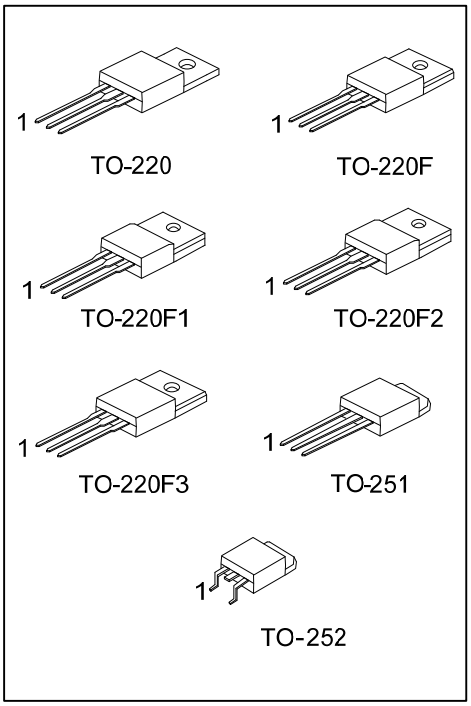
4N60K-TC

Power MOSFET

4A, 600V N-CHANNEL POWER MOSFET



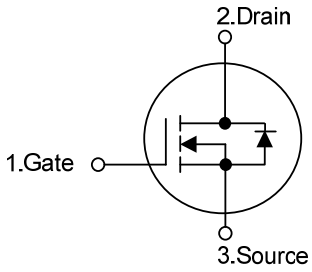
■ DESCRIPTION

The UTC **4N60K-TC** is a high voltage power 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 AC to DC converters and bridge circuits.

■ FEATURES

* $R_{DS(ON)} \leq 2.2\ \Omega$ @ V_{GS}=10V, I_D=2.0A
* Fast Switching Capability
* Avalanche Energy Specified
* Improved dv/dt Capability, high Ruggedness

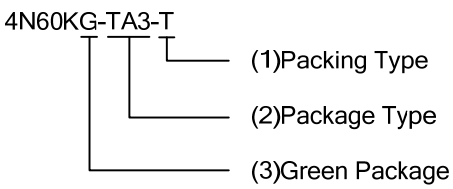
■ SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4N60KL-TA3-T	4N60KG-TA3-T	TO-220	G	D	S	Tube
4N60KL-TF3-T	4N60KG-TF3-T	TO-220F	G	D	S	Tube
4N60KL-TF1-T	4N60KG-TF1-T	TO-220F1	G	D	S	Tube
4N60KL-TF2-T	4N60KG-TF2-T	TO-220F2	G	D	S	Tube
4N60KL-TF3T-T	4N60KG-TF3T-T	TO-220F3	G	D	S	Tube
4N60KL-TM3-T	4N60KG-TM3-T	TO-251	G	D	S	Tube
4N60KL-TN3-R	4N60KG-TN3-R	TO-252	G	D	S	Tape Reel

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



(1) T: Tube, R: Tape Reel
(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TF3T: TO-220F3, TM3: TO-251, TN3: TO-252
(3) G: Halogen Free and Lead Free, L: Lead Free

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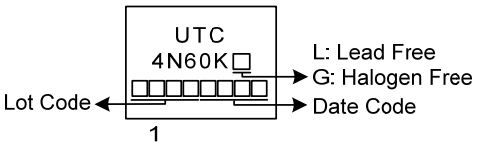
■ MARKING



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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	600	V
Gate-Source Voltage		V_{GSS}	±30	V
Avalanche Current (Note 2)		I_{AR}	4.0	A
Drain Current	Continuous	I_D	4.0	A
	Pulsed (Note 2)	I_{DM}	16	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	100	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1.5	V/ns
Power Dissipation	TO-220	P_D	106	W
	TO-220F/TO-220F1 TO-220F2/TO-220F3		36	W
	TO-251/TO-252		50	W
Derate above 25°C	TO-220		0.85	W/°C
	TO-220F/TO-220F1 TO-220F2/TO-220F3		0.288	W/°C
	TO-251/TO-252		0.40	W/°C
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 maximum junction temperature
3. L = 13mH, I_{AS} = 4.0A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
4. I_{SD}≤4.0A, di/dt ≤200A/μs, V_{DD}≤BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

