



24NM60

Preliminary

Power MOSFET

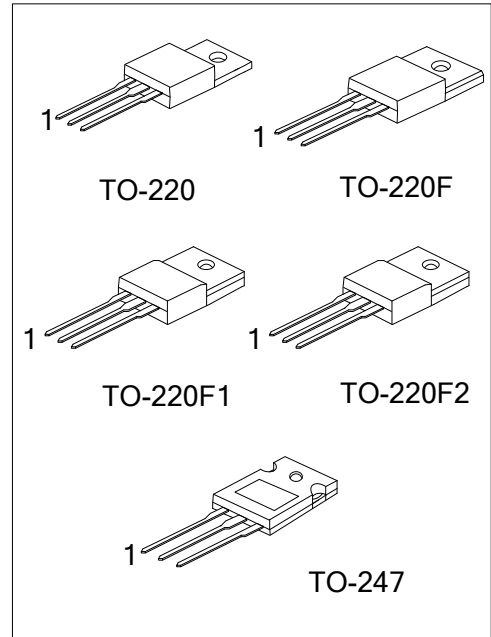
24A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

■ DESCRIPTION

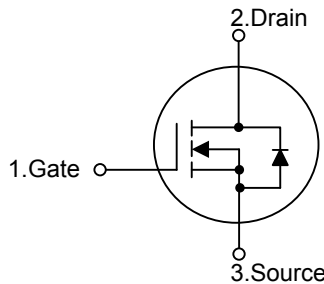
The **UTC 24NM60** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at DC-DC, AC-DC converters for power applications.

■ FEATURES

- * $R_{DS(ON)} < 0.16\Omega @ V_{GS}=10V, I_D=12A$
- * High Switching Speed
- * 100% Avalanche Tested



■ SYMBOL



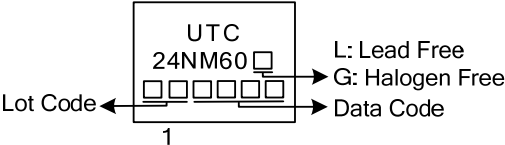
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
24NM60L-TA3-T	24NM60G-TA3-T	TO-220	G	D	S	Tube
24NM60L-TF1-T	24NM60G-TF1-T	TO-220F1	G	D	S	Tube
24NM60L-TF2-T	24NM60G-TF2-T	TO-220F2	G	D	S	Tube
24NM60L-TF3-T	24NM60G-TF3-T	TO-220F	G	D	S	Tube
24NM60L-T47-T	24NM60G-T47-T	TO-247	G	D	S	Tube

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

<p>24NM60L-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, T47: TO-247</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}	± 30	V
Drain Current	Continuous	I_D	24	A
	Pulsed (Note 2)	I_{DM}	96	A
Avalanche Current (Note 2)		I_{AR}	5.0	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	725	mJ
Peak Diode Recovery dv/dt		dv/dt	10.5	V/ns
Power Dissipation	TO-220	P_D	250	W
	TO-220F/TO-220F1		128	W
	TO-220F2			
	TO-247		290	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. $L = 58 \text{ mH}$, $I_{AS} = 5.0 \text{ A}$, $V_{DD} = 50 \text{ V}$, $R_G = 25 \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 24 \text{ A}$, $di/dt \leq 200 \text{ A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-220F	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2			
	TO-247		40	
Junction to Case	TO-220	θ_{JC}	0.5	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		0.98	
	TO-220F2			
	TO-247		0.43	

