



9NM60-S

Power MOSFET

9.0A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

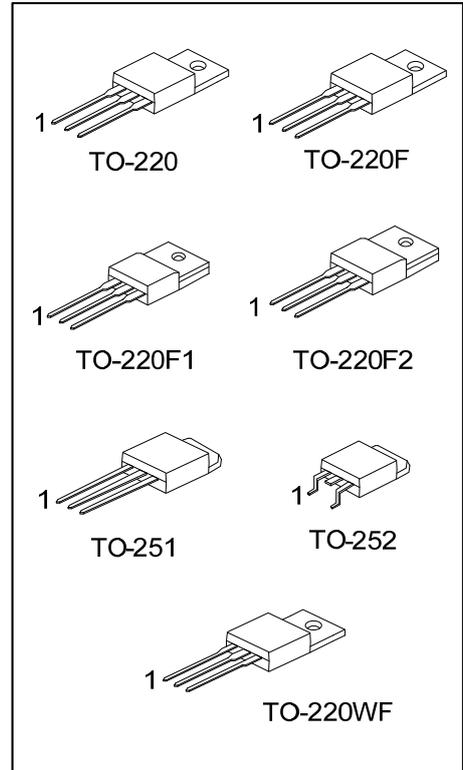
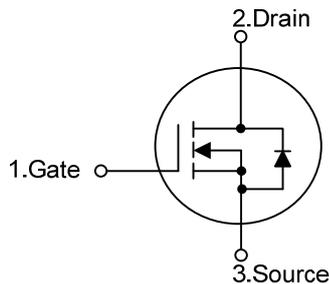
DESCRIPTION

The **UTC 9NM60-S** 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

- * $R_{DS(ON)} \leq 0.64 \Omega @ V_{GS} = 10 V, I_D = 4.5 A$
- * By using Super Junction Structure
- * Fast Switching
- * With 100% Avalanche Tested

SYMBOL



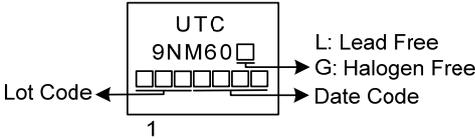
ORDERING INFORMATION

Order Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
9NM60L-TA3-T	9NM60G-TA3-T	TO-220	G	D	S	Tube
9NM60L-TF1-T	9NM60G-TF1-T	TO-220F1	G	D	S	Tube
9NM60L-TF2-T	9NM60G-TF2-T	TO-220F2	G	D	S	Tube
9NM60L-TF3-T	9NM60G-TF3-T	TO-220F	G	D	S	Tube
9NM60L-TW1-T	9NM60G-TW1-T	TO-220WF	G	D	S	Tube
9NM60L-TM3-T	9NM60G-TM3-T	TO-251	G	D	S	Tube
9NM60L-TN3-R	9NM60G-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>9NM60G-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, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TW1: TO-220WF, TM3: TO-251, TN3: TO-252</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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MARKING



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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}	600	V
Gate-Source Voltage		V_{GSS}	± 30	V
Drain Current	Continuous	I_D	9.0	A
	Pulsed (Note 2)	I_{DM}	36	A
Avalanche Current		I_{AR}	2.2	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	380	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	5.5	V/ns
Power Dissipation	TO-220	P_D	165	W
	TO-220F/TO-220F1		26	W
	TO-220F2/TO-220WF			
	TO-251/TO-252		70	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. $L=157\text{mH}$, $I_{AS}=2.2\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\Omega$, Starting $T_J=25^\circ\text{C}$.

4. $I_{SD} \leq 9.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$.

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2			
	TO-220WF			
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220	θ_{JC}	0.75	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		4.8	$^\circ\text{C}/\text{W}$
	TO-220F2/TO-220WF			
	TO-251/TO-252		1.8	$^\circ\text{C}/\text{W}$

