

N- and P-Channel 40-V (D-S) MOSFET

PRODUCT SUMMARY				
	V _{DS} (V)	R _{DS(on)} (Ω)	I _D (A) ^a	Q _g (Typ.)
N-Channel	40	0.125 at V _{GS} = 10 V	2.250	2.2
		0.165 at V _{GS} = 4.5 V	1.95	
P-Channel	- 40	0.215 at V _{GS} = - 10 V	- 1.76	2.3
		0.335 at V _{GS} = - 4.5 V	- 1.4	

FEATURES

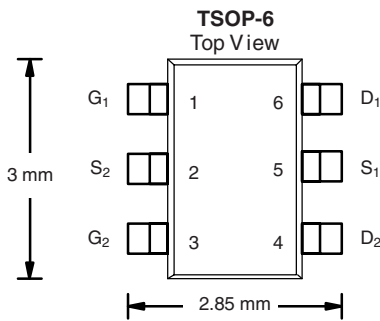
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET[®] Power MOSFETs
- Compliant to RoHS Directive 2002/95/EC



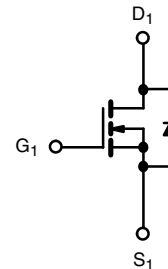
RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

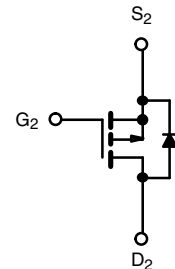
- Stepper Motor
- Motor Drives



Ordering Information: Si3529DV-T1-E3 (Lead (Pb)-free)
Si3529DV-T1-GE3 (Lead (Pb)-free and Halogen-free)



N-Channel MOSFET



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS T _A = 25 °C, unless otherwise noted					
Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	V _{DS}	40	- 40	V	
Gate-Source Voltage	V _{GS}	± 20			
Continuous Drain Current (T _J = 150 °C)	I _D	T _C = 25 °C	2.5	- 1.95	A
		T _C = 70 °C	2.0	- 1.56	
		T _A = 25 °C	2.25 ^{b, c}	- 1.76 ^{b, c}	
		T _A = 70 °C	1.8 ^{b, c}	- 1.4 ^{b, c}	
Pulsed Drain Current (10 μs Pulse Width)	I _{DM}	10	- 6	A	
Source-Drain Current Diode Current	I _S	T _C = 25 °C	1.26		- 1.26
		T _A = 25 °C	1.05 ^{b, c}		- 1.05 ^{b, c}
Pulsed Source-Drain Current	I _{SM}	10	- 6		mJ
Single Pulse Avalanche Current	L = 0.1 mH	I _{AS}	5	5	
Single Pulse Avalanche Energy		E _{AS}	1.25	1.25	
Maximum Power Dissipation	P _D	T _C = 25 °C	1.4	1.4	W
		T _C = 70 °C	0.9	0.9	
		T _A = 25 °C	1.15 ^{b, c}	1.15 ^c	
		T _A = 70 °C	0.7 ^{b, c}	0.78 ^{b, c}	
Operating Junction and Storage Temperature Range	T _J , T _{stg}	- 55 to 150		°C	

THERMAL RESISTANCE RATINGS							
Parameter	Symbol	N-Channel		P-Channel		Unit	
		Typ.	Max.	Typ.	Max.		
Maximum Junction-to-Ambient ^{b, d}	t ≤ 10 sec	R _{thJA}	93	110	93	110	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R _{thJF}	75	90	75	90	

Notes:

a. Based on T_C = 25 °C.

b. Surface Mounted on 1" x 1" FR4 Board.

c. t = 10 s.

d. Maximum under Steady State conditions is 150 °C/W (N-Channel) and 150 °C/W (P-Channel).

SPECIFICATIONS $T_J = 25^\circ\text{C}$, unless otherwise noted								
Parameter	Symbol	Test Conditions		Min.	Typ. ^a	Max.	Unit	
Static								
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	N-Ch	40			V	
		$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	P-Ch	-40				
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\ \mu\text{A}$	N-Ch		40		mV/°C	
		$I_D = -250\ \mu\text{A}$	P-Ch		-40			
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\ \mu\text{A}$	N-Ch		-5.4			
		$I_D = -250\ \mu\text{A}$	P-Ch		3.7			
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	N-Ch	1		3	V	
		$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	P-Ch	-1		-3		
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$	N-Ch			100	nA	
			P-Ch			-100		
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	N-Ch			1	μA	
			P-Ch			-1		
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55^\circ\text{C}$	N-Ch			10		
			P-Ch			-10		
On-State Drain Current ^b	$I_{D(on)}$	$V_{DS} = 5\text{ V}, V_{GS} = 10\text{ V}$	N-Ch	10			A	
		$V_{DS} = -5\text{ V}, V_{GS} = -10\text{ V}$	P-Ch	-6				
Drain-Source On-State Resistance ^b	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 2.2\text{ A}$	N-Ch		0.100	0.125	Ω	
		$V_{GS} = -10\text{ V}, I_D = -1.7\text{ A}$	P-Ch		0.172	0.215		
		$V_{GS} = 4.5\text{ V}, I_D = 1.9\text{ A}$	N-Ch		0.130	0.165		
		$V_{GS} = -4.5\text{ V}, I_D = -1.4\text{ A}$	P-Ch		0.268	0.335		
Forward Transconductance ^b	g_{fs}	$V_{DS} = 15\text{ V}, I_D = 2.2\text{ A}$	N-Ch		2		S	
		$V_{DS} = -15\text{ V}, I_D = -3.6\text{ A}$	P-Ch		1.3			
Dynamic^a								
Input Capacitance	C_{iss}	N-Channel $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		205		pF	
			P-Ch		175			
Output Capacitance	C_{oss}		P-Channel $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		33		
				P-Ch		35		
Reverse Transfer Capacitance	C_{rss}			N-Ch		17		
				P-Ch		21		
Total Gate Charge	Q_g		$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 2.25\text{ A}$	N-Ch		4.6	7.0	nC
				P-Ch		4.8	7.2	
	$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 2.25\text{ A}$	N-Ch		2.2	3.3			
		P-Ch		2.3	3.5			
Gate-Source Charge	Q_{gs}	P-Channel $V_{DS} = -20\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.8\text{ A}$	N-Ch		1.0			
	P-Ch			0.8				
Gate-Drain Charge	Q_{gd}		N-Ch		0.9			
			P-Ch		1.1			
Gate Resistance	R_g	$f = 1\text{ MHz}$	N-Ch		2.7	4.1	Ω	
			P-Ch		12.0			