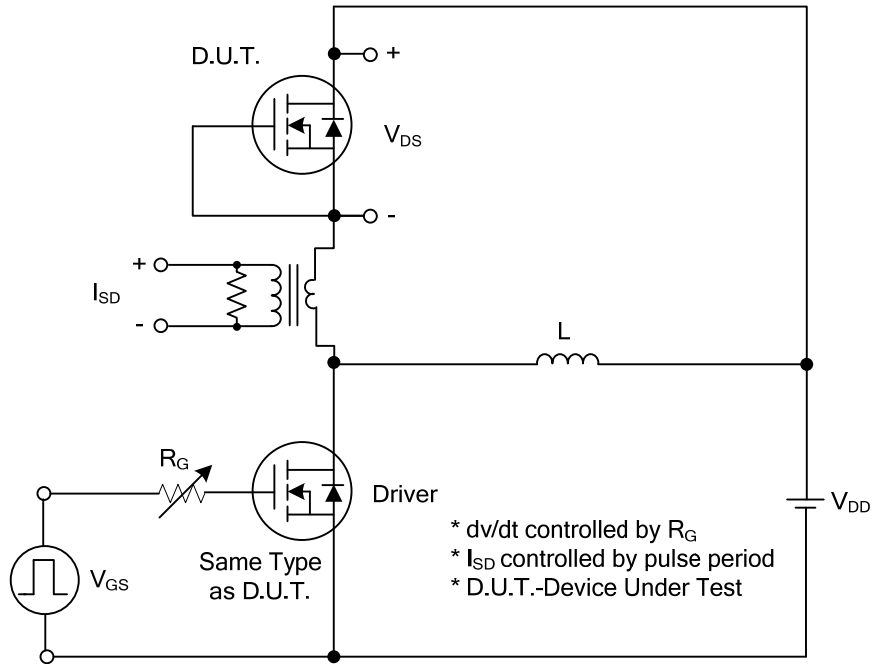
■ ELECTRICAL CHARACTERISTICS ($T_J=25^\circ\text{C}$, unless otherwise specified)

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}	$V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$			50	μA
Gate- Source Leakage Current	Forward	I_{GSS} , $V_{GS}=+30\text{V}$, $V_{DS}=0\text{V}$			+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	$R_{DS(ON)}$	$V_{GS}=10\text{V}$, $I_D=12\text{A}$			0.16	Ω
DYNAMIC PARAMETERS						
Input Capacitance	C_{ISS}	$V_{GS}=0\text{V}$, $V_{DS}=25\text{V}$, $f=1.0\text{MHz}$		2200		pF
Output Capacitance	C_{OSS}			1250		pF
Reverse Transfer Capacitance	C_{RSS}			75		pF
SWITCHING PARAMETERS						
Total Gate Charge (Note 1)	Q_G	$V_{DS}=30\text{V}$, $V_{GS}=10\text{V}$, $I_D=10\text{A}$ $I_G=100\mu\text{A}$ (Note 1, 2)		140		nC
Gate to Source Charge	Q_{GS}			9.6		nC
Gate to Drain Charge	Q_{GD}			45		nC
Turn-ON Delay Time (Note 1)	$t_{D(ON)}$	$V_{DS}=50\text{V}$, $V_{GS}=10\text{V}$, $I_D=0.5\text{A}$, $R_G=25\Omega$ (Note 1, 2)		100		ns
Rise Time	t_R			265		ns
Turn-OFF Delay Time	$t_{D(OFF)}$			680		ns
Fall-Time	t_F			350		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Body-Diode Continuous Current	I_S				24	A
Maximum Body-Diode Pulsed Current	I_{SM}				96	A
Drain-Source Diode Forward Voltage (Note 1)	V_{SD}	$I_S=24\text{A}$, $V_{GS}=0\text{V}$			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t_{rr}	$I_S=24\text{A}$, $V_{GS}=0\text{V}$, $di_F/dt=100\text{A}/\mu\text{s}$		490		ns
Body Diode Reverse Recovery Charge	Q_{rr}				9.3	

