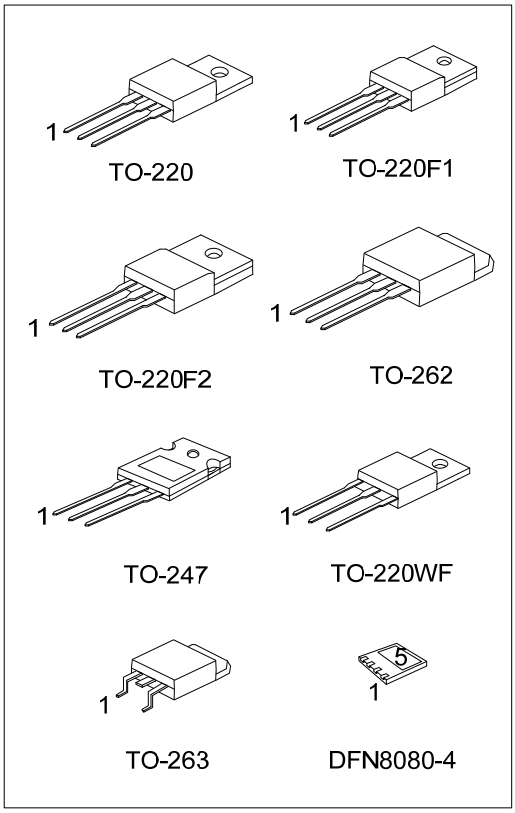
20A, 600V N-CHANNEL SUPER-JUNCTION MOSFET



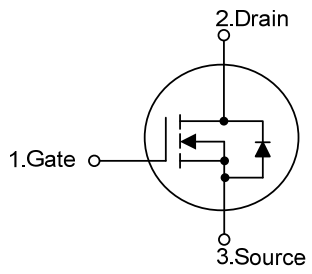
■ DESCRIPTION

The **UTC 20NM60** 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.

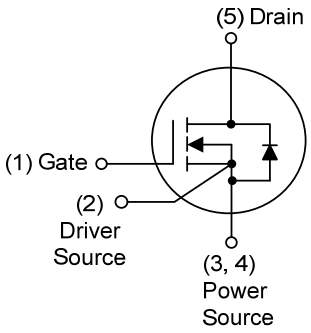
■ FEATURES

* For TO-220/TO-220F1/TO-220F2/TO-220WF
  $R_{DS(ON)} \leq 0.19\ \Omega$ @ V_{GS}=10V, I_D=9.5A
* For TO-262/TO-263/TO-247/DFN8080-4
  $R_{DS(ON)} \leq 0.21\ \Omega$ @ V_{GS}=10V, I_D=9.5A
* By using Super Junction Structure
* Fast Switching
* With 100% Avalanche Tested

■ SYMBOL



TO-220/TO-220F1/TO-220F2
TO-220WF/TO-247/TO-262/TO-263

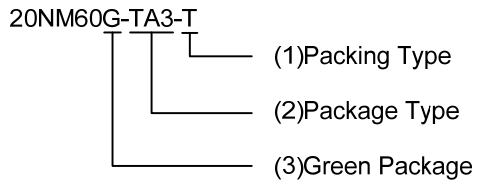


DFN8080-4

■ ORDERING INFORMATION

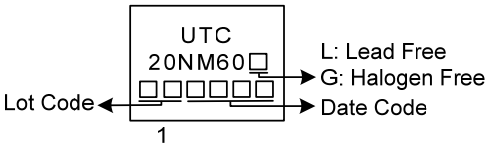
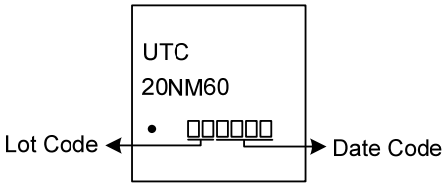
Ordering Number		Package	Pin Assignment					Packing
Lead Free	Halogen Free		1	2	3	4	5	
20NM60L-TA3-T	20NM60G-TA3-T	TO-220	G	D	S	-	-	Tube
20NM60L-TF1-T	20NM60G-TF1-T	TO-220F1	G	D	S	-	-	Tube
20NM60L-TF2-T	20NM60G-TF2-T	TO-220F2	G	D	S	-	-	Tube
20NM60L-TW1-T	20NM60G-TW1-T	TO-220WF	G	D	S	-	-	Tube
20NM60L-T2Q-T	20NM60G-T2Q-T	TO-262	G	D	S	-	-	Tube
20NM60L-TQ2-T	20NM60G-TQ2-T	TO-263	G	D	S	-	-	Tube
20NM60L-TQ2-R	20NM60G-TQ2-R	TO-263	G	D	S	-	-	Tape Reel
20NM60L-T47-T	20NM60G-T47-T	TO-247	G	D	S	-	-	Tube
20NM60L-K04-8080-R	20NM60G-K04-8080-R	DFN8080-4	G	S	S	S	D	Tape Reel

