



## 4NM65A

Power MOSFET

### 4.0A, 650V N-CHANNEL SUPER-JUNCTION MOSFET

#### DESCRIPTION

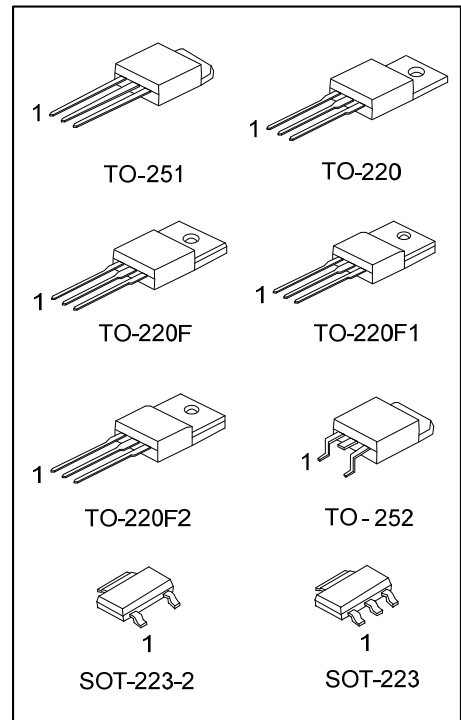
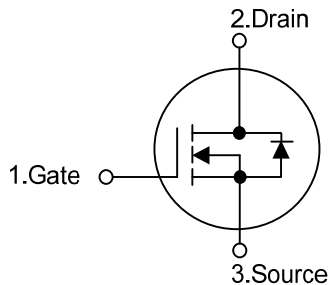
The UTC **4NM65A** is a high voltage super junction MOSFET and is designed to have better characteristics.

The UTC **4NM65A** Utilizing an advanced charge-balance technology, enhance system efficiency, improve EMI and reliability, such as low gate charge, low on-state resistance and have a high power density and high rugged avalanche characteristics. This super junction MOSFET usually used at AC/DC power conversion, and industrial power applications.

#### FEATURES

- \*  $R_{DS(ON)} \leq 1.44 \Omega @ V_{GS}=10V, I_D=2.0A$
- \* 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	
4NM65AL-AA2-R	4NM65AG-AA2-R	SOT-223-2	G	D	S	Tape Reel
4NM65AL-AA3-R	4NM65AG-AA3-R	SOT-223	G	D	S	Tape Reel
4NM65AL-TA3-T	4NM65AG-TA3-T	TO-220	G	D	S	Tube
4NM65AL-TF1-T	4NM65AG-TF1-T	TO-220F1	G	D	S	Tube
4NM65AL-TF2-T	4NM65AG-TF2-T	TO-220F2	G	D	S	Tube
4NM65AL-TF3-T	4NM65AG-TF3-T	TO-220F	G	D	S	Tube
4NM65AL-TM3-T	4NM65AG-TM3-T	TO-251	G	D	S	Tube
4NM65AL-TN3-R	4NM65AG-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>4NM65AG-AA2-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) AA2: SOT-223-2, AA3: SOT-223, TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING

SOT-223-2 / SOT-223	TO-220 / TO-220F / TO-220F1 TO-220F2 / TO-251 / TO-252
<p>L: Lead Free G: Halogen Free Date Code</p> <p>1</p>	<p>UTC 4NM65A L: Lead Free G: Halogen Free Date Code</p> <p>Lot Code ←</p> <p>1</p>

■ ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	650	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Drain Current	Continuous	$I_D$	4	A
	Pulsed (Note2)	$I_{DM}$	16	A
Avalanche Current (Note 2)		$I_{AR}$	1.3	A
Avalanche Energy	Single Pulsed (Note3)	$E_{AS}$	122	mJ
Peak Diode Recovery dv/dt (Note4)		dv/dt	4.83	V/ns
Power Dissipation	SOT-223-2/SOT-223	$P_D$	6	W
	TO-220		72	W
	TO-220F/TO-220F1		23	W
	TO-220F2			
	TO-251/TO-252		45	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.  $L=144\text{mH}$ ,  $I_{AS}=1.3\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 4.0\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223-2/SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-220/TO-220F		62.5	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2			
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-223-2/SOT-223	$\theta_{JC}$	20.8	$^\circ\text{C}/\text{W}$
	TO-220		1.73	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		5.43	$^\circ\text{C}/\text{W}$
	TO-220F2			
	TO-251/TO-252		2.77 (Note)	$^\circ\text{C}/\text{W}$

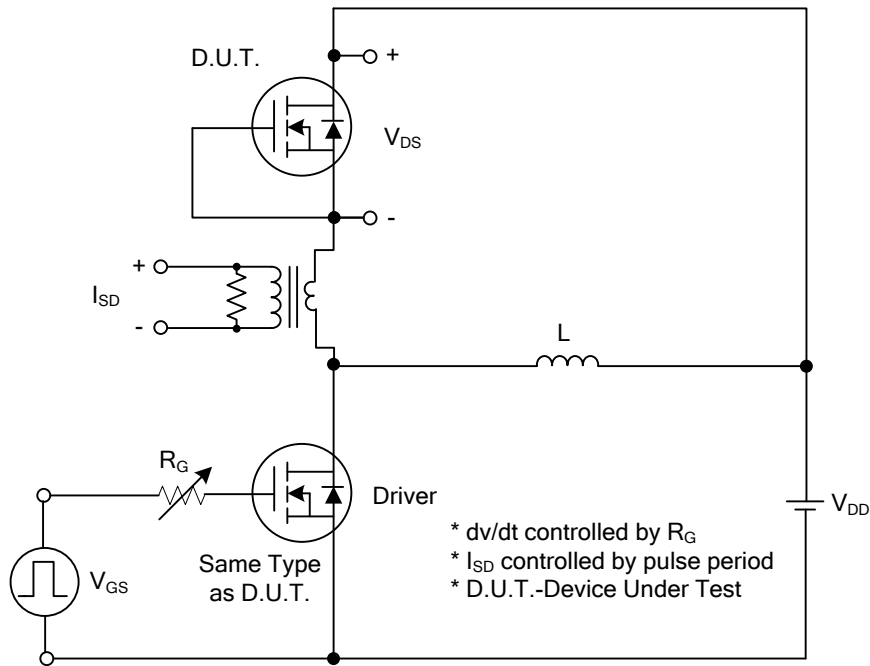
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

■ ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25°C, unless otherwise specified)