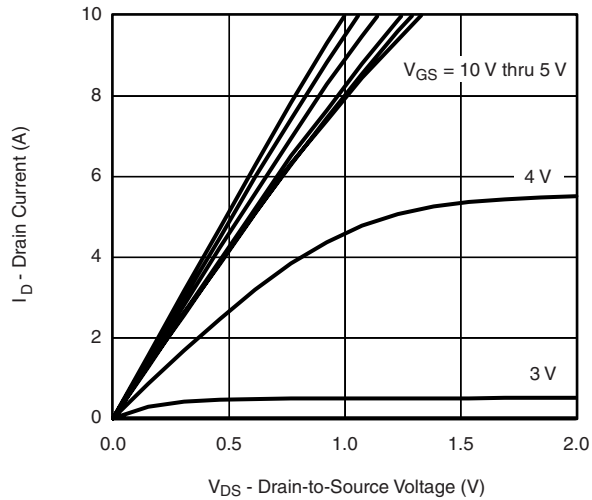
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ. ^a	Max.	Unit	
Dynamic^a							
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong 1\text{ A}$, $V_{GEN} = 10\text{ V}$, $R_g = 1\ \Omega$	N-Ch		2.5	4	ns
Rise Time	t_r		P-Ch		5	7.5	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong -1\text{ A}$, $V_{GEN} = -10\text{ V}$, $R_g = 1\ \Omega$	N-Ch		12.5	20	
Fall Time	t_f		P-Ch		12.5	20	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong 1\text{ A}$, $V_{GEN} = 4.5\text{ V}$, $R_g = 1\ \Omega$	N-Ch		8	12	
Rise Time	t_r		P-Ch		10	15	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong -1\text{ A}$, $V_{GEN} = -4.5\text{ V}$, $R_g = 16\ \Omega$	N-Ch		6.0	9	
Fall Time	t_f		P-Ch		7.5	12	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong 1\text{ A}$, $V_{GEN} = 4.5\text{ V}$, $R_g = 1\ \Omega$	N-Ch		13	20	
Rise Time	t_r		P-Ch		23	35	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong -1\text{ A}$, $V_{GEN} = -4.5\text{ V}$, $R_g = 16\ \Omega$	N-Ch		65	100	
Fall Time	t_f		P-Ch		38	60	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong 1\text{ A}$, $V_{GEN} = 4.5\text{ V}$, $R_g = 1\ \Omega$	N-Ch		5	7.5	
Rise Time	t_r		P-Ch		20	30	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -20\text{ V}$, $R_L = 4\ \Omega$ $I_D \cong -1\text{ A}$, $V_{GEN} = -4.5\text{ V}$, $R_g = 16\ \Omega$	N-Ch		8	12	
Fall Time	t_f		P-Ch		16	25	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$	N-Ch			1.05	A
Pulse Diode Forward Current ^a	I_{SM}		P-Ch			-1.05	
Body Diode Voltage	V_{SD}	$I_S = 1.0\text{ A}$	N-Ch		0.8	1.2	V
Body Diode Reverse Recovery Time	t_{rr}		P-Ch		-0.8	-1.2	
Body Diode Reverse Recovery Charge	Q_{rr}	N-Channel $I_F = 2\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^\circ\text{C}$	N-Ch		20	40	ns
Reverse Recovery Fall Time	t_a	P-Channel $I_F = -2\text{ A}$, $dI/dt = -100\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^\circ\text{C}$	P-Ch		26	40	
Reverse Recovery Rise Time	t_b			N-Ch		20	30
			P-Ch		22	35	
			N-Ch		17		ns
			P-Ch		12		
			N-Ch		3		ns
			P-Ch		14		

Notes:

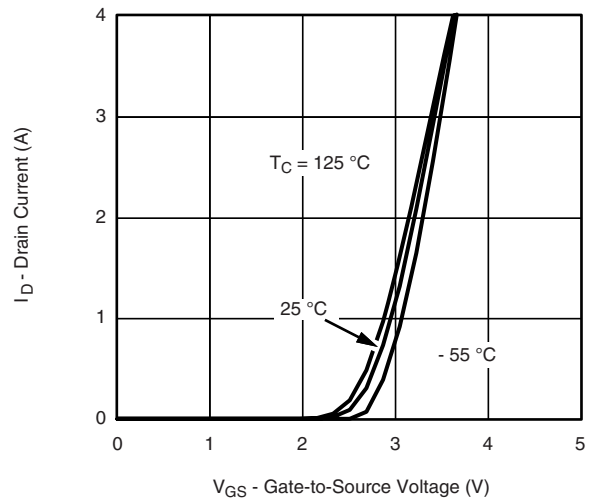
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.

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.

