

4NM65

Power MOSFET

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

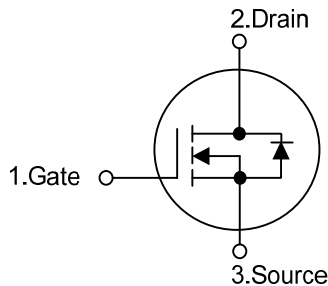
DESCRIPTION

The **4NM65** is a Super Junction MOSFET, designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristic. This power MOSFET is usually used in high speed switching applications including power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.

FEATURES

- * $R_{DS(ON)} \leq 1.4\Omega$ @ $V_{GS}=10V$, $I_D=2.0A$
- * Fast Switching Capability
- * Avalanche Energy Specified
- * Improved dv/dt Capability, High Ruggedness

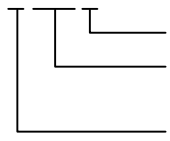
SYMBOL

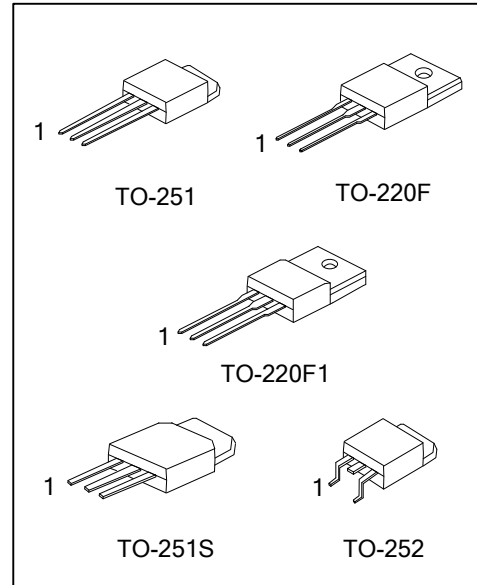


ORDERING INFORMATION

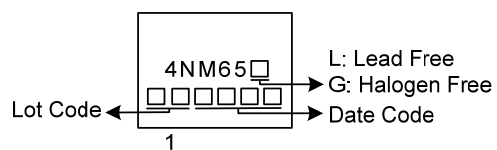
Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4NM65L-TF3-T	4NM65G-TF3-T	TO-220F	G	D	S	Tube
4NM65L-TF1-T	4NM65G-TF1-T	TO-220F1	G	D	S	Tube
4NM65L-TM3-T	4NM65G-TM3-T	TO-251	G	D	S	Tube
4NM65L-TMS-T	4NM65G-TMS-T	TO-251S	G	D	S	Tube
4NM65L-TN3-R	4NM65G-TN3-R	TO-252	G	D	S	Tape Reel

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

4NM65G-TF3-T  (1)Packing Type (2)Package Type (3)Green Package	(1) T: Tube, R: Tape Reel (2) TF3: TO-220F, TF1: TO-220F1, TM3: TO-251, TMS: TO-251S, TN3: TO-252 (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_{DS}	650	V
Gate-Source Voltage		V_{GS}	± 30	V
Drain Current	Continuous	I_D	4.0	A
	Pulsed (Note2)	I_{DM}	16	A
Avalanche Current (Note 2)		I_{AR}	1.4	A
Avalanche Energy	Single Pulsed (Note3)	E_{AS}	141	mJ
Peak Diode Recovery dv/dt (Note4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220F/TO-220F1	P_D	24	W
	TO-251/TO-251S		46	W
	TO-252			
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. $L=144\text{ mH}$, $I_{AS}=1.4\text{ A}$, $V_{DD}=50\text{ V}$, $R_G=25\ \Omega$, 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 RESISTANCES CHARACTERISTICS**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F	θ_{JA}	62.5	$^\circ\text{C/W}$
	TO-220F1			
	TO-251/TO-252		110	$^\circ\text{C/W}$
Junction to Case	TO-220F/TO-220F1	θ_{JC}	5.2	$^\circ\text{C/W}$
	TO-251/TO-251S		2.71 (Note)	$^\circ\text{C/W}$
	TO-252			

