

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

### PRODUCT SUMMARY

	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)
N-Channel	20	0.0145 at V <sub>GS</sub> = 10 V	9.6
		0.017 at V <sub>GS</sub> = 4.5 V	8.6
P-Channel	- 20	0.033 at V <sub>GS</sub> = - 4.5 V	- 6.2
		0.050 at V <sub>GS</sub> = - 2.5 V	- 5

### FEATURES

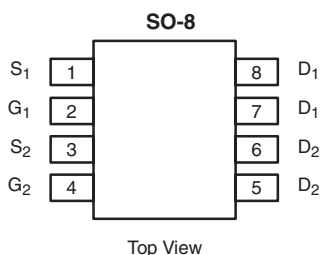
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- Compliant to RoHS directive 2002/95/EC



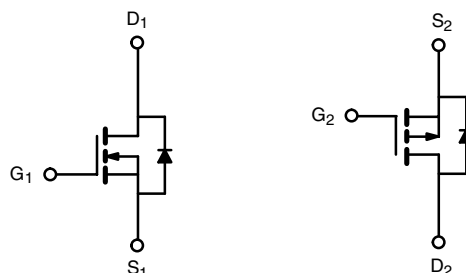
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### APPLICATIONS

- Level Shift
- Load Switch



**Ordering Information:** Si4511DY-T1-E3 (Lead (Pb)-free)  
Si4511DY-T1-GE3 (Lead (Pb)-free and Halogen-free)



### ABSOLUTE MAXIMUM RATINGS T<sub>A</sub> = 25 °C, unless otherwise noted

Parameter		Symbol	N-Channel		P-Channel		Unit
			10 s	Steady State	10 s	Steady State	
Drain-Source Voltage		V <sub>DS</sub>	20		- 20		V
Gate-Source Voltage		V <sub>GS</sub>	± 16		± 12		
Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a, b</sup>	T <sub>A</sub> = 25 °C	I <sub>D</sub>	9.6	7.2	- 6.2	- 4.6	A
	T <sub>A</sub> = 70 °C		7.7	5.8	- 4.9	- 3.7	
Pulsed Drain Current		I <sub>DM</sub>	40		- 40		
Continuous Source Current (Diode Conduction) <sup>a</sup>		I <sub>S</sub>	1.7	0.9	- 1.7	- 0.9	
Maximum Power Dissipation <sup>a</sup>	T <sub>A</sub> = 25 °C	P <sub>D</sub>	2	1.1	2	1.1	W
	T <sub>A</sub> = 70 °C		1.3	0.7	1.3	0.7	
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>sta</sub>	- 55 to 150				°C

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	N-Channel		P-Channel		Unit
		Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient <sup>a</sup>	R <sub>thJA</sub>	50	62.5	50	62.5	°C/W
		85	110	90	110	
Maximum Junction-to-Foot (Drain)	R <sub>thJF</sub>	30	40	30	35	

Notes:

a. Surface Mounted on 1" x 1" FR4 board.

b. t ≤ 10 s.

SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Unit
Static							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.6		1.8	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	- 0.6		- 1.4	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 16\text{ V}$	N-Ch			$\pm 100$	nA
		$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$	P-Ch			$\pm 100$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	N-Ch			1	$\mu\text{A}$
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	P-Ch			- 1	
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^{\circ}\text{C}$	N-Ch			5	
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^{\circ}\text{C}$	P-Ch			- 5	
On-State Drain Current <sup>b</sup>	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$	N-Ch	40			A
		$V_{DS} = -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	- 40			
Drain-Source On-State Resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 9.6\text{ A}$	N-Ch		0.0115	0.0145	$\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -6.2\text{ A}$	P-Ch		0.022	0.033	
		$V_{GS} = 4.5\text{ V}, I_D = 8.6\text{ A}$	N-Ch		0.0135	0.017	
		$V_{GS} = -2.5\text{ V}, I_D = -5\text{ A}$	P-Ch		0.035	0.050	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 9.6\text{ A}$	N-Ch		33		S
		$V_{DS} = -15\text{ V}, I_D = -6.2\text{ A}$	P-Ch		17		
Diode Forward Voltag <sup>b</sup>	$V_{SD}$	$I_S = 1.7\text{ A}, V_{GS} = 0\text{ V}$	N-Ch		0.8	1.2	V
		$I_S = -1.7\text{ A}, V_{GS} = 0\text{ V}$	P-Ch		- 0.8	- 1.2	
Dynamic <sup>a</sup>							
Total Gate Charge	$Q_g$	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 9.6\text{ A}$	N-Ch		11.5	18	nC
Gate-Source Charge	$Q_{gs}$		P-Ch		17	20	
Gate-Drain Charge	$Q_{gd}$	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -6.2\text{ A}$	N-Ch		3.7		
			P-Ch		4.1		
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}, R_L = 10\text{ }\Omega$ $I_D \equiv 1\text{ A}, V_{GEN} = 10\text{ V}, R_g = 6\text{ }\Omega$	N-Ch		12	20	ns
			P-Ch		25	40	
Rise Time	$t_r$		N-Ch		12	20	
			P-Ch		30	45	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -10\text{ V}, R_L = 10\text{ }\Omega$ $I_D \equiv -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 6\text{ }\Omega$	N-Ch		55	85	
			P-Ch		70	105	
Fall Time	$t_f$		N-Ch		15	25	
			P-Ch		50	75	
Source-Drain Reverse Recovery Time	$t_{rr}$	$I_F = 1.7\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}$	N-Ch		50	100	
		$I_F = -1.7\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}$	P-Ch		40	80	