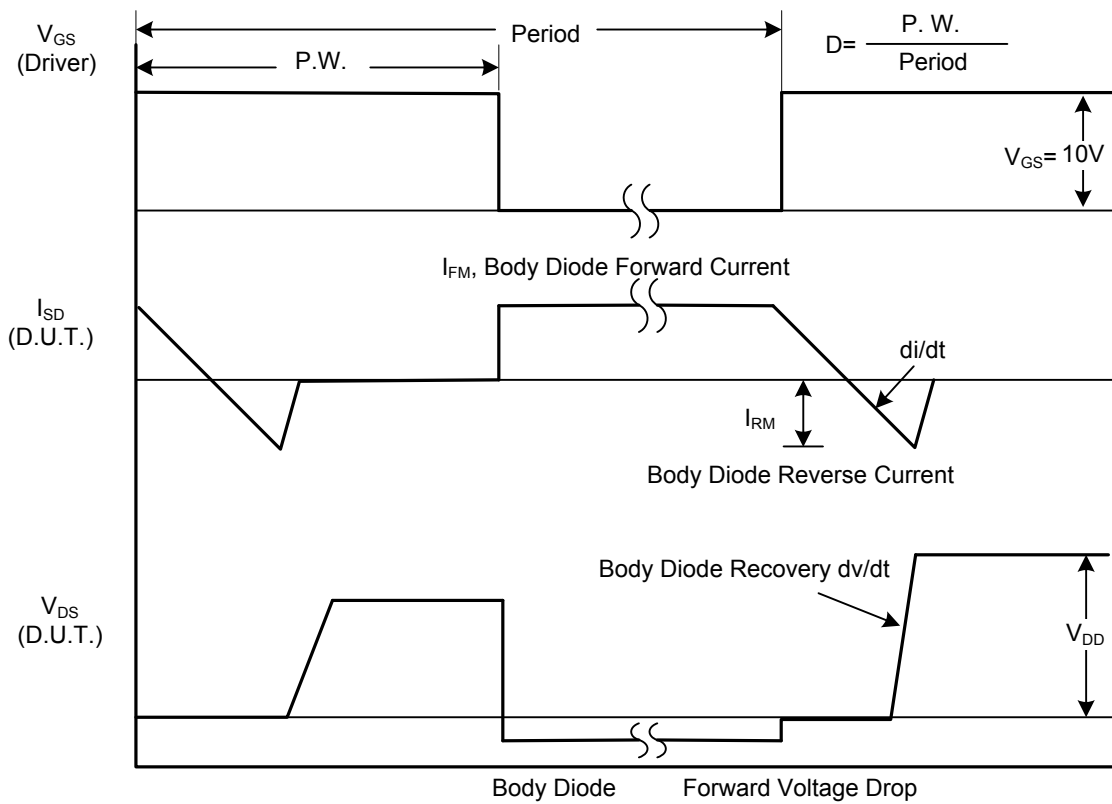
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250μA	650			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA
	Reverse					
		V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V			-100	nA
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.5		4.5	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.0A			1.44	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz		250		pF
Output Capacitance	C <sub>OSS</sub>			184		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			17		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge (Note 1)	Q <sub>G</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.0A I <sub>G</sub> =1mA (Note 1, 2)		10		nC
Gate-Source Charge	Q <sub>GS</sub>			2.7		nC
Gate-Drain Charge	Q <sub>GD</sub>			2.5		nC
Turn-On Delay Time (Note 1)	t <sub>D(ON)</sub>	V <sub>DD</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =4.0A, R <sub>GS</sub> =25Ω		5.6		ns
Turn-On Rise Time	t <sub>R</sub>			17		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			30		ns
Turn-Off Fall Time	t <sub>F</sub>			27		ns
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				4	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				16	A
Drain-Source Diode Forward Voltage (Note 1)	V <sub>SD</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t <sub>rr</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V dI <sub>F</sub> /dt=100A/μs		236		ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>				3.85	

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%  
 2. Essentially independent of operating temperature

