



3N65K-MK

Preliminary

Power MOSFET

3A, 650V N-CHANNEL  
POWER MOSFET

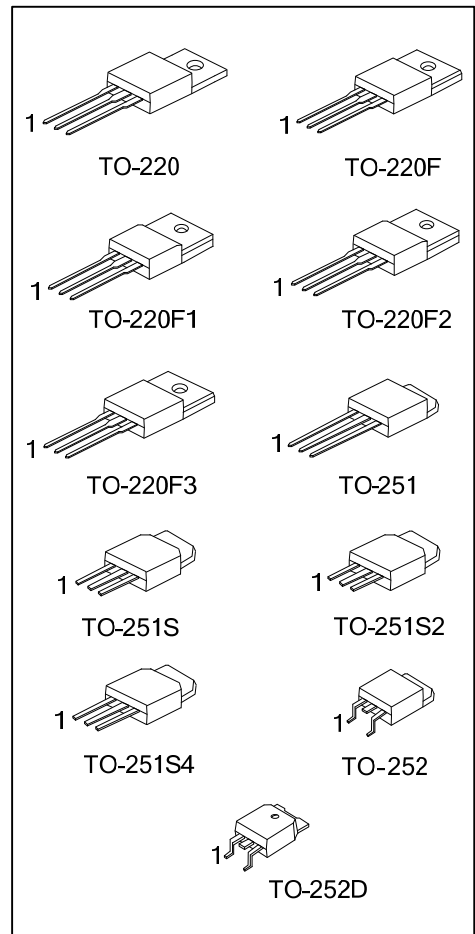
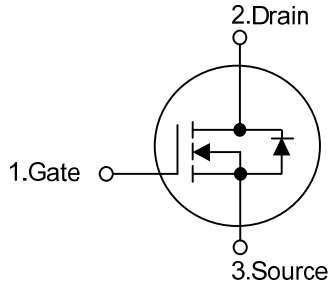
DESCRIPTION

The UTC **3N65K-MK** is a high voltage and high current 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

- \*  $R_{DS(ON)} < 4.0\Omega$  @  $V_{GS} = 10V, I_D = 1.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved  $dv/dt$  capability, high ruggedness

SYMBOL



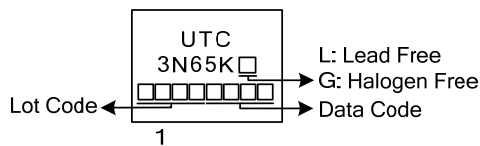
### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
3N65KL-TA3-T	3N65KG-TA3-T	TO-220	G	D	S	Tube
3N65KL-TF3-T	3N65KG-TF3-T	TO-220F	G	D	S	Tube
3N65KL-TF1-T	3N65KG-TF1-T	TO-220F1	G	D	S	Tube
3N65KL-TF2-T	3N65KG-TF2-T	TO-220F2	G	D	S	Tube
3N65KL-TF3-T	3N65KG-TF3-T	TO-220F3	G	D	S	Tube
3N65KL-TM3-T	3N65KG-TM3-T	TO-251	G	D	S	Tube
3N65KL-TMS-T	3N65KG-TMS-T	TO-251S	G	D	S	Tube
3N65KL-TMS2-T	3N65KG-TMS2-T	TO-251S2	G	D	S	Tube
3N65KL-TMS4-T	3N65KG-TMS4-T	TO-251S4	G	D	S	Tube
3N65KL-TN3-R	3N65KG-TN3-R	TO-252	G	D	S	Tape Reel
3N65KL-TND-R	3N65KG-TND-R	TO-252D	G	D	S	Tape Reel

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

<p>3N65KL-TA3-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel</p> <p>(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F3, TM3: TO-251 TMS: TO-251S, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TND: TO-252D</p> <p>(3) L: Lead Free, G: Halogen Free and 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		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	3.0	A
Continuous Drain Current		$I_D$	3.0	A
Pulsed Drain Current (Note 2)		$I_{DM}$	12	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	75	mJ
	Repetitive (Note 2)	$E_{AR}$	7.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220	$P_D$	75	W
	TO-220F/TO-220F1 TO-220F3		34	W
	TO-220F2		35	W
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		50	W
	Derate above $25^\circ\text{C}$			
Derate above $25^\circ\text{C}$	TO-220	$P_D$	0.6	W/ $^\circ\text{C}$
	TO-220F/TO-220F1 TO-220F3		0.27	W/ $^\circ\text{C}$
	TO-220F2		0.28	W/ $^\circ\text{C}$
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		0.4	W/ $^\circ\text{C}$
	Junction Temperature		$T_J$	+150
Operating Temperature		$T_{OPR}$	-55 ~ +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  $T_J$ .

