



# 2N60

**Power MOSFET**

## 2 Amps, 600 Volts N-CHANNEL MOSFET

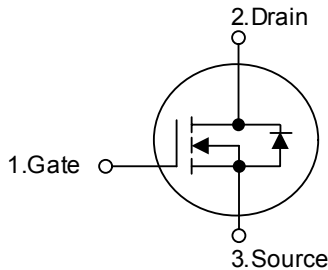
■ **DESCRIPTION**

The UTC 2N60 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**

- \*  $R_{DS(ON)} = 3.8\Omega @ V_{GS} = 10V$ .
- \* Ultra Low gate charge (typical 9.0nC)
- \* Low reverse transfer capacitance ( $C_{rss} =$  typical 5.0 pF)
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

■ **SYMBOL**

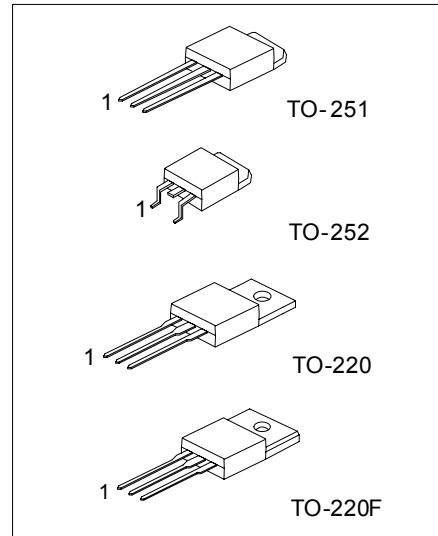


■ **ORDERING INFORMATION**

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

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

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

■ 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)		$I_{AR}$	2.0	A
Drain Current Continuous	$T_C = 25^\circ\text{C}$	$I_D$	2.0	A
	$T_C = 100^\circ\text{C}$		1.26	A
Drain Current Pulsed (Note 2)		$I_{DP}$	8.0	A
Avalanche Energy	Repetitive(Note 2)	$E_{AR}$	4.5	mJ
	Single Pulse(Note 3)	$E_{AS}$	140	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Total Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	45	W
	Derate above $25^\circ\text{C}$		0.36	W/
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.  $L=64\text{mH}$ ,  $I_{AS}=2.0\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
4.  $I_{SD}\leq 2.4\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

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

■ ELECTRICAL CHARACTERISTICS ( $T_J=25$  , unless Otherwise specified.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Off Characteristics</b>							
Drain-Source Breakdown Voltage		$BV_{DSS}$	$V_{GS} = 0\text{V}$ , $I_D = 250\ \mu\text{A}$	600			V
Zero Gate Voltage Drain Current		$I_{DSS}$	$V_{DS} = 600\text{V}$ , $V_{GS} = 0\text{V}$			10	$\mu\text{A}$
			$V_{DS} = 480\text{V}$ , $T_C = 125^\circ\text{C}$			100	$\mu\text{A}$
Gate-Body Leakage Current	Forward	$I_{GSS}$	$V_{GS} = 30\text{V}$ , $V_{DS} = 0\text{V}$			100	nA
	Reverse		$V_{GS} = -30\text{V}$ , $V_{DS} = 0\text{V}$			-100	nA
Breakdown Voltage Temperature Coefficient		$BV_{DSS}/T_J$	$I_D = 250\ \mu\text{A}$		0.4		V/
<b>On Characteristics</b>							
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2.0		4.0	V
Static Drain-Source On-Resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{V}$ , $I_D = 1\text{A}$		3.8	5	$\Omega$
Forward Transconductance		$g_{FS}$	$V_{DS} = 50\text{V}$ , $I_D = 1\text{A}$ (Note 1)		2.25		S
<b>Dynamic Characteristics</b>							
Input Capacitance	$C_{ISS}$	$V_{DS}=25\text{V}$ , $V_{GS}=0\text{V}$ , $f=1\text{MHz}$			270	350	pF
Output Capacitance	$C_{OSS}$				40	50	pF
Reverse Transfer Capacitance	$C_{RSS}$				5	7	pF

