



## 10N65

Power MOSFET

### 10A, 650V N-CHANNEL POWER MOSFET

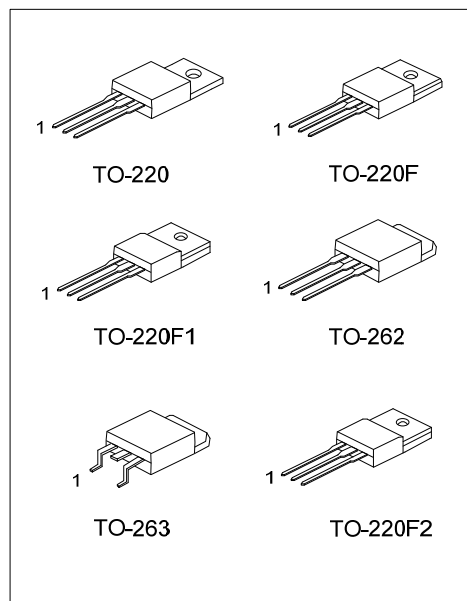
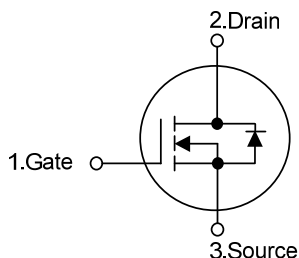
#### DESCRIPTION

The **UTC 10N65** is a high voltage and high current power MOSFET, 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 high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 0.86\Omega @ V_{GS} = 10V$
- \* Low gate charge ( typical 44 nC)
- \* Low Crss ( typical 18 pF)
- \* Fast switching
- \* 100% avalanche tested
- \* Improved dv/dt capability

#### SYMBOL



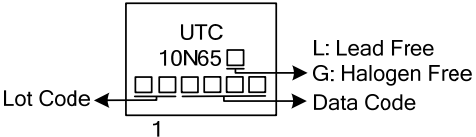
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
10N65L-TA3-T	10N65G-TA3-T	TO-220	G	D	S	Tube
10N65L-TF1-T	10N65G-TF1-T	TO-220F1	G	D	S	Tube
10N65L-TF2-T	10N65G-TF2-T	TO-220F2	G	D	S	Tube
10N65L-TF3-T	10N65G-TF3-T	TO-220F	G	D	S	Tube
10N65L-T2Q-T	10N65G-T2Q-T	TO-262	G	D	S	Tube
10N65L-TQ2-T	10N65G-TQ2-T	TO-263	G	D	S	Tube
10N65L-TQ2-R	10N65G-TQ2-R	TO-263	G	D	S	Tape Reel

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

<p>10N65L-TA3-T</p> <p>(1)Packing Type (2)Package Type (3)Lead Free</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO220-F1, TF2: TO-220F2 TF3: TO-220F, T2Q:TO-262, TQ2: TO-263 (3) L: Lead Free, G: Halogen Free</p>
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■ MARKING INFORMATION

PACKAGE	MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-262 TO-263	 <p>                         L: Lead Free                          G: Halogen Free                          Data Code                     </p>

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■ 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
Avalanche Current (Note 2)		$I_{AR}$	10	A
Drain Current	Continuous	$I_D$	10	A
	Pulsed (Note 2)	$I_{DM}$	38	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	700	mJ
	Repetitive (Note 2)	$E_{AR}$	15.6	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	$P_D$	156	W
	TO-220F/TO-220F1		50	W
	TO-220F2		52	W
	TO-262		156	W
	TO-263		178	W
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Operating Temperature		$T_{OPR}$	-55 ~ +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.  $L = 14.2\text{mH}$ ,  $I_{AS} = 10\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$  Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 9.5\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient		$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220	$\theta_{JC}$	0.8	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		2.5	$^\circ\text{C}/\text{W}$
	TO-220F2		2.4	$^\circ\text{C}/\text{W}$
	TO-262		0.8	$^\circ\text{C}/\text{W}$
	TO-263		0.7	$^\circ\text{C}/\text{W}$

