



24NM60

Power MOSFET

24A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

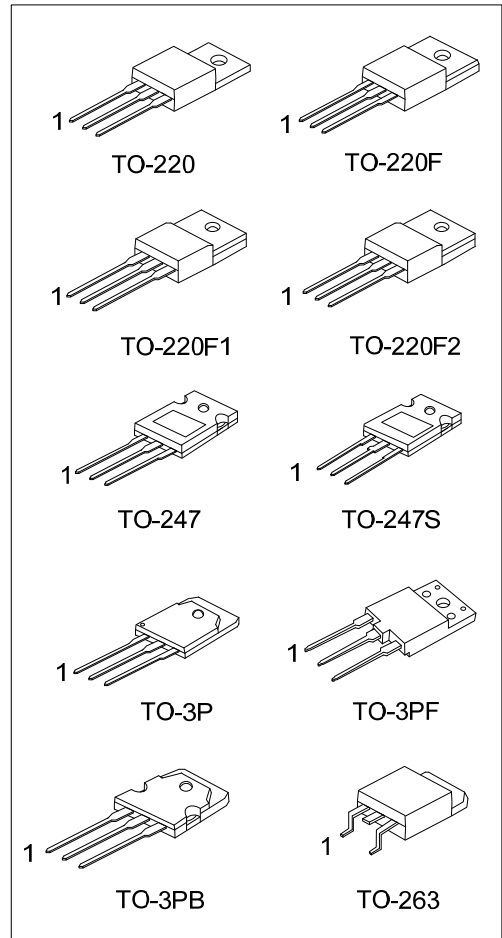
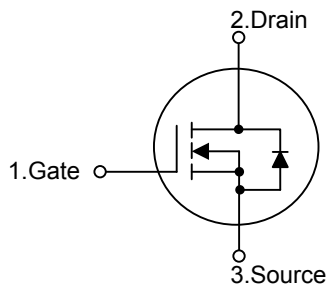
DESCRIPTION

The **UTC 24NM60** 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

- * $R_{DS(ON)} \leq 0.16\Omega$ @ $V_{GS}=10V, I_D=12A$
- * High Switching Speed
- * 100% Avalanche Tested

SYMBOL



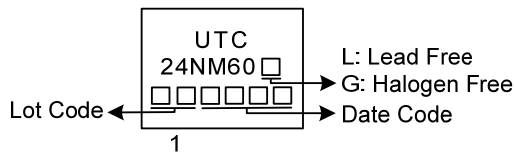
ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
24NM60L-TA3-T	24NM60G-TA3-T	TO-220	G	D	S	Tube
24NM60L-TF1-T	24NM60G-TF1-T	TO-220F1	G	D	S	Tube
24NM60L-TF2-T	24NM60G-TF2-T	TO-220F2	G	D	S	Tube
24NM60L-TF3-T	24NM60G-TF3-T	TO-220F	G	D	S	Tube
24NM60L-TQ2-T	24NM60G-TQ2-T	TO-263	G	D	S	Tube
24NM60L-TQ2-R	24NM60G-TQ2-R	TO-263	G	D	S	Tape Reel
24NM60L-T3P-T	24NM60G-T3P-T	TO-3P	G	D	S	Tube
24NM60L-T3B-T	24NM60G-T3B-T	TO-3PB	G	D	S	Tube
24NM60L-T3F-T	24NM60G-T3F-T	TO-3PF	G	D	S	Tube
24NM60L-T47-T	24NM60G-T47-T	TO-247	G	D	S	Tube
24NM60L-T47S-T	24NM60G-T47S-T	TO-247S	G	D	S	Tube

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

<p>24NM60G-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, TQ2: TO-263, T3P: TO-3P, T3B: TO-3PB, T3F: TO-3PF, T47: TO-247, T47S: TO-247S (3) G: Halogen Free and Lead Free, L: Lead Free</p>
---	---

