



38NM60-U2

Preliminary

Power MOSFET

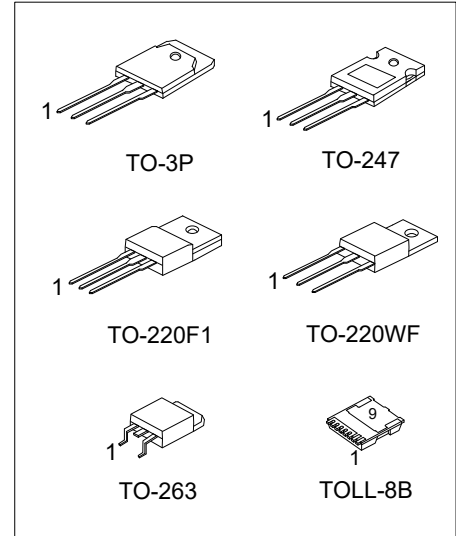
38A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

DESCRIPTION

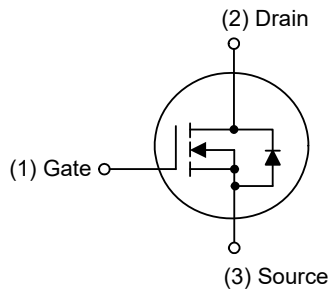
The **UTC 38NM60-U2** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

FEATURES

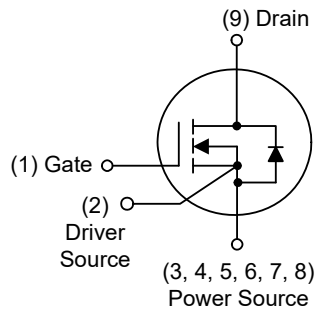
- * $R_{DS(ON)} \leq 90 \text{ m}\Omega$ @ $V_{GS}=10\text{V}$, $I_D=9.5\text{A}$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness



SYMBOL



TO-220F1 / TO-220WF
TO-247 / TO-263 / TO-3P



TOLL-8B

■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment									Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	9	
38NM60L-U2-TF1-T	38NM60G-U2-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U2-TW1-T	38NM60G-U2-TW1-T	TO-220WF	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U2-TQ2-T	38NM60G-U2-TQ2-T	TO-263	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U2-TQ2-R	38NM60G-U2-TQ2-R	TO-263	G	D	S	-	-	-	-	-	-	Tape Reel
38NM60L-U2-T47-T	38NM60G-U2-T47-T	TO-247	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U2-T3P-T	38NM60G-U2-T3P-T	TO-3P	G	D	S	-	-	-	-	-	-	Tube
38NM60L-U2-T8B-R	38NM60G-U2-T8B-R	TOLL-8B	G	S	S	S	S	S	S	S	D	Tape Reel

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

38NM60G-U2-TF1-T (1) Packing Type (2) Package Type (3) Version Code (4) Green Package	(1) T: Tube, R: Tape Reel (2) TF1: TO-220F1, TW1: TO-220WF, TQ2: TO-263 T47: TO-247, T3P: TO-3P, T8B: TOLL-8B (3) Version U2 (4) G: Halogen Free and Lead Free, L: Lead Free
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■ MARKING

TO-220F1 / TO-220WF TO-247 / TO-263 / TO-3P	TOLL-8B
Version Code ← UTC 38NM60 U2 □ □ □ □ → L: Lead Free Lot Code ← → G: Halogen Free Date Code 1	Version Code ← UTC 38NM60 U2 □ □ □ □ → L: Lead Free Lot Code ← → G: Halogen Free Date Code 1

■ **ABSOLUTE MAXIMUM RATINGS** ($T_C=25^{\circ}\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DS}	600	V
Gate-Source Voltage		V_{GS}	± 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/TO-220WF	P_D	40	W
	TO-247		145	W
	TO-263		128	W
	TO-3P		158	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/TO-220WF	θ_{JA}	62.5	$^{\circ}\text{C}/\text{W}$
	TO-263			
	TO-247		40	$^{\circ}\text{C}/\text{W}$
	TO-3P		30	$^{\circ}\text{C}/\text{W}$
	TOLL-8B		35 (Note)	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220F1/TO-220WF	θ_{JC}	3.125	$^{\circ}\text{C}/\text{W}$
	TO-247		0.86	$^{\circ}\text{C}/\text{W}$
	TO-263		0.97	$^{\circ}\text{C}/\text{W}$
	TO-3P		0.79	$^{\circ}\text{C}/\text{W}$
	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.

