



21NM65

Power MOSFET

21A, 650V N-CHANNEL POWER MOSFET

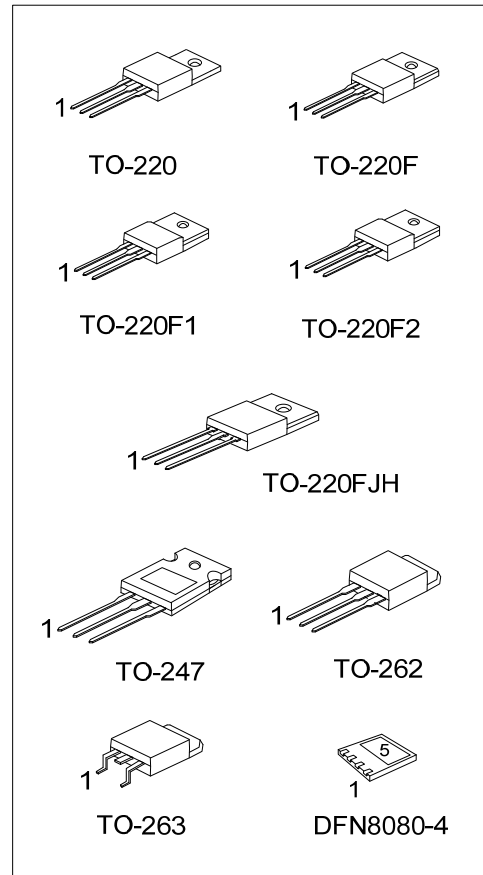
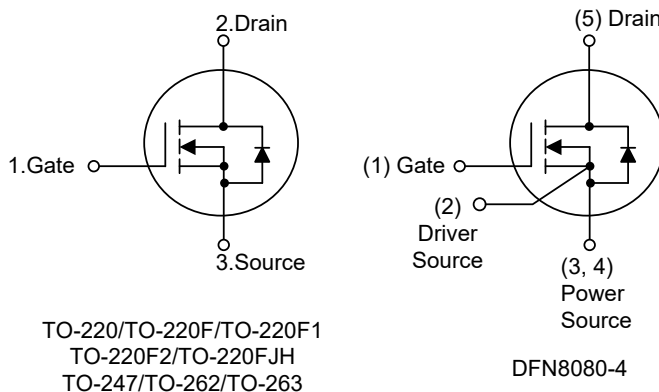
DESCRIPTION

The **UTC 21NM65** 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 a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

FEATURES

- * $R_{DS(ON)} \leq 0.19 \Omega$ @ $V_{GS}=10V$, $I_D=5.6A$
- * High Switching Speed
- * 100% Avalanche Tested

SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment					Packing
Lead Free	Halogen Free		1	2	3	4	5	
21NM65L-TA3-T	21NM65G-TA3-T	TO-220	G	D	S	-	-	Tube
21NM65L-TF1-T	21NM65G-TF1-T	TO-220F1	G	D	S	-	-	Tube
21NM65L-TF2-T	21NM65G-TF2-T	TO-220F2	G	D	S	-	-	Tube
21NM65L-TF3-T	21NM65G-TF3-T	TO-220F	G	D	S	-	-	Tube
21NM65L-TFJH-T	21NM65G-TFJH-T	TO-220FJH	G	D	S	-	-	Tube
21NM65L-T47-T	21NM65G-T47-T	TO-247	G	D	S	-	-	Tube
21NM65L-T2Q-T	21NM65G-T2Q-T	TO-262	G	D	S	-	-	Tube
21NM65L-TQ2-T	21NM65G-TQ2-T	TO-263	G	D	S	-	-	Tube
21NM65L-TQ2-R	21NM65G-TQ2-R	TO-263	G	D	S	-	-	Tape Reel
21NM65L-K04-8080-R	21NM65G-K04-8080-R	DFN8080-4	G	S	S	S	D	Tape Reel

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

21NM65G-TA3-T (1) Packing Type (2) Package Type (3) Green Package	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TF3T: TO-220F3, T47: TO-247, T2Q: TO-262, TQ2: TO-263, K04-8080: DFN8080-4 (3) G: Halogen Free and Lead Free, L: Lead Free
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■ MARKING

