



# 12N60

*Power MOSFET*

## 12A, 600V N-CHANNEL POWER MOSFET

■ DESCRIPTION

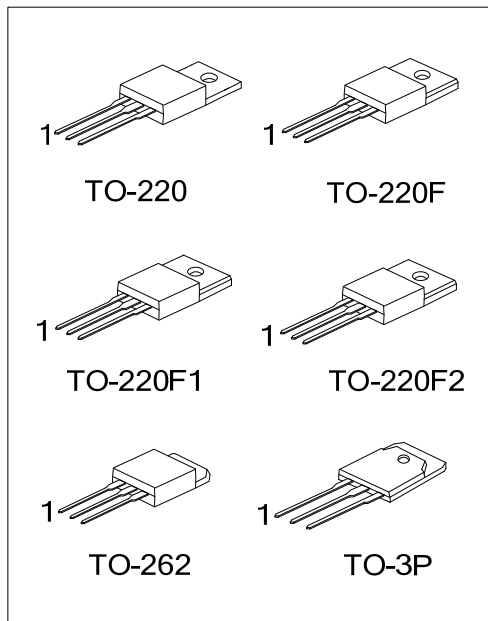
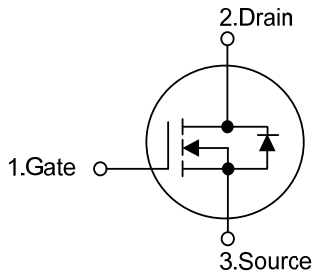
The UTC **12N60** are N-Channel enhancement mode power field effect transistors (MOSFET) which are produced using UTC's proprietary, planar stripe, DMOS technology.

These devices are suited for high efficiency switch mode power supply. To minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode the advanced technology has been especially tailored.

■ FEATURES

- \*  $R_{DS(ON)} < 0.8\Omega @ V_{GS} = 10V$
- \* Ultra low gate charge ( typical 42 nC )
- \* Low reverse transfer capacitance (  $C_{RSS} =$  typical 25 pF )
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

■ SYMBOL



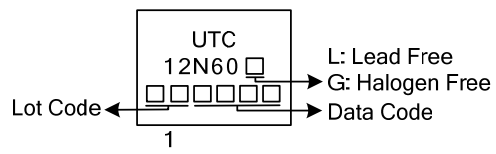
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
12N60L-TA3-T	12N60G-TA3-T	TO-220	G	D	S	Tube
12N60L-TF1-T	12N60G-TF1-T	TO-220F1	G	D	S	Tube
12N60L-TF2-T	12N60G-TF2-T	TO-220F2	G	D	S	Tube
12N60L-TF3-T	12N60G-TF3-T	TO-220F	G	D	S	Tube
12N60L-T2Q-T	12N60G-T2Q-T	TO-262	G	D	S	Tube
12N60L-T3P-T	12N60G-T3P-T	TO-3P	G	D	S	Tube

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

<p>12N60L-TA3-T</p>	<p>(1) T: Tube                  (2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2                  TF3: TO-220F, T2Q: TO-262, T3P: TO-3P                  (3) L: Lead Free, G: Halogen 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		$V_{DSS}$	600	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	12	A
Drain Current	Continuous	$I_D$	12	A
	Pulsed (Note 2)	$I_{DM}$	48	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	790	mJ
	Repetitive (Note 2)	$E_{AR}$	24	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220 / TO-262	$P_D$	225	W
	TO-220F / TO-220F1		51	W
	TO-220F2		54	W
	TO-3P		260	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.  $L = 10\text{mH}$ ,  $I_{AS} = 12\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 12\text{A}$ ,  $di/dt \leq 200\text{A/s}$ ,  $V_{DD} \leq BV_{DSS}$  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	$\theta_{JA}$	62.5	$^\circ\text{C/W}$	
	TO-3P		40	$^\circ\text{C/W}$	
	Junction to Case		$\theta_{JC}$	0.56	$^\circ\text{C/W}$
				2.43	$^\circ\text{C/W}$
2.31		$^\circ\text{C/W}$			
0.48		$^\circ\text{C/W}$			

