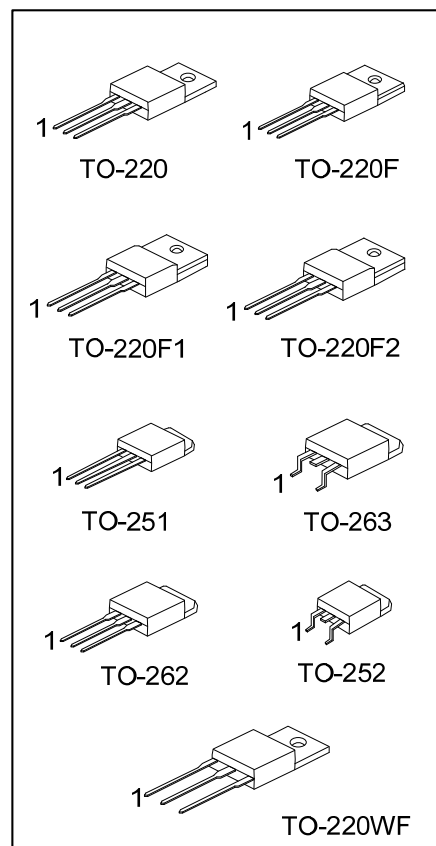
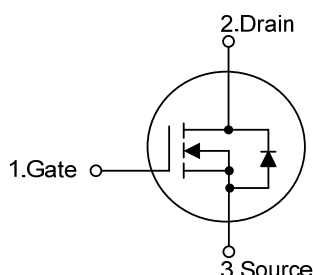


**13NM60****Power MOSFET****13A, 600V N-CHANNEL
SUPER-JUNCTION MOSFET****DESCRIPTION**

The **UTC 13NM60** 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

- * $R_{DS(ON)} \leq 0.45 \Omega$ @ $V_{GS}=10V$, $I_D=6.5A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness

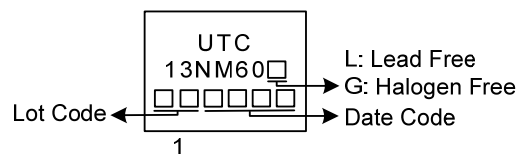
SYMBOL**ORDERING INFORMATION**

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
13NM60L-TA3-T	13NM60G-TA3-T	TO-220	G	D	S	Tube
13NM60L-TF1-T	13NM60G-TF1-T	TO-220F1	G	D	S	Tube
13NM60L-TF2-T	13NM60G-TF2-T	TO-220F2	G	D	S	Tube
13NM60L-TF3-T	13NM60G-TF3-T	TO-220F	G	D	S	Tube
13NM60L-TW1-T	13NM60G-TW1-T	TO-220WF	G	D	S	Tube
13NM60L-TM3-T	13NM60G-TM3-T	TO-251	G	D	S	Tube
13NM60L-TN3-R	13NM60G-TN3-R	TO-252	G	D	S	Tape Reel
13NM60L-T2Q-T	13NM60G-T2Q-T	TO-262	G	D	S	Tube
13NM60L-TQ2-T	13NM60G-TQ2-T	TO-263	G	D	S	Tube
13NM60L-TQ2-R	13NM60G-TQ2-R	TO-263	G	D	S	Tape Reel

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

13NM60G-TA3-T (1) Packing Type (2) Package Type (3) Green Package	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TW1: TO-220WF, TM3: TO-251, TN3: TO-252, T2Q: TO-262, TQ2: TO-263 (3) G: Halogen Free and Lead Free, L: Lead Free
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■ MARKING



■ **ABSOLUTE MAXIMUM RATINGS** ($T_c = 25^\circ\text{C}$, 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	13	A
	Pulsed (Note 2)	I_{DM}	39	A
Avalanche Current (Note 2)		I_{AR}	2.4	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	452	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220/TO-262/TO-263	P_D	120	W
	TO-220F/TO-220F1		30	W
	TO-220F2/TO-220WF		60	W
	TO-251/TO-252		60	W
Junction Temperature		T_J	+150	$^\circ\text{C}$
Storage Temperature Range		T_{STG}	-55 ~ +150	$^\circ\text{C}$

