

21NM60-F

Power MOSFET

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

■ DESCRIPTION

The **UTC 21NM60-F** 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

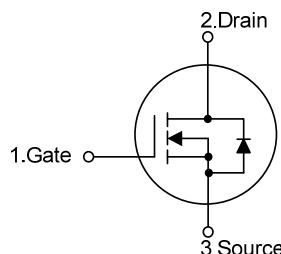
- * $R_{DS(ON)} \leq 0.19\Omega$ @ $V_{GS}=10V$, $I_D=10.5A$

- * By using Super Junction Structure

- * Fast Switching

- * With 100% Avalanche Tested

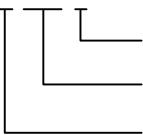
■ SYMBOL



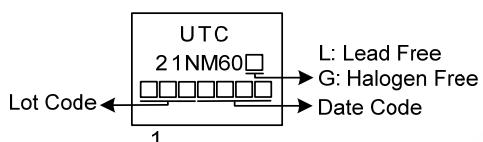
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
21NM60L-TF1-T	21NM60G-TF1-T	TO-220F1	G	D	S	Tube
21NM60L-TF3-T	21NM60G-TF3-T	TO-220F	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

21NM60G-TF1-T 	(1)Packing Type (2)Package Type (3)Green Package	(1) T: Tube, R: Tape Reel (2) TF1: TO-220F1, TF3: TO-220F, T47: TO-247 (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	21	A
	Pulsed (Note 2)	I_{DM}	42	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	224.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	7.5	V/ns
Power Dissipation	TO-220F/TO-220F1	P_D	33	W
	TO-247		180	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. $L = 10\text{mH}$, $I_{AS} = 6.7\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, 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-220F/TO-220F1	θ_{JA}	62.5	$^\circ\text{C/W}$
	TO-247		60	$^\circ\text{C/W}$
Junction to Case	TO-220F/TO-220F1	θ_{JC}	3.78	$^\circ\text{C/W}$
	TO-247		0.69	$^\circ\text{C/W}$

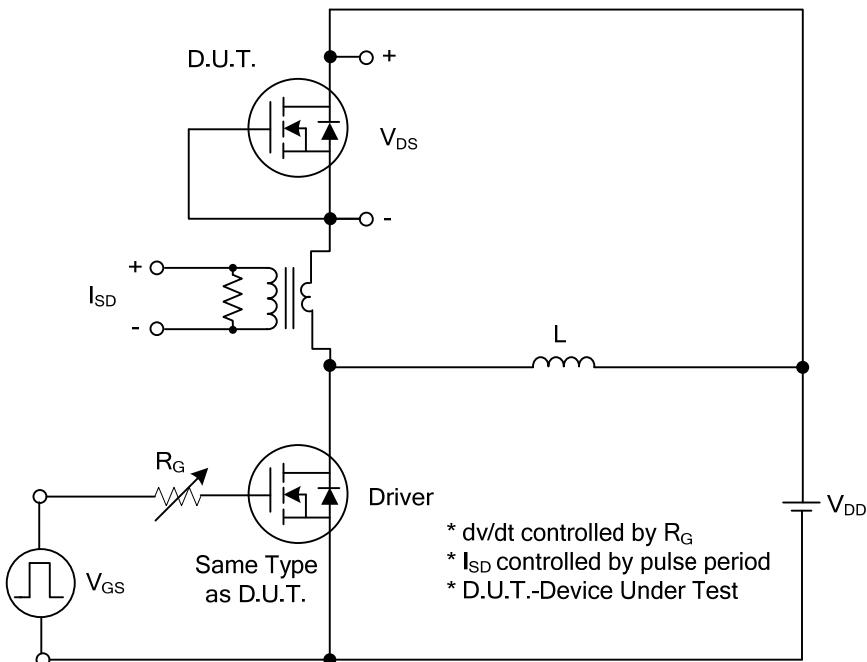
■ ELECTRICAL CHARACTERISTICS ($T_J=25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{\text{GS}}=0\text{V}, I_{\text{D}}=250\mu\text{A}$	600			V
