

**13NM60-U3**

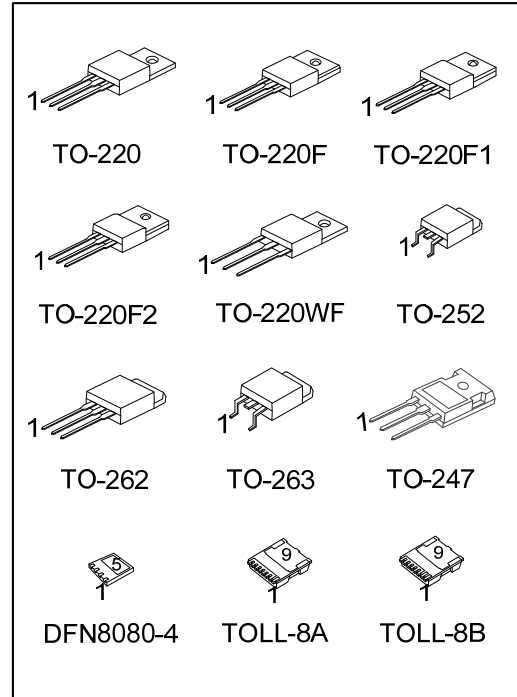
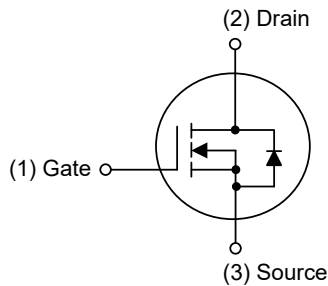
Preliminary

*Power MOSFET***13A, 600V N-CHANNEL
SUPER-JUNCTION MOSFET****DESCRIPTION**

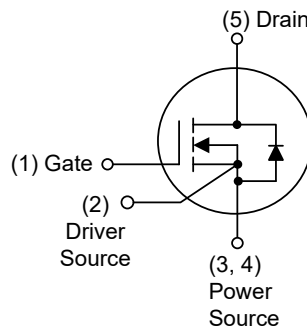
The **UTC 13NM60-U3** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

FEATURES

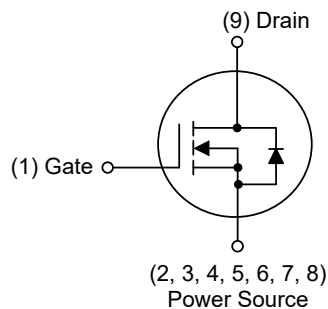
- * $R_{DS(ON)} \leq 0.36 \Omega$ @ $V_{GS}=10V$, $I_D=3.8A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness

**SYMBOL**

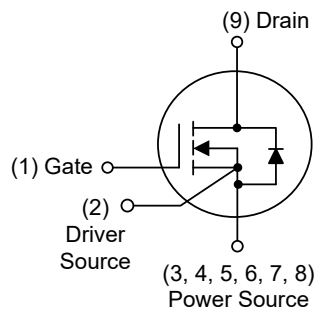
TO-220 / TO-220F / TO-220F1
TO-220F2 / TO-220WF / TO-252
TO-247 / TO-262 / TO-263



DFN8080-4



TOLL-8A



TOLL-8B

■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment									Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	9	
13NM60L-TA3-T	13NM60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TF1-T	13NM60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TF2-T	13NM60G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TF3-T	13NM60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TW1-T	13NM60G-TW1-T	TO-220WF	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TN3-R	13NM60G-TN3-R	TO-252	G	D	S	-	-	-	-	-	-	Tape Reel
13NM60L-T2Q-T	13NM60G-T2Q-T	TO-262	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TQ2-T	13NM60G-TQ2-T	TO-263	G	D	S	-	-	-	-	-	-	Tube
13NM60L-TQ2-R	13NM60G-TQ2-R	TO-263	G	D	S	-	-	-	-	-	-	Tape Reel
13NM60L-T47-T	13NM60G-T47-T	TO-247	G	D	S	-	-	-	-	-	-	Tube
13NM60L-K04-8080-R	13NM60G-K04-8080-R	DFN8080-4	G	S	S	S	D	-	-	-	-	Tape Reel
13NM60L-T8A-R	13NM60G-T8A-R	TOLL-8A	G	S	S	S	S	S	S	S	D	Tape Reel
13NM60L-T8B-R	13NM60G-T8B-R	TOLL-8B	G	S	S	S	S	S	S	S	D	Tape Reel