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. $L=157\text{mH}$, $I_{AS}=2.4\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\Omega$, Starting $T_J=25^\circ\text{C}$

4. $I_{SD}\leq 13\text{A}$, $di/dt\leq 200\text{A}/\mu\text{s}$, $V_{DD}\leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$

■ **THERMAL DATA**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220WF/TO-262 TO-263	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/TO-262/TO-263	θ_{JC}	1.04	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220WF/TO-220F2		4.2	$^\circ\text{C}/\text{W}$
	TO-251/TO-252 (Note)		2.08 (Note)	$^\circ\text{C}/\text{W}$

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

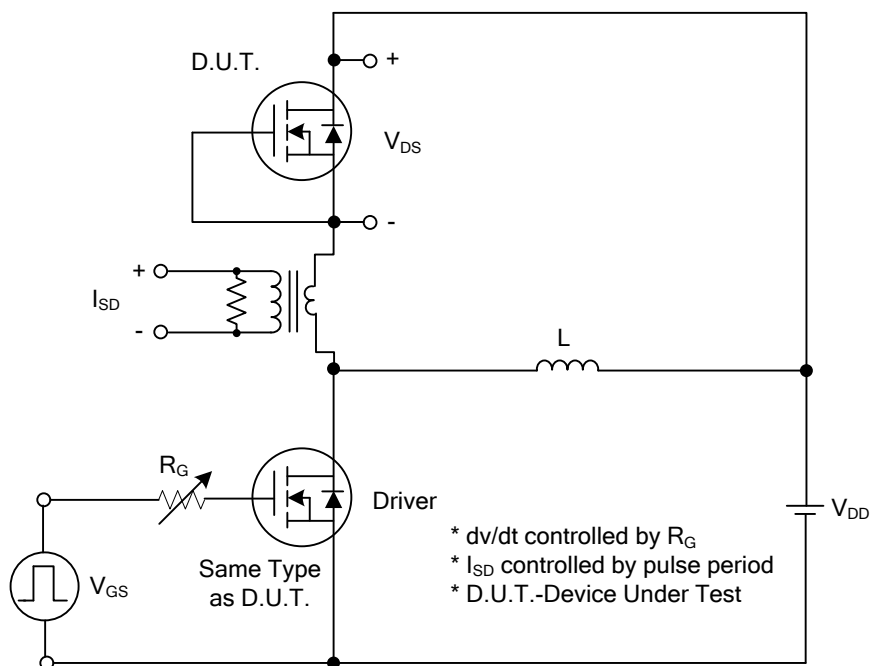
■ ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$, unless otherwise specified)

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 _{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 = 6.5A			0.45	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =25V, f=1.0MHz		760		pF
Output Capacitance		C _{OSS}			600		pF
Reverse Transfer Capacitance		C _{RSS}			65		pF
Gate Resistance		R _G	V _{DS} =0V, V _{GS} =0V, f =1MHz		1.185		Ω
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =480V, V _{GS} =10V, I _D =13A, I _G =1mA (Note 1,2)		28.5		nC
Gate to Source Charge		Q _{GS}			4.5		nC
Gate to Drain Charge		Q _{GD}			10		nC
Turn-ON Delay Time (Note 1)		t _{D(ON)}	V _{DD} =100V, I _D =13A, R _G =25Ω, V _{GS} =10V (Note 1,2)		10		nS
Rise Time		t _R			24		nS
Turn-OFF Delay Time		t _{D(OFF)}			80		nS
Fall-Time		t _F			47		nS
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I _S				13	A
Maximum Body-Diode Pulsed Current		I _{SM}				39	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	I _S =13A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t _{rr}	I _S =13A, V _{GS} =0V,		370		nS
Body Diode Reverse Recovery Charge		Q _{rr}	dl _F /dt=100A/μs		5.4		μC