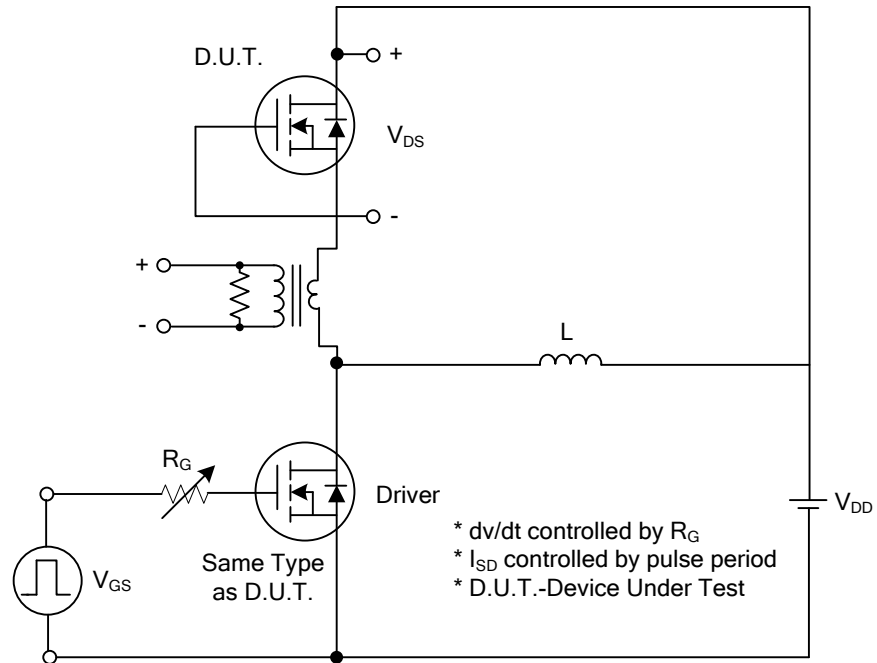
■ ELECTRICAL CHARACTERISTICS(  $T_C=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			1	$\mu A$
Gate-Source Leakage Current	Forward	$I_{GSS}$ $V_{GS}=30V, V_{DS}=0V$ $V_{GS}=-30V, V_{DS}=0V$			100	nA
	Reverse				-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$ , Referenced to $25^{\circ}\text{C}$		0.7		$V/^{\circ}\text{C}$
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=4.75A$		0.72	0.86	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1.0\text{ MHz}$		1570	2040	pF
Output Capacitance	$C_{OSS}$			166	215	pF
Reverse Transfer Capacitance	$C_{RSS}$			18	24	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=325V, I_D=10A, R_G=25\Omega$ (Note1, 2)		23	55	ns
Turn-On Rise Time	$t_R$			69	150	ns
Turn-Off Delay Time	$t_{D(OFF)}$			144	300	ns
Turn-Off Fall Time	$t_F$			77	165	ns
Total Gate Charge	$Q_G$	$V_{DS}=520V, I_D=10A, V_{GS}=10V$ (Note1, 2)		44	57	nC
Gate-Source Charge	$Q_{GS}$			6.7		nC
Gate-Drain Charge	$Q_{GD}$			18.5		nC
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=10A$			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				10	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$				38	A
Reverse Recovery Time	$t_{rr}$	$V_{GS}=0V, I_S=10A,$		420		ns
Reverse Recovery Charge	$Q_{RR}$	$di_F/dt=100A/\mu s$ (Note1)		4.2		$\mu C$