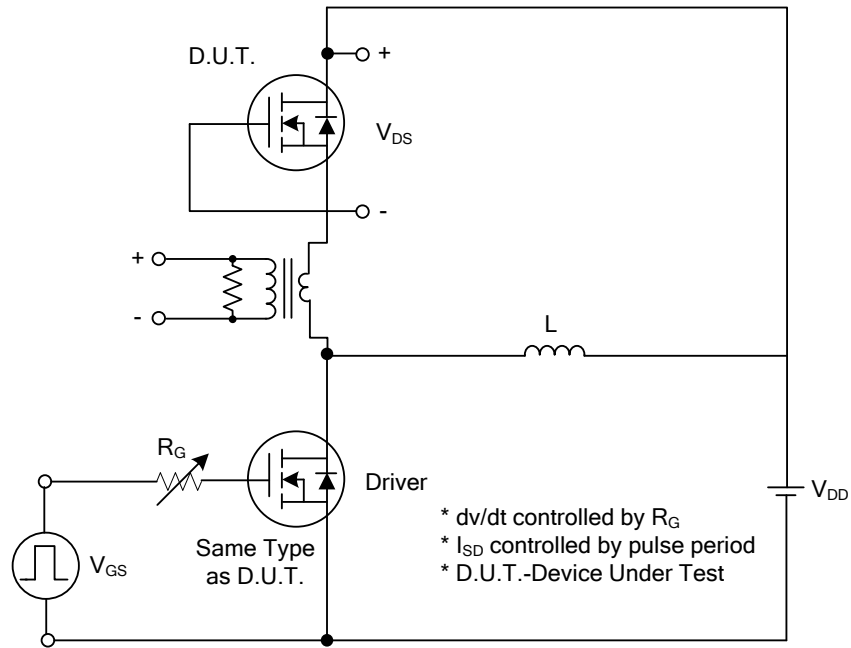
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V			1	μA
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V			±100	nA
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.7		V/°C
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0		4.0	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 6.0A		0.6	0.8	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1MHz		1480	1900	pF
Output Capacitance	C <sub>OSS</sub>			200	270	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			25	35	pF
Gate Resistance	R <sub>G</sub>	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz	0.2		1.2	Ω
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 300V, I <sub>D</sub> = 12A, R <sub>G</sub> = 25Ω (Note 1, 2)		30	70	ns
Turn-On Rise Time	t <sub>R</sub>			115	240	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			95	200	ns
Turn-Off Fall Time	t <sub>F</sub>			85	180	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> = 480V, I <sub>D</sub> = 12A, V <sub>GS</sub> = 10 V (Note 1, 2)		42	54	nC
Gate-Source Charge	Q <sub>GS</sub>			8.6		nC
Gate-Drain Charge	Q <sub>GD</sub>			21		nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 12A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				12	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				48	A
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 12A, dI <sub>F</sub> /dt = 100 A/μs (Note 1)		380		ns
Reverse Recovery Charge	Q <sub>RR</sub>				3.5	

