



21NM60

Power MOSFET

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

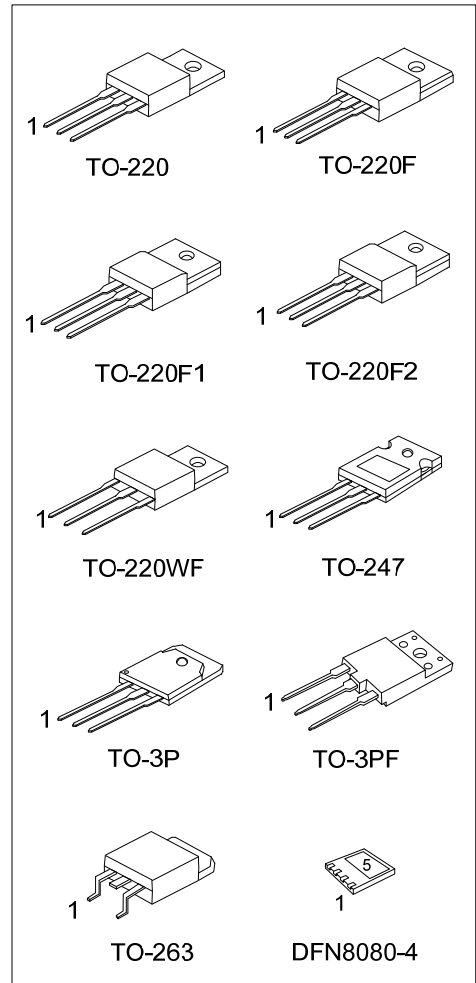
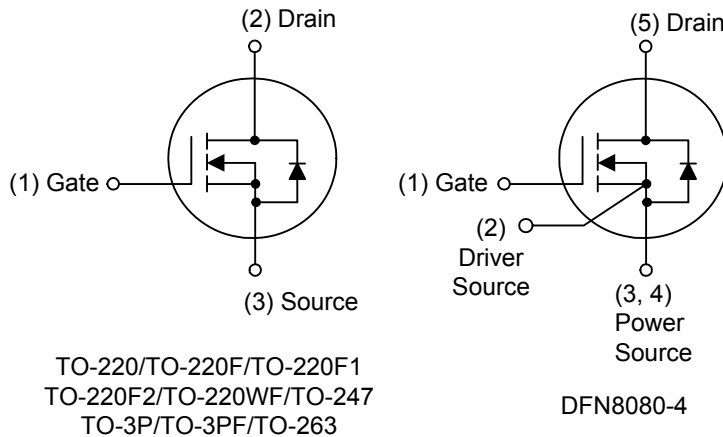
DESCRIPTION

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	4	5	
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
21NM60L-K04-8080-R	21NM60G-K04-8080-R	DFN8080-4	G	S	S	S	D	Tape Reel

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

<p>21NM60G-TA3-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, T47: TO-247, TW1: TO-220WF, T3P: TO-3P, T3F: TO-3PF, TQ2: TO-263, K04-8080: DFN8080-4 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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MARKING

TO-220 / TO-220F / TO-220F1 / TO-220F2 TO-220WF / TO-263 / TO-3P / TO-3PF / TO-247	DFN8080-4
<p>UTC 21NM60 L: Lead Free G: Halogen Free Date Code Lot Code</p>	<p>UTC 21NM60 Date Code Lot Code</p>

■ 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	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
	DFN8080-4		66	W
Junction Temperature		T_J	+150	$^\circ\text{C}$
Storage Temperature		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. $L = 73\text{mH}$, $I_{AS} = 4.4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 21\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, 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-263	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-247		60	$^\circ\text{C}/\text{W}$
	TO-3P/TO-3PF		40	$^\circ\text{C}/\text{W}$
	DFN8080-4		35	$^\circ\text{C}/\text{W}$
	TO-220/TO-263		0.83	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F/TO-220F1 TO-220F2/TO-220WF	θ_{JC}	3.7	$^\circ\text{C}/\text{W}$
	TO-247		0.7	$^\circ\text{C}/\text{W}$
	TO-3P		0.6	$^\circ\text{C}/\text{W}$
	TO-3PF		1.8	$^\circ\text{C}/\text{W}$
	DFN8080-4		1.89 (Note)	$^\circ\text{C}/\text{W}$