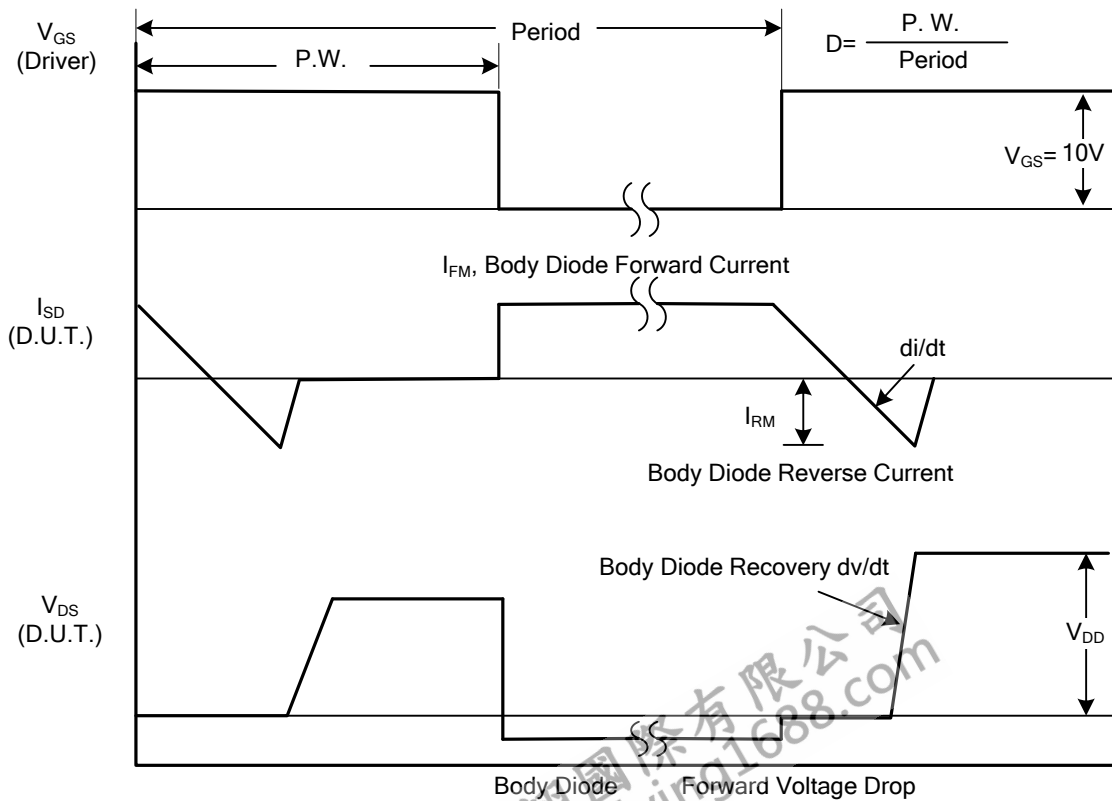
Notes: 1. Pulse Test : Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