TO-220 / TO-220F / TO-220F1 / TO-220F2 TO-220FJH / TO-247 / TO-262 / TO-263	DFN8080-4
UTC 21NM65 Lot Code → [L G □ □ □] → Date Code 1	UTC 21NM65 Lot Code → [• □ □ □ □] → 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	21	A
	Pulsed (Note 2)	I_{DM}	42	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	122	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	8.4	V/ns
Power Dissipation	TO-220/TO-262 TO-263	P_D	125	W
	TO-220F/TO-220F1 TO-220F2/TO-220FJH		34	W
	TO-247		135	W
	DFN8080-4		65	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. $L=9.0\text{mH}$, $I_{AS}=5.2\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\Omega$, Starting $T_J=25^{\circ}\text{C}$

4. $I_{SD}\leq 21\text{A}$, $di/dt\leq 200\text{A}/\mu\text{s}$, $V_{DD}\leq BV_{DSS}$, Starting $T_J=25^{\circ}\text{C}$

■ **THERMAL DATA**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220FJH/TO-262 TO-263	θ_{JA}	62.5	$^{\circ}\text{C}/\text{W}$
	TO-247		40	$^{\circ}\text{C}/\text{W}$
	DFN8080-4		30 (Note)	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220/TO-262 TO-263	θ_{JC}	1	$^{\circ}\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F2/TO-220FJH		3.67	$^{\circ}\text{C}/\text{W}$
	TO-247		0.92	$^{\circ}\text{C}/\text{W}$
	DFN8080-4		1.92 (Note)	$^{\circ}\text{C}/\text{W}$

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

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

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	I _D =250μA, V _{GS} =0V	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 =5.6A			0.19	Ω
DYNAMIC PARAMETERS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =50V, f=1.0MHz		1500		pF
Output Capacitance		C _{OSS}			130		pF
Reverse Transfer Capacitance		C _{RSS}			3.6		pF
SWITCHING PARAMETERS							
Total Gate Charge		Q _G	V _{DS} =520V, V _{GS} =10V, I _D =21A (Note1, 2)		52		nC
Gate to Source Charge		Q _{GS}			8		nC
Gate to Drain Charge		Q _{GD}			18		nC
Turn-ON Delay Time		t _{D(ON)}	V _{DS} =100V, V _{GS} =10V, I _D =15A, R _G =25Ω (Note1, 2)		26		ns
Rise Time		t _R			26		ns
Turn-OFF Delay Time		t _{D(OFF)}			220		ns
Fall-Time		t _F			80		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I _S				21	A
Maximum Body-Diode Pulsed Current		I _{SM}				42	A
Drain-Source Diode Forward Voltage		V _{SD}	I _S =21A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time		t _{rr}	I _S =21A, V _{GS} =0V,		470		ns
Body Diode Reverse Recovery Charge		Q _{rr}	dI _F /dt=100A/μs (Note 1)		8.6		μC

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

2. Essentially independent of operating ambient temperature.

D.U.T.

V_{DS}

I_{SD}

L

V_{DD}

V_{GS}

R_G

Driver

Same Type as D.U.T.

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

Timing diagram for a MOSFET switching a load inductor. The diagram shows three waveforms: V_{GS} (Driver), I_{SD} (D.U.T.), and V_{DS} (D.U.T.).

- V_{GS} (Driver): A square wave with pulse width (P.W.) and period (Period). The duty cycle is $D = \frac{P.W.}{Period}$. The MOSFET is a 10V device ($V_{GS} = 10V$).
- I_{SD} (D.U.T.): The MOSFET current (I_{FM}) and the body diode reverse current (I_{RM}) during the off-state. The reverse current is labeled I_{RM} and di/dt .
- V_{DS} (D.U.T.): The MOSFET drain-source voltage, including the body diode forward voltage drop and the recovery dv/dt .