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

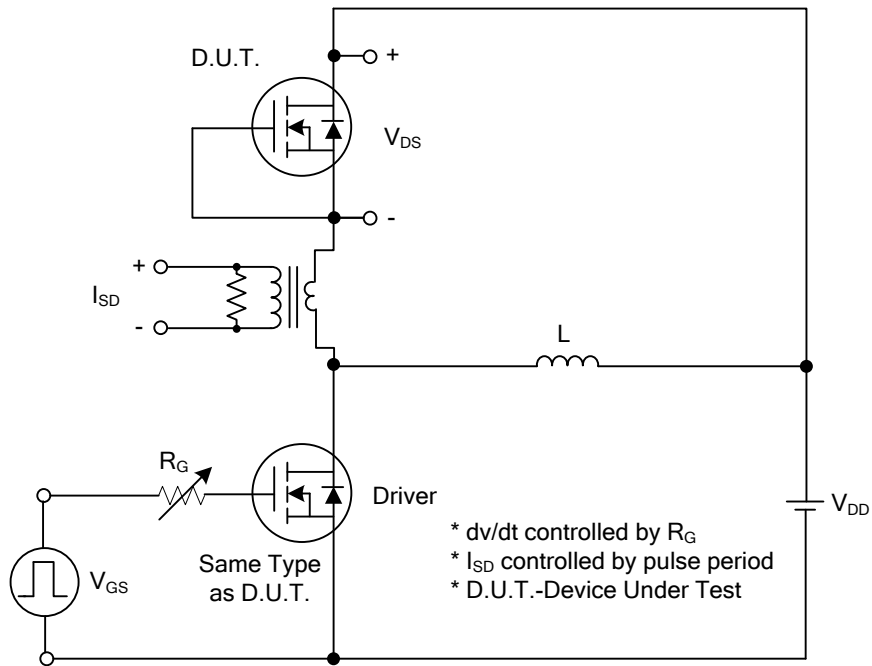
■ ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$	600			V
Drain-Source Leakage Current	I_{DSS}	$V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$			10	μA
Gate- Source Leakage Current	Forward	$V_{GS}=+30\text{V}$, $V_{DS}=0\text{V}$			+100	nA
	Reverse	$V_{GS}=-30\text{V}$, $V_{DS}=0\text{V}$			-100	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$	2.5		4.5	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10\text{V}$, $I_D=10.5\text{A}$			0.19	Ω
DYNAMIC PARAMETERS						
Input Capacitance	C_{ISS}	$V_{GS}=0\text{V}$, $V_{DS}=50\text{V}$, $f=1.0\text{MHz}$		1450		pF
Output Capacitance	C_{OSS}			250		pF
Reverse Transfer Capacitance	C_{RSS}			12		pF
SWITCHING PARAMETERS						
Total Gate Charge (Note 1)	Q_G	$V_{DS}=480\text{V}$, $V_{GS}=10\text{V}$, $I_D=21\text{A}$ (Note 1, 2)		74		nC
Gate to Source Charge	Q_{GS}			20		nC
Gate to Drain Charge	Q_{GD}			35		nC
Turn-ON Delay Time (Note 1)	$t_{D(ON)}$	$V_{DS}=100\text{V}$, $V_{GS}=10\text{V}$, $I_D=21\text{A}$, $R_G=25\Omega$ (Note 1, 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}	$I_S=21\text{A}$, $V_{GS}=0\text{V}$			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t_{rr}	$I_S=21\text{A}$, $V_{GS}=0\text{V}$, $di_f/dt=200\text{A}/\mu\text{s}$		470		ns
Body Diode Reverse Recovery Charge	Q_{rr}				9.4	

