



6N70-ML

Power MOSFET

6.0A, 700V N-CHANNEL POWER MOSFET

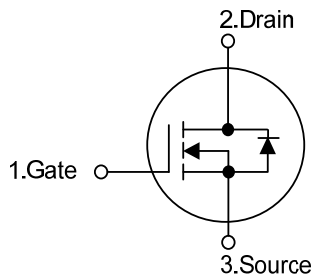
DESCRIPTION

The UTC **6N70-ML** is a high voltage power MOSFET combines advanced planar MOSFET 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 of switching power supplies and adaptors.

FEATURES

- * $R_{DS(ON)} \leq 2.4 \Omega$ @ $V_{GS}=10V$, $I_D=3.0A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness

SYMBOL

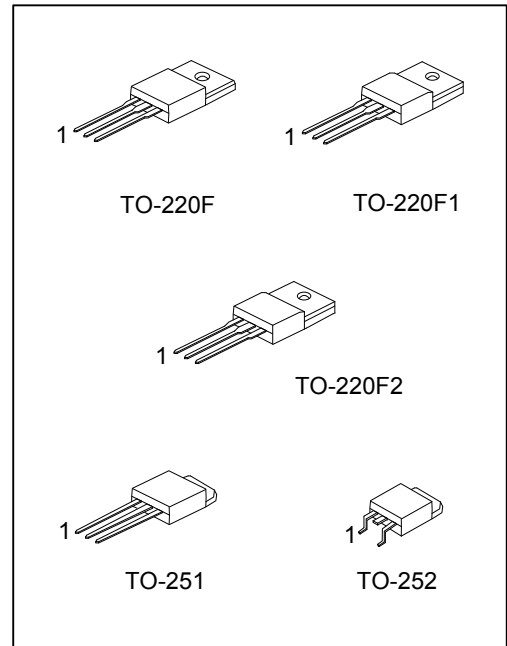


ORDERING INFORMATION

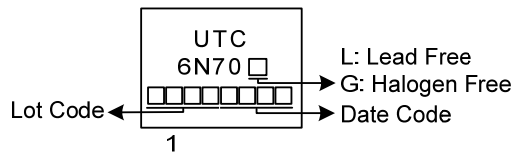
Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
6N70L-TF1-T	6N70G-TF1-T	TO-220F1	G	D	S	Tube
6N70L-TF2-T	6N70G-TF2-T	TO-220F2	G	D	S	Tube
6N70L-TF3-T	6N70G-TF3-T	TO-220F	G	D	S	Tube
6N70L-TM3-T	6N70G-TM3-T	TO-251	G	D	S	Tube
6N70L-TN3-R	6N70G-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>6N70G-TN3-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>		<p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2</p> <p>TM3: TO-251, TN3: TO-252</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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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_{DSS}	700	V
Gate-Source Voltage		V_{GSS}	± 30	V
Continuous Drain Current		I_D	6	A
Pulsed Drain Current (Note 2)		I_{DM}	24	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	108	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	3	V/ns
Power Dissipation	TO-220F/TO-220F1	P_D	33	W
	TO-220F2			
	TO-251/TO-252		51	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. $L = 30\text{mH}$, $I_{AS} = 2.6\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^{\circ}\text{C}$

4. $I_{SD} \leq 6.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^{\circ}\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220F/TO-220F1	θ_{JA}	62.5	$^{\circ}\text{C}/\text{W}$
	TO-220F2			
	TO-251/TO-252		110	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220F/TO-220F1	θ_{JC}	3.78	$^{\circ}\text{C}/\text{W}$
	TO-220F2			
	TO-251/TO-252		2.45 (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°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	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} , I _D =250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V, I _D =3.0A			2.4	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1.0MHz		725		pF
Output Capacitance		C _{OSS}			67		pF
Reverse Transfer Capacitance		C _{RSS}			7.5		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =560V, V _{GS} =10V, I _D =6.0A I _G =1mA (Note 1, 2)		25		nC
Gate-Source Charge		Q _{GS}			7.8		nC
Gate-Drain Charge		Q _{GD}			6		nC
Turn-On Delay Time (Note 1)		t _{D(ON)}	V _{DS} =100V, V _{GS} =10V, I _D =6.0A, R _G =25Ω (Note 1, 2)		9		ns
Turn-On Rise Time		t _R			17		ns
Turn-Off Delay Time		t _{D(OFF)}			57		ns
Turn-Off Fall Time		t _F			31		ns
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
Maximum Body-Diode Continuous Current		I _S				6	A
Maximum Body-Diode Pulsed Current		I _{SM}				24	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	I _S =6.0A, V _{GS} =0V			1.4	V
Reverse Recovery Time (Note 1)		t _{rr}	I _S =6.0A, V _{GS} =0V		290		ns
Reverse Recovery Charge		Q _{rr}	di/dt=100A/μs		2.73		μC

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

[illegible]

The diagram illustrates the timing relationships for a MOSFET switching event, showing the relationship between the gate voltage (V_{GS}), the drain current (I_{SD}), and the drain-source voltage (V_{DS}).

