



4NM65A

Power MOSFET

4A, 650V N-CHANNEL SUPER-JUNCTION MOSFET

■ DESCRIPTION

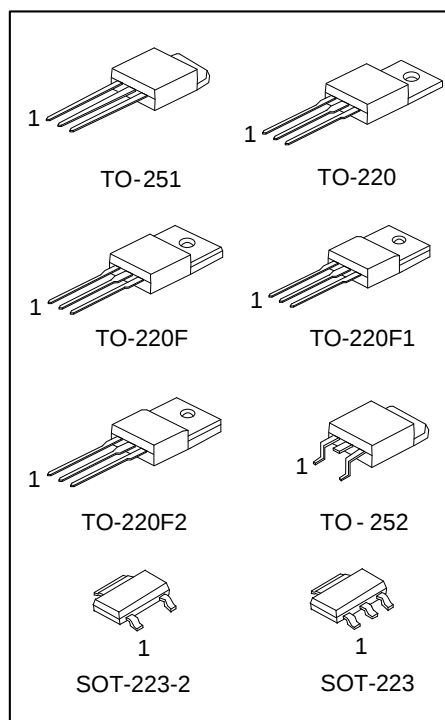
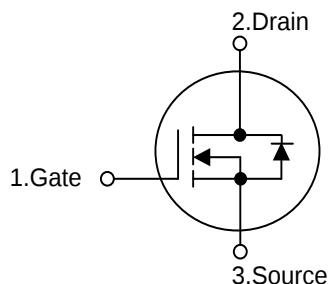
The UTC **4NM65A** is a high voltage super junction MOSFET and is designed to have better characteristics.

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

4NM65AG-AA2-R (1) Packing Type (2) Package Type (3) Green Package	(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
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■ MARKING

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

■ **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}	± 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 TO-220F2		23	W
	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	θ_{JA}	150	$^\circ\text{C/W}$
	TO-220/TO-220F		62.5	$^\circ\text{C/W}$
	TO-220F1/TO-220F2			
	TO-251/TO-252		110	$^\circ\text{C/W}$
Junction to Case	SOT-223-2/SOT-223	θ_{JC}	20.8	$^\circ\text{C/W}$
	TO-220		1.73	$^\circ\text{C/W}$
	TO-220F/TO-220F1 TO-220F2		5.43	$^\circ\text{C/W}$
	TO-251/TO-252		2.77 (Note)	$^\circ\text{C/W}$

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

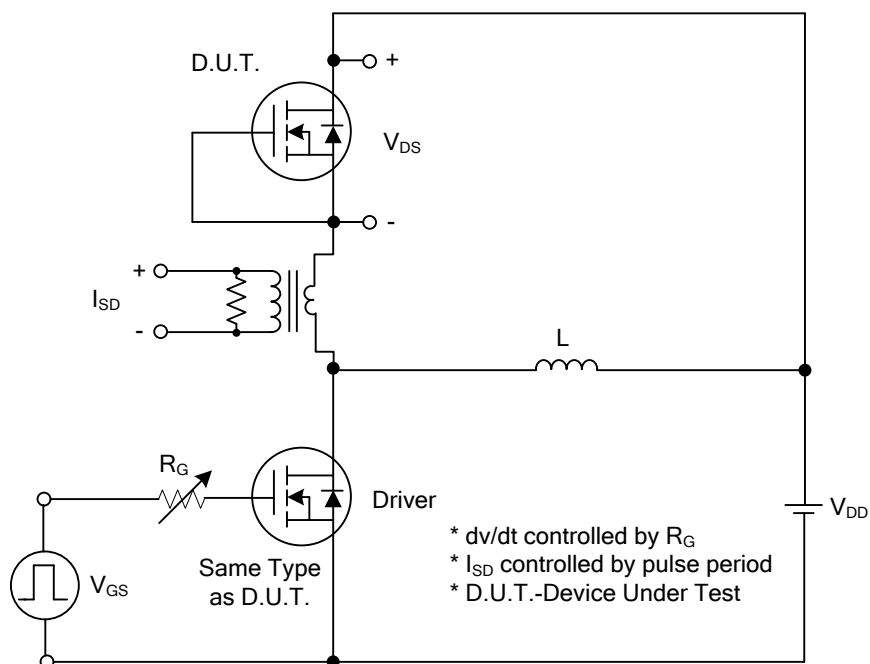
■ **ELECTRICAL CHARACTERISTICS** ($T_J = 25^\circ\text{C}$, unless otherwise specified)