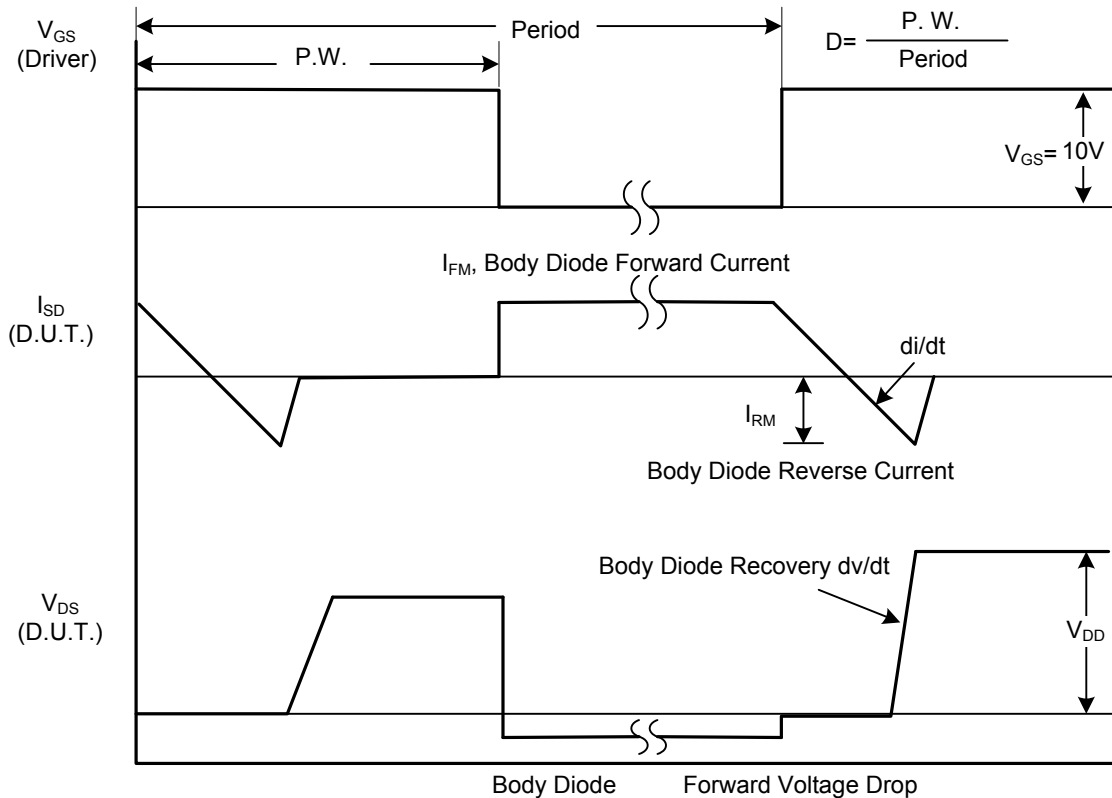
Notes: 1. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating ambient temperature.

