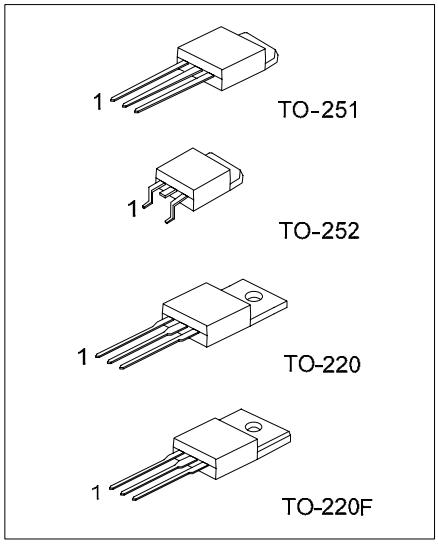
2N60L

Power MOSFET

2 Amps, 600/650 Volts N-CHANNEL MOSFET



*Pb-free plating product number: 2N60LL

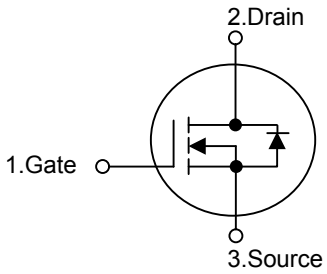
■ DESCRIPTION

The UTC **2N60L** 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

* $R_{DS(ON)}$ = 5Ω@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

Ordering Number		Package	Pin Assignment			Packing
Normal	Lead Free Plating		1	2	3	
2N60L-x-TA3-T	2N60LL-x-TA3-T	TO-220	G	D	S	Tube
2N60L-x-TF3-T	2N60LL-x-TF3-T	TO-220F	G	D	S	Tube
2N60L-x-TM3-T	2N60LL-x-TM3-T	TO-251	G	D	S	Tube
2N60L-x-TN3-R	2N60LL-x-TN3-R	TO-252	G	D	S	Tape Reel
2N60L-x-TN3-T	2N60LL-x-TN3-T	TO-252	G	D	S	Tube

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

2N60LL-x-TA3-T (1)Packing Type (2)Package Type (3)Drain-Source Voltage (4)Lead Plating	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TM3: TO-251, TN3: TO-252 (3) A: 600V, B: 650V (4) L: Lead Free Plating, Blank: Pb/Sn

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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage	2N60L-A	V_{DSS}	600	V
	2N60L-B		650	V
Gate-Source Voltage		V_{GSS}	±30	V
Avalanche Current (Note 1)		I_{AR}	2.0	A
Drain Current Continuous	T_C = 25°C	I_D	2.0	A
	T_C = 100°C		1.26	A
Drain Current Pulsed (Note 1)		I_{DP}	8.0	A
Avalanche Energy	Single Pulsed (Note 2)	E_{AS}	140	mJ
	Repetitive (Note 1)	E_{AR}	4.5	mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	4.5	V/ns
Total Power Dissipation	TO-220	P_D	32	W
	TO-220F		9	W
	TO-251		25	W
	TO-252		20	W
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-55 ~ +150	°C
Storage Temperature		T_{STG}	-55 ~ +150	°C

Note: 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.

■ THERMAL DATA

PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Thermal Resistance Junction-Ambient	TO-251	θ_{JA}	65	°C/W
	TO-252		58	
	TO-220		43	
	TO-220F		38	
Thermal Resistance Junction-Case	TO-251	θ_{Jc}	5	
	TO-252		6	
	TO-220		4	
	TO-220F		12	

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

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage	2N60L-A	BV_{DSS}	V_{GS} = 0V, I_D = 250μA	600			V
	2N60L-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		$\triangle BV_{DSS}/\triangle T_J$	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=25Ω (Note 4, 5)		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 4, 5)		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/μs (Note4)		180		ns
Reverse Recovery Charge	Q_{RR}			0.72		μC

Note: 1. Repetitive Rating : Pulse width limited by T_J
2. L=64mH, I_{AS}=2.0A, V_{DD}=50V, R_G=25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 2.4A, di/dt ≤200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