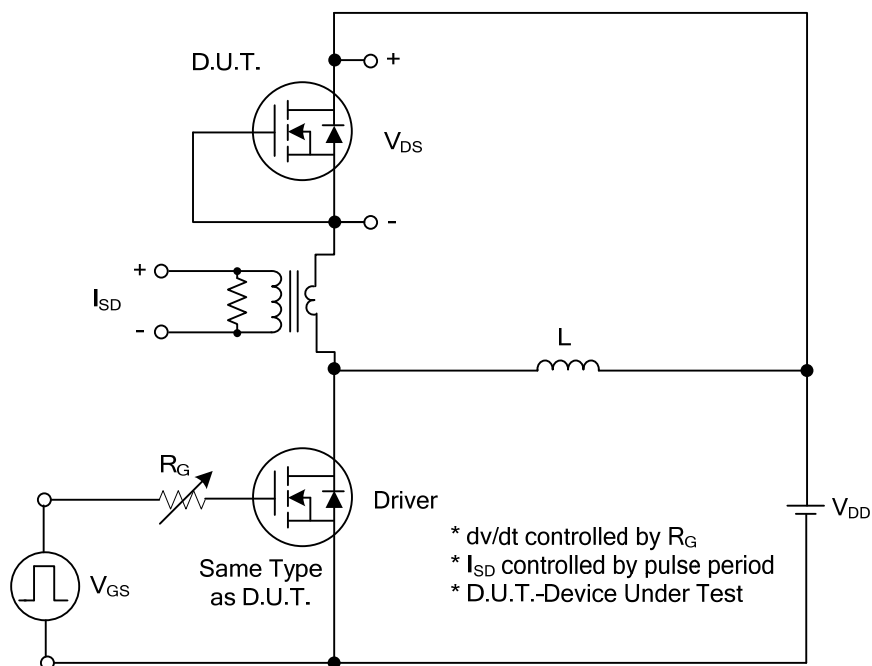
■ **ELECTRICAL CHARACTERISTICS** ($T_J=25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =250μA	600			V
Drain-Source Leakage Current	I _{DSS}	V _{DS} =600V, V _{GS} =0V			10	μA
Gate-Source Leakage Current	I _{GSS}	V _{GS} =±30V, V _{DS} =0V			±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 =9.5A			90	mΩ
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ISS}	V _{GS} =0V, V _{DS} =50V, f=1MHz		2336		pF
Output Capacitance	C _{OSS}			1001		pF
Reverse Transfer Capacitance	C _{RSS}			94		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge	Q _G	V _{DS} =480V, V _{GS} =10V, I _D =38A (Note 1, 2)		102		nC
Gate-Source Charge	Q _{GS}			17		nC
Gate-Drain Charge	Q _{DD}			65		nC
Turn-On Delay Time	t _{D(ON)}	V _{DD} =100V, V _{GS} =10V, I _D =38A, R _G =25Ω (Note 1, 2)		41		ns
Turn-On Rise Time	t _R			91		ns
Turn-Off Delay Time	t _{D(OFF)}			229		ns
Turn-Off Fall Time	t _F			93		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	I _S				38	A
Maximum Pulsed Drain-Source Diode Forward Current	I _{SM}				114	A
Drain-Source Diode Forward Voltage	V _{SD}	I _S =30A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time	t _{rr}	I _S =30A, V _{GS} =0V,		572		nS
Body Diode Reverse Recovery Charge	Q _{rr}	dl _F /dt=100A/μs		11.7		μC

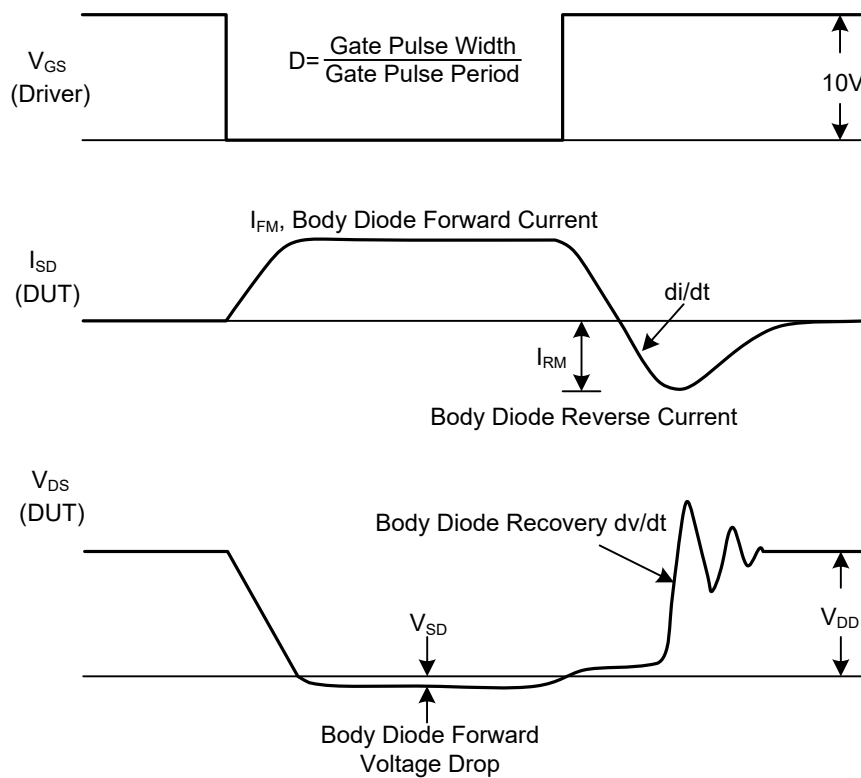
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

