



## 3NM60

Preliminary

Power MOSFET

### 3.0A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

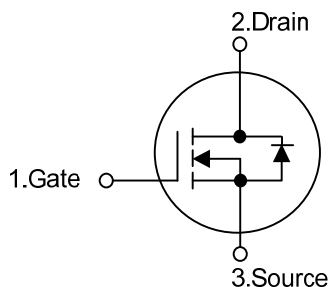
#### DESCRIPTION

The **UTC 3NM60** 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 DC-DC, AC-DC converters for power applications.

#### FEATURES

- \*  $R_{DS(ON)} < 1.86\Omega$  @  $V_{GS} = 10V$ ,  $I_D = 1.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved  $dv/dt$  capability, high ruggedness

#### SYMBOL

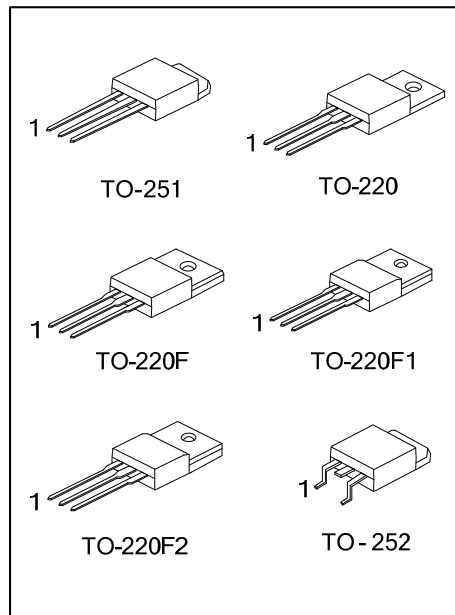


#### ORDERING INFORMATION

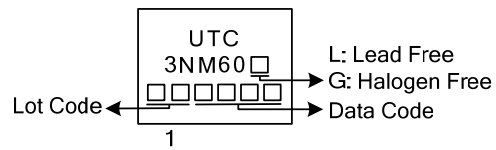
Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
3NM60L-TA3-T	3NM60G-TA3-T	TO-220	G	D	S	Tube
3NM60L-TF1-T	3NM60G-TF1-T	TO-220F1	G	D	S	Tube
3NM60L-TF2-T	3NM60G-TF2-T	TO-220F2	G	D	S	Tube
3NM60L-TF3-T	3NM60G-TF3-T	TO-220F	G	D	S	Tube
3NM60L-TM3-T	3NM60G-TM3-T	TO-251	G	D	S	Tube
3NM60L-TN3-R	3NM60G-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>3NM60L-TA3-T</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) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252</p> <p>(3) L: Lead Free, G: Halogen Free and 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		$V_{DSS}$	600	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Continuous Drain Current		$I_D$	3.0	A
Pulsed Drain Current (Note 2)		$I_{DM}$	12	A
Avalanche Current (Note 2)		$I_{AR}$	1.2	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	104	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	5.0	V/ns
Power Dissipation	TO-220	$P_D$	75	W
	TO-220F/TO-220F1		34	W
	TO-220F2		35	W
	TO-251/TO-252		50	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.  $L=144\text{mH}$ ,  $I_{AS}=1.2\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 3.0\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-220F	$\theta_{JA}$	62.5	$^\circ\text{C/W}$
	TO-220F1/TO-220F2			
	TO-251/TO-252		110	
Junction to Case	TO-220	$\theta_{JC}$	1.67	$^\circ\text{C/W}$
	TO-220F/TO-220F1		3.68	
	TO-220F2		3.58	
	TO-251/TO-252		2.5	