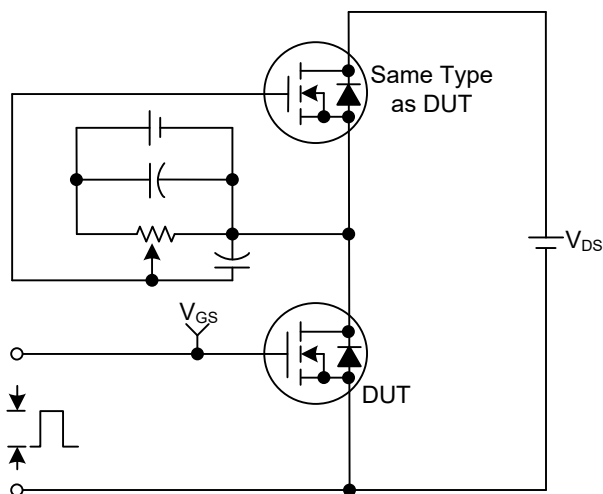
Labels at the bottom indicate the regions: Body Diode and Forward Voltage Drop.



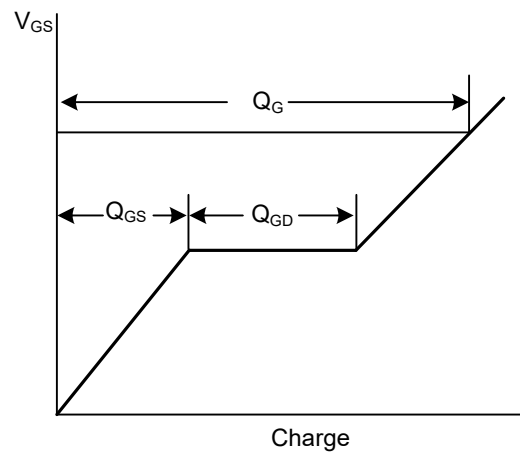
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■ TEST CIRCUITS AND WAVEFORMS

