



# 2NM60

*Power MOSFET*

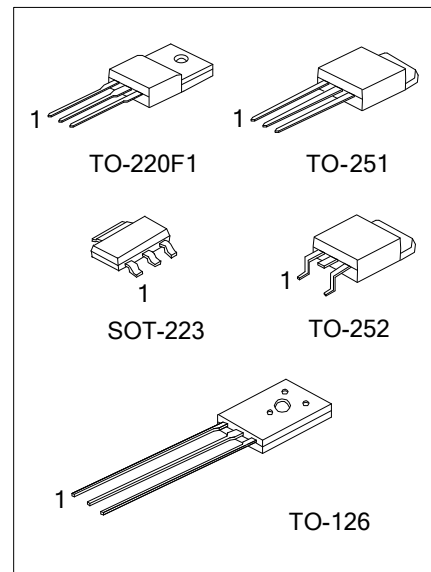
## 2A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

■ DESCRIPTION

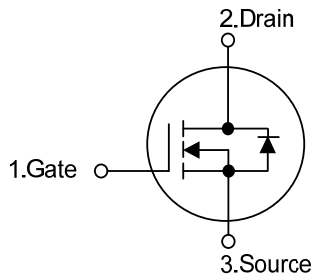
The **UTC 2NM60** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

■ FEATURES

- \*  $R_{DS(ON)} \leq 2.5\Omega @ V_{GS}=10V, I_D=1.0A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness



■ SYMBOL



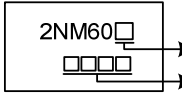
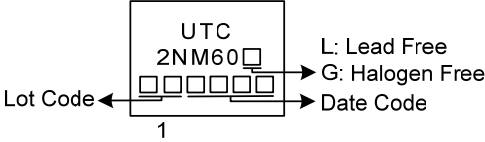
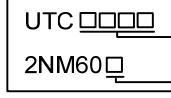
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
2NM60L-AA3-R	2NM60G-AA3-R	SOT-223	G	D	S	Tape Reel
2NM60L-TF1-T	2NM60G-TF1-T	TO-220F1	G	D	S	Tube
2NM60L-TM3-T	2NM60G-TM3-T	TO-251	G	D	S	Tube
2NM60L-TN3-R	2NM60G-TN3-R	TO-252	G	D	S	Tape Reel
2NM60L-T60-K	2NM60G-T60-K	TO-126	G	D	S	Bulk

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

<p>2NM60G-AA3-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) R: Tape Reel, T: Tube</p> <p>(2) AA3: SOT-223, TF1: TO-220F1, TM3: TO-251 TN3: TO-252, T60: TO-126</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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■ MARKING

PACKAGE	MARKING
SOT-223	 <p>L: Lead Free G: Halogen Free Date Code</p> <p>1</p>
TO-220F1 / TO-251 / TO-252	 <p>UTC 2NM60 Lot Code L: Lead Free G: Halogen Free Date Code</p> <p>1</p>
TO-126	 <p>UTC 2NM60 Date Code L: Lead Free G: Halogen Free</p> <p>1</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		$V_{GSS}$	$\pm 30$	V
Drain Current	Continuous	$I_D$	2	A
	Pulsed (Note 2)	$I_{DM}$	4	A
Avalanche Current (Note 2)		$I_{AR}$	2.1	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	22.1	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	SOT-223	$P_D$	3.3	W
	TO-220F1		24	W
	TO-251/TO-252		44	W
	TO-126		40	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.  $L=10\text{mH}$ ,  $I_{AS}=2.1\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 2.0\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL CHARACTERISTICS

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-220F1		62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		100	$^\circ\text{C}/\text{W}$
	TO-126		89	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-223	$\theta_{JC}$	38 (Note)	$^\circ\text{C}/\text{W}$
	TO-220F1		5.2	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.8 (Note)	$^\circ\text{C}/\text{W}$
	TO-126		3.12 (Note)	$^\circ\text{C}/\text{W}$