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	24	A
	Pulsed (Note 2)	I_{DM}	96	A
Avalanche Current (Note 2)		I_{AR}	5.0	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	725	mJ
Peak Diode Recovery dv/dt		dv/dt	10.5	V/ns
MOSFET dv/dt Ruggedness		dv/dt	50	V/ns
Power Dissipation	TO-220/TO-263	P_D	176	W
	TO-220F/TO-220F1 TO-220F2		34	W
	TO-247/TO-247S		192	W
	TO-3P/TO-3PB		227	W
	TO-3PF		113	W
	Junction Temperature		T_J	+150
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. $L = 58 \text{ mH}$, $I_{AS} = 5.0\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 24\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL CHARACTERISTICS

PARAMETER		SYMBOL	RATING	UNIT	
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-263	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$	
	TO-247/TO-247S		60	$^\circ\text{C}/\text{W}$	
	TO-3P/TO-3PB TO-3PF		40	$^\circ\text{C}/\text{W}$	
	Junction to Case		θ_{JC}	0.71	$^\circ\text{C}/\text{W}$
	TO-220/TO-263			3.67	$^\circ\text{C}/\text{W}$
TO-220F/TO-220F1 TO-220F2	0.65	$^\circ\text{C}/\text{W}$			
TO-247/TO-247S	0.55	$^\circ\text{C}/\text{W}$			
TO-3P/TO-3PB TO-3PF	1.1	$^\circ\text{C}/\text{W}$			

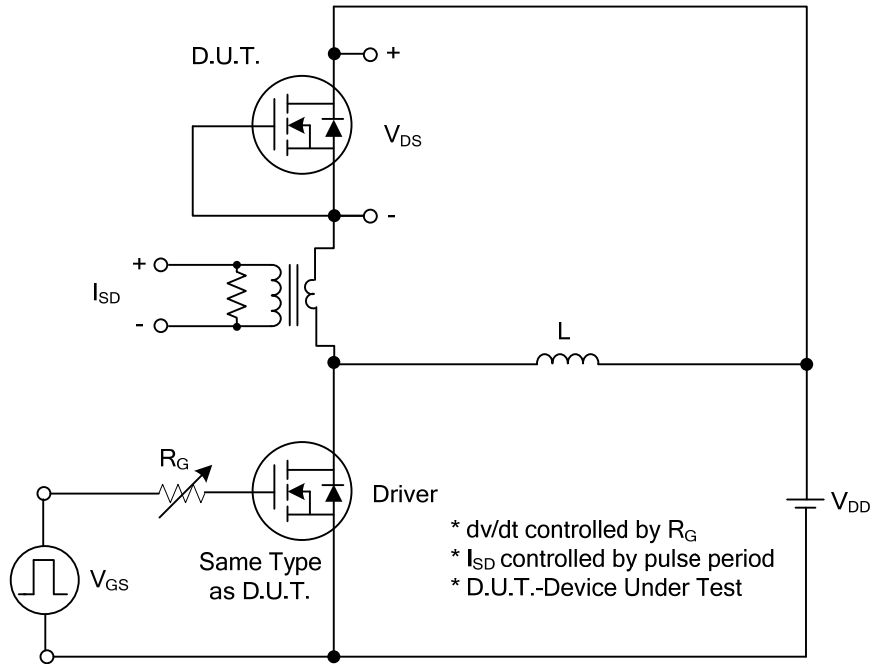
■ ELECTRICAL CHARACTERISTICS ($T_J=25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$	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	I_{GSS} , $V_{GS}=+30\text{V}$, $V_{DS}=0\text{V}$			+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	$R_{DS(ON)}$	$V_{GS}=10\text{V}$, $I_D=12\text{A}$		0.145	0.16	Ω
DYNAMIC PARAMETERS						
Input Capacitance	C_{ISS}	$V_{GS}=0\text{V}$, $V_{DS}=25\text{V}$, $f=1.0\text{MHz}$		2000		pF
Output Capacitance	C_{OSS}			1100		pF
Reverse Transfer Capacitance	C_{RSS}			110		pF
SWITCHING PARAMETERS						
Total Gate Charge (Note 1)	Q_G	$V_{DS}=480\text{V}$, $V_{GS}=10\text{V}$, $I_D=24\text{A}$ $I_G=1\text{mA}$ (Note1, 2)		76		nC
Gate to Source Charge	Q_{GS}			22		nC
Gate to Drain Charge	Q_{GD}			30		nC
Turn-ON Delay Time (Note 1)	$t_{D(ON)}$	$V_{DS}=100\text{V}$, $V_{GS}=10\text{V}$, $I_D=24\text{A}$, $R_G=25\Omega$ (Note1, 2)		26		ns
Rise Time	t_R			48.2		ns
Turn-OFF Delay Time	$t_{D(OFF)}$			248		ns
Fall-Time	t_F			112.8		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Body-Diode Continuous Current	I_S				24	A
Maximum Body-Diode Pulsed Current	I_{SM}				96	A
Drain-Source Diode Forward Voltage (Note 1)	V_{SD}	$I_S=24\text{A}$, $V_{GS}=0\text{V}$			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t_{rr}	$I_S=24\text{A}$, $V_{GS}=0\text{V}$, $di_F/dt=100\text{A}/\mu\text{s}$		490		ns
Body Diode Reverse Recovery Charge	Q_{rr}				9.3	