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

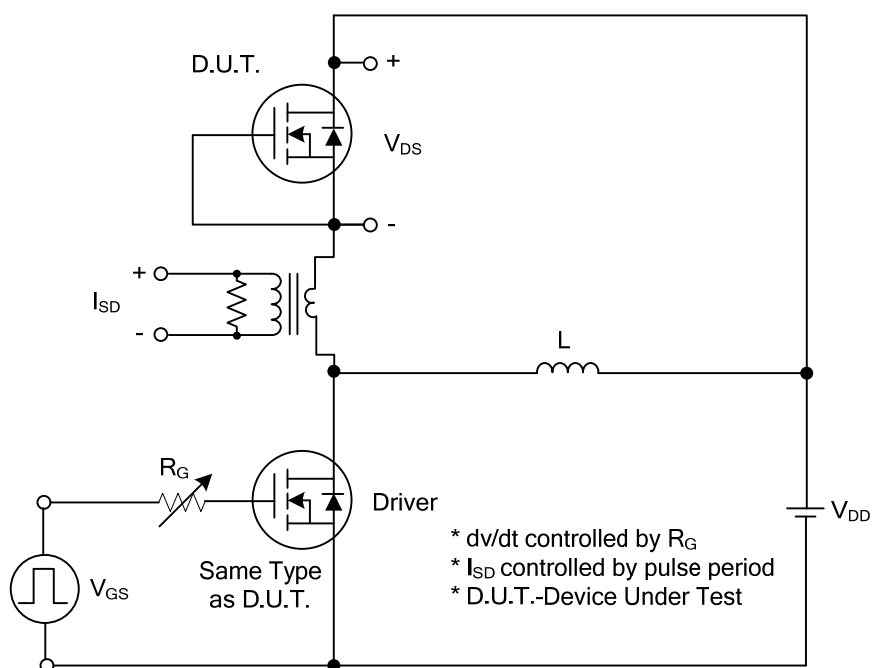
■ **ELECTRICAL CHARACTERISTICS** ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V, I _D =250μA	650			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =650V, V _{GS} =0V			10	μA
Gate-Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V, V _{DS} =0V			100	nA
	Reverse		V _{GS} =-30V, V _{DS} =0V			-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} =10V, I _D =2.0A			1.4	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =25V, f=1MHz		255		pF
Output Capacitance		C _{OSS}			179		pF
Reverse Transfer Capacitance		C _{RSS}			24		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =520V, V _{GS} =10V I _D =4A, I _G =1mA (Note 1,2)		11		nC
Gate to Source Charge		Q _{GS}			3		nC
Gate to Drain Charge		Q _{GD}			3.3		nC
Turn-ON Delay Time (Note 1)		t _{D(ON)}	V _{DD} =100V, V _{GS} =10V, I _D =4A, R _G =25Ω (Note 1, 2)		4.5		ns
Rise Time		t _R			18		ns
Turn-OFF Delay Time		t _{D(OFF)}			35		ns
Fall-Time		t _F			28		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I _S				4.4	A
Maximum Body-Diode Pulsed Current		I _{SM}				17.6	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	V _{GS} =0V, I _S =4.0A			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t _{rr}	V _{GS} =0V, I _S =4.0A		250		ns
Body Diode Reverse Recovery Charge		Q _{rr}	dl _F /dt=100A/μs		2.0		μC

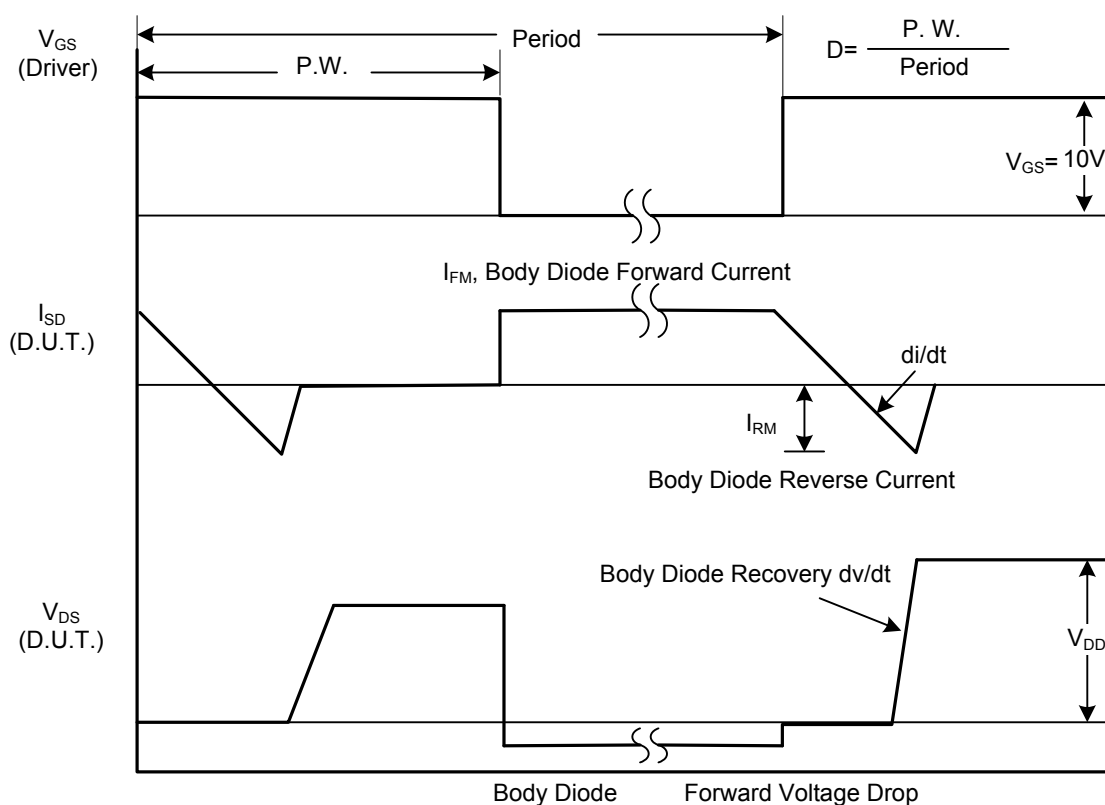
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

