



**38NM60-U3**

Preliminary

*Power MOSFET*

**38A, 600V N-CHANNEL  
SUPER-JUNCTION MOSFET**

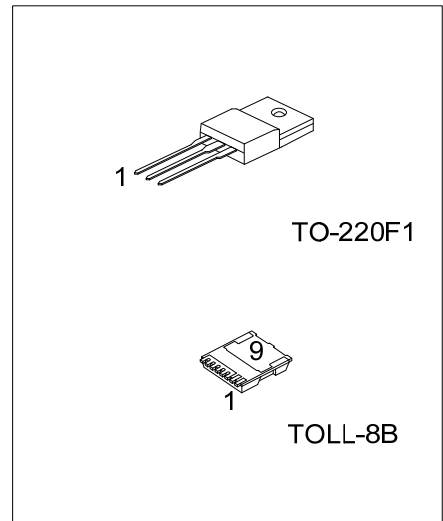
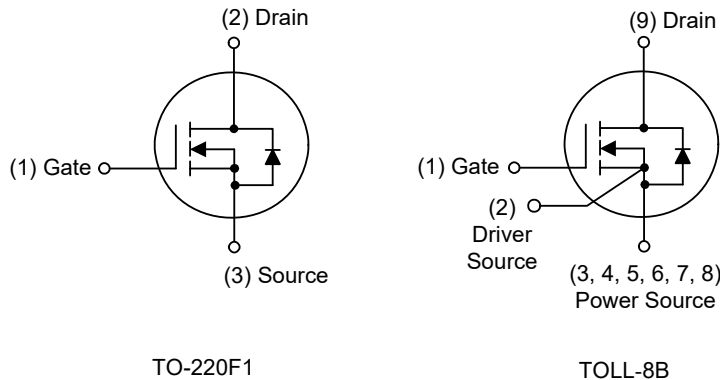
■ DESCRIPTION

The **UTC 38NM60-U3** 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 AC-DC converters for power applications.

■ FEATURES

- \*  $R_{DS(ON)} \leq 90 \text{ m}\Omega @ V_{GS}=10\text{V}, I_D=15\text{A}$
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved dv/dt capability, high ruggedness

■ SYMBOL



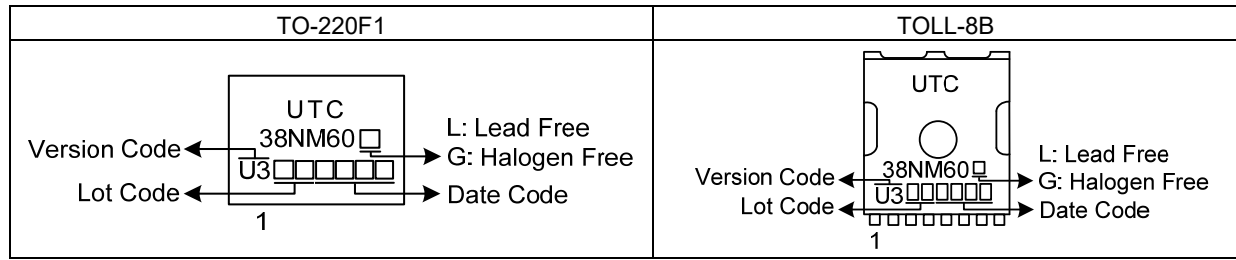
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment							Packing		
Lead Free	Halogen Free		1	2	3	4	5	6	7		8	9
38NM60L-U3-TF1-T	38NM60G-U3-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U3-T8B-R	38NM60G-U3-T8B-R	TOLL-8B	G	S	S	S	S	S	S	S	D	Tape Reel

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

<p>38NM60G-U3-TF1-T</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Version Code</li> <li>(4) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) T: Tube, R: Tape Reel</li> <li>(2) TF1: TO-220F1, T8B: TOLL-8B</li> <li>(3) Version U3</li> <li>(4) G: Halogen Free and Lead Free, L: Lead Free</li> </ul>
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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
Drain Current	Continuous	$I_D$	38	A
	Pulsed (Note 2)	$I_{DM}$	114	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	1600	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	8.3	V/ns
Power Dissipation	TO-220F1	$P_D$	40	W
	TOLL-8B		220	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.  $L = 100\text{mH}$ ,  $I_{AS} = 5.7\text{A}$ ,  $V_{DD} = 90\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 30\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220F1	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TOLL-8B		35 (Note)	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F1	$\theta_{JC}$	3.125	$^\circ\text{C}/\text{W}$
	TOLL-8B		0.57 (Note)	$^\circ\text{C}/\text{W}$