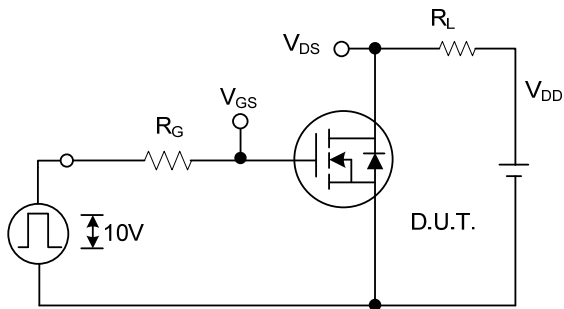


Peak Diode Recovery  $dv/dt$  Test Circuit

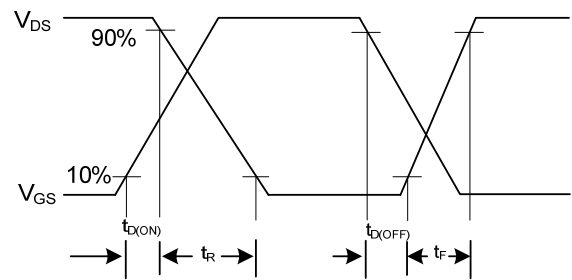


Peak Diode Recovery  $dv/dt$  Waveforms

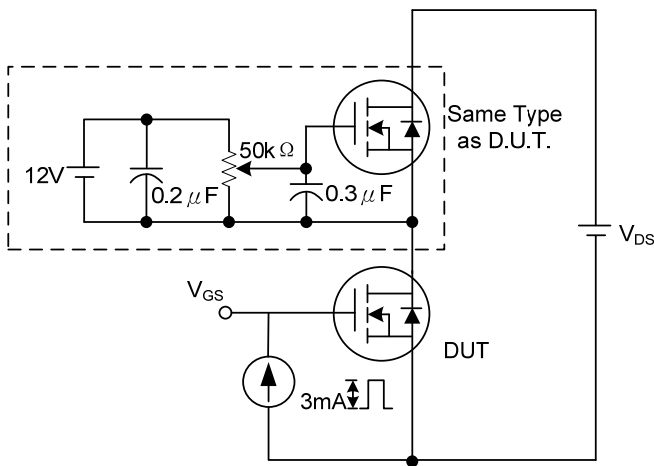
## TEST CIRCUITS AND WAVEFORMS (Cont.)



