

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

PRODUCT SUMMARY			
$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A)	$Q_g$ (Typ.)
20	0.089 at $V_{GS} = 4.5$ V	1.32	5.2
	0.098 at $V_{GS} = 2.5$ V	1.26	
	0.121 at $V_{GS} = 1.8$ V	1.13	

### FEATURES

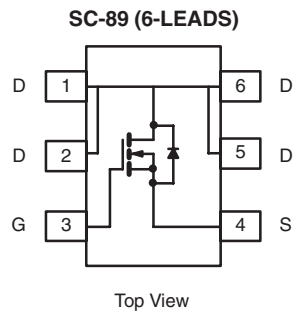
- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFET
- 100 %  $R_g$  Tested



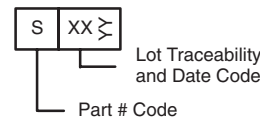
**RoHS**  
COMPLIANT

### APPLICATIONS

- Load Switch for Portable Devices



Marking Code



**Ordering Information:** Si1056X-T1-E3 (Lead (Pb)-free)  
Si1056X-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	20	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_A = 25$ °C	1.32 <sup>b, c</sup>
		$T_A = 70$ °C	1.05 <sup>b, c</sup>
Pulsed Drain Current	$I_{DM}$	6	A
Avalanche Current	$I_{AS}$	8	
Repetitive Avalanche Energy	$E_{AS}$	3.2	mJ
Continuous Source-Drain Diode Current	$I_S$	$T_A = 25$ °C	0.2 <sup>b, c</sup>
		$T_A = 70$ °C	0.151 <sup>b, c</sup>
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25$ °C	0.236 <sup>b, c</sup>
		$T_A = 70$ °C	0.151 <sup>b, c</sup>
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b, d</sup>	$R_{thJA}$	$t \leq 5$ s	440	530	°C/W
		Steady State	540	650	

Notes:

- Based on  $T_C = 25$  °C.
- Surface Mounted on 1" x 1" FR4 board.
- $t = 5$  s.
- Maximum under steady state conditions is 650 °C/W.

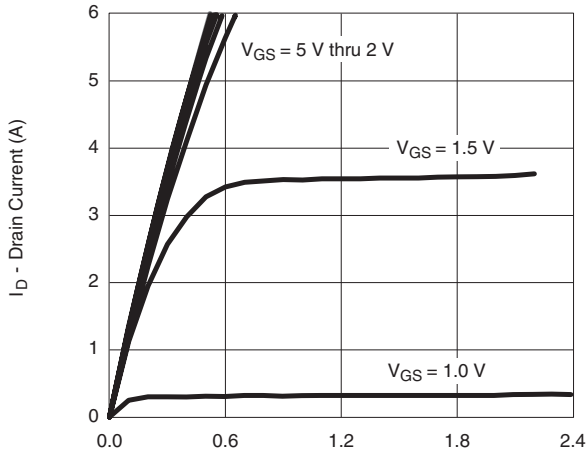
<b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	20			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$		18.2		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			-2.71		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	0.35		0.95	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$			1	nA
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$			10	$\mu\text{A}$
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 4.5\text{ V}$	6			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 1.32\text{ A}$		0.074	0.089	$\Omega$
		$V_{GS} = 2.5\text{ V}, I_D = 1.26\text{ A}$		0.082	0.098	
		$V_{GS} = 1.8\text{ V}, I_D = 1.13\text{ A}$		0.093	0.121	
Forward Transconductance	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 1.32\text{ A}$		7.5		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		400		pF
Output Capacitance	$C_{oss}$			70		
Reverse Transfer Capacitance	$C_{rss}$			40		
Total Gate Charge	$Q_g$	$V_{DS} = 10\text{ V}, V_{GS} = 5\text{ V}, I_D = 1.32\text{ A}$		5.8	8.7	nC
				5.2	7.8	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 1.32\text{ A}$		0.83		
Gate-Drain Charge	$Q_{gd}$			0.71		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		3.8	5.7	$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\text{ V}, R_L = 9.52\text{ }\Omega$ $I_D \cong 1.05\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$		6.8	10.2	ns
Rise Time	$t_r$			19	28.5	
Turn-Off Delay Time	$t_{d(off)}$			18	27	
Fall Time	$t_f$			6	9	
<b>Drain-Source Body Diode Characteristics</b>						
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				6	A
Body Diode Voltage	$V_{SD}$	$I_S = 1.0\text{ A}$		0.8	1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = 1.0\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		10.0	15	nC
Body Diode Reverse Recovery Charge	$Q_{rr}$			3.5	5.3	ns
Reverse Recovery Fall Time	$t_a$			6.6		
Reverse Recovery Rise Time	$t_b$			3.4		