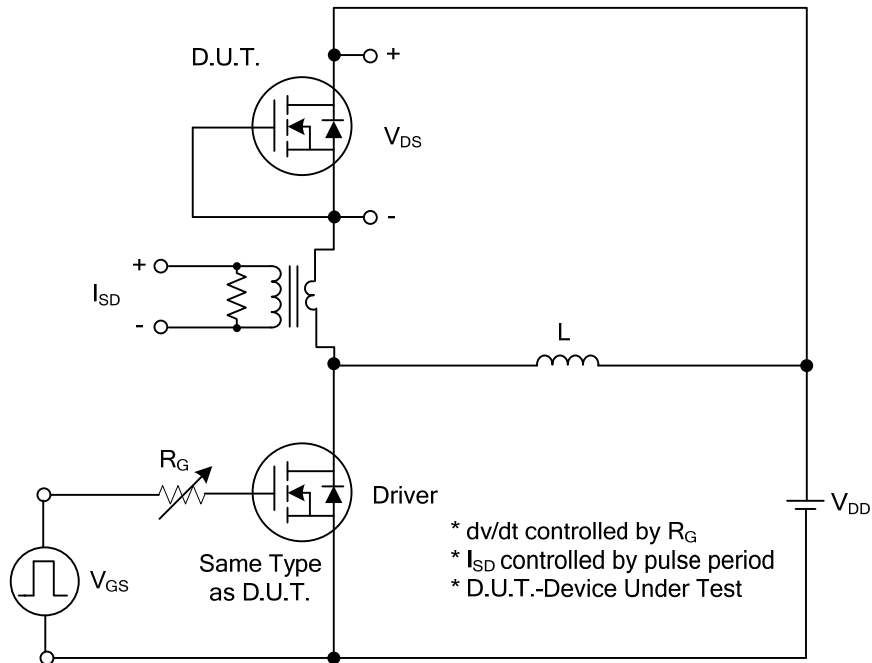
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