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

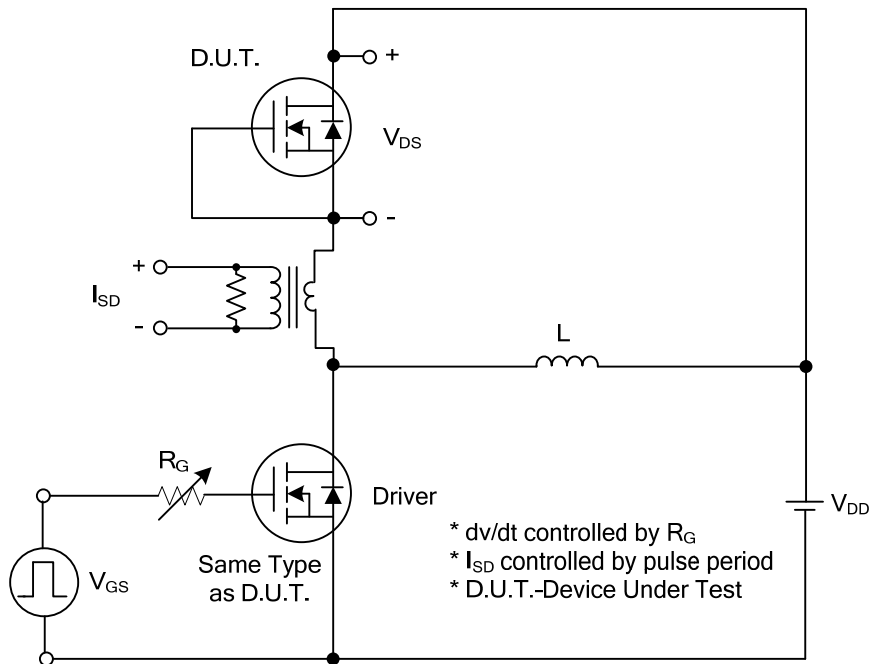
■ ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			10	μA
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V			±100	nA
<b>ON CHARACTERISTICS</b>						
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> =15A			90	mΩ
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1MHz		2336		pF
Output Capacitance	C <sub>OSS</sub>			1001		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			94		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =38A (Note 1, 2)		102		nC
Gate-Source Charge	Q <sub>GS</sub>			17		nC
Gate-Drain Charge	Q <sub>DD</sub>			65		nC
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =38A, R <sub>G</sub> =25Ω (Note 1, 2)		41		ns
Turn-On Rise Time	t <sub>R</sub>			91		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			229		ns
Turn-Off Fall Time	t <sub>F</sub>			93		ns
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				38	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				114	A
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =30A, V <sub>GS</sub> =0V			1.4	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> =30A, V <sub>GS</sub> =0V, dI <sub>F</sub> /dt=100A/μs		572		ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			11.7		μC

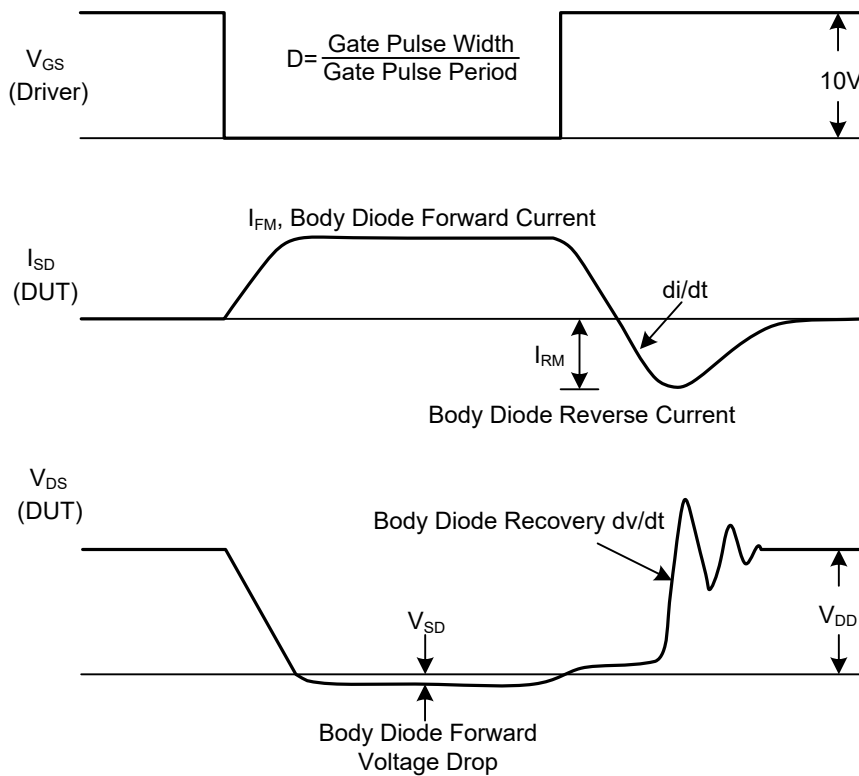
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