## TEST CIRCUITS AND WAVEFORMS

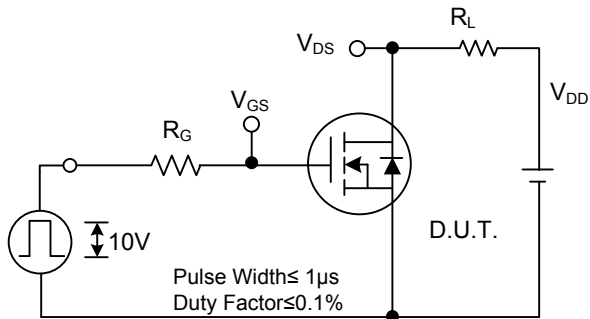


**Peak Diode Recovery  $dv/dt$  Test Circuit**

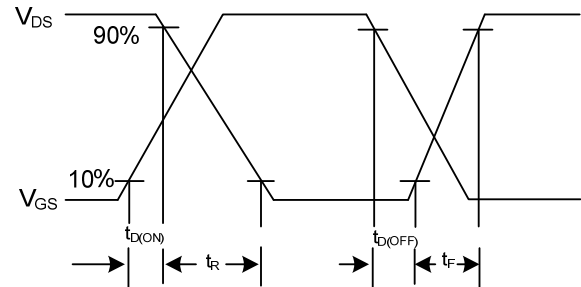


**Peak Diode Recovery  $dv/dt$  Waveforms**

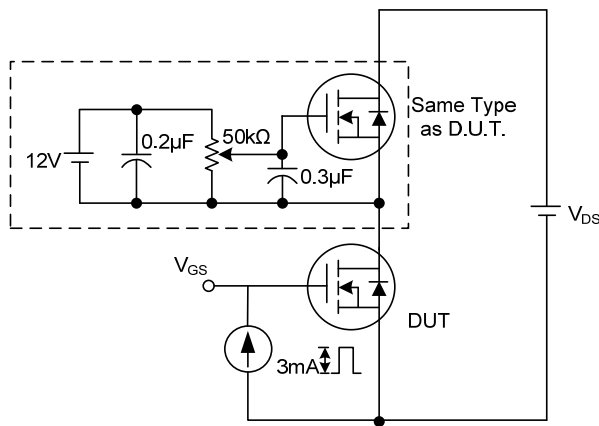
## TEST CIRCUITS AND WAVEFORMS



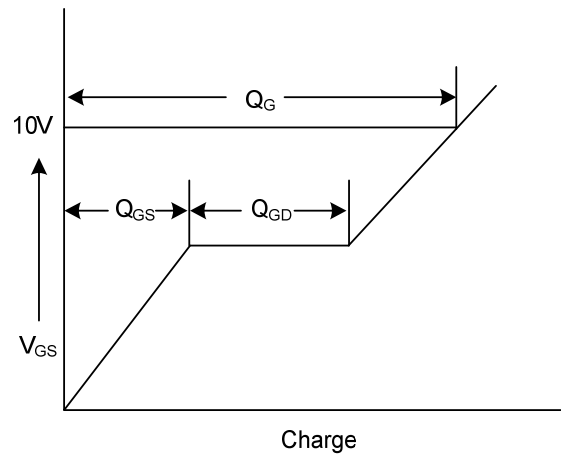
**Switching Test Circuit**



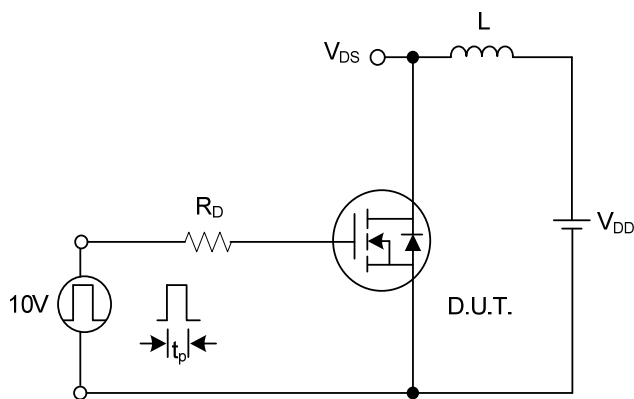