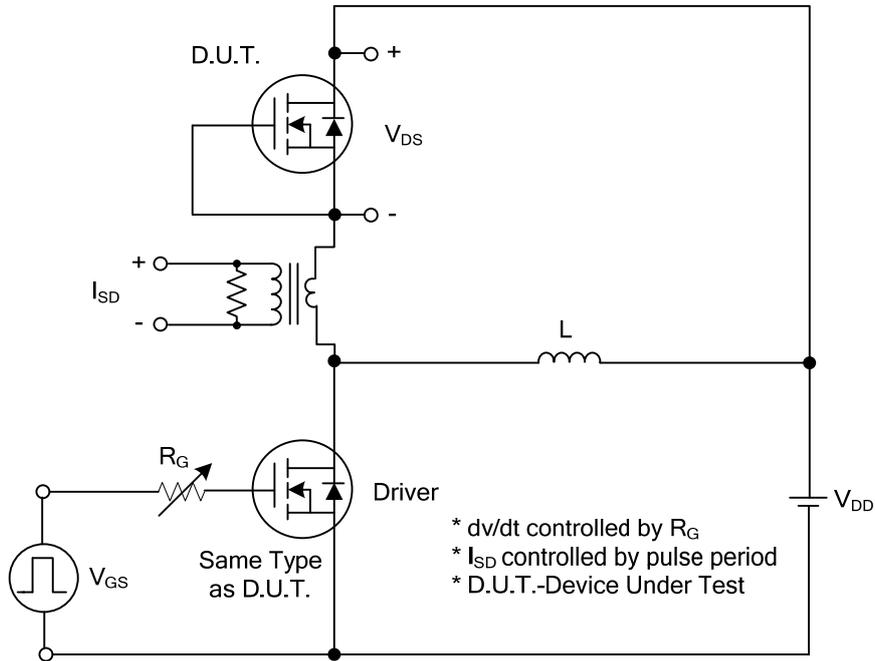
■ ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV _{DSS}	I _D =250μA, V _{GS} =0V	600			V
Drain-Source Leakage Current	I _{DSS}	V _{DS} =600V, V _{GS} =0V			10	μA
Gate- Source Leakage Current	Forward	I _{GSS} V _{GS} =30V V _{GS} =-30V			100	nA
	Reverse				-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 =4.5A			0.64	Ω
DYNAMIC PARAMETERS						
Input Capacitance	C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1.0MHz		510		pF
Output Capacitance	C _{OSS}			350		pF
Reverse Transfer Capacitance	C _{RSS}			26		pF
Gate Resistance	R _G	V _{DS} =0V, V _{GS} =0V, f=1MHz		2.4		Ω
SWITCHING PARAMETERS						
Total Gate Charge (Note 1)	Q _G	V _{DS} =50V, V _{GS} =10V, I _D =1.3A, I _G =100μA (Note 1, 2)		39		nC
Gate to Source Charge	Q _{GS}			5.0		nC
Gate to Drain Charge	Q _{GD}			14		nC
Turn-ON Delay Time (Note 1)	t _{D(ON)}	V _{DD} =30V, I _D =0.5A, R _G =25Ω V _{GS} =10V (Note 1, 2)		50		ns
Rise Time	t _R			47		ns
Turn-OFF Delay Time	t _{D(OFF)}			185		ns
Fall-Time	t _F			60		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Body-Diode Continuous Current	I _S				9	A
Maximum Body-Diode Pulsed Current	I _{SM}				36	A
Drain-Source Diode Forward Voltage (Note 1)	V _{SD}	I _S =9.0A, V _{GS} =0V			1.4	V
Reverse Recovery Time (Note 1)	t _{rr}	I _S =9.0A, V _{GS} =0V,		320		ns
Reverse Recovery Charge	Q _{rr}	dI _F /dt=100A/μs		3.9		μC

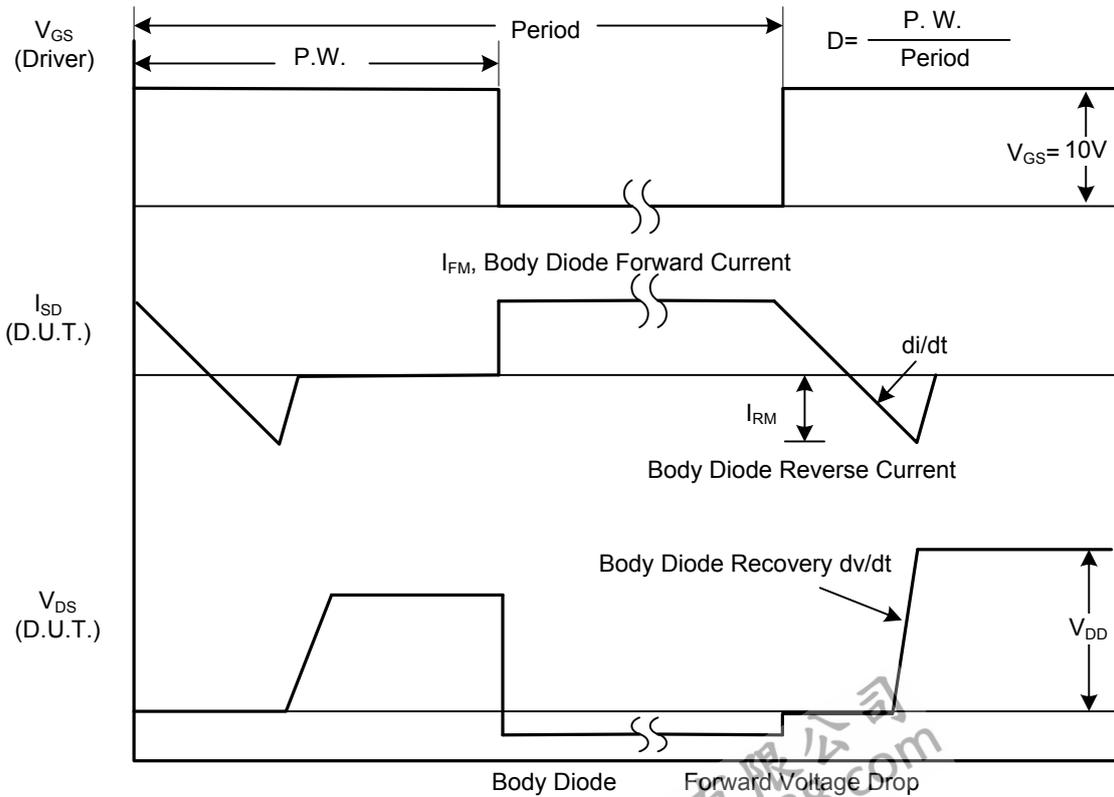
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