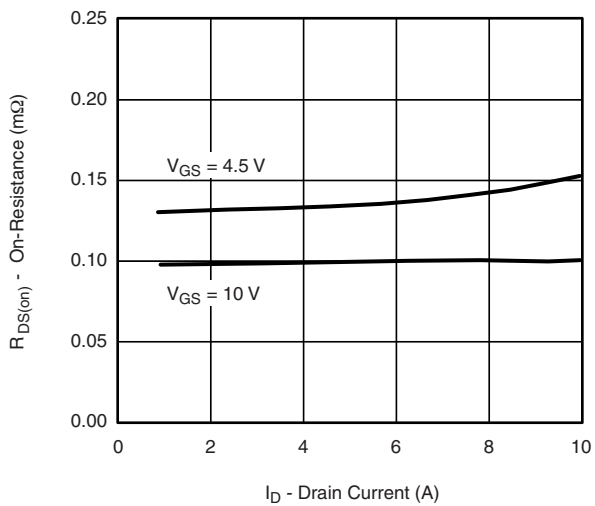
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



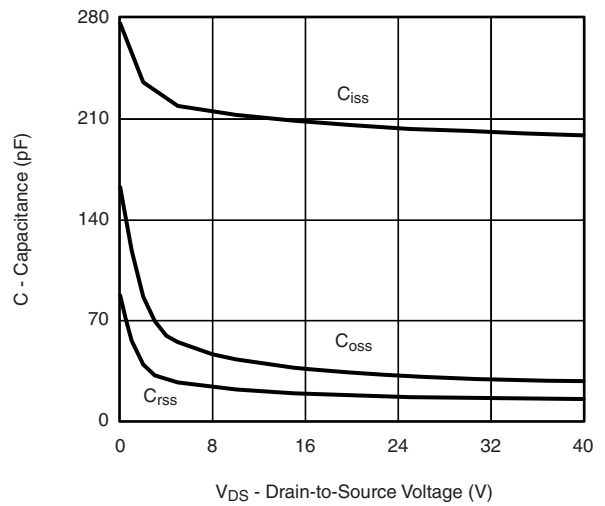
Output Characteristics



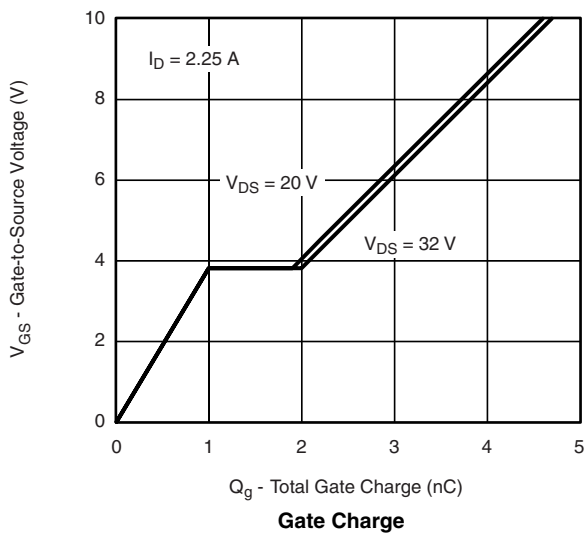
Transfer Characteristics



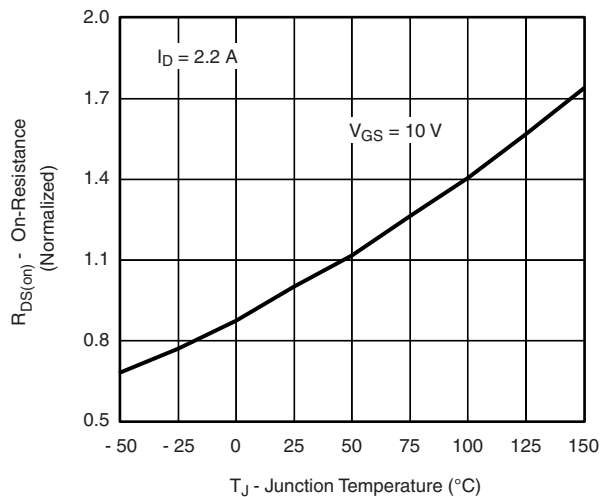
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