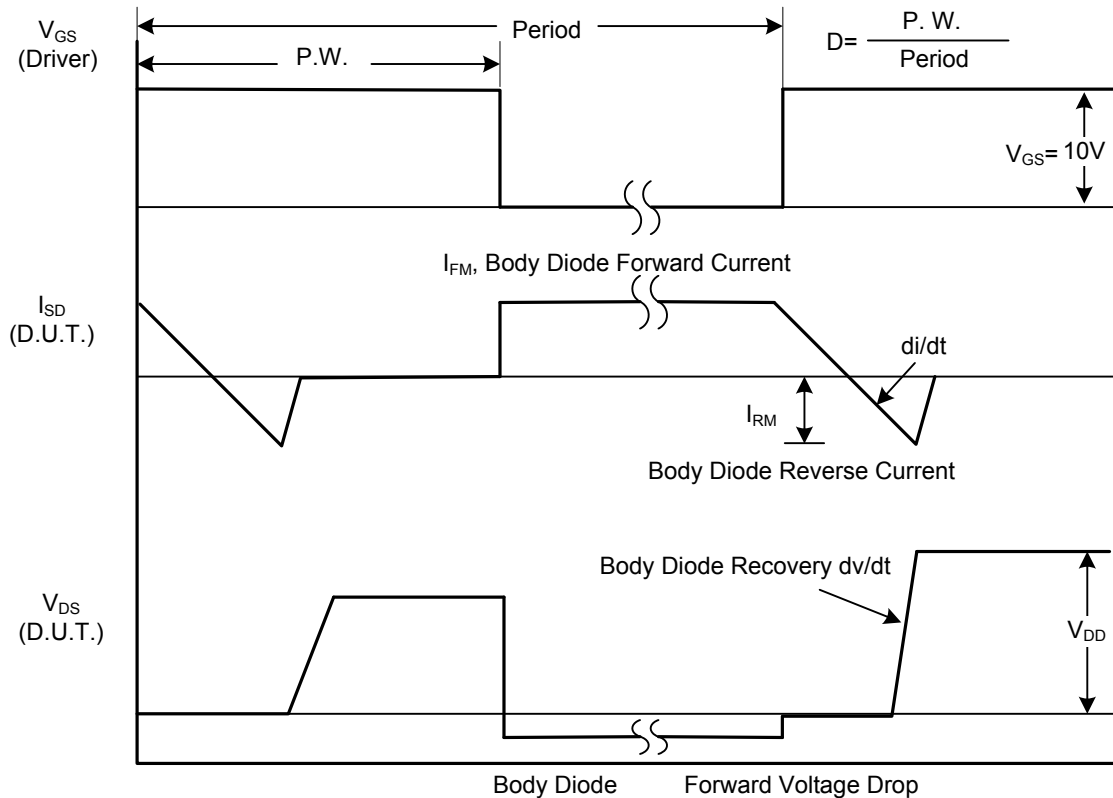
Notes: 1. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS



