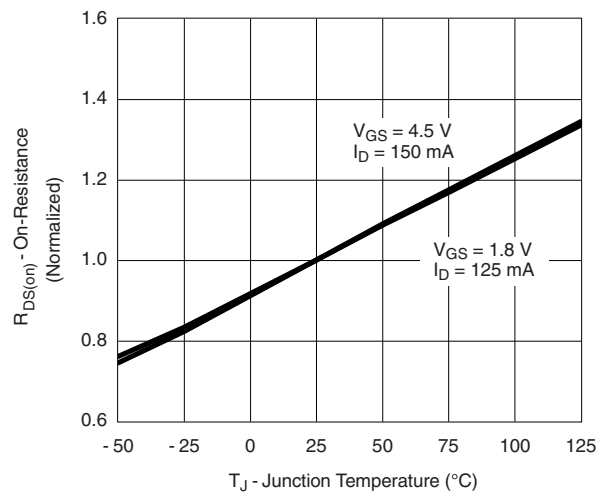
**On-Resistance vs. Drain Current**



**Capacitance**

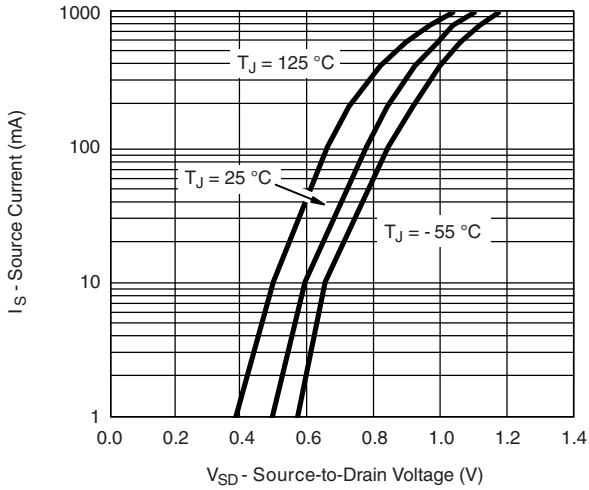


**Gate Charge**

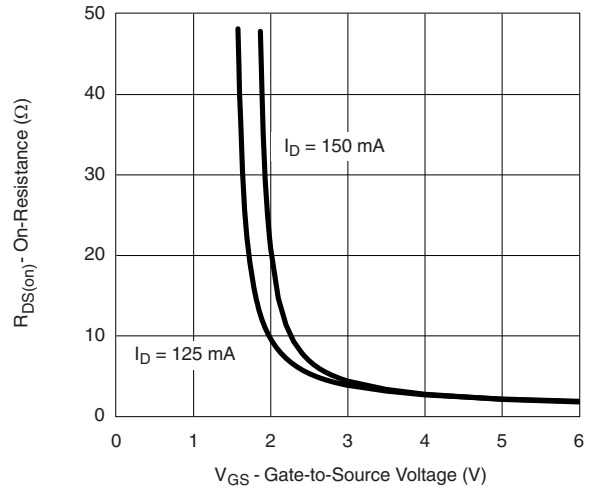


**On-Resistance vs. Junction Temperature**

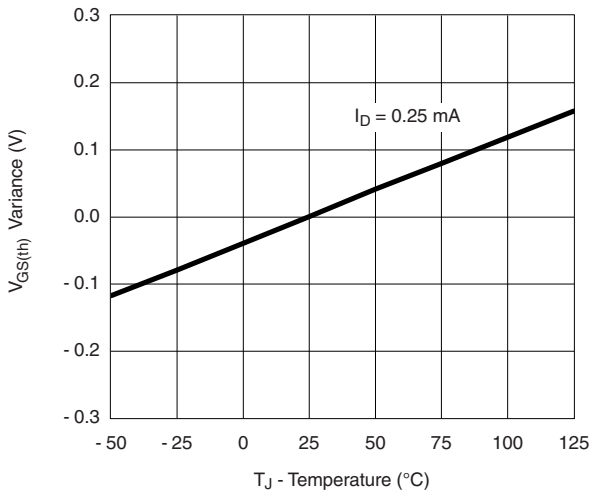
## P-CHANNEL TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