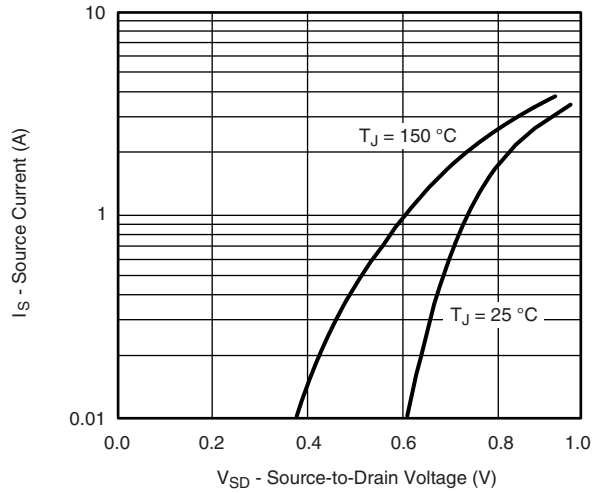


Gate Charge

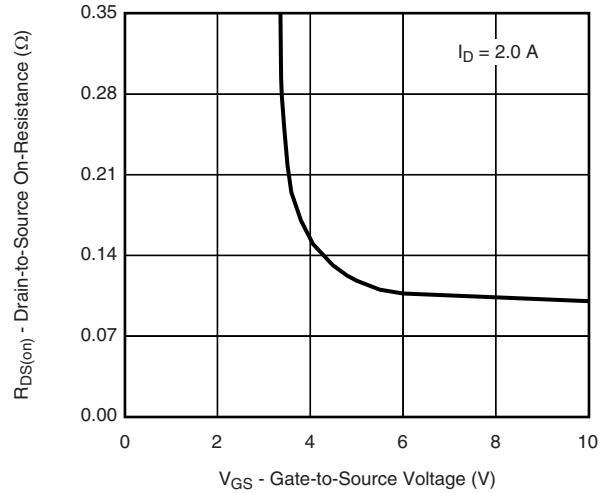


On-Resistance vs. Junction Temperature

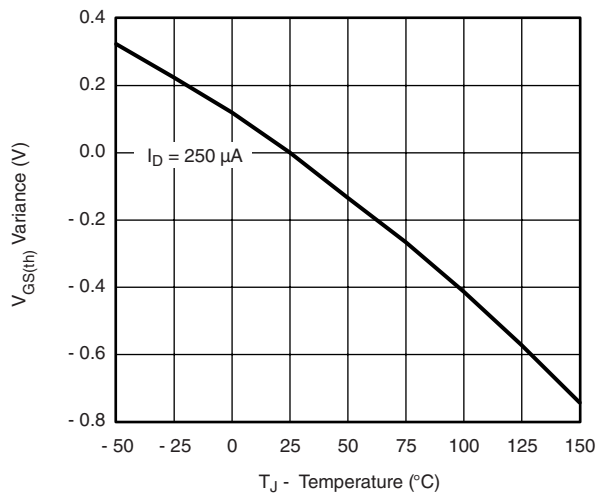
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



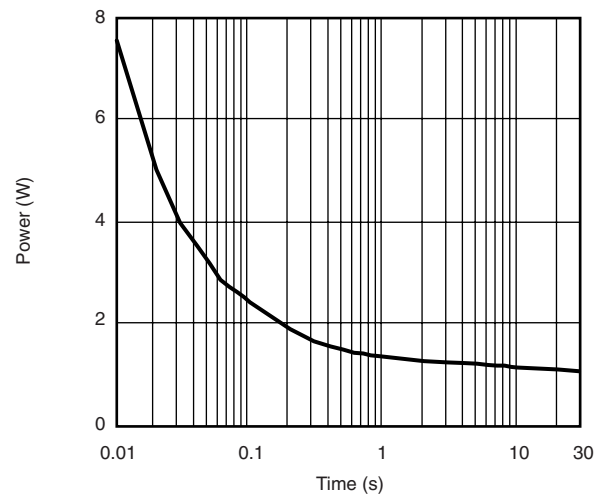
Source-Drain Diode Forward Voltage



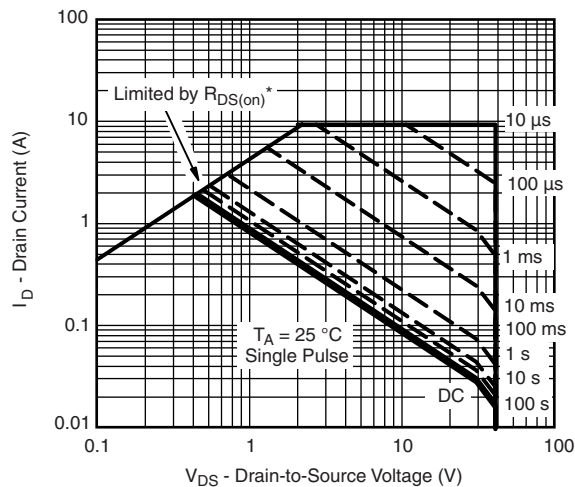
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



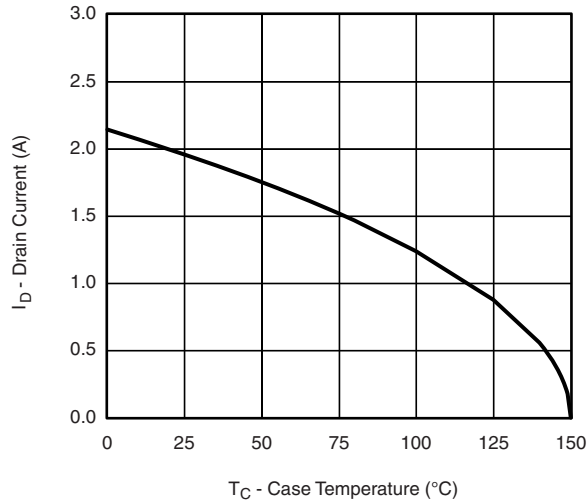
Single Pulse Power, Junction-to-Ambient



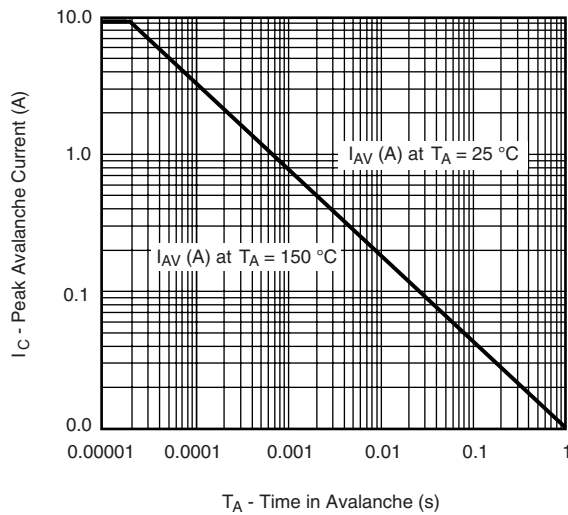
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

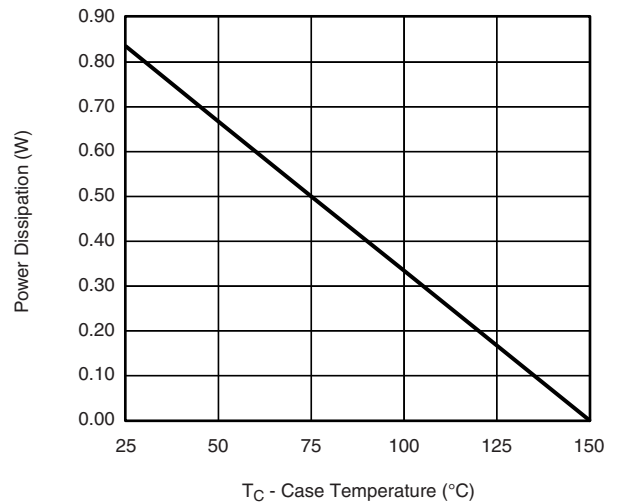
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