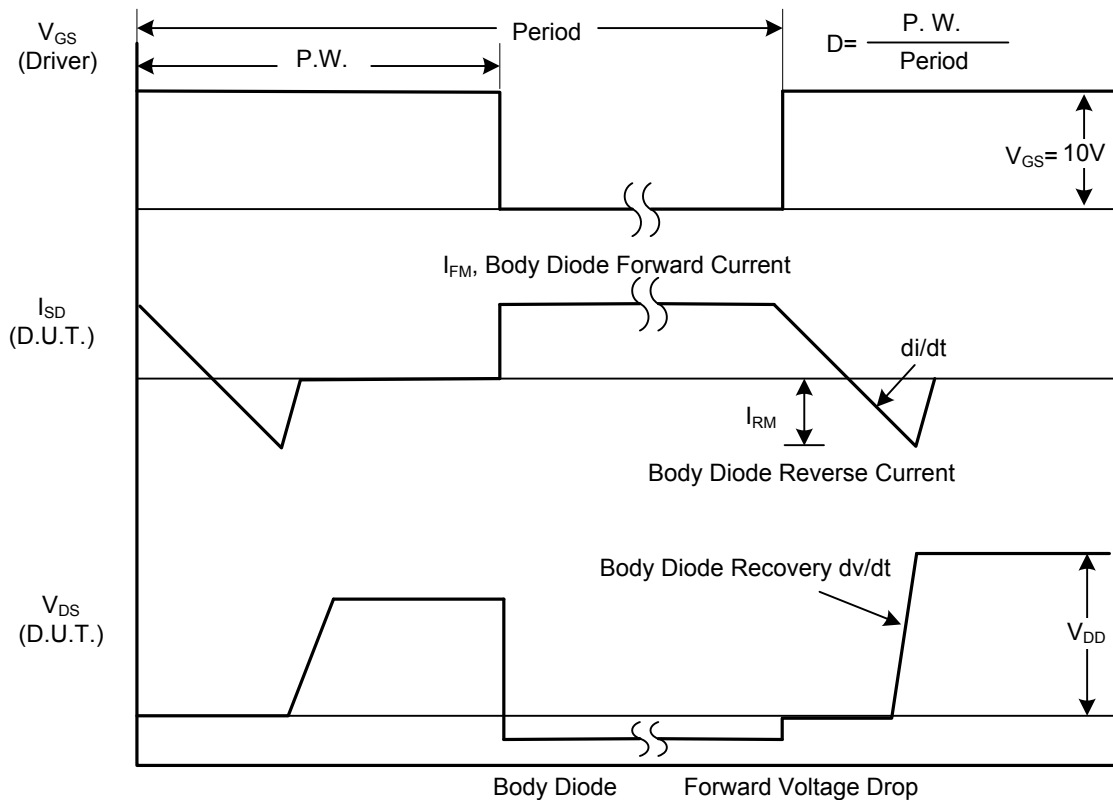
Notes: 1. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS



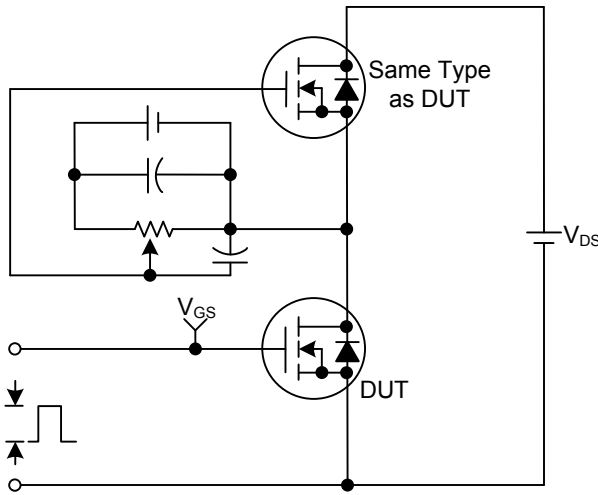
Peak Diode Recovery dv/dt Test Circuit



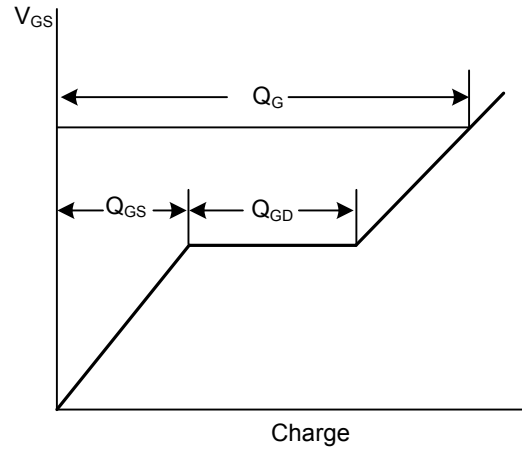
Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS

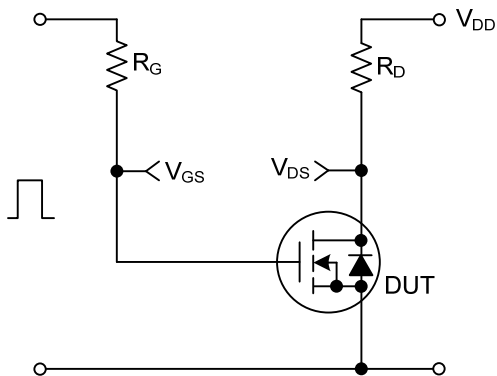
Gate Charge Test Circuit



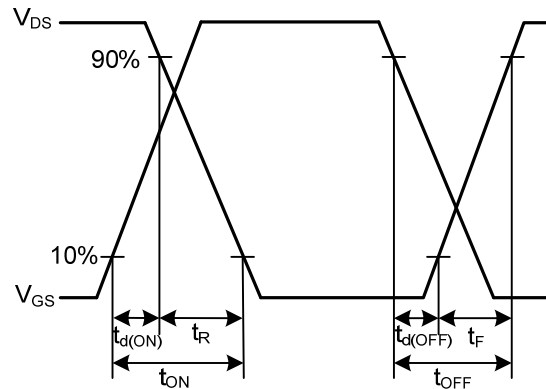
Gate Charge Waveforms



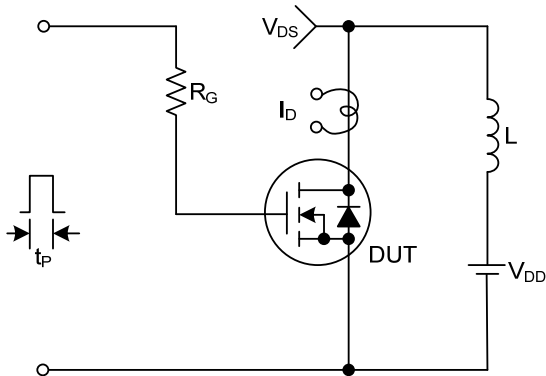
Resistive Switching Test Circuit



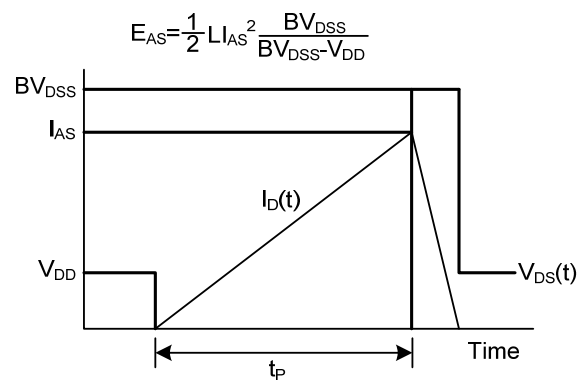
Resistive Switching Waveforms



