



## 5N65Z

Preliminary

Power MOSFET

### 5A, 650V N-CHANNEL POWER MOSFET

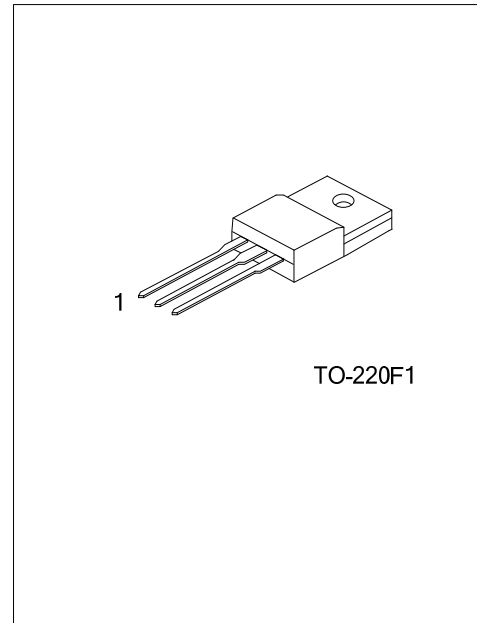
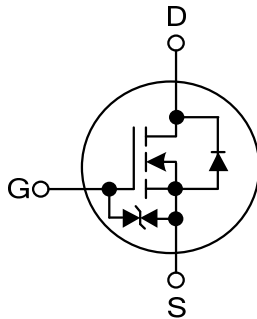
#### DESCRIPTION

The UTC **5N65Z** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications at power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} = 2.4\Omega @ V_{GS} = 10V$
- \* Ultra Low Gate Charge ( Typical 15 nC )
- \* Low Reverse Transfer Capacitance (  $C_{RSS} =$  Typical 6.5 pF )
- \* Fast Switching Capability
- \* Avalanche Energy Specified
- \* Improved dv/dt Capability, High Ruggedness

#### SYMBOL



#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
5N65ZL-TF1-T	5N65ZG-TF1-T	TO-220F1	G	D	S	Tube

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

<p>5N65ZL-TF1-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Lead Free</p>	<p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF1: TO-220F1</p> <p>(3) L: Lead Free, G: Halogen Free</p>
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■ 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
Avalanche Current (Note 2)	$I_{AR}$	5	A
Continuous Drain Current	$I_D$	5	A
Pulsed Drain Current (Note 2)	$I_{DM}$	20	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	210
	Repetitive (Note 2)	$E_{AR}$	10
Peak Diode Recovery dv/dt (Note 4)	dv/dt	4.5	V/ns
Power Dissipation	$P_D$	36	W
Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Operation Temperature	$T_{OPR}$	-55 ~ +150	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-55 ~ +150	$^\circ\text{C}$

Note: 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. Pulse width limited by  $T_{J(MAX)}$

3.  $L = 16.8\text{mH}$ ,  $I_{AS} = 5\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 5\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
Junction to Case	$\theta_{JC}$	3.47	$^\circ\text{C}/\text{W}$

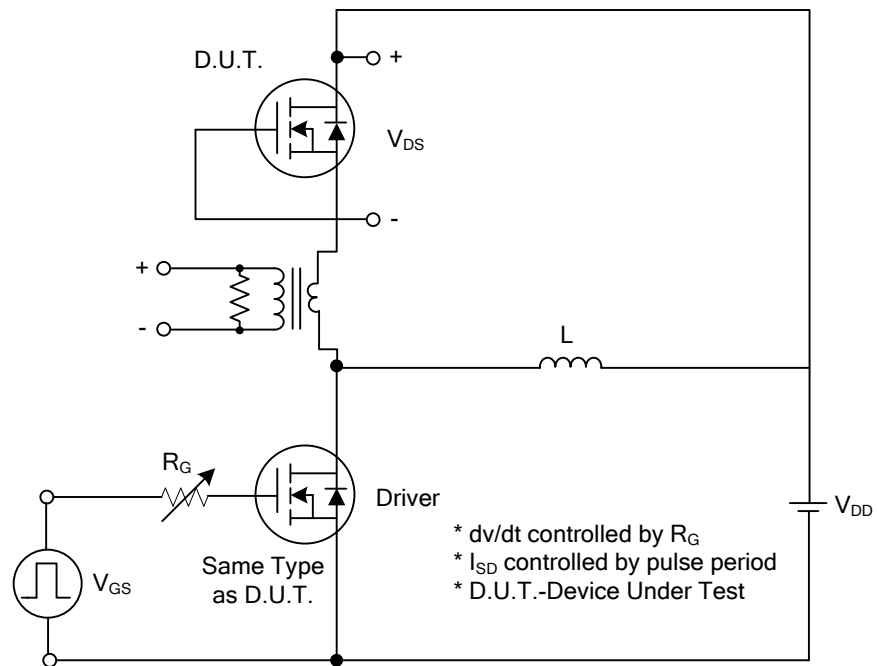
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise specified)

