



2N60

Power MOSFET

2 Amps, 600/650 Volts N-CHANNEL POWER MOSFET

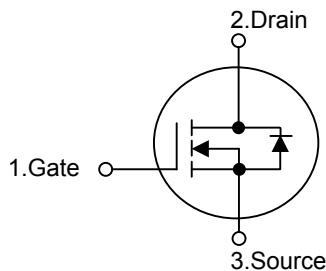
DESCRIPTION

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

- * $R_{DS(ON)} = 5\Omega @ V_{GS} = 10V$
- * 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

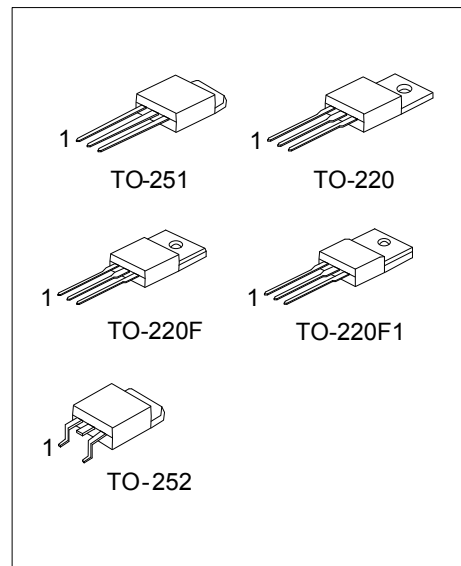


ORDERING INFORMATION

Normal	Ordering Number		Package	Pin Assignment			Packing
	Lead Free Plating	Halogen Free		1	2	3	
2N60-x-TA3-T	2N60L-x-TA3-T	2N60G-x-TA3-T	TO-220	G	D	S	Tube
2N60-x-TF1-T	2N60L-x-TF1-T	2N60G-x-TF1-T	TO-220F1	G	D	S	Tube
2N60-x-TF3-T	2N60L-x-TF3-T	2N60G-x-TF3-T	TO-220F	G	D	S	Tube
2N60-x-TM3-T	2N60L-x-TM3-T	2N60G-x-TM3-T	TO-251	G	D	S	Tube
2N60-x-TN3-R	2N60L-x-TN3-R	2N60G-x-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>2N60L-x-TA3-T</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO-220-F1, TF3: TO-220F TM3: TO-251, TN3: TO-252 (3) A: 600V, B: 650V (4) G: Halogen Free, L: Lead Free, Blank: Pb/Sn</p>
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Lead-free: 2N60L
Halogen-free: 2N60G

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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage	2N60-A	V _{DSS}	600	V
	2N60-B		650	V
Gate-Source Voltage		V _{GSS}	±30	V
Avalanche Current (Note 2)		I _{AR}	2.0	A
Drain Current	Continuous	I _D	2.0	A
	Pulsed (Note 2)	I _{DM}	8.0	A
Avalanche Energy	Single Pulsed (Note 3)	E _{AS}	140	mJ
	Repetitive (Note 2)	E _{AR}	4.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	P _D	54	W
	TO-220F/TO-220F1		23	W
	TO-251		44	W
	TO-252		44	W
Junction Temperature		T _J	+150	°C
Operating Temperature		T _{OPR}	-55 ~ +150	°C
Storage Temperature		T _{STG}	-55 ~ +150	°C

Notes: 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 T_J
3. L=64mH, I_{AS}=2.0A, V_{DD}=50V, R_G=25 Ω, Starting T_J = 25°C
4. I_{SD} ≤ 2.4A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220	θ _{JA}	62.5	°C/W
	TO-220F/TO-220F1		62.5	
	TO-251		50	
	TO-252		50	
Junction to Case	TO-220	θ _{Jc}	2.32	°C/W
	TO-220F/TO-220F1		5.5	
	TO-251		2.87	
	TO-252		2.87	

■ ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	2N60-A	BV _{DSS}	V _{GS} = 0V, I _D = 250μA	600		V
	2N60-B			650		V
Drain-Source Leakage Current		I _{DSS}	V _{DS} = 600V, V _{GS} = 0V		10	μA
Gate-Source Leakage Current	Forward	I _{GSS}	V _{GS} = 30V, V _{DS} = 0V		100	nA
	Reverse		V _{GS} = -30V, V _{DS} = 0V		-100	nA
Breakdown Voltage Temperature Coefficient		ΔBV _{DSS} /ΔT _J	I _D = 250 μA, Referenced to 25°C	0.4		V/°C
ON CHARACTERISTICS						
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} = V _{GS} , I _D = 250μA	2.0	4.0	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} = 10V, I _D = 1A		3.8	5 Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance		C _{ISS}	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz		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
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=2.4A, R_G=25\Omega$ (Note 1, 2)		10	30	ns
Turn-On Rise Time	t_R			25	60	ns
Turn-Off Delay Time	$t_{D(OFF)}$			20	50	ns
Turn-Off 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
DRAIN-SOURCE DIODE CHARACTERISTICS						
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		μC

Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

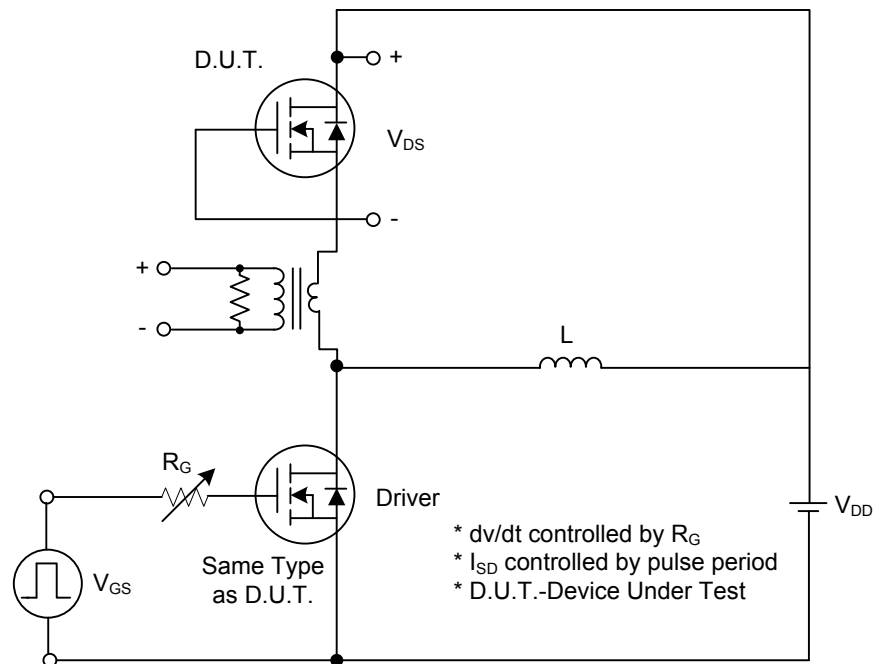


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