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



(1) T: Tube, R:Tape Reel
(2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TO-220WF, T2Q: TO-262, TQ2: TO-263, T47: TO-247, K04-8080: DFN8080-4
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

TO-220 / TO-220F1 / TO-220F2 TO-220WF / TO-247 / TO-262/TO-263	DFN8080-4
	

■ 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
Continuous Drain Current	Continuous	T_C=25°C	I_D	20	A
		T_C=100°C		13	A
Pulsed Drain Current	Pulsed (Note 2)		I_{DM}	60	A
Avalanche energy	Single Pulsed (Note 3)		E_{AS}	265	mJ
Peak Diode Recovery dv/dt (Note 4)			dv/dt	2.8	V/nS
Power Dissipation	TO-220/TO-262/TO-263		P_D	114	W
	TO-220F1/TO-220F2 TO-220WF			34	W
	TO-247			130	W
	DFN8080-4			63.5	W
Junction Temperature			T_J	+150	°C
Storage Temperature Range			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 = 30mH, I_{AS} = 4.2A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
4. I_{SD} ≤ 10A, 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-220F1 TO-220F2/TO-220WF TO-262/TO-263	θ_{JA}	62.5	°C/W
	TO-247		40	°C/W
	DFN8080-4		35 (Note)	°C/W
Junction to Case	TO-220/TO-262/TO-263	θ_{JC}	1.09	°C/W
	TO-220F1/TO-220F2 TO-220WF		3.67	°C/W
	TO-247		0.96	°C/W
	DFN8080-4		1.95 (Note)	°C/W

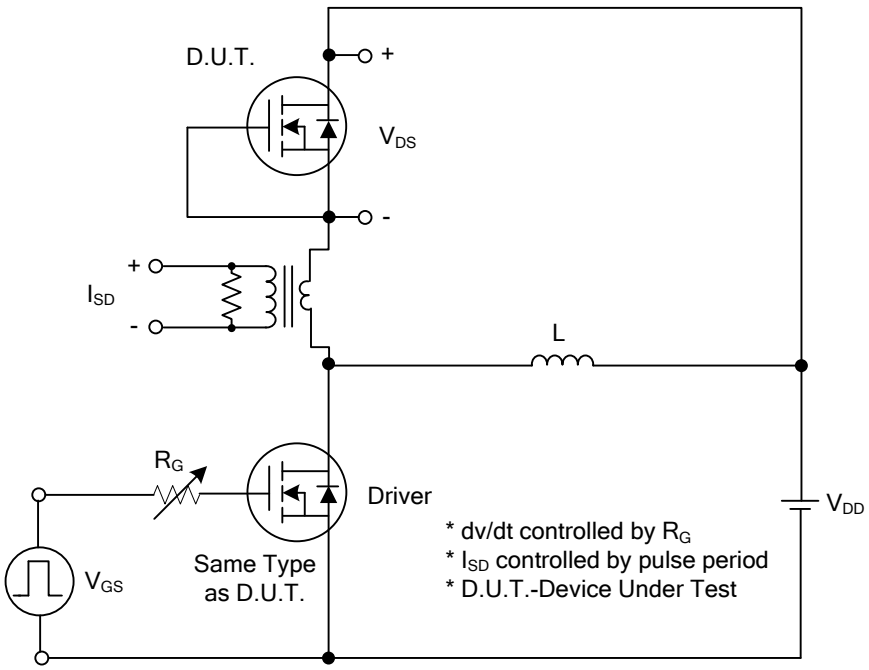
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