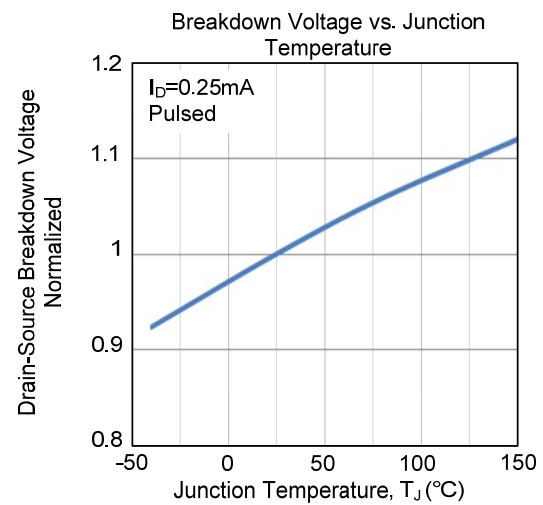
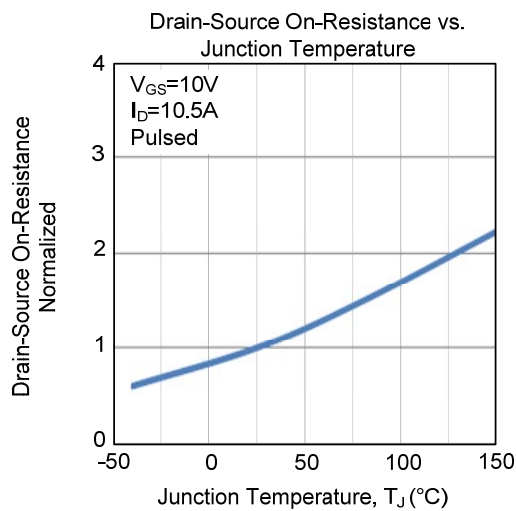
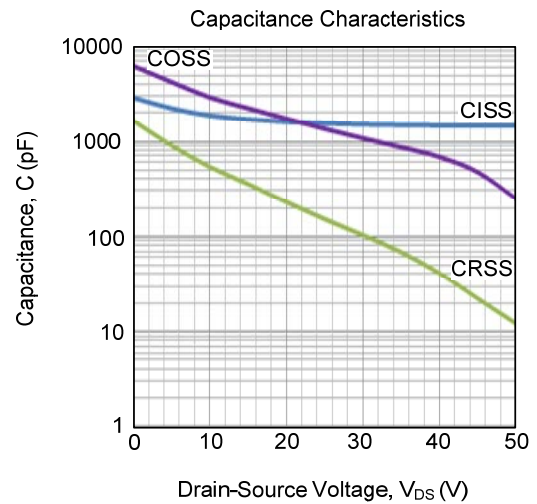
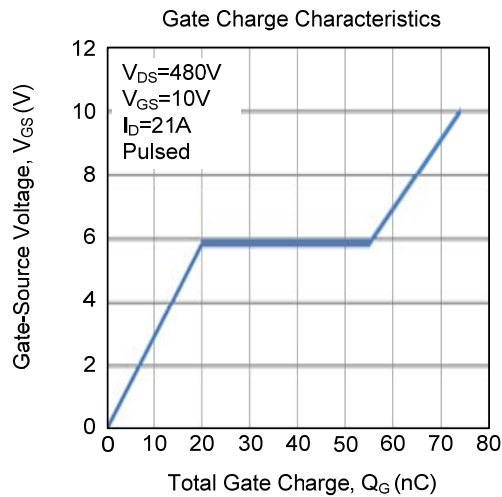
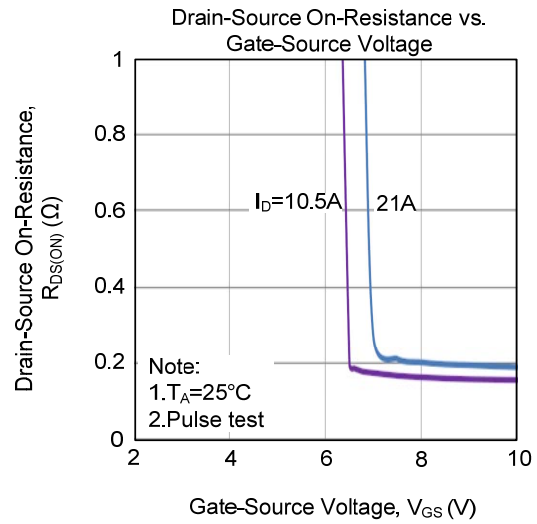
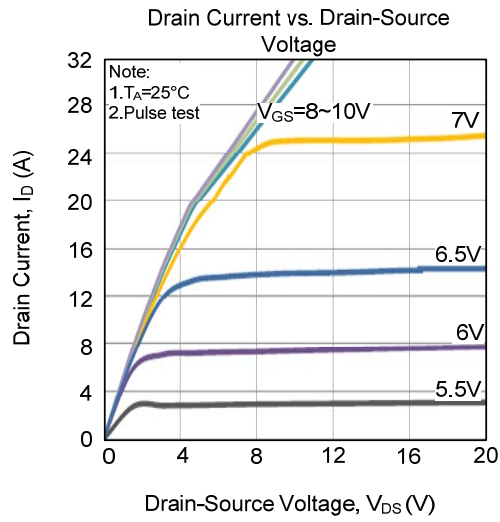
Unclamped Inductive Switching Test Circuit