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Switching Characteristics</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=2.4A, R_G=25\Omega$ (Note 1, 2)		10	30	ns
Rise Time	$t_R$			25	60	ns
Turn-Off Delay Time	$t_{D(OFF)}$			20	50	ns
Fall Time	$t_F$			25	60	ns
Total Gate Charge	$Q_G$	$V_{DS}=480V, V_{GS}=10V, I_D=2.4A$ (Note 1, 2)		9.0	11	nC
Gate-Source Charge	$Q_{GS}$			1.6		nC
Gate-Drain Charge	$Q_{GD}$			4.3		nC
<b>Drain-Source Diode Characteristics</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0 V, I_{SD} = 2.0 A$			1.4	V
Continuous Drain-Source Current	$I_{SD}$				2.0	A
Pulsed Drain-Source Current	$I_{SM}$				8.0	A
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0 V, I_{SD} = 2.4A,$ $di/dt = 100 A/\mu s$ (Note1)		180		ns
Reverse Recovery Charge	$Q_{RR}$			0.72		$\mu C$

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

2. Essentially Independent of Operating Temperature

■ TEST CIRCUITS AND WAVEFORMS

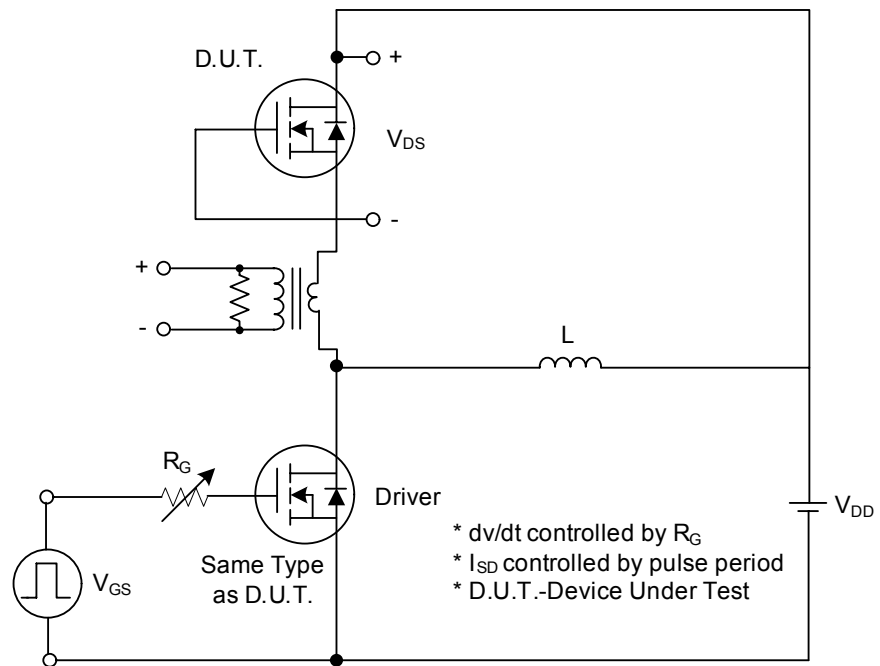


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

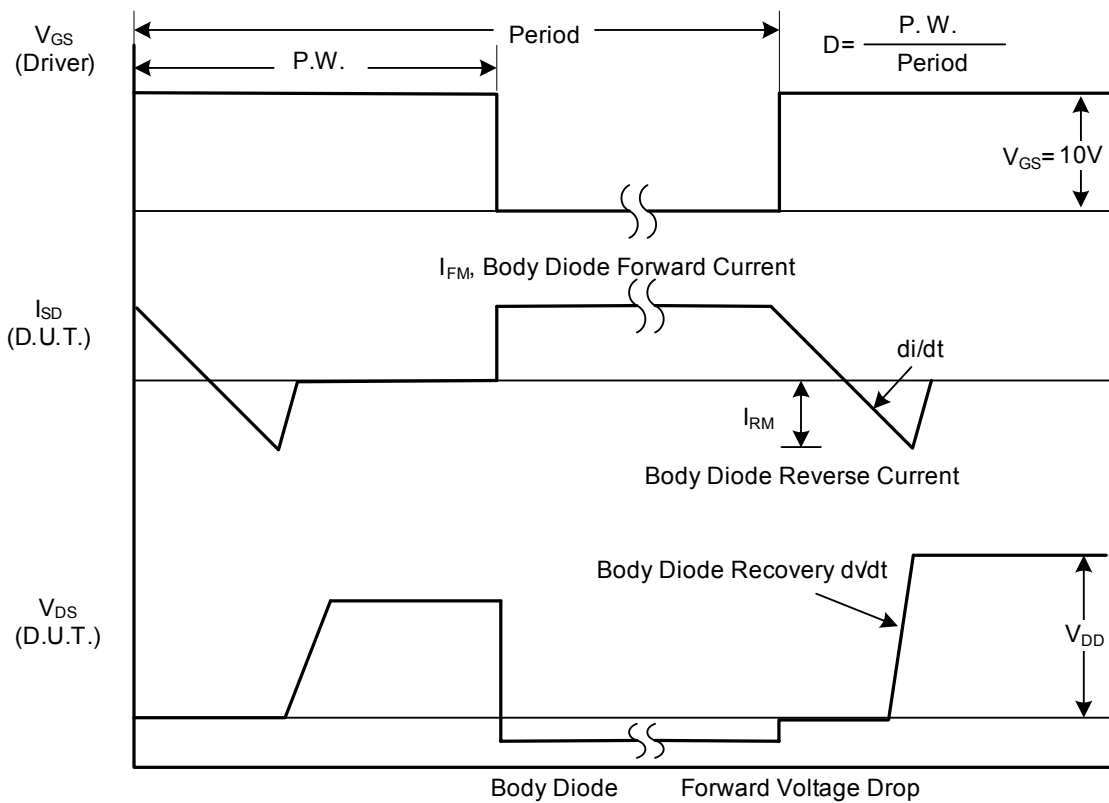


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