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

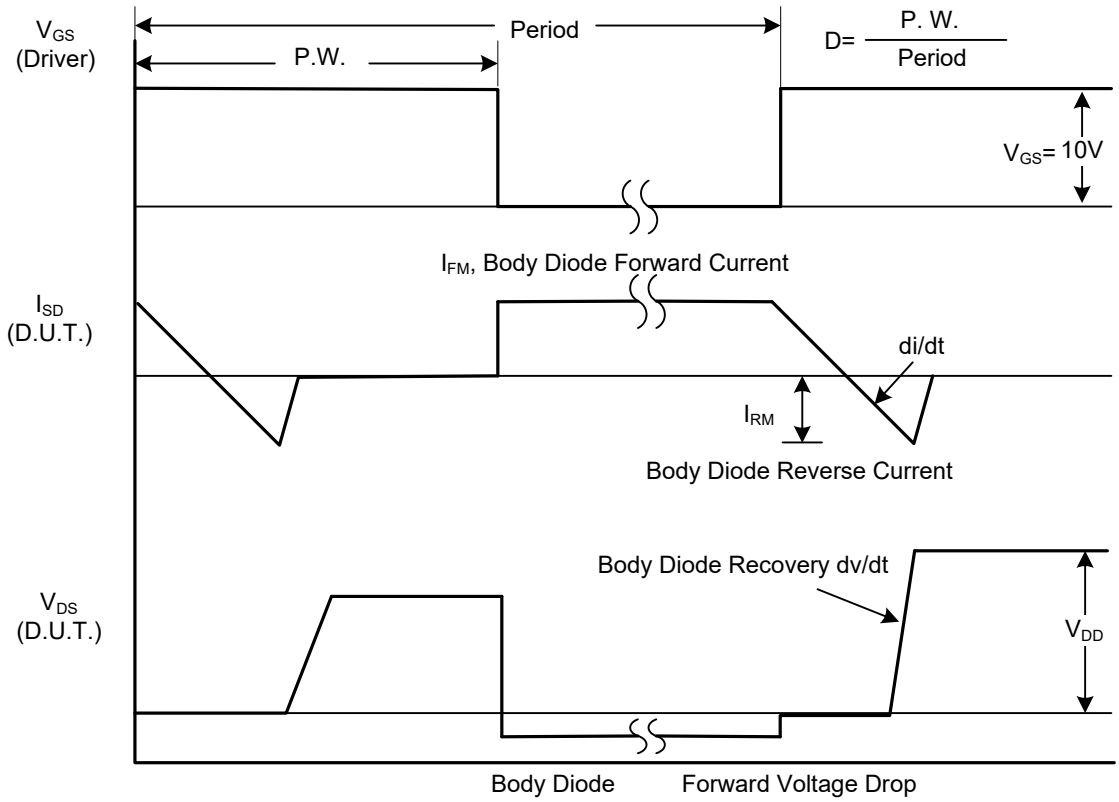
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D=250μA	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{DS}=0V ,V_{GS}=+30V			+100	nA
	Reverse		V_{DS}=0V ,V_{GS}=-30V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}= V_{GS}, I_D=250μA	2.5		4.5	V
Drain-Source On-State Resistance	TO-220/TO-220F1 TO-220F2/TO-220WF	$R_{DS(ON)}$	V_{GS}=10V, I_D=9.5A		0.175	0.19	Ω
	TO-262/TO-263 TO-247/DFN8080-4		V_{GS}=10V, I_D=9.5A		0.185	0.21	Ω
DYNAMIC PARAMETERS							
Input Capacitance		C_{ISS}	V_{GS}=0V, V_{DS}=50V, f=1.0MHz		1300		pF
Output Capacitance		C_{OSS}			145		pF
Reverse Transfer Capacitance		C_{RSS}			5		pF
SWITCHING PARAMETERS							
Total Gate Charge (Note 1)		Q_G	V_{DS}=480V, V_{GS}=10V, I_D=20A , I_G=1mA (Note 1, 2)		47		nC
Gate to Source Charge		Q_{GS}			12		nC
Gate to Drain Charge		Q_{GD}			20		nC
Turn-on Delay Time (Note 1)		$t_{D(ON)}$	V_{DD}=100V, V_{GS}=10V, I_D=20A, R_G=25Ω (Note 1, 2)		20		ns
Rise Time		t_R			28		ns
Turn-off Delay Time		$t_{D(OFF)}$			146		ns
Fall-Time		t_F			57		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Pulsed Current		I_S				20	A
Drain-Source Diode Forward Voltage (Note 1)		I_{SM}				60	A
Maximum Body-Diode Continuous Current		V_{SD}	I_S =20A, V_{GS}=0V			1.4	V
Reverse Recovery Time (Note 1)		t_{rr}	I_S =20A, V_{GS}=0V, dI_F/dt=100A/μs		421		ns
Reverse Recovery Charge		Q_{rr}			7.5		μC