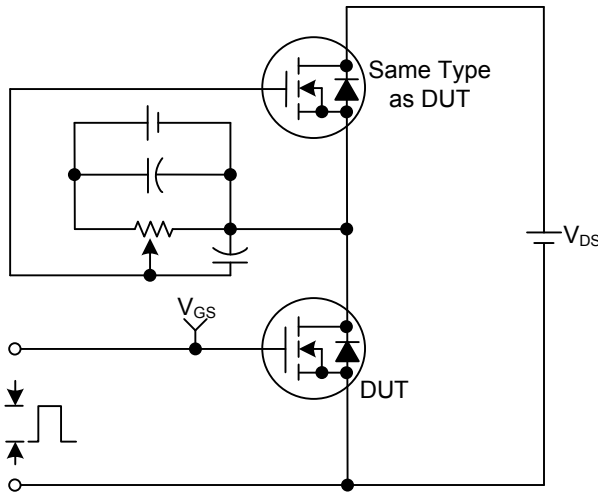
Peak Diode Recovery dv/dt Test Circuit



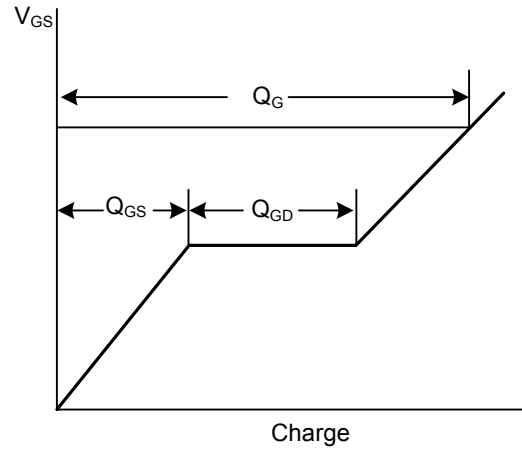
Peak Diode Recovery dv/dt Waveforms

TEST CIRCUITS AND WAVEFORMS

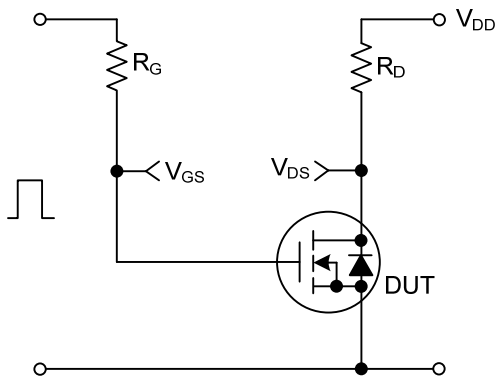
Gate Charge Test Circuit



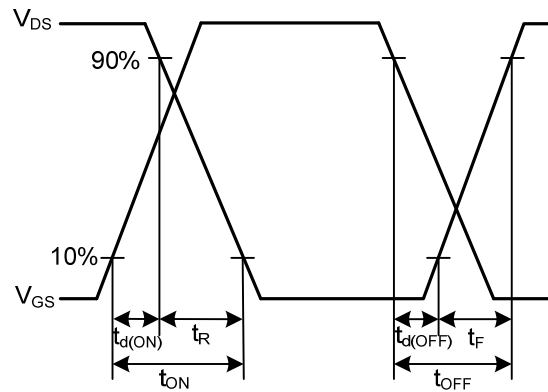
Gate Charge Waveforms



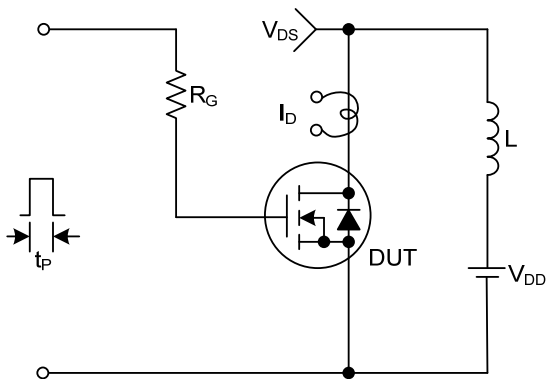
