

## P-Channel 60-V (D-S) MOSFET

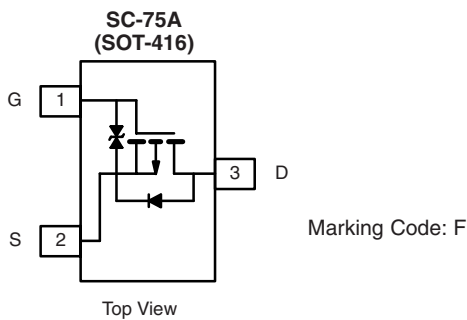
<b>PRODUCT SUMMARY</b>			
$V_{DS(min.)}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$V_{GS(th)}$ (V)	$I_D$ (mA)
- 60	4.0 at $V_{GS} = - 10$ V	- 1 to 3.0	- 190

### FEATURES

- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFETs
- High-Side Switching
- Low On-Resistance: 4  $\Omega$
- Low Threshold: - 2 V (typ.)
- Fast Switching Speed: 20 ns (typ.)
- Low Input Capacitance: 20 pF (typ.)
- Miniature Package
- ESD Protected: 2000 V



**RoHS**  
COMPLIANT



**Ordering Information:** Si1021R-T1-E3 (Lead (Pb)-free)  
Si1021R-T1-GE3 (Lead (Pb)-free and Halogen-free)

### APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Power Supply Converter Circuits
- Solid-State Relays

### BENEFITS

- Ease in Driving Switches
- Low Offset Voltage
- Low-Voltage Operation
- High-Speed Circuits
- Easily Driven without Buffer
- Small Board Area

<b>ABSOLUTE MAXIMUM RATINGS</b> $T_A = 25$ °C, unless otherwise noted			
Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	- 60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_A = 25$ °C	- 190
		$T_A = 85$ °C	- 135
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	- 650	mA
Power Dissipation <sup>a</sup>	$P_D$	$T_A = 25$ °C	250
		$T_A = 85$ °C	130
Maximum Junction-to-Ambient <sup>a</sup>	$R_{thJA}$	500	°C/W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

Notes:

- a. Surface mounted on FR4 board.  
b. Pulse width limited by maximum junction temperature.

<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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -10\text{ }\mu\text{A}$	- 60			V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -0.25\text{ mA}$	- 1		- 3.0	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$			$\pm 200$	
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}, T_J = 85\text{ }^\circ\text{C}$			$\pm 500$	
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -50\text{ V}, V_{GS} = 0\text{ V}$			- 25	
		$V_{DS} = -50\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$			- 250	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}$	- 50			mA
		$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}$	- 600			
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -25\text{ mA}$			8	
		$V_{GS} = -10\text{ V}, I_D = -500\text{ mA}$			4	$\Omega$
		$V_{GS} = -10\text{ V}, I_D = -500\text{ mA}, T_J = 125\text{ }^\circ\text{C}$			6	
Forward Transconductance	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -100\text{ mA}$	80			mS
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$V_{DS} = -200\text{ mA}, V_{GS} = 0\text{ V}$	80			V
<b>Dynamic</b>						
Total Gate Charge	$Q_g$	$V_{DS} = -30\text{ V}, V_{GS} = -15\text{ V}, I_D \cong -500\text{ mA}$		1.7		nC
Gate-Source Charge	$Q_{gs}$			0.26		
Gate-Drain Charge	$Q_{gd}$			0.46		
Input Capacitance	$C_{iss}$	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		23		pF
Output Capacitance	$C_{oss}$			10		
Reverse Transfer Capacitance	$C_{rss}$			5		
<b>Switching<sup>b</sup></b>						
Turn-On Time	$t_{ON}$	$V_{DD} = -25\text{ V}, R_L = 150\text{ }\Omega,$		20		ns
Turn-Off Time	$t_{OFF}$	$I_D \cong -200\text{ mA}, V_{GEN} = -10\text{ V}, R_G = 10\text{ }\Omega$		35		

