

**13NM60Z-U3**

Preliminary

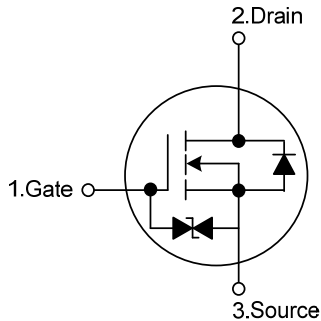
Power MOSFET

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

The **UTC 13NM60Z-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

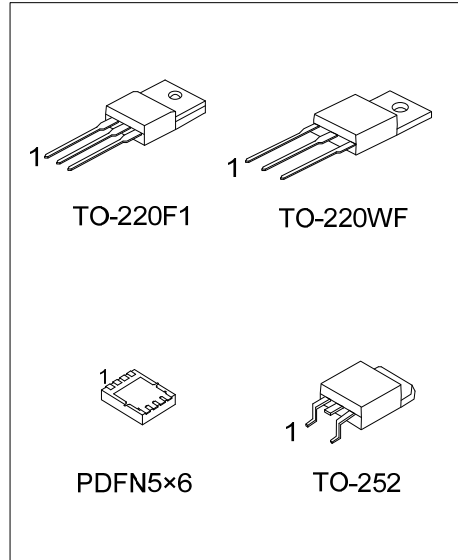
- * $R_{DS(ON)} \leq 0.43 \Omega$ @ $V_{GS}=10V$, $I_D=3.8A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness
- * With ESD protection

SYMBOL**ORDERING INFORMATION**

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
13NM60ZL-U3-TF1-T	13NM60ZG-U3-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
13NM60ZL-U3-TW1-T	13NM60ZG-U3-TW1-T	TO-220WF	G	D	S	-	-	-	-	-	Tube
13NM60ZL-U3-TN3-R	13NM60ZG-U3-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
13NM60ZL-U3-P5060-R	13NM60ZG-U3-P5060-R	PDFN5×6	S	S	S	G	D	D	D	D	Tape Reel

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

13NM60ZG-U3-TF1-T	(1) T: Tube, R: Tape Reel
(1)Packing Type	(2) TF1: TO-220F1, TW1: TO-220WF, TN3: TO-252
(2)Package Type	P5060: PDFN5×6
(3)Version Code	(3) Version U3
(4)Green Package	(4) G: Halogen Free and Lead Free, L: Lead Free



MARKING

TO-220F1 / TO-220WF / TO-252	PDFN5×6
UTC 13NM60Z U3 1 Version Code Lot Code L: Lead Free G: Halogen Free Date Code	UTC 13NM60Z U3 • Version Code Lot Code Date Code

■ **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}	±20	V
Drain Current	Continuous	T _C =25°C	I _D	13	A
	Pulsed (Note 2)		I _{DM}	39	A
Avalanche Energy	Single Pulsed (Note 3)		E _{AS}	12.5	mJ
Peak Diode Recovery dv/dt (Note 4)			dv/dt	1.3	V/ns
Power Dissipation	TO-220F1/TO-220WF		P _D	28	W
	TO-252			58	W
	PDFN5×6			45	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. $L = 100\text{mH}$, $I_{AS} = 0.5\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$ 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-220F1/TO-220WF	θ_{JA}	62.5	$^{\circ}\text{C}/\text{W}$
	TO-252		110	$^{\circ}\text{C}/\text{W}$
	PDFN5×6		75	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220F1/TO-220WF	θ_{JC}	4.46	$^{\circ}\text{C}/\text{W}$
	TO-252		2.15 (Note)	$^{\circ}\text{C}/\text{W}$
	PDFN5×6		2.77 (Note)	$^{\circ}\text{C}/\text{W}$