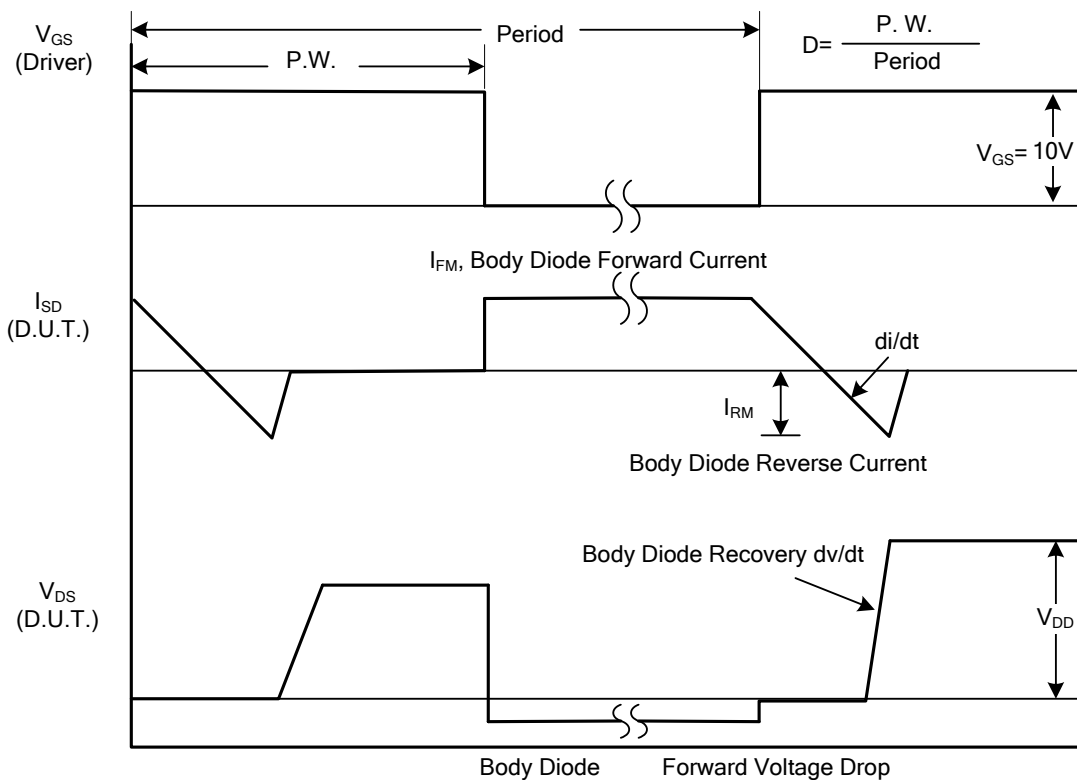
Notes: 1. Pulse Test : Pulse width ≤ 300 μs, Duty cycle ≤ 2%

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

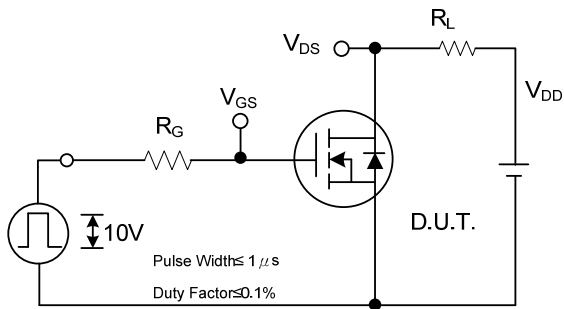


Peak Diode Recovery  $dv/dt$  Test Circuit

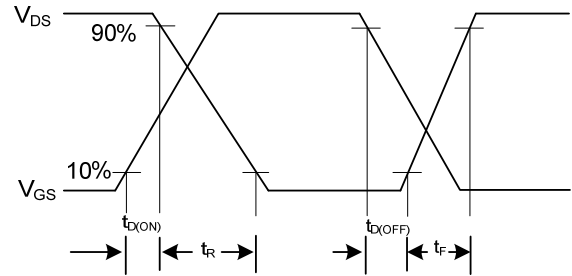


Peak Diode Recovery  $dv/dt$  Waveforms

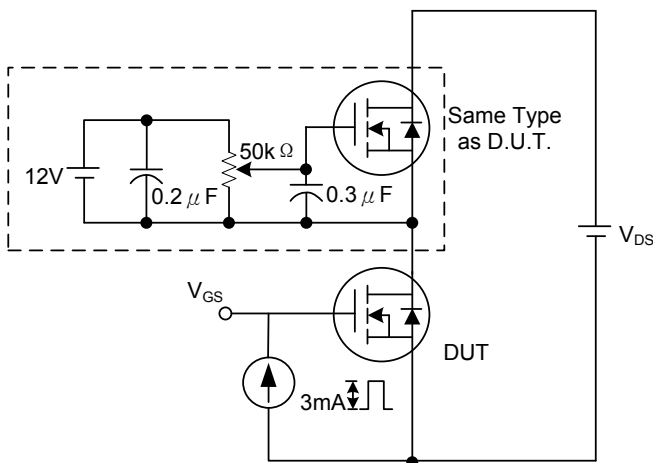
## TEST CIRCUITS AND WAVEFORMS (Cont.)