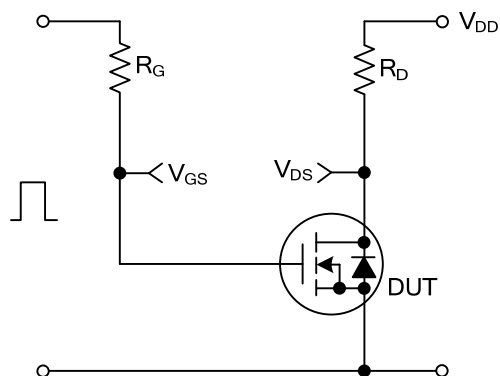
Gate Charge Test Circuit



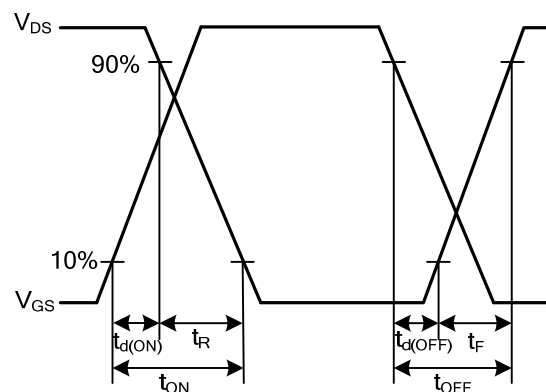
Gate Charge Waveforms



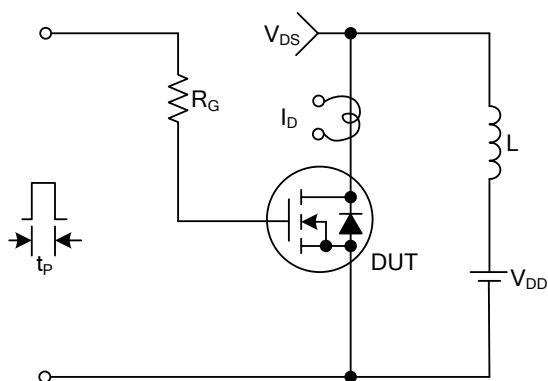
Resistive Switching Test Circuit



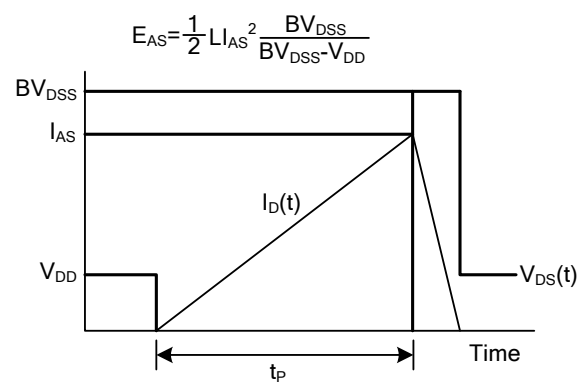
Resistive Switching Waveforms