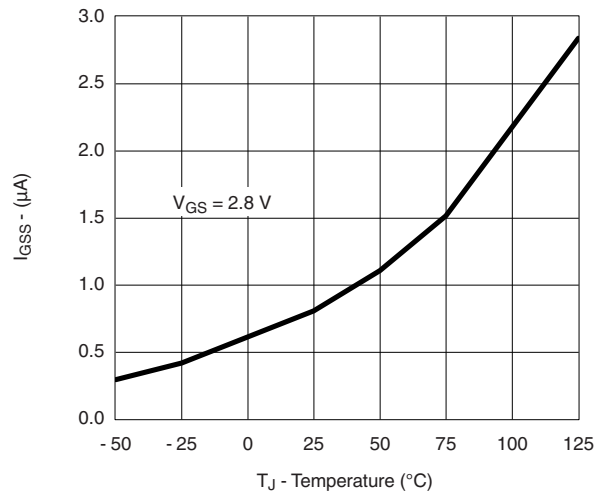
**Source-Drain Diode Forward Voltage**



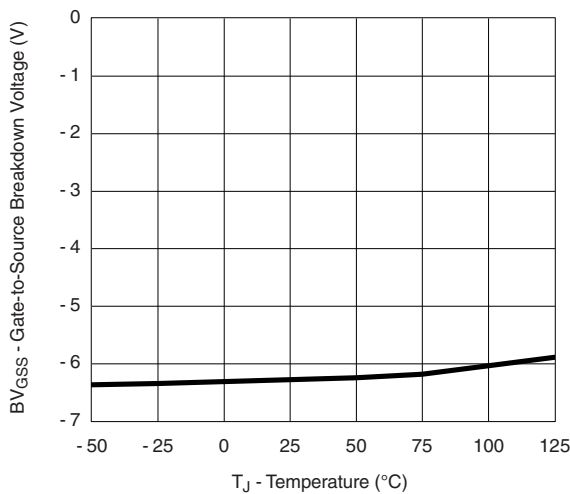
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage Variance vs. Temperature**

