



## 24NM65

Power MOSFET

### 24A, 650V N-CHANNEL SUPER-JUNCTION MOSFET

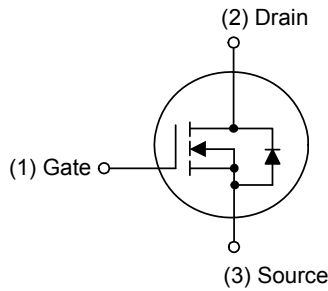
#### DESCRIPTION

The **UTC 24NM65** 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.

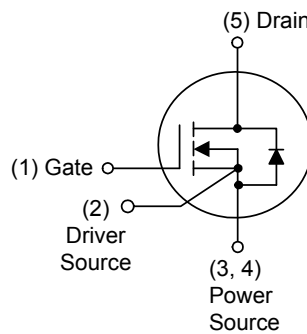
#### FEATURES

- \*  $R_{DS(ON)} \leq 0.16 \Omega @ V_{GS}=10V, I_D=12A$
- \* High Switching Speed
- \* 100% Avalanche Tested

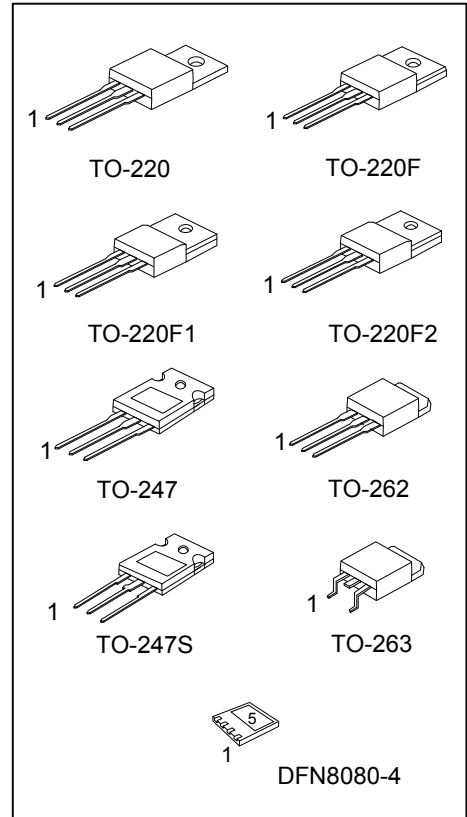
#### SYMBOL



TO-220F  
TO-220F1 / TO-220F2



DFN8080-4



### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment					Packing
Lead Free	Halogen Free		1	2	3	4	5	
24NM65L-TA3-T	24NM65G-TA3-T	TO-220	G	D	S	-	-	Tube
24NM65L-TF1-T	24NM65G-TF1-T	TO-220F1	G	D	S	-	-	Tube
24NM65L-TF2-T	24NM65G-TF2-T	TO-220F2	G	D	S	-	-	Tube
24NM65L-TF3-T	24NM65G-TF3-T	TO-220F	G	D	S	-	-	Tube
24NM65L-T47-T	24NM65G-T47-T	TO-247	G	D	S	-	-	Tube
24NM65L-T47S-T	24NM65G-T47S-T	TO-247S	G	D	S	-	-	Tube
24NM65L-T2Q-T	24NM65G-T2Q-T	TO-262	G	D	S	-	-	Tube
24NM65L-TQ2-T	24NM65G-TQ2-T	TO-263	G	D	S	-	-	Tube
24NM65L-TQ2-R	24NM65G-TQ2-R	TO-263	G	D	S	-	-	Tape Reel
24NM65L-K04-8080-R	24NM65G-K04-8080-R	DFN8080-4	G	S	S	S	D	Tape Reel

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

<p>24NM65G-TA3-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, T47: TO-247, T47S: TO-247S, T2Q: TO-262, TQ2: TO-263 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING

TO-220 / TO-220F / TO-220F1 / TO-220F2 TO-247 / TO-247S / TO-262 / TO-263	DFN8080-4
<p>UTC 24NM65</p> <p>Lot Code ← [ ] [ ] [ ] [ ] [ ] → Date Code</p> <p>1</p> <p>L: Lead Free G: Halogen Free</p>	<p>UTC 24NM65</p> <p>Lot Code ← [•] [ ] [ ] [ ] [ ] → Date Code</p>