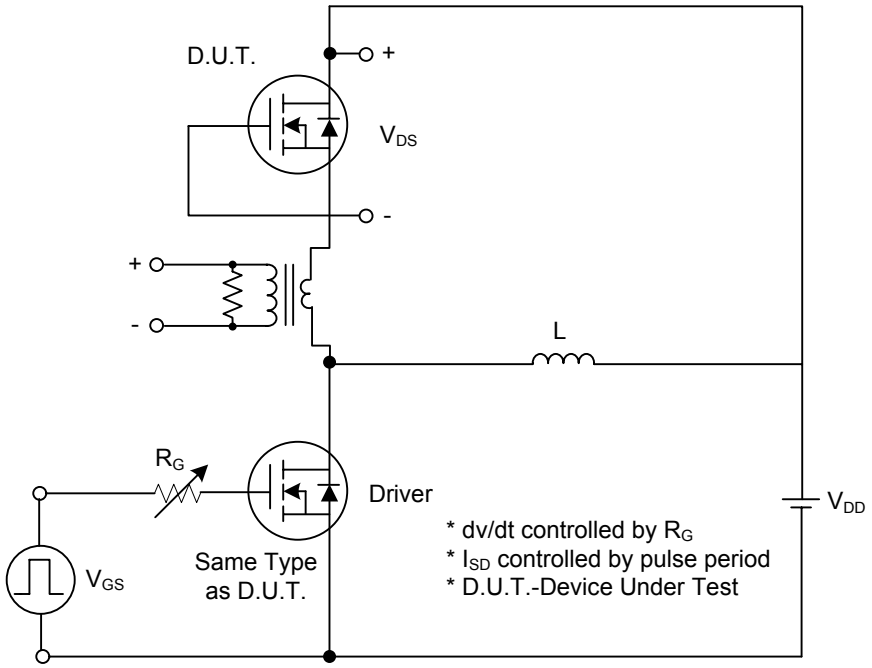


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

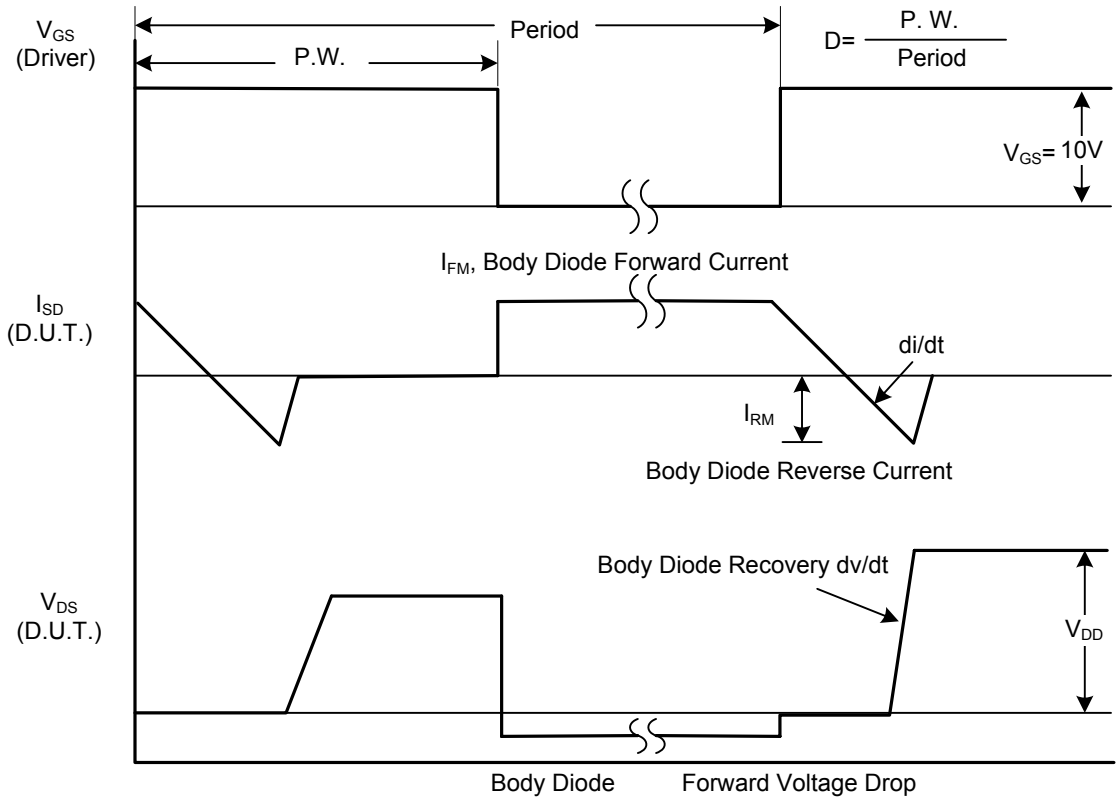


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

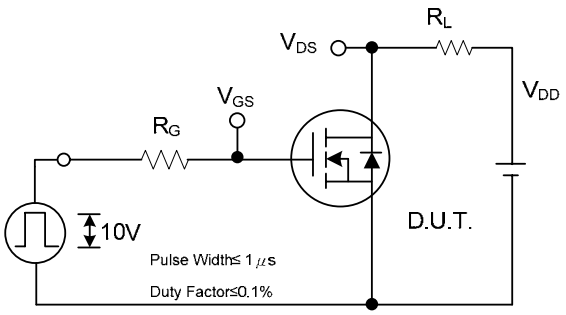


Fig. 2A Switching Test Circuit

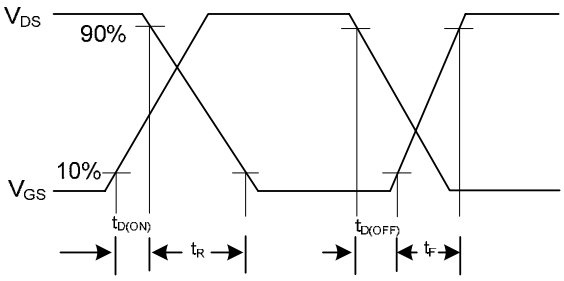


Fig. 2B Switching Waveforms