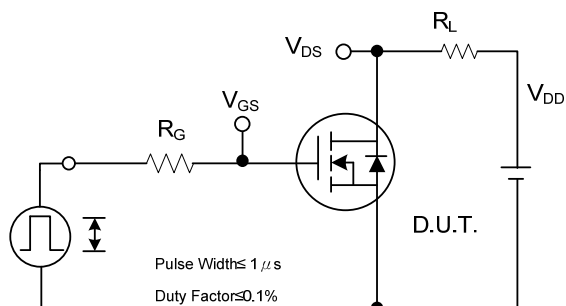


Peak Diode Recovery dv/dt Test Circuit

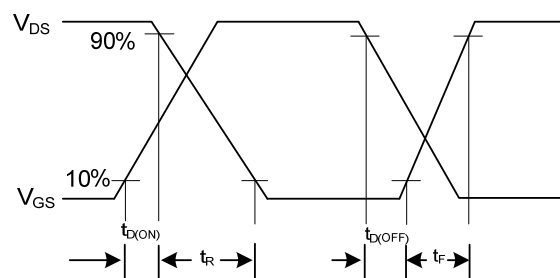


Peak Diode Recovery dv/dt Waveforms

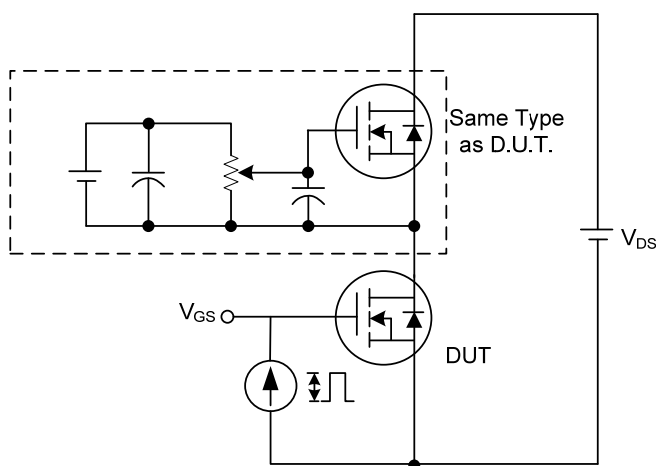
■ TEST CIRCUITS AND WAVEFORMS



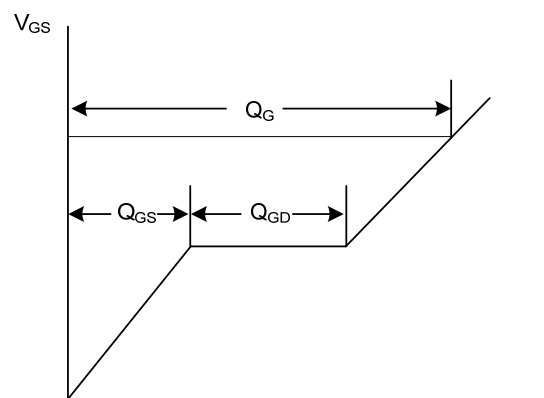
Switching Test Circuit



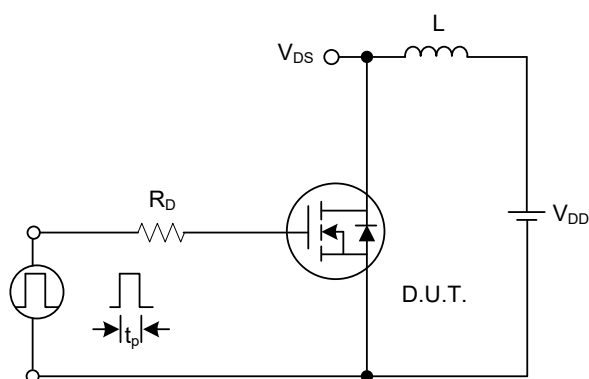
Switching Waveforms



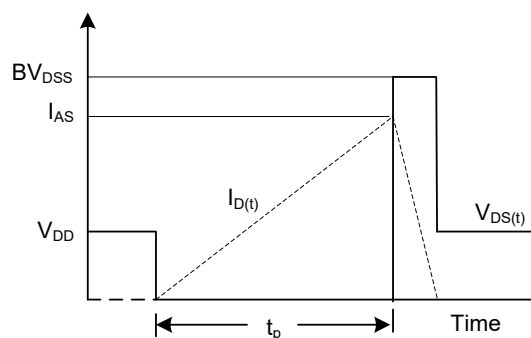
Gate Charge Test Circuit



Charge
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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