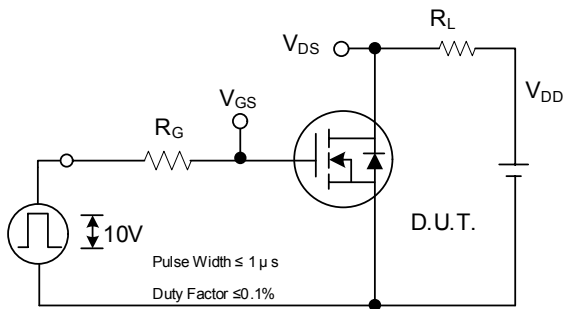


Fig. 2A Switching Test Circuit

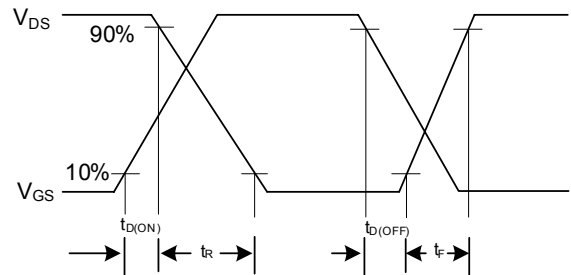


Fig. 2B Switching Waveforms

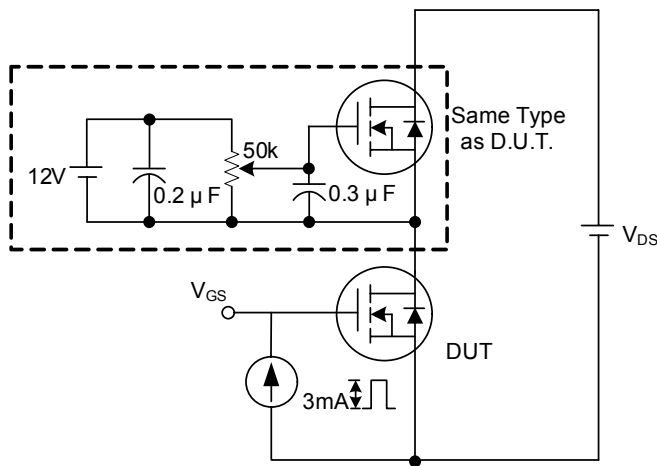


Fig. 3A Gate Charge Test Circuit

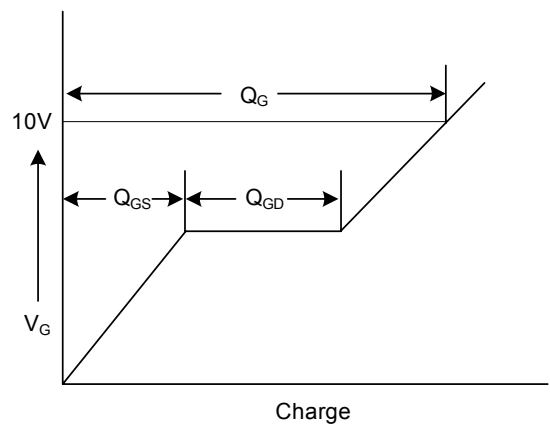


Fig. 3B Gate Charge Waveform

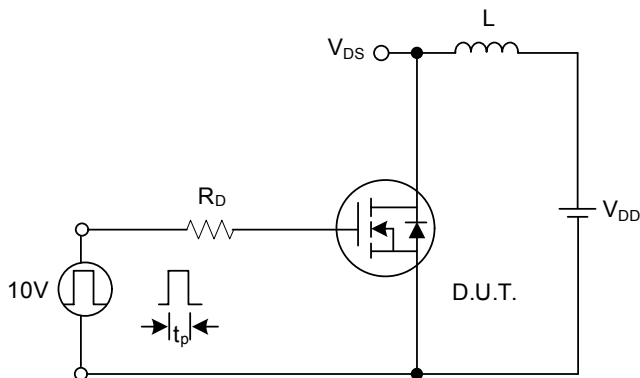


Fig. 4A Unclamped Inductive Switching Test Circuit

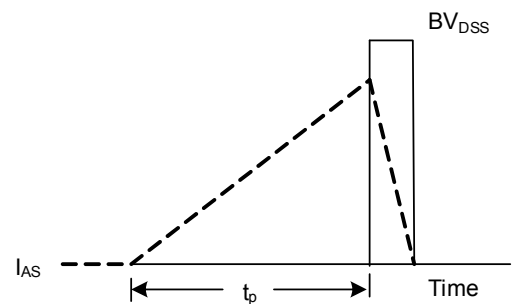
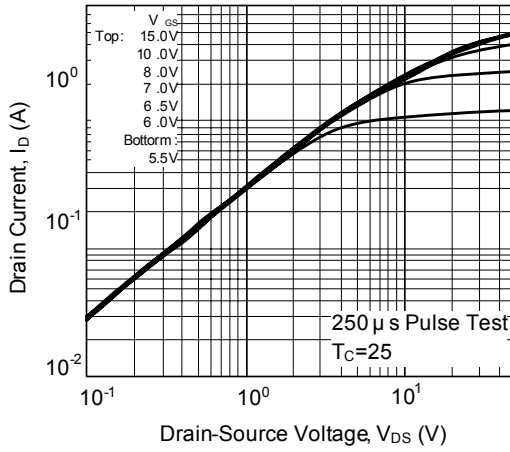


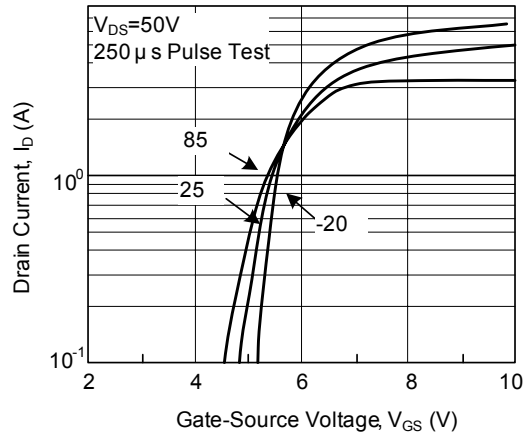
Fig. 4B Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

