



## 20NM65Z-U3

Preliminary

Power MOSFET

### 20A, 650V N-CHANNEL SUPER-JUNCTION MOSFET

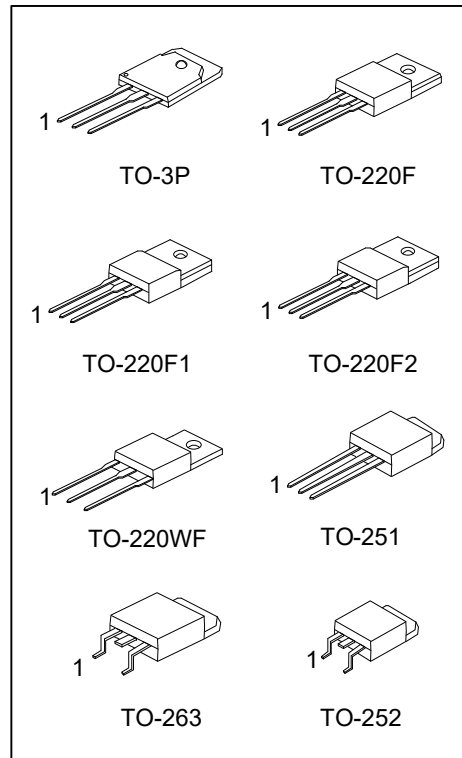
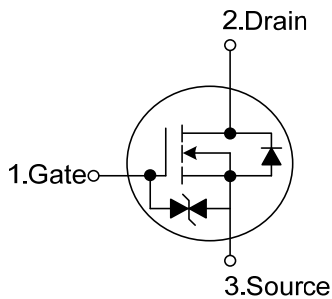
#### DESCRIPTION

The **UTC 20NM65Z-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

- \*  $R_{DS(ON)} \leq 0.2 \Omega$  @  $V_{GS}=10V$ ,  $I_D=5.0A$
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved dv/dt capability, high ruggedness
- \* With ESD Protected: HBM=2KV

#### SYMBOL



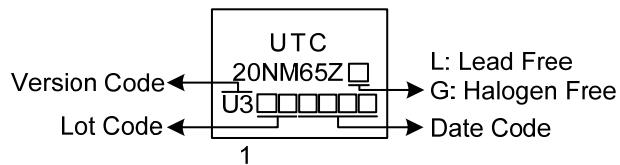
### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
20NM65ZL-U3-TF1-T	20NM65ZG-U3-TF1-T	TO-220F1	G	D	S	Tube
20NM65ZL-U3-TF2-T	20NM65ZG-U3-TF2-T	TO-220F2	G	D	S	Tube
20NM65ZL-U3-TF3-T	20NM65ZG-U3-TF3-T	TO-220F	G	D	S	Tube
20NM65ZL-U3-TW1-T	20NM65ZG-U3-TW1-T	TO-220WF	G	D	S	Tube
20NM65ZL-U3-TM3-T	20NM65ZG-U3-TM3-T	TO-251	G	D	S	Tube
20NM65ZL-U3-TN3-R	20NM65ZG-U3-TN3-R	TO-252	G	D	S	Tape Reel
20NM65ZL-U3-TQ2-T	20NM65ZG-U3-TQ2-T	TO-263	G	D	S	Tube
20NM65ZL-U3-TQ2-R	20NM65ZG-U3-TQ2-R	TO-263	G	D	S	Tape Reel
20NM65ZL-U3-T3P-T	20NM65ZG-U3-T3P-T	TO-3P	G	D	S	Tube

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

<p>20NM65ZG-U3-TF1-T</p> <p>(1) Packing Type (2) Package Type (3) Version Code (4) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F TW1: TO-220WF, TM3: TO-251, TN3: TO-252 TQ2: TO-263, T3P: TO-3P (3) Version U3 (4) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING



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

PARAMETER		SYMBOL	RATINGS	UNIT	
Drain-Source Voltage		$V_{DSS}$	650	V	
Gate-Source Voltage		$V_{GSS}$	$\pm 20$	V	
Drain Current	Continuous	$I_D$	$T_C=25^\circ\text{C}$	20	A
			$T_C=100^\circ\text{C}$	12	A
	Pulsed (Note 2)		$I_{DM}$	60	A
Avalanche Energy	Single Pulsed (Note 3)		$E_{AS}$	75.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1.2	V/ns	
Power Dissipation	TO-220F/TO-220F1 TO-220F2/TO-220WF		$P_D$	33	W
	TO-252			64	W
	TO-263			105	W
	TO-3P			130	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.  $L = 10\text{mH}$ ,  $I_{AS} = 3.89\text{A}$ ,  $V_{DD} = 90\text{V}$ ,  $R_G = 25\Omega$  Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 20\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT	
Junction to Ambient	TO-220F/TO-220F1 TO-220F2/TO-220WF		$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-252			110	$^\circ\text{C}/\text{W}$
	TO-263			62.5	$^\circ\text{C}/\text{W}$
	TO-3P			30	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F/TO-220F1 TO-220F2/TO-220WF		$\theta_{JC}$	3.78	$^\circ\text{C}/\text{W}$
	TO-252			1.95 (Note)	$^\circ\text{C}/\text{W}$
	TO-263			1.19	$^\circ\text{C}/\text{W}$
	TO-3P			0.96	$^\circ\text{C}/\text{W}$