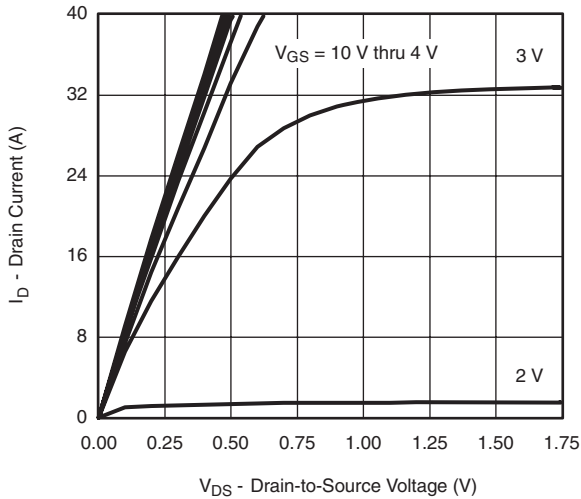
Notes:

a. Guaranteed by design, not subject to production testing.

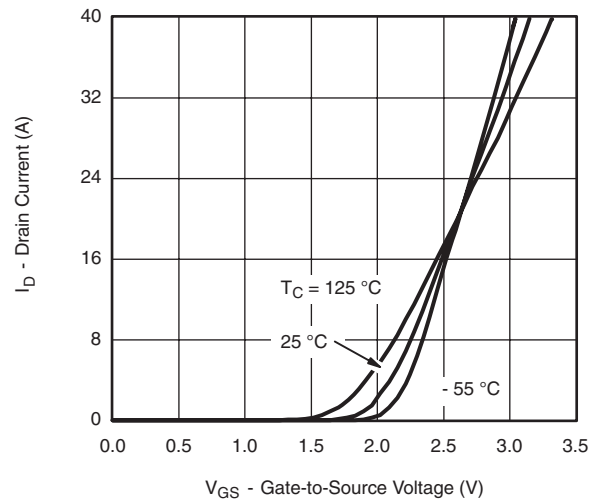
b. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

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.

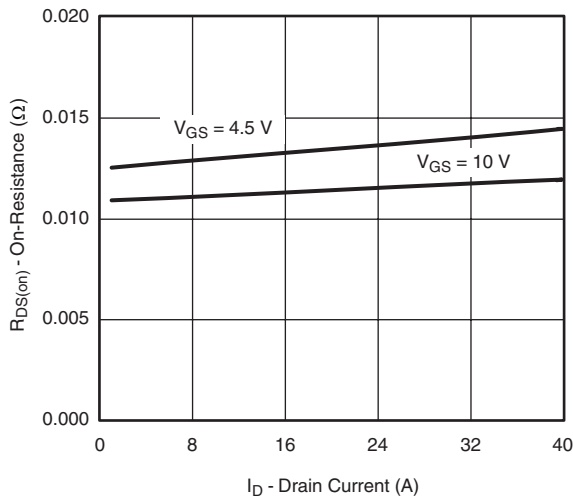
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