TEST CIRCUITS AND WAVEFORMS

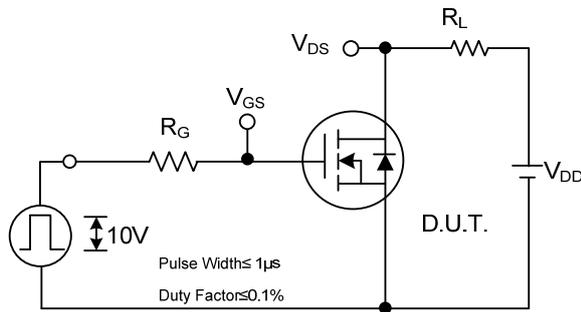


Peak Diode Recovery dv/dt Test Circuit

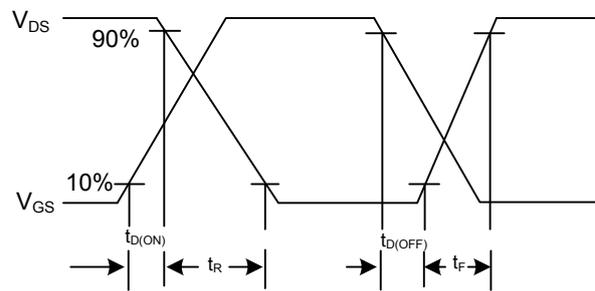


Peak Diode Recovery dv/dt Waveforms

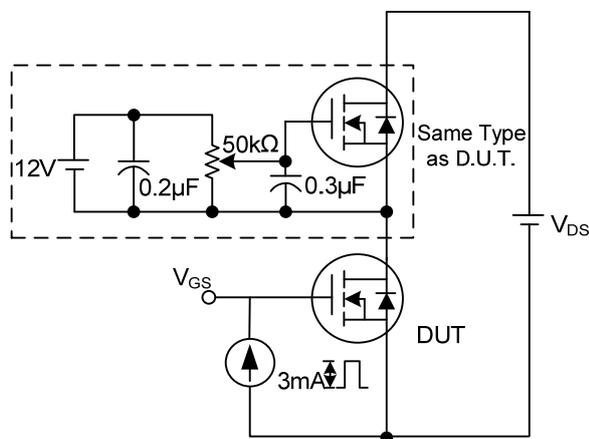
TEST CIRCUITS AND WAVEFORMS



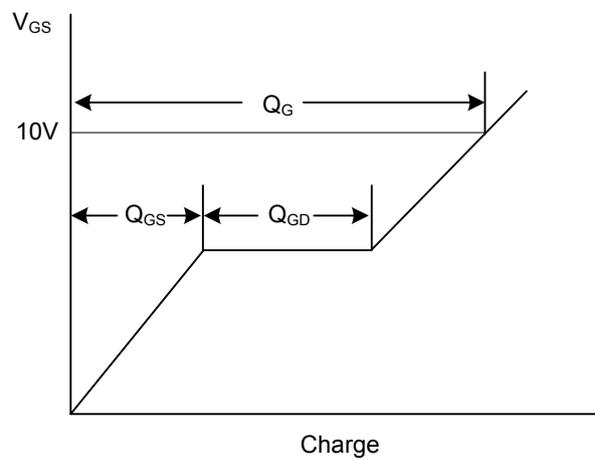
Switching Test Circuit



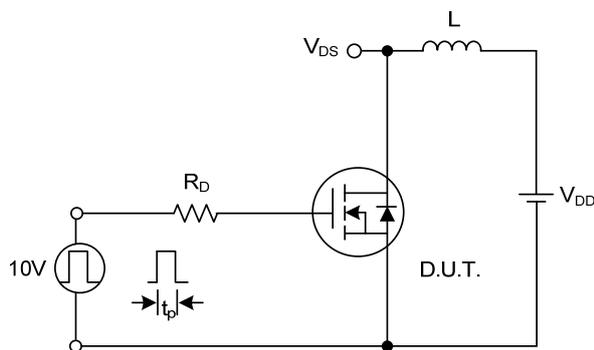