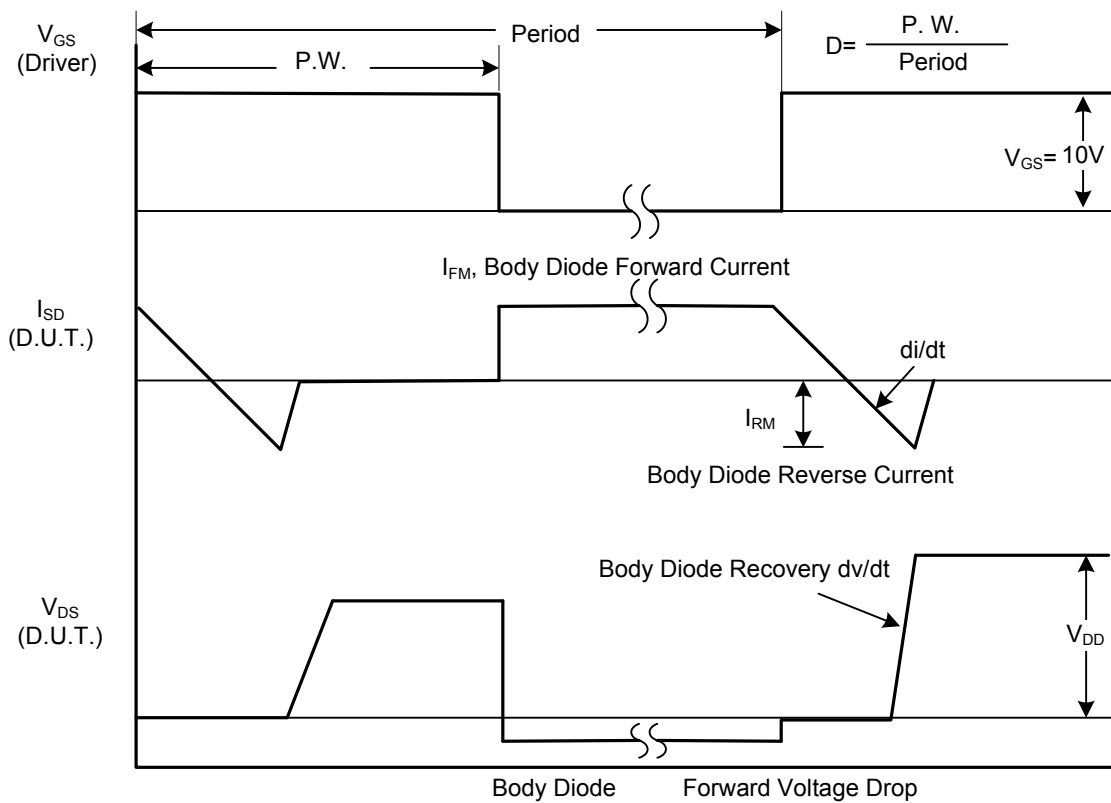


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

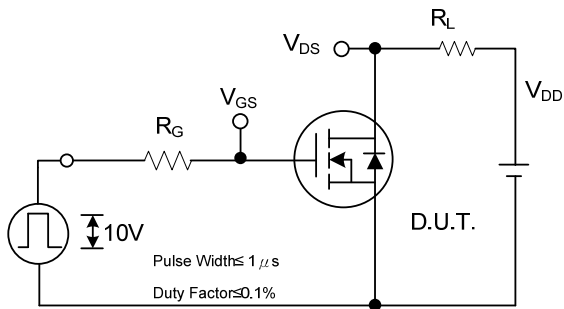


Fig. 2A Switching Test Circuit

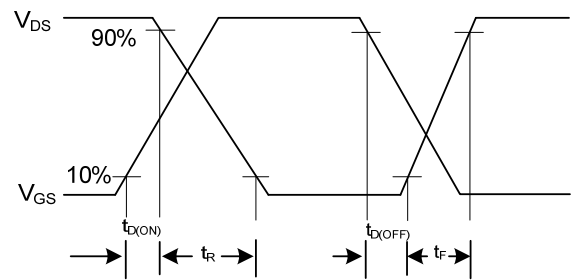


Fig. 2B Switching Waveforms

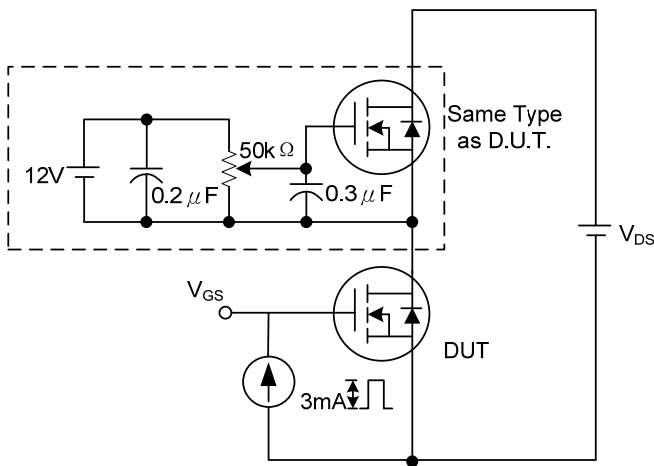


Fig. 3A Gate Charge Test Circuit

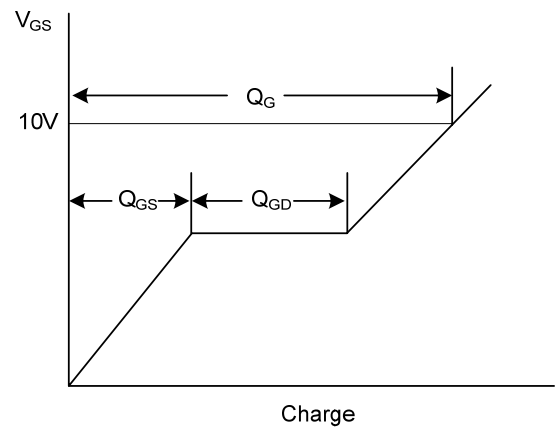


Fig. 3B Gate Charge Waveform

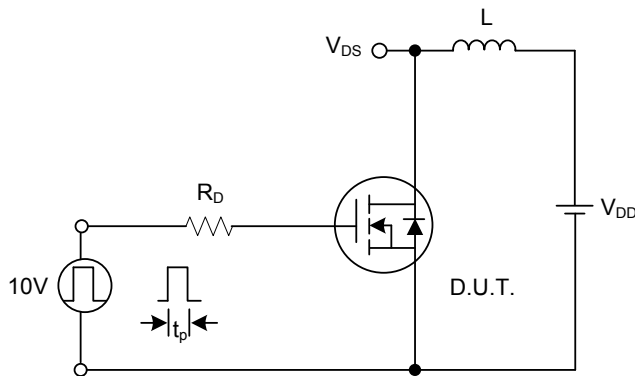


Fig. 4A Unclamped Inductive Switching Test Circuit

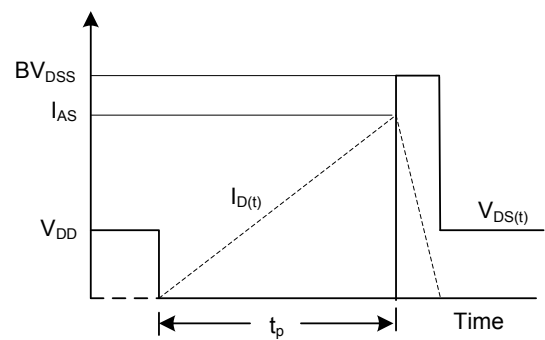
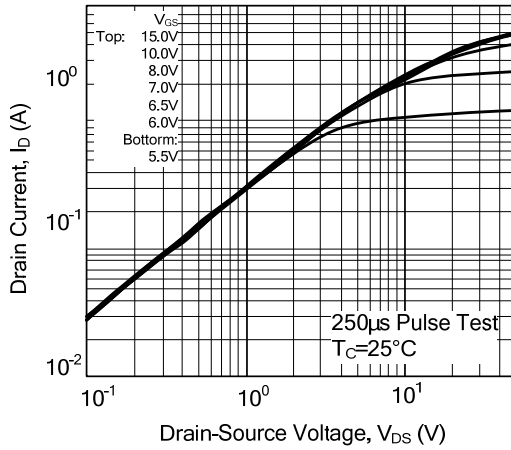


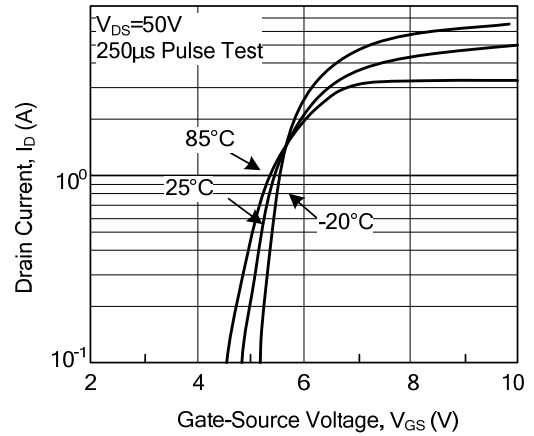
Fig. 4B Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