Top Trace: V_{GS} (Driver)

- Shows a square wave pulse with a pulse width (P.W.) and a period.
- The duty cycle is defined as $D = \frac{P.W.}{Period}$.
- The peak gate voltage is $V_{GS} = 10V$.

Middle Trace: I_{SD} (D.U.T.)

- Shows the drain current during the switching event.
- During the forward conduction phase, the current is I_{FM} (Body Diode Forward Current).
- During the reverse conduction phase, the current is I_{RM} (Body Diode Reverse Current).
- The reverse recovery time is indicated by di/dt .
- The reverse recovery voltage is indicated by dv/dt .

Bottom Trace: V_{DS} (D.U.T.)

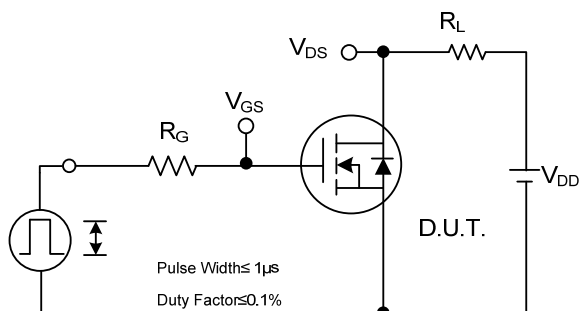
- Shows the drain-source voltage during the switching event.
- The voltage is V_{DD} during the forward conduction phase.
- The voltage drops to zero during the reverse conduction phase.
- The reverse recovery voltage is indicated by dv/dt .

Labels and Annotations:

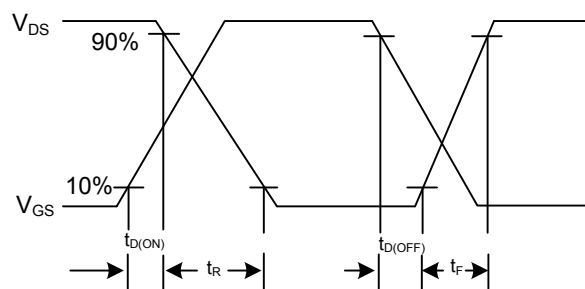
- Body Diode Forward Current:** I_{FM}
- Body Diode Reverse Current:** I_{RM}
- Body Diode Recovery dv/dt :** Indicated by an arrow pointing to the reverse recovery phase.
- Body Diode Forward Voltage Drop:** Indicated by an arrow pointing to the forward conduction phase.

