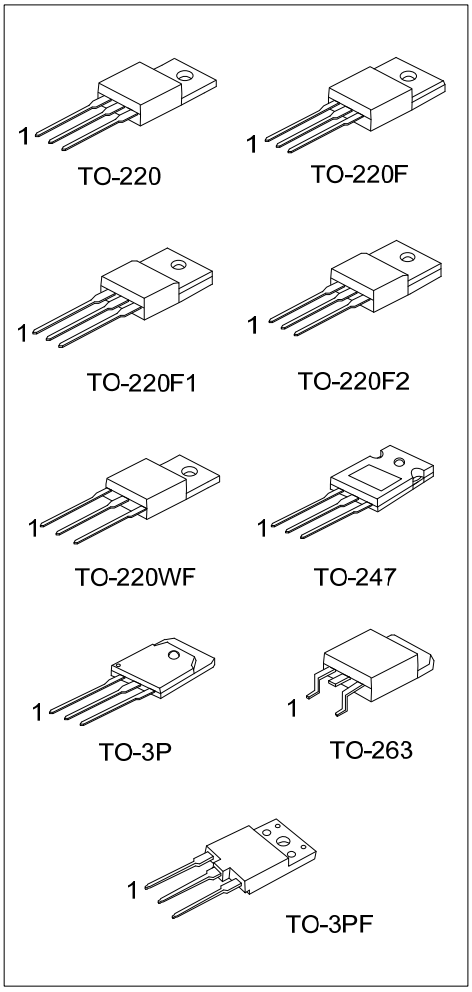
21A, 600V N-CHANNEL SUPER-JUNCTION MOSFET



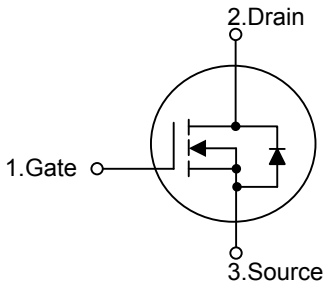
■ DESCRIPTION

The **UTC 21NM60** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

■ FEATURES

* $R_{DS(ON)} \leq 0.19\Omega$ @ V_{GS}=10V, I_D=10.5A
* High Switching Speed
* 100% Avalanche Tested

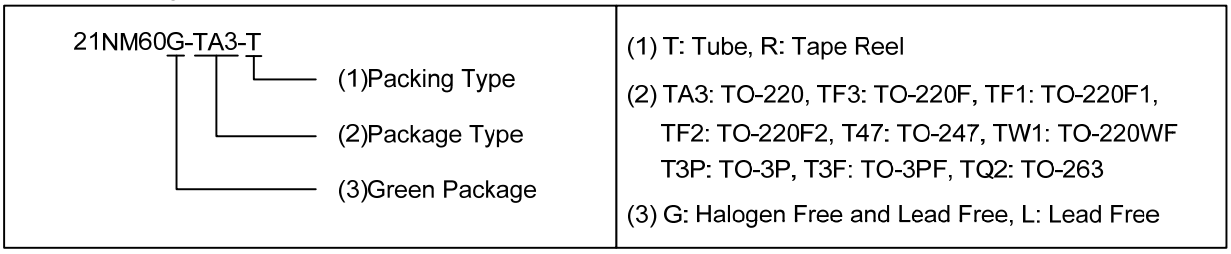
■ SYMBOL



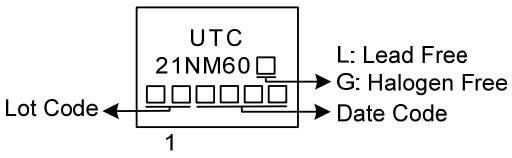
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
21NM60L-TA3-T	21NM60G-TA3-T	TO-220	G	D	S	Tube
21NM60L-TF1-T	21NM60G-TF1-T	TO-220F1	G	D	S	Tube
21NM60L-TF2-T	21NM60G-TF2-T	TO-220F2	G	D	S	Tube
21NM60L-TF3-T	21NM60G-TF3-T	TO-220F	G	D	S	Tube
21NM60L-TW1-T	21NM60G-TW1-T	TO-220WF	G	D	S	Tube
21NM60L-TQ2-T	21NM60G-TQ2-T	TO-263	G	D	S	Tube
21NM60L-TQ2-R	21NM60G-TQ2-R	TO-263	G	D	S	Tape Reel
21NM60L-T3P-T	21NM60G-T3P-T	TO-3P	G	D	S	Tube
21NM60L-T3F-T	21NM60G-T3F-T	TO-3PF	G	D	S	Tube
21NM60L-T47-T	21NM60G-T47-T	TO-247	G	D	S	Tube