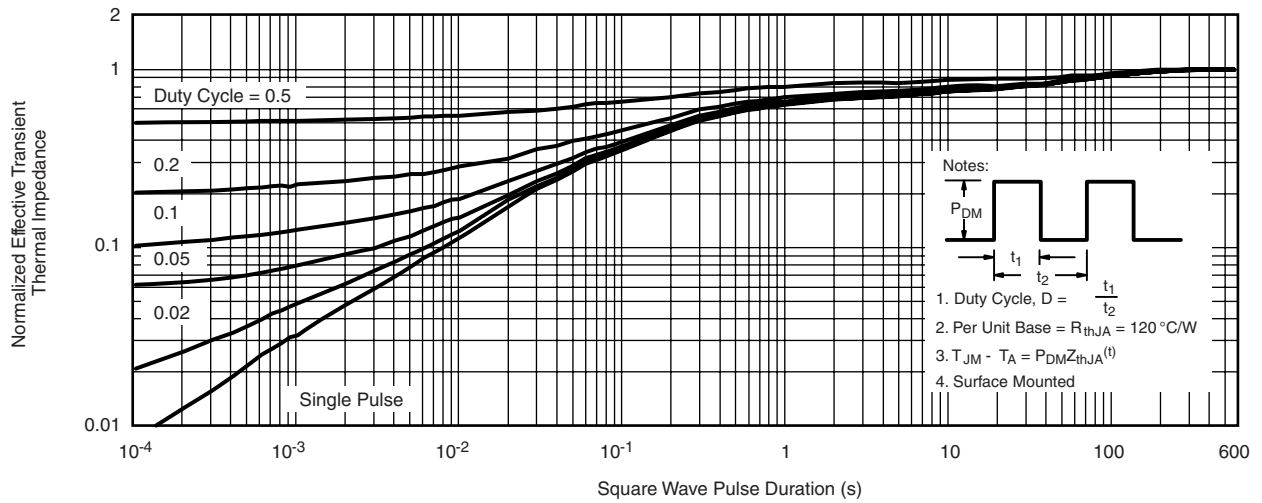
Single Pulse Avalanche Capability



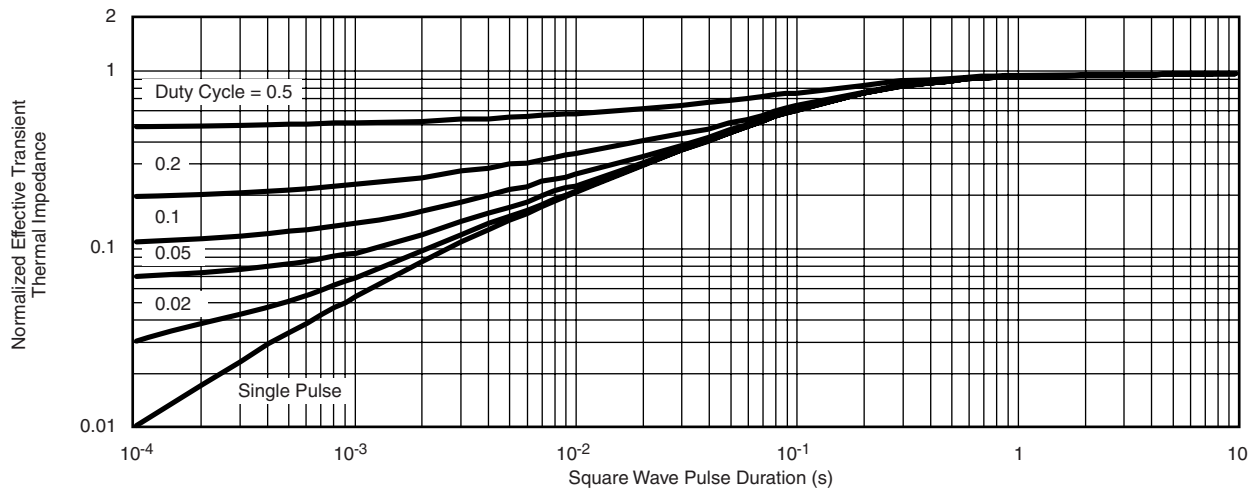
Power Derating, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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