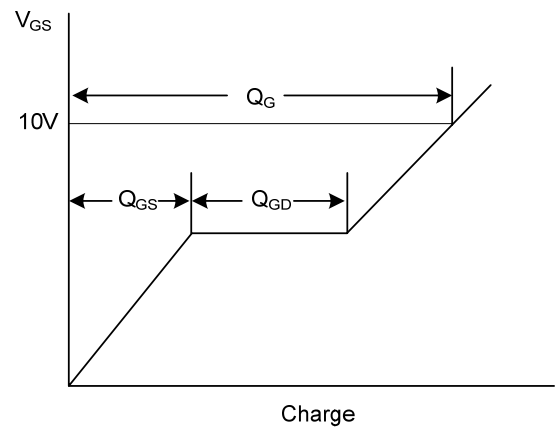
Switching Test Circuit



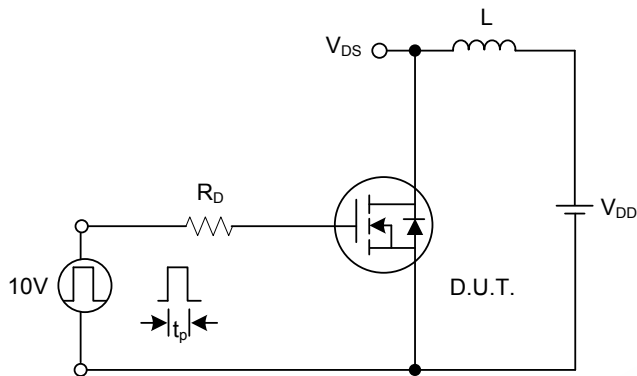
Switching Waveforms



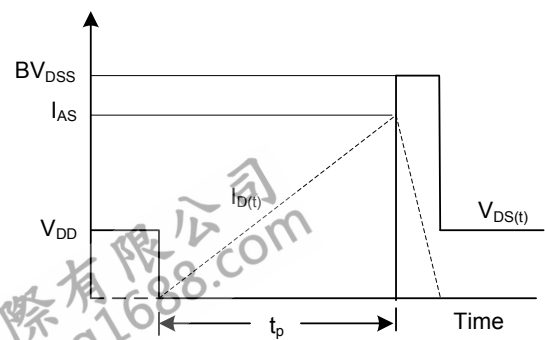
Gate Charge Test Circuit



Gate Charge Waveform



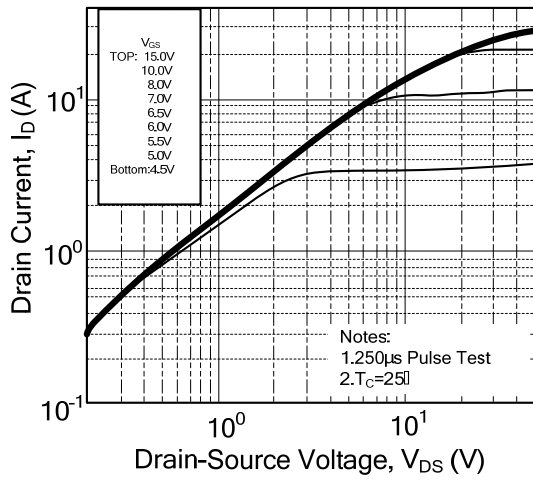
Unclamped Inductive Switching Test Circuit



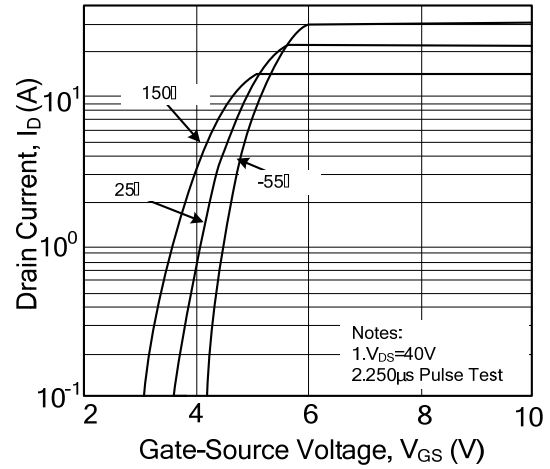
Unclamped Inductive Switching Waveforms

## TYPICAL CHARACTERISTICS

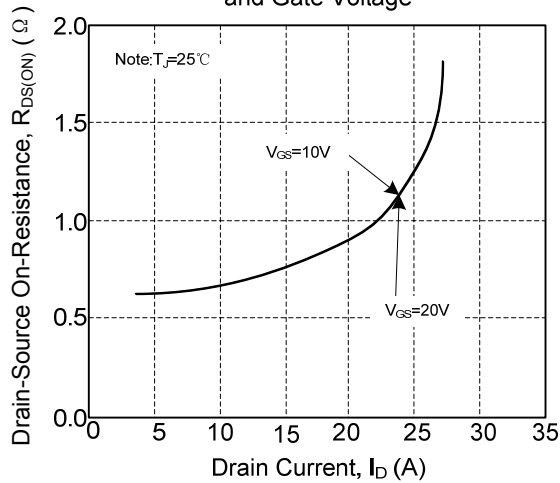
### On-Region Characteristics



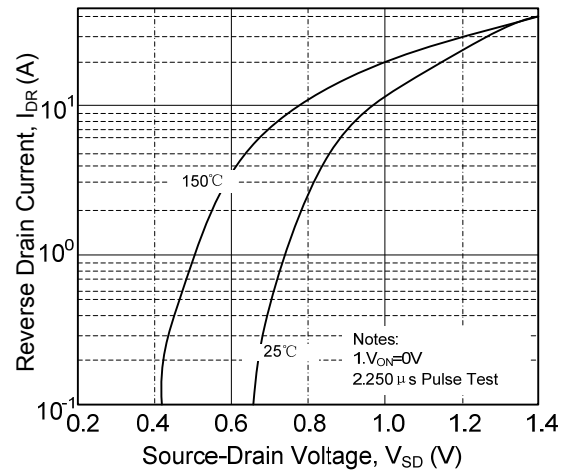
### Transfer Characteristics



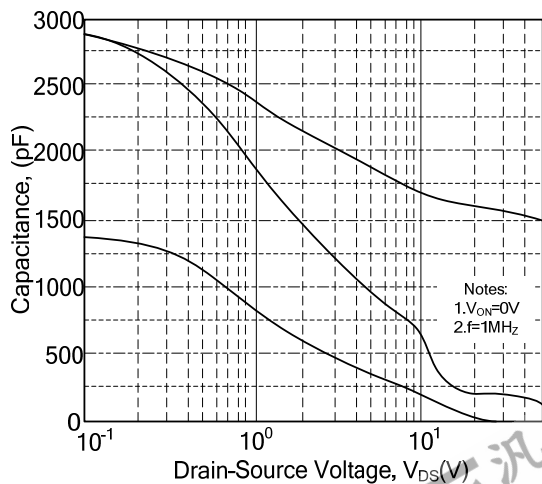
### On-Resistance Variation vs. Drain Current and Gate Voltage