Drain-Source Leakage Current	I_{DSS}	$V_{\text{DS}}=600\text{V}, V_{\text{GS}}=0\text{V}$		10		μA
Gate- Source Leakage Current	Forward	$V_{\text{GS}} = 30\text{V}, V_{\text{DS}} = 0\text{V}$		100		nA
	Reverse	$V_{\text{GS}} = -30\text{V}, V_{\text{DS}} = 0\text{V}$		-100		nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{\text{GS(TH)}}$	$V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=250\mu\text{A}$	2.5		4.5	V
Static Drain-Source On-State Resistance	$R_{\text{DS(ON)}}$	$V_{\text{GS}}=10\text{V}, I_{\text{D}}=10.5\text{A}$		0.19		Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	$V_{\text{DS}}=25\text{V}, V_{\text{GS}}=0\text{V}, f=1.0\text{MHz}$		1530		pF
Output Capacitance	C_{OSS}			1200		pF
Reverse Transfer Capacitance	C_{RSS}			120		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge	Q_G	$V_{\text{DS}}=480\text{V}, V_{\text{GS}}=10\text{V}, I_{\text{D}}=21\text{A}$ $I_G=1\text{mA}$ (Note1,2)		57		nC
Gate-Source Charge	Q_{GS}			8		nC
Gate-Drain Charge	Q_{GD}			22		nC
Turn-On Delay Time	$t_{\text{D(ON)}}$	$V_{\text{DS}}=100\text{V}, V_{\text{GS}}=10\text{V}, I_{\text{D}}=21\text{A},$ $R_G=25\Omega$ (Note1,2)		22		ns
Turn-On Rise Time	t_R			31		ns
Turn-Off Delay Time	$t_{\text{D(OFF)}}$			205		ns
Turn-Off Fall Time	t_F			95		ns
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Maximum Body-Diode Continuous Current	I_S			21		A
Maximum Body-Diode Pulsed Current	I_{SM}			42		A
Drain-Source Diode Forward Voltage	V_{SD}	$V_{\text{GS}}=0\text{V}, I_{\text{S}}=21\text{A}$		1.4		V
Reverse Recovery Time	t_{rr}	$V_{\text{GS}}=0\text{V}, I_{\text{S}}=21\text{A},$ $dI_F/dt=100\text{A}/\mu\text{s}$ (Note1)		420		ns
Reverse Recovery Charge	Q_{rr}			5.4		μC