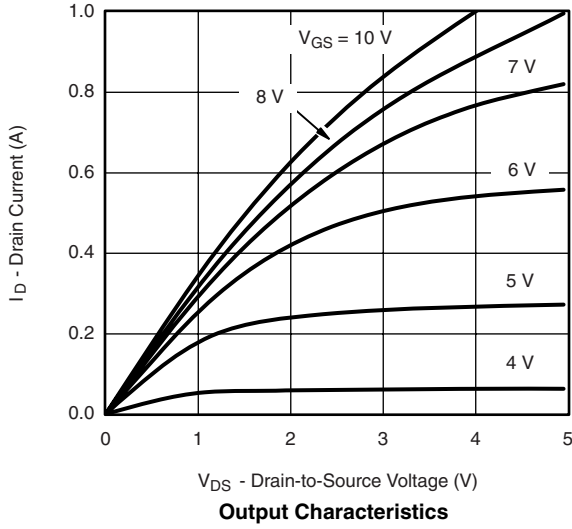
Notes:

a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

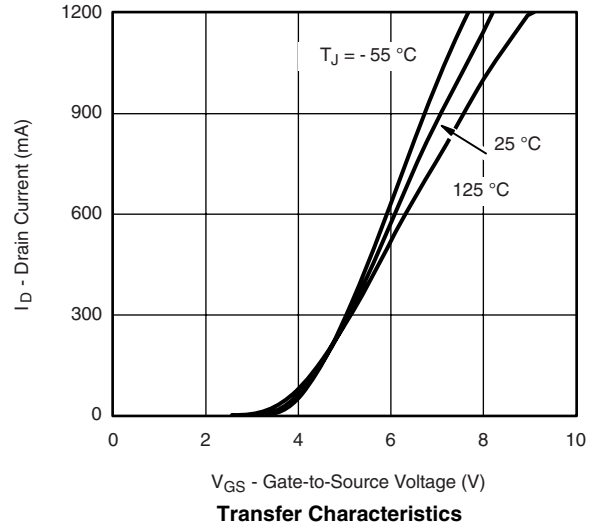
b. Switching time is essentially independent of operating temperature.

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.

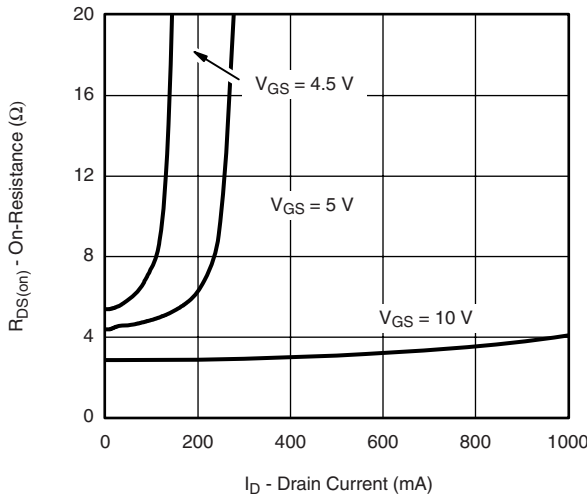
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