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



■ 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
Drain Current	Continuous	I_D	21	A
	Pulsed (Note 2)	I_{DM}	63	A
Avalanche Current (Note 3)		I_{AR}	4.4	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	706	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	20	V/ns
Power Dissipation	TO-220/TO-263	P_D	151	W
	TO-220F/TO-220F1 TO-220F2/TO-220WF		34	W
	TO-247		178	W
	TO-3P		208	W
	TO-3PF		69	W
Junction Temperature		T_J	+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 = 73mH, I_{AS} = 4.4A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
4. I_{SD} ≤ 21A, di/dt ≤200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

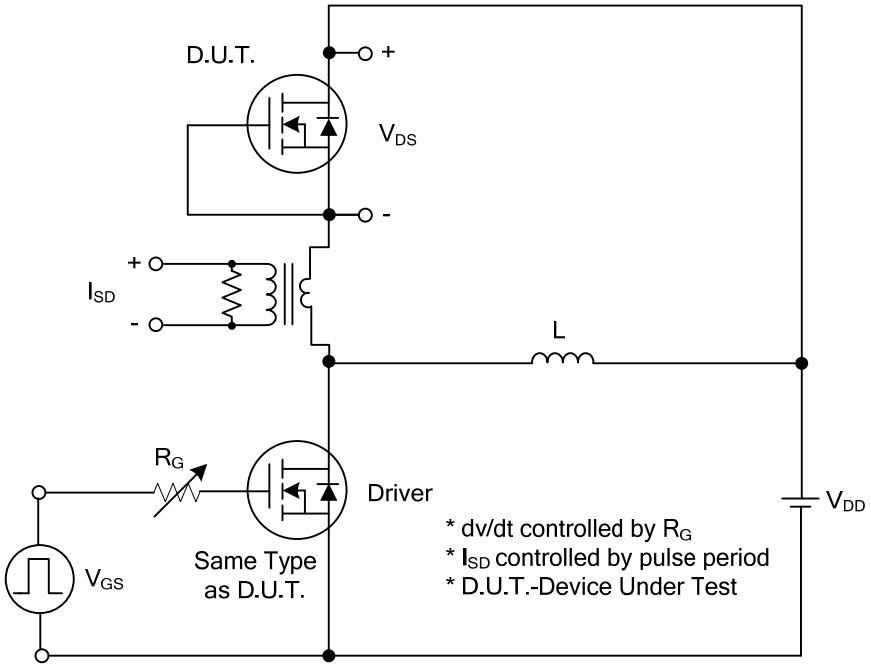
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220WF/TO-263	θ_{JA}	62.5	°C/W
	TO-247		60	°C/W
	TO-3P/TO-3PF		40	°C/W
Junction to Case	TO-220/TO-263	θ_{JC}	0.83	°C/W
	TO-220F/TO-220F1 TO-220F2/TO-220WF		3.7	°C/W
	TO-247		0.7	°C/W
	TO-3P		0.6	°C/W
	TO-3PF		1.8	°C/W