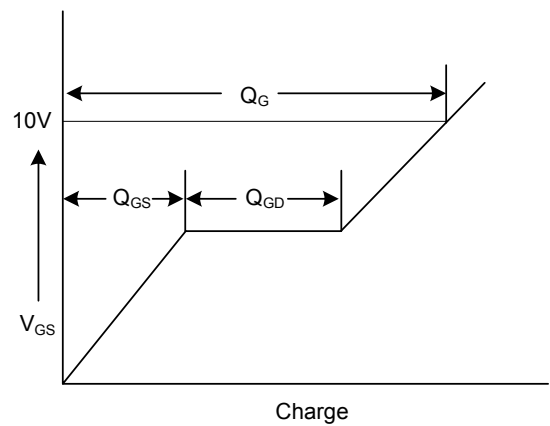
**Switching Test Circuit**



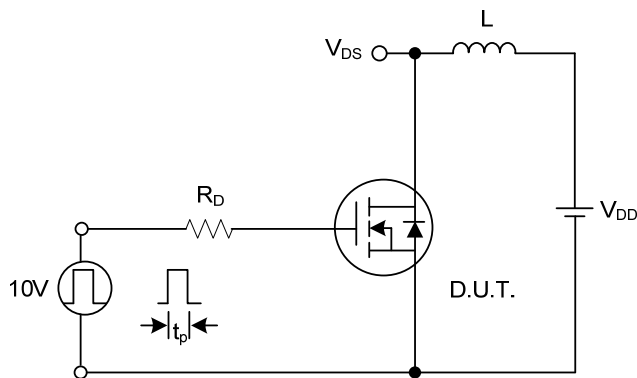
**Switching Waveforms**



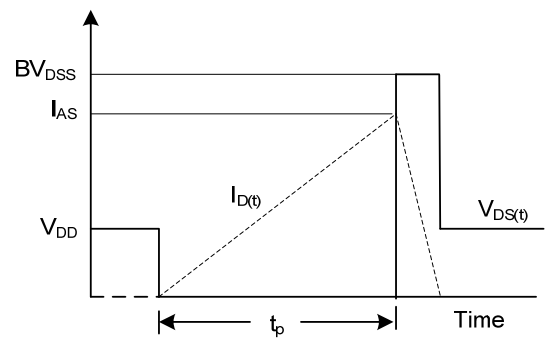
**Gate Charge Test Circuit**



**Gate Charge Waveform**

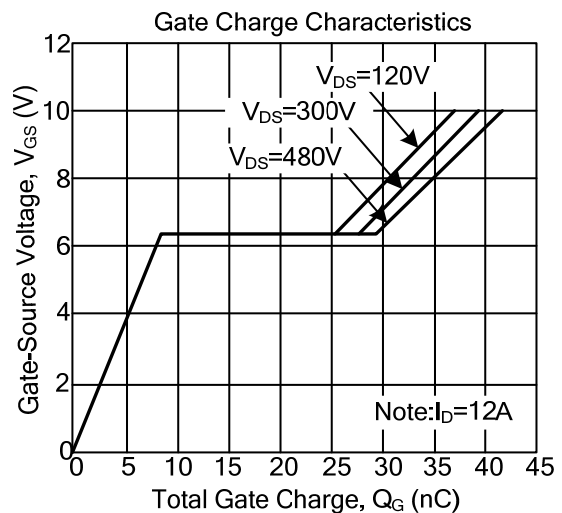