■ 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		$V_{GSS}$	$\pm 30$	V	
Drain Current	Continuous	$I_D$	$T_C=25^\circ\text{C}$	24	A
			$T_C=100^\circ\text{C}$	14.4	
	Pulsed (Note 2)	$I_{DM}$	72	A	
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	725	mJ	
Peak Diode Recovery dv/dt		dv/dt	10.5	V/ns	
Power Dissipation	TO-220/TO-262 TO-263	$P_D$	130	W	
	TO-220F/TO-220F1 TO-220F2		35	W	
	TO-247/TO-247S		150	W	
	DFN8080-4		67	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.  $L = 58\text{mH}$ ,  $I_{AS} = 5.0\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 24\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-262/TO-263	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	DFN8080-4		35(Note)	$^\circ\text{C}/\text{W}$
	TO-247/TO-247S		50	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/TO-262 TO-263	$\theta_{JC}$	0.96	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F2		3.57	$^\circ\text{C}/\text{W}$
	TO-247/TO-247S		0.83	$^\circ\text{C}/\text{W}$
	DFN8080-4		1.86(Note)	$^\circ\text{C}/\text{W}$

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

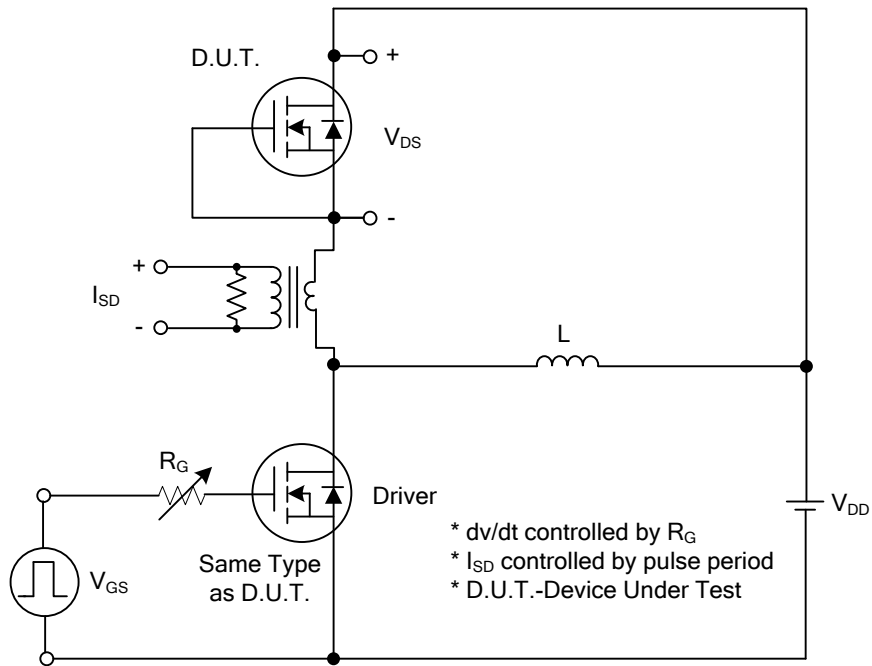
■ ELECTRICAL CHARACTERISTICS ( $T_J=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$I_D=250\mu\text{A}$ , $V_{GS}=0\text{V}$	650			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=650\text{V}$ , $V_{GS}=0\text{V}$			50	$\mu\text{A}$
Gate- Source Leakage Current	Forward	$I_{GSS}$ , $V_{GS}=+30\text{V}$ , $V_{DS}=0\text{V}$			+100	nA
	Reverse	$V_{GS}=-30\text{V}$ , $V_{DS}=0\text{V}$			-100	nA
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	2.5		4.5	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10\text{V}$ , $I_D=12\text{A}$			0.16	$\Omega$
<b>DYNAMIC PARAMETERS</b>						
Input Capacitance	$C_{ISS}$	$V_{GS}=0\text{V}$ , $V_{DS}=50\text{V}$ , $f=1.0\text{MHz}$		1924		pF
Output Capacitance	$C_{OSS}$			220		pF
Reverse Transfer Capacitance	$C_{RSS}$			7.8		pF
<b>SWITCHING PARAMETERS</b>						
Total Gate Charge (Note 1)	$Q_G$	$V_{DS}=520\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=24\text{A}$ (Note1, 2)		66		nC
Gate to Source Charge	$Q_{GS}$			10		nC
Gate to Drain Charge	$Q_{GD}$			22		nC
Turn-ON Delay Time (Note 1)	$t_{D(ON)}$	$V_{DS}=100\text{V}$ , $V_{GS}=10\text{V}$ , $I_D=24\text{A}$ , $R_G=25\Omega$ (Note1, 2)		28		ns
Rise Time	$t_R$			36		ns
Turn-OFF Delay Time	$t_{D(OFF)}$			240		ns
Fall-Time	$t_F$			120		ns
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Body-Diode Continuous Current	$I_S$				24	A
Maximum Body-Diode Pulsed Current	$I_{SM}$				72	A
Drain-Source Diode Forward Voltage (Note 1)	$V_{SD}$	$I_S=24\text{A}$ , $V_{GS}=0\text{V}$			1.4	V
Body Diode Reverse Recovery Time (Note 1)	$t_{rr}$	$I_S=24\text{A}$ , $V_{GS}=0\text{V}$ , $dI_F/dt=100\text{A}/\mu\text{s}$		640		ns
Body Diode Reverse Recovery Charge	$Q_{rr}$				13	