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			1	μA	
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			+5	μA	
	Reverse						V <sub>GS</sub> = 20V, V <sub>DS</sub> = 0V
		V <sub>GS</sub> = -20V, V <sub>DS</sub> = 0V			-5		
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> = 250μA, Referenced to 25°C		0.6		V/°C	
<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	2.0		4.0	V	
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.5A		2.0	2.4	Ω	
<b>DYNAMIC CHARACTERISTICS</b>							
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz		515	670	pF	
Output Capacitance	C <sub>OSS</sub>				55	72	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>				6.5	8.5	pF
<b>SWITCHING CHARACTERISTICS</b>							
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 325V, I <sub>D</sub> = 5A, R <sub>G</sub> = 25Ω (Note 1, 2)		10	30	ns	
Turn-On Rise Time	t <sub>R</sub>				42	90	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>				38	85	ns
Turn-Off Fall Time	t <sub>F</sub>			46	100	ns	
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> = 520 V, I <sub>D</sub> = 5A, V <sub>GS</sub> = 10 V (Note 1, 2)		15	19	nC	
Gate-Source Charge	Q <sub>GS</sub>				2.5		nC
Gate-Drain Charge	Q <sub>GD</sub>				6.6		nC
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>							
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5A			1.4	V	
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				5	A	
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				20	A	
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5A, dI <sub>F</sub> / dt = 100 A/μs (Note 1)		300		ns	
Reverse Recovery Charge	Q <sub>RR</sub>				2.2		μC

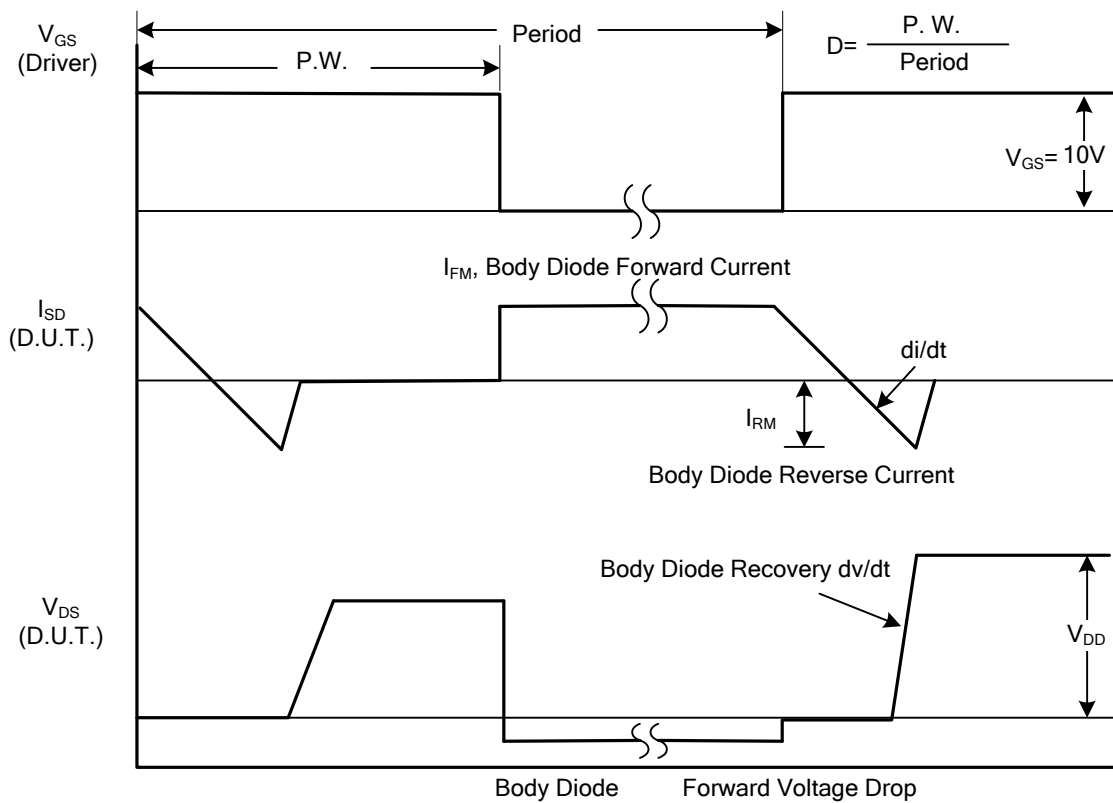
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

