

**33NM60Z-U3**

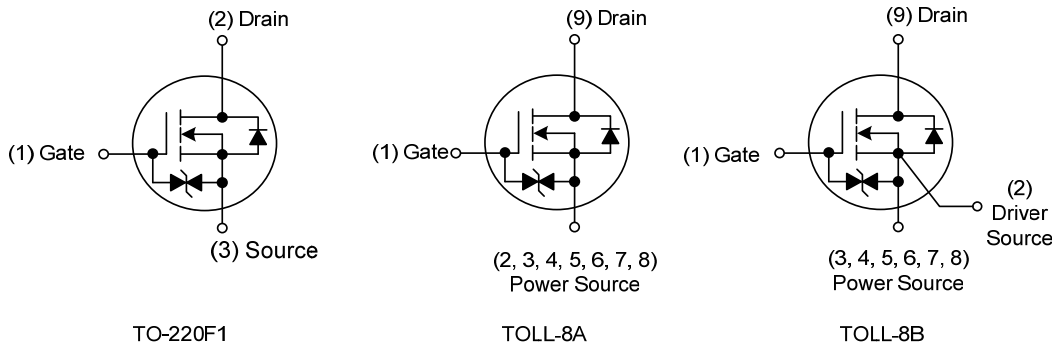
Preliminary

Power MOSFET**33A, 600V N-CHANNEL
SUPER-JUNCTION MOSFET****DESCRIPTION**

The **UTC 33NM60Z-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

- * $R_{DS(ON)} \leq 0.13 \Omega$ @ $V_{GS}=10V$, $I_D=16A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness
- * With ESD Protected: HBM=2KV

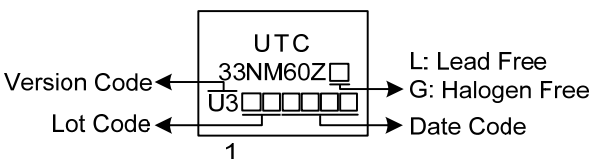
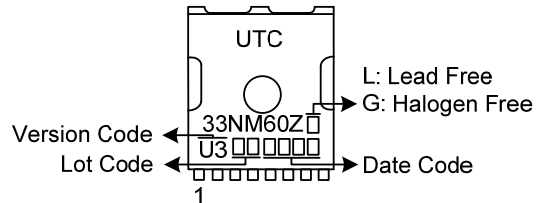
SYMBOL**ORDERING INFORMATION**

Ordering Number		Package	Pin Assignment									Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	9	
33NM60ZL-U3-TF1-T	33NM60ZG-U3-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
33NM60ZL-U3-T8A-R	33NM60ZG-U3-T8A-R	TOLL-8A	G	S	S	S	S	S	S	S	D	Tape Reel
33NM60ZL-U3-T8B-R	33NM60ZG-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

	(1)Packing Type	(1) T: Tube, R: Tape Reel
	(2)Package Type	(2) TF1: TO-220F1, T8A: TOLL-8A, T8B: TOLL-8B
	(3)Version Code	(3) Version U3
	(4)Green Package	(4) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

TO-220F1	TOLL-8A / TOLL-8B
 UTC 33NM60Z U3 1 Version Code ← Lot Code ← → Date Code L: Lead Free G: Halogen Free	 UTC 33NM60Z U3 1 Version Code ← Lot Code ← → 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_{DS}	600	V
Gate-Source Voltage		V_{GS}	± 20	V
Drain Current	Continuous ($T_C=25^{\circ}\text{C}$)	I_D	33	A
	Pulsed (Note 2)	I_{DM}	99	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	22.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1.3	V/ns
Power Dissipation	TO-220F1	P_D	41	W
	TOLL-8A/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. $L = 10\text{mH}$, $I_{AS} = 2.1\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$ Starting $T_J = 25^{\circ}\text{C}$.

4. $I_{SD} \leq 33\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DS}$, Starting $T_J = 25^{\circ}\text{C}$.

■ **THERMAL DATA**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F1	θ_{JA}	62.5	$^{\circ}\text{C}/\text{W}$
	TOLL-8A/TOLL-8B		35 (Note)	$^{\circ}\text{C}/\text{W}$
Junction to Case	TO-220F1	θ_{JC}	3.05	$^{\circ}\text{C}/\text{W}$
	TOLL-8A/TOLL-8B		0.56 (Note)	$^{\circ}\text{C}/\text{W}$