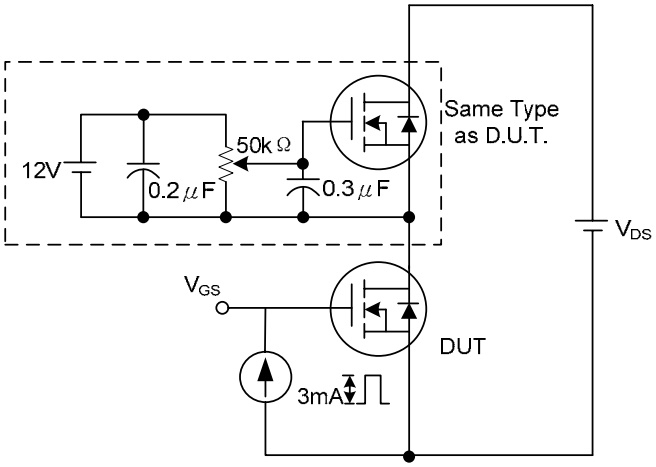


Fig. 3A Gate Charge Test Circuit

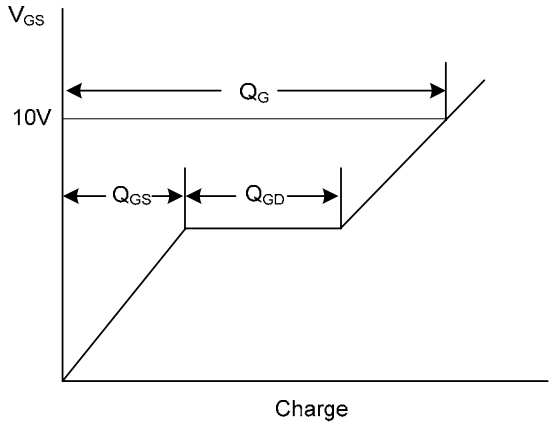


Fig. 3B Gate Charge Waveform

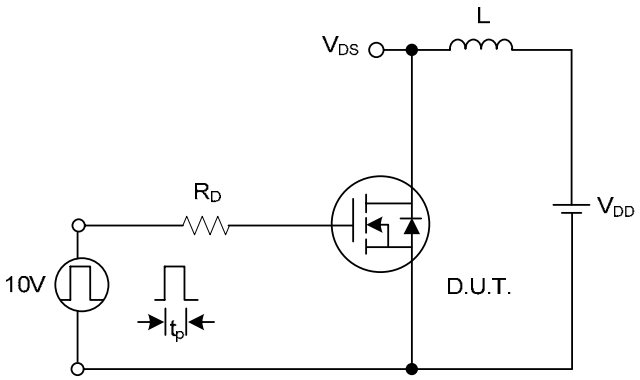


Fig. 4A Unclamped Inductive Switching Test Circuit

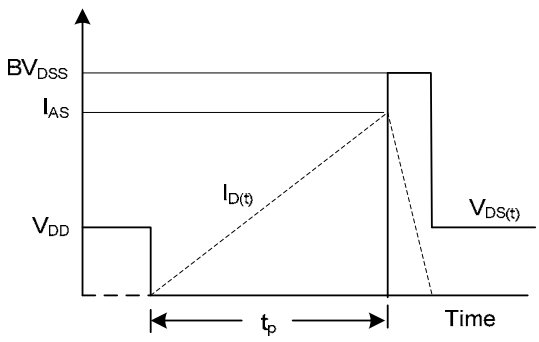
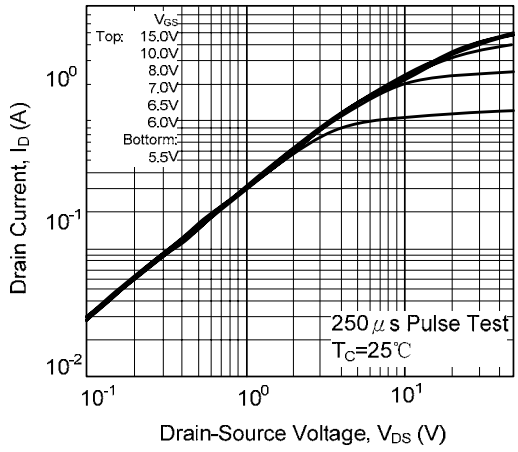