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

■ TEST CIRCUITS AND WAVEFORMS

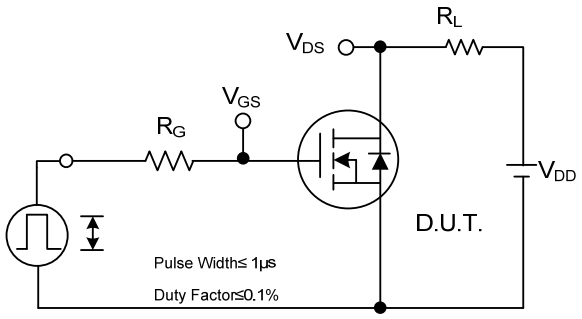


Peak Diode Recovery dv/dt Test Circuit

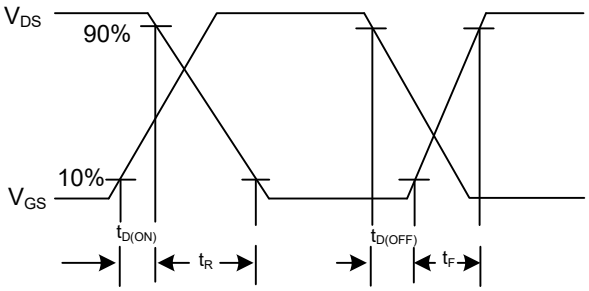


Peak Diode Recovery dv/dt Waveforms

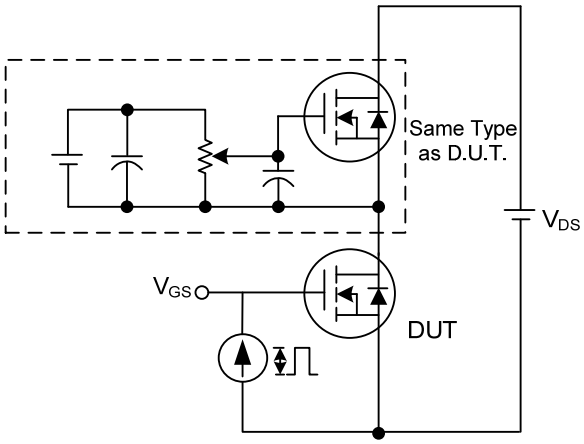
■ TEST CIRCUITS AND WAVEFORMS



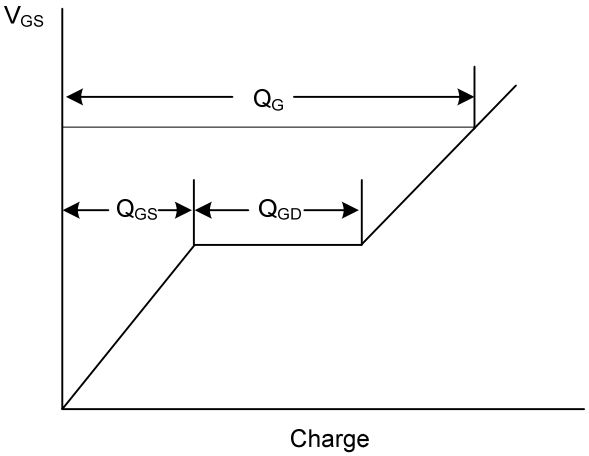