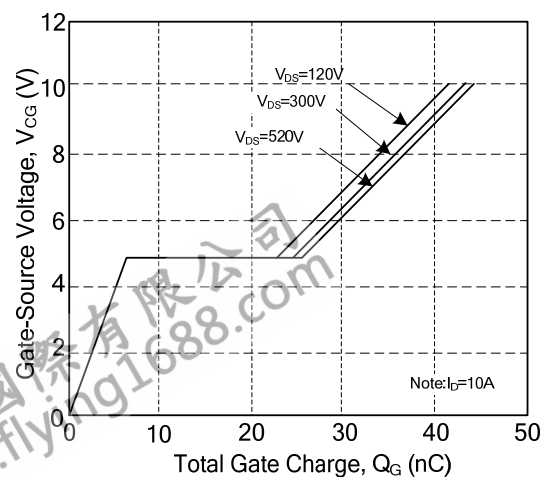
### Body Diode Forward Voltage Variation with Source Current and Temperature



### Capacitance Characteristics

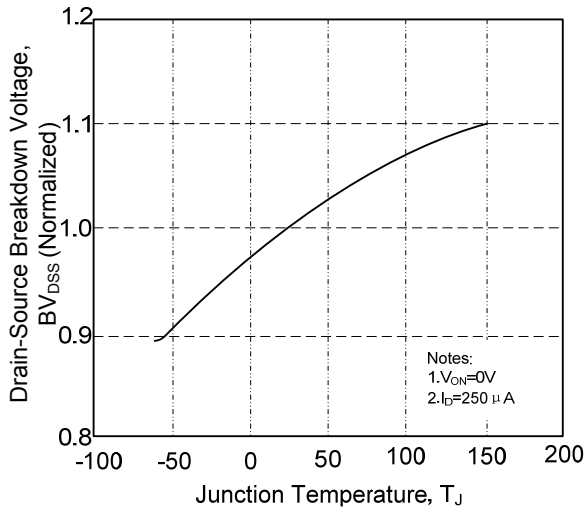


### Gate Charge Characteristics

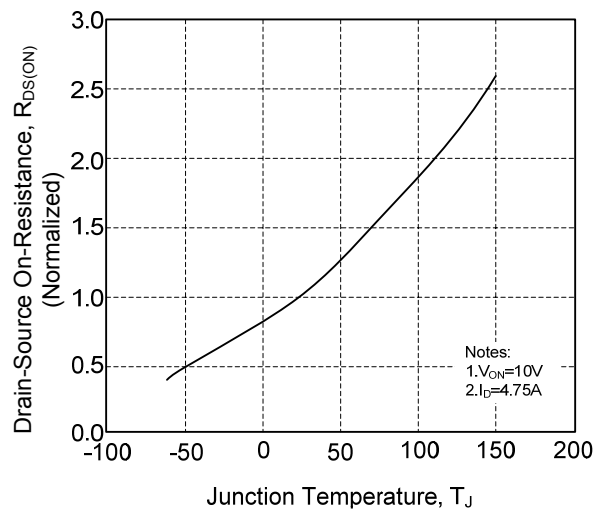


■ TYPICAL CHARACTERISTICS(Cont.)