Switching Waveforms



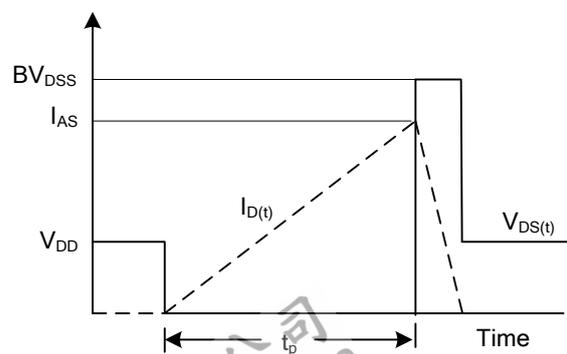
Gate Charge Test Circuit



Gate Charge Waveform

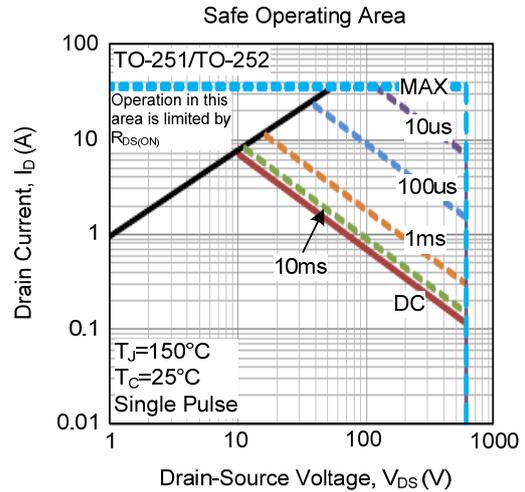
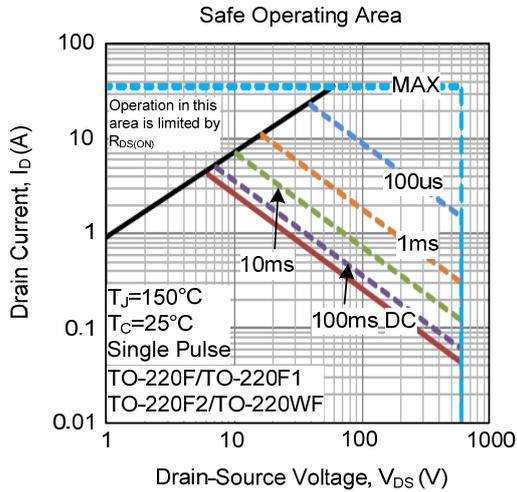
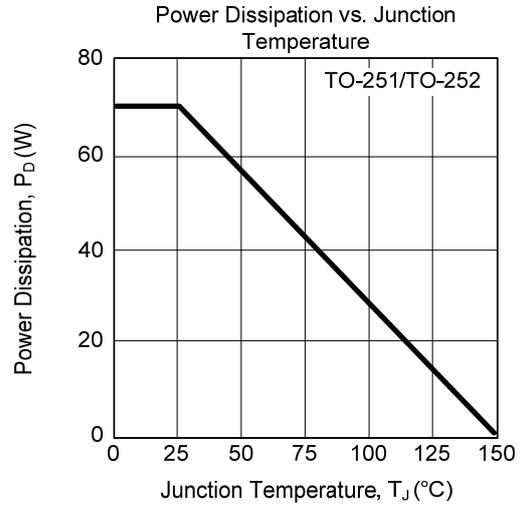
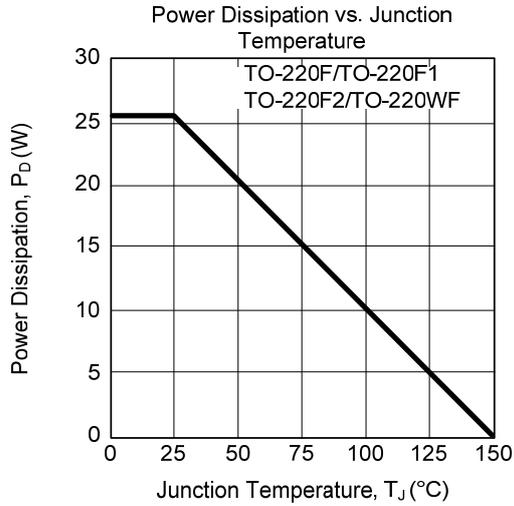


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS



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