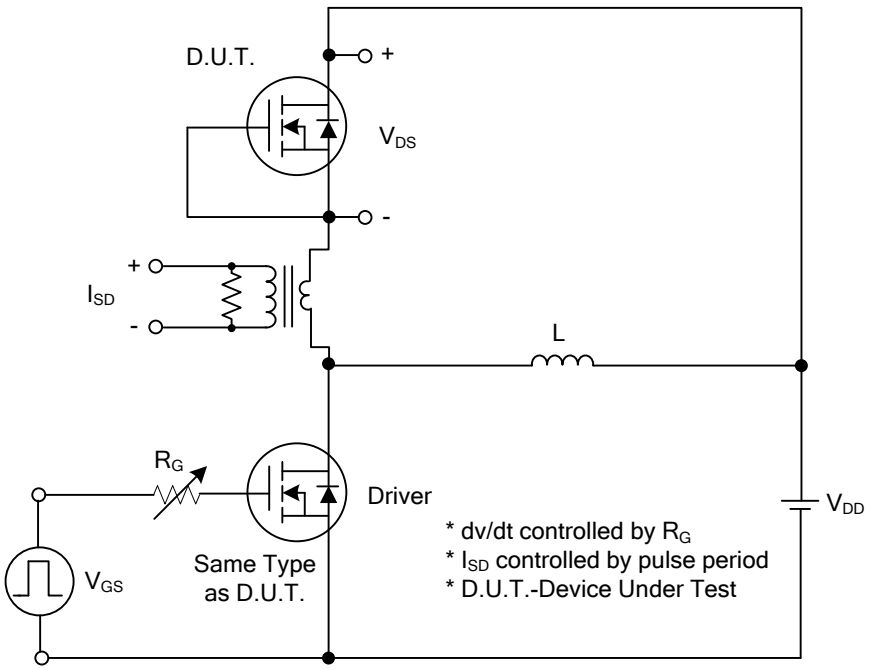
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3	θ_{JA}	62.5	°C/W
	TO-251/TO-252		110	°C/W
Junction to Case	TO-220	θ_{JC}	1.18	°C/W
	TO-220F/TO-220F1 TO-220F3		3.47	°C/W
	TO-220F2		3.4	°C/W
	TO-251/TO-252		2.5	°C/W