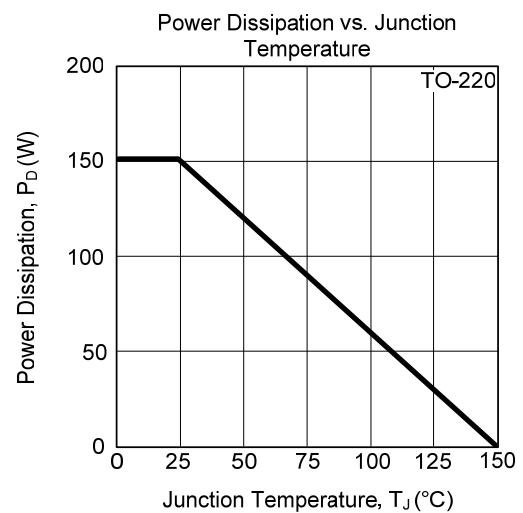
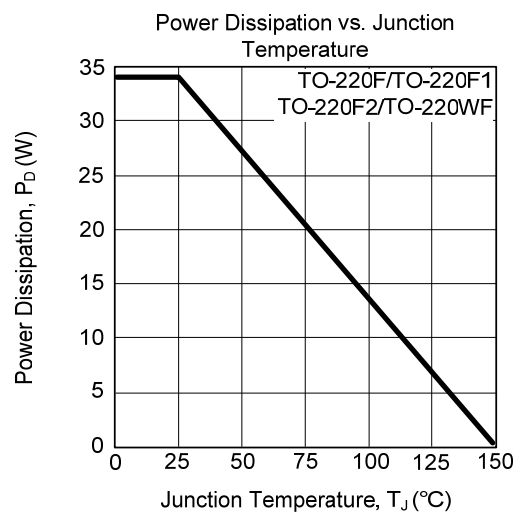
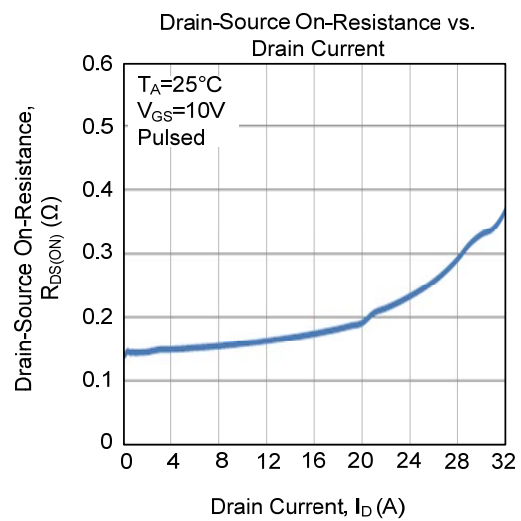
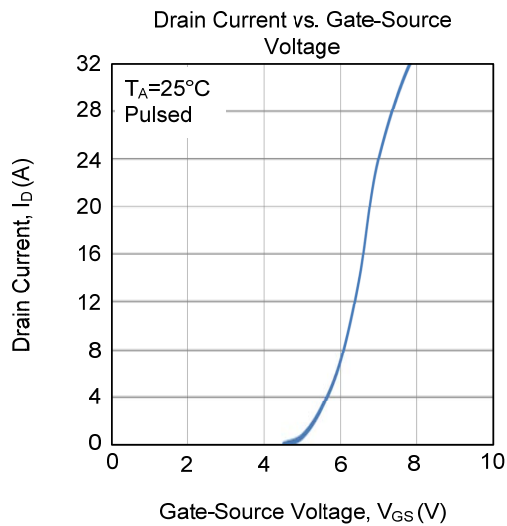
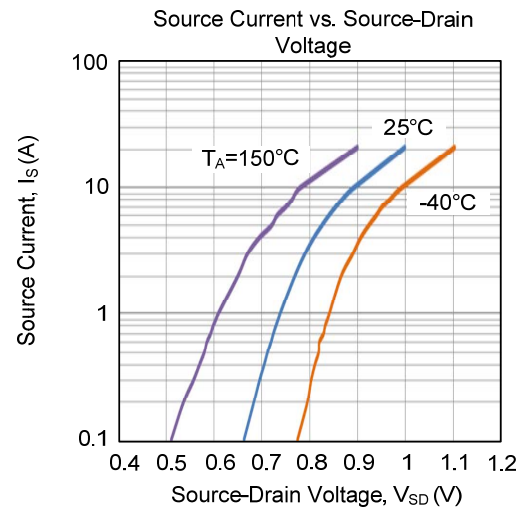
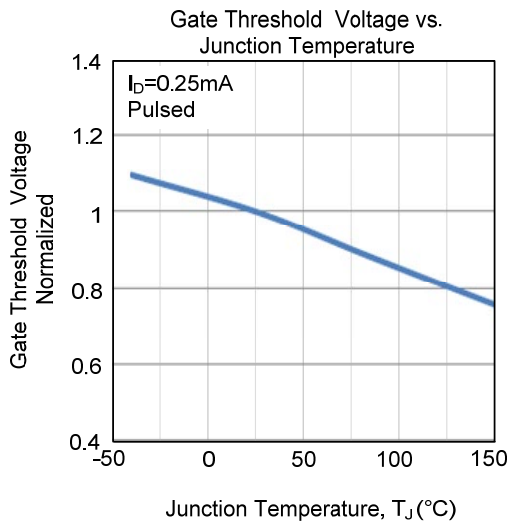
Unclamped Inductive Switching Waveforms