Switching Test Circuit



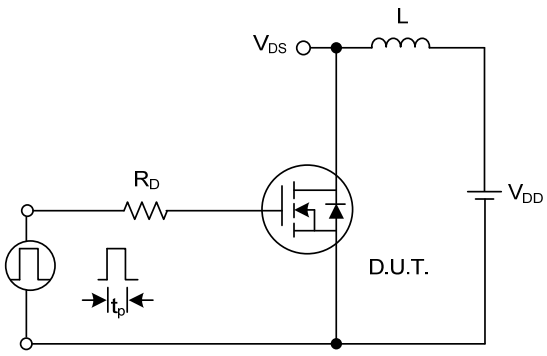
Switching Waveforms



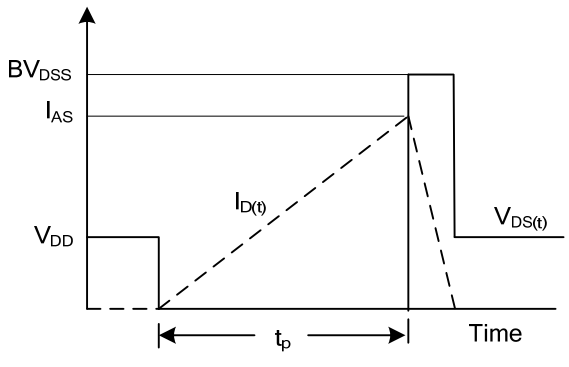
Gate Charge Test Circuit



Gate Charge Waveform



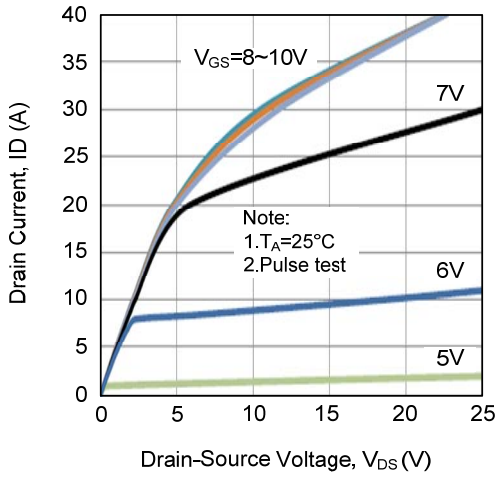
Unclamped Inductive Switching Test Circuit



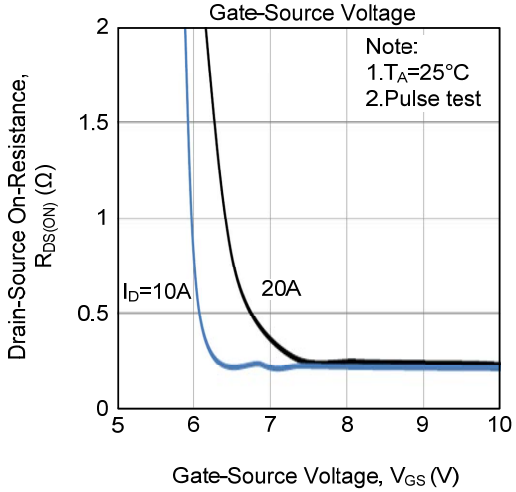
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