Notes:

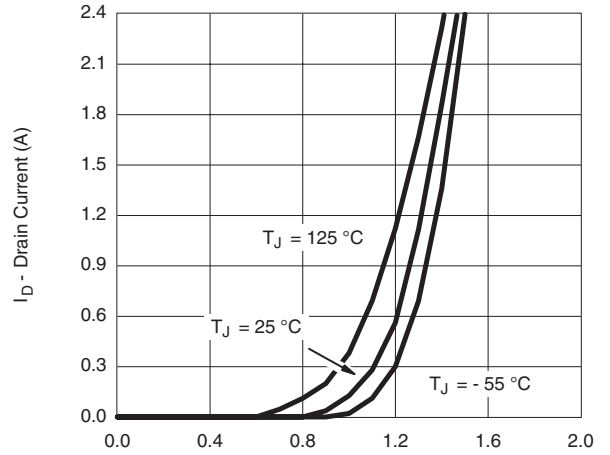
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

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.

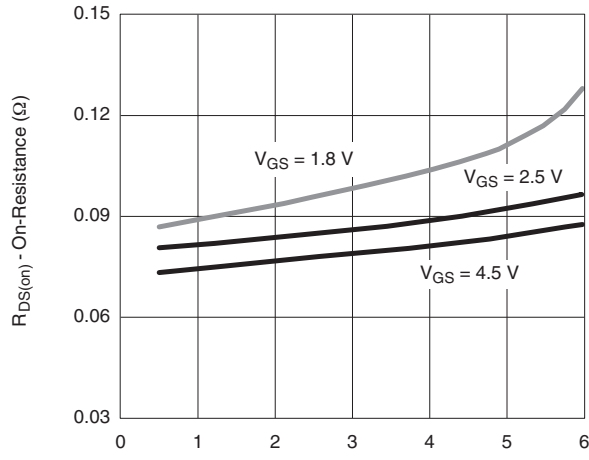
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



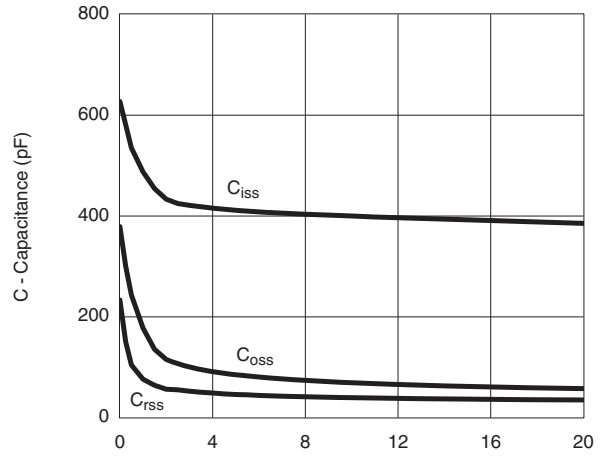
$V_{DS}$  - Drain-to-Source Voltage (V)  
**Output Characteristics**



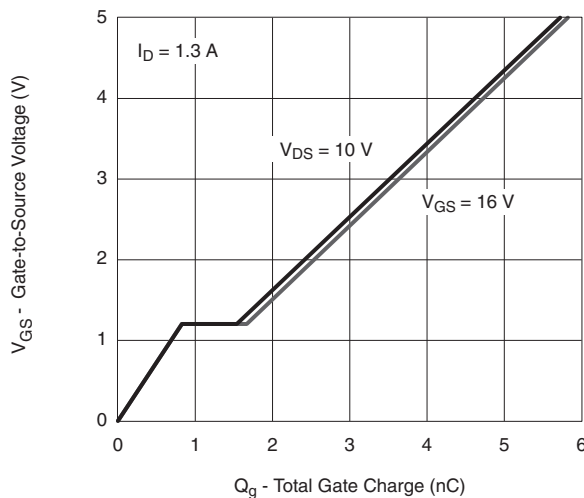
$V_{GS}$  - Gate-to-Source Voltage (V)  
**Transfer Characteristics Curves vs. Temp**