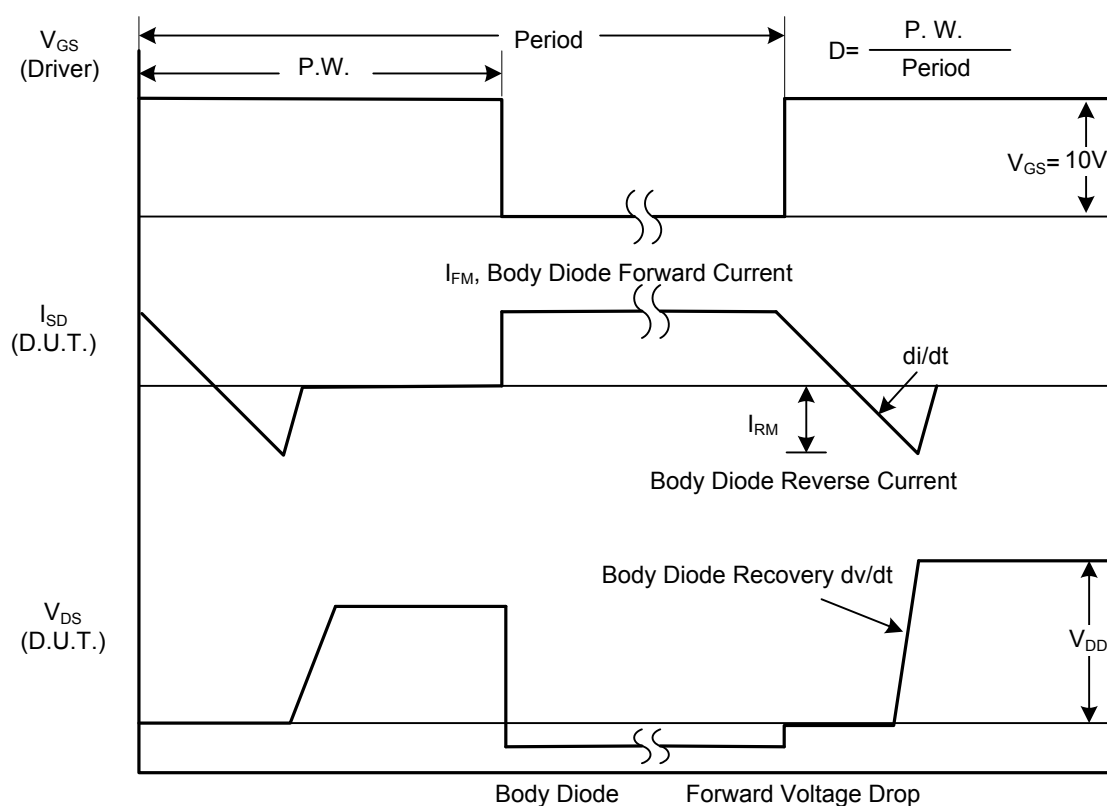
Notes: 1. Pulse Test : Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS

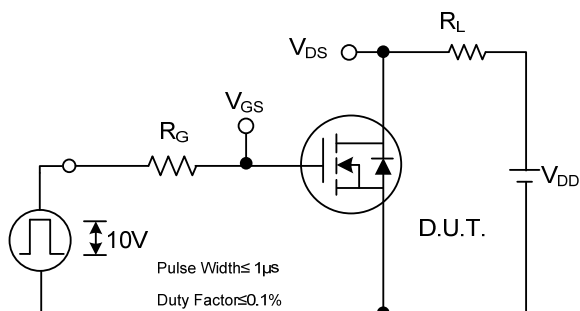


Peak Diode Recovery dv/dt Test Circuit

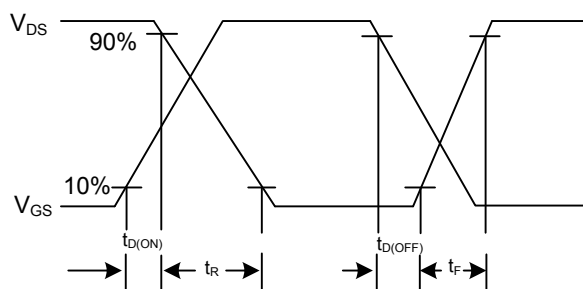


Peak Diode Recovery dv/dt Waveforms

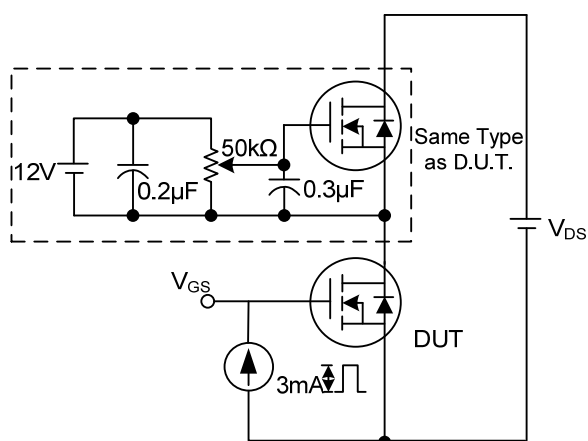
■ TEST CIRCUITS AND WAVEFORMS



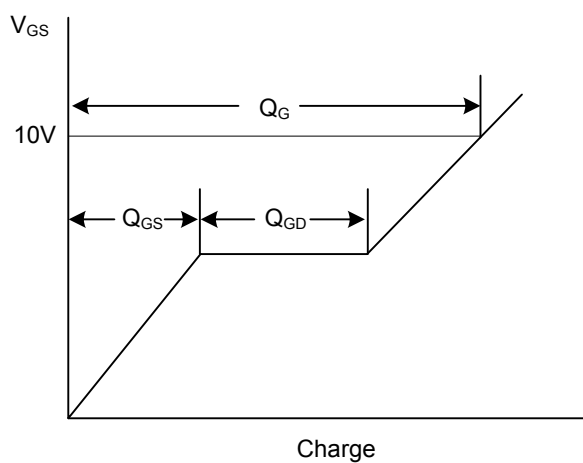
Switching Test Circuit



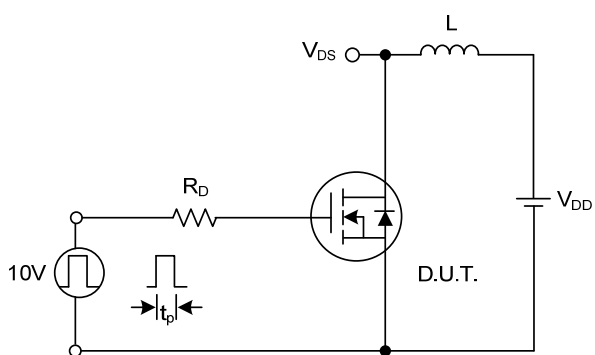