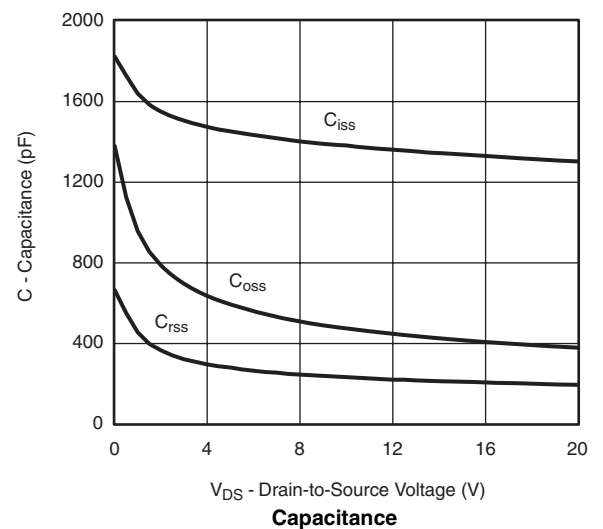
Output Characteristics



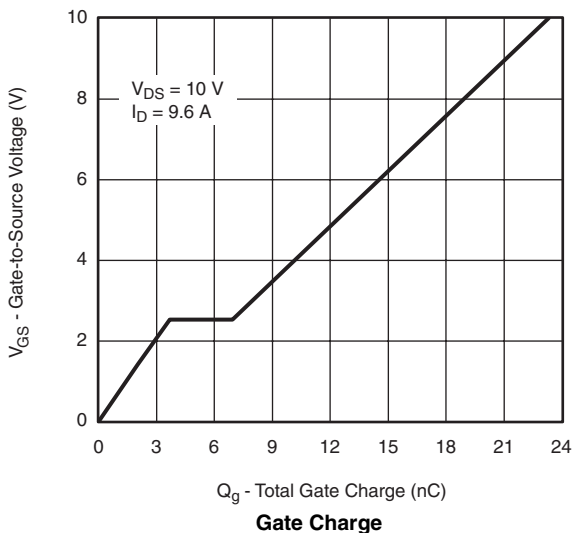
Transfer Characteristics



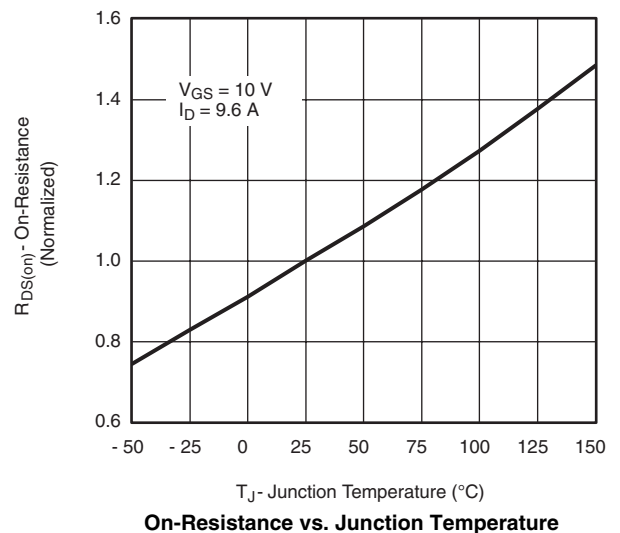
On-Resistance vs. Drain Current