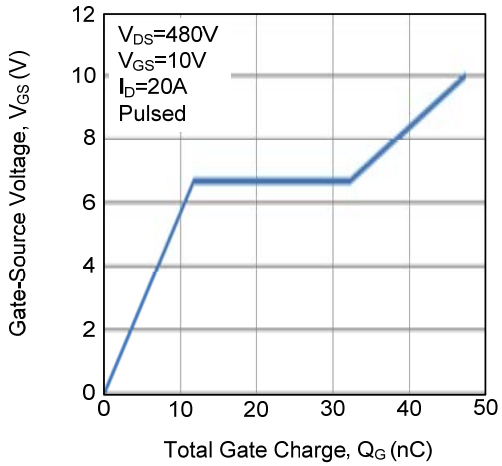
Drain Current vs. Drain-Source Voltage



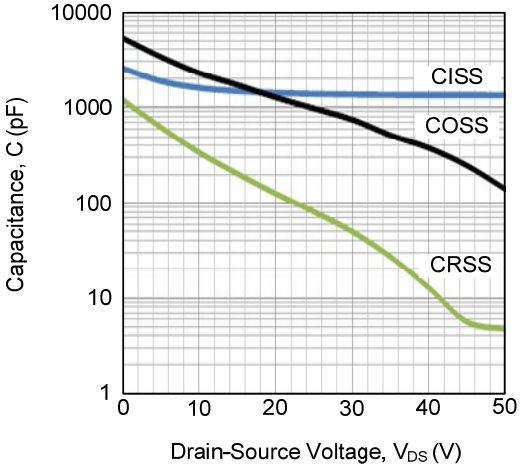
Drain-Source On-Resistance vs. Gate-Source Voltage



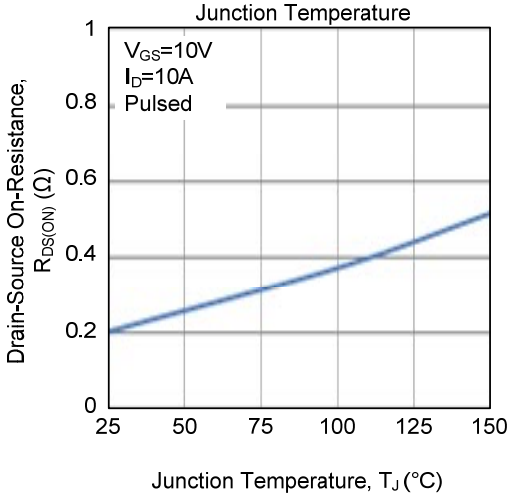
Gate Charge Characteristics



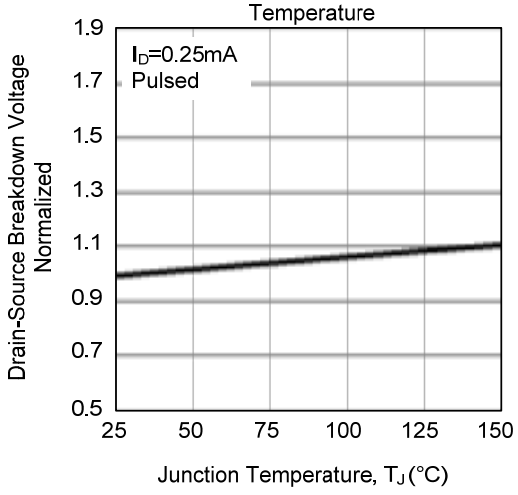
Capacitance Characteristics



Drain-Source On-Resistance vs. Junction Temperature

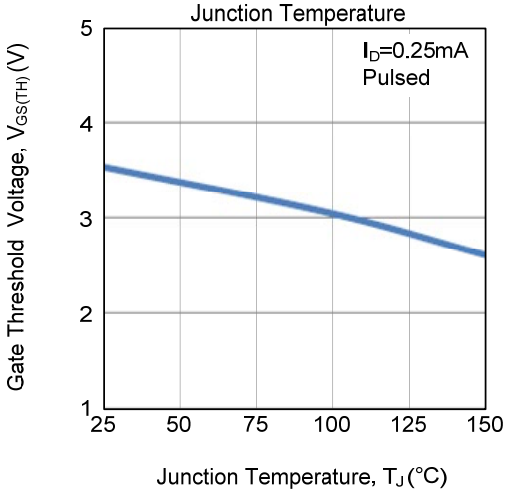


Breakdown Voltage vs. Junction Temperature

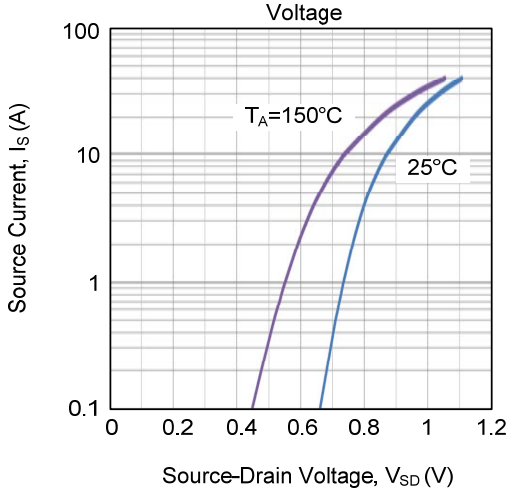


■ TYPICAL CHARACTERISTICS (Cont.)