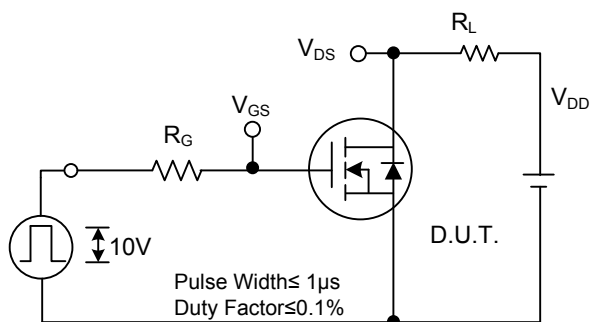


Peak Diode Recovery dv/dt Test Circuit

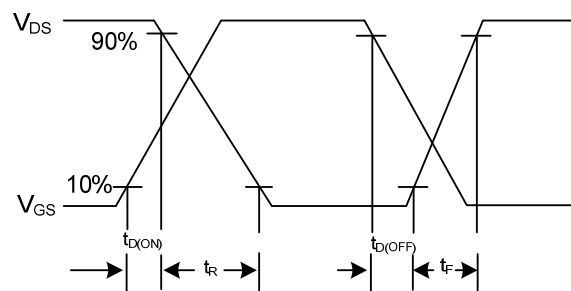


Peak Diode Recovery dv/dt Waveforms

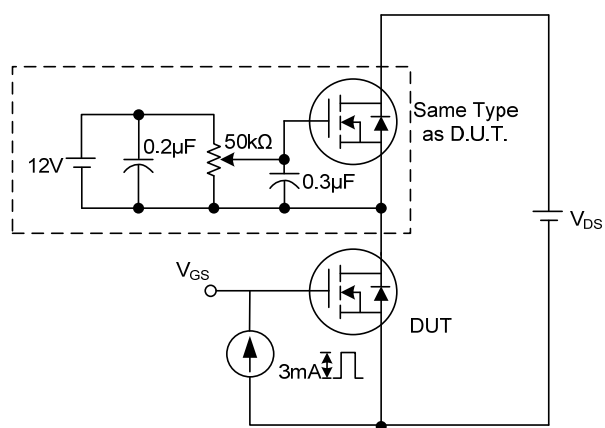
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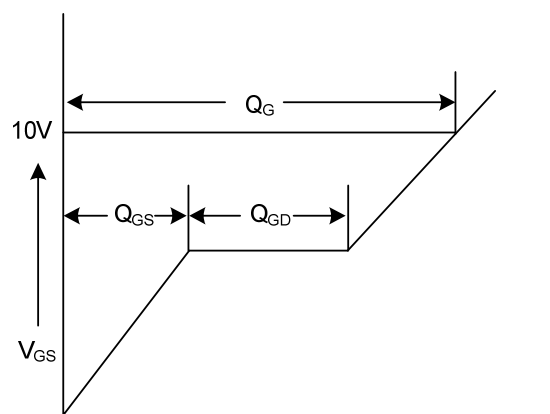
Switching Test Circuit