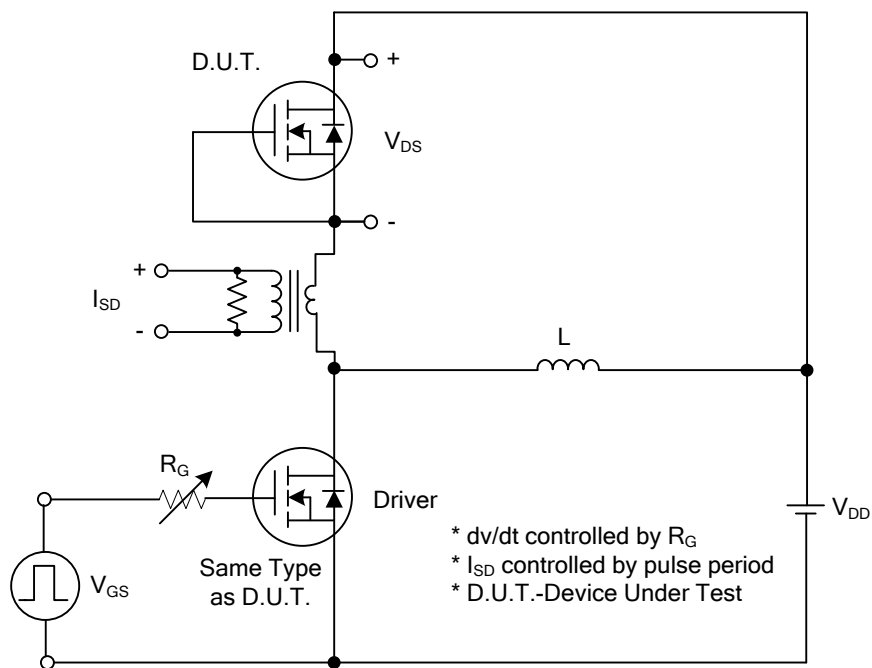
■ ELECTRICAL CHARACTERISTICS ( $T_J=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV <sub>DSS</sub>	V <sub>GS</sub> =0 V, I <sub>D</sub> =250μA	600			V
Drain-Source Leakage Current		I <sub>DSS</sub>	V <sub>DS</sub> =600 V, V <sub>GS</sub> =0V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> =+30 V, V <sub>DS</sub> =0V			+100	nA
	Reverse		V <sub>GS</sub> =-30 V, V <sub>DS</sub> =0V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		V <sub>GS(TH)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.5		4.5	V
Static Drain-Source On-State Resistance		R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =1.5A			1.86	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C <sub>ISS</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz		222		pF
Output Capacitance		C <sub>OSS</sub>			148		pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			15		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q <sub>G</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.3A, I <sub>G</sub> =100μA (Note 1, 2)		30		nC
Gate to Source Charge		Q <sub>GS</sub>			3.6		nC
Gate to Drain Charge		Q <sub>DD</sub>			6.4		nC
Turn-ON Delay Time (Note 1)		t <sub>D(ON)</sub>	V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A, R <sub>G</sub> =25Ω (Note 1, 2)		38		ns
Rise Time		t <sub>R</sub>			45		ns
Turn-OFF Delay Time		t <sub>D(OFF)</sub>			90		ns
Fall-Time		t <sub>F</sub>			31		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I <sub>S</sub>				3.0	A
Maximum Body-Diode Pulsed Current		I <sub>SM</sub>				8.0	A
Drain-Source Diode Forward Voltage (Note 1)		V <sub>SD</sub>	I <sub>S</sub> =3.0 A, V <sub>GS</sub> =0 V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t <sub>rr</sub>	I <sub>S</sub> =3.0 A, V <sub>GS</sub> =0 V		210		ns
Body Diode Reverse Recovery Charge		Q <sub>rr</sub>	dl <sub>F</sub> /dt=100A/μs		1.4		μC

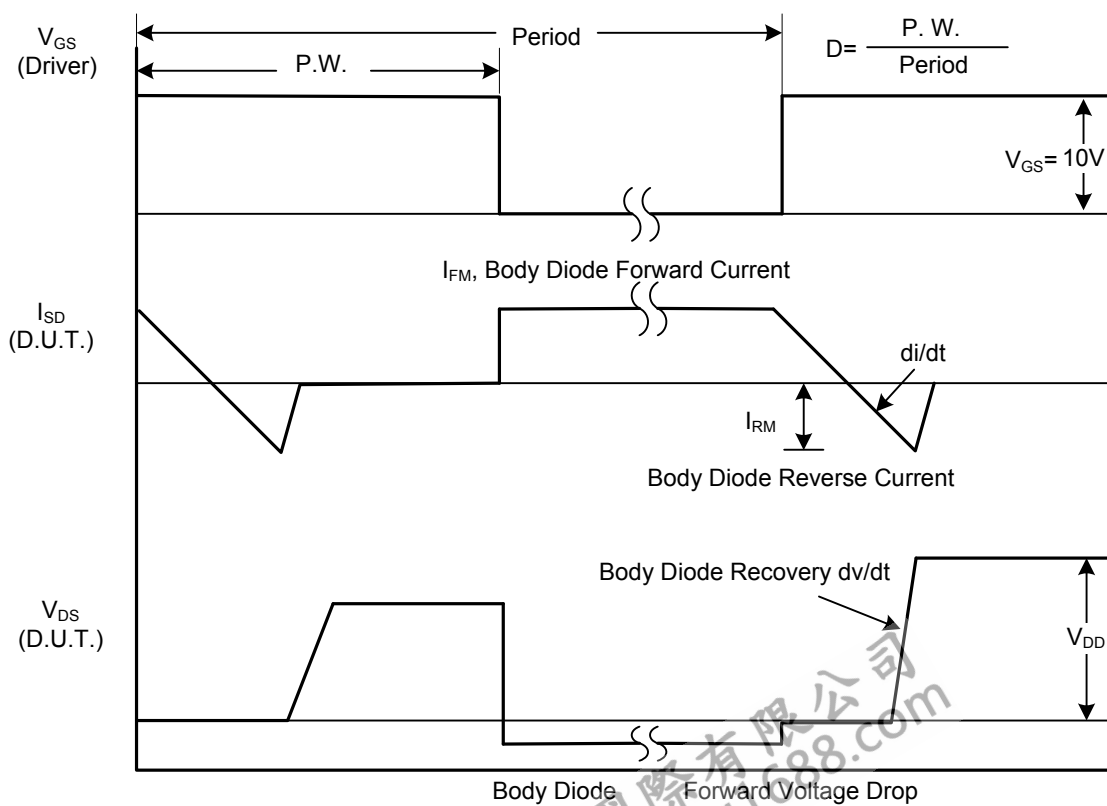
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