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

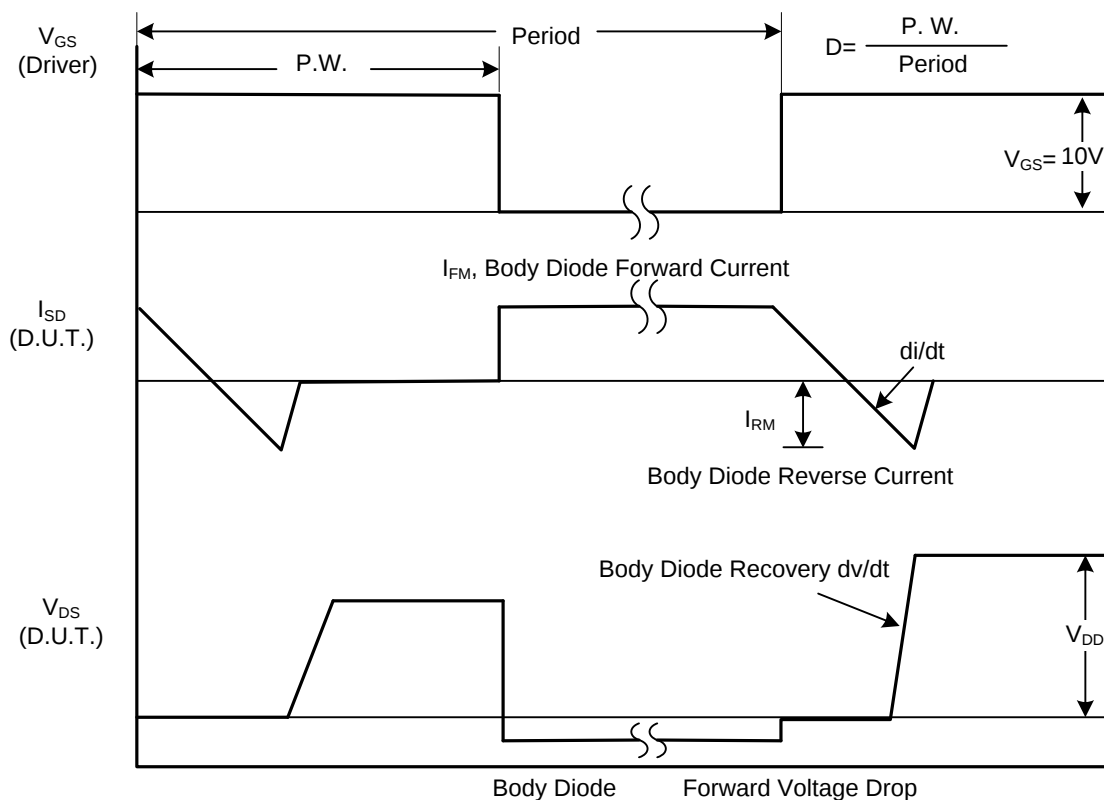
Notes: 1. Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