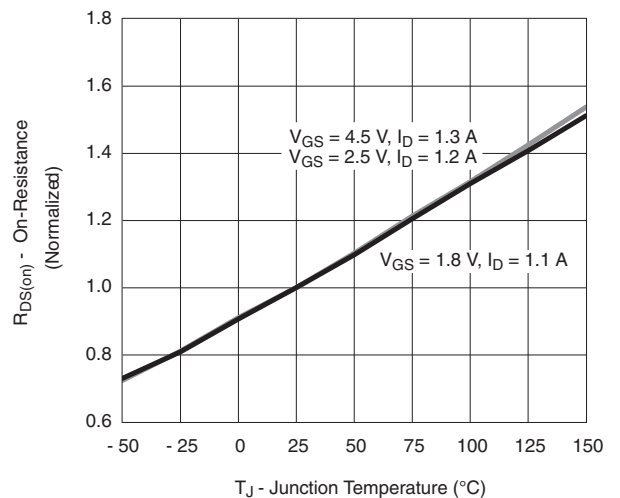
$I_D$  - Drain Current (A)  
**On-Resistance vs. Drain Current**



$V_{DS}$  - Drain-to-Source Voltage (V)  
**Capacitance**

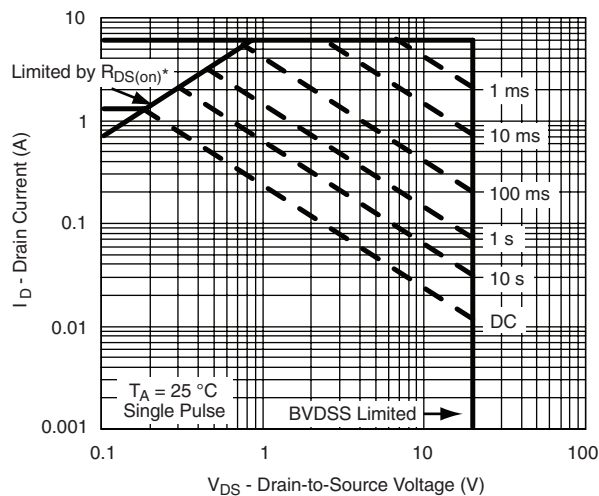
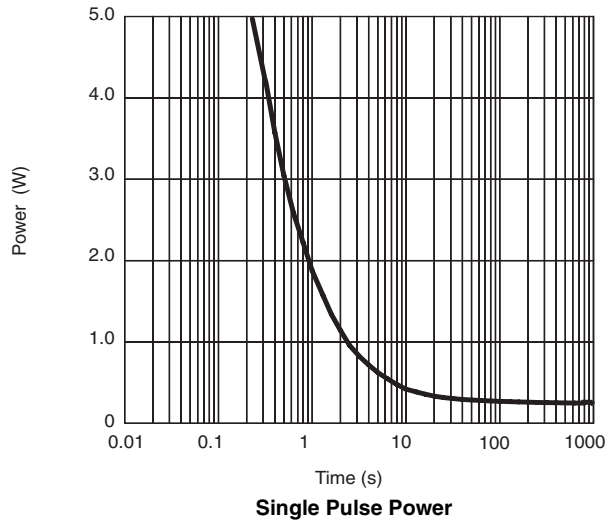
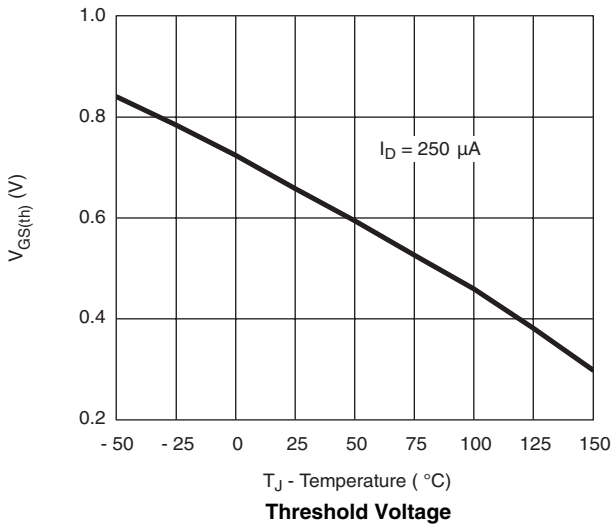
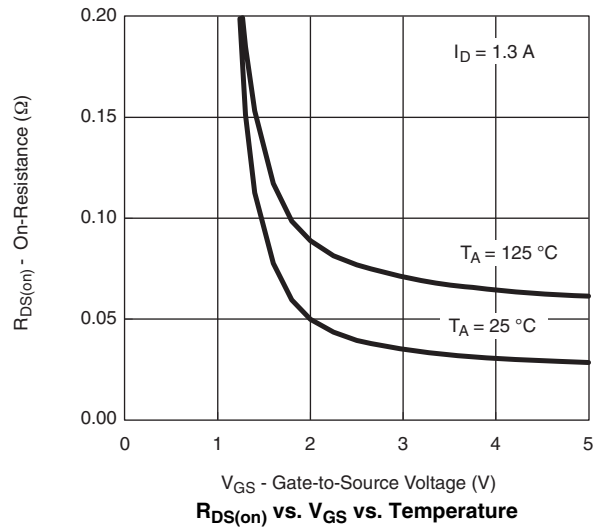
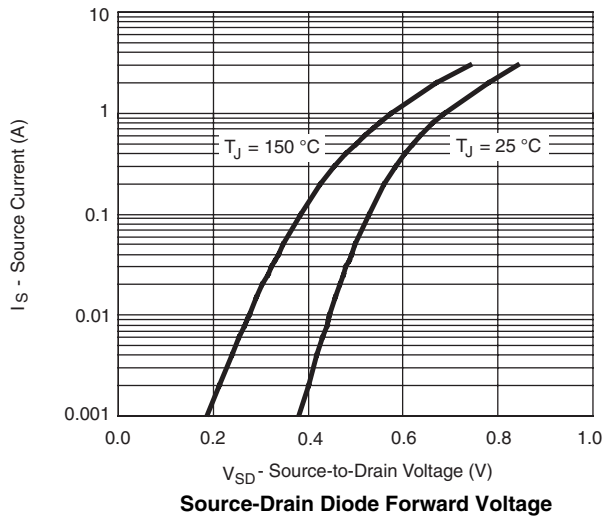