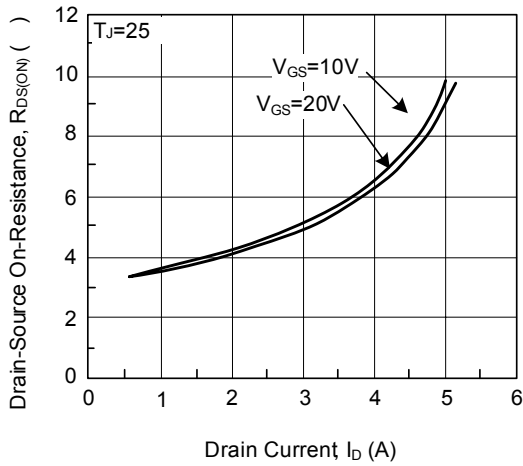
On-Region Characteristics



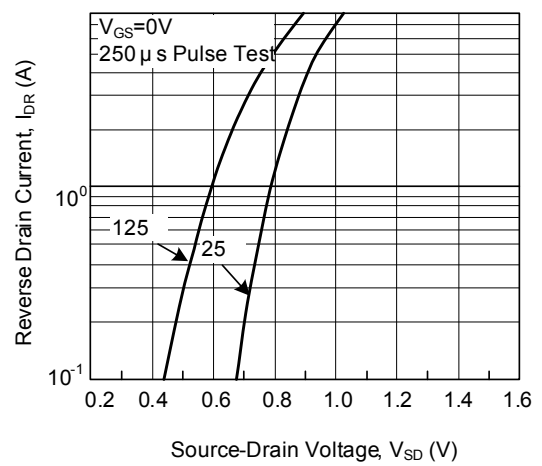
Transfer Characteristics



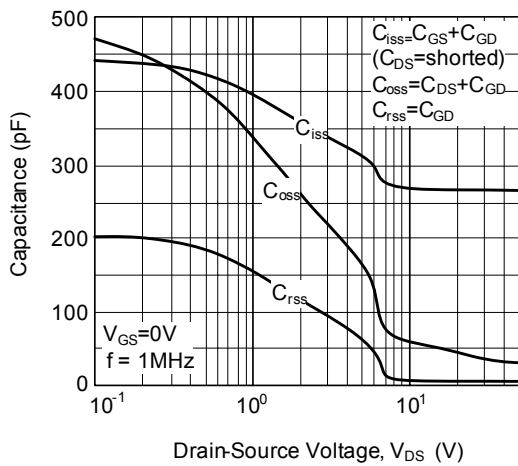
On-Resistance Variation vs Drain Current and Gate Voltage



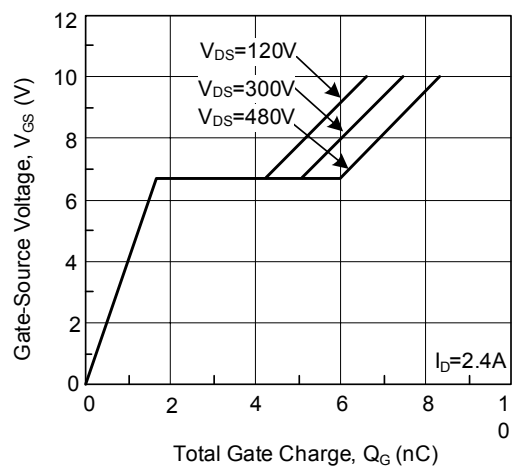
Body Diode Forward Voltage Variations vs. Source Current and Temperature