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

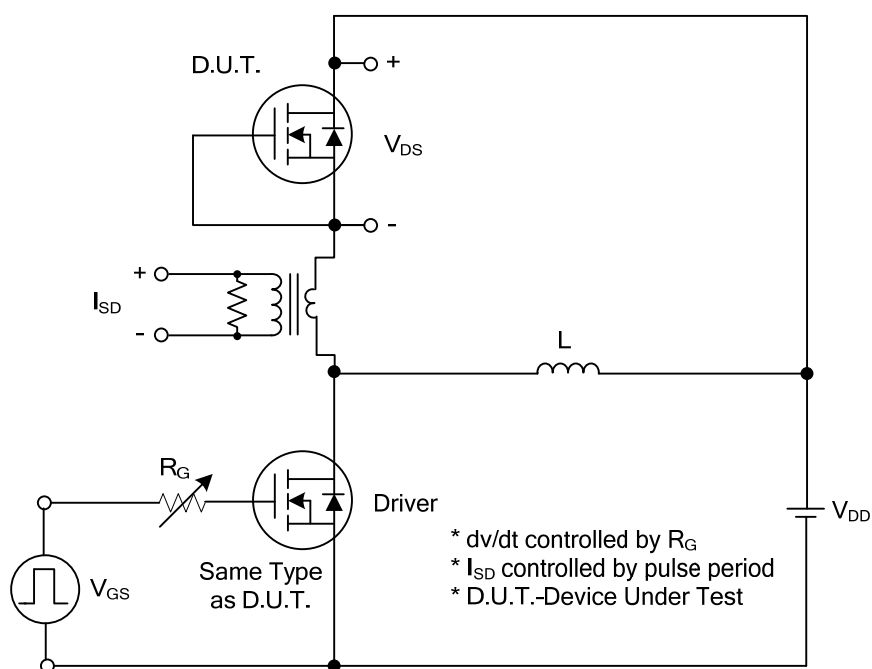
■ **ELECTRICAL CHARACTERISTICS** ($T_J=25^\circ\text{C}$, unless otherwise specified)

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} =±20V, V _{DS} =0V			±10	μA
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 =16A			0.13	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ISS}	V _{GS} =0V, V _{DS} =50V, f=1MHz		1767		pF
Output Capacitance	C _{OSS}			540		pF
Reverse Transfer Capacitance	C _{RSS}			19		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge (Note 1)	Q _G	V _{DS} =480V, V _{GS} =10V, I _D =33A (Note 1, 2)		71		nC
Gate-Source Charge	Q _{GS}			12		nC
Gate-Drain Charge	Q _{DD}			36		nC
Turn-On Delay Time (Note 1)	t _{D(ON)}	V _{DD} =100V, V _{GS} =10V, I _D =33A, R _G =25Ω (Note 1, 2)		28		ns
Turn-On Rise Time	t _R			36		ns
Turn-Off Delay Time	t _{D(OFF)}			218		ns
Turn-Off Fall Time	t _F			118		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	I _S				33	A
Drain-Source Diode Forward Voltage (Note 1)	V _{SD}	I _S =33A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t _{rr}	I _S =33A, V _{GS} =0V, dI _F /dt=100A/μs		448		ns
Body Diode Reverse Recovery Charge	Q _{rr}			7548		nC

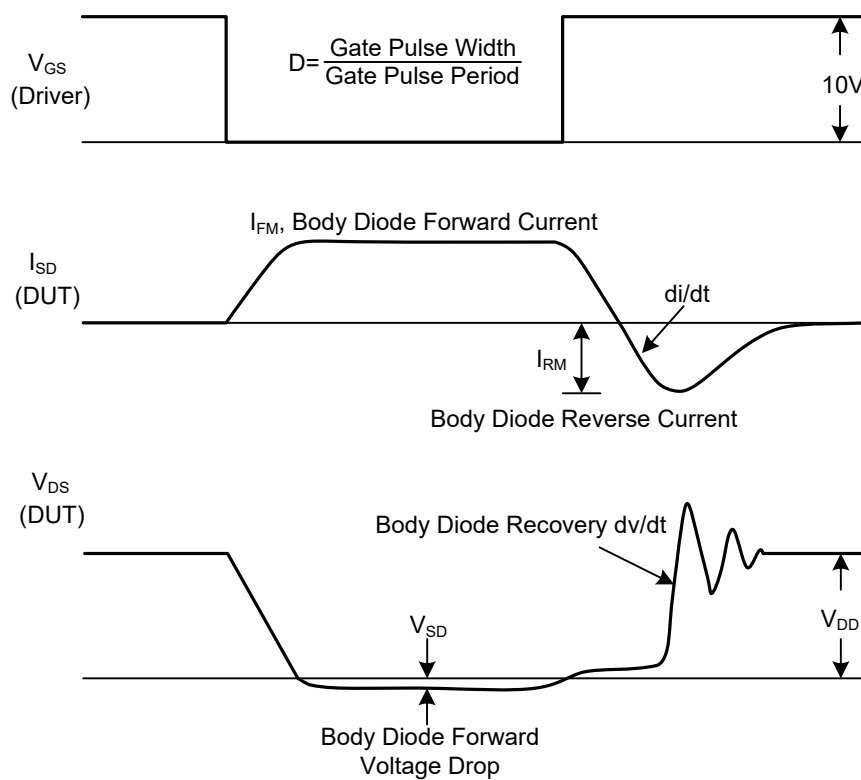
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