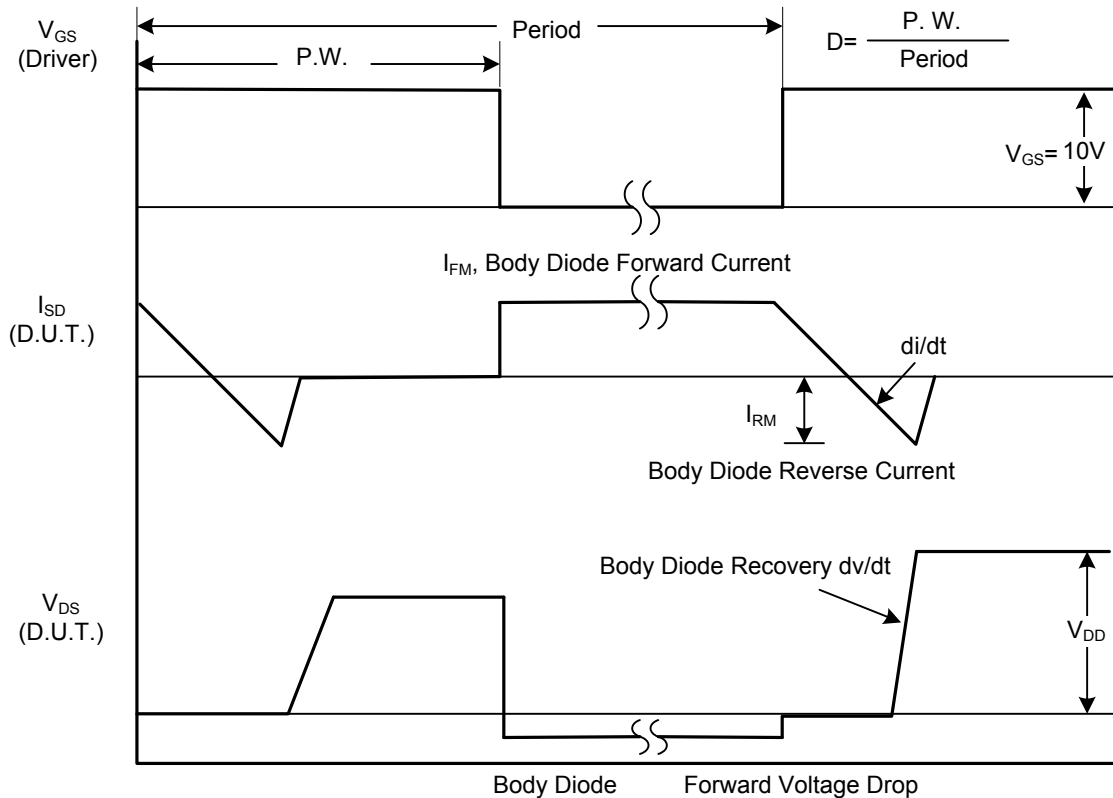
Notes: 1. Pulse Test : Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS