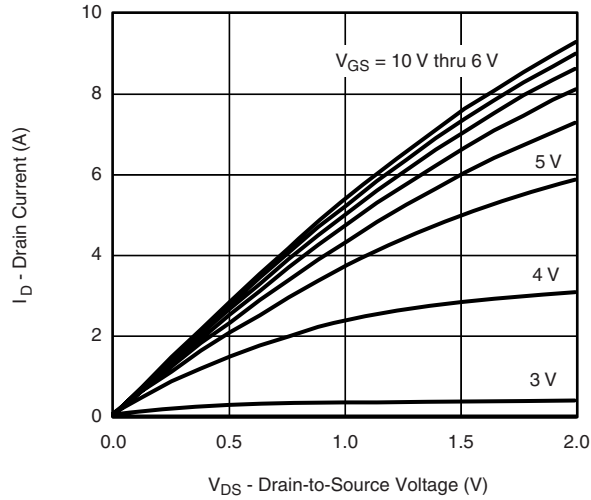


Normalized Thermal Transient Impedance, Junction-to-Ambient

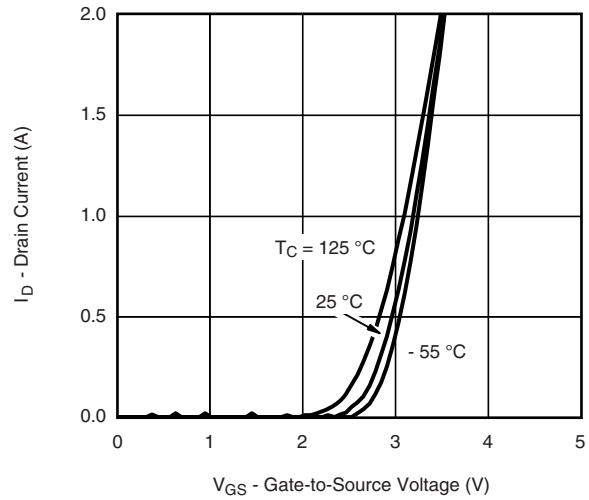


Normalized Thermal Transient Impedance, Junction-to-Foot

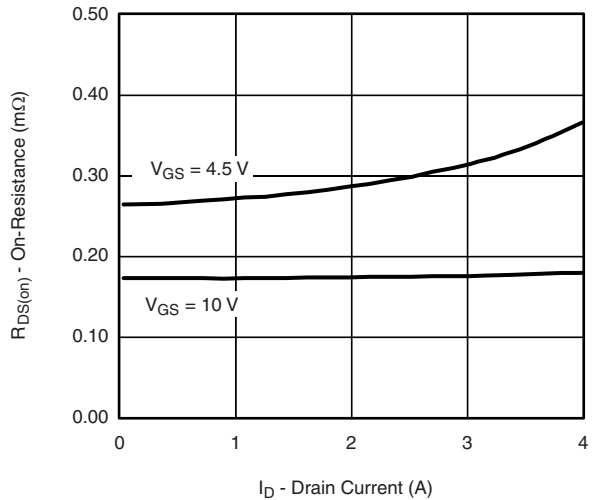
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



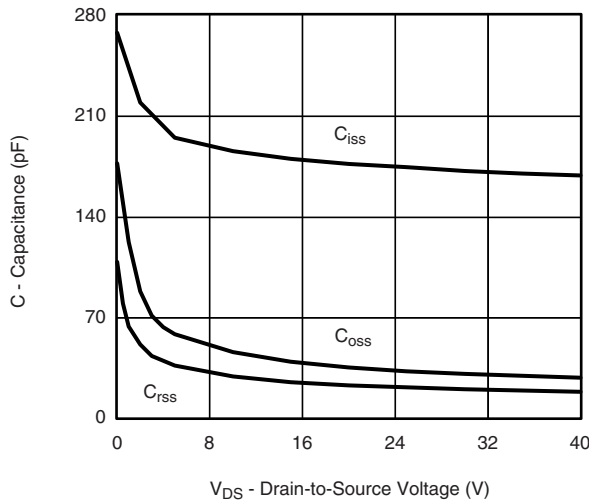
Output Characteristics



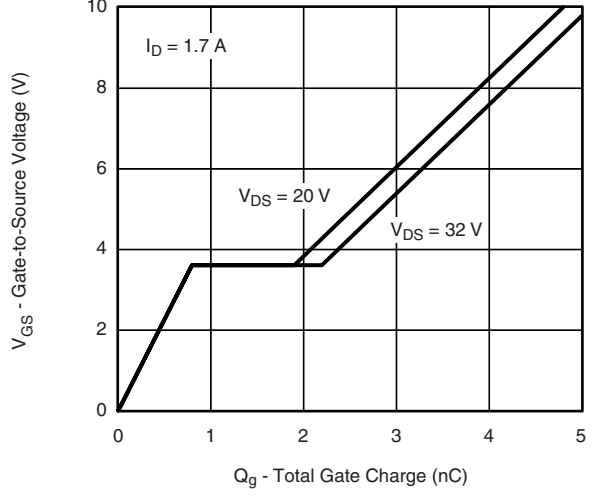
Transfer Characteristics



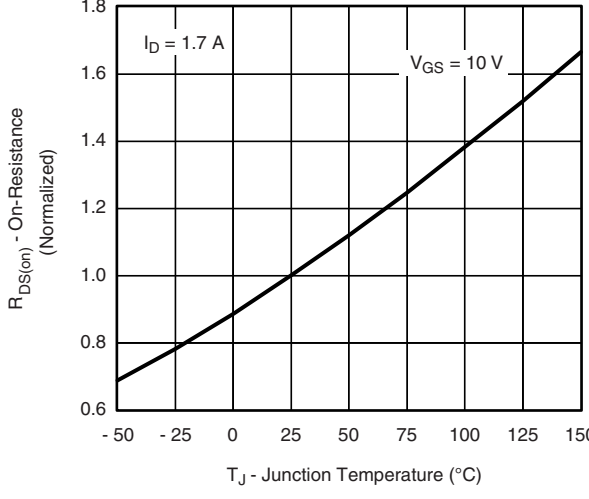
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