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

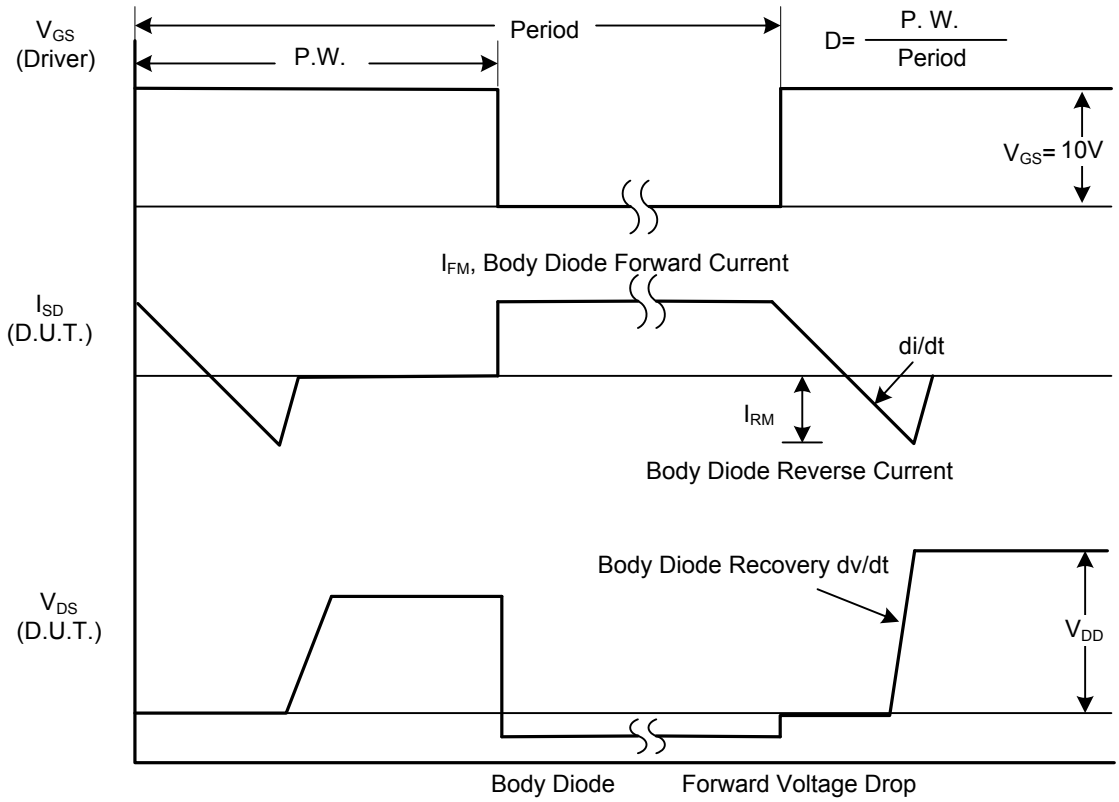
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D=250μA	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
			V_{DS}=600V, V_{GS}=0V, T_C=125°C			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS}=30V, V_{DS}=0V			100	nA
	Reverse		V_{GS}= -30V, V_{DS}=0V			-100	nA
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}=10 V, I_D=2.0A		2.0	2.2	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS}=25V, V_{GS}=0V, f=1MHz		510		pF
Output Capacitance		C_{OSS}			58		pF
Reverse Transfer Capacitance		C_{RSS}			5.6		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge		Q_G	V_{DS}=480V, V_{GS}=10V, I_D=4.0A I_G= 1mA (Note1, 2)		13		nC
Gate-Source Charge		Q_{GS}			4		nC
Gate-Drain Charge		Q_{GD}			2.5		nC
Turn-On Delay Time		$t_{D(ON)}$	V_{DS}=100V, V_{GS}=10V, I_D=4.0A, R_G=25Ω (Note1, 2)		4		ns
Turn-On Rise Time		t_R			18		ns
Turn-Off Delay Time		$t_{D(OFF)}$			38		ns
Turn-Off Fall Time		t_F			26		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Continuous Drain-Source Diode Forward Current		I_S				4.0	A
Maximum Pulsed Drain-Source Diode Forward Current		I_{SM}				16	A
Drain-Source Diode Forward Voltage		V_{SD}	I_S=4.0A, V_{GS}=0V			1.4	V
Reverse Recovery Time		t_{rr}	I_S=4.0A, V_{GS}=0V, di/dt=100A/μs		300		nS
Reverse Recovery Charge		Q_{rr}			2.9		μC

Notes: 1. Pulse Test: Pulse width≤300μs, Duty cycle≤2%
2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