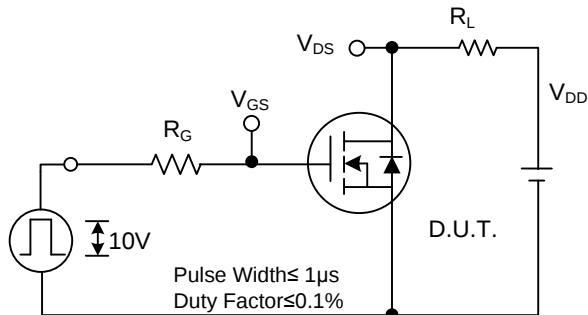


Peak Diode Recovery dv/dt Test Circuit

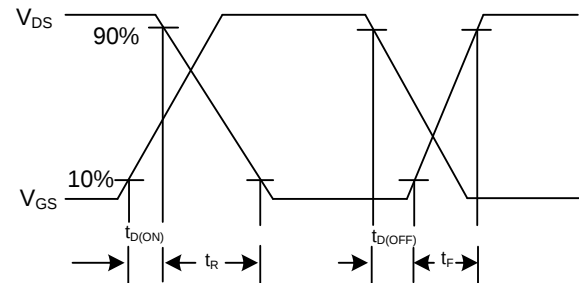


Peak Diode Recovery dv/dt Waveforms

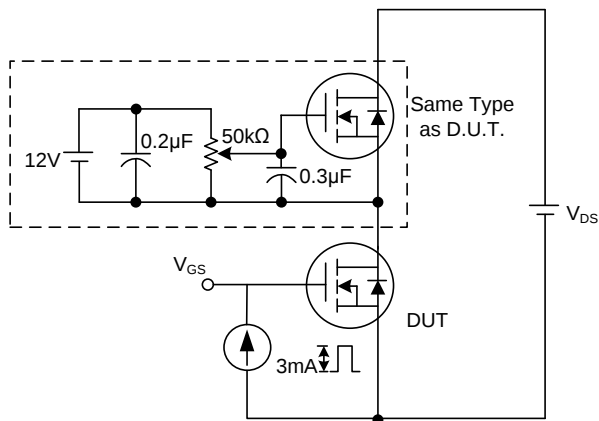
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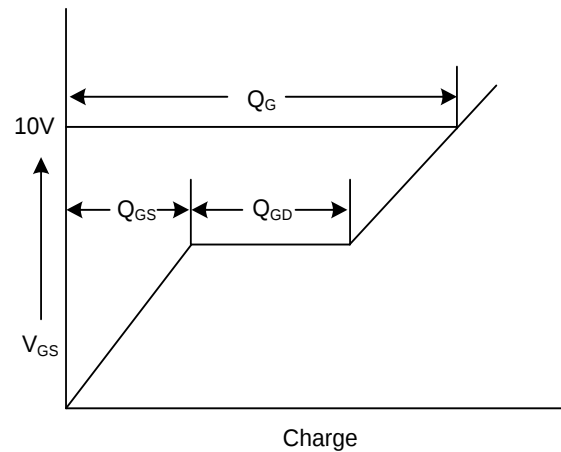
Switching Test Circuit