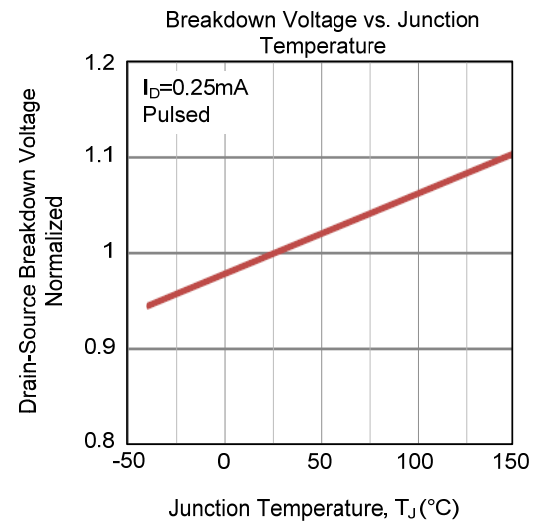
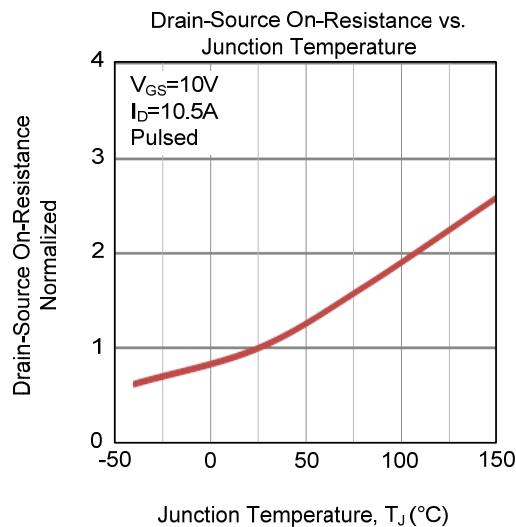
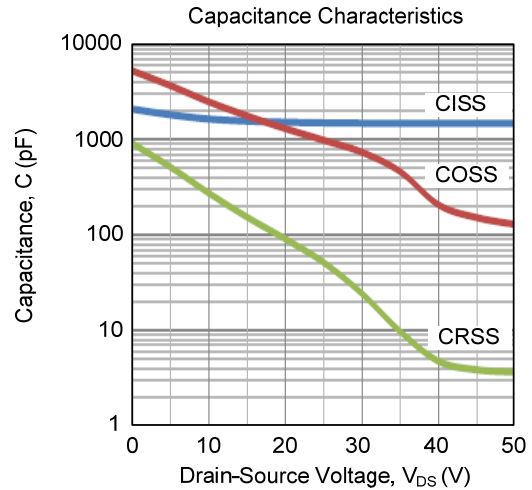
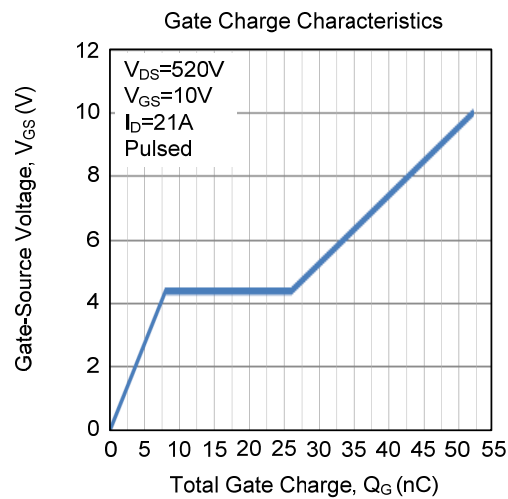
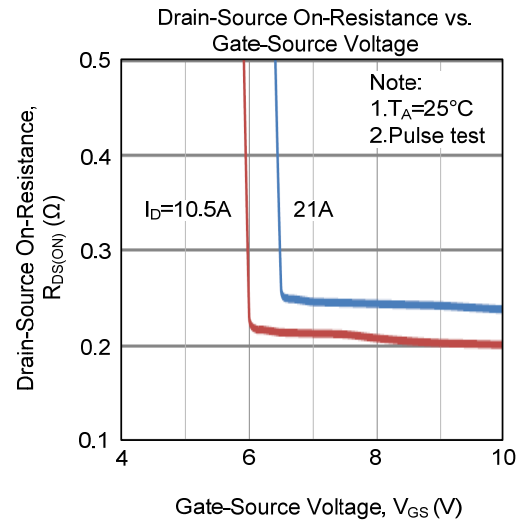
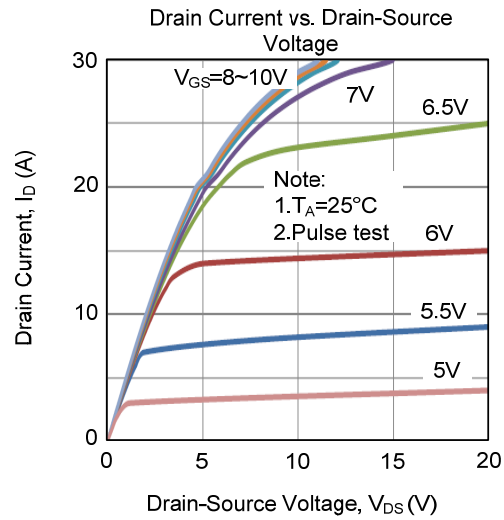
Unclamped Inductive Switching Test Circuit