3.  $L=16.6\text{mH}$ ,  $I_{AS}=3\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 3.0\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		110	
Junction to Case	TO-220	$\theta_{JC}$	1.67	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F3		3.68	
	TO-220F2		3.58	
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		2.5	

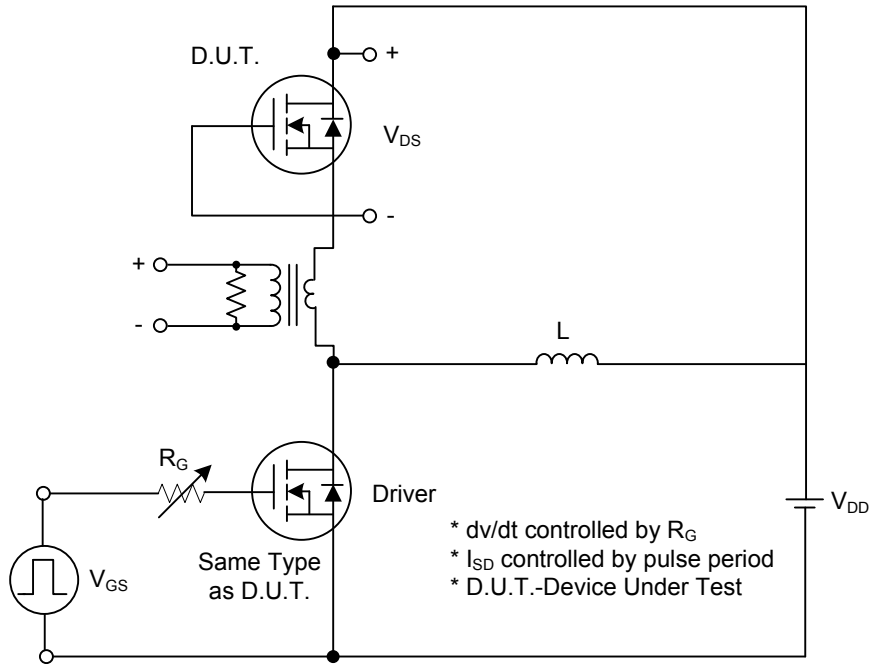
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	650			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA
	Reverse					
		V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V			-100	nA
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> = 250 μA	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> = 1.5A			4.0	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1MHz		388	500	pF
Output Capacitance	C <sub>OSS</sub>			41	65	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			5.1	11	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 30V, I <sub>D</sub> = 0.5A, R <sub>G</sub> = 25Ω (Note 1, 2)		43		ns
Turn-On Rise Time	t <sub>R</sub>			20		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			94		ns
Turn-Off Fall Time	t <sub>F</sub>			22		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> = 50V, I <sub>D</sub> = 1.3A, V <sub>GS</sub> = 10 V (Note 1, 2)		14	16	nC
Gate-Source Charge	Q <sub>GS</sub>			4.2		nC
Gate-Drain Charge	Q <sub>DD</sub>			1.6		nC
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3.0 A			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				3.0	A
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				12	A

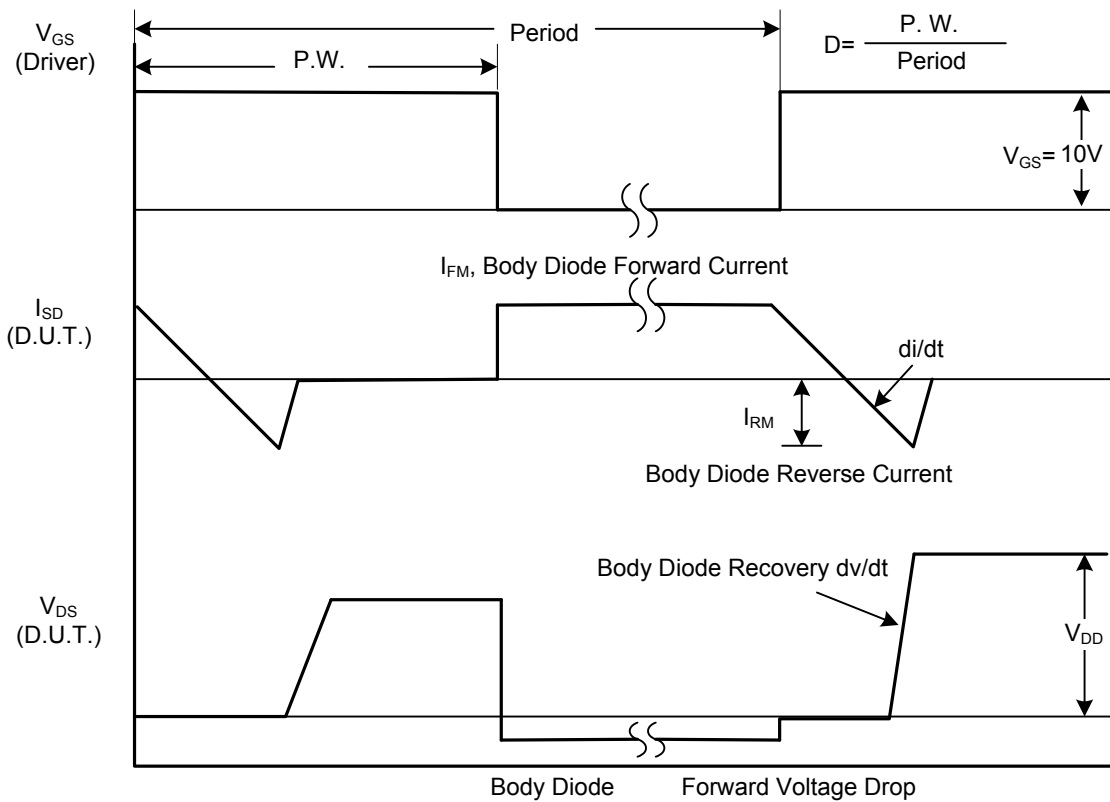
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