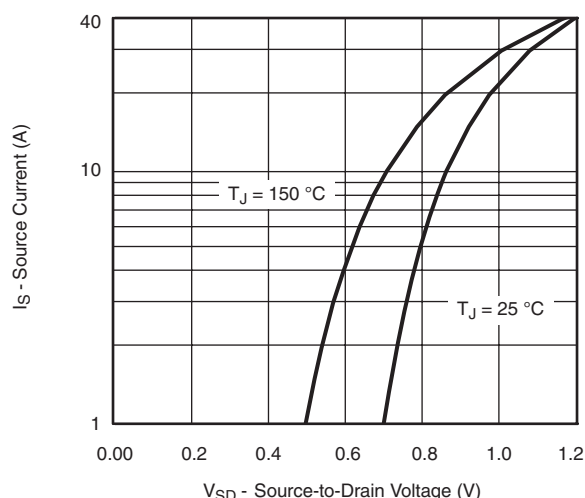
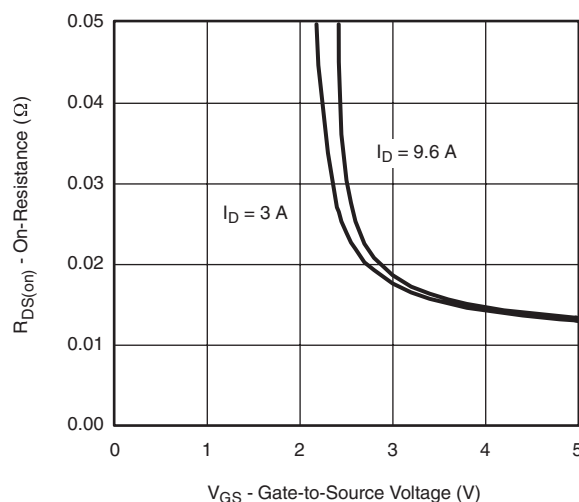
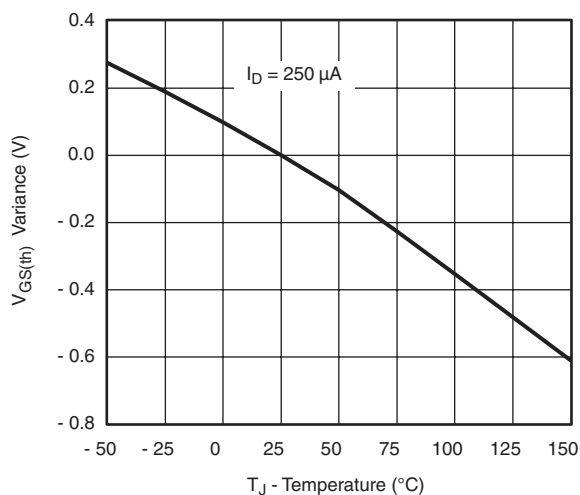
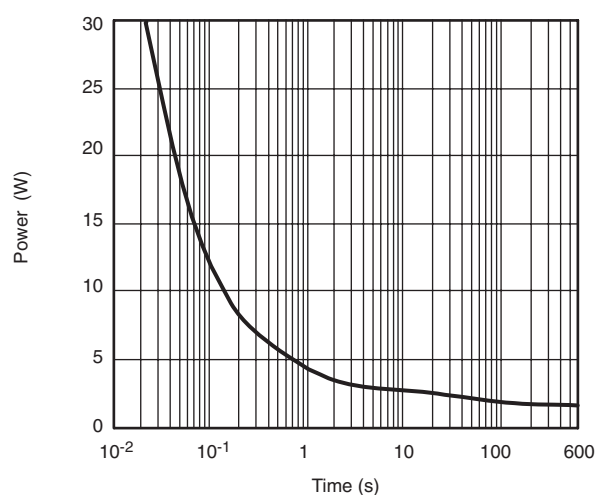
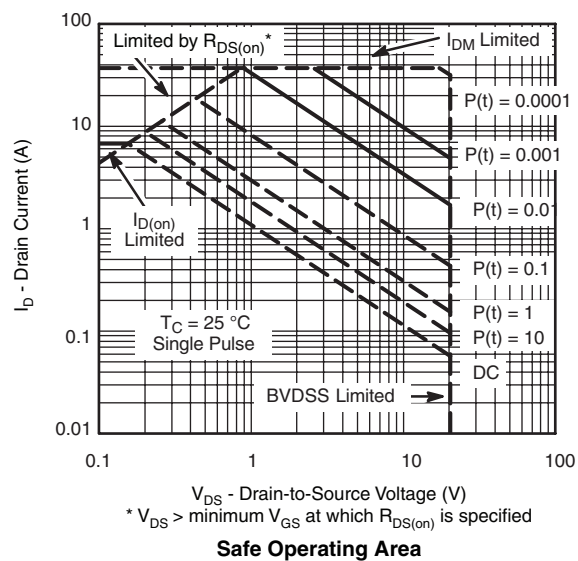
Capacitance