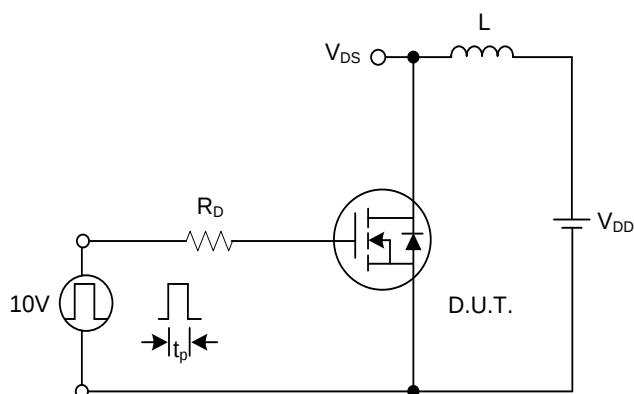
Switching Waveforms



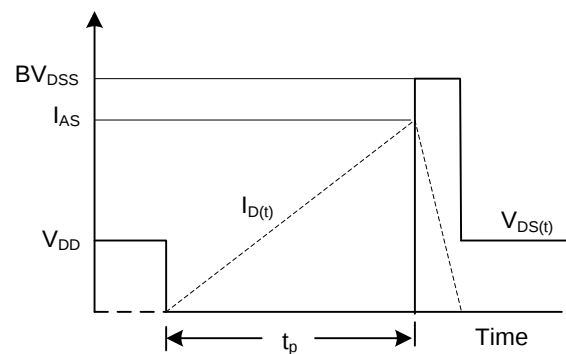
Gate Charge Test Circuit



Gate Charge Waveform

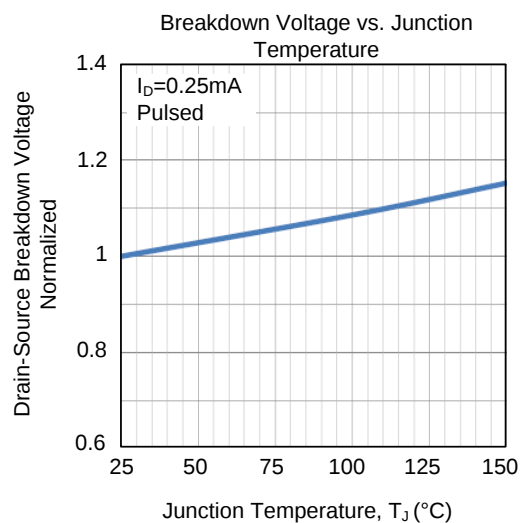
