



5NM60-U2

Power MOSFET

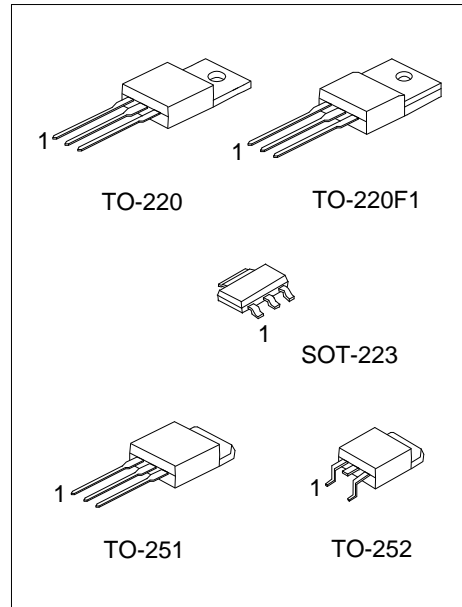
5A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

DESCRIPTION

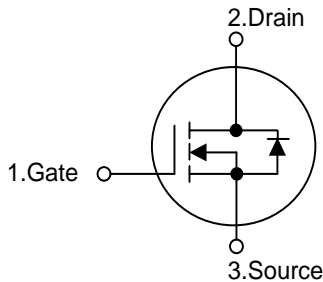
The UTC **5NM60-U2** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications at power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.

FEATURES

- * $R_{DS(ON)} \leq 1.15\Omega$ @ $V_{GS}=10V, I_D=2.5A$
- * Fast Switching Capability
- * Improved dv/dt Capability, High Ruggedness



SYMBOL



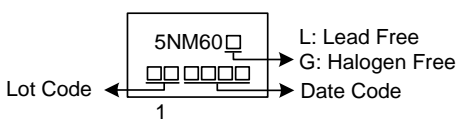
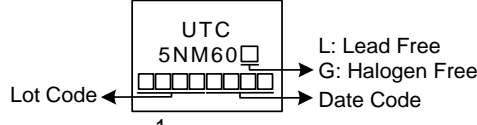
ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
5NM60L-AA3-R	5NM60G-AA3-R	SOT-223	G	D	S	Tape Reel
5NM60L-TA3-T	5NM60G-TA3-T	TO-220	G	D	S	Tube
5NM60L-TF1-T	5NM60G-TF1-T	TO-220F1	G	D	S	Tube
5NM60L-TM3-T	5NM60G-TM3-T	TO-251	G	D	S	Tube
5NM60L-TN3-R	5NM60G-TN3-R	TO-252	G	D	S	Tape Reel

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

<p>5NM60G-AA3-R</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Green Package</p>	<p>(1) R: Tape Reel, T: Tube</p> <p>(2) AA3: SOT-223, TA3: TO-220, TF1: TO-220F1, TM3: TO-251, TN3: TO-252</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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MARKING

SOT-223	TO-220 / TO-220F1 / TO-251 / TO-252
 <p>Diagram of SOT-223 marking: A rectangular package with '5NM60' and a small square symbol at the top. Below it are four small squares representing a lot code and four small squares representing a date code. Arrows point from the lot code to 'Lot Code' and from the date code to 'Date Code'. To the right, 'L: Lead Free' and 'G: Halogen Free' are listed. A '1' is at the bottom.</p>	 <p>Diagram of TO-220 marking: A rectangular package with 'UTC' and '5NM60' and a small square symbol at the top. Below it are six small squares representing a lot code and four small squares representing a date code. Arrows point from the lot code to 'Lot Code' and from the date code to 'Date Code'. To the right, 'L: Lead Free' and 'G: Halogen Free' are listed. A '1' is at the bottom.</p>

■ 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	5.0	A
	Pulsed (Note 2)	I_{DM}	20	A
Avalanche Current (Note 2)		I_{AR}	1.2	A
Avalanche Energy		E_{AS}	104	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.6	V/ns
Power Dissipation	SOT-223	P_D	5	W
	TO-220		72	W
	TO-220F1		24	W
	TO-251/TO-252		48	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. $I_{SD} \leq 5.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL CHARACTERISTICS