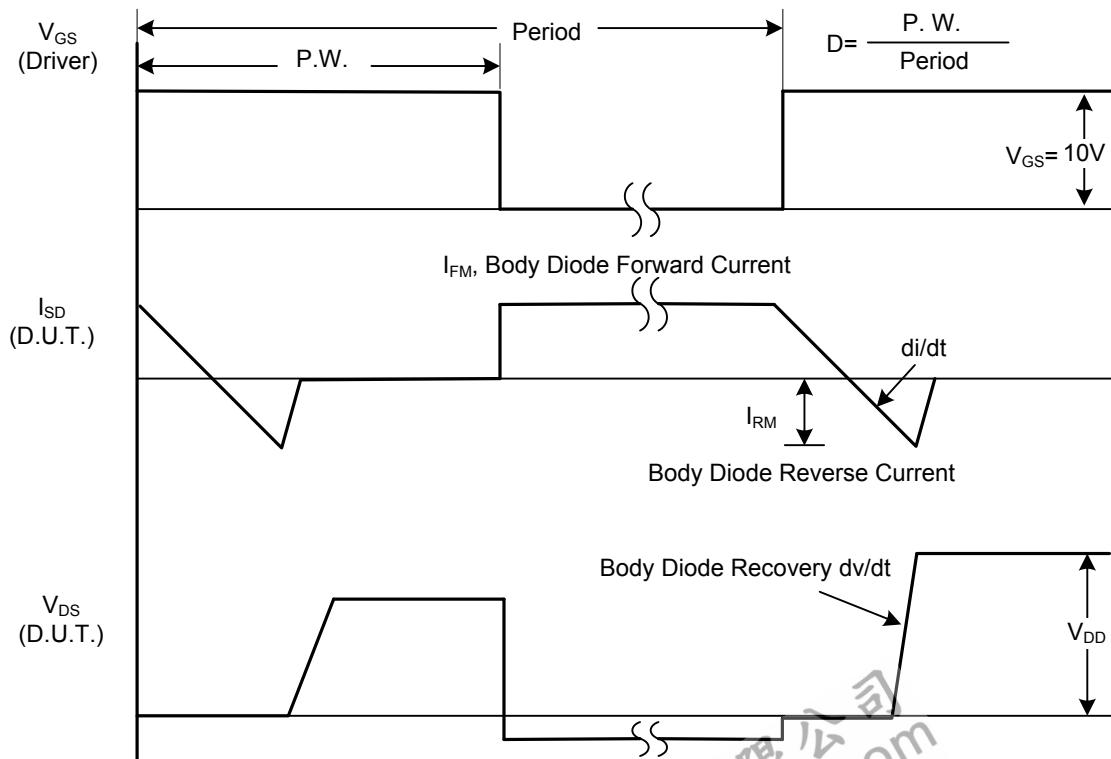
Notes: 1. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS