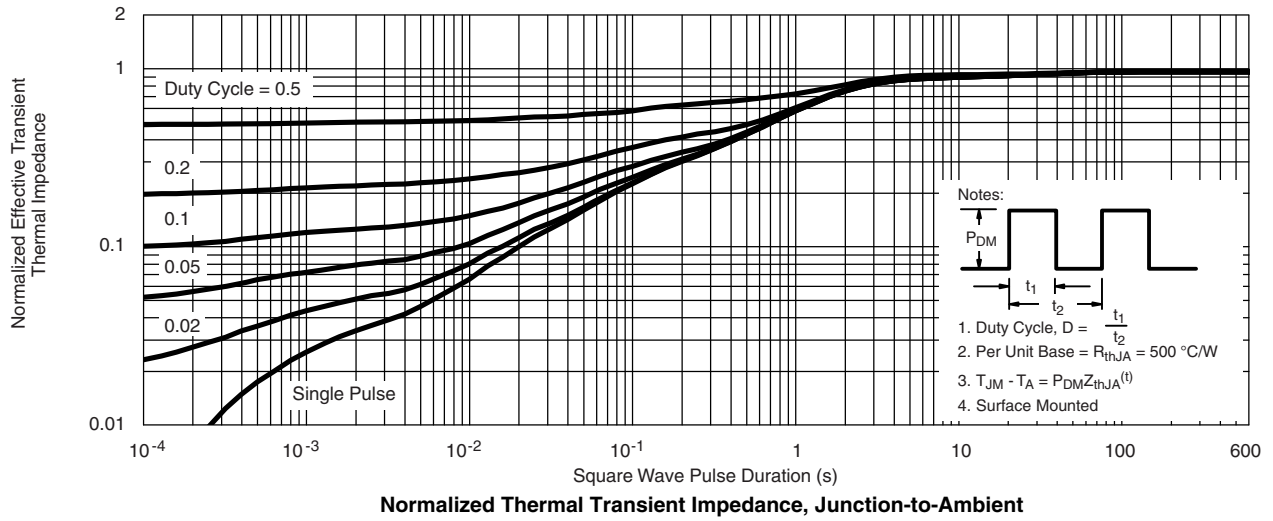


**$I_{GSS}$  vs. Temperature**



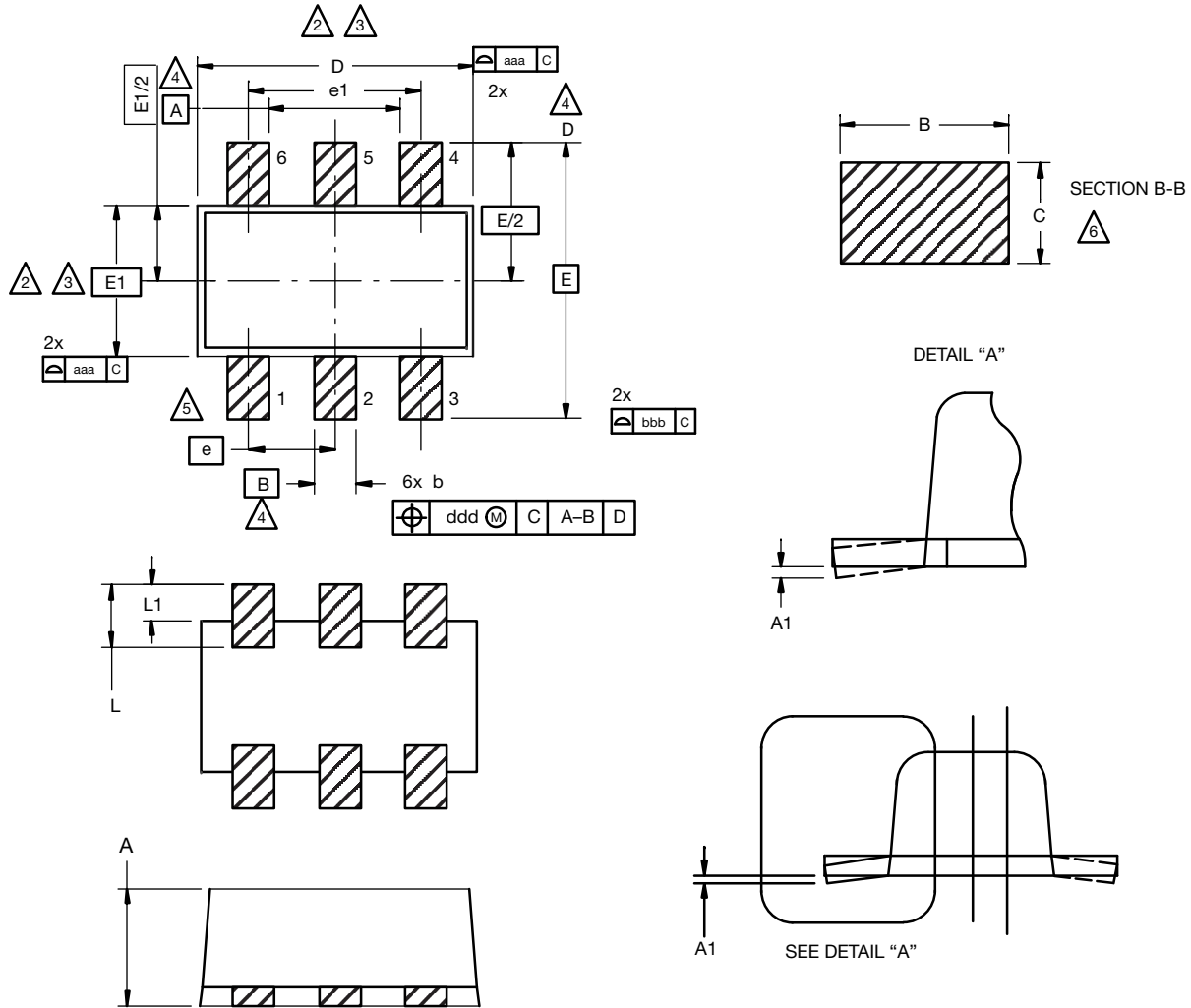
**$BV_{GSS}$  vs. Temperature**

**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

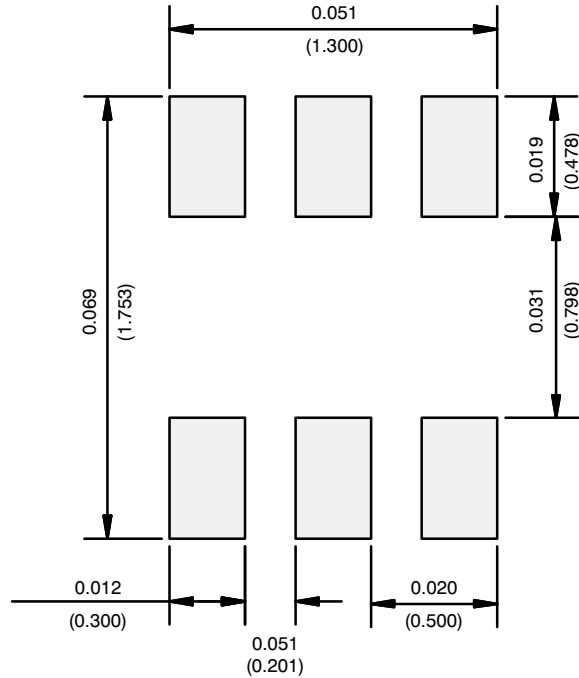
1. Dimensions in millimeters.
- ⚠ Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per dimension E1 does not include interlead flash or protrusion, interlead flash or protrusion shall not exceed 0.15 mm per side.
- ⚠ Dimensions 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)

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