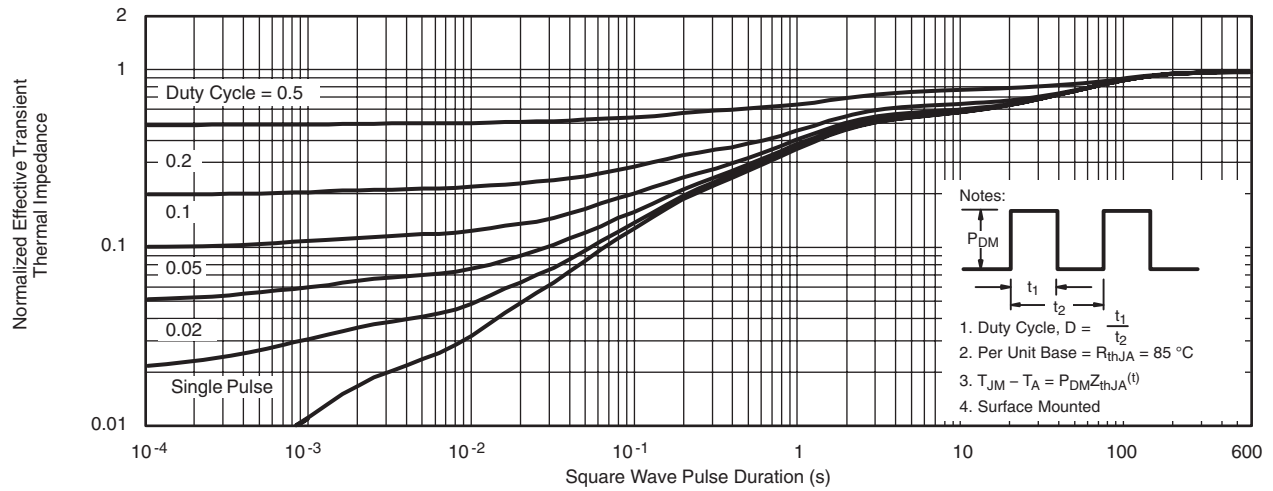
Gate Charge



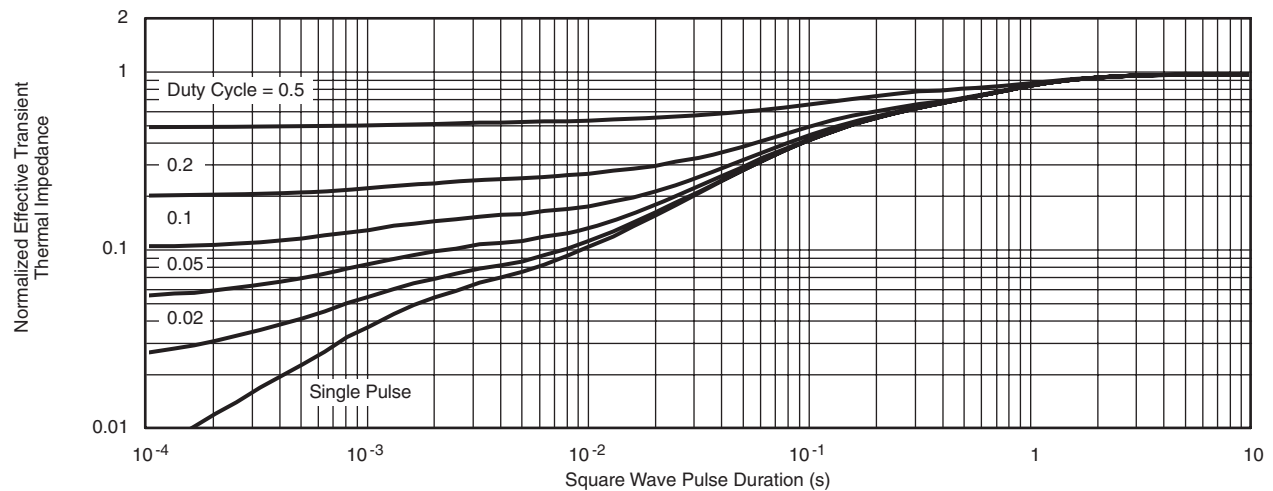
On-Resistance vs. Junction Temperature

**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Source-Drain Diode Forward Voltage****On-Resistance vs. Gate-to-Source Voltage****Threshold Voltage****Single Pulse Power**