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	θ_{JA}	75 (Note)	$^\circ\text{C}/\text{W}$
	TO-220/TO-220F1		62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		110 (Note)	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-223	θ_{JC}	25 (Note)	$^\circ\text{C}/\text{W}$
	TO-220		1.73	$^\circ\text{C}/\text{W}$
	TO-220F1		5.2	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.6 (Note)	$^\circ\text{C}/\text{W}$

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

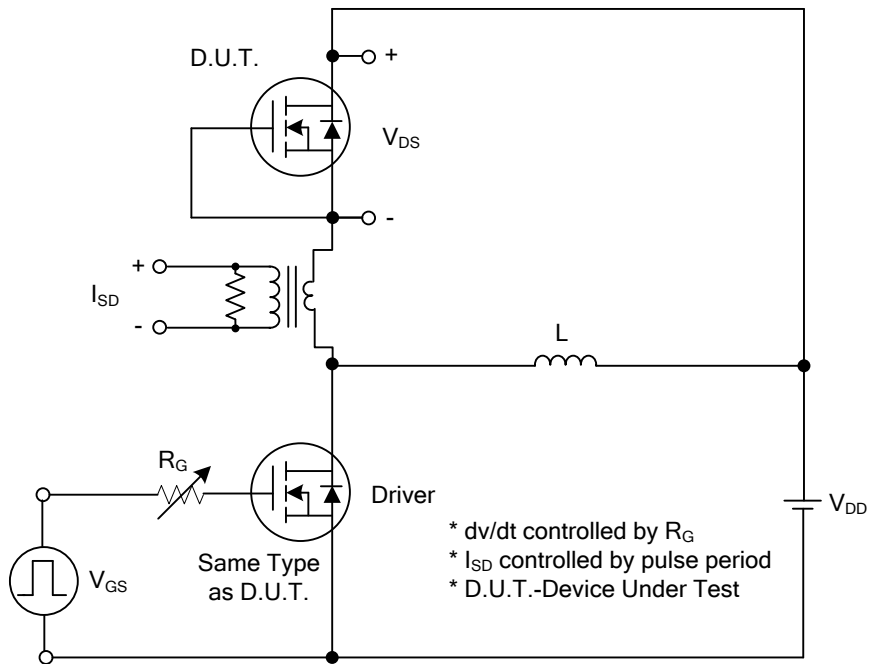
■ **ELECTRICAL CHARACTERISTICS** ($T_J = 25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage	BV_{DSS}	$I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$	600			V	
Drain-Source Leakage Current	I_{DSS}	$V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$			10	μA	
Gate-Source Leakage Current	Forward	I_{GSS}			+100	nA	
	Reverse						$V_{GS}=+30\text{V}$, $V_{DS}=0\text{V}$
					-100	nA	
ON CHARACTERISTICS							
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	$R_{DS(ON)}$	$V_{GS}=10\text{V}$, $I_D=2.5\text{A}$			1.15	Ω	
DYNAMIC PARAMETERS							
Input Capacitance	C_{ISS}	$V_{GS}=0\text{V}$, $V_{DS}=25\text{V}$, $f=1.0\text{MHz}$		243		pF	
Output Capacitance	C_{OSS}				205		pF
Reverse Transfer Capacitance	C_{RSS}				23		pF
SWITCHING PARAMETERS							
Total Gate Charge (Note 1)	Q_G	$V_{DS}=50\text{V}$, $V_{GS}=10\text{V}$, $I_D=1.3\text{A}$, $I_D=100\mu\text{A}$ (Note 1, 2)		40		nC	
Gate to Source Charge	Q_{GS}				3.5		nC
Gate to Drain Charge	Q_{GD}				9.5		nC
Turn-on Delay Time (Note 1)	$t_{D(ON)}$	$V_{DS}=30\text{V}$, $V_{GS}=10\text{V}$, $I_D=0.5\text{A}$, $R_G=25\Omega$ (Note 1, 2)		42		ns	
Rise Time	t_R				71		ns
Turn-off Delay Time	$t_{D(OFF)}$				126		ns
Fall-Time	t_F				51		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current	I_S				5	A	
Maximum Body-Diode Pulsed Current	I_{SM}				20	A	
Drain-Source Diode Forward Voltage (Note 1)	V_{SD}	$I_S=5.0\text{A}$, $V_{GS}=0\text{V}$			1.4	V	
Reverse Recovery Time (Note 1)	t_{rr}	$I_S=5.0\text{A}$, $V_{GS}=0\text{V}$, $di_f/dt = 100\text{A}/\mu\text{s}$		230		nS	
Reverse Recovery Charge	Q_{rr}				1.81		μC