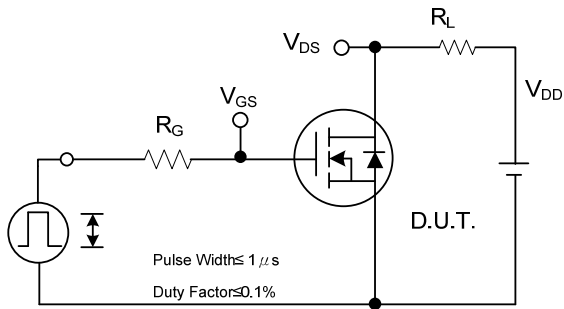


Peak Diode Recovery dv/dt Test Circuit

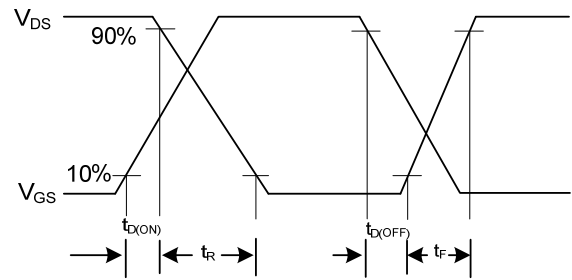


Peak Diode Recovery dv/dt Waveforms

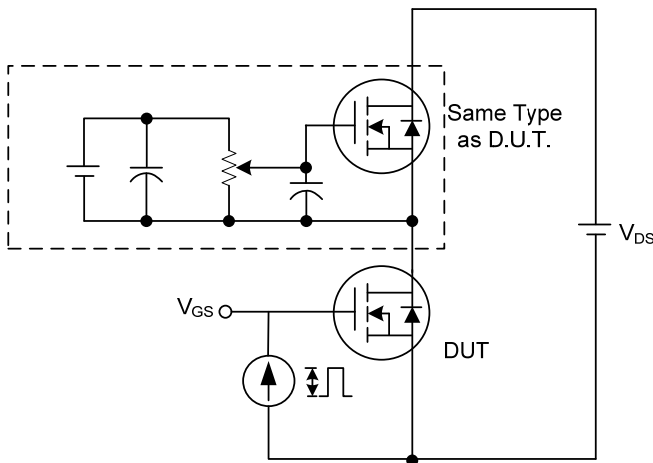
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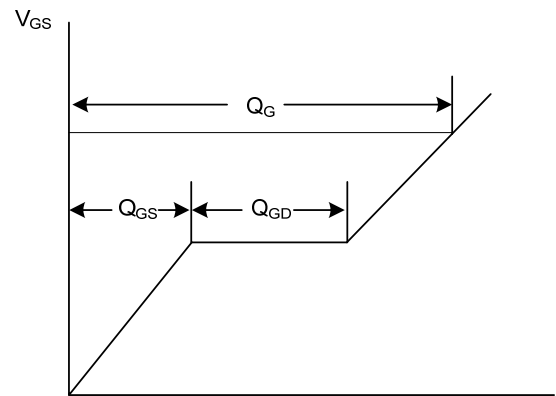
Switching Test Circuit



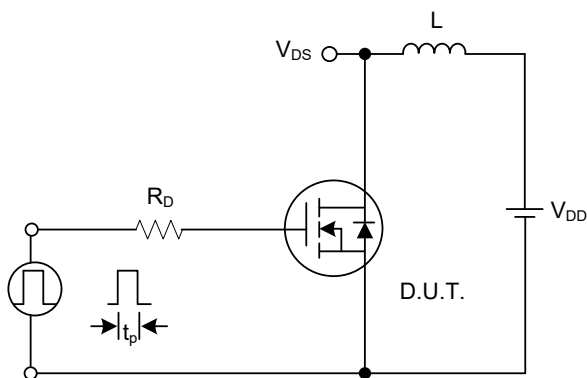
Switching Waveforms



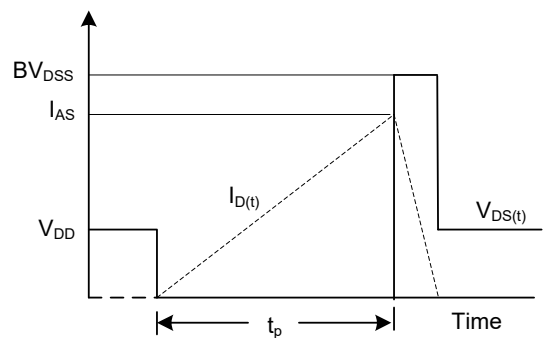
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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