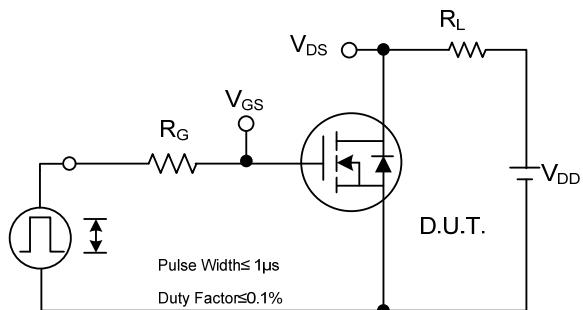


Peak Diode Recovery dv/dt Test Circuit

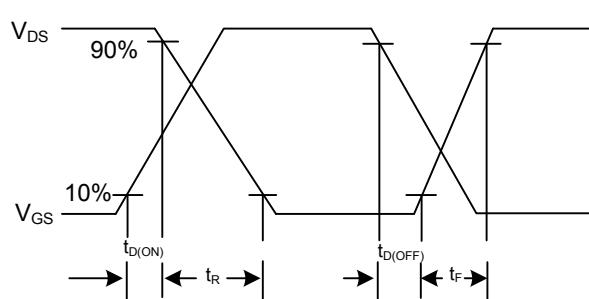


Peak Diode Recovery dv/dt Waveforms

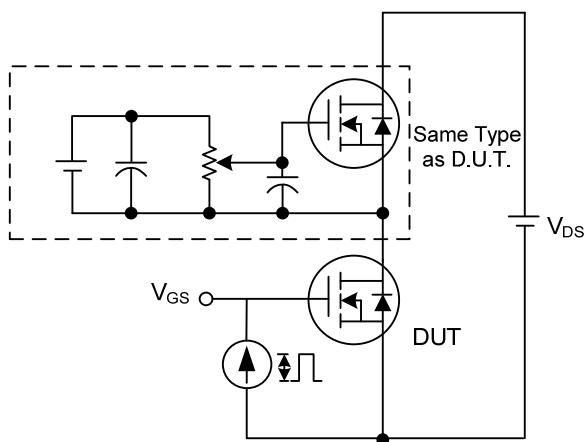
■ TEST CIRCUITS AND WAVEFORMS



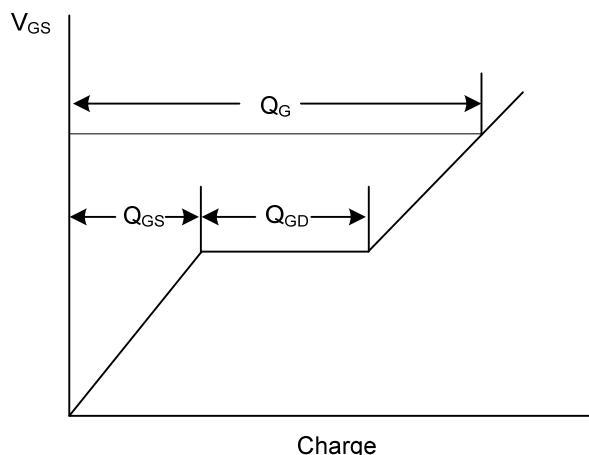
Switching Test Circuit



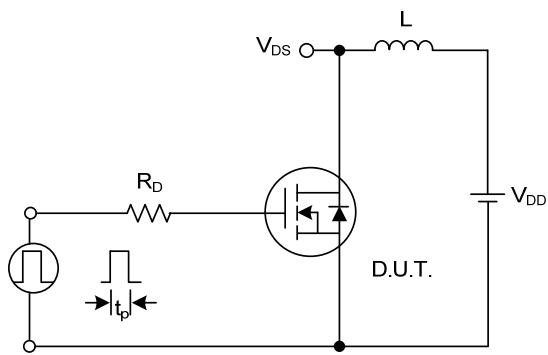