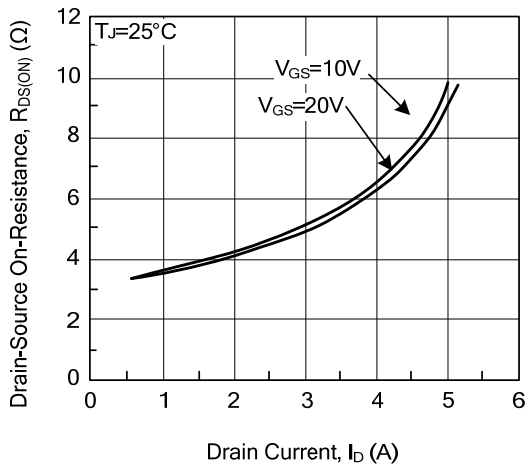
On-Region Characteristics



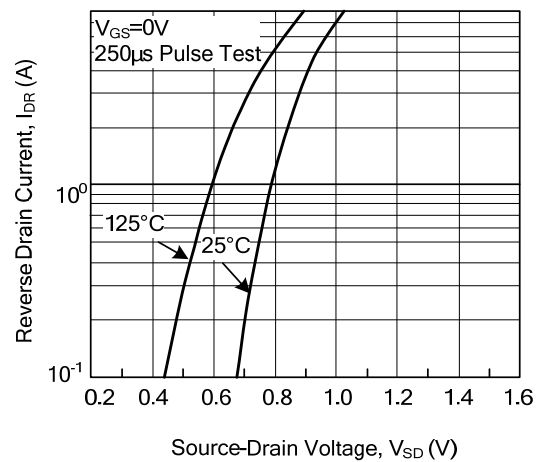
Transfer Characteristics



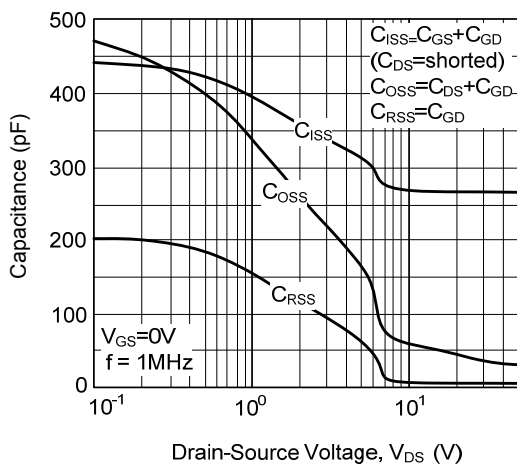
On-Resistance Variation vs. Drain Current and Gate Voltage



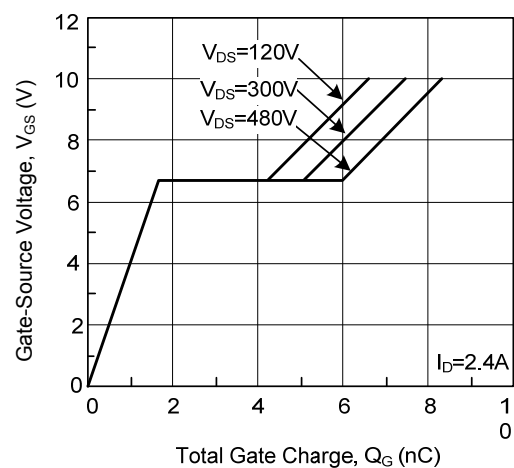
Body Diode Forward Voltage Variation vs. Source Current and Temperature