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

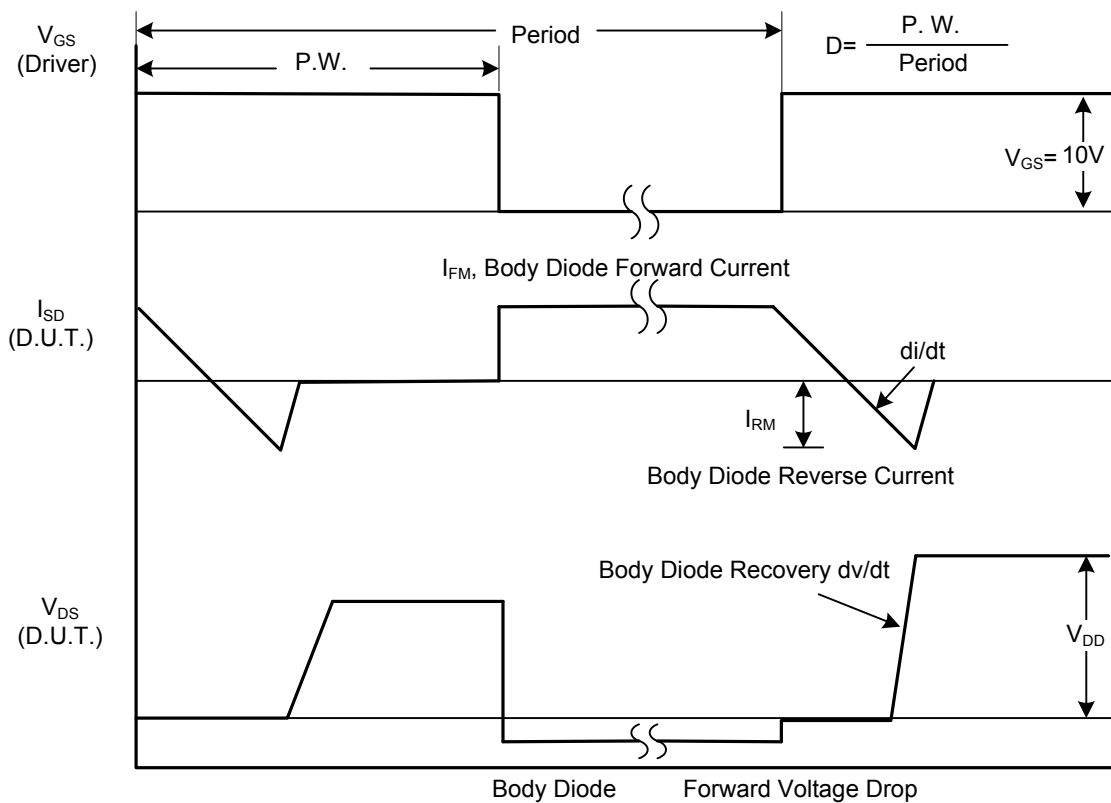
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$			10	$\mu A$
Gate-Source Leakage Current	Forward	$V_{GS} = 30V, V_{DS} = 0V$			100	nA
	Reverse		$V_{GS} = -30V, V_{DS} = 0V$			-100
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5		4.5	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 1.0A$			2.5	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$		157		pF
Output Capacitance	$C_{OSS}$			142		pF
Reverse Transfer Capacitance	$C_{RSS}$			18		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge (Note 1)	$Q_G$	$V_{DS} = 480V, V_{GS} = 10V, I_D = 2A$ $I_G = 1mA$ (Note 1, 2)		7.7		nC
Gate to Source Charge	$Q_{GS}$			2.7		nC
Gate to Drain Charge	$Q_{GD}$			2		nC
Turn-ON Delay Time (Note 1)	$t_{D(ON)}$	$V_{DD} = 100V, V_{GS} = 10V, I_D = 2A,$ $R_G = 25\Omega$ (Note 1, 2)		4		ns
Rise Time	$t_R$			17		ns
Turn-OFF Delay Time	$t_{D(OFF)}$			24		ns
Fall-Time	$t_F$			26		ns
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Body-Diode Continuous Current	$I_S$				2	A
Maximum Body-Diode Pulsed Current	$I_{SM}$				4	A
Maximum Body-Diode Pulsed Current	$V_{SD}$	$I_S = 2.0A, V_{GS} = 0V$			1.4	V
Drain-Source Diode Forward Voltage (Note 1)	$t_{rr}$	$I_S = 2.0A, V_{GS} = 0V$		192		nS
Body Diode Reverse Recovery Time (Note 1)	$Q_{rr}$	$di_F/dt = 100A/\mu s$		1		$\mu C$

Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .  
2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