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

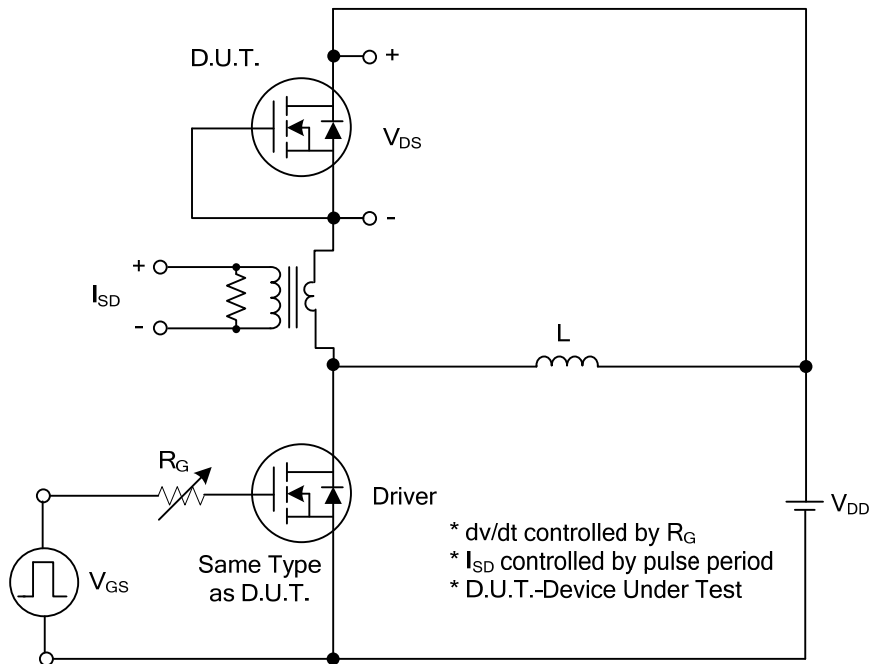
■ ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25°C, unless otherwise specified)

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	650			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V			10	μA
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V			±10	μA
<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> =5.0A			0.2	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1MHz		1250		pF
Output Capacitance	C <sub>OSS</sub>			422		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			15		pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge (Note 1)	Q <sub>G</sub>	V <sub>DS</sub> =520V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A (Note 1, 2)		49		nC
Gate-Source Charge	Q <sub>GS</sub>			20		nC
Gate-Drain Charge	Q <sub>DD</sub>			13		nC
Turn-On Delay Time (Note 1)	t <sub>D(ON)</sub>	V <sub>DD</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A, R <sub>G</sub> =25Ω (Note 1, 2)		20		ns
Turn-On Rise Time	t <sub>R</sub>			31		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			146		ns
Turn-Off Fall Time	t <sub>F</sub>			64		ns
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				20	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				60	A
Drain-Source Diode Forward Voltage (Note 1)	V <sub>SD</sub>	I <sub>S</sub> =20A, V <sub>GS</sub> =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t <sub>rr</sub>	I <sub>S</sub> =20A, V <sub>GS</sub> =0V, dI <sub>F</sub> /dt=100A/μs		400		nS
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>				6214	

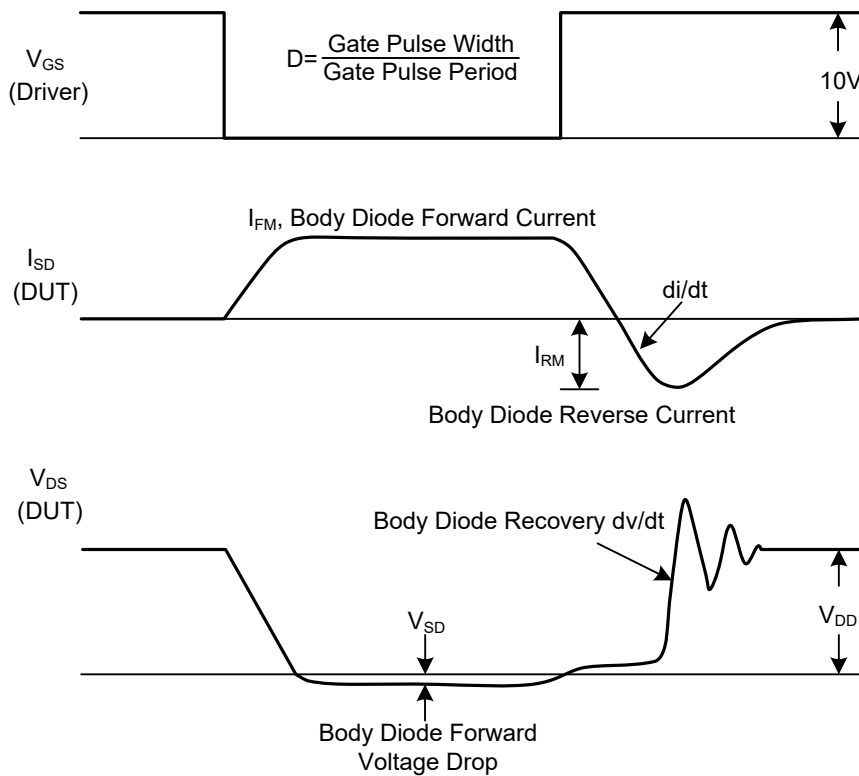
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