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

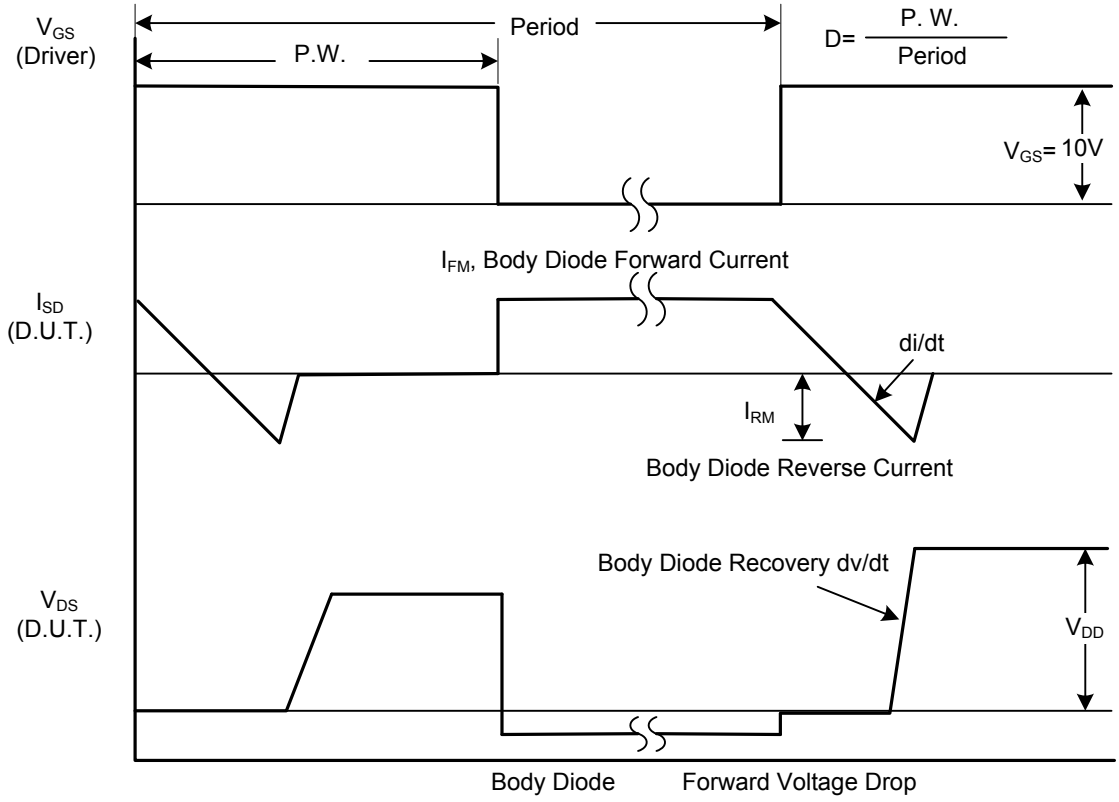
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	I_D=250μA, V_{GS}=0V	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
Gate- Source Leakage Current	Forward	I_{GSS}	V_{GS}=+30V, V_{DS}=0V			+100	nA
	Reverse		V_{GS}=-30V, V_{DS}=0V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=250μA	2.5		4.5	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS}=10V, I_D=10.5A			0.19	Ω
DYNAMIC PARAMETERS							
Input Capacitance		C_{ISS}	V_{GS}=0V, V_{DS}=25V, f=1.0MHz		1600		pF
Output Capacitance		C_{OSS}			1200		pF
Reverse Transfer Capacitance		C_{RSS}			120		pF
SWITCHING PARAMETERS							
Total Gate Charge (Note 1)		Q_G	V_{DS}=480V, V_{GS}=10V, I_D=21A I_G= 1mA (Note1, 2)		54		nC
Gate to Source Charge		Q_{GS}			13		nC
Gate to Drain Charge		Q_{GD}			23		nC
Turn-ON Delay Time (Note 1)		$t_{D(ON)}$	V_{DS}=100V, V_{GS}=10V, I_D=21A, R_G=25Ω (Note1, 2)		28		ns
Rise Time		t_R			35		ns
Turn-OFF Delay Time		$t_{D(OFF)}$			170		ns
Fall-Time		t_F			60		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I_S				21	A
Maximum Body-Diode Pulsed Current		I_{SM}				63	A
Drain-Source Diode Forward Voltage (Note 1)		V_{SD}	I_S=21A, V_{GS}=0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t_{rr}	I_S=21A, V_{GS}=0V, dI_F/dt=200A/μs		470		ns
Body Diode Reverse Recovery Charge		Q_{rr}			9.4		μC