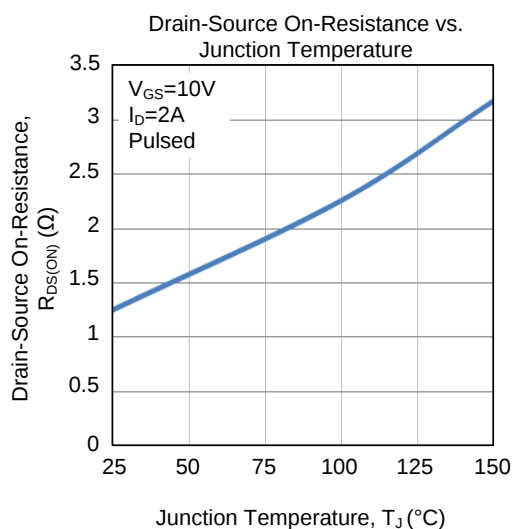
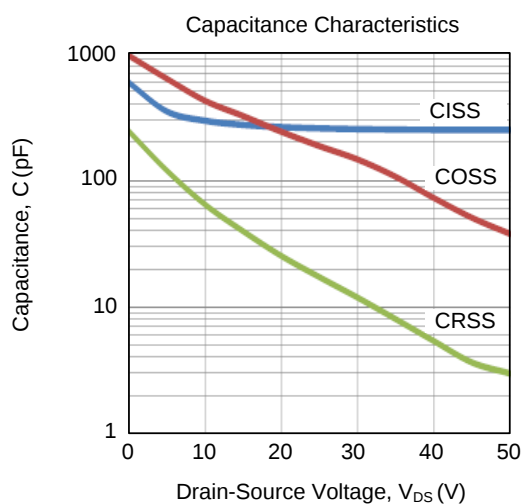
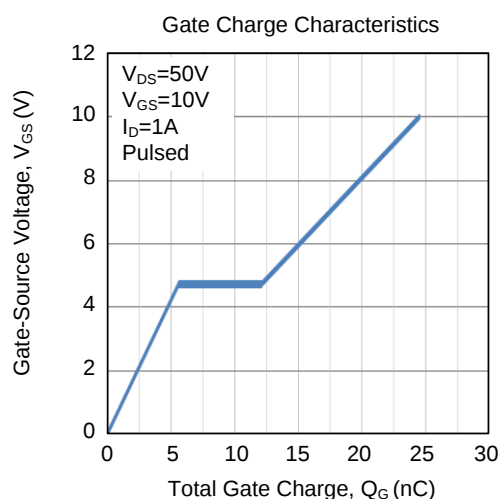
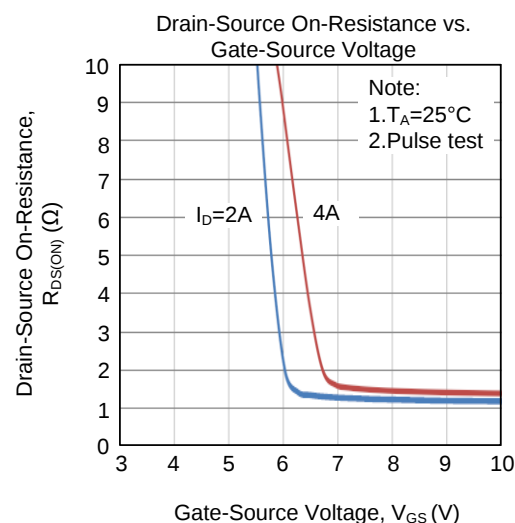
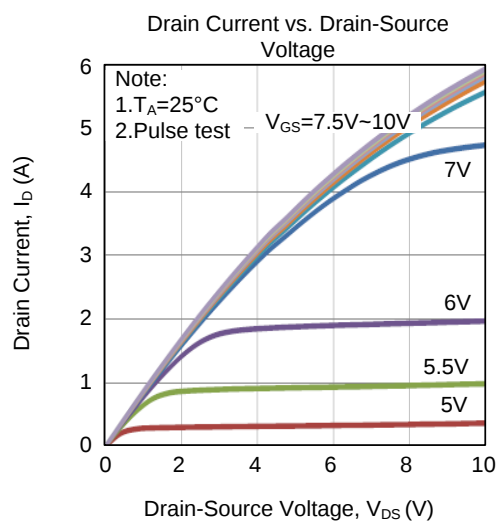