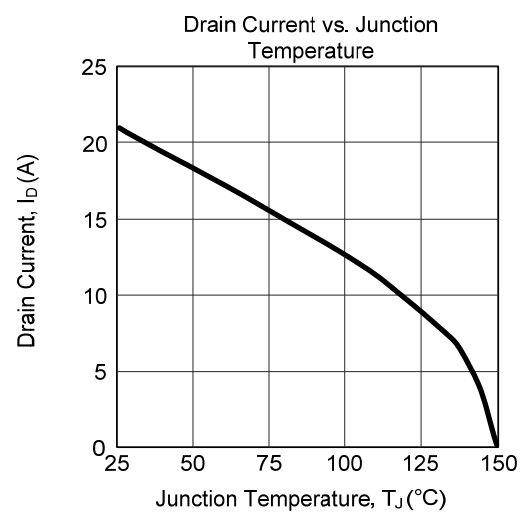
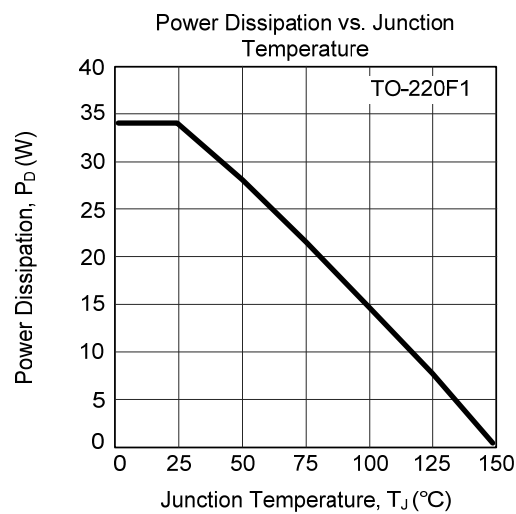
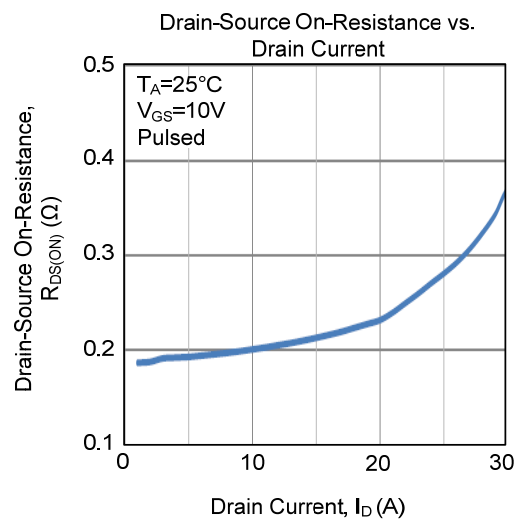
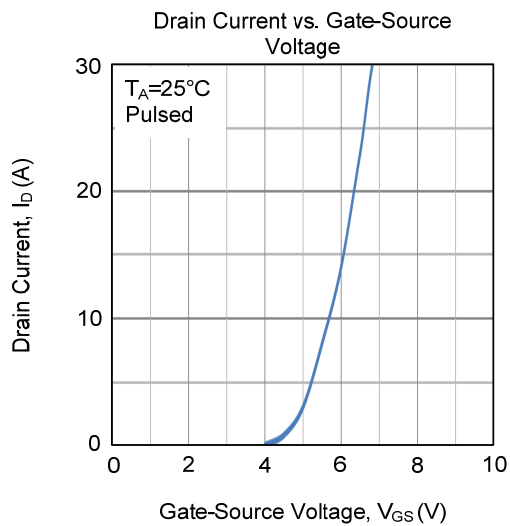
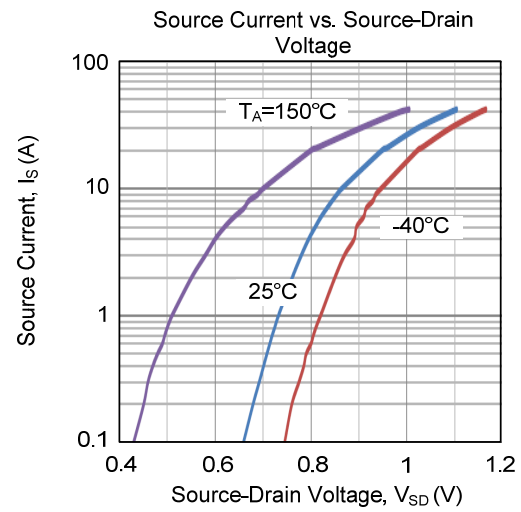
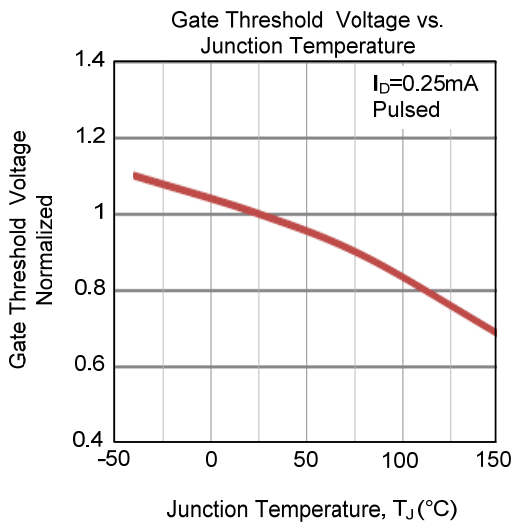
Unclamped Inductive Switching Waveforms



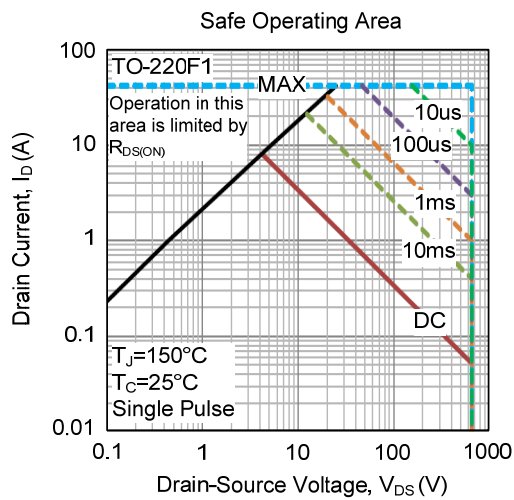
■ TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (Cont.)



■ TYPICAL CHARACTERISTICS (Cont.)



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