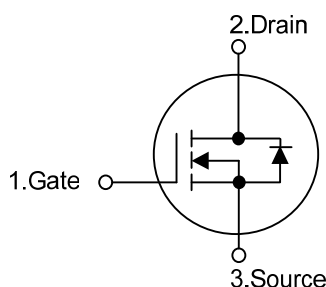


**4NM70-U2****Power MOSFET****4A, 700V N-CHANNEL
SUPER-JUNCTION MOSFET****DESCRIPTION**

The UTC **4NM70-U2** 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 high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications at power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.

FEATURES

- * $R_{DS(ON)} \leq 2.2 \Omega$ @ $V_{GS}=10V$, $I_D=2.0A$
- * Fast Switching Capability
- * Improved dv/dt Capability, High Ruggedness

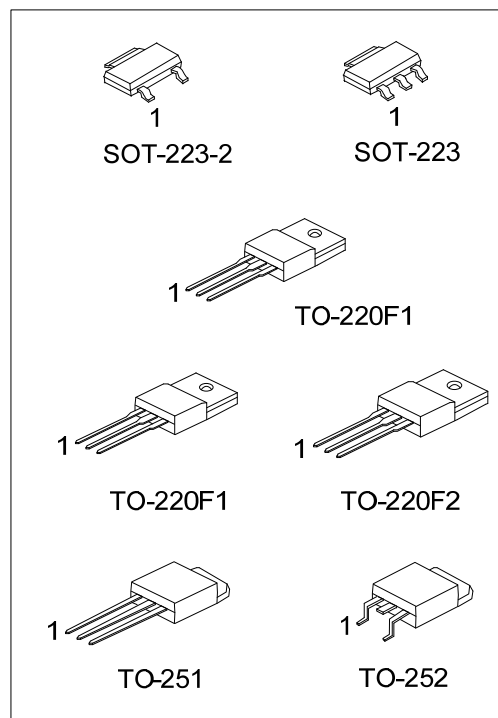
SYMBOL**ORDERING INFORMATION**

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4NM70L-AA2-R	4NM70G-AA2-R	SOT-223-2	G	D	S	Tape Reel
4NM70L-AA3-R	4NM70G-AA3-R	SOT-223	G	D	S	Tape Reel
4NM70L-TA3-T	4NM70G-TA3-T	TO-220	G	D	S	Tube
4NM70L-TF1-T	4NM70G-TF1-T	TO-220F1	G	D	S	Tube
4NM70L-TF2-T	4NM70G-TF2-T	TO-220F2	G	D	S	Tube
4NM70L-TM3-T	4NM70G-TM3-T	TO-251	G	D	S	Tube
4NM70L-TN3-R	4NM70G-TN3-R	TO-252	G	D	S	Tape Reel

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

	(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, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252
 (3) G: Halogen Free and Lead Free, L: Lead Free



MARKING

SOT-223-2 / SOT-223	TO-220 / TO-220F1 / TO-220F2 TO-251 / TO-252
4NM70 Lot Code 1 L: Lead Free G: Halogen Free Date Code	UTC 4NM70 Lot Code 1 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_{DS}	700	V
Gate-Source Voltage		V_{GS}	± 30	V
Drain Current	Continuous	I_D	4.0	A
	Pulsed (Note 2)	I_{DM}	16	A
Avalanche Current (Note 2)		I_{AR}	1.2	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	104	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4	V/ns
Power Dissipation	SOT-223-2/SOT-223	P_D	10	W
	TO-220		70	W
	TO-220F1/TO-220F2		24	W
	TO-251/TO-252		50	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. $L = 144\text{ mH}$, $I_{AS} = 1.2\text{ A}$, $V_{DD} = 50\text{ V}$, $R_G = 25\ \Omega$, 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-220F1		62.5	$^\circ\text{C/W}$
	TO-220F2			
	TO-251/TO-252		110	$^\circ\text{C/W}$
Junction to Case	SOT-223-2/SOT-223	θ_{JC}	12.5	$^\circ\text{C/W}$
	TO-220		1.78	$^\circ\text{C/W}$
	TO-220F1/TO-220F2		5.2	$^\circ\text{C/W}$
	TO-251/TO-252		2.5 (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} =0V, I _D =250μA	700			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =700V, 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	
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			2.2	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =25V, f=1.0MHz		215		pF
Output Capacitance		C _{OSS}			150		pF
Reverse Transfer Capacitance		C _{RSS}			15		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =560V, V _{GS} =10V, I _D =4A , I _G =1mA (Note 1, 2)		13		nC
Gate to Source Charge		Q _{GS}			5		nC
Gate to Drain Charge		Q _{GD}			4		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)		6		ns
Rise Time		t _R			18		ns
Turn-OFF Delay Time		t _{D(OFF)}			25		ns
Fall-Time		t _F			27		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I _S				4.0	A
Maximum Body-Diode Pulsed 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,		270		ns
Body Diode Reverse Recovery Charge		Q _{rr}	dI _F /dt=100A/μs		4		μC

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

2. Essentially independent of operating temperature.

D.U.T.

