



## 1N60

### Power MOSFET

## 1.2 Amps, 600 Volts N-CHANNEL MOSFET

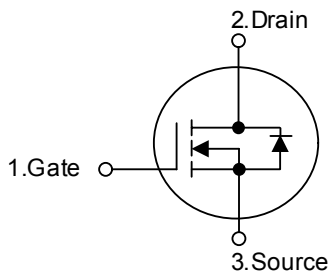
### DESCRIPTION

The UTC 1N60 is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

### FEATURES

- \*  $R_{DS(ON)} = 9.3\Omega @ V_{GS} = 10V$ .
- \* Ultra Low gate charge (typical 5.0nC)
- \* Low reverse transfer capacitance ( $C_{RSS} =$  typical 3.0 pF)
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

### SYMBOL

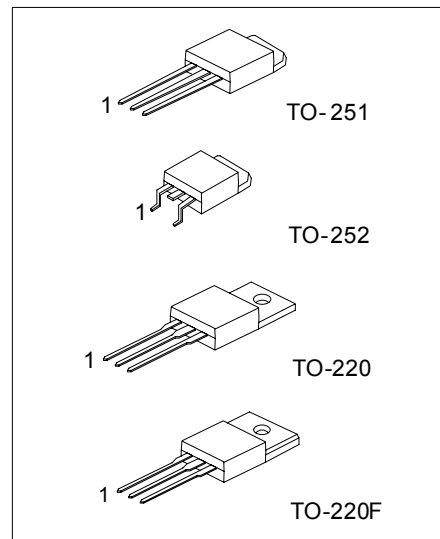


### ORDERING INFORMATION

Order Number		Package	Pin Assignment			Packing
Normal	Lead Free Plating		1	2	3	
1N60-TA3-T	1N60L-TA3-T	TO-220	G	D	S	Tube
1N60-TF3-T	1N60L-TF3-T	TO-220F	G	D	S	Tube
1N60-TM3-T	1N60L-TM3-T	TO-251	G	D	S	Tube
1N60-TN3-R	1N60L-TN3-R	TO-252	G	D	S	Tape Reel
1N60-TN3-T	1N60L-TN3-T	TO-252	G	D	S	Tube

Note: Pin Assignment: G: Gate D: Drain S: Source

<p>1N60L-TA3-T</p> <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TM3: TO-251, TN 3: TO-252 (3) L: Lead Free Plating Blank: Pb/Sn</p>
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\*Pb-free plating product number: 1N60L

■ ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$  , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	600	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	1.2	A
Continuous Drain Current	$T_C = 25$	$I_D$	1.2	A
	$T_C = 100$		0.76	
Drain Current-Pulsed (Note 2)		$I_{DP}$	4.8	A
Avalanche Energy	Repetitive(Note 2)	$E_{AR}$	4.0	mJ
	Single Pulse(Note 3)	$E_{AS}$	50	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Total Power Dissipation	$T_C=25$	$P_D$	40	W
	Derate above 25°C		0.32	
Junction Temperature		$T_J$	+150	
Storage Temperature		$T_{STG}$	-55 ~ +150	

Note:1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
3.  $L=64mH$ ,  $I_{AS}=1.2A$ ,  $V_{DD}=50V$ ,  $R_G=25\Omega$ , Starting  $T_J = 25^\circ C$
4.  $I_{SD} \leq 1.2A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ C$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Thermal Resistance Junction-Ambient	TO-251	$\theta_{JA}$	112	/W
	TO-252		112	
	TO-220		54	
Thermal Resistance Junction-Case	TO-251	$\theta_{JC}$	12	
	TO-252		12	
	TO-220		4	

■ ELECTRICAL CHARACTERISTICS ( $T_C=25$  , unless otherwise specified.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Off Characteristics</b>							
Drain-Source Breakdown Voltage		$BV_{DSS}$	$V_{GS} = 0V, I_D = 250Ma$	600			V
Zero Gate Voltage Drain Current		$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$			10	Ma
			$V_{DS} = 480V, T_C = 125$			100	Ma
Gate-Body Leakage Current	Forward	$I_{GSS}$	$V_{GS} = 30V, V_{DS} = 0V$			100	Na
	Reverse		$V_{GS} = -30V, V_{DS} = 0V$			-100	
Breakdown Voltage Temperature Coefficient		$BV_{DSS}/T_J$	$I_D = 250Ma$		0.4		V/
<b>On Characteristics</b>							
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250Ma$	2.0		4.0	V
Static Drain-Source On-Resistance		$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 0.6A$		9.3	11.5	$\Omega$
Forward Transconductance		$g_{FS}$	$V_{DS} = 50V, I_D = 0.6A$ (Note 1)		0.9		S
<b>Dynamic Characteristics</b>							
Input Capacitance		$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1MHz$		120	150	Pf
Output Capacitance		$C_{OSS}$			20	25	Pf
Reverse Transfer Capacitance		$C_{RSS}$			3.0	4.0	Pf