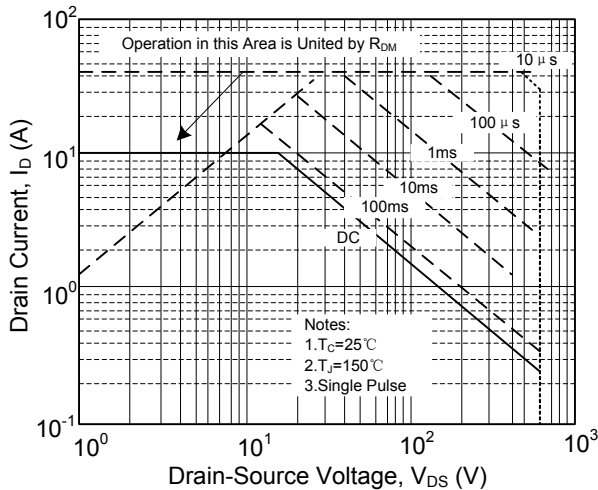
Breakdown Voltage Variation vs. Temperature



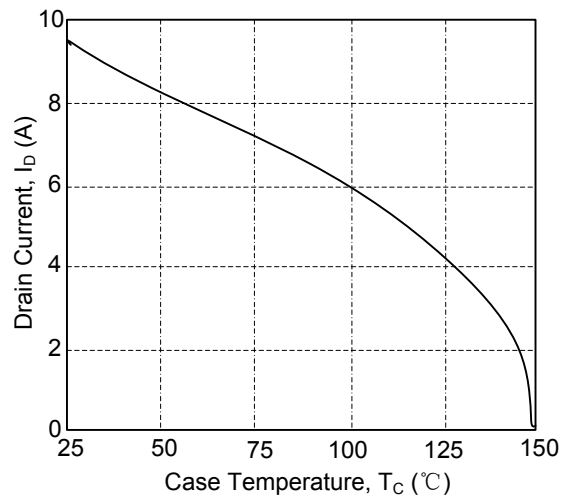
On-Resistance Variation vs. Temperature



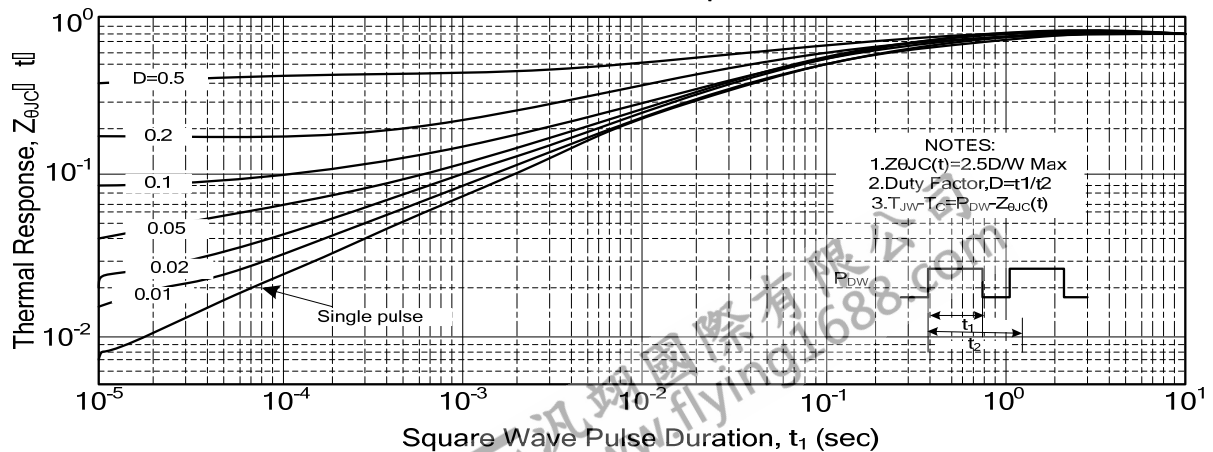
Maximum Safe Operating Area



Maximum Drain Current vs. Case Temperature



Transient Thermal Response Curve





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