Resistive Switching Test Circuit



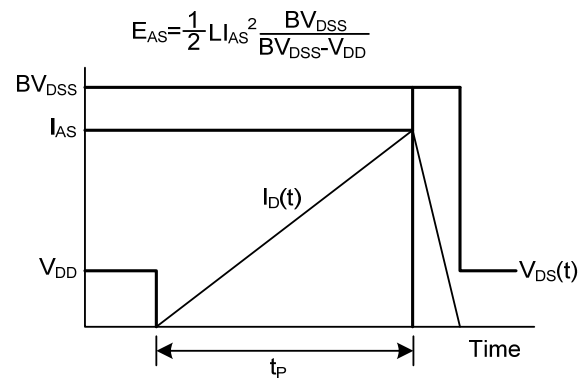
Resistive Switching Waveforms



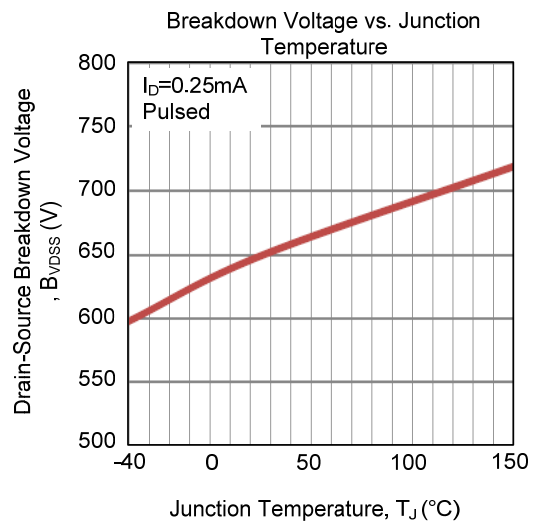
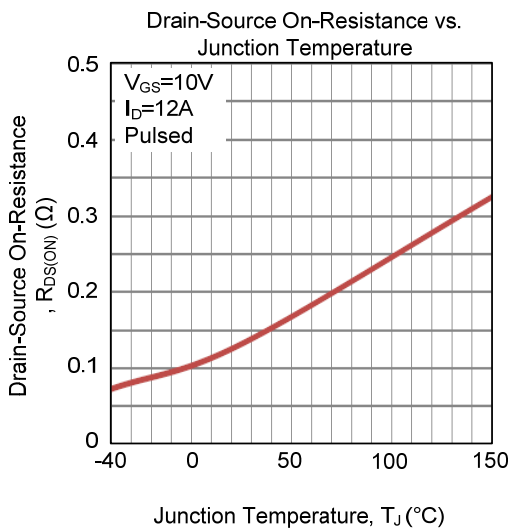
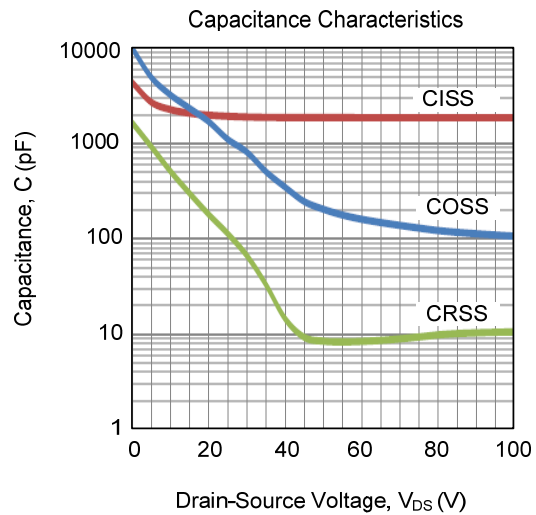
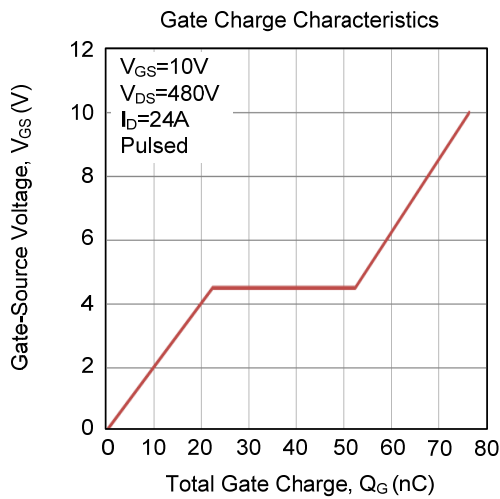
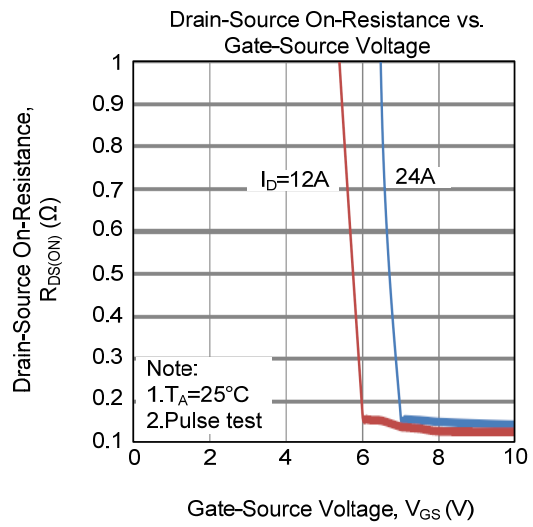
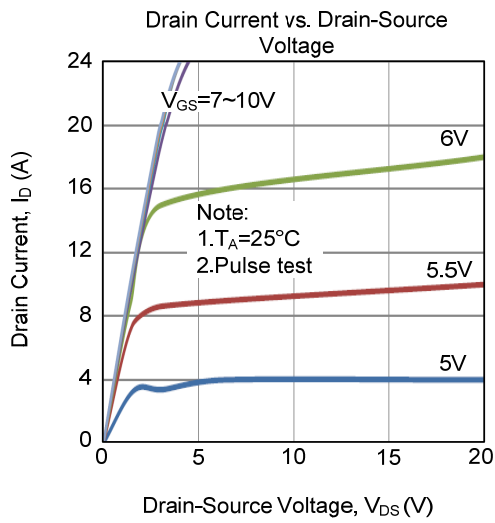
Unclamped Inductive Switching Test Circuit