■ ELECTRICAL CHARACTERISTICS (Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Switching Characteristics</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=1.2A, R_G=50\Omega$ (Note 1,2)		5	20	ns
Rise Time	$t_R$			25	60	ns
Turn-Off Delay Time	$t_{D(OFF)}$			7	25	ns
Fall Time	$t_F$			25	60	ns
Total Gate Charge	$Q_G$	$V_{DS}=480V, V_{GS}=10V, I_D=1.2A$ (Note 1,2)		5.0	6.0	nC
Gate-Source Charge	$Q_{GS}$			1.0		nC
Gate-Drain Charge	$Q_{GD}$			2.6		nC
<b>Drain-Source Diode Characteristics</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_{SD} = 1.2A,$			1.4	V
Continuous Drain-Source Current	$I_{SD}$				1.2	A
Pulsed Drain-Source Current	$I_{SM}$				4.8	A
Reverse Recovery Time	$t_{RR}$	$V_{GS}=0V, I_{SD} = 1.2A$		160		ns
Reverse Recovery Charge	$Q_{RR}$	$di/dt = 100A/\mu s$ (Note1)		0.3		$\mu C$

Note: 1. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$

2. Essentially Independent of Operating Temperature

■ TEST CIRCUITS AND WAVEFORMS

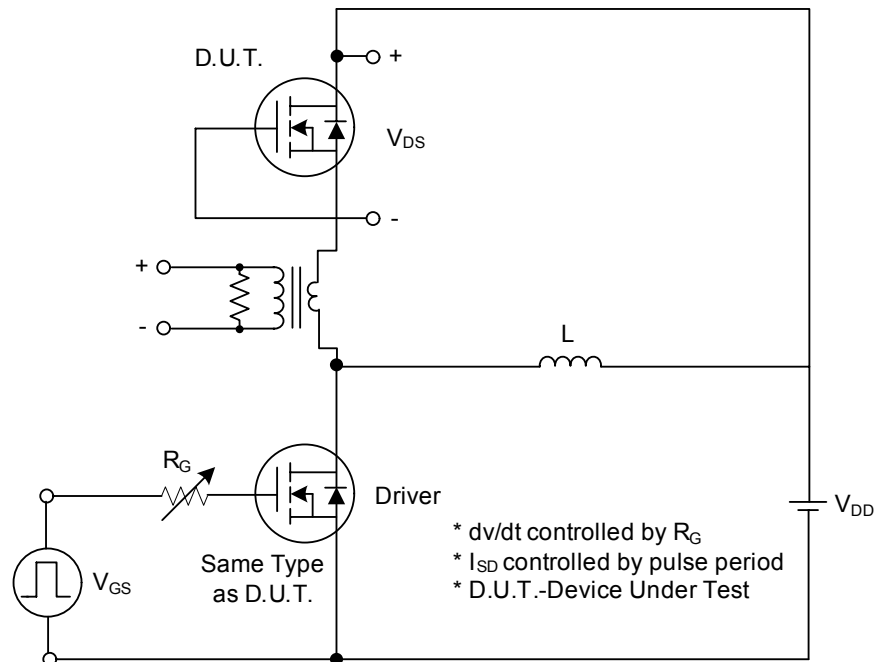


Fig. 1A Peak Diode Recovery  $dv/dt$  Test Circuit

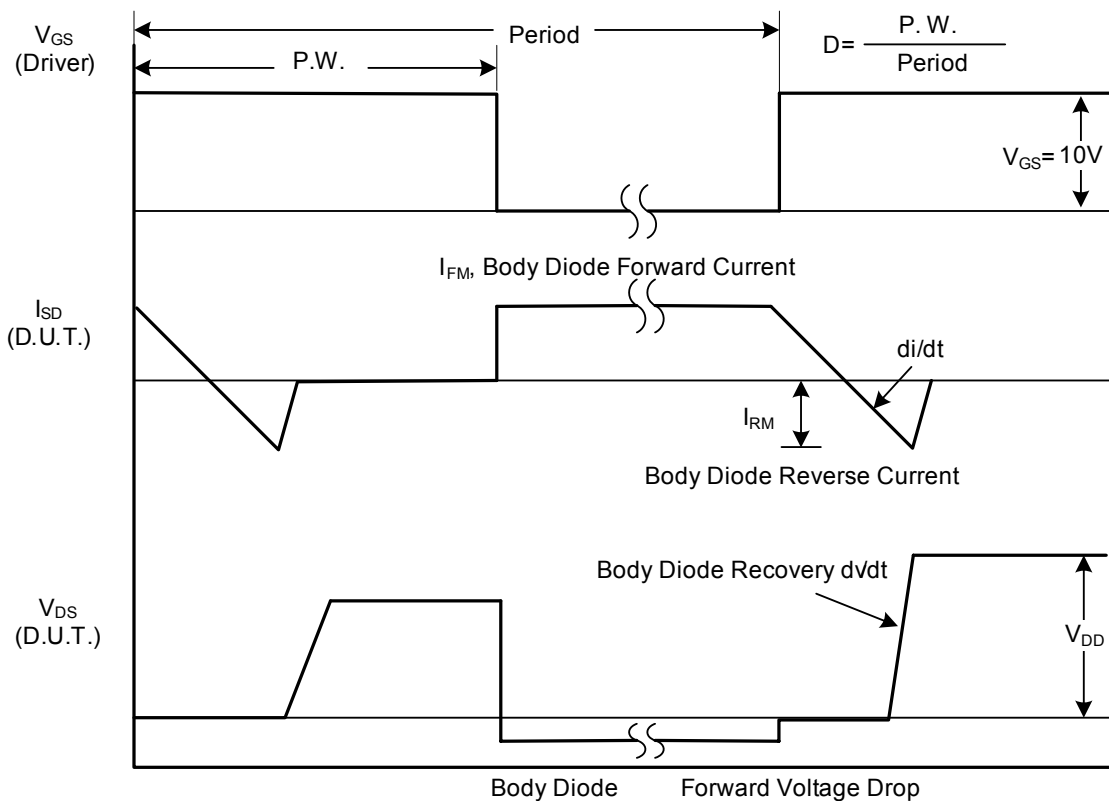


Fig. 1B Peak Diode Recovery  $dv/dt$  Waveforms