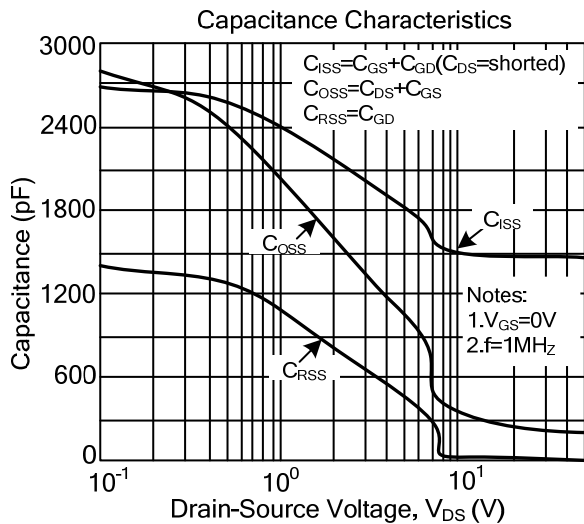
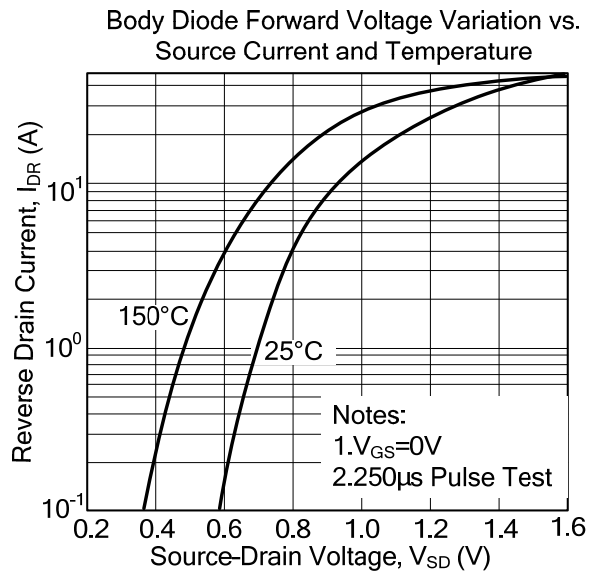
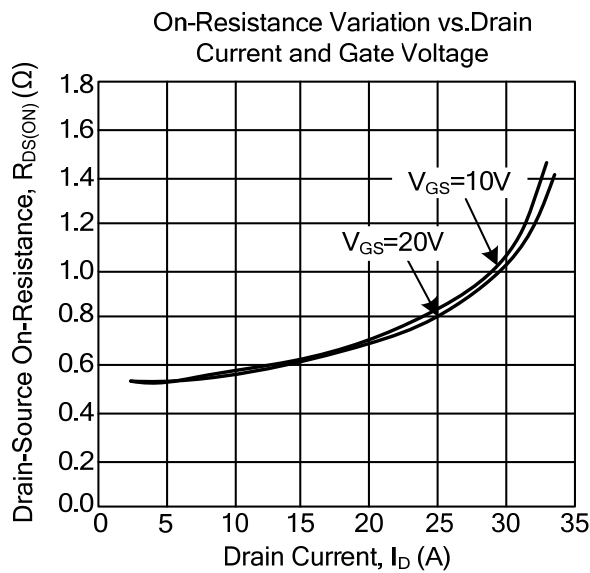
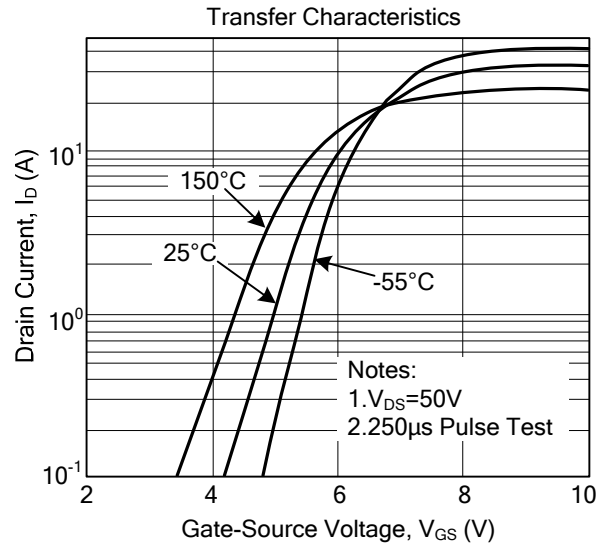
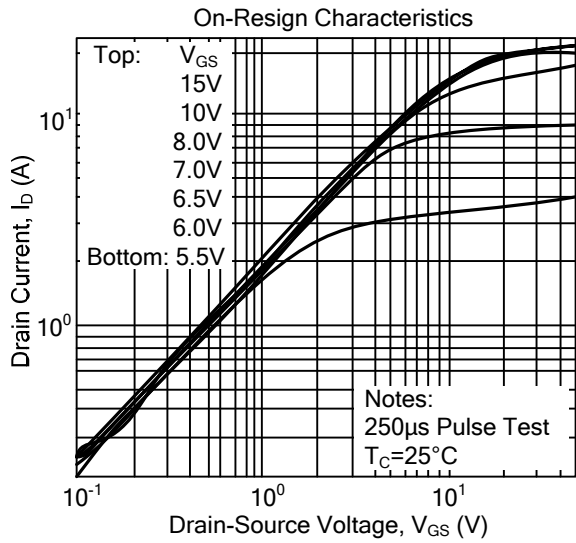