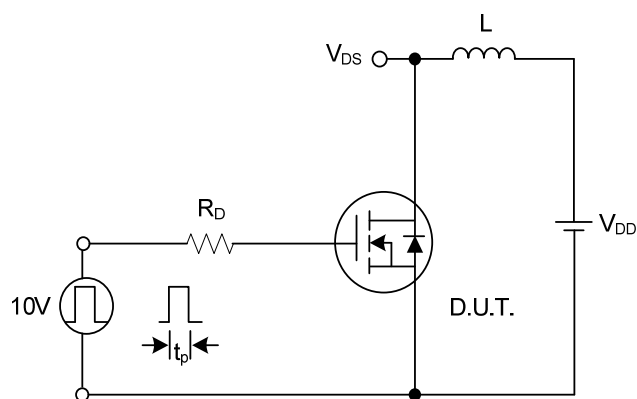
Switching Waveforms



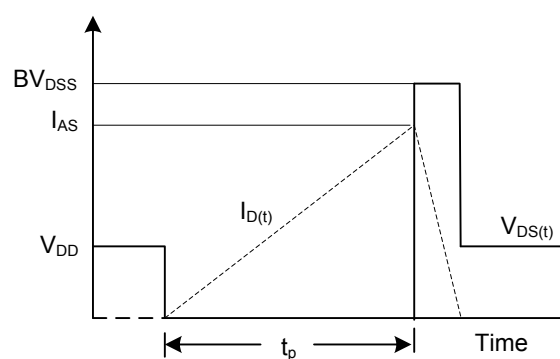
Gate Charge Test Circuit



Gate Charge Waveform

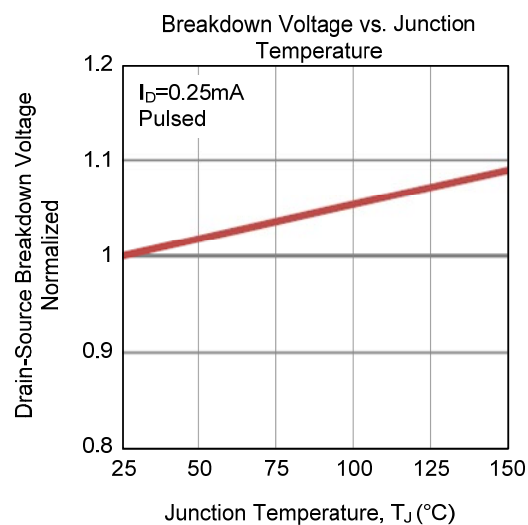