Peak Diode Recovery dv/dt Waveforms

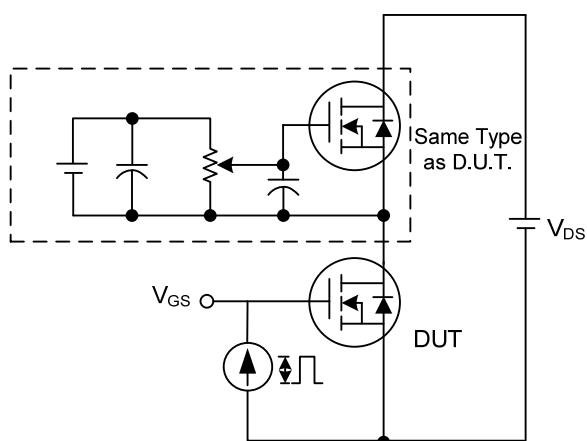
■ TEST CIRCUITS AND WAVEFORMS



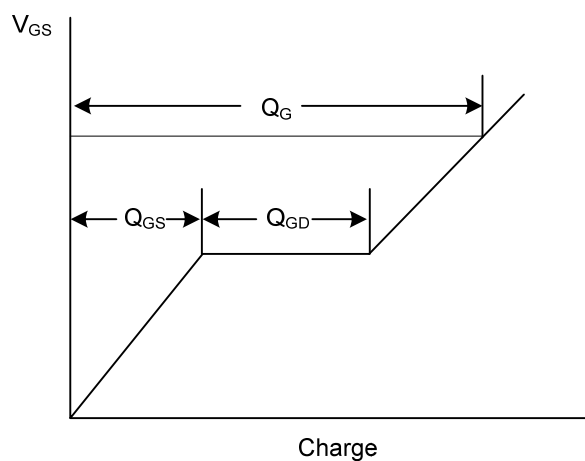
Switching Test Circuit



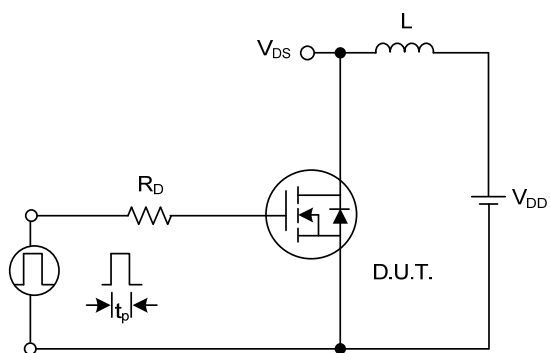
Switching Waveforms



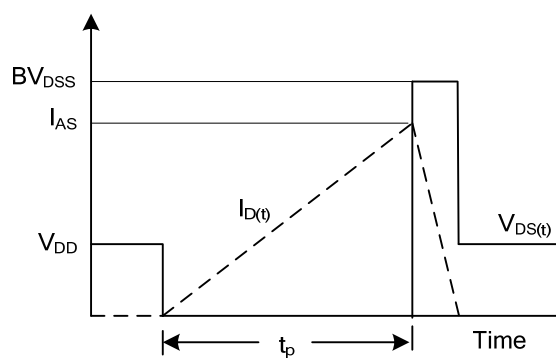