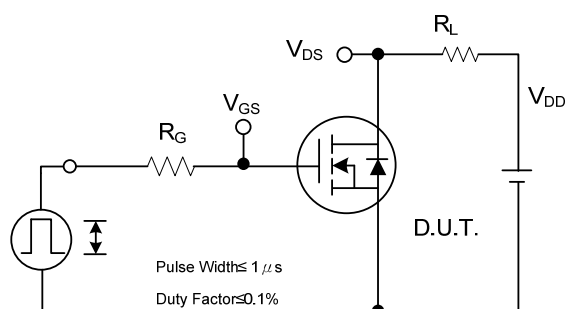


Peak Diode Recovery dv/dt Test Circuit

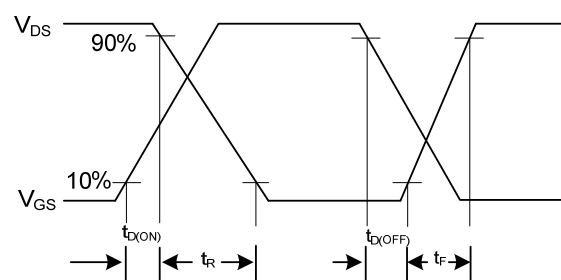


Peak Diode Recovery dv/dt Waveforms

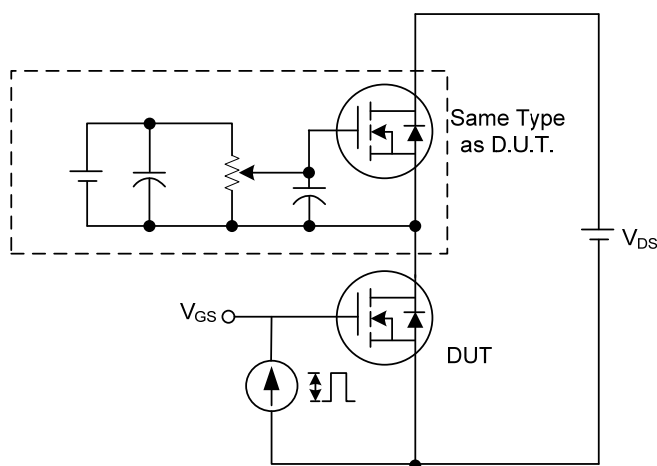
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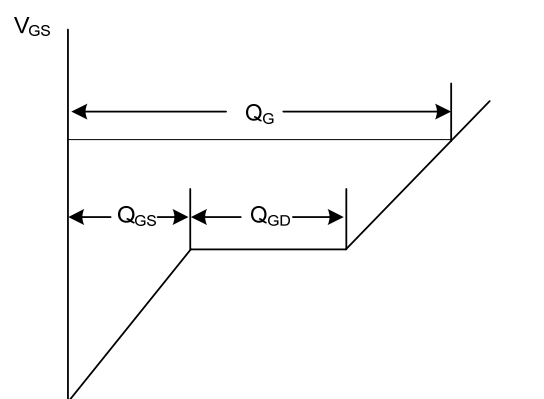
Switching Test Circuit



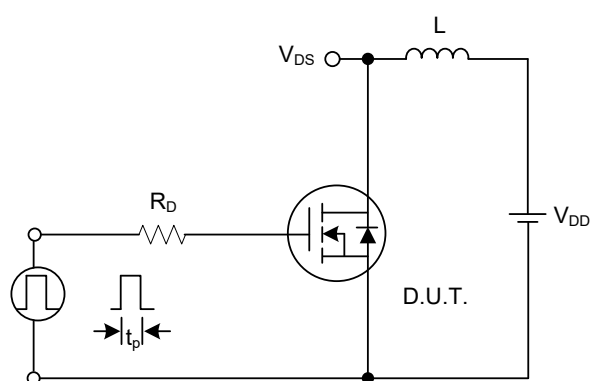
Switching Waveforms



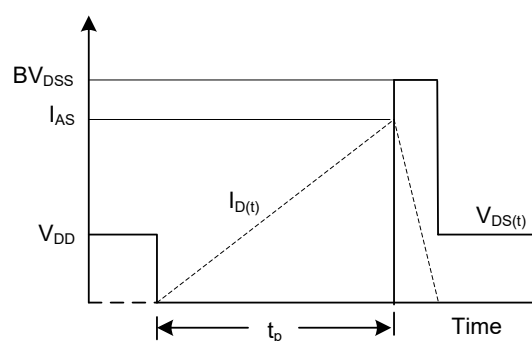
Gate Charge Test Circuit



Charge
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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