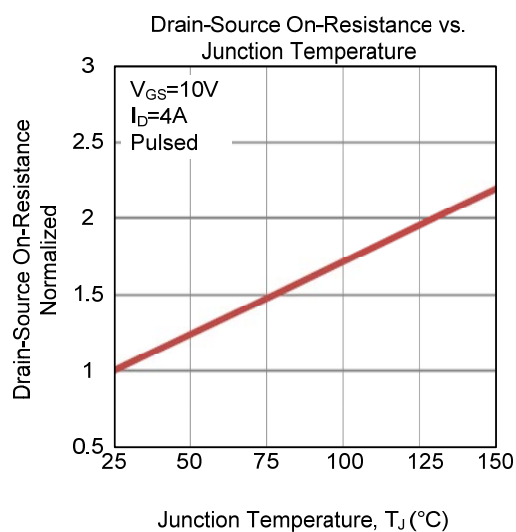
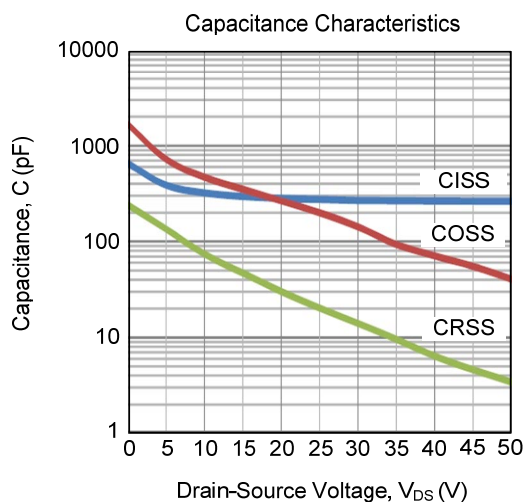
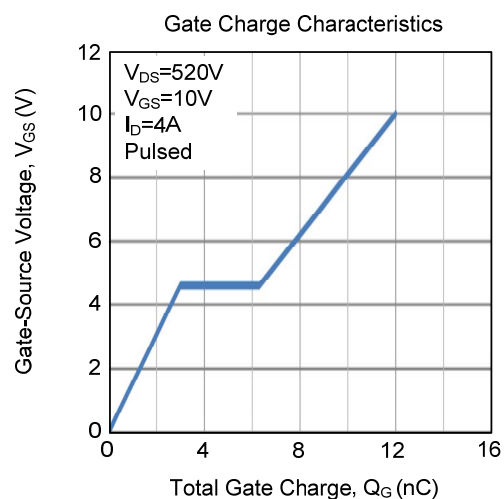
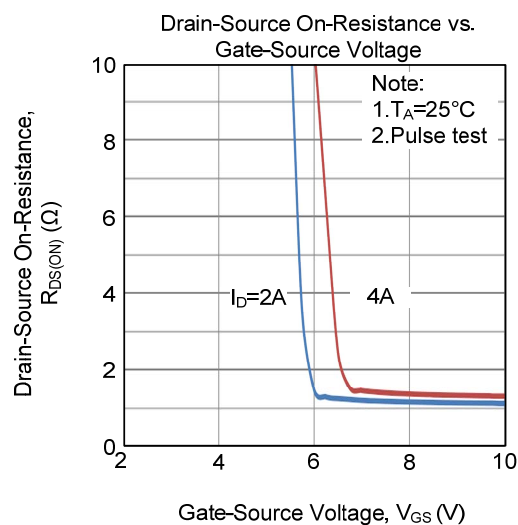
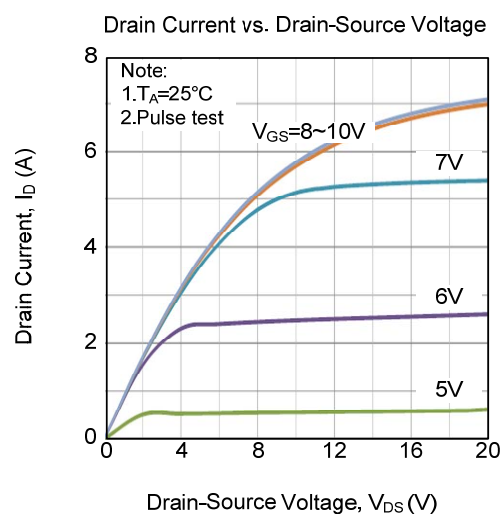