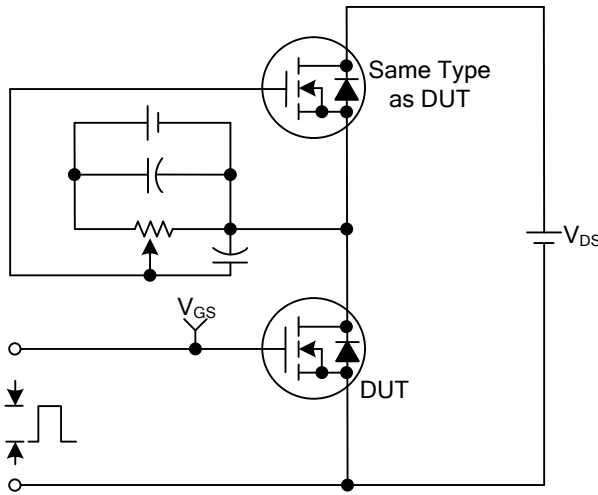
Peak Diode Recovery  $dv/dt$  Test Circuit



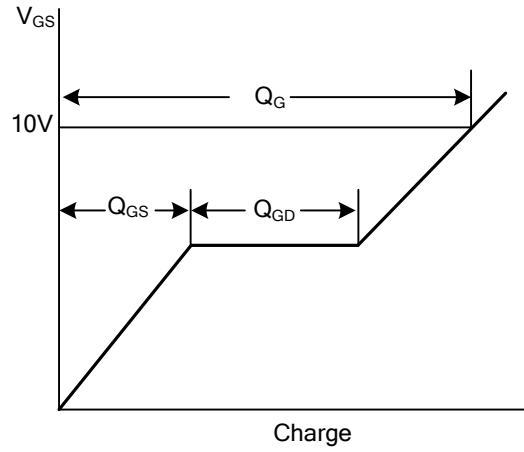
Peak Diode Recovery  $dv/dt$  Waveforms

## ■ TEST CIRCUITS AND WAVEFORMS

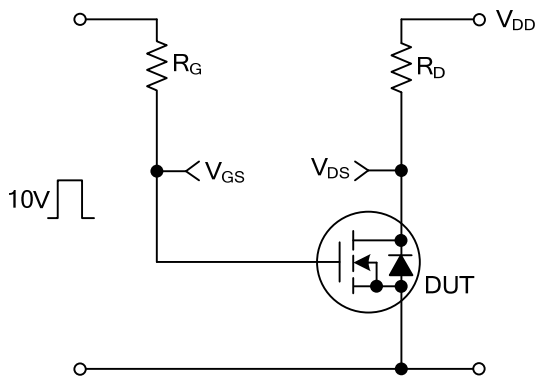
Gate Charge Test Circuit



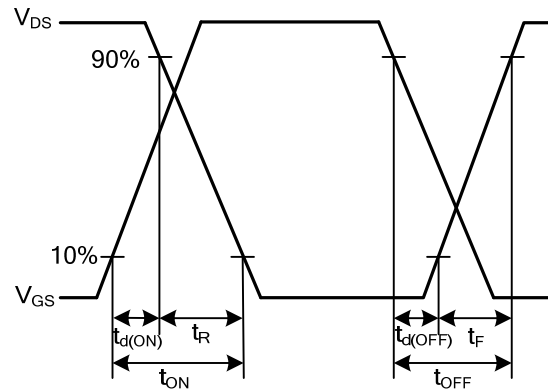
Gate Charge Waveforms



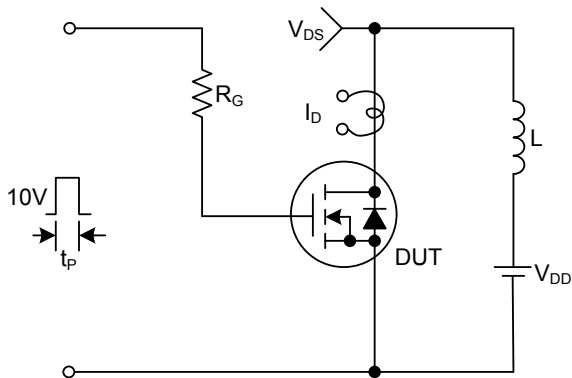