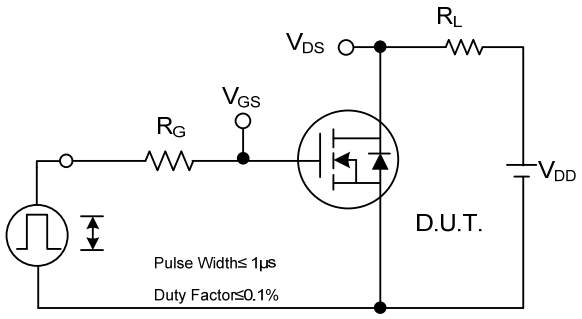


Peak Diode Recovery dv/dt Test Circuit

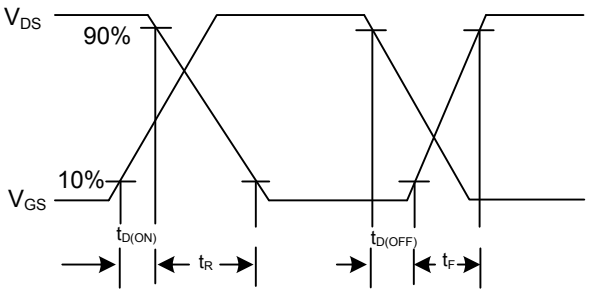


Peak Diode Recovery dv/dt Waveforms

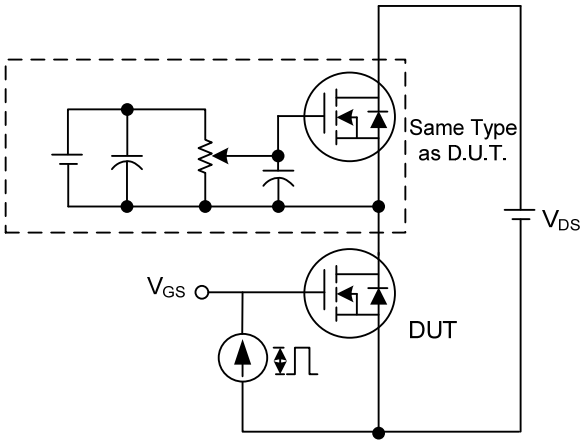
■ TEST CIRCUITS AND WAVEFORMS



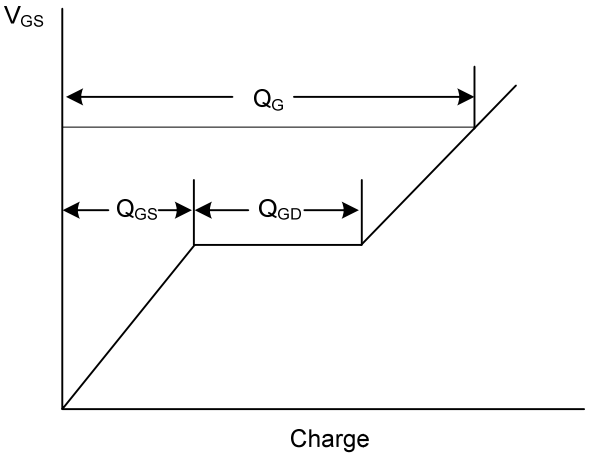
Switching Test Circuit



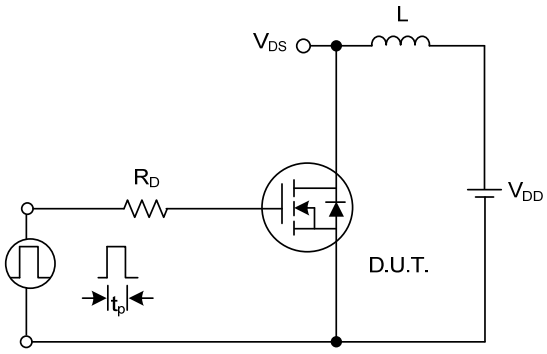
Switching Waveforms



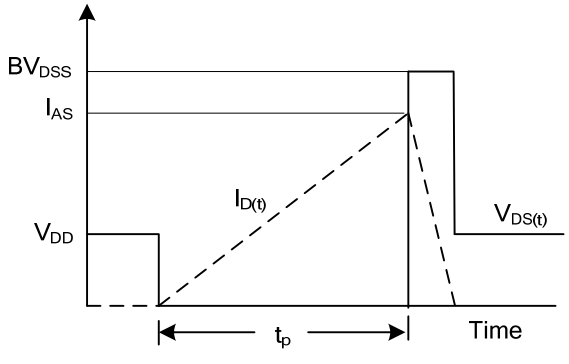