Unclamped Inductive Switching Test Circuit

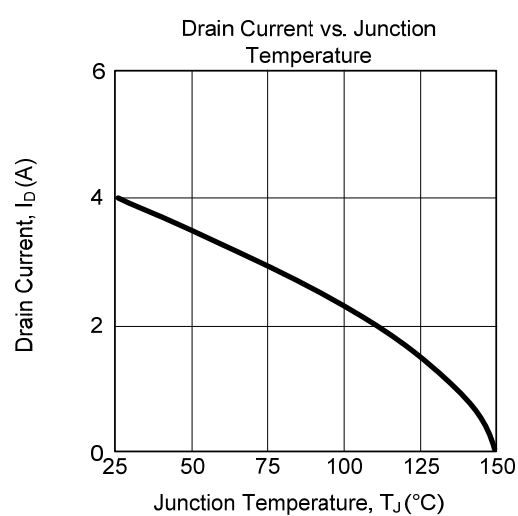
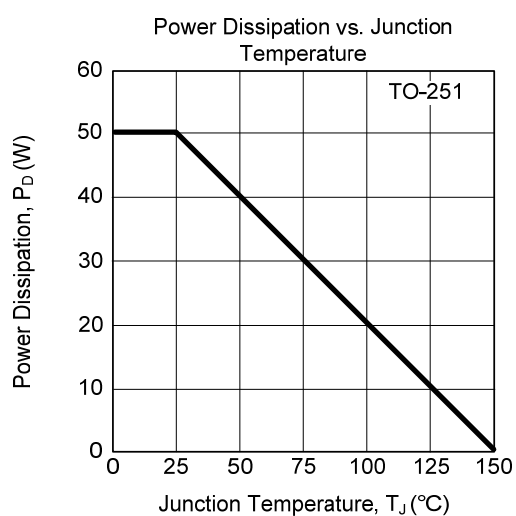
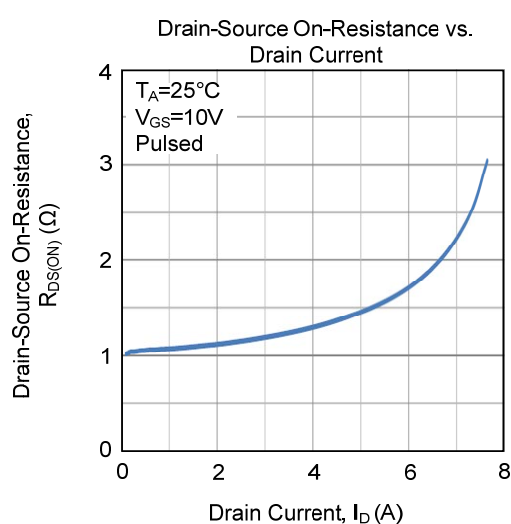
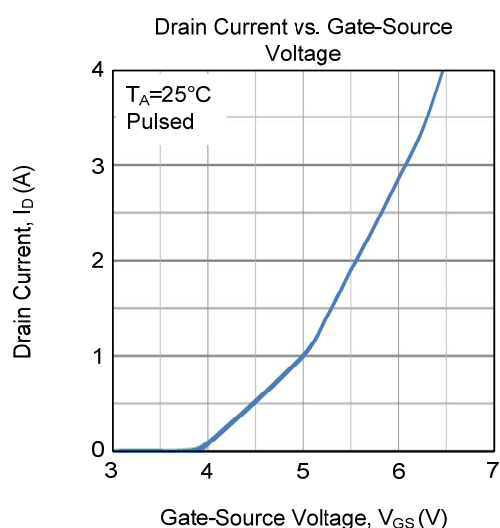
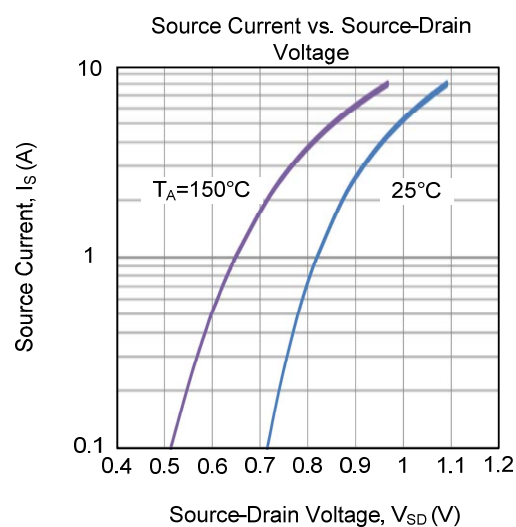
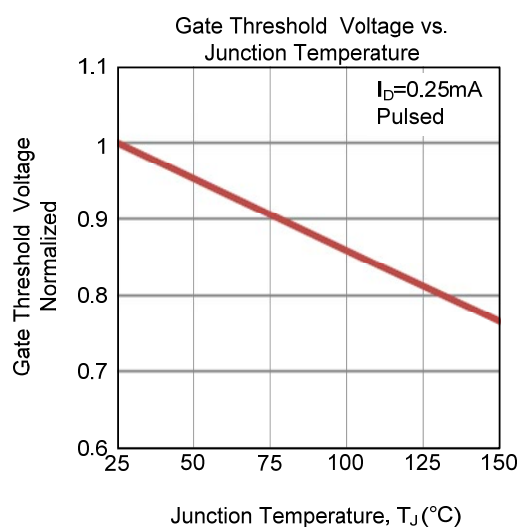


Unclamped Inductive Switching Waveforms

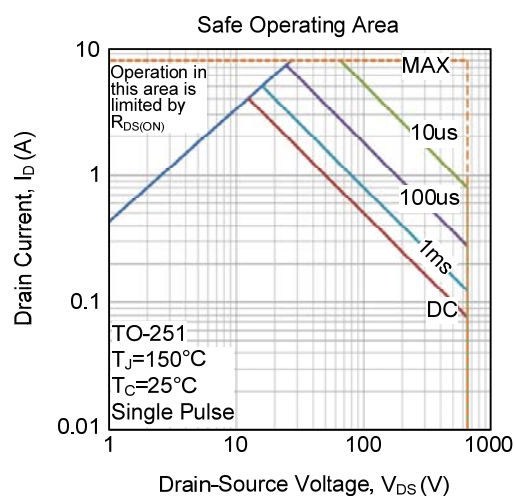
■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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