V_{DS}

I_{SD}

L

V_{DD}

Driver

R_G

V_{GS}

Same Type as D.U.T.

- * dv/dt controlled by R_G
- * I_{SD} controlled by pulse period
- * D.U.T.-Device Under Test

The diagram illustrates the timing relationships for a MOSFET's body diode during switching. It consists of three vertically aligned waveforms:

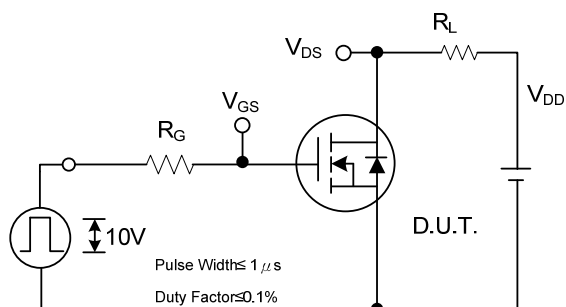
- V_{GS} (Driver):** A square wave with pulse width (P.W.) and period (Period). The duty cycle is defined as $D = \frac{P.W.}{Period}$. The peak voltage is $V_{GS} = 10V$.
- I_{SD} (D.U.T.):** The source-drain current. During the MOSFET's on-time, it is the forward current I_{FM} . During the off-time, it is the reverse current I_{RM} . The reverse current shows a recovery phase with a slope labeled di/dt .
- V_{DS} (D.U.T.):** The drain-source voltage. It is zero during the on-time and rises during the off-time. The rising edge is labeled "Body Diode Recovery dv/dt ". The peak voltage is V_{DD} .

Labels at the bottom indicate the "Body Diode" conduction during the off-time and the "Forward Voltage Drop" during the on-time.

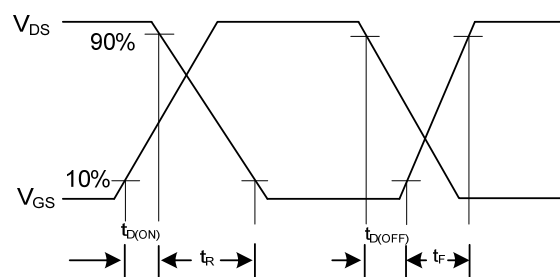


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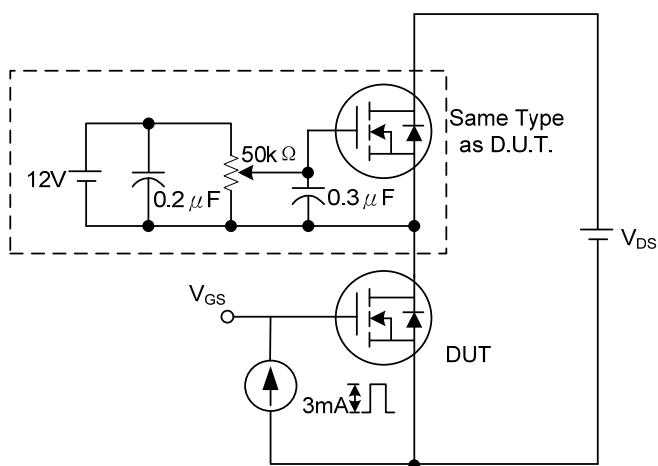
■ TEST CIRCUITS AND WAVEFORMS