## ■ TEST CIRCUITS AND WAVEFORMS (Cont.)

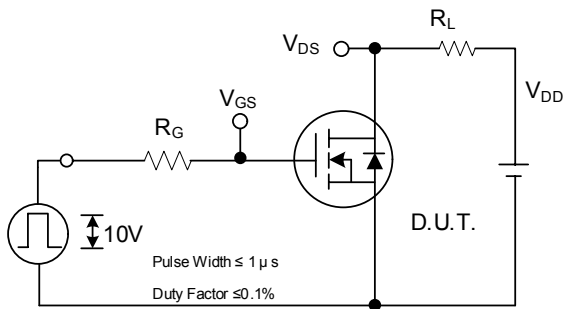


Fig. 2A Switching Test Circuit

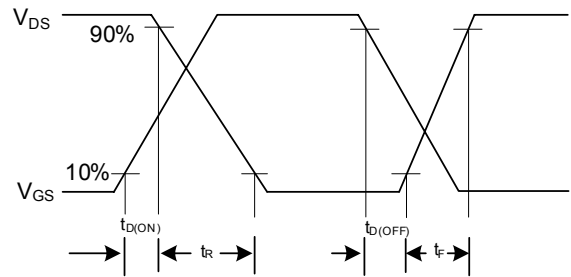


Fig. 2B Switching Waveforms

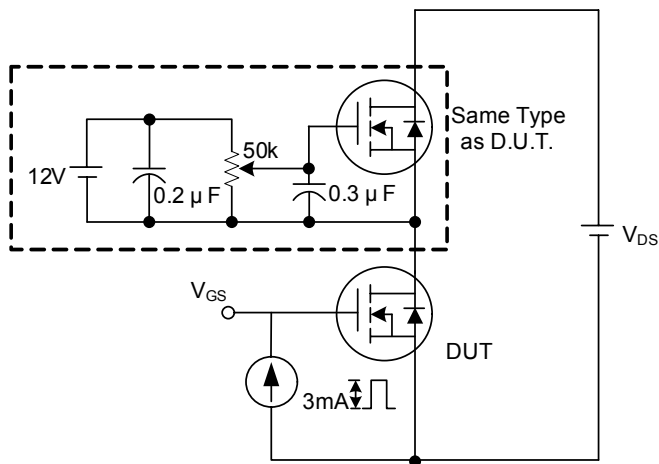


Fig. 3A Gate Charge Test Circuit

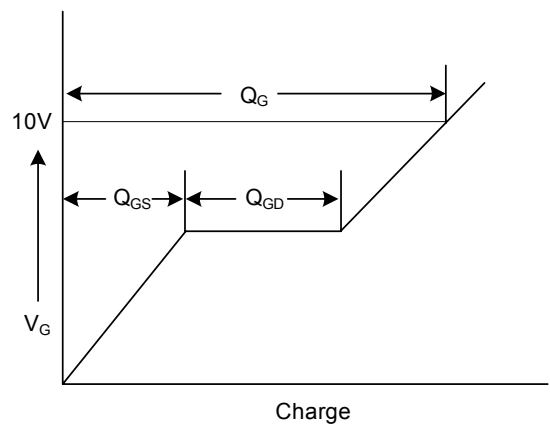


Fig. 3B Gate Charge Waveform

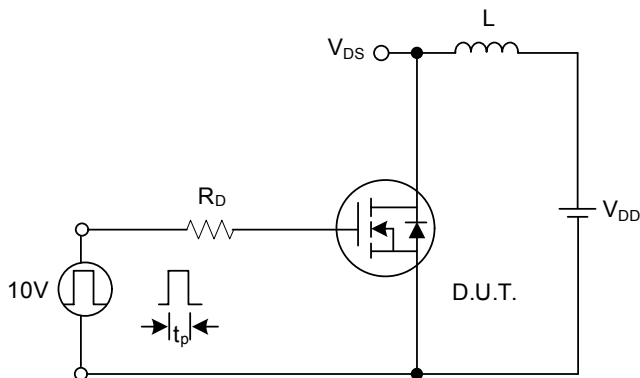


Fig. 4A Unclamped Inductive Switching Test Circuit

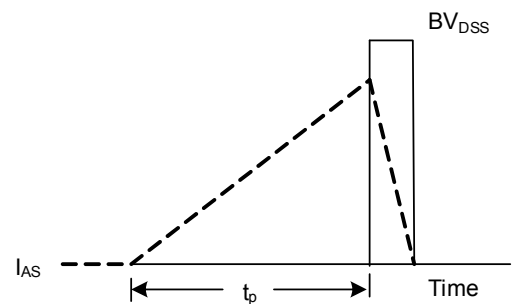
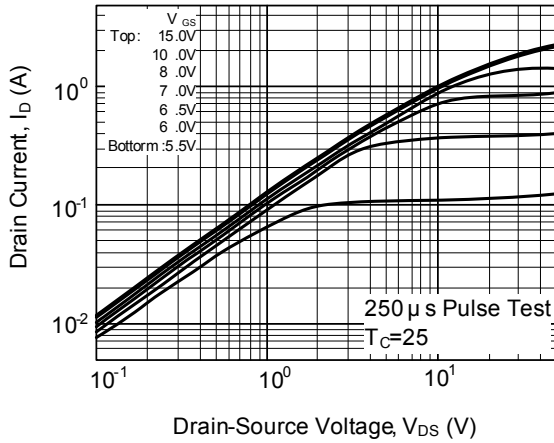


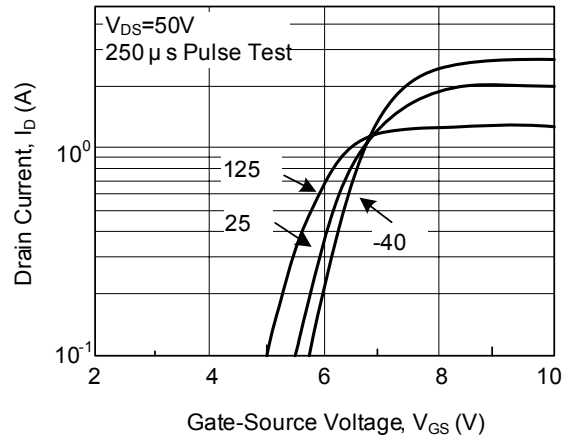
Fig. 4B Unclamped Inductive Switching Waveforms