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

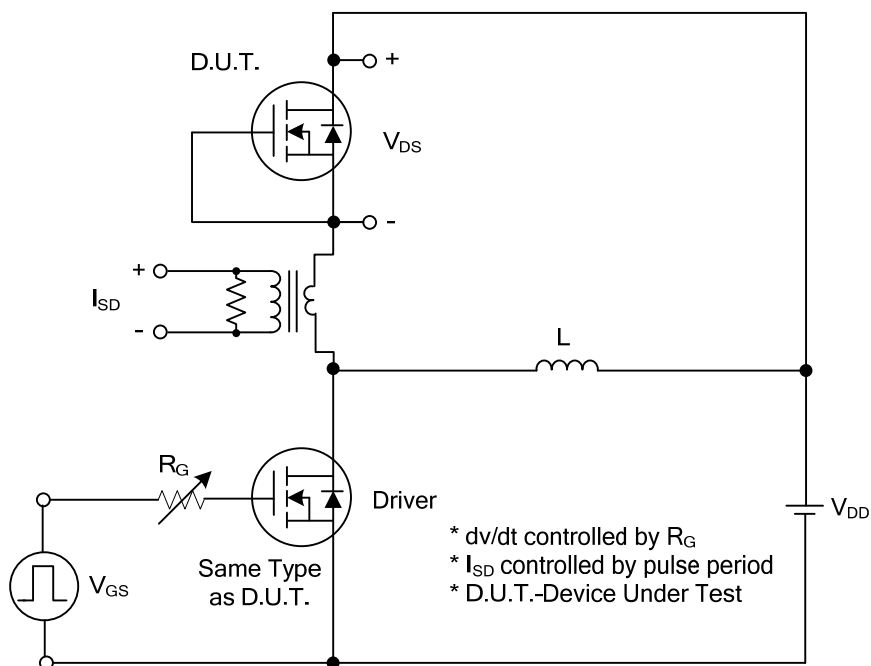
■ **ELECTRICAL CHARACTERISTICS** ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

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} =20V			10	μA
	Reverse		V _{DS} =0V, V _{GS} =-20V			-10	μA
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			0.43	Ω
DYNAMIC PARAMETERS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =50V, f=1.0MHz		846		pF
Output Capacitance		C _{OSS}			143		pF
Reverse Transfer Capacitance		C _{RSS}			6		pF
SWITCHING PARAMETERS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =480V, V _{GS} =10V, I _D =1.0A (Note 1, 2)		33		Nc
Gate to Source Charge		Q _{GS}			6		nC
Gate to Drain Charge		Q _{GD}			10		nC
Turn-ON Delay Time (Note 1)		t _{D(ON)}	V _{DD} =100V, V _{GS} =10V, I _D =3.25A, R _G =25Ω (Note 1, 2)		9		ns
Rise Time		t _R			22		ns
Turn-OFF Delay Time		t _{D(OFF)}			91		ns
Fall-Time		t _F			37		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Continuous Drain-Source Diode Forward Current		I _S				13	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		268		ns
Body Diode Reverse Recovery Charge		Q _{rr}			2711		nC

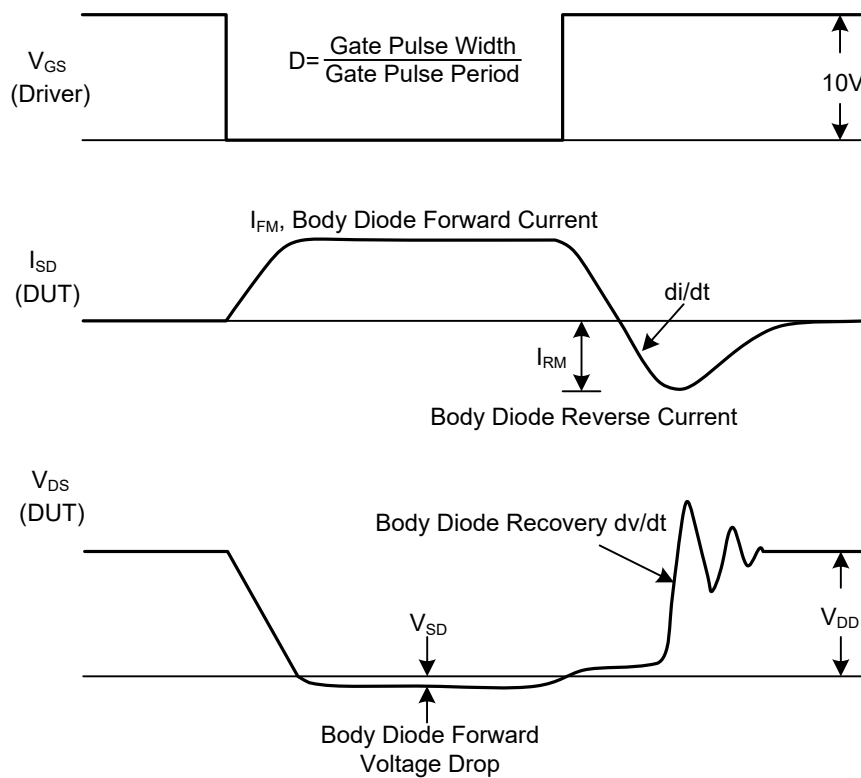
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