**Unclamped Inductive Switching Test Circuit**

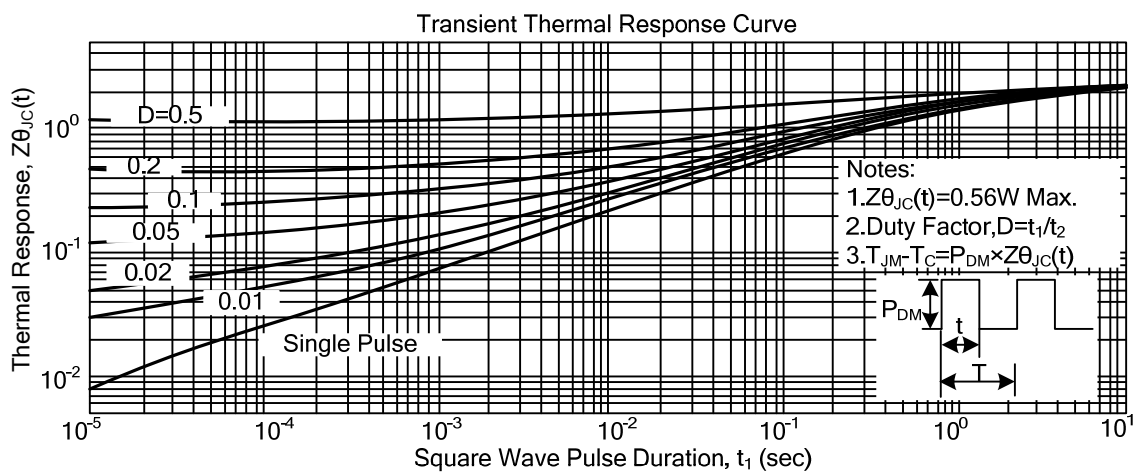
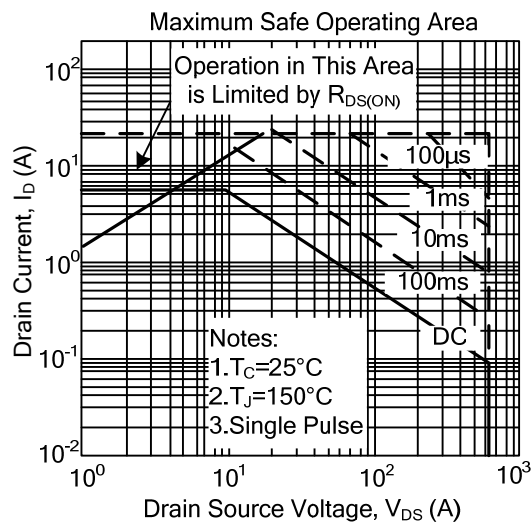


**Unclamped Inductive Switching Waveforms**

## TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS



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