## TYPICAL PERFORMANCE CHARACTERISTICS

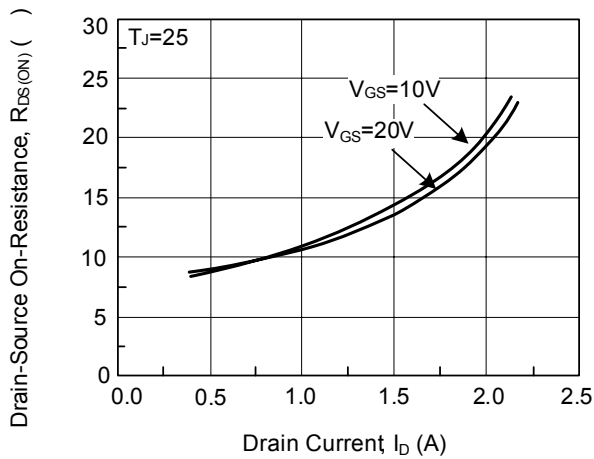
Output Characteristics



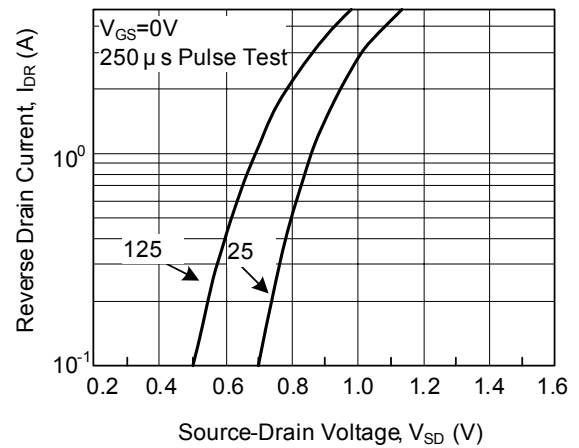
Transfer Characteristics



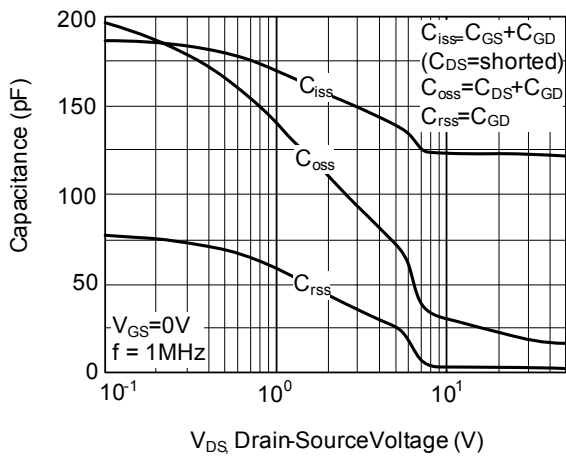
On-Resistance vs. Drain Current



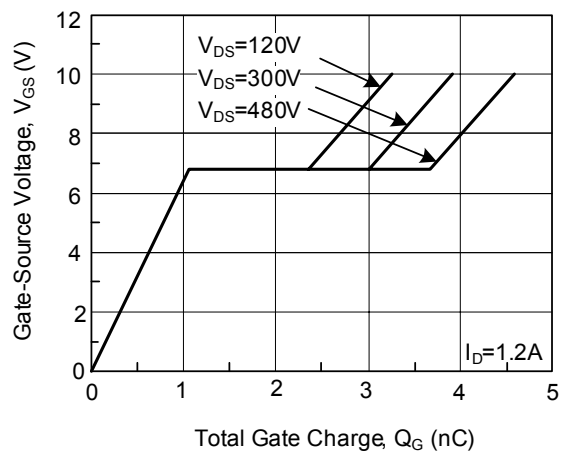
Source- Drain Diode Forward Voltage



Capacitance vs Drain-Source Voltage

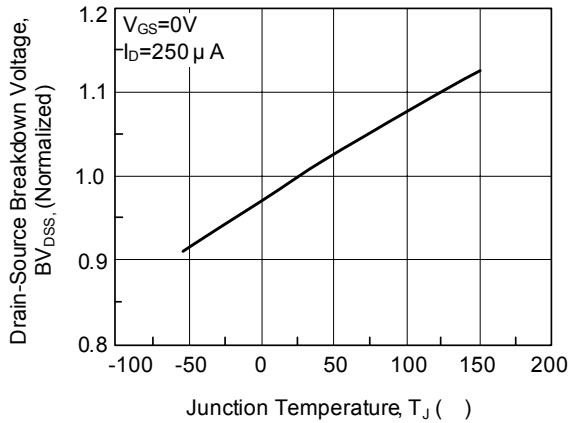


Gate Charge vs. Gate-Source Voltage