Capacitance vs. Drain-Source Voltage

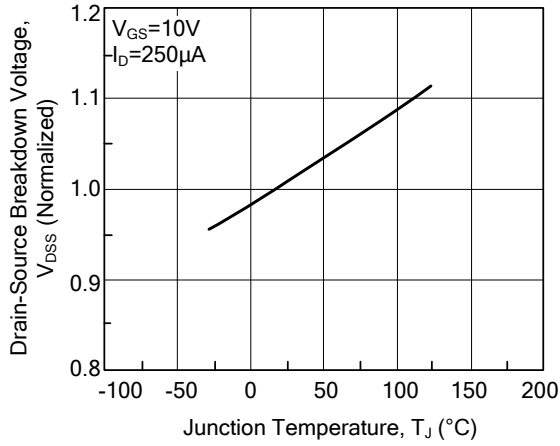


Gate Charge vs. Gate Charge Voltage

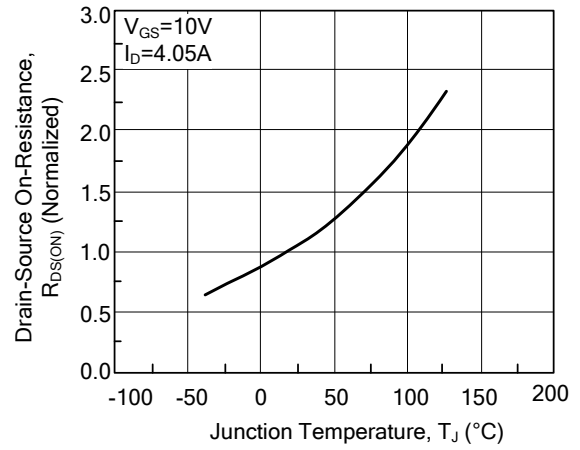


■ TYPICAL CHARACTERISTICS(Cont.)

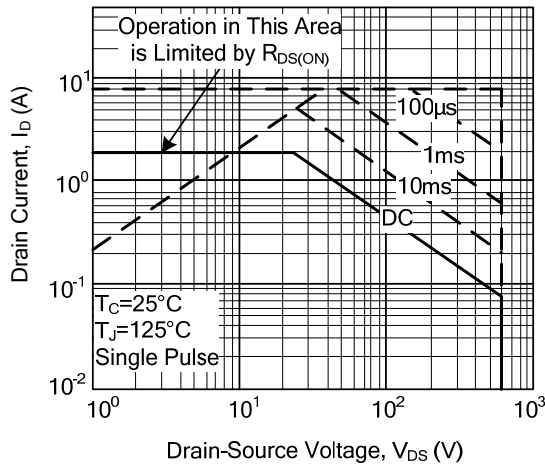
Breakdown Voltage vs. Temperature



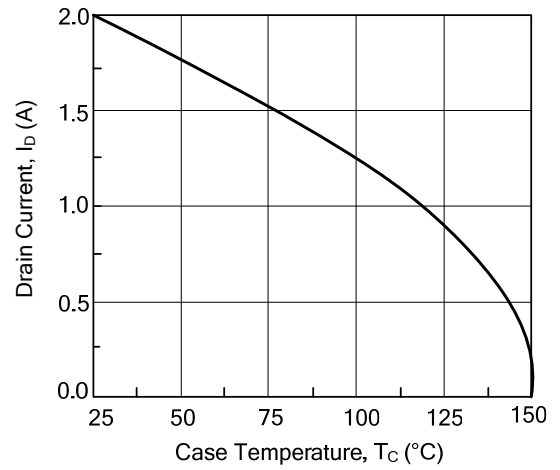
On-Resistance vs. Temperature



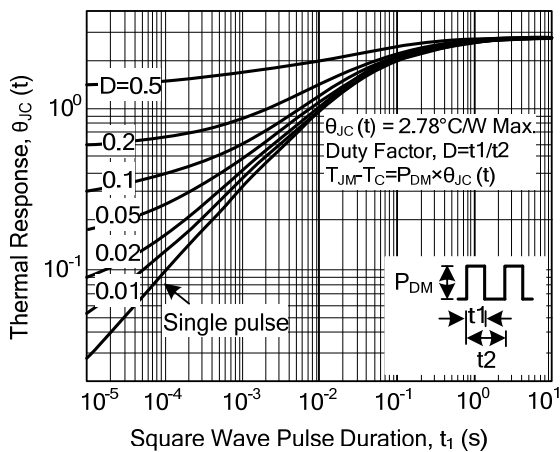
Max. Safe Operating Area



Max. Drain Current vs. Case Temperature



Thermal Response



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