# ■ TEST CIRCUITS AND WAVEFORMS

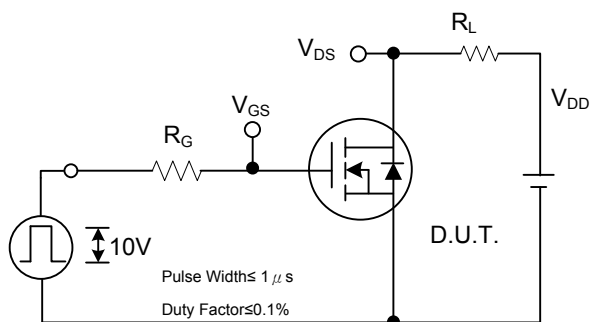


Peak Diode Recovery  $dv/dt$  Test Circuit

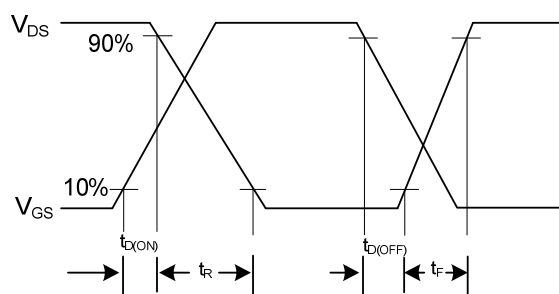


Peak Diode Recovery  $dv/dt$  Waveforms

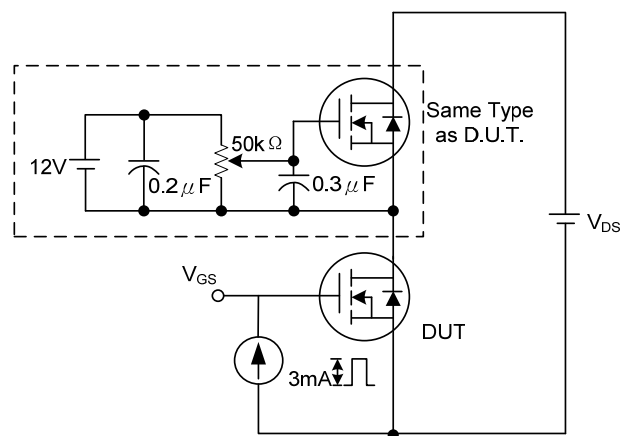
# ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



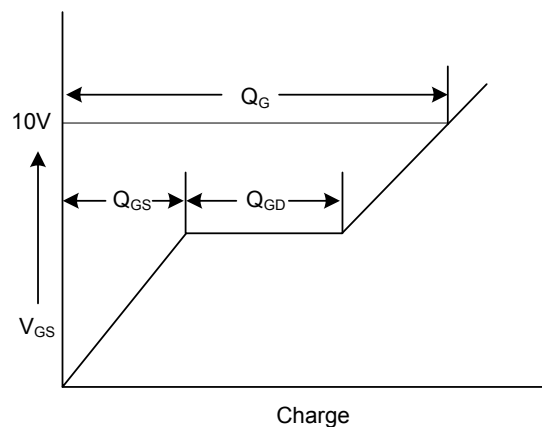
Switching Test Circuit



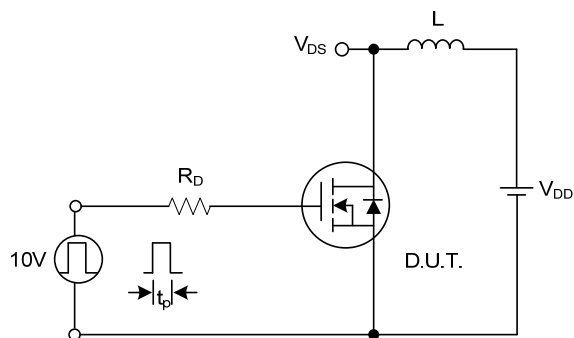
Switching Waveforms



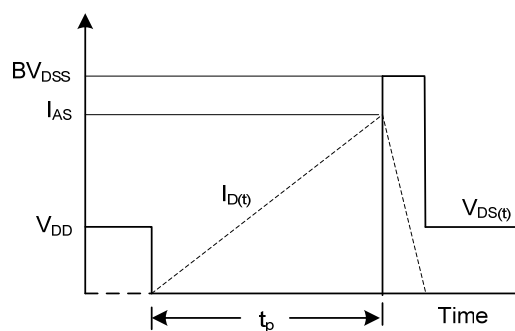
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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