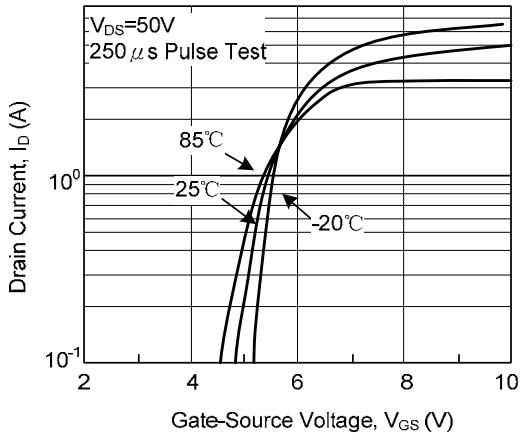
Fig. 4B Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

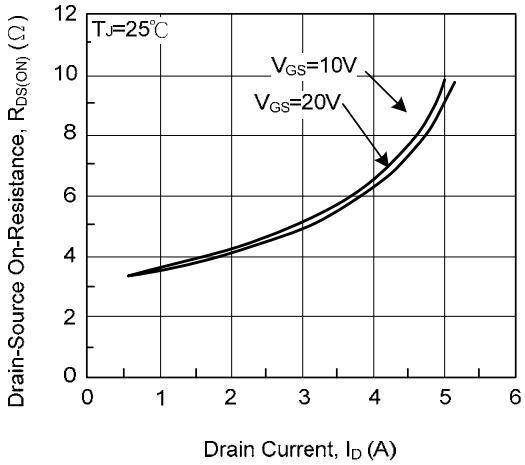
On-Region Characteristics



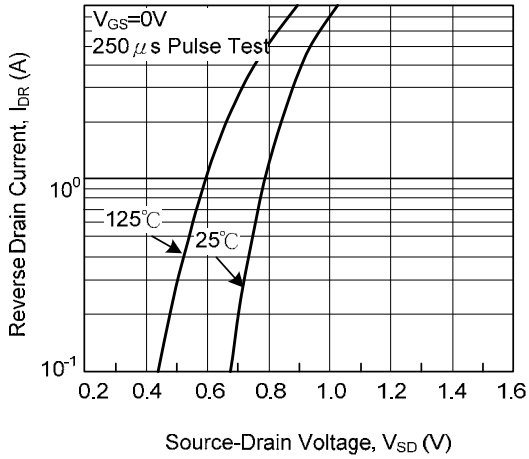
Transfer Characteristics



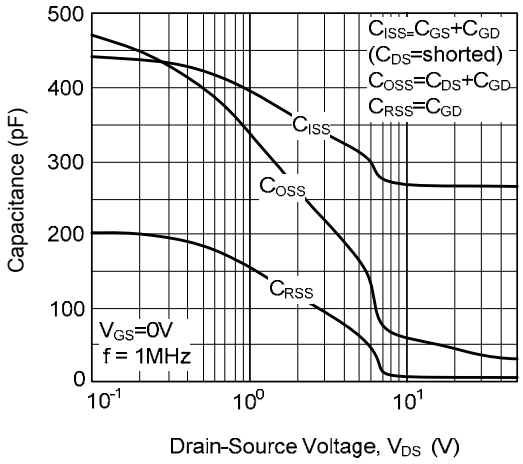
On-Resistance Variation vs. Drain Current and Gate Voltage