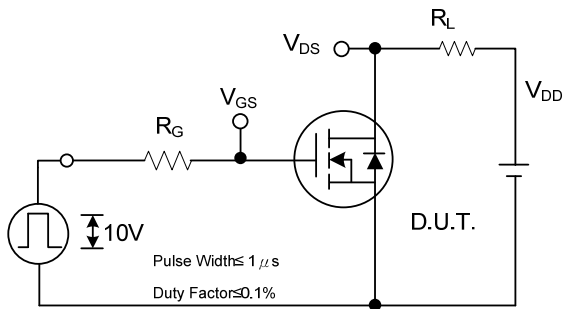


Peak Diode Recovery  $dv/dt$  Test Circuit

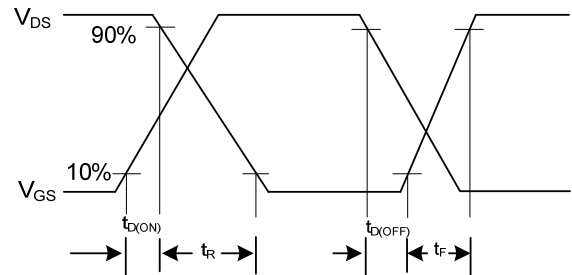


Peak Diode Recovery  $dv/dt$  Waveforms

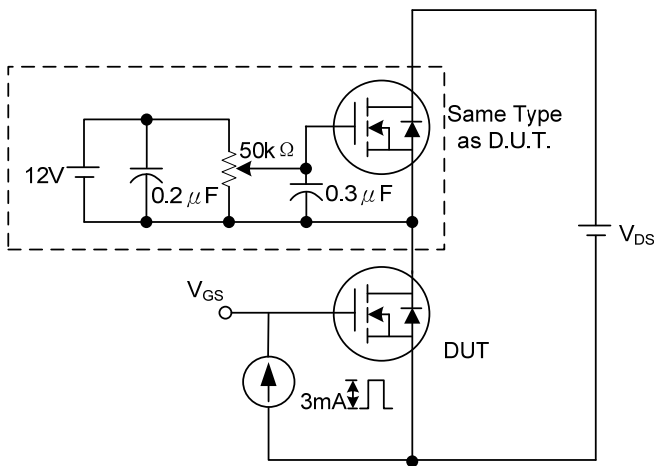
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



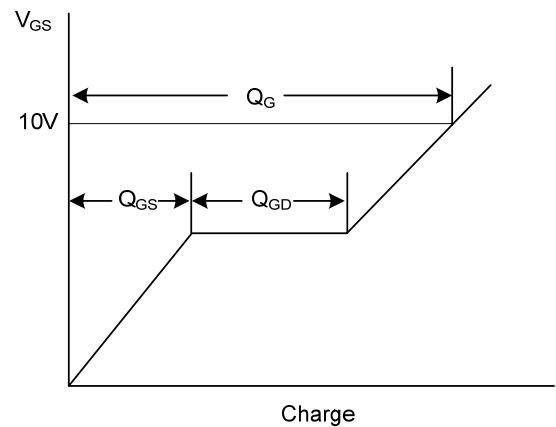
Switching Test Circuit



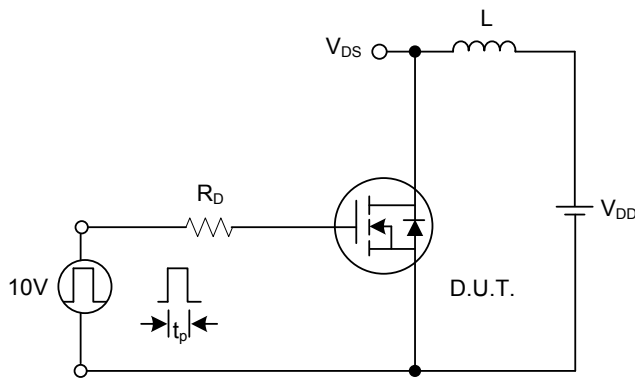
Switching Waveforms



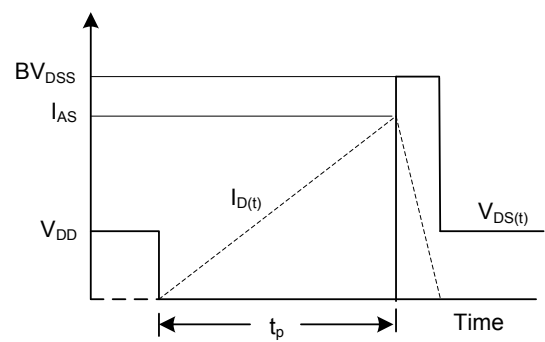
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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