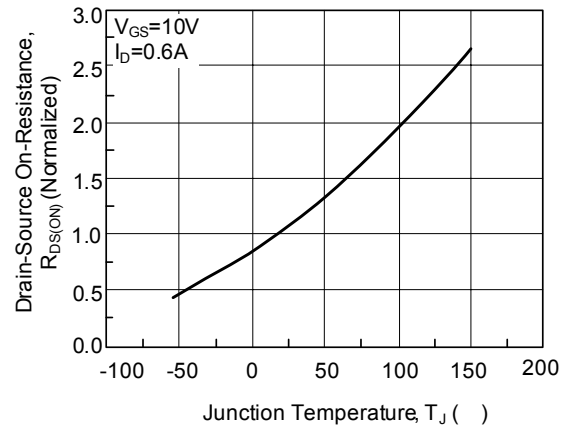


## TYPICAL PERFORMANCE CHARACTERISTICS(cont.)

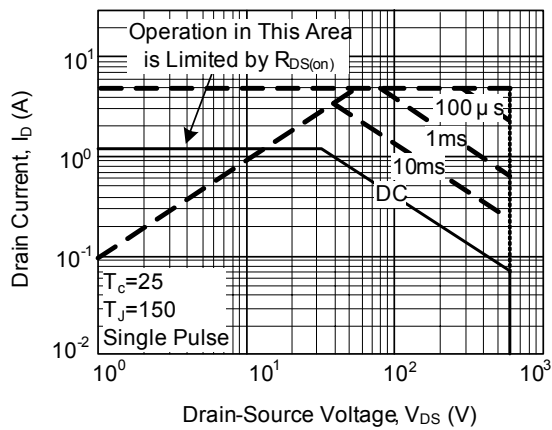
Breakdown Voltage vs Temperature



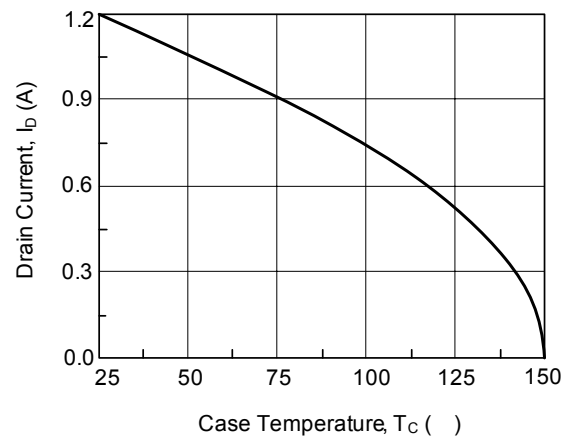
On-Resistance vs. Temperature



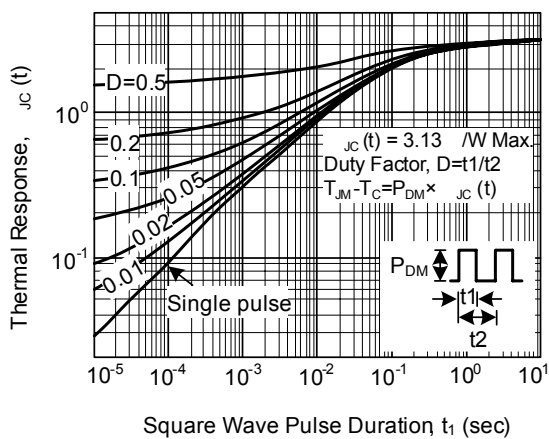
Max. Safe Operating Area



Max. Drain Current vs. Case Temperature



Thermal Response



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