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

13NM60G-TA3-T (1) Packing Type (2) Package Type (3) Green Package	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TW1: TO-220WF, TN3: TO-252, TN3: TO-252, T2Q: TO-262, TQ2: TO-263, T47: TO-247, T474: TO-247-4, K04-8080: DFN8080-4, T8A: TOLL-8A, T8B: TOLL-8B (3) G: Halogen Free and Lead Free L: Lead Free
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■ MARKING

TO-220 / TO-220F / TO-220F1 TO-220F2 / TO-220WF / TO-252 TO-252 / TO-247 / TO-262 / TO-263	DFN8080-4
UTC 13NM60 Lot Code → 1 → Date Code L: Lead Free G: Halogen Free	UTC 13NM60 Lot Code → 1 → Date Code L: Lead Free G: Halogen Free
TOLL-8A / TOLL-8B	-
UTC 13NM60 Lot Code → 1 → Date Code L: Lead Free G: Halogen Free	-

■ **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	T _C =25°C	I _D	13	A
		T _C =100°C		8	A
	Pulsed (Note 2)		I _{DM}	39	A
Avalanche Energy	Single Pulsed (Note 3)		E _{AS}	136	mJ
Peak Diode Recovery dv/dt (Note 4)			dv/dt	1.18	V/ns
Power Dissipation	TO-220/TO-262/TO-263		P _D	82	W
	TO-220F/TO-220F1			28	W
	TO-220F2/TO-220WF				
	TO-247			90	W
	TO-252			58	W
	DFN8080-4			54	W
	TOLL-8A /TOLL-8A			160	W
Junction Temperature			T _J	+150	°C
Storage Temperature			T _{STG}	-55 ~ +150	°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. $L = 100\text{mH}$, $I_{AS} = 1.65\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$ Starting $T_J = 25^{\circ}\text{C}$

4. $I_{SD} \leq 13\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, 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-262/TO-263			
	TO-247		40	$^{\circ}\text{C}/\text{W}$
	TO-252		110	$^{\circ}\text{C}/\text{W}$
	DFN8080-4		35	$^{\circ}\text{C}/\text{W}$
Junction to Case	TOLL-8A /TOLL-8A	θ_{JC}	35	$^{\circ}\text{C}/\text{W}$
	TO-220/TO-262/TO-263		1.52	$^{\circ}\text{C}/\text{W}$
	TO-220F/TO-220F1		4.46	$^{\circ}\text{C}/\text{W}$
	TO-220F2/TO-220WF			
	TO-247		1.39	$^{\circ}\text{C}/\text{W}$
	TO-252		2.15 (Note)	$^{\circ}\text{C}/\text{W}$
	DFN8080-4		2.31 (Note)	$^{\circ}\text{C}/\text{W}$
	TOLL-8A /TOLL-8A		0.78 (Note)	$^{\circ}\text{C}/\text{W}$

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

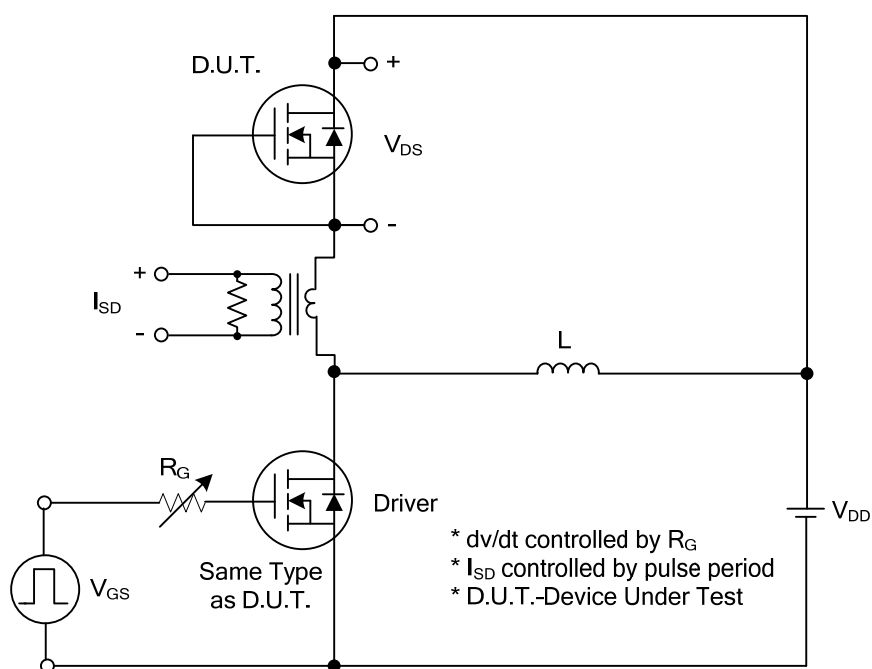
■ **ELECTRICAL CHARACTERISTICS** ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