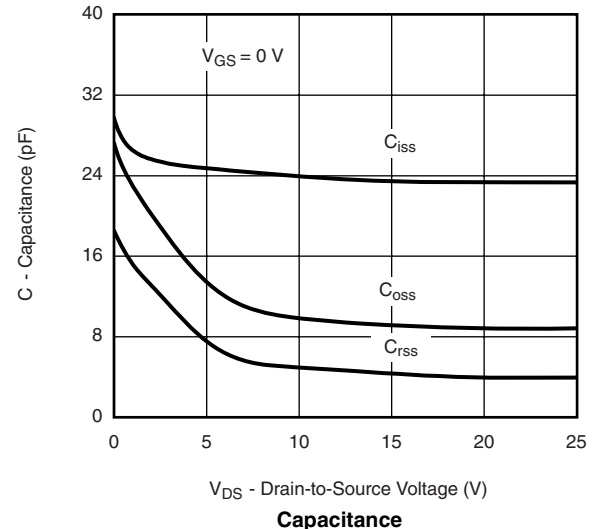
**Output Characteristics**



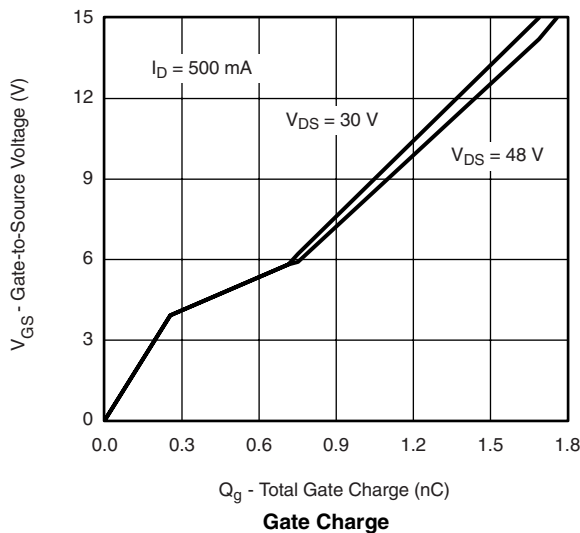
**Transfer Characteristics**



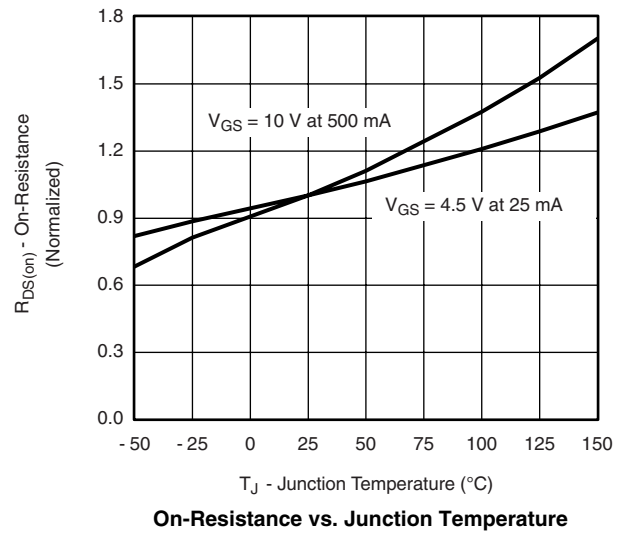
**On-Resistance vs. Drain Current**



**Capacitance**

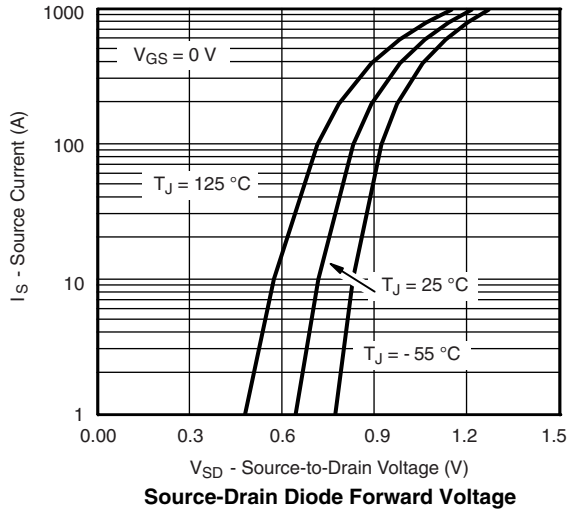


**Gate Charge**

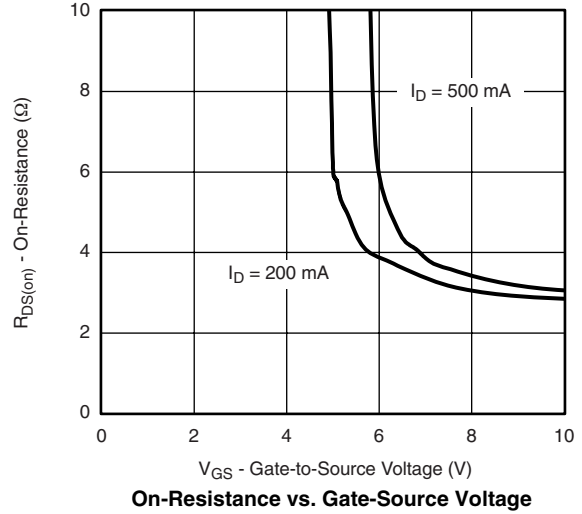


**On-Resistance vs. Junction Temperature**

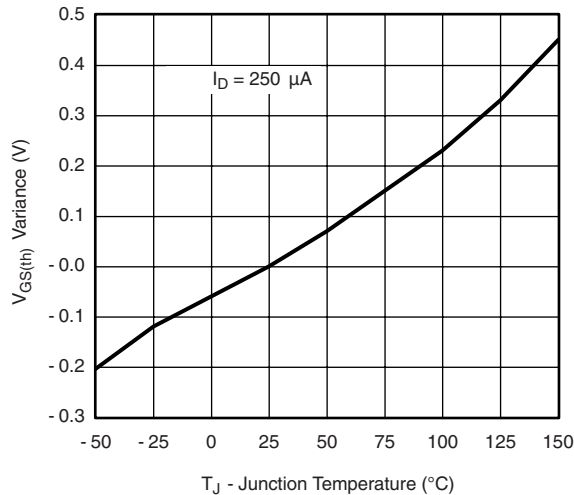