Capacitance vs. Drain-Source Voltage

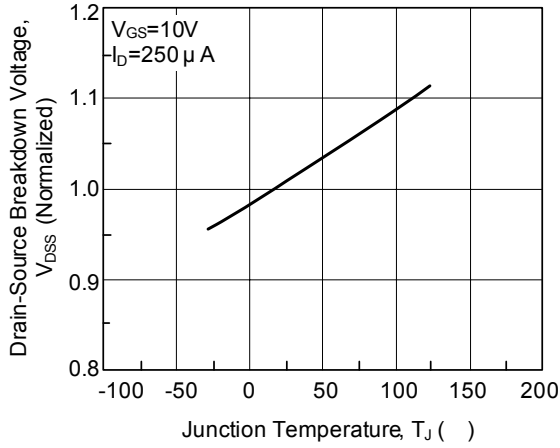


Gate Charge vs. Gate Charge Voltage

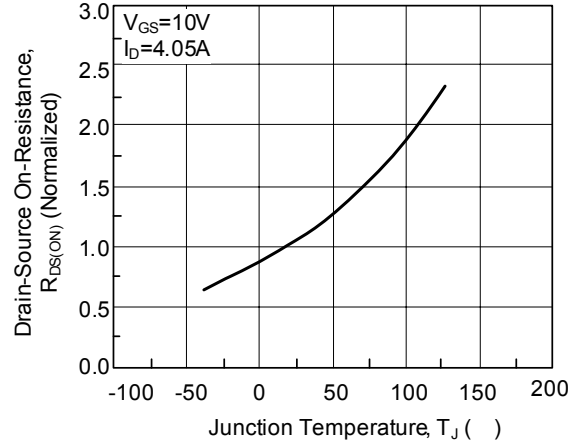


■ TYPICAL CHARACTERISTICS(Cont.)

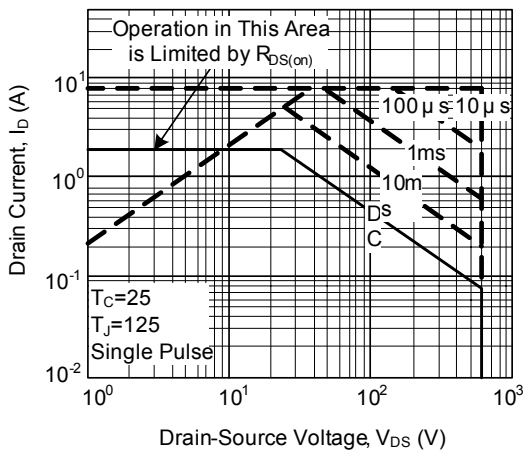
Breakdown Voltage vs Temperature



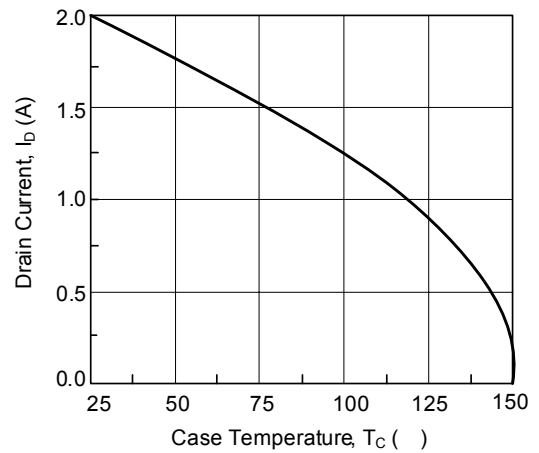
On-Resistance vs. Temperature



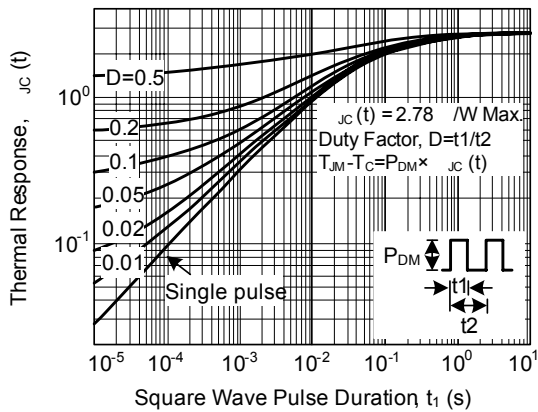
Max. Safe Operating Area



Max. Drain Current vs. Case Temperature



Thermal Response



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