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

■ TEST CIRCUITS AND WAVEFORMS



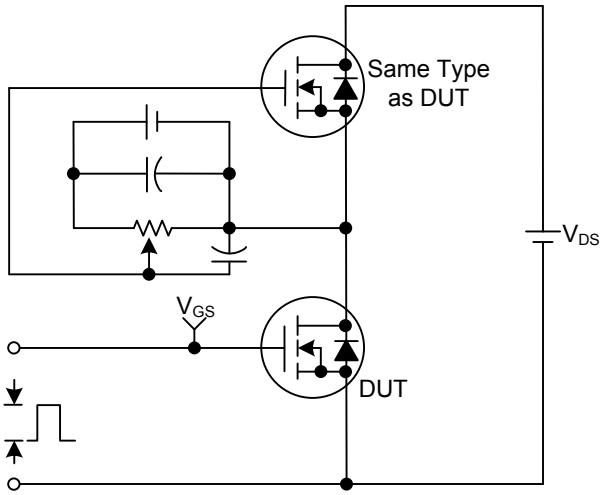
Peak Diode Recovery dv/dt Test Circuit



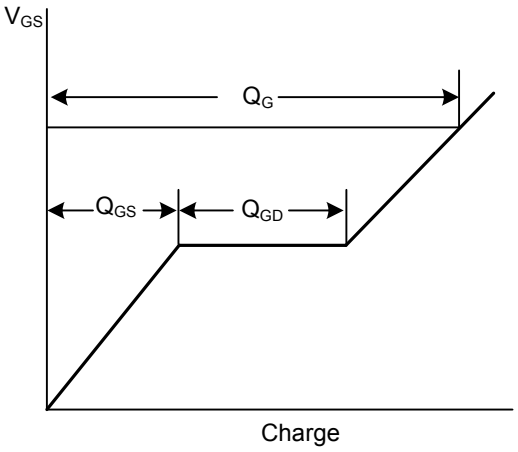
Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS

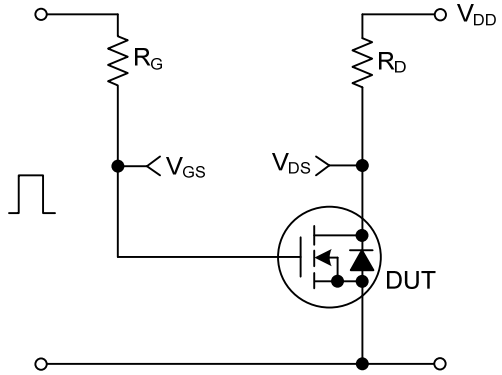
Gate Charge Test Circuit



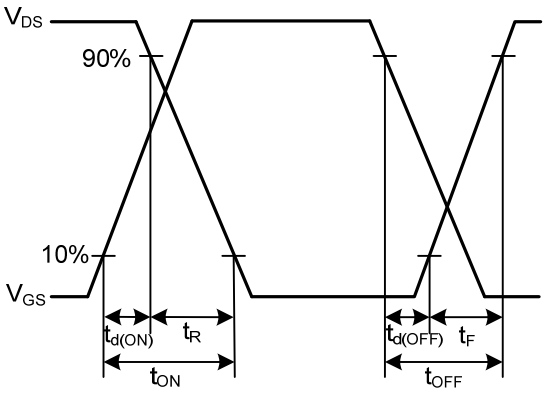
Gate Charge Waveforms



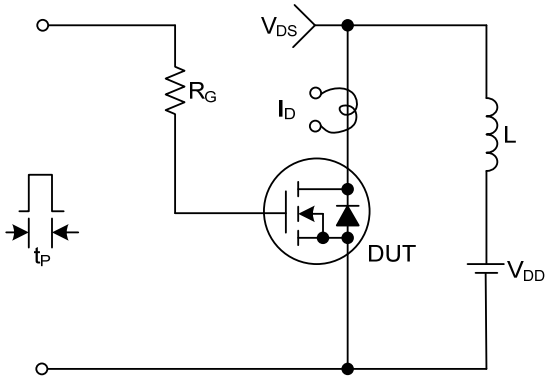
Resistive Switching Test Circuit



Resistive Switching Waveforms

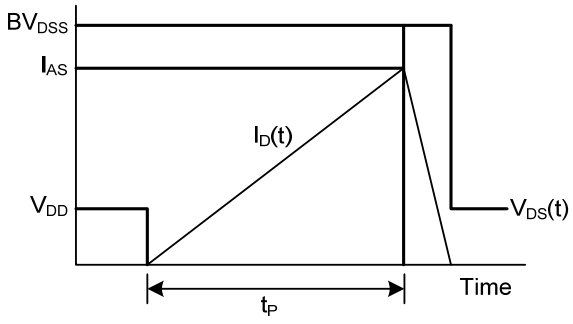


Unclamped Inductive Switching Test Circuit



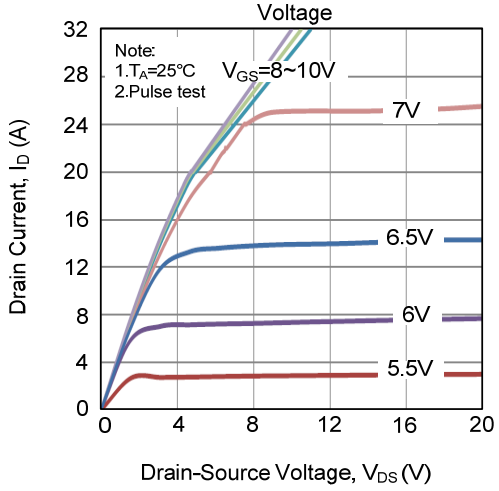
Unclamped Inductive Switching Waveforms

$$E_{AS}=\frac{1}{2}LI_{AS}^{2}\frac{BV_{DSS}}{BV_{DSS}-V_{DD}}$$

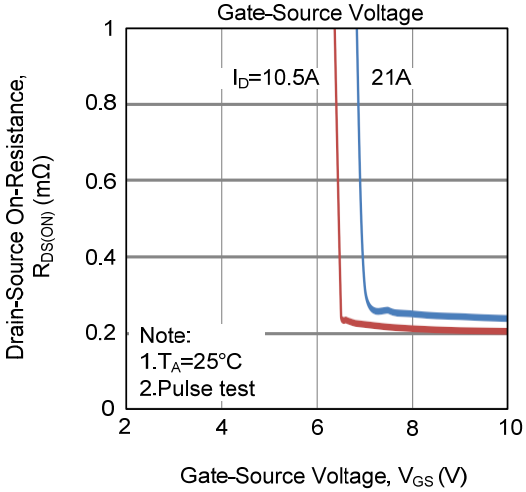


■ TYPICAL CHARACTERISTICS