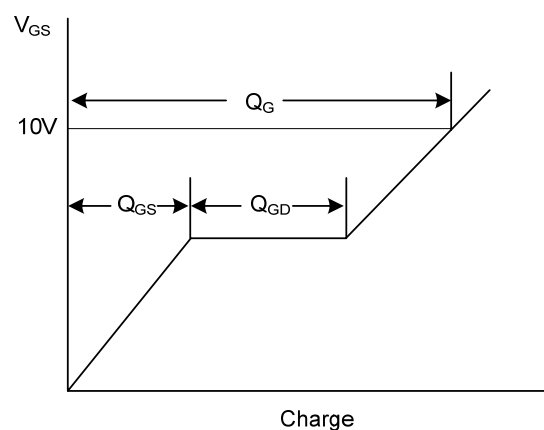
Switching Test Circuit



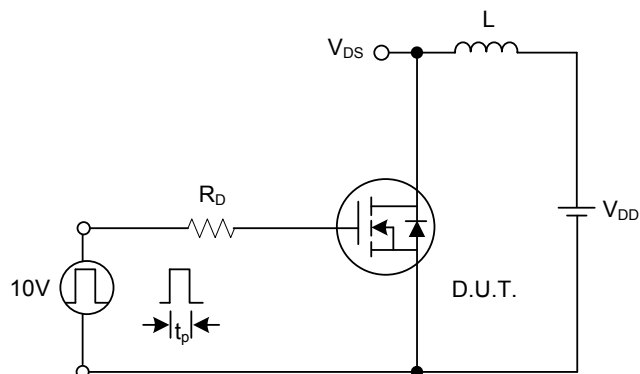
Switching Waveforms



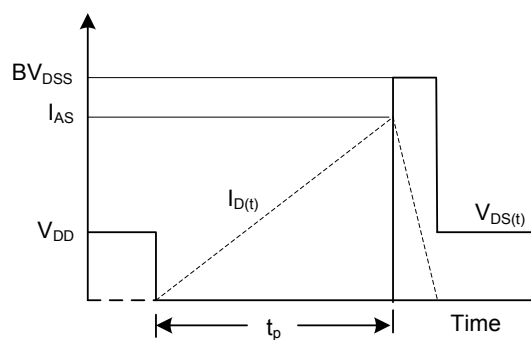
Gate Charge Test Circuit



Gate Charge Waveform