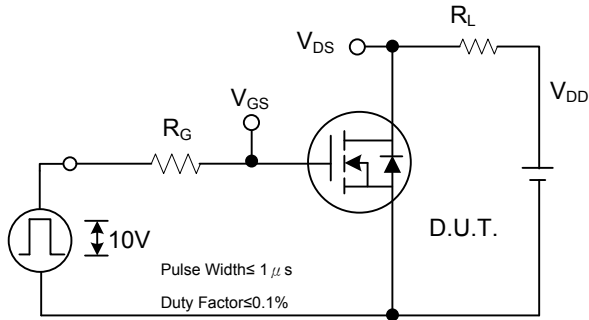


Peak Diode Recovery  $dv/dt$  Test Circuit

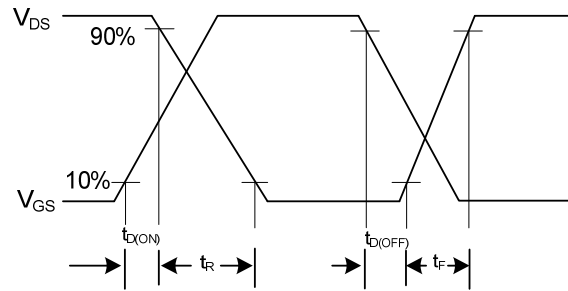


Peak Diode Recovery  $dv/dt$  Waveforms

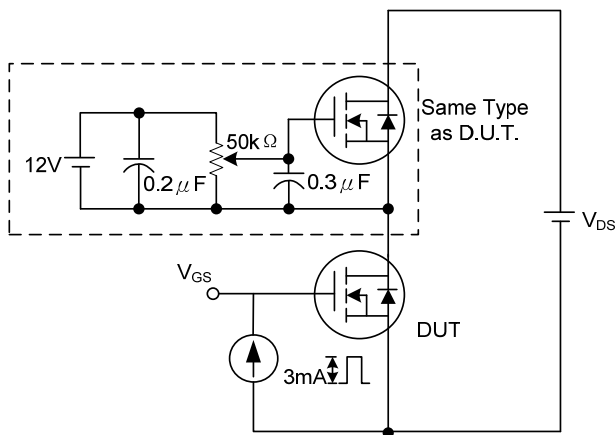
### ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



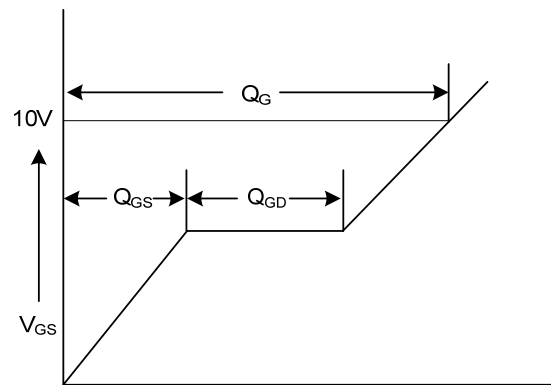
**Switching Test Circuit**



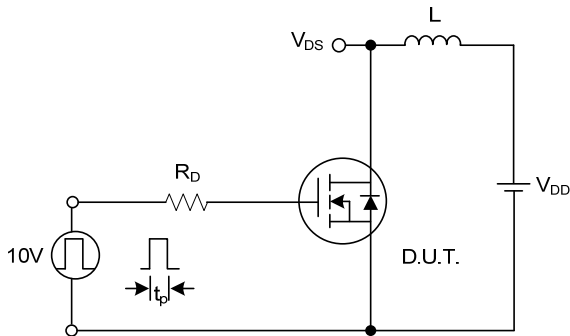
**Switching Waveforms**



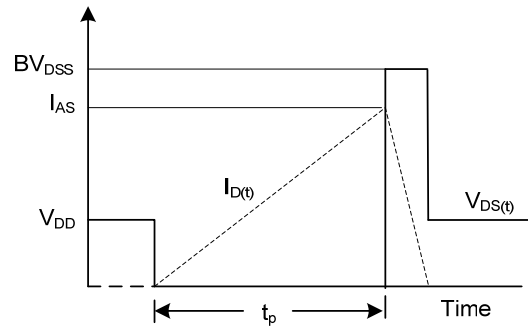
**Gate Charge Test Circuit**



**Gate Charge Waveform**



**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

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