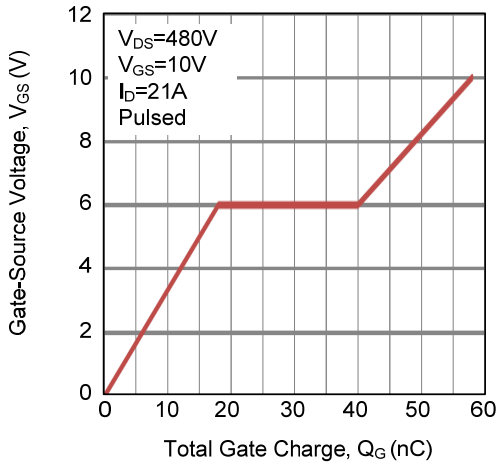
Drain Current vs. Drain-Source Voltage



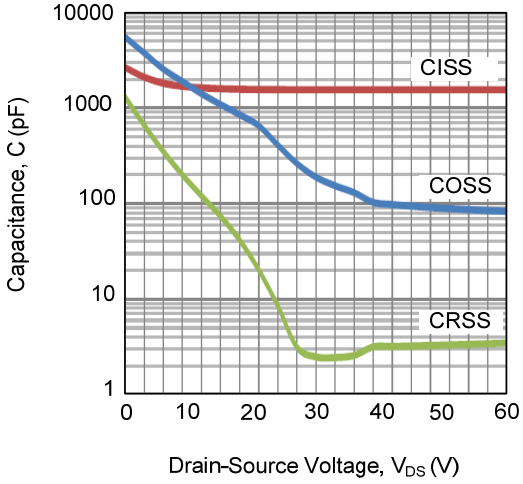
Drain-Source On-Resistance vs. Gate-Source Voltage



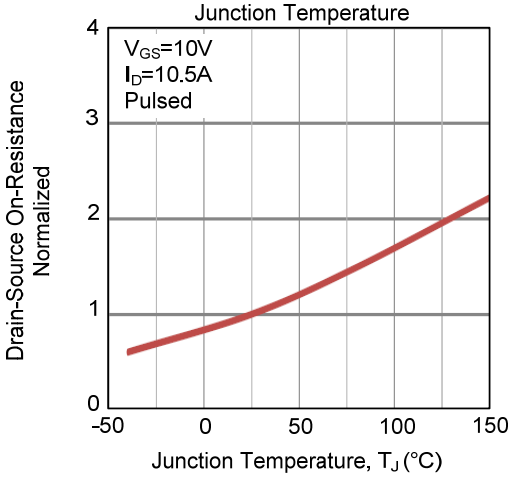
Gate Charge Characteristics



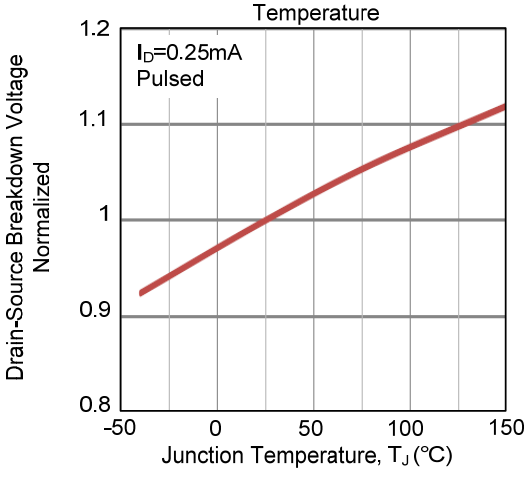
Capacitance Characteristics



Drain-Source On-Resistance vs. Junction Temperature

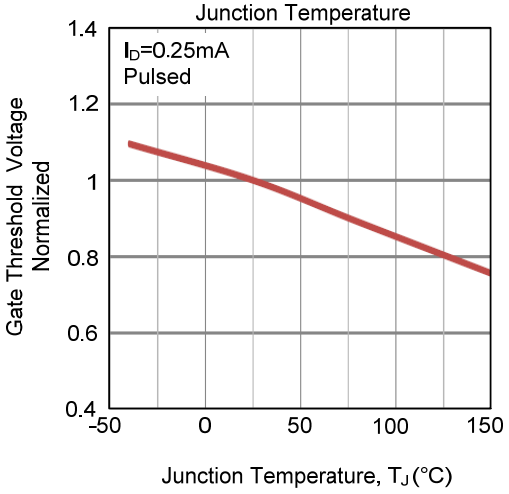


Breakdown Voltage vs. Junction Temperature

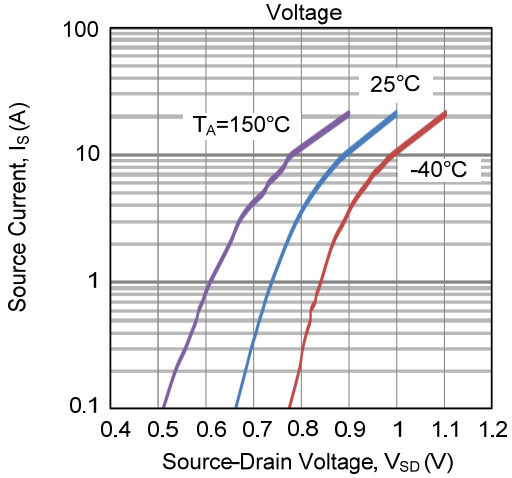


■ TYPICAL CHARACTERISTICS (Cont.)