Gate Charge Test Circuit



Gate Charge Waveform



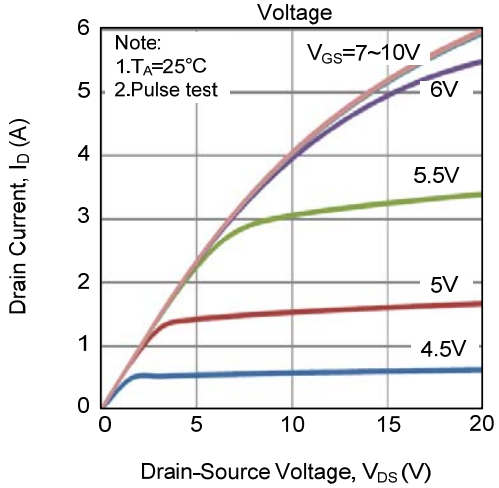
Unclamped Inductive Switching Test Circuit



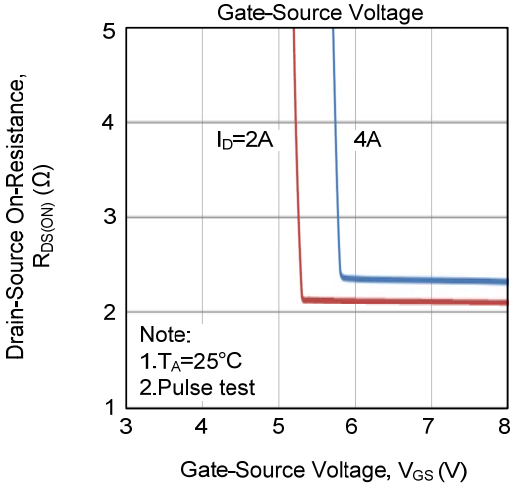
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

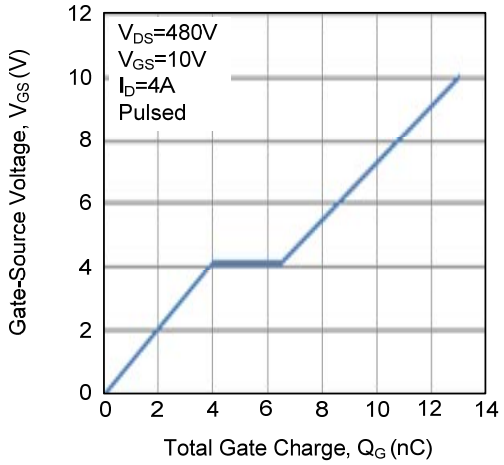
Drain Current vs. Drain-Source Voltage



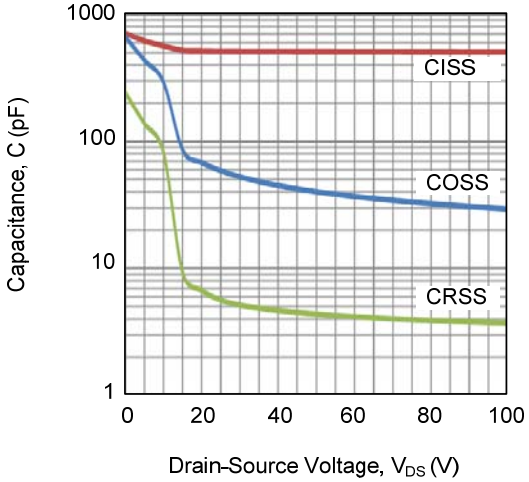
Drain-Source On-Resistance vs. Gate-Source Voltage