Unclamped Inductive Switching Test Circuit

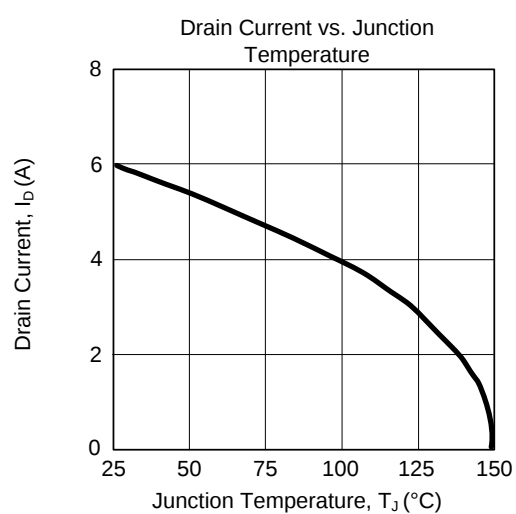
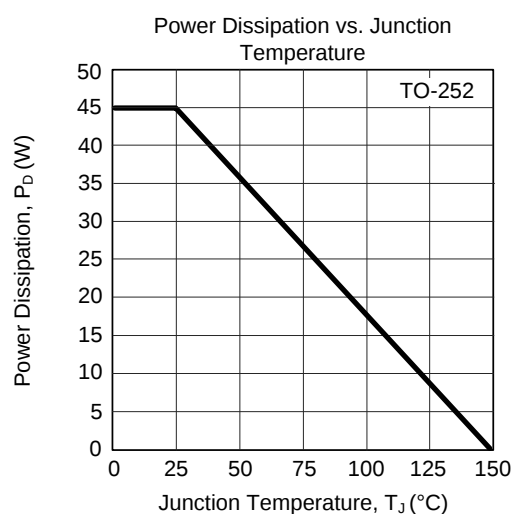
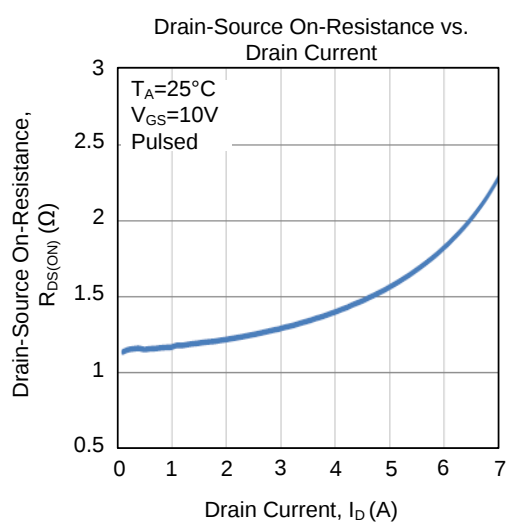
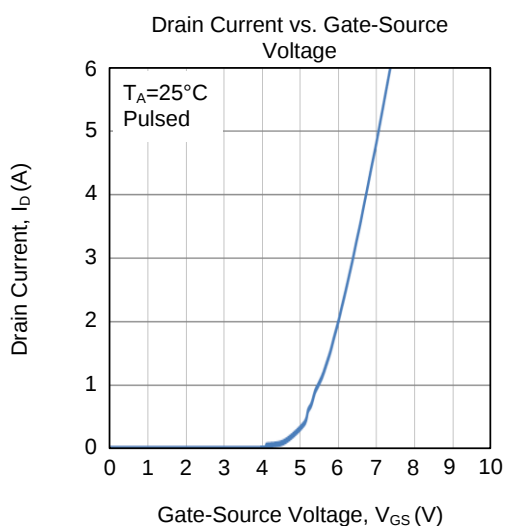
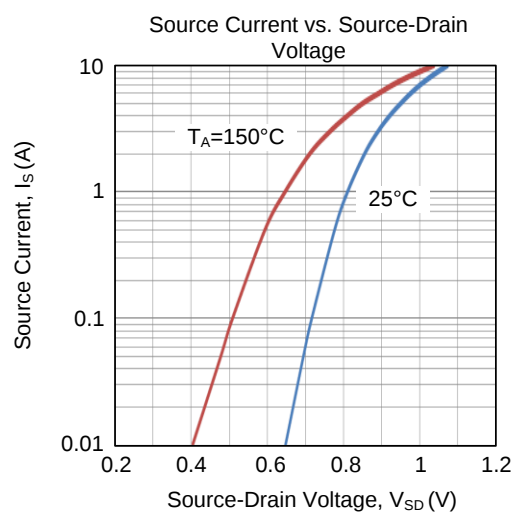
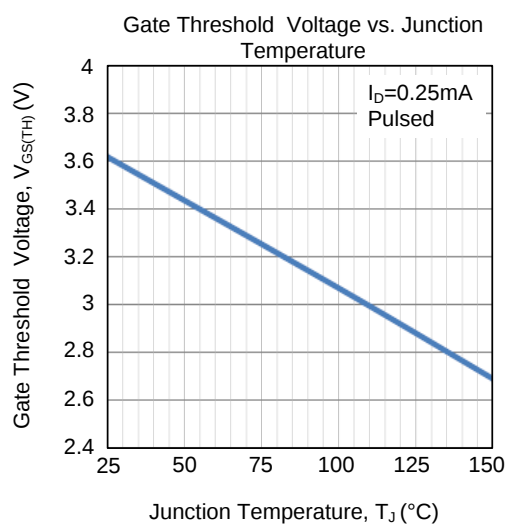


Unclamped Inductive Switching Waveforms

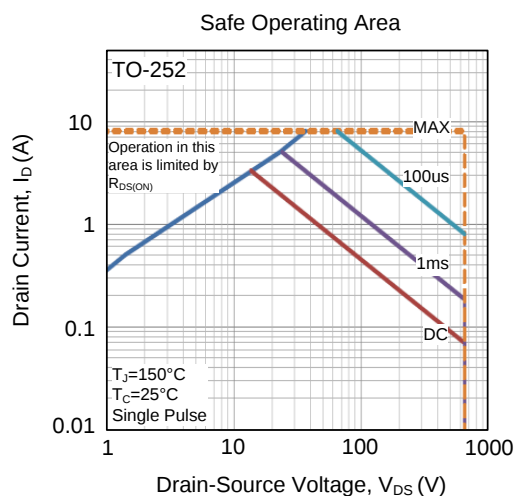
■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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