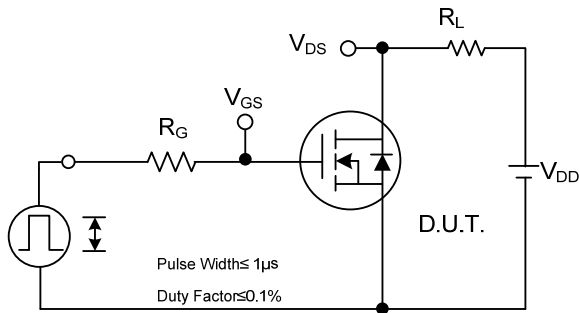


Peak Diode Recovery  $dv/dt$  Test Circuit

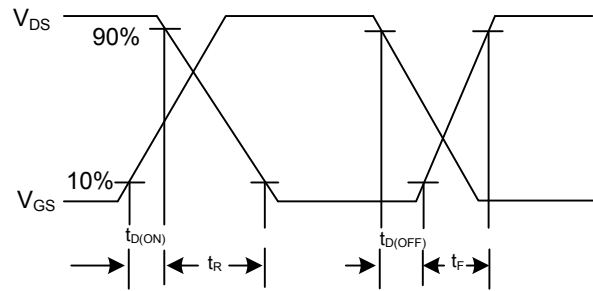


Peak Diode Recovery  $dv/dt$  Waveforms

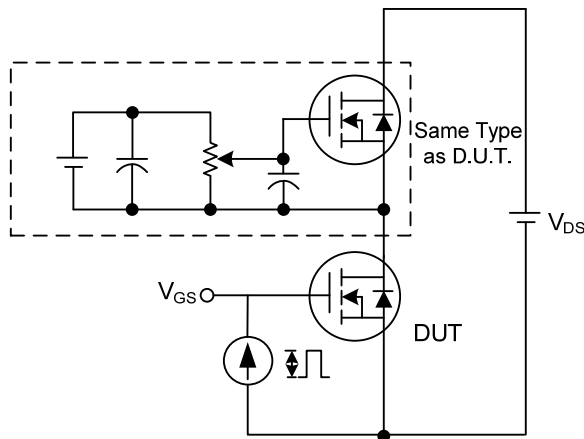
## TEST CIRCUITS AND WAVEFORMS



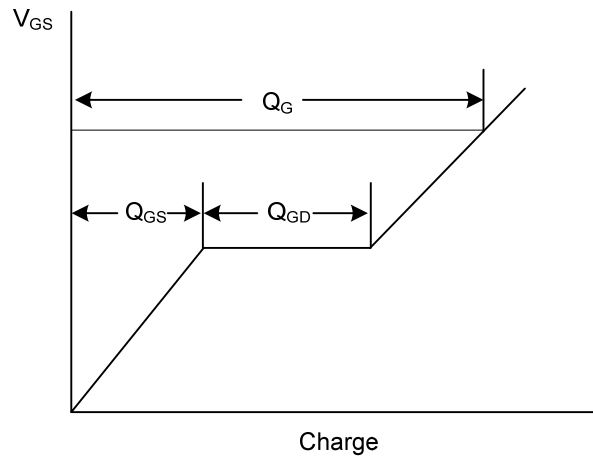
**Switching Test Circuit**



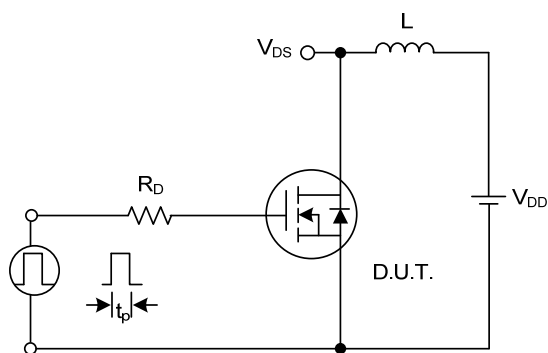