Switching Waveforms



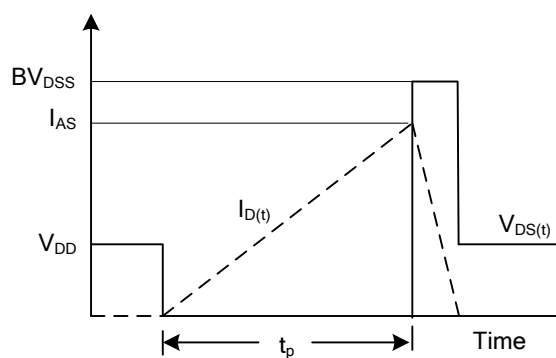
Gate Charge Test Circuit



Gate Charge Waveform

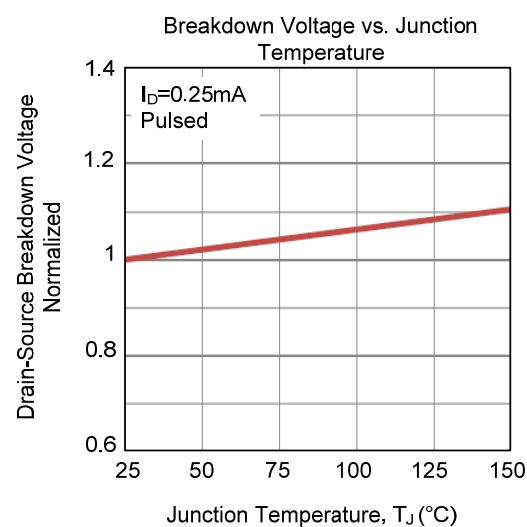
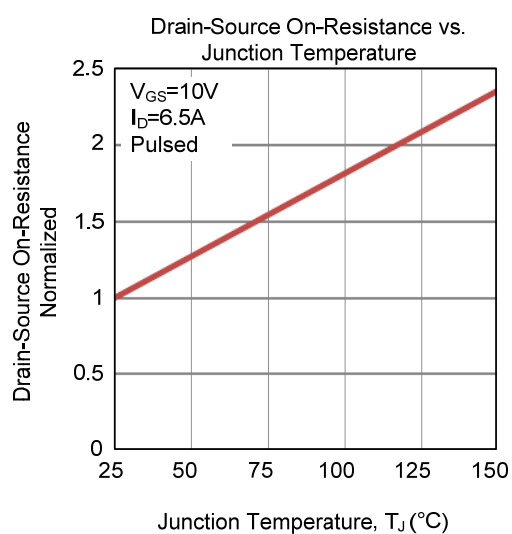
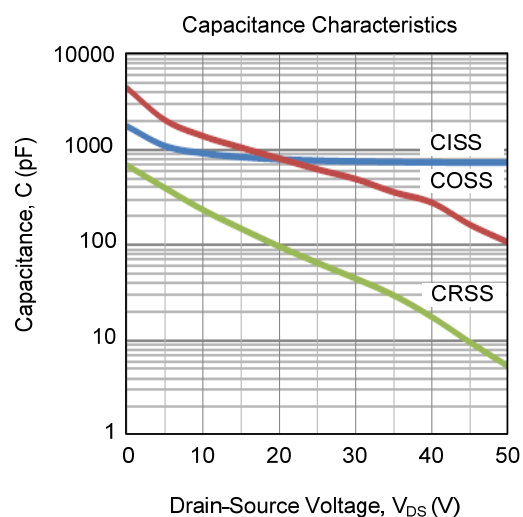
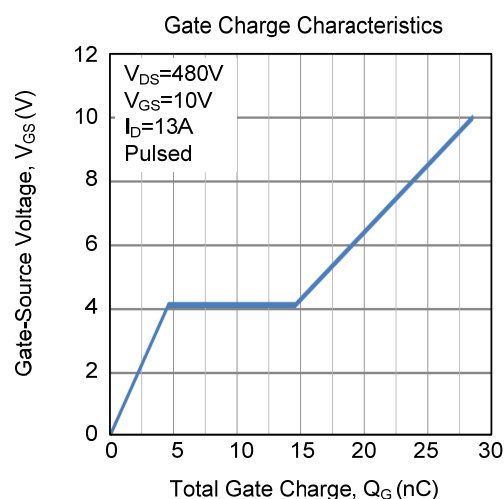
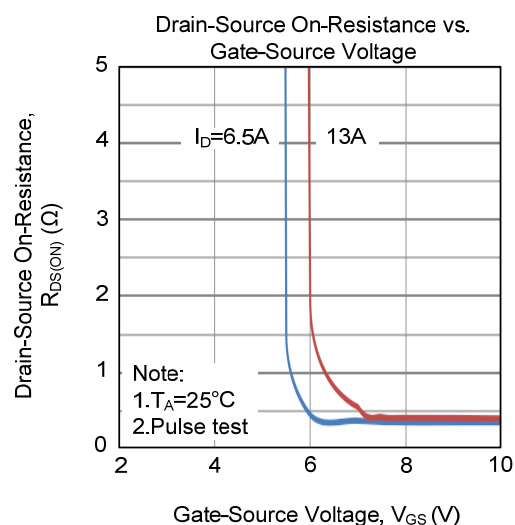
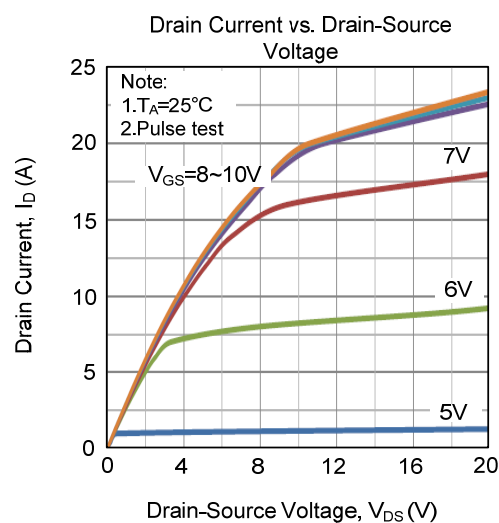