Resistive Switching Test Circuit



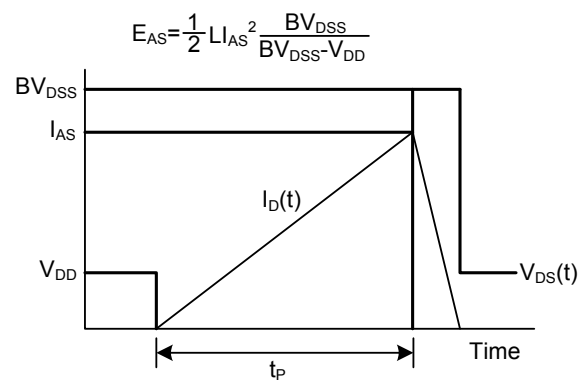
Resistive Switching Waveforms



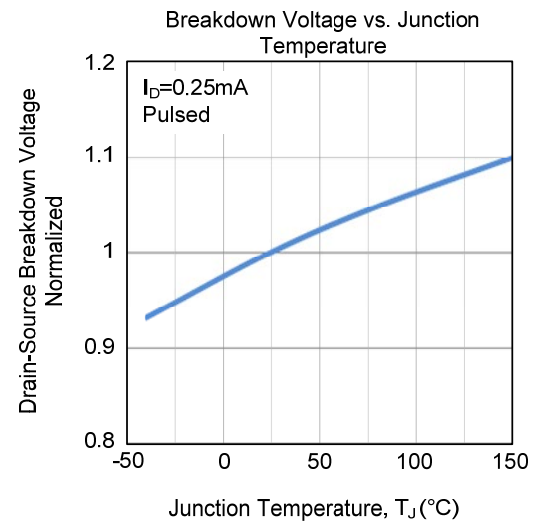
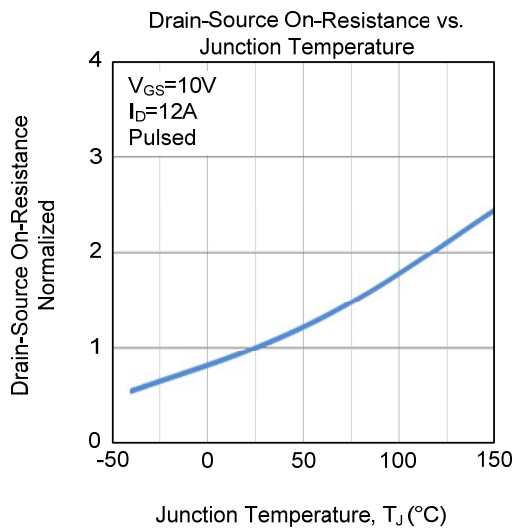
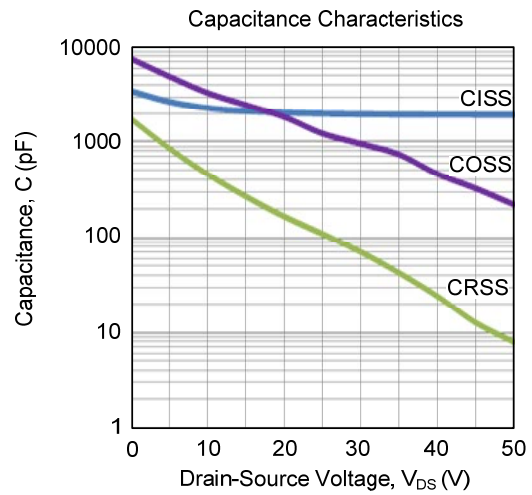
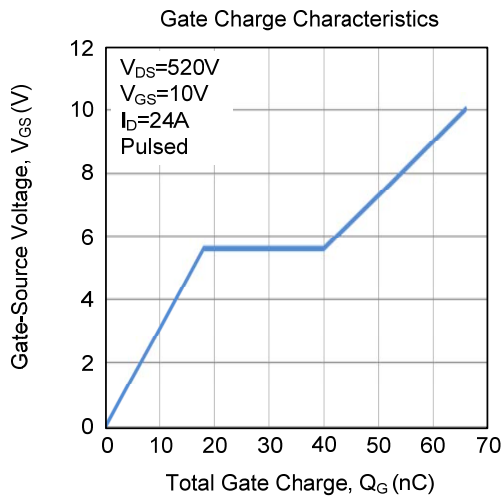
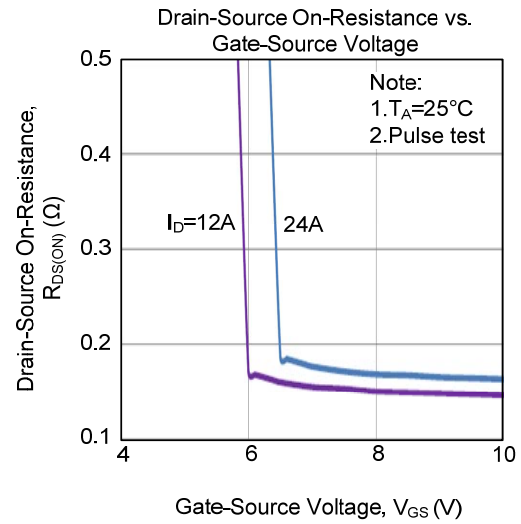
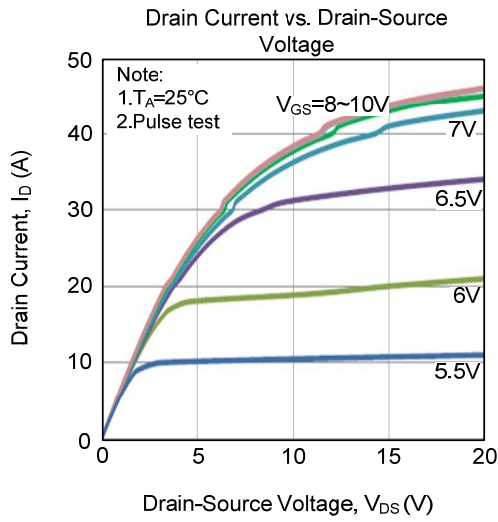
Unclamped Inductive Switching Test Circuit