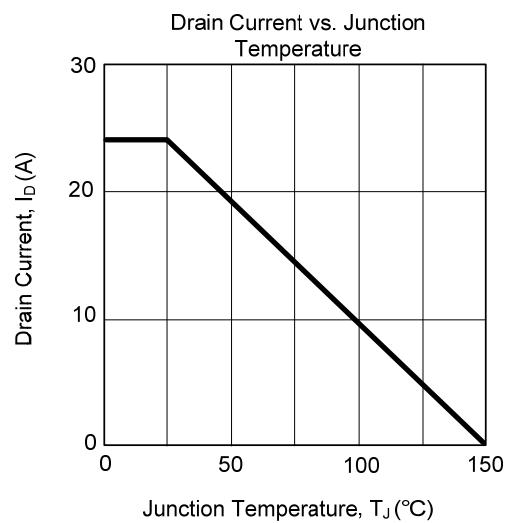
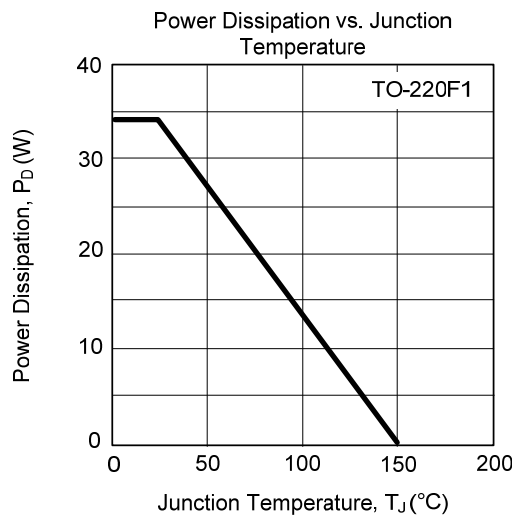
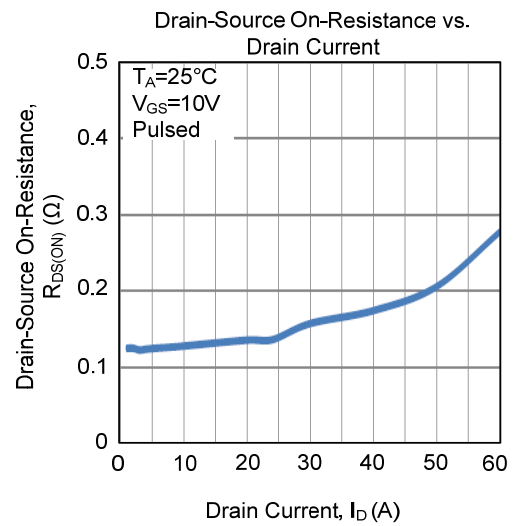
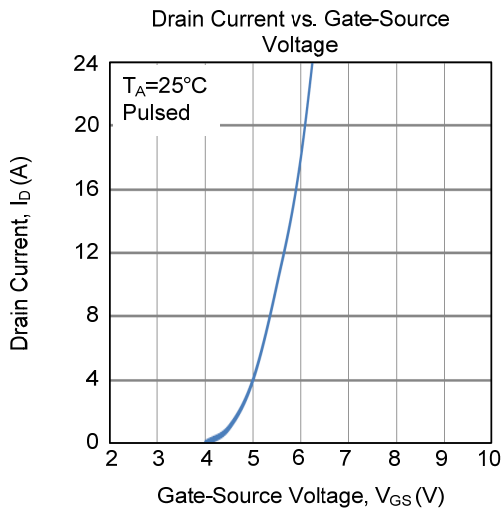
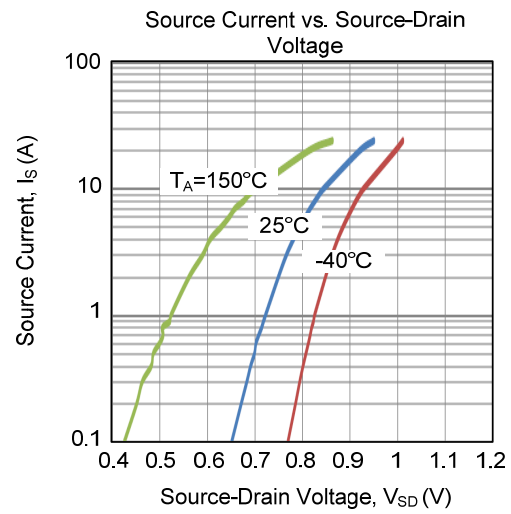