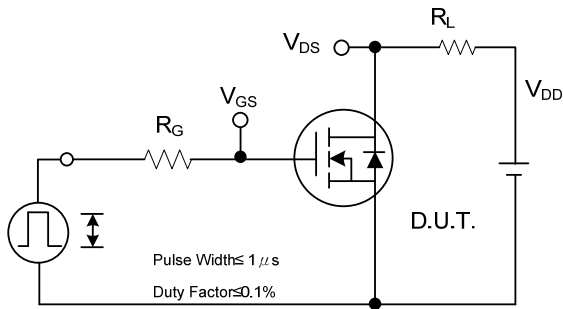


Peak Diode Recovery dv/dt Test Circuit

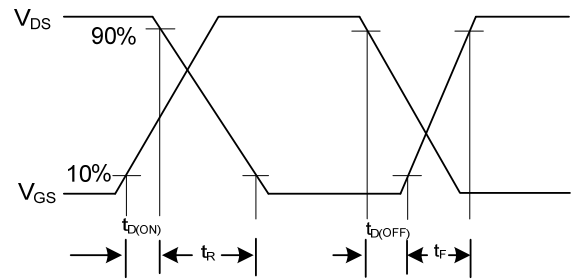


Peak Diode Recovery dv/dt Waveforms

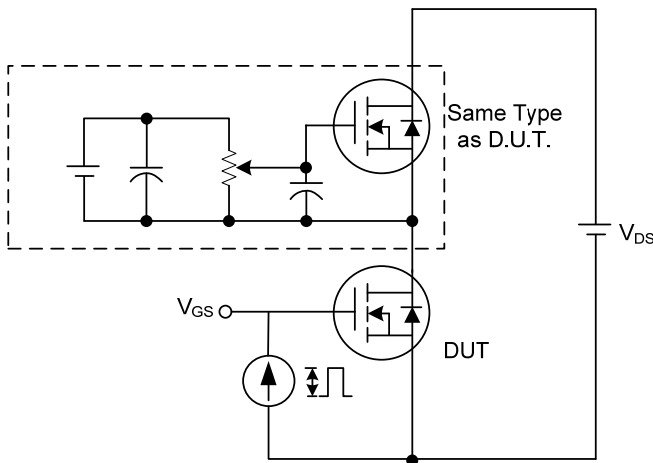
■ TEST CIRCUITS AND WAVEFORMS



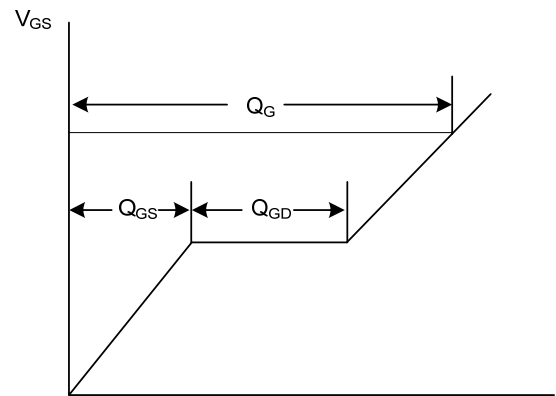
Switching Test Circuit



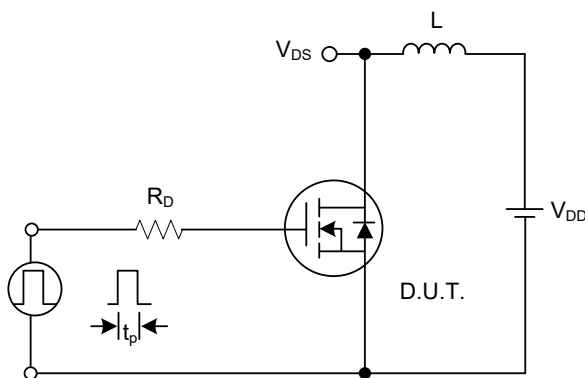
Switching Waveforms



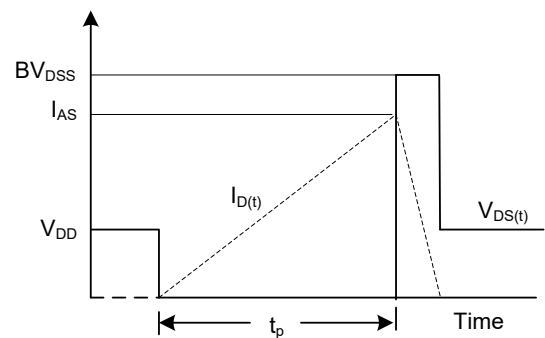
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



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