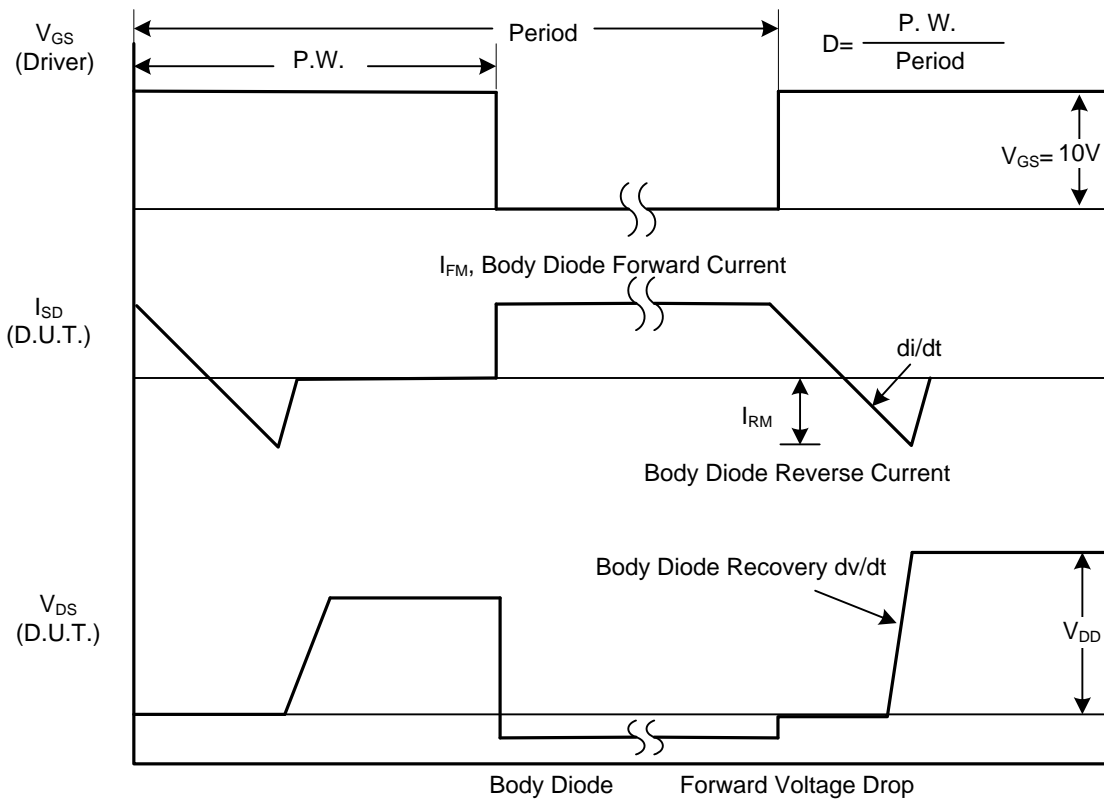
Notes: 1. Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