**Switching Waveforms**



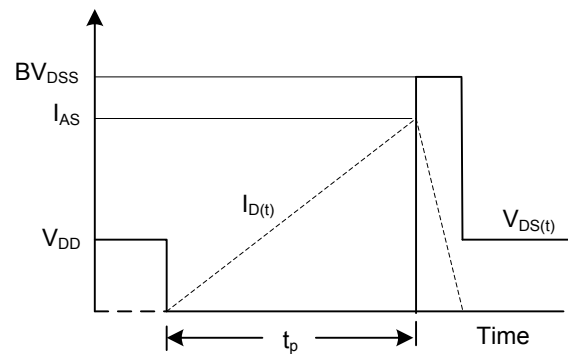
**Gate Charge Test Circuit**



**Gate Charge Waveform**

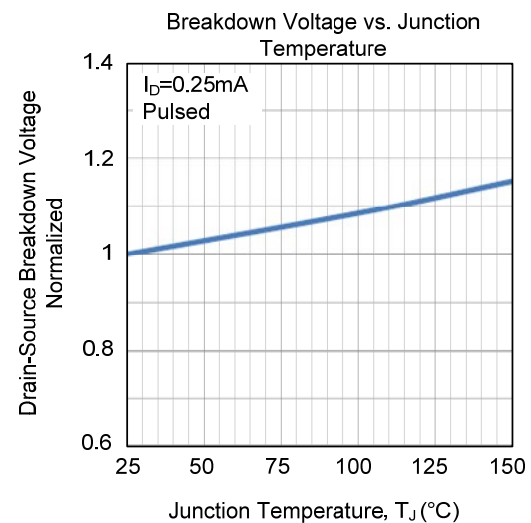
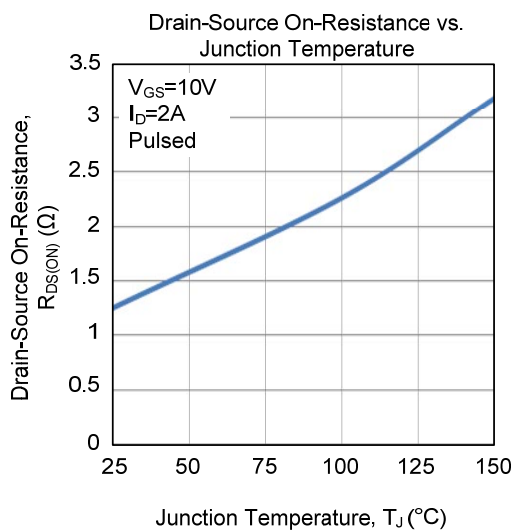
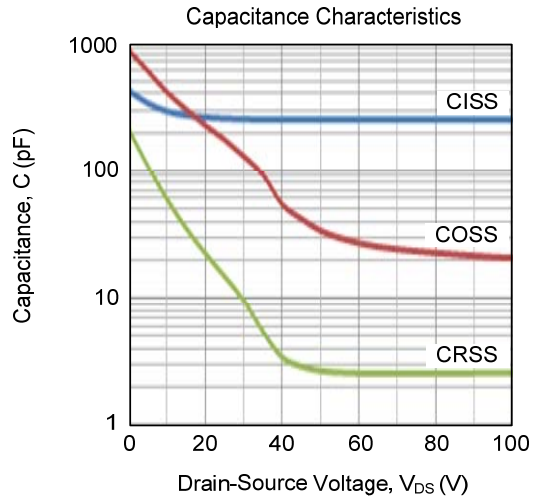
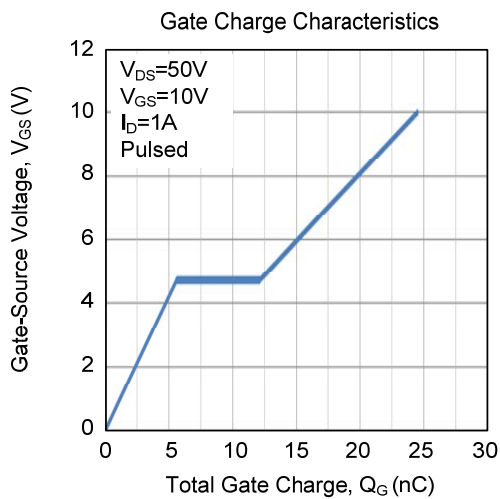
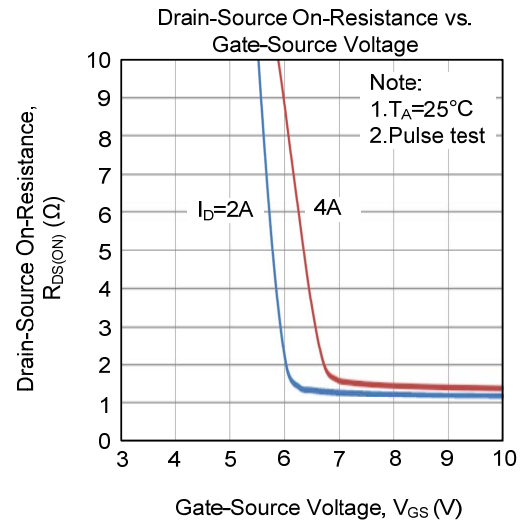
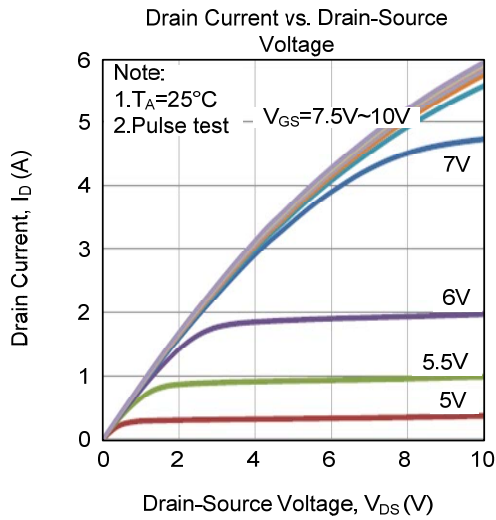