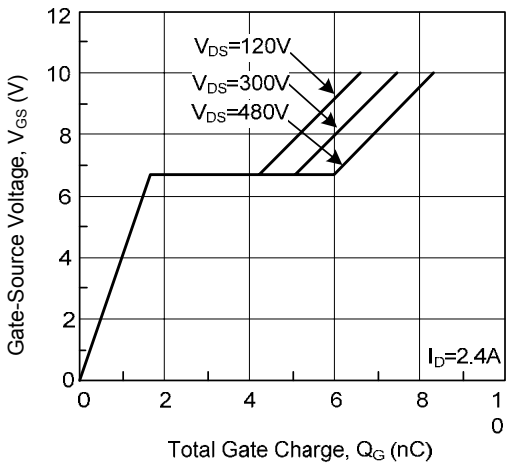
Body Diode Forward Voltage Variation vs. Source Current and Temperature



Capacitance vs. Drain-Source Voltage

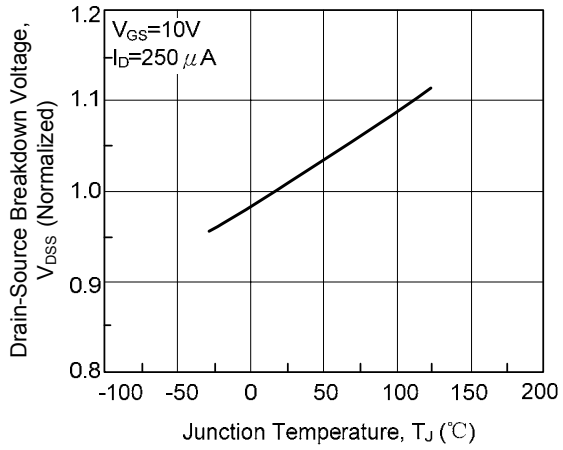


Gate Charge vs. Gate Charge Voltage

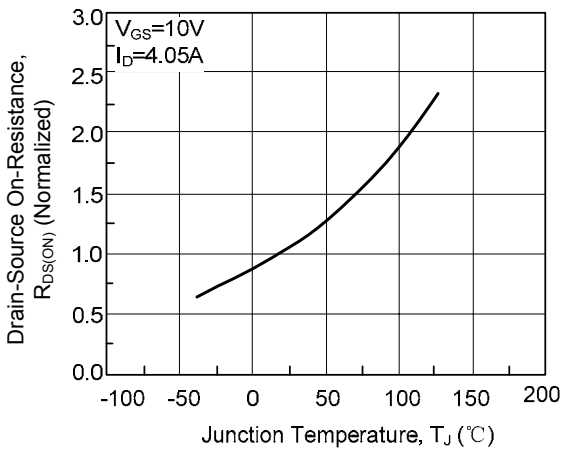


■ TYPICAL CHARACTERISTICS(Cont.)

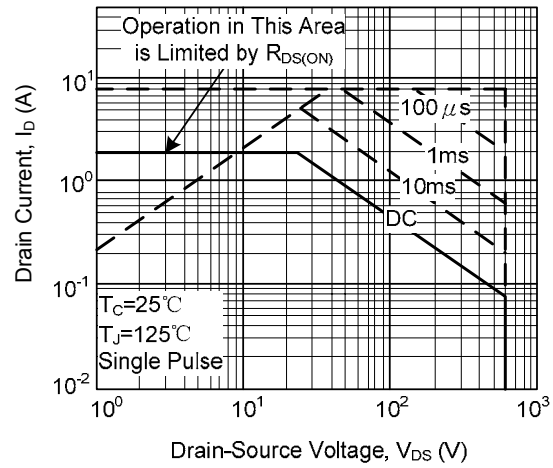
Breakdown Voltage vs. Temperature



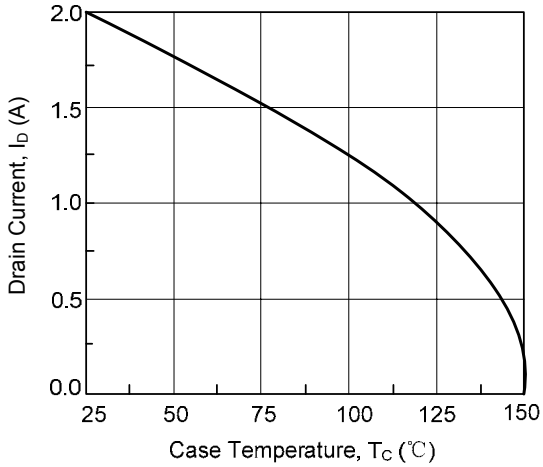
On-Resistance vs. Temperature



Max. Safe Operating Area



Max. Drain Current vs. Case Temperature



Thermal Response