Unclamped Inductive Switching Test Circuit

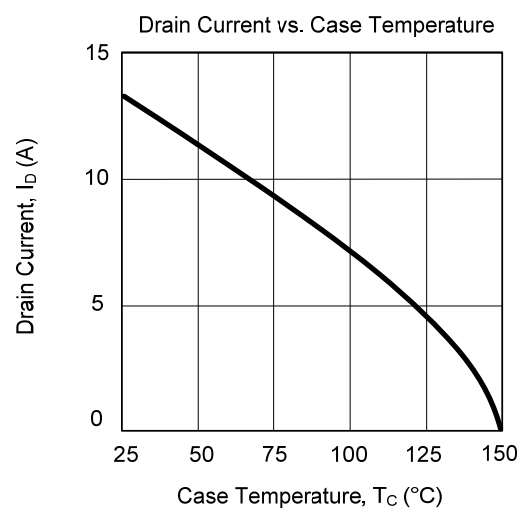
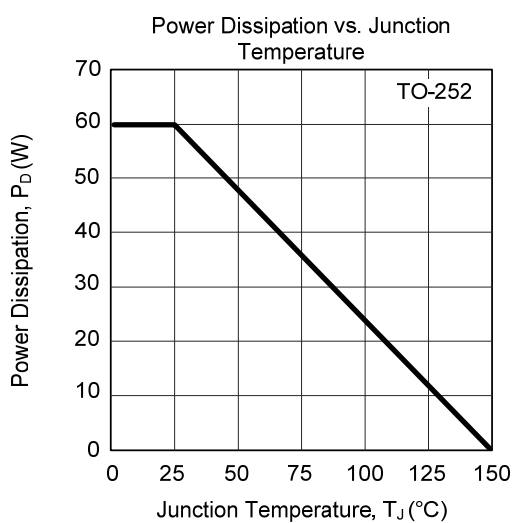
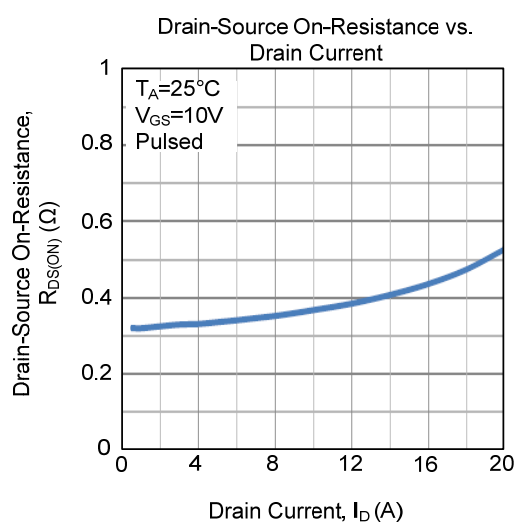
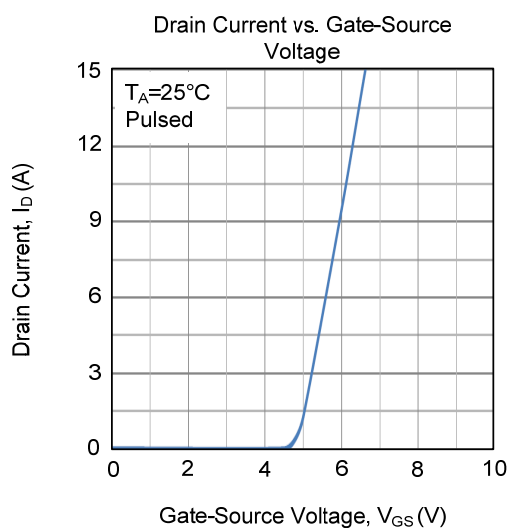
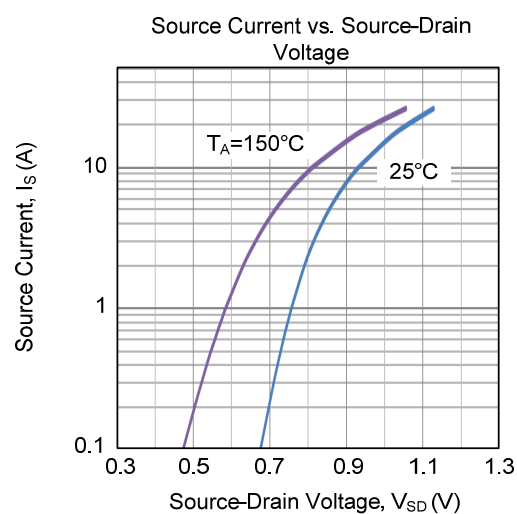
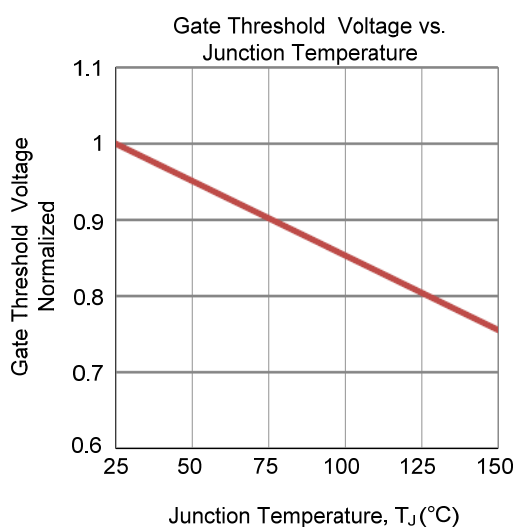