■ TEST CIRCUITS AND WAVEFORMS



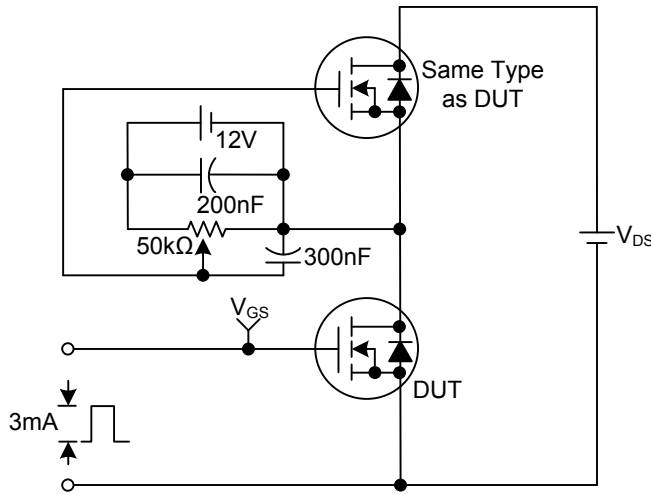
Peak Diode Recovery dv/dt Test Circuit



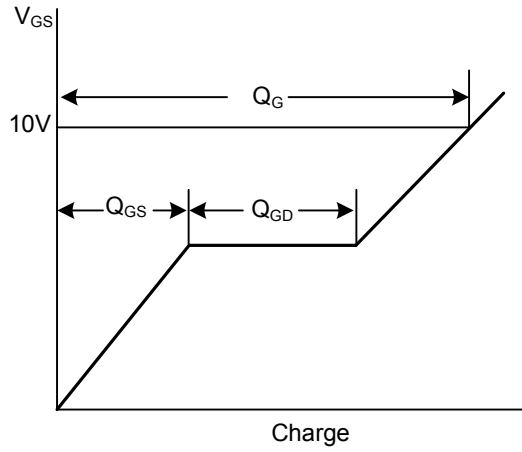
Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

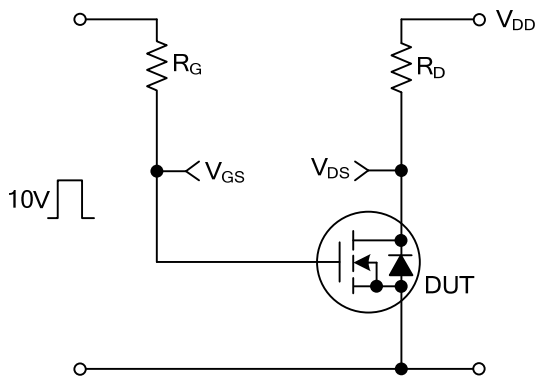
Gate Charge Test Circuit



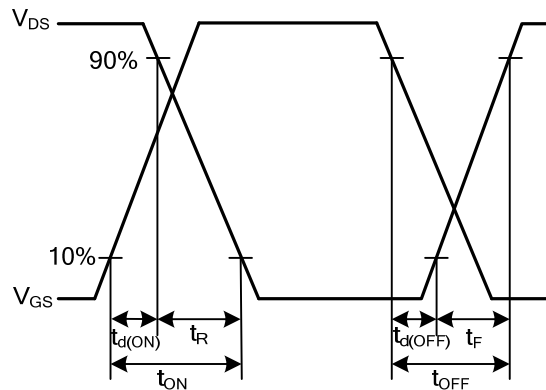
Gate Charge Waveforms



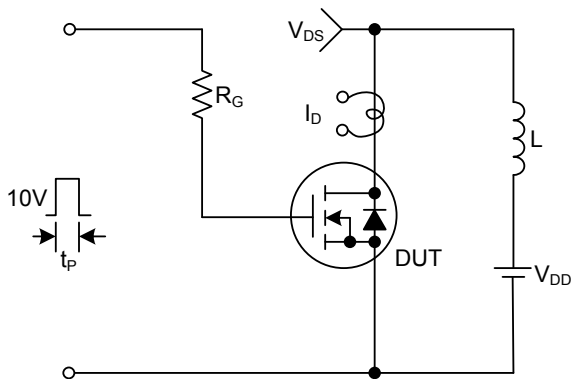
Resistive Switching Test Circuit



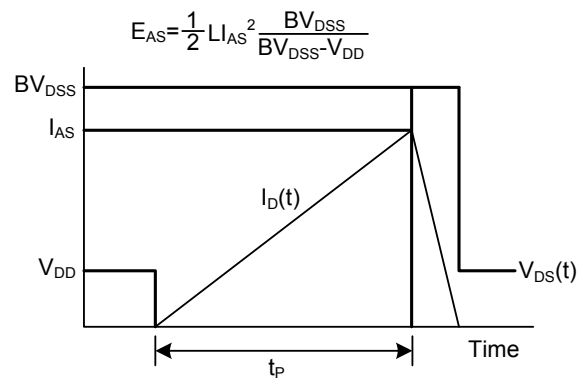
Resistive Switching Waveforms



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



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