Switching Waveforms



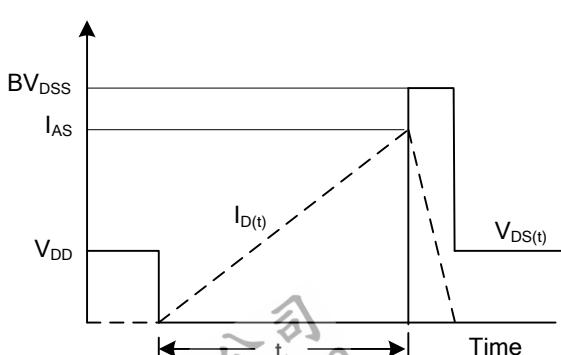
Gate Charge Test Circuit



Gate Charge Waveform

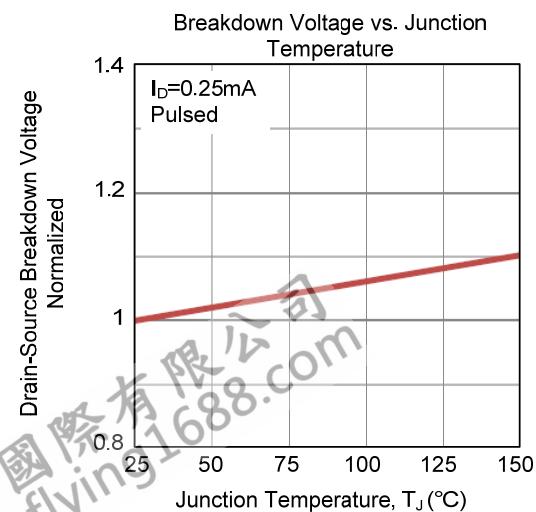
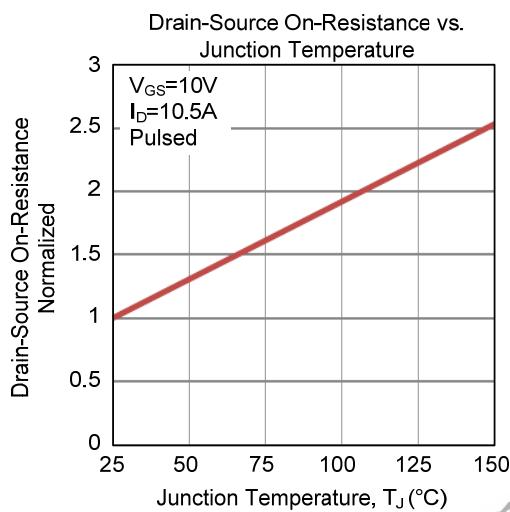
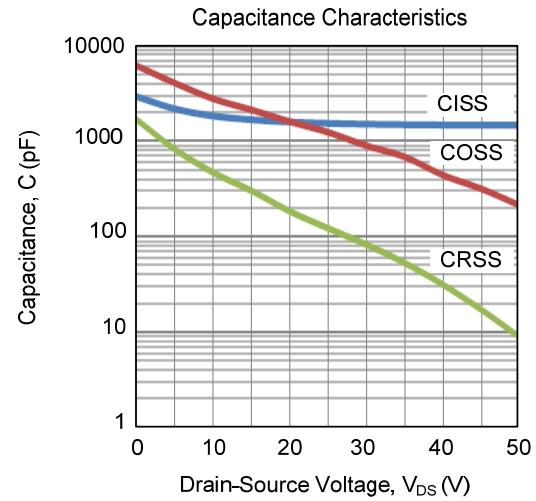
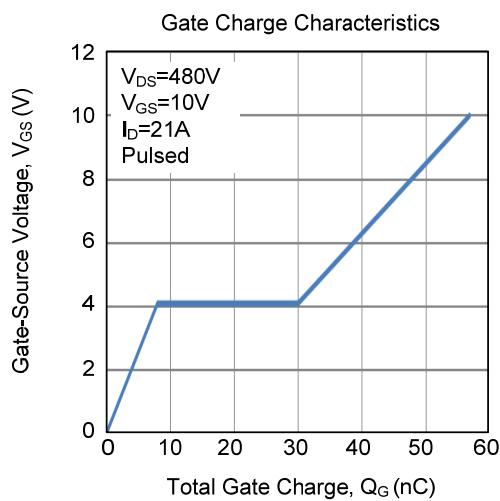
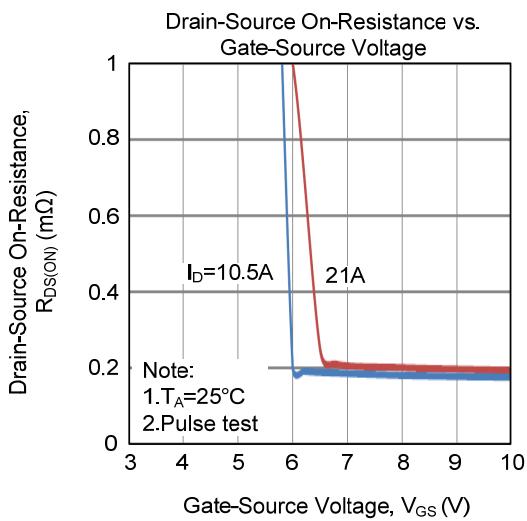
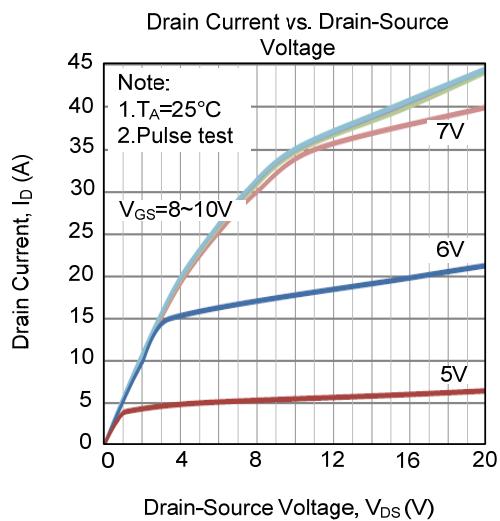