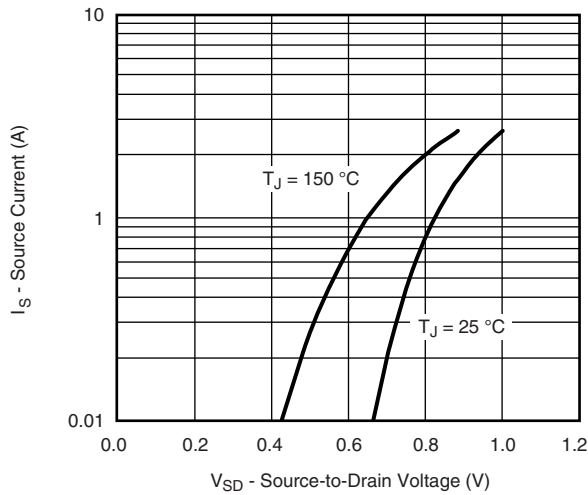


Gate Charge

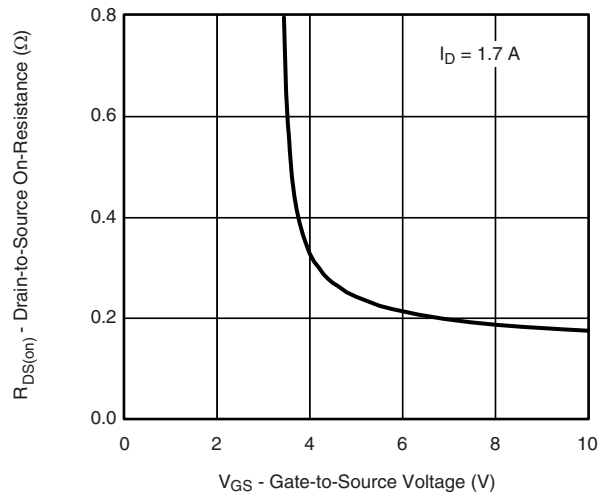


On-Resistance vs. Junction Temperature

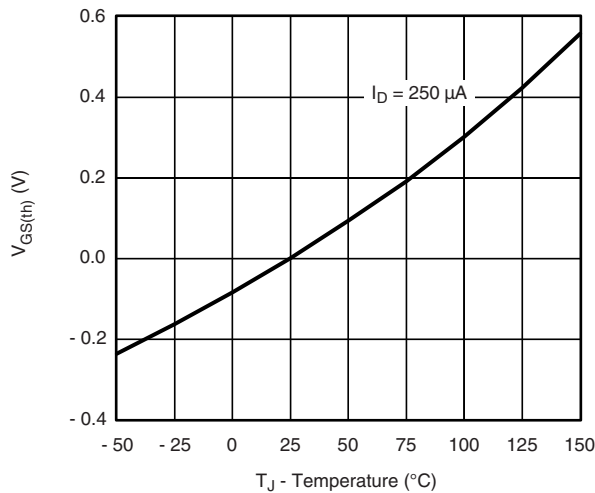
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



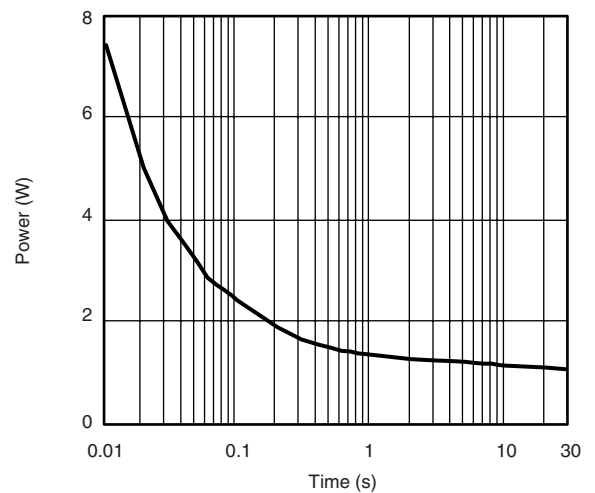
Source-Drain Diode Forward Voltage



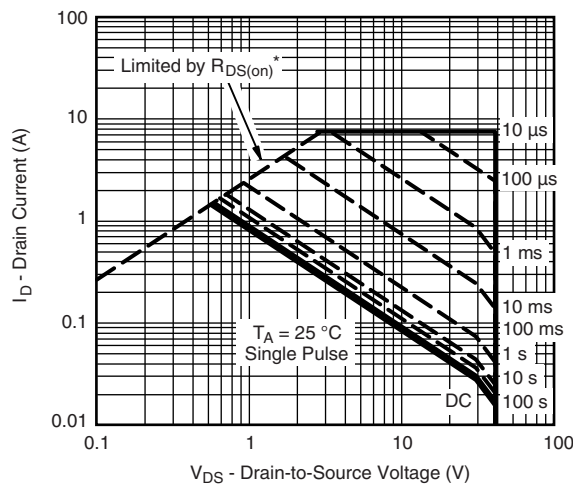
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



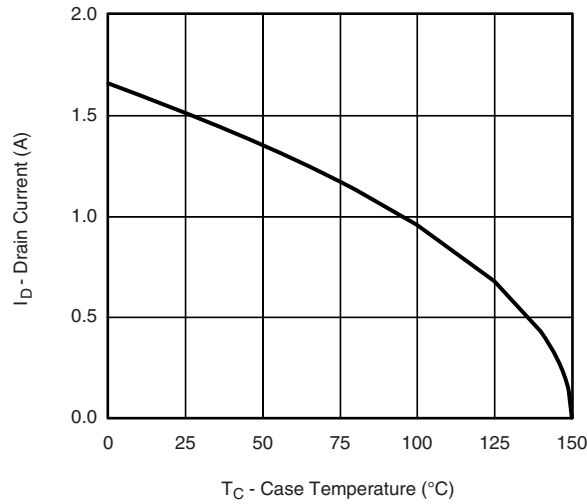
Single Pulse Power, Junction-to-Ambient



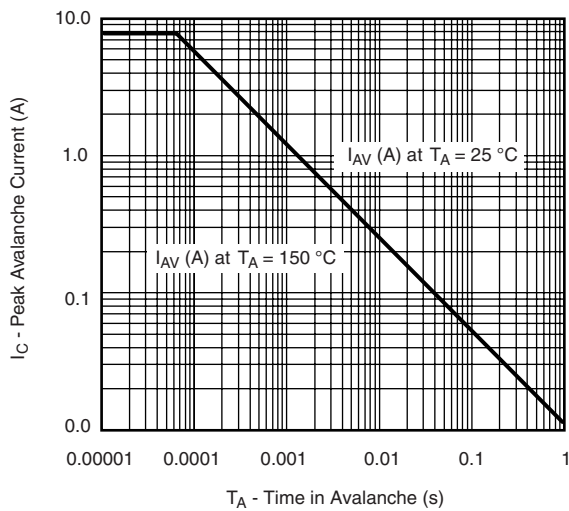
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