**Unclamped Inductive Switching Test Circuit**

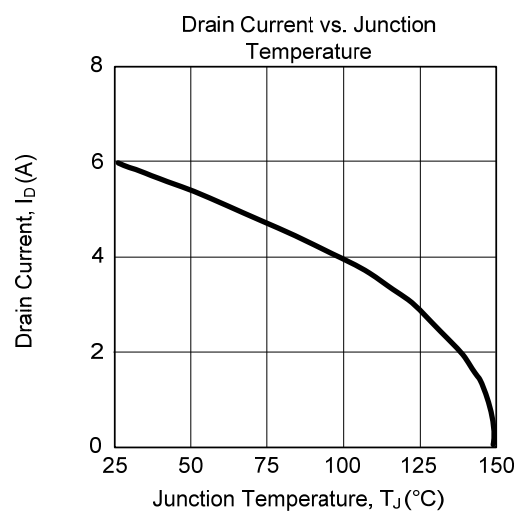
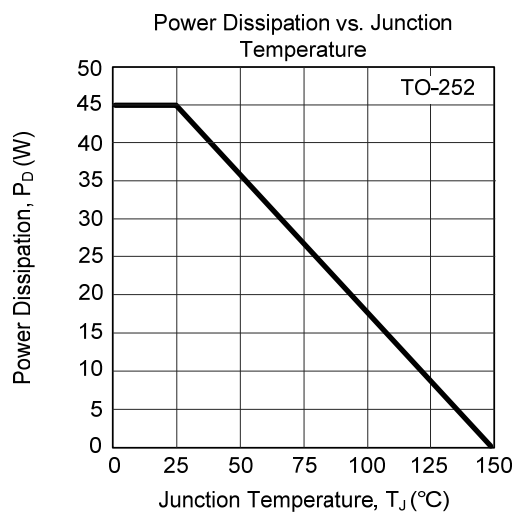
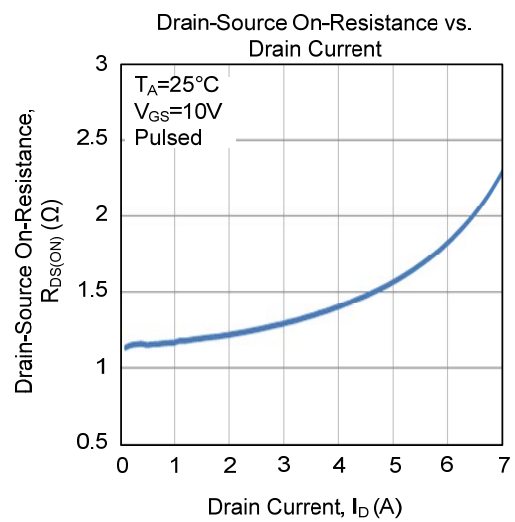
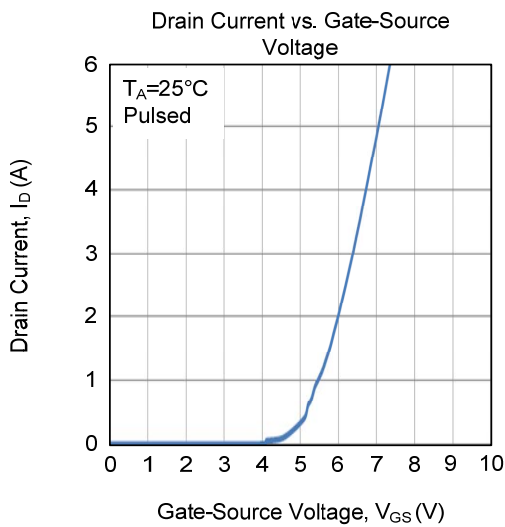
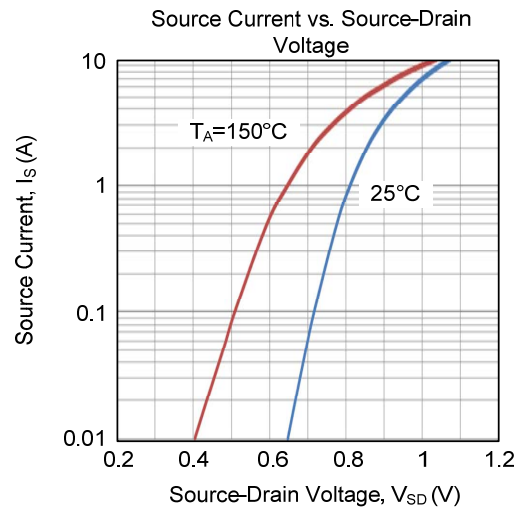