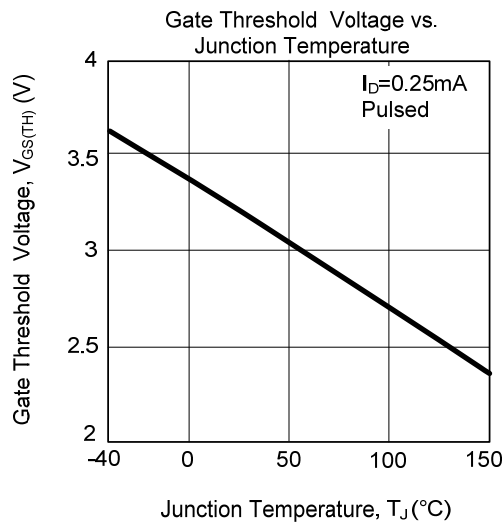
Unclamped Inductive Switching Waveforms



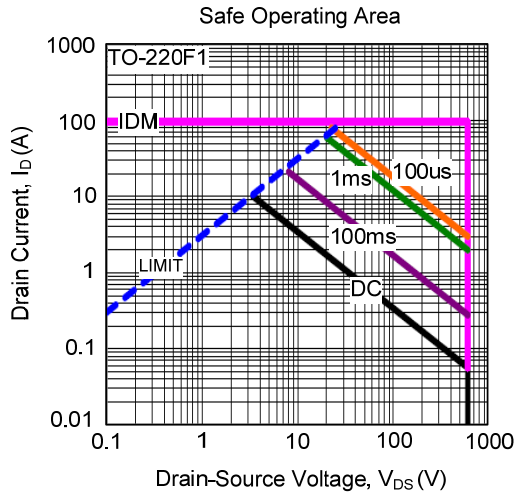
TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. UTC reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.