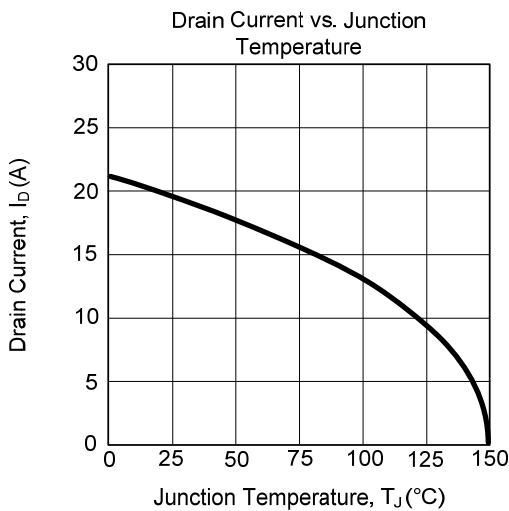
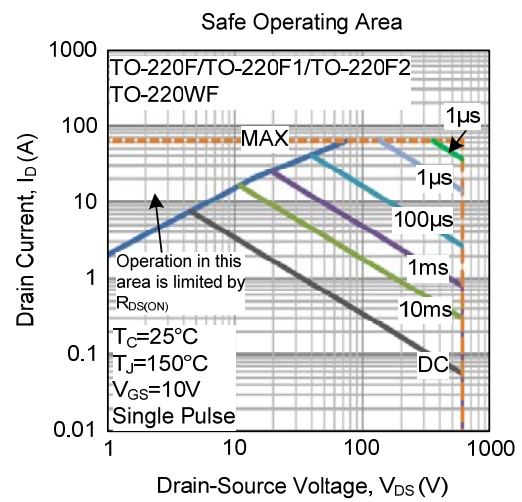
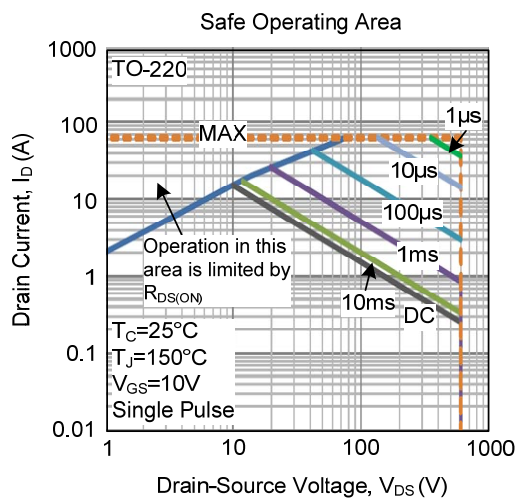
TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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