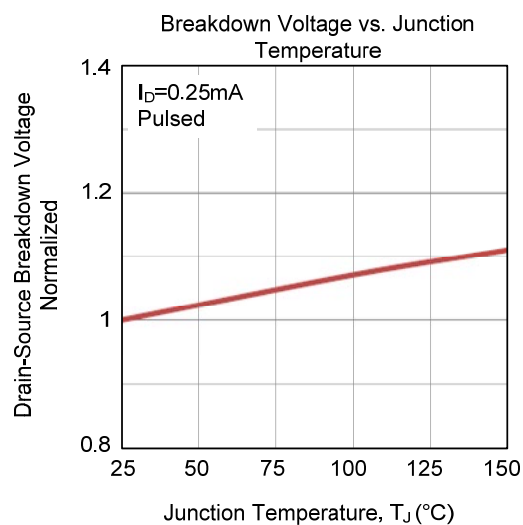
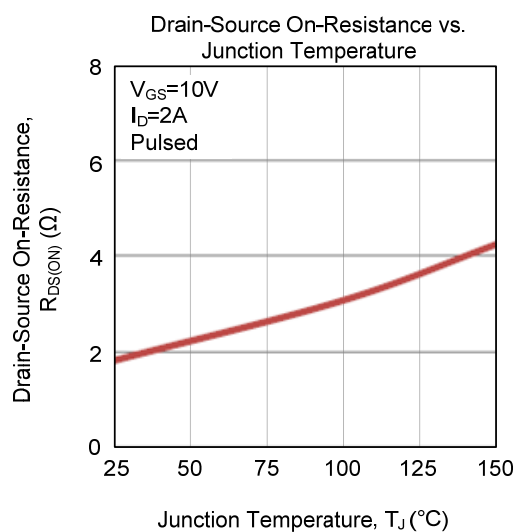
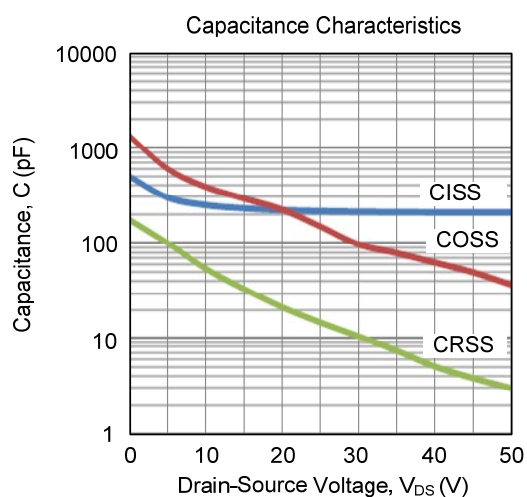
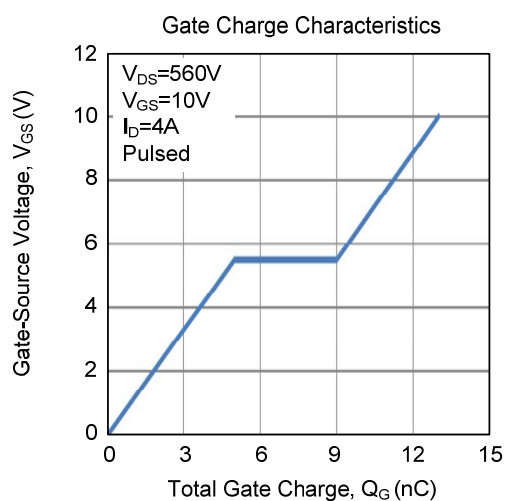
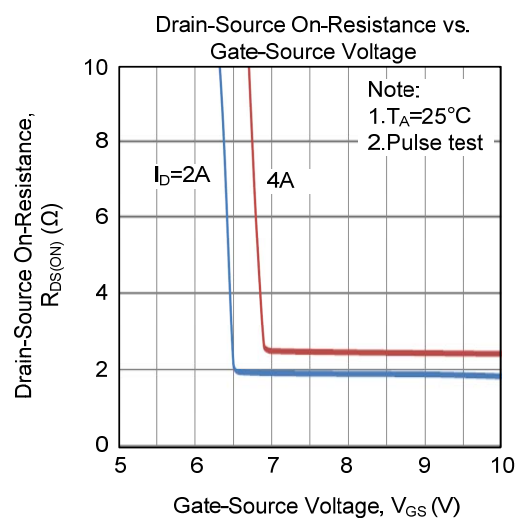
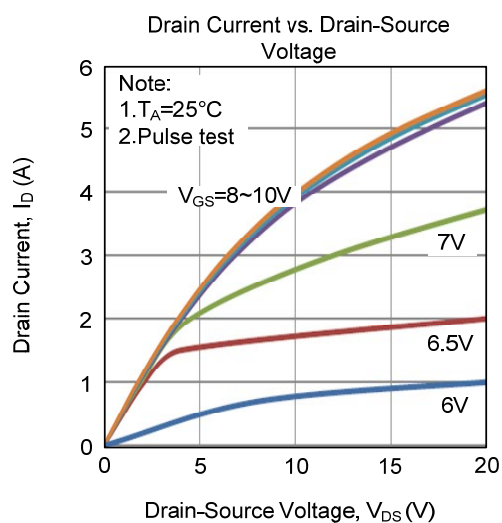