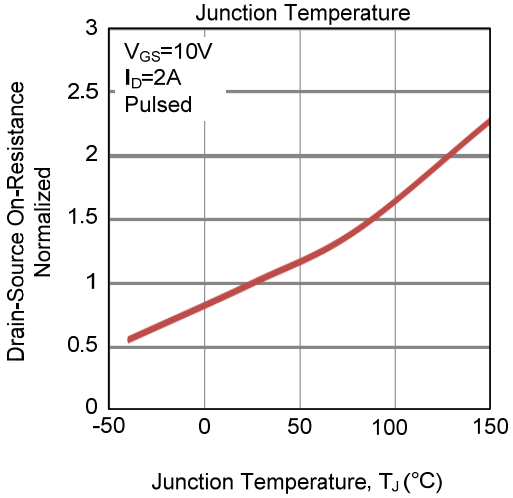
Gate Charge Characteristics



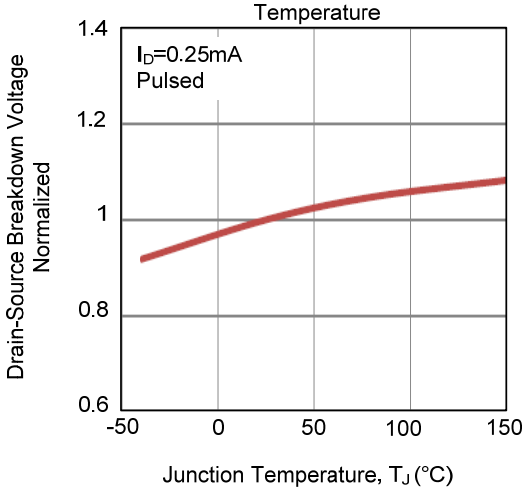
Capacitance Characteristics



Drain-Source On-Resistance vs. Junction Temperature

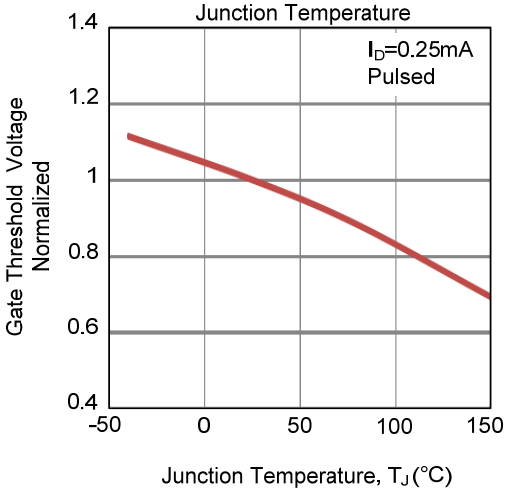


Breakdown Voltage vs. Junction Temperature

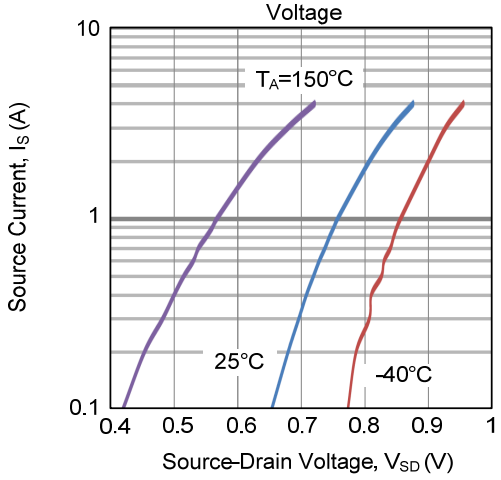


■ TYPICAL CHARACTERISTICS (Cont.)

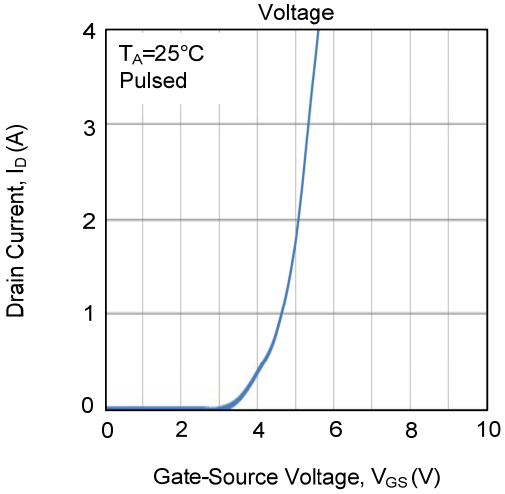
Gate Threshold Voltage vs. Junction Temperature