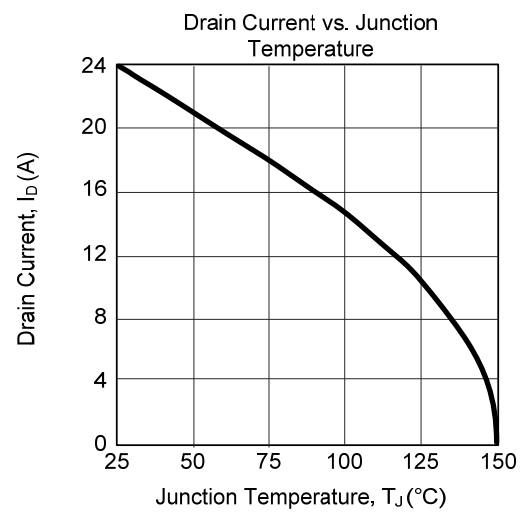
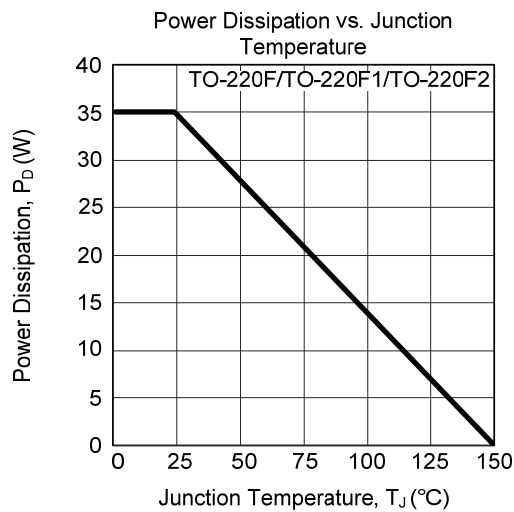
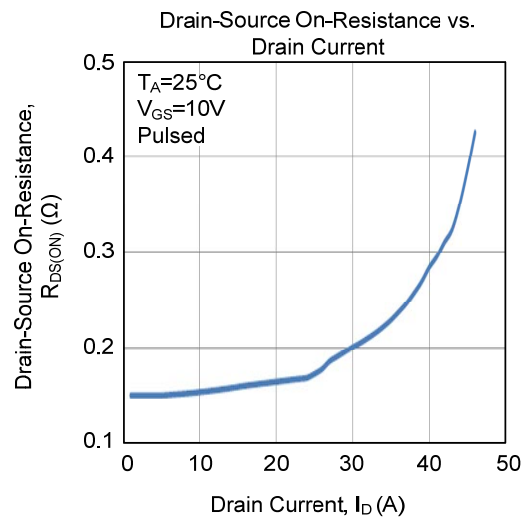
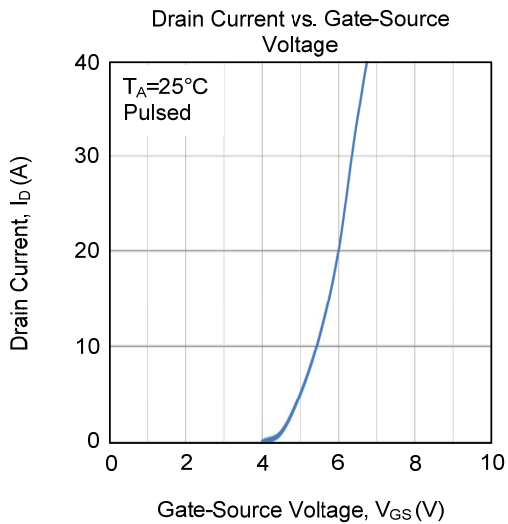
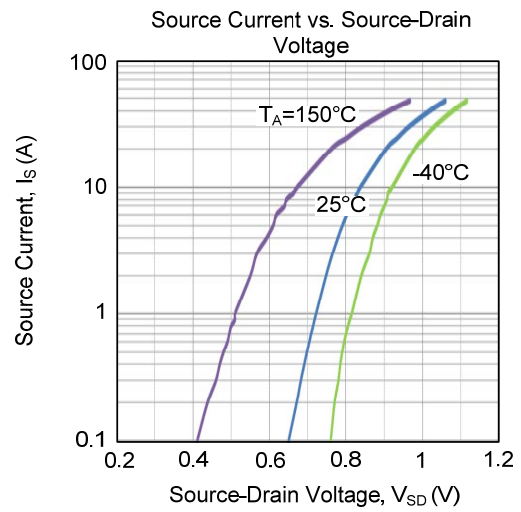
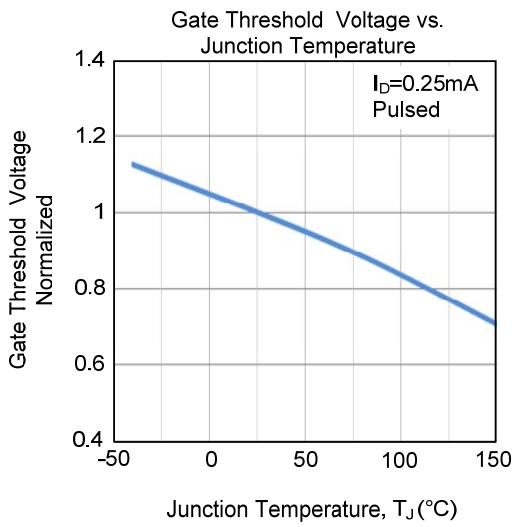
Unclamped Inductive Switching Waveforms



## TYPICAL CHARACTERISTICS

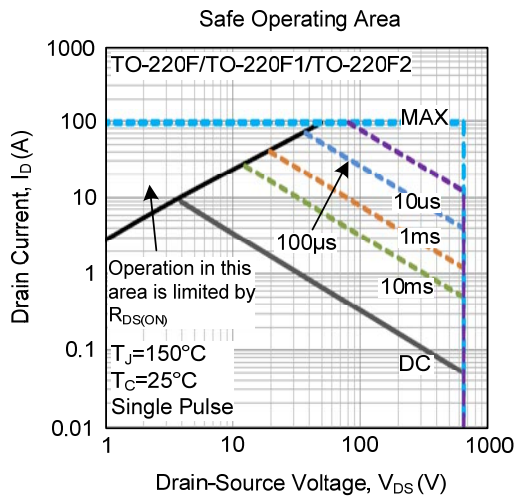


## ■ TYPICAL CHARACTERISTICS (Cont.)





■ TYPICAL CHARACTERISTICS (Cont.)



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