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	Forward	I _{GSS}	V _{DS} =0V ,V _{GS} =30V			100	nA
	Reverse		V _{DS} =0V ,V _{GS} =-30V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} , I _D =250μA	2.5		4.5	V
Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V, I _D =3.8A		0.33	0.36	Ω
DYNAMIC PARAMETERS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =50V, f=1.0MHz		653		pF
Output Capacitance		C _{OSS}			202		pF
Reverse Transfer Capacitance		C _{RSS}			9.7		pF
SWITCHING PARAMETERS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =480V, V _{GS} =10V, I _D =13A (Note 1, 2)		44		Nc
Gate to Source Charge		Q _{GS}			9		nC
Gate to Drain Charge		Q _{GD}			21.3		nC
Turn-ON Delay Time (Note 1)		t _{D(ON)}	V _{DD} =100V, V _{GS} =10V, I _D =13A, R _G =25Ω (Note 1, 2)		7.2		ns
Rise Time		t _R			18.4		ns
Turn-OFF Delay Time		t _{D(OFF)}			24		ns
Fall-Time		t _F			19		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Continuous Drain-Source Diode Forward Current		I _S				13	A
Maximum Pulsed Drain-Source Diode Forward Current		I _{SM}				39	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	I _S =13A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t _{rr}	I _S =13A, V _{GS} =0V, dI _F /dt=100A/μs		318		ns
Body Diode Reverse Recovery Charge		Q _{rr}			4.1		μC

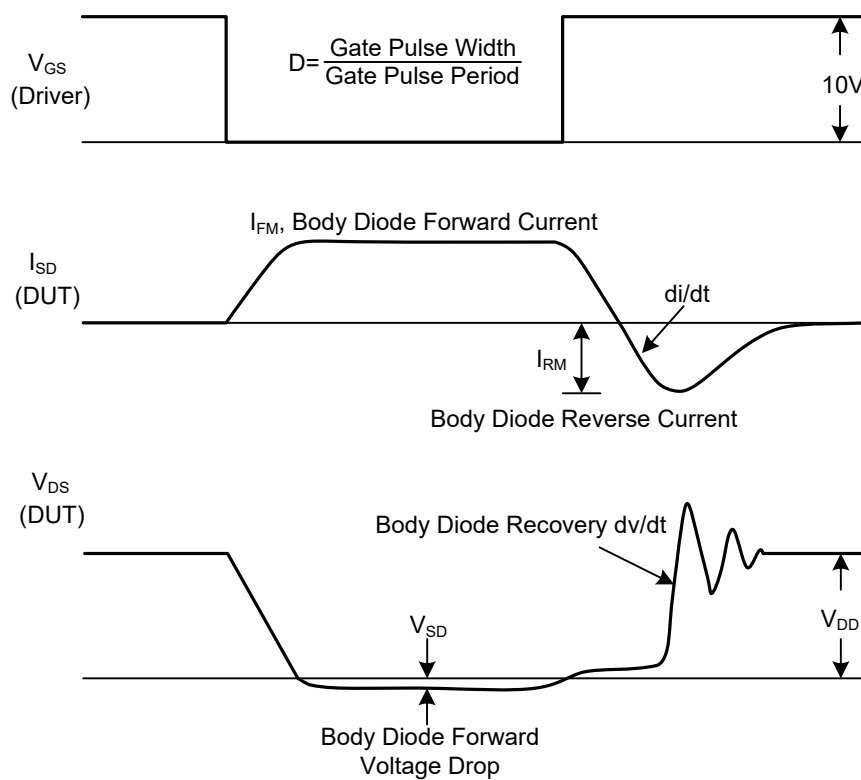
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