Unclamped Inductive Switching Waveforms

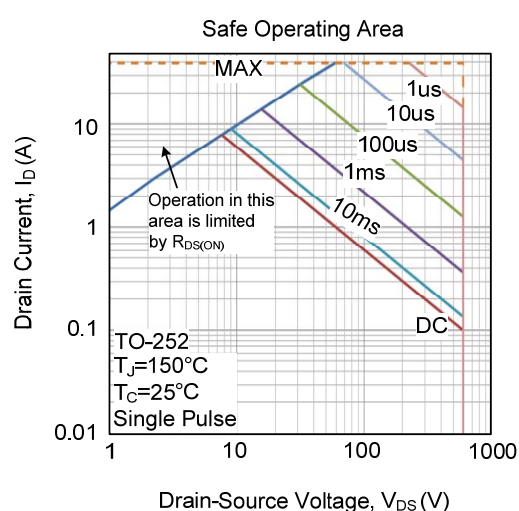
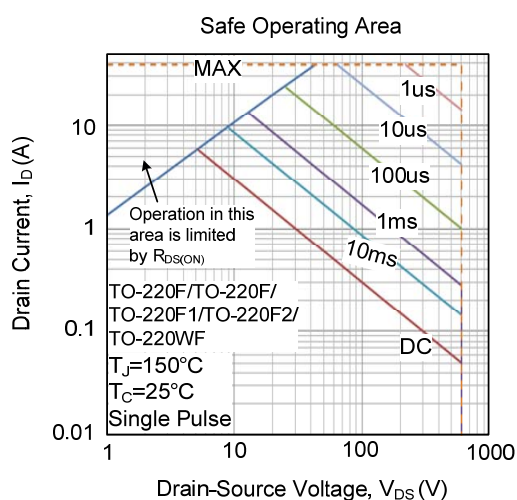
■ TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (Cont.)



TYPICAL CHARACTERISTICS (Cont.)



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