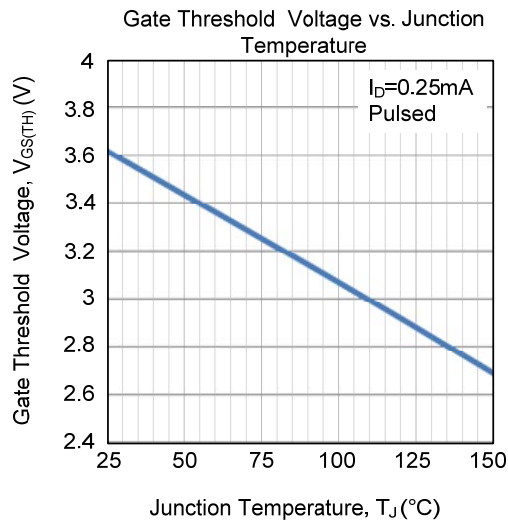


**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS

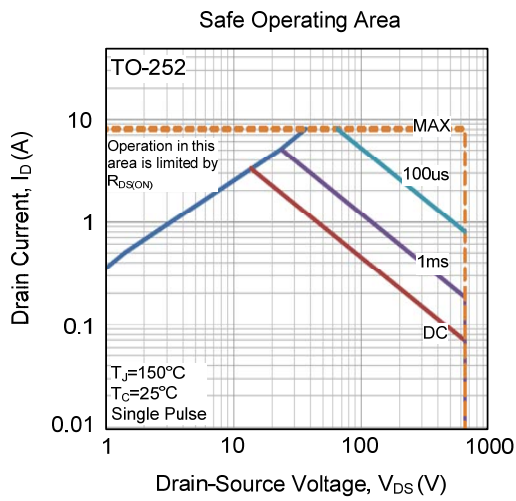


### ■ TYPICAL CHARACTERISTICS (Cont.)





■ TYPICAL CHARACTERISTICS (Cont.)



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