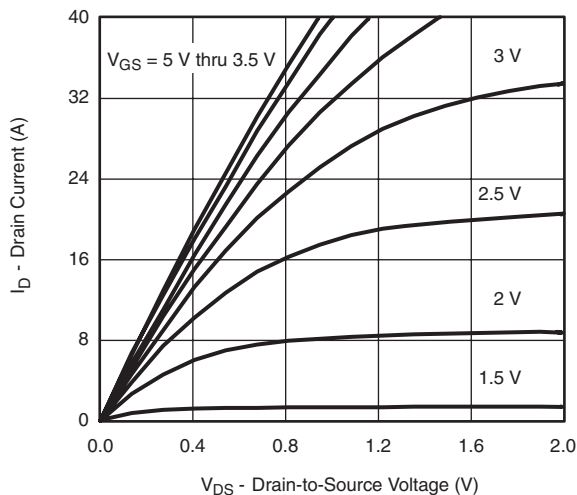
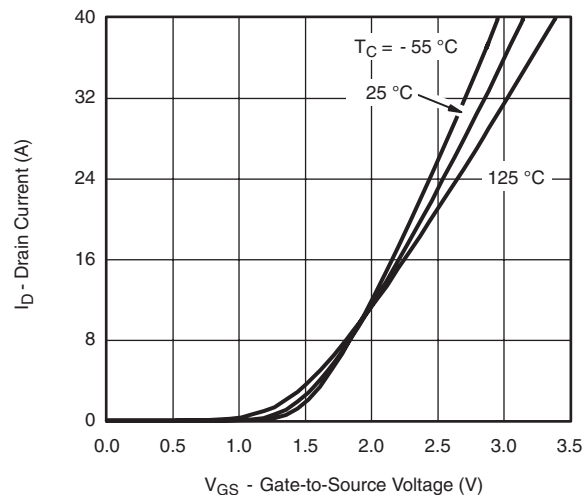
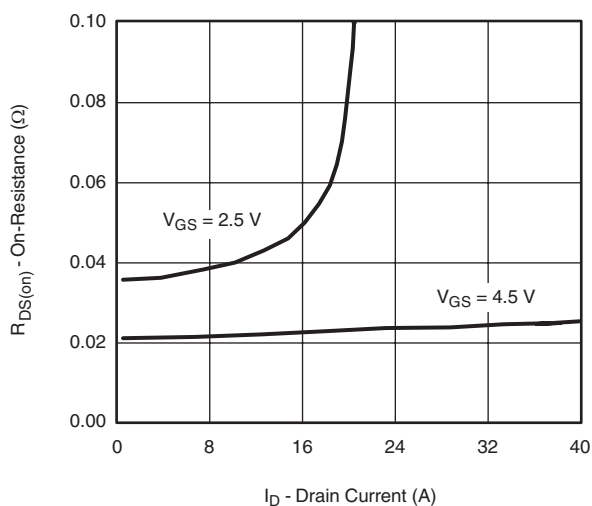
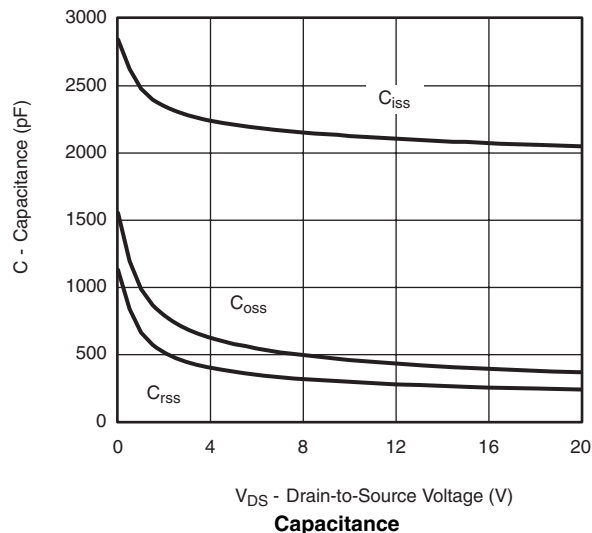
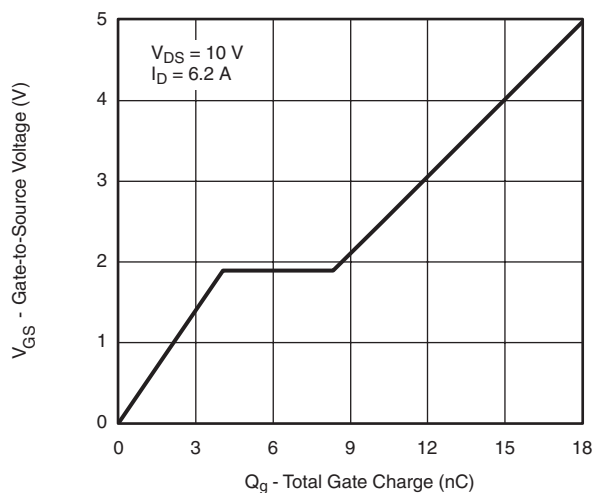
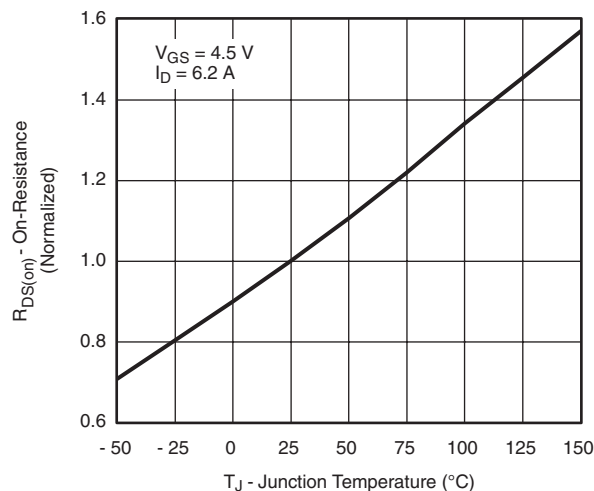
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