**Switching Waveforms**



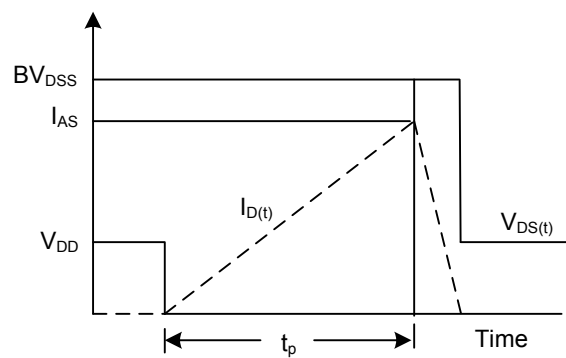
**Gate Charge Test Circuit**



**Gate Charge Waveform**

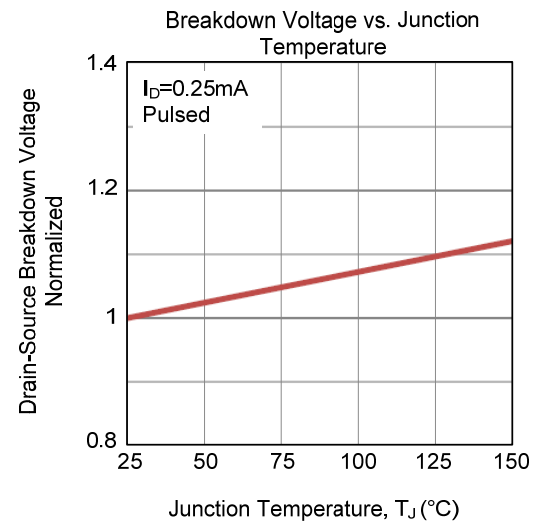
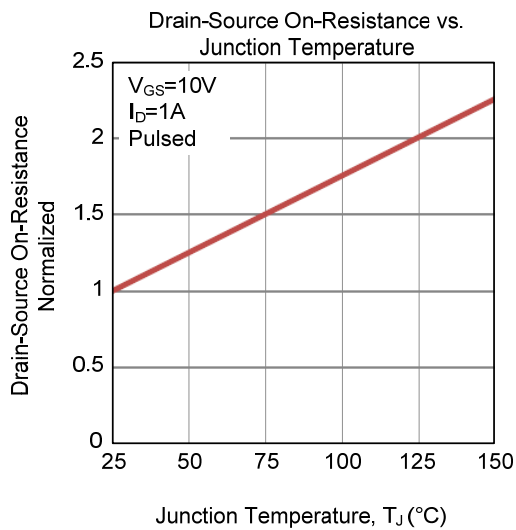
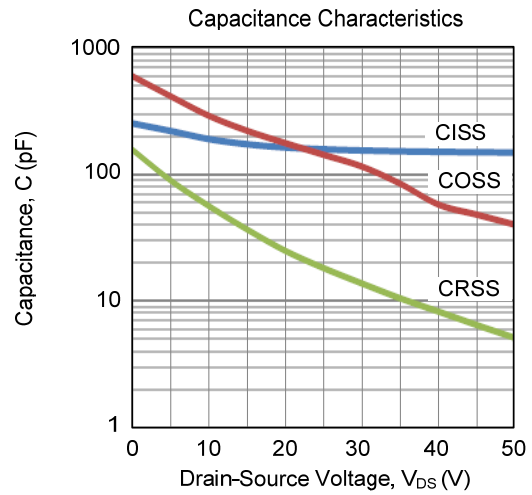
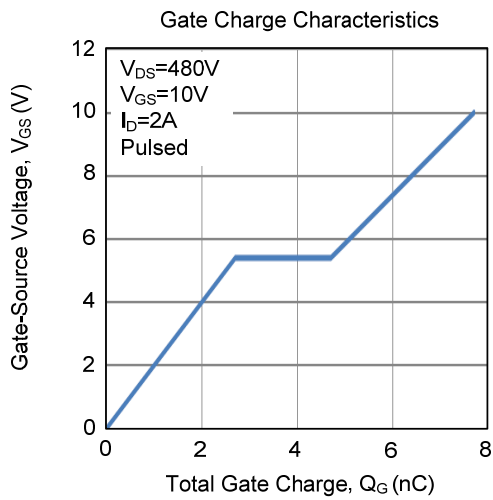
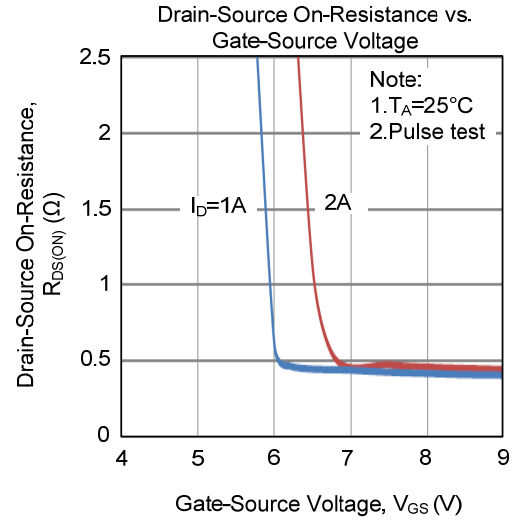
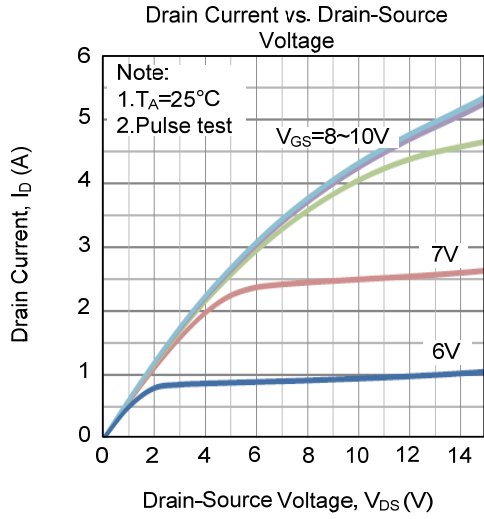