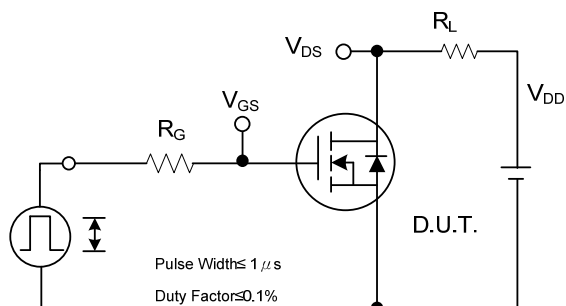


Peak Diode Recovery dv/dt Test Circuit

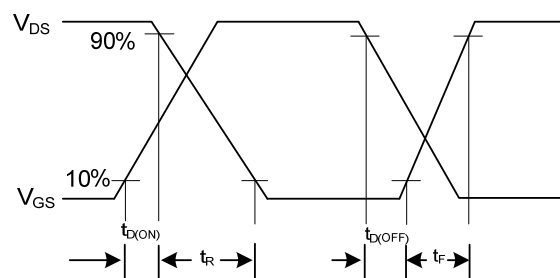


Peak Diode Recovery dv/dt Waveforms

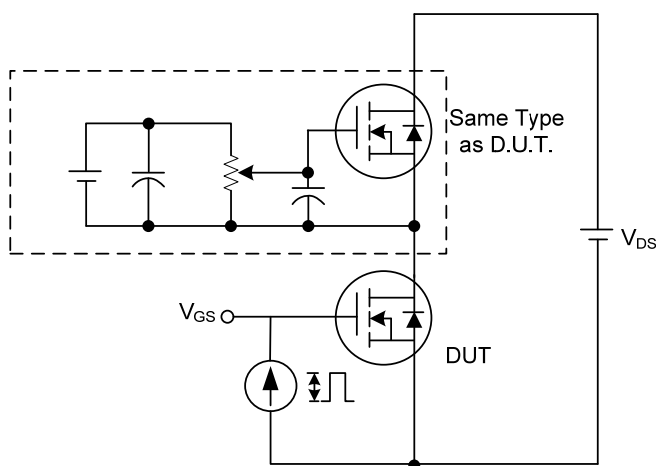
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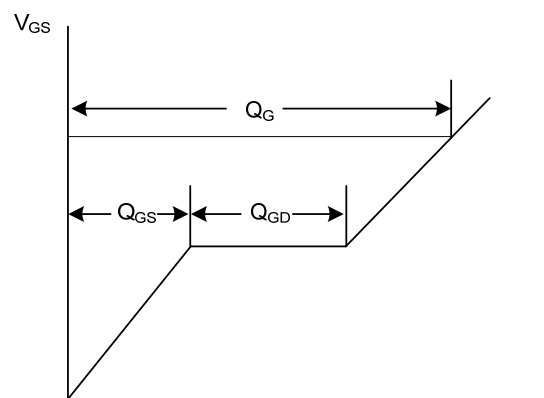
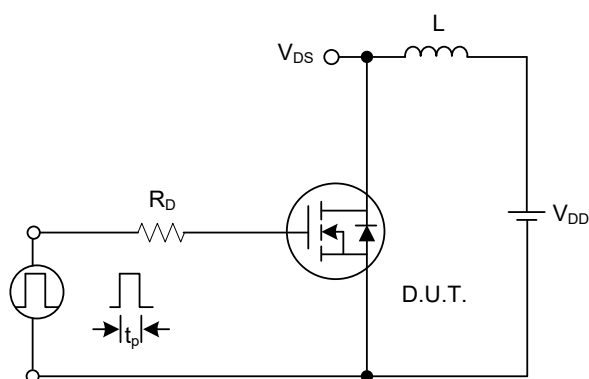
Switching Test Circuit



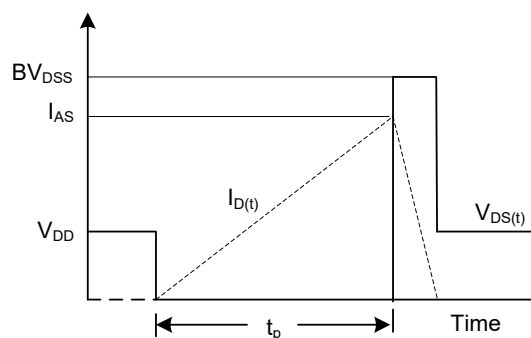
Switching Waveforms



Gate Charge Test Circuit

Charge
Gate Charge Waveform

Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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