Unclamped Inductive Switching Test Circuit

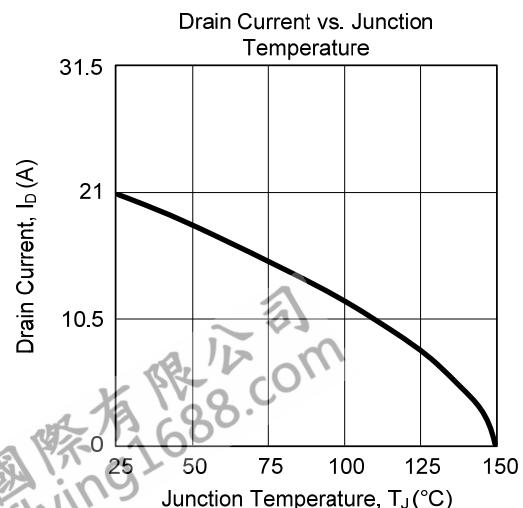
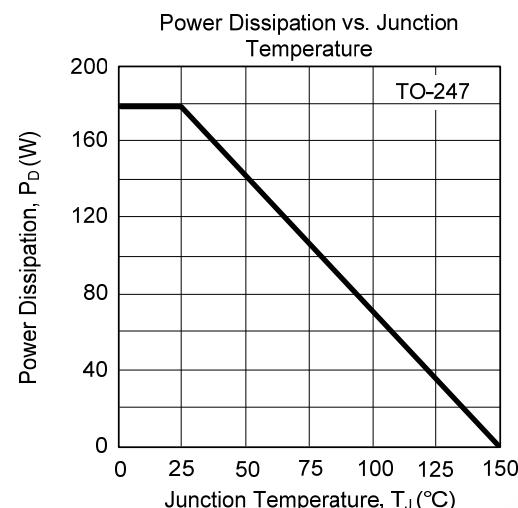
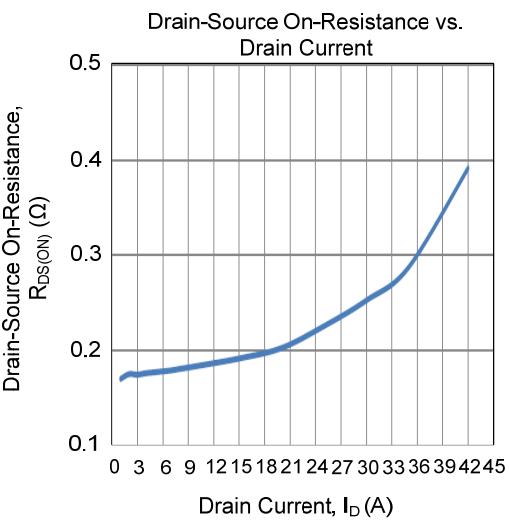
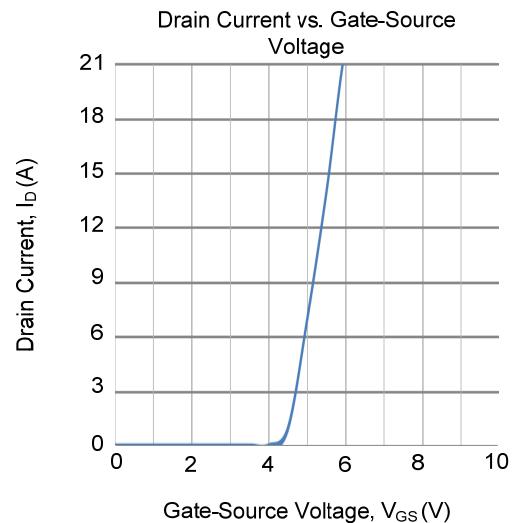
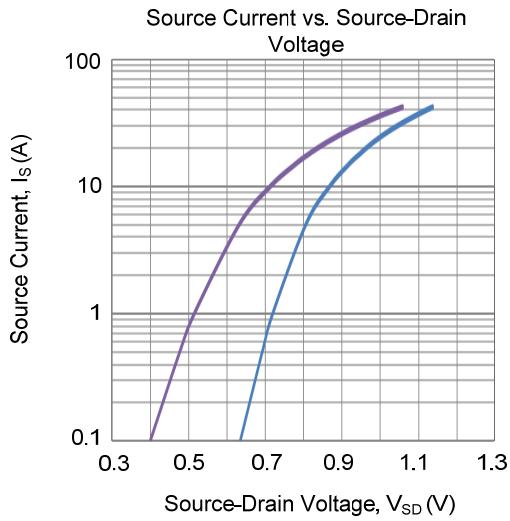
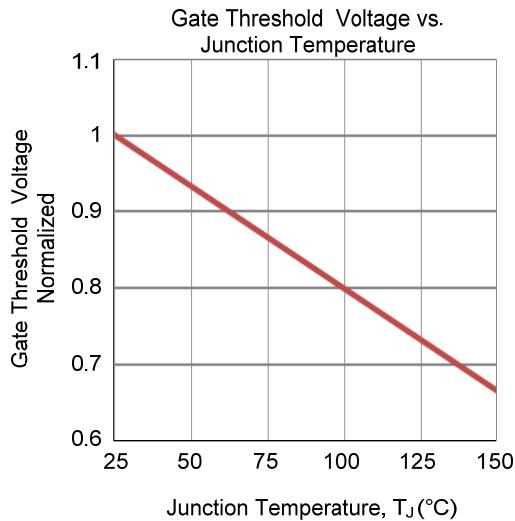


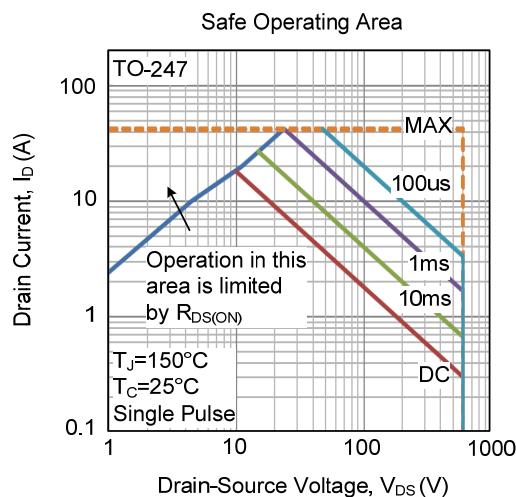
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)

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