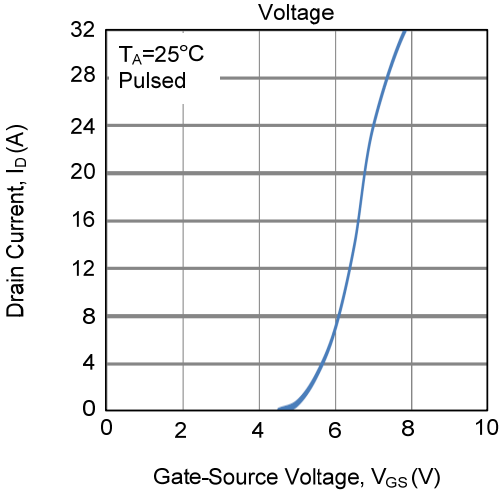
Gate Threshold Voltage vs. Junction Temperature



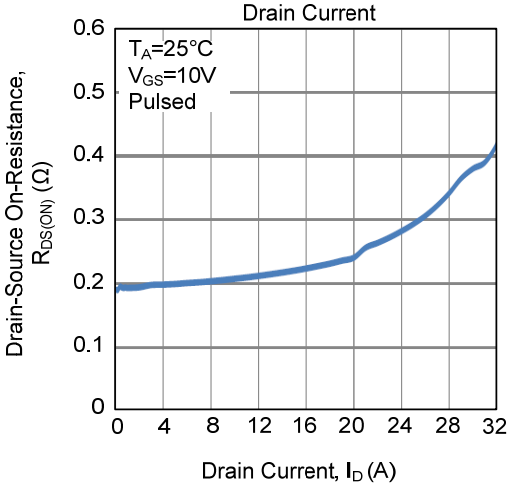
Source Current vs. Source-Drain Voltage



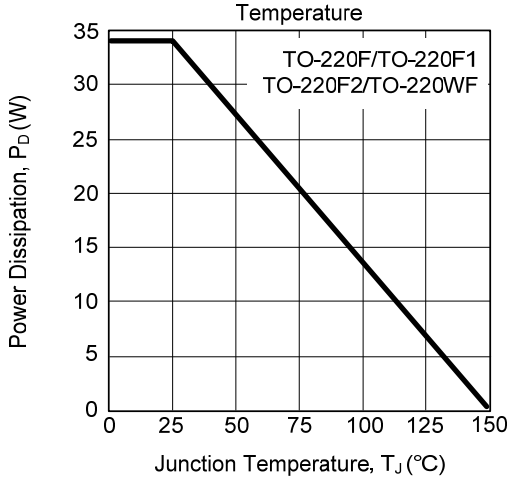
Drain Current vs. Gate-Source Voltage



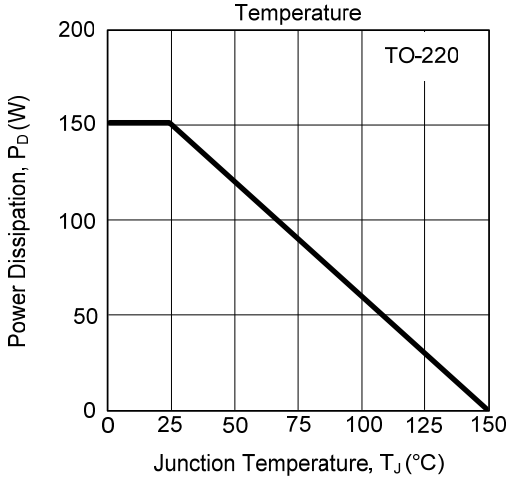
Drain-Source On-Resistance vs. Drain Current



Power Dissipation vs. Junction Temperature



Power Dissipation vs. Junction Temperature



■ TYPICAL CHARACTERISTICS (Cont.)