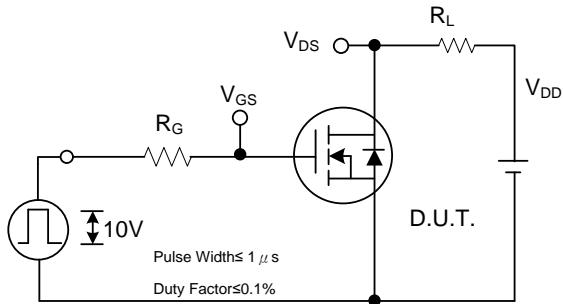


Peak Diode Recovery dv/dt Test Circuit

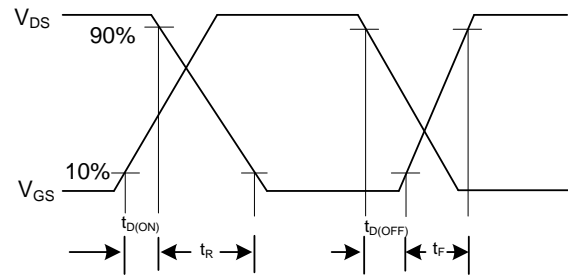


Peak Diode Recovery dv/dt Waveforms

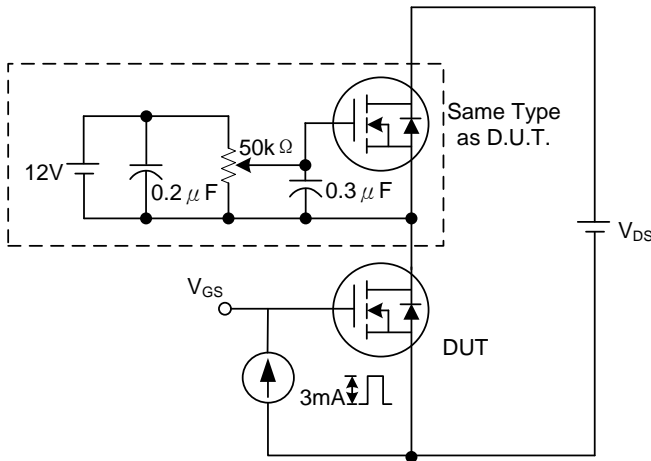
TEST CIRCUITS AND WAVEFORMS



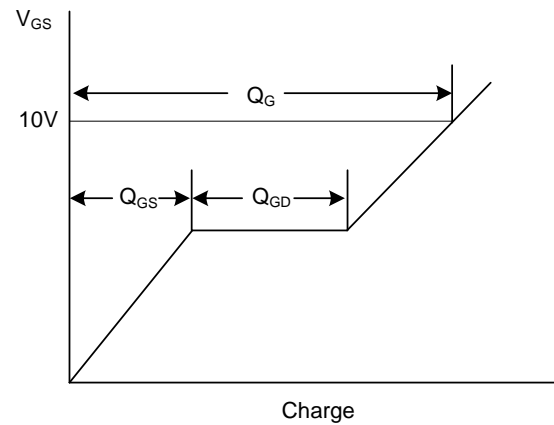
Switching Test Circuit



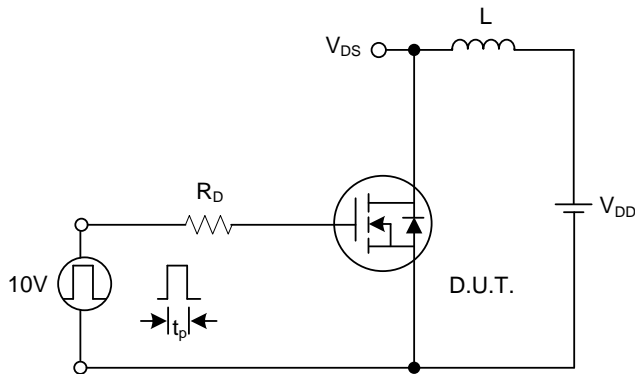
Switching Waveforms



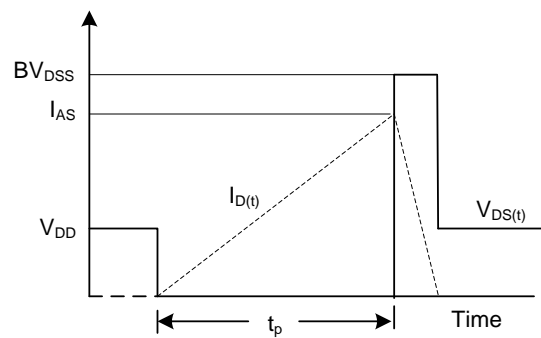
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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