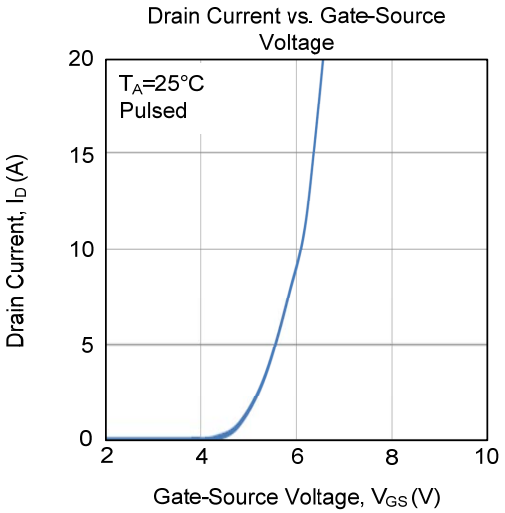
Gate Threshold Voltage vs. Junction Temperature



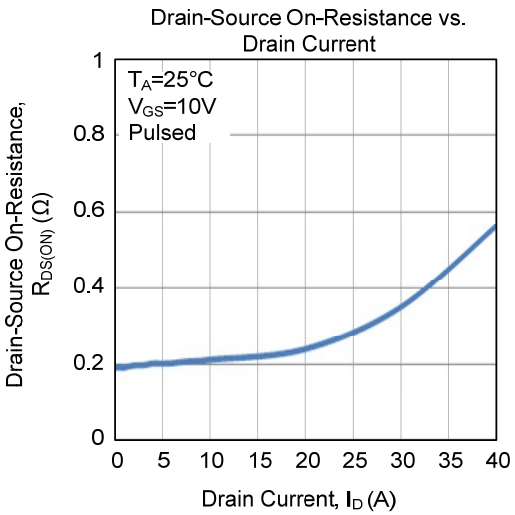
Source Current vs. Source-Drain Voltage



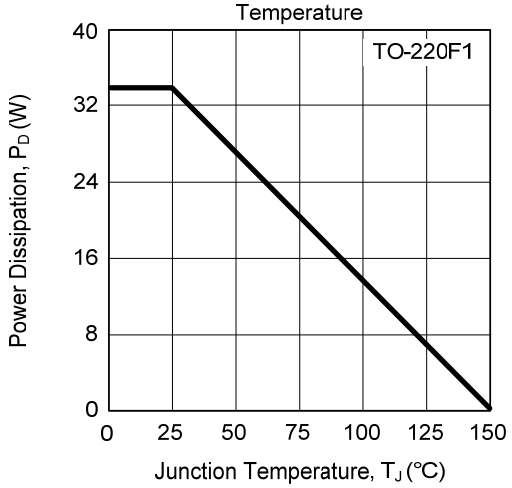
Drain Current vs. Gate-Source Voltage



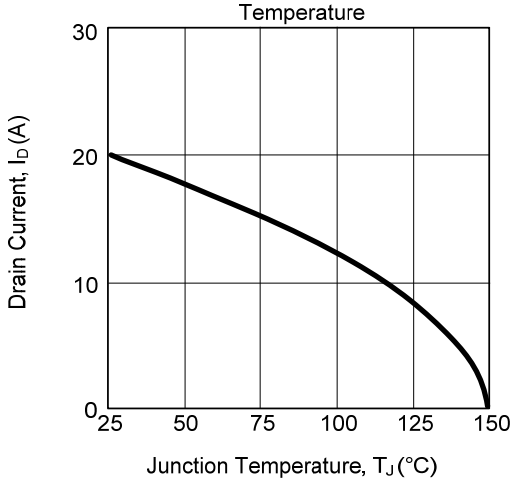
Drain-Source On-Resistance vs. Drain Current



Power Dissipation vs. Junction Temperature



Drain Current vs. Junction Temperature



■ TYPICAL CHARACTERISTICS (Cont.)