Gate Charge Test Circuit



Gate Charge Waveform

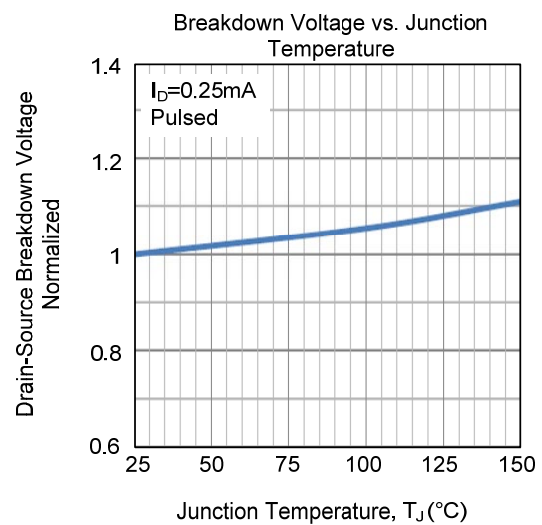
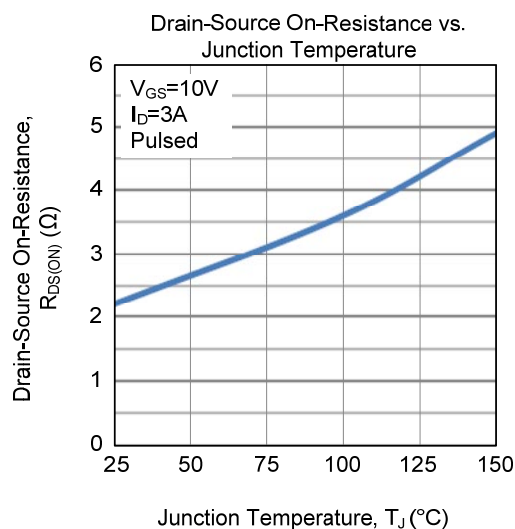
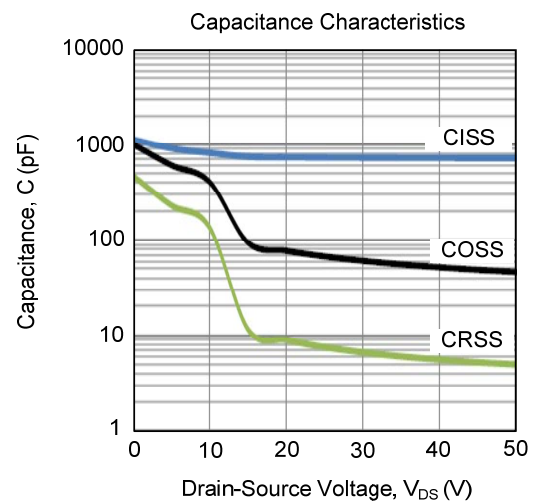
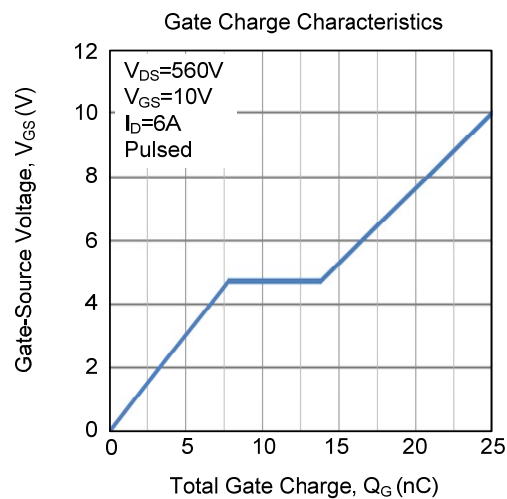
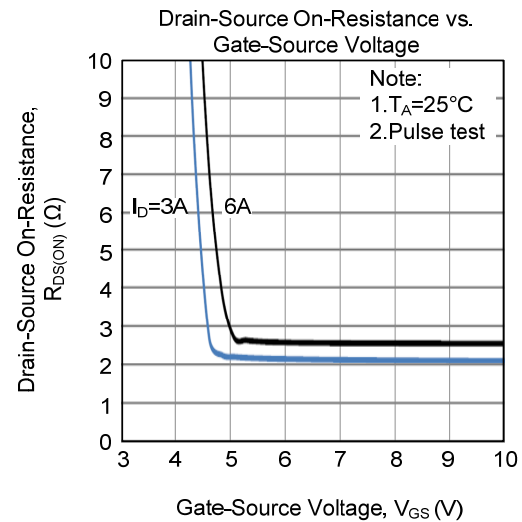
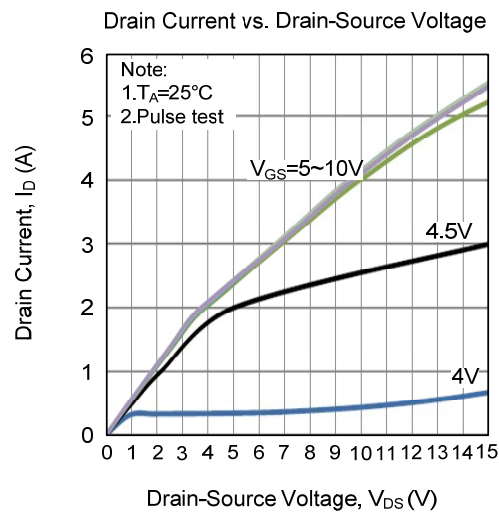