**Unclamped Inductive Switching Test Circuit**

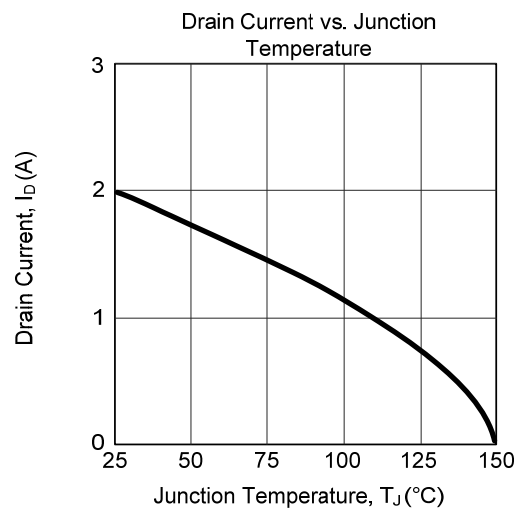
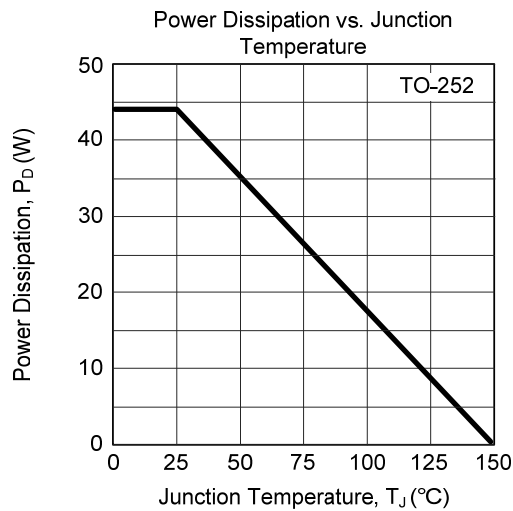
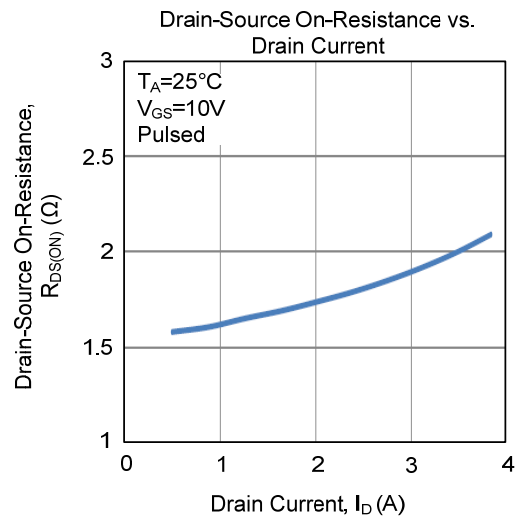
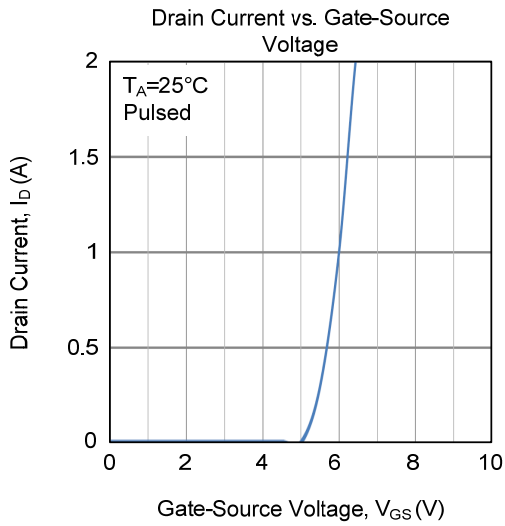
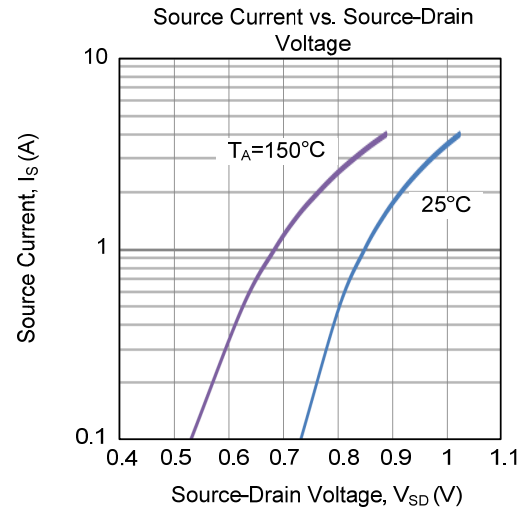