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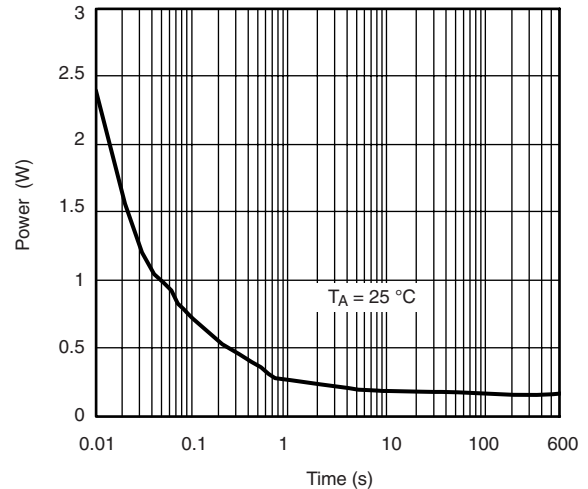
Source-Drain Diode Forward Voltage



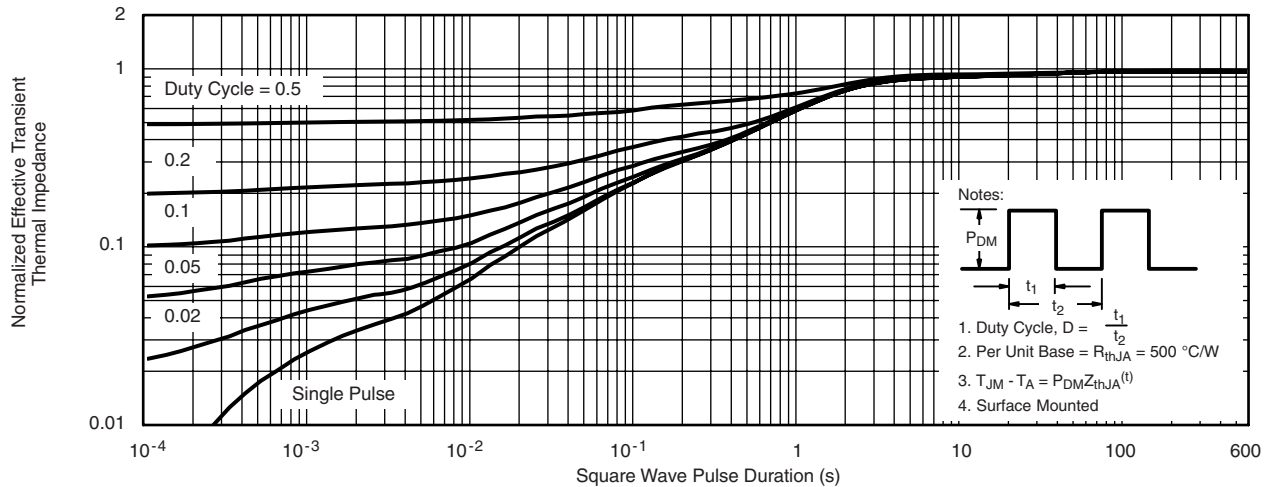
On-Resistance vs. Gate-Source Voltage



Threshold Voltage Variance Over Temperature



Single Pulse Power, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Ambient

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