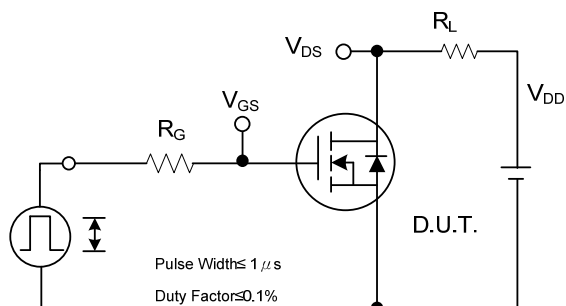


Peak Diode Recovery dv/dt Test Circuit

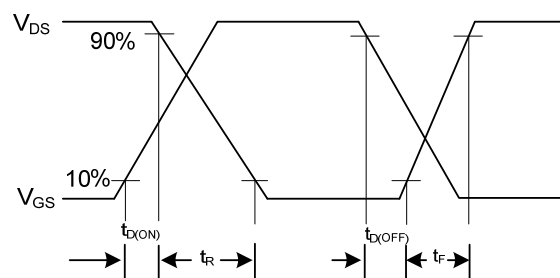


Peak Diode Recovery dv/dt Waveforms

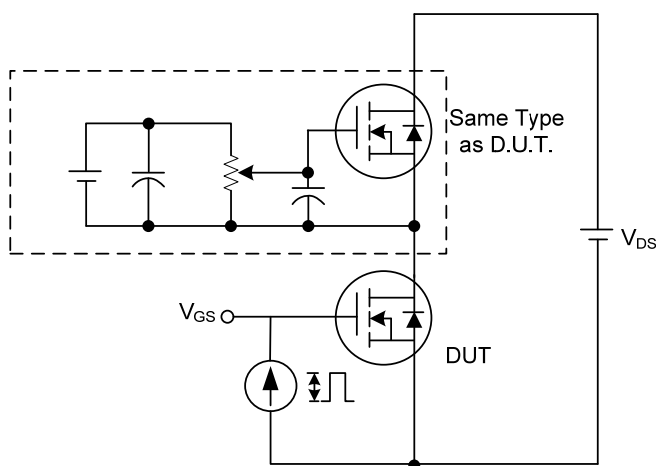
■ TEST CIRCUITS AND WAVEFORMS



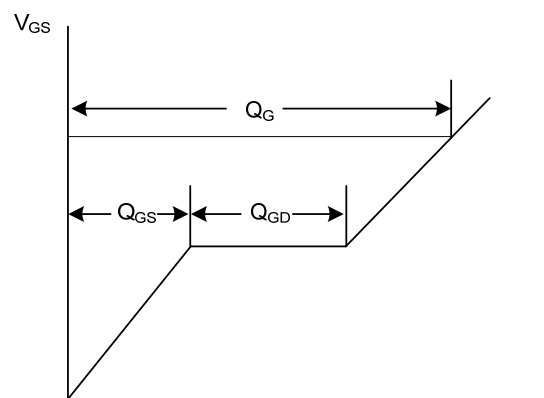
Switching Test Circuit



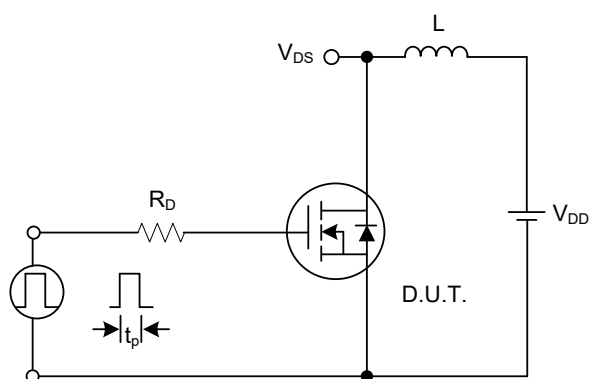
Switching Waveforms



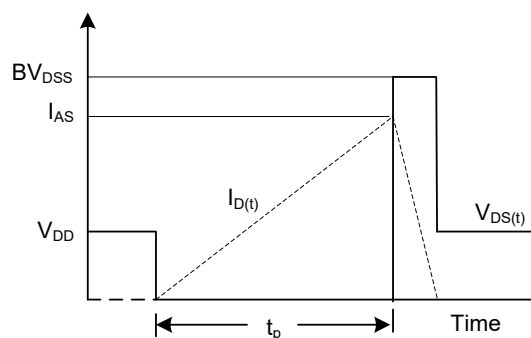
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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