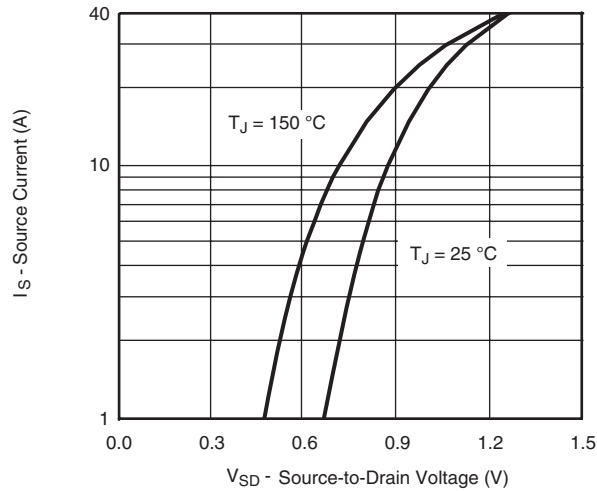
Normalized Thermal Transient Impedance, Junction-to-Ambient



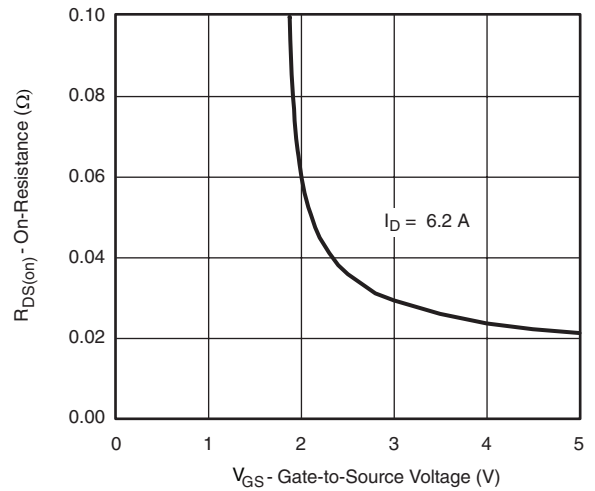
Normalized Thermal Transient Impedance, Junction-to-Foot

**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Output Characteristics****Transfer Characteristics****On-Resistance vs. Drain Current****Capacitance****Gate Charge****On-Resistance vs. Junction Temperature**

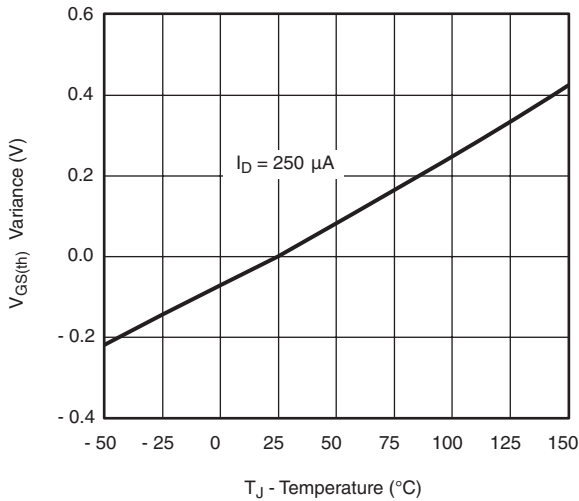
## P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



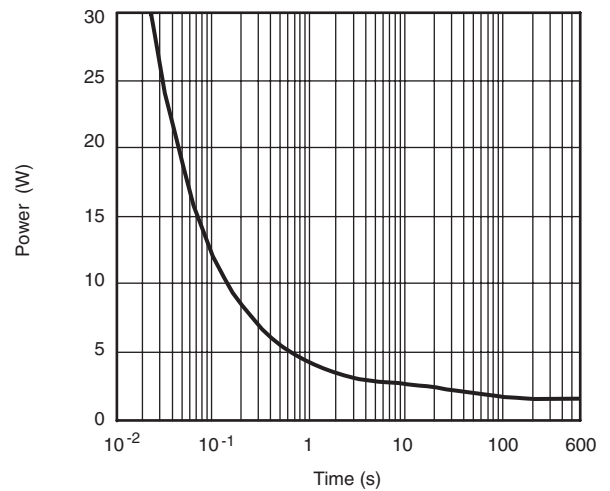
Source-Drain Diode Forward Voltage



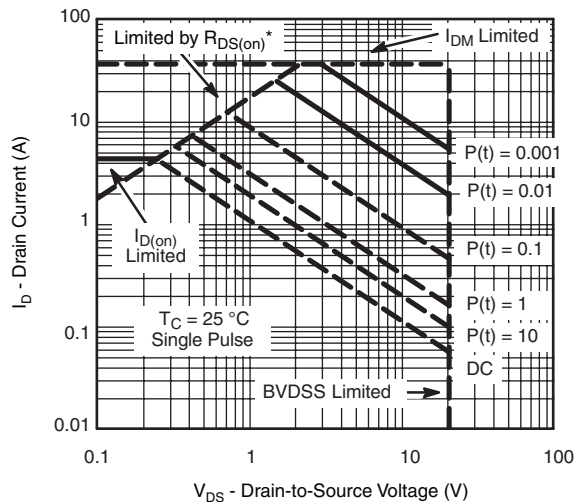
On-Resistance vs. Gate-to-Source Voltage