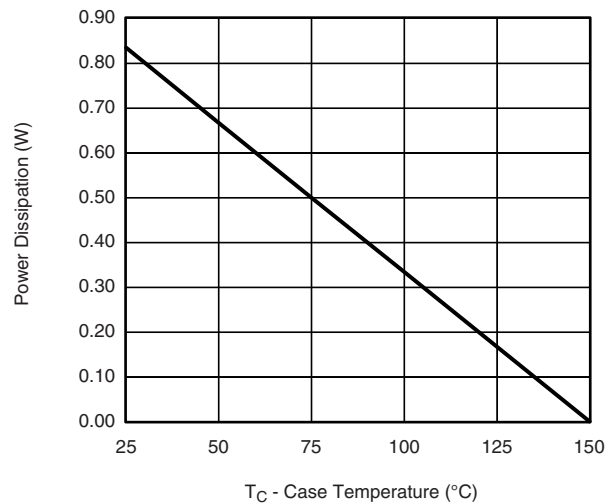
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



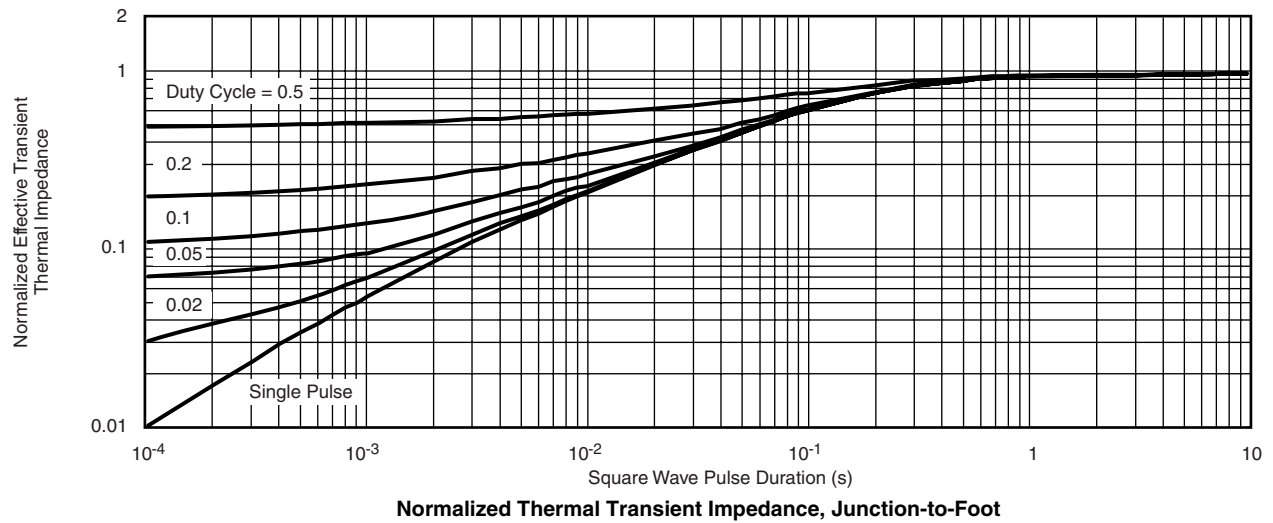
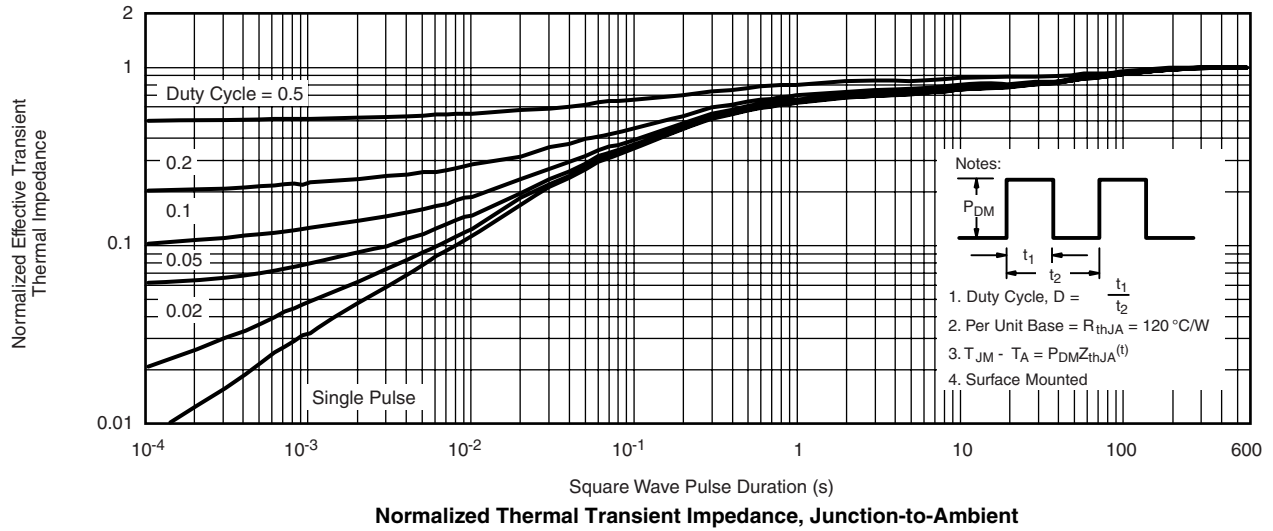
Single Pulse Avalanche Capability



Power Derating, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150\text{ °C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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



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