Unclamped Inductive Switching Test Circuit

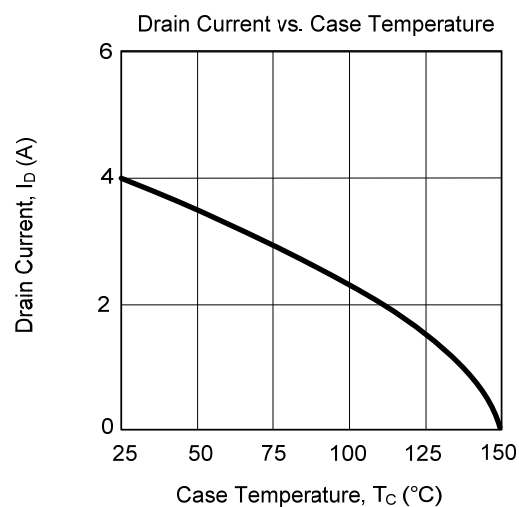
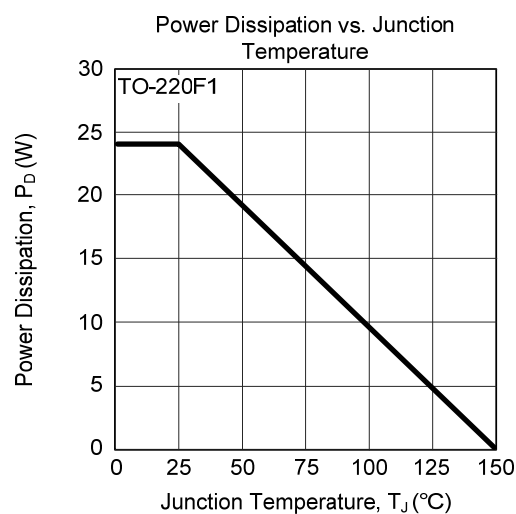
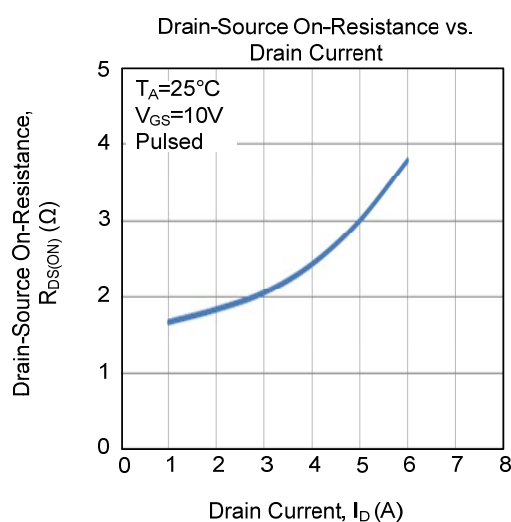
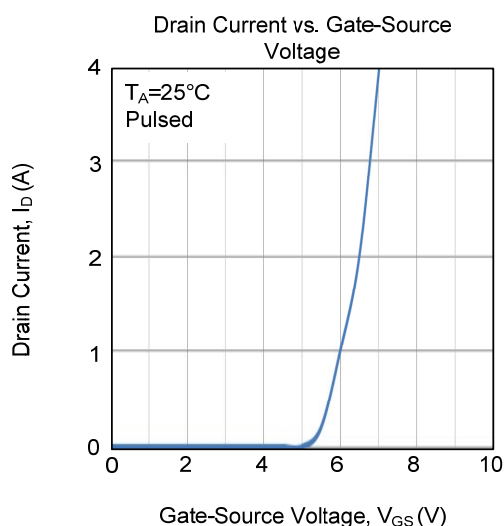
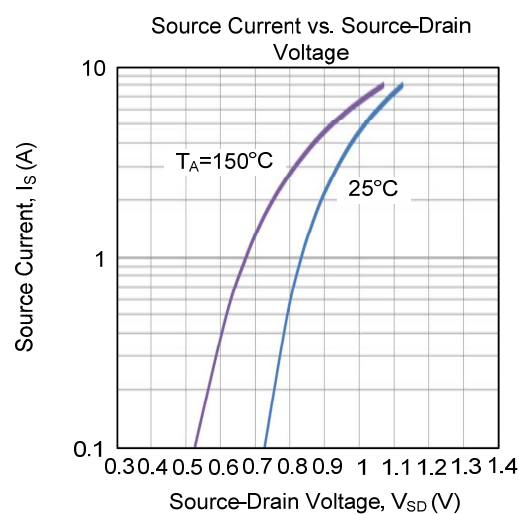
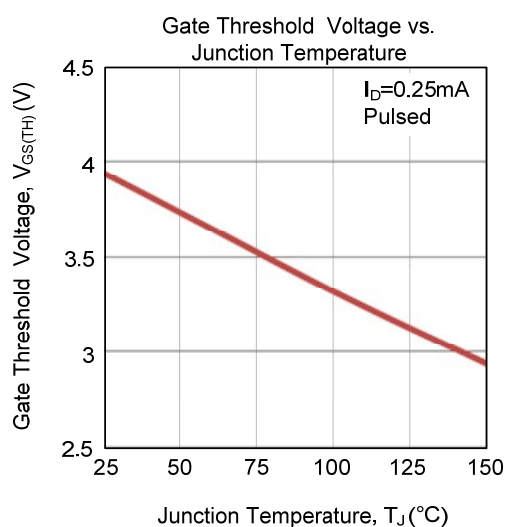


Unclamped Inductive Switching Waveforms

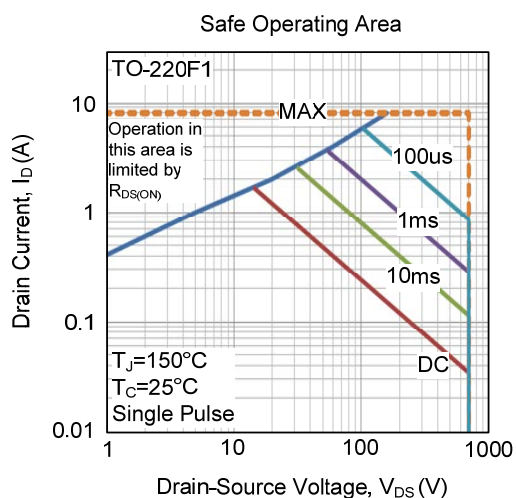
TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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