Unclamped Inductive Switching Test Circuit

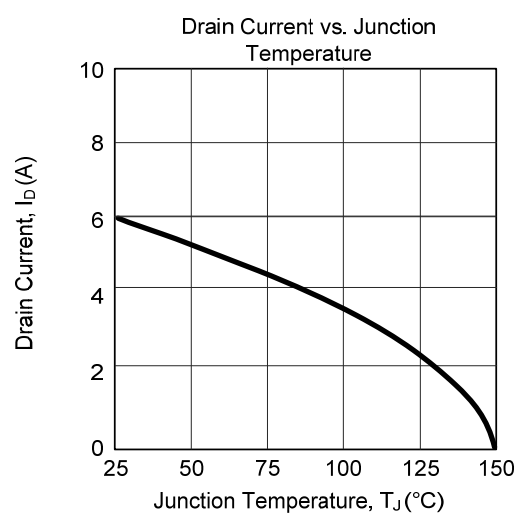
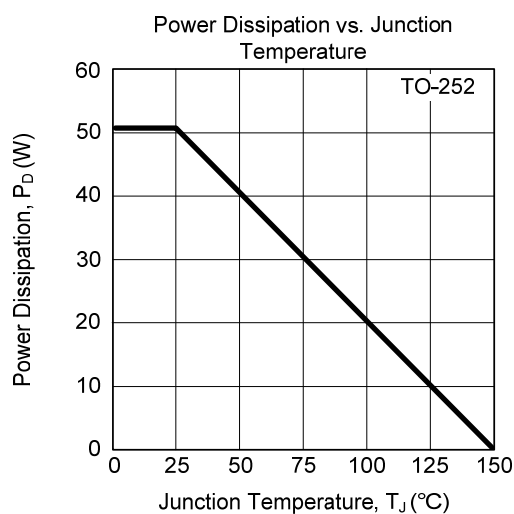
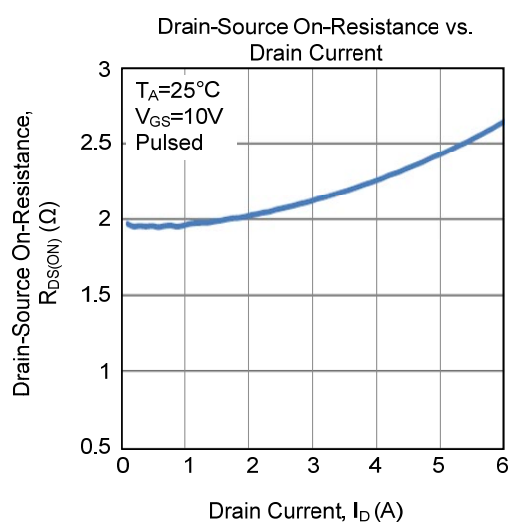
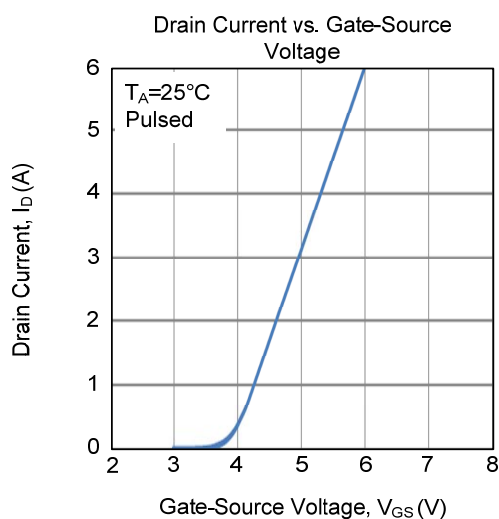
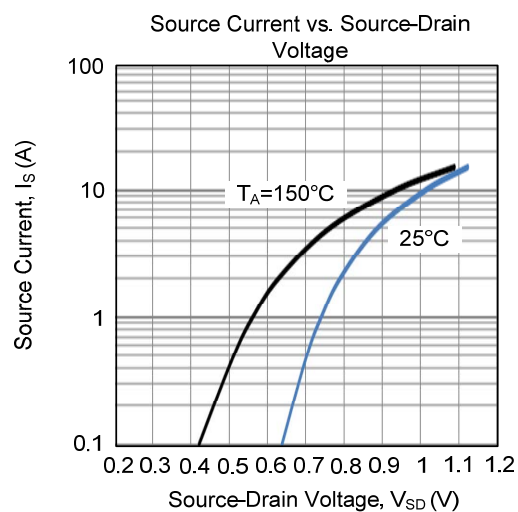
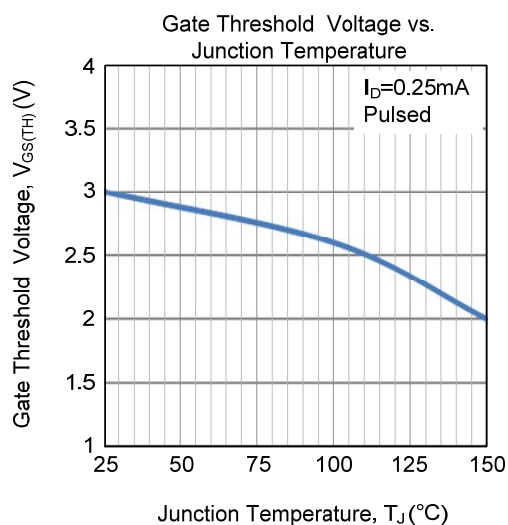


Unclamped Inductive Switching Waveforms

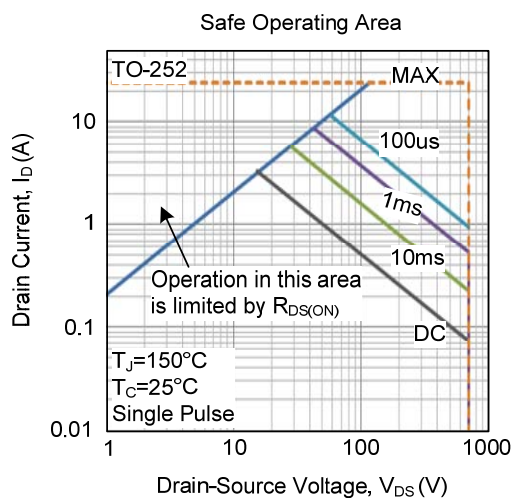
TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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