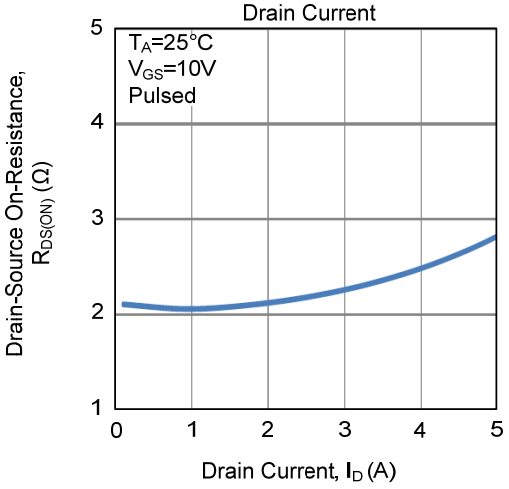
Source Current vs. Source-Drain Voltage



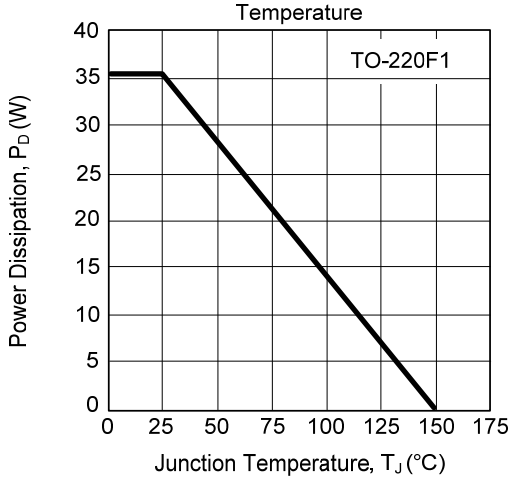
Drain Current vs. Gate-Source Voltage



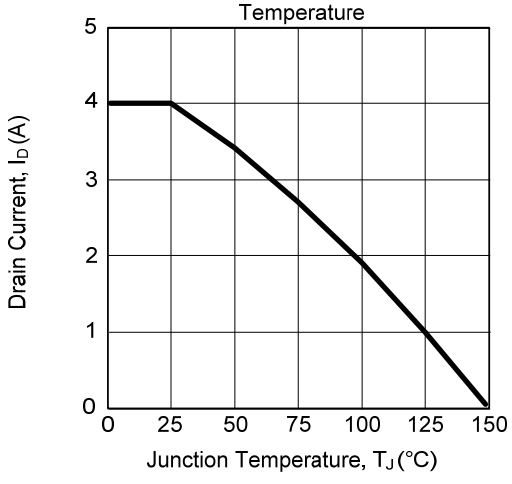
Drain-Source On-Resistance vs. Drain Current



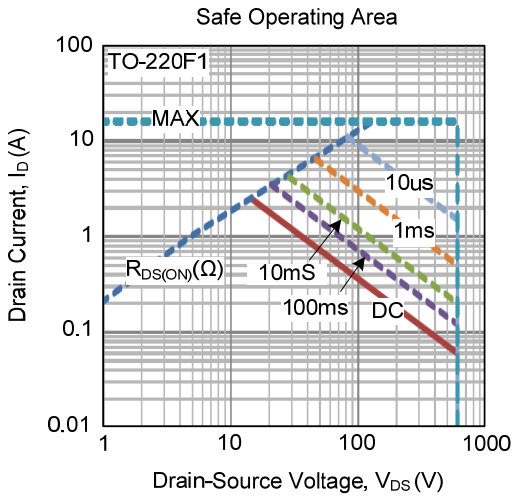
Power Dissipation vs. Junction Temperature



Drain Current vs. Junction Temperature



■ TYPICAL CHARACTERISTICS (Cont.)



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