$Q_g$  - Gate Charge



**On-Resistance vs. Junction Temperature**

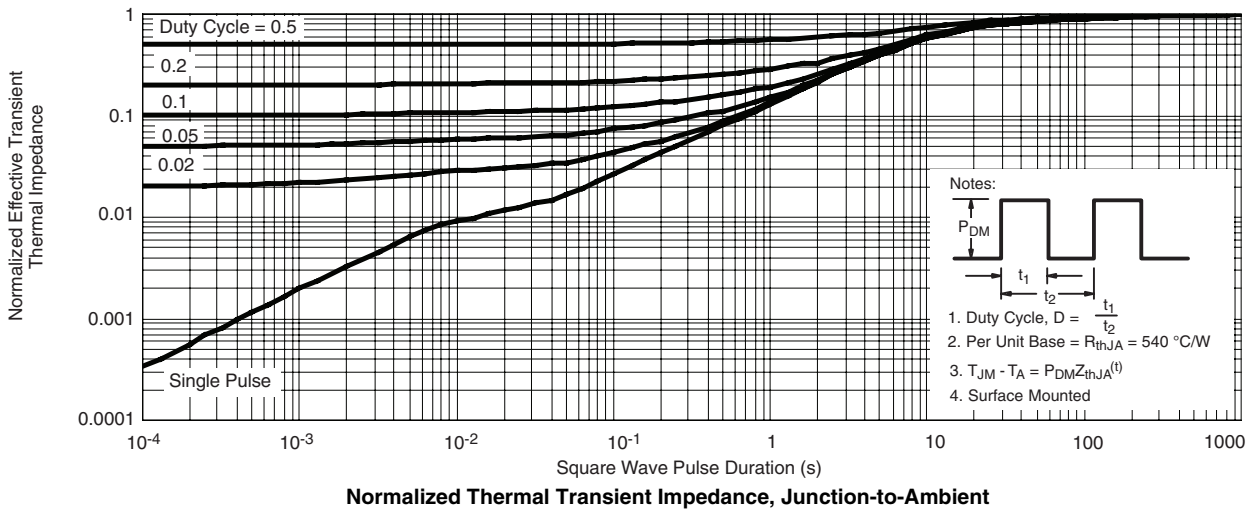
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

**Safe Operating Area, Junction-to-Ambient**

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



Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <http://www.vishay.com/ppg?73895>.



## Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.