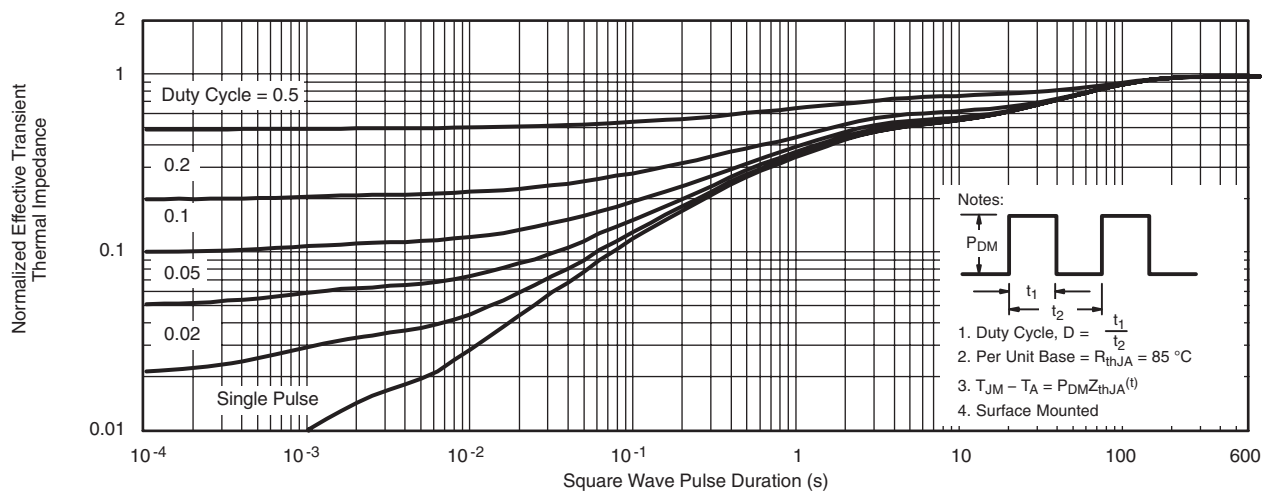
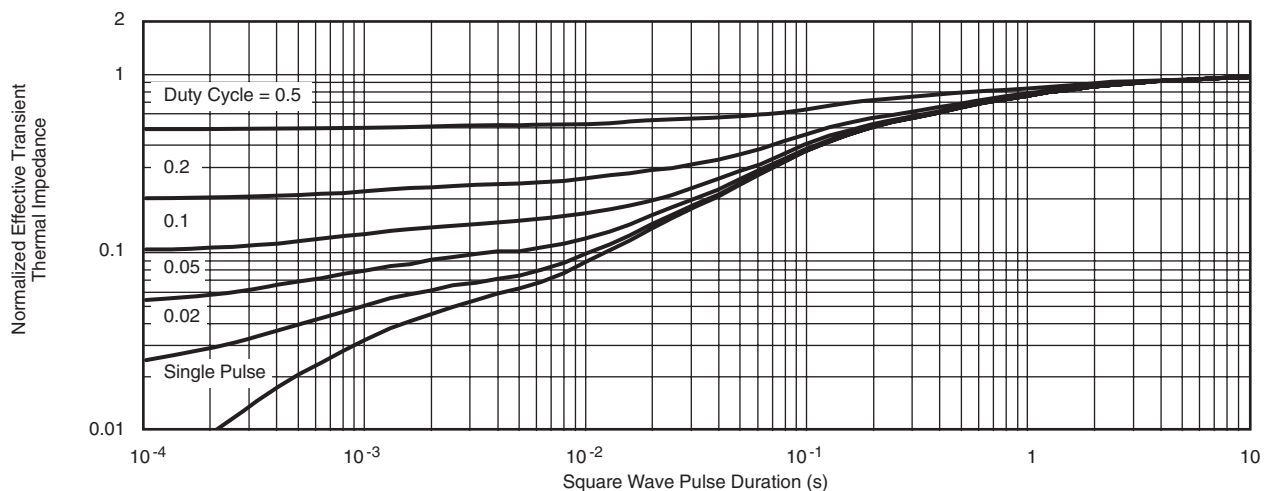
Threshold Voltage



Single Pulse Power



Safe Operating Area

**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Normalized Thermal Transient Impedance, Junction-to-Ambient****Normalized Thermal Transient Impedance, Junction-to-Foot**

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