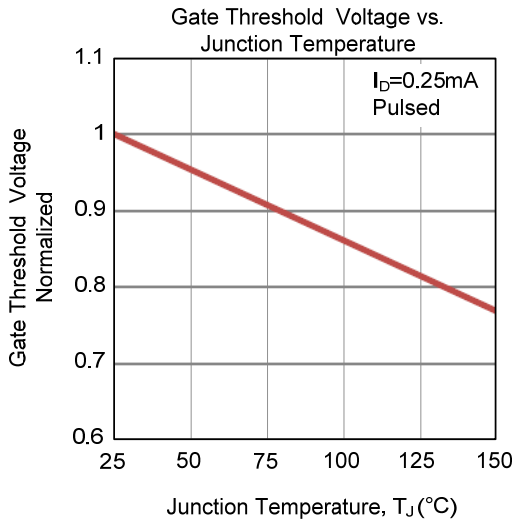


**Unclamped Inductive Switching Waveforms**

## TYPICAL CHARACTERISTICS

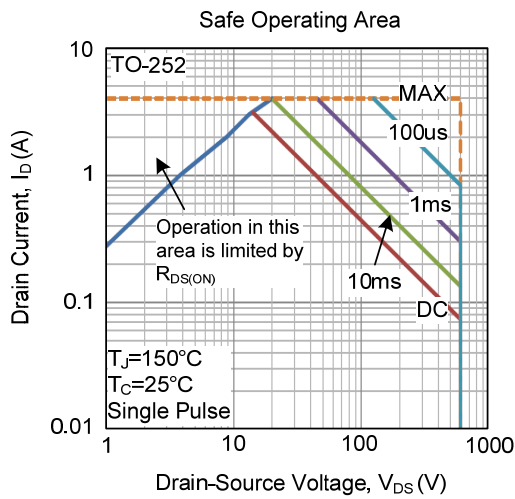


■ TYPICAL CHARACTERISTICS (Cont.)





■ TYPICAL CHARACTERISTICS (Cont.)



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