



4N65K

Power MOSFET

4.0A, 650V N-CHANNEL POWER MOSFET

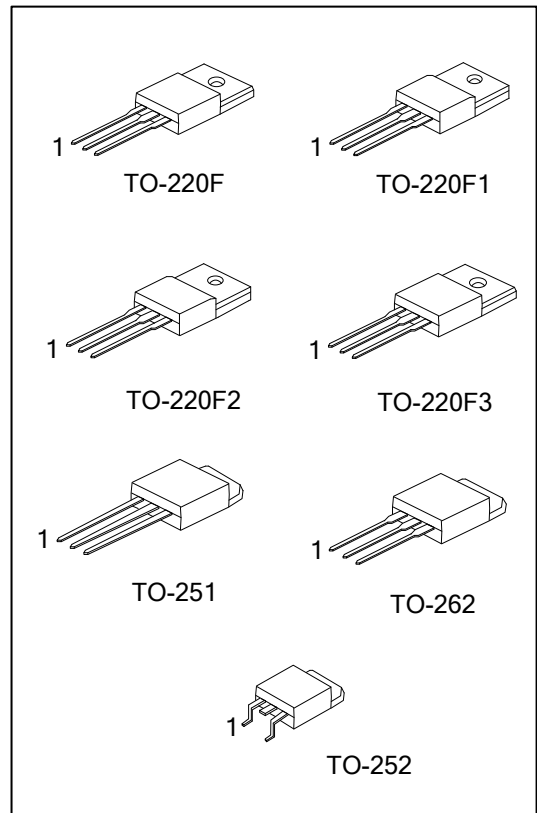
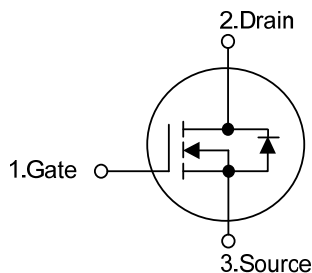
DESCRIPTION

The UTC **4N65K** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristic. This power MOSFET is usually used in high speed switching applications including power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

FEATURES

- * $R_{DS(ON)} < 2.5\Omega @ V_{GS} = 10V, I_D = 2.2A$
- * Fast Switching Capability
- * Avalanche Energy Specified
- * Improved dv/dt Capability, High Ruggedness

SYMBOL



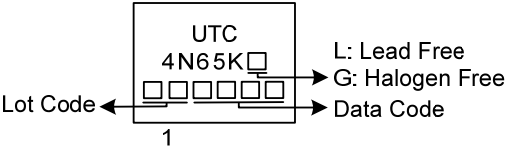
ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4N65KL-TF3-T	4N65KG-TF3-T	TO-220F	G	D	S	Tube
4N65KL-TF1-T	4N65KG-TF1-T	TO-220F1	G	D	S	Tube
4N65KL-TF2-T	4N65KG-TF2-T	TO-220F2	G	D	S	Tube
4N65KL-TF3T-T	4N65KG-TF3T-T	TO-220F3	G	D	S	Tube
4N65KL-TM3-T	4N65KG-TM3-T	TO-251	G	D	S	Tube
4N65KL-TN3-R	4N65KG-TN3-R	TO-252	G	D	S	Tape Reel
4N65KL-T2Q-R	4N65KG-T2Q-R	TO-262	G	D	S	Tube

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

<p>4N65KL-TF2-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) TF1: TO-220F1, TF2: TO-220F2, TF3T: TO-220F3</p> <p>TM3: TO-251, TN3: TO-252, T2Q: TO-262</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}	± 30	V
Avalanche Current (Note2)		I_{AR}	4.4	A
Drain Current	Continuous	I_D	4.0	A
	Pulsed (Note2)	I_{DM}	16	A
Avalanche Energy	Single Pulsed (Note3)	E_{AS}	50	mJ
	Repetitive (Note2)	E_{AR}	10.6	mJ
Peak Diode Recovery dv/dt (Note4)		dv/dt	3.1	V/ns
Power Dissipation	TO-220F	P_D	34	W
	TO-220F1/TO-220F2		35	W
	TO-220F3			
	TO-251/TO-252		50	W
	TO-262		106	W
Junction Temperature		T_J	+150	$^\circ\text{C}$
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 maximum junction temperature

3. $L=6.25\text{mH}$, $I_{AS}=4\text{A}$, $V_{DD}=50\text{V}$, $R_G=25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD}\leq 4.4\text{A}$, $di/dt\leq 200\text{A}/\mu\text{s}$, $V_{DD}\leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F/TO-220F1 TO-220F2/TO-220F3	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252 TO-262		110	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F	θ_{JC}	3.66	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2 TO-220F3		3.54	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.5	$^\circ\text{C}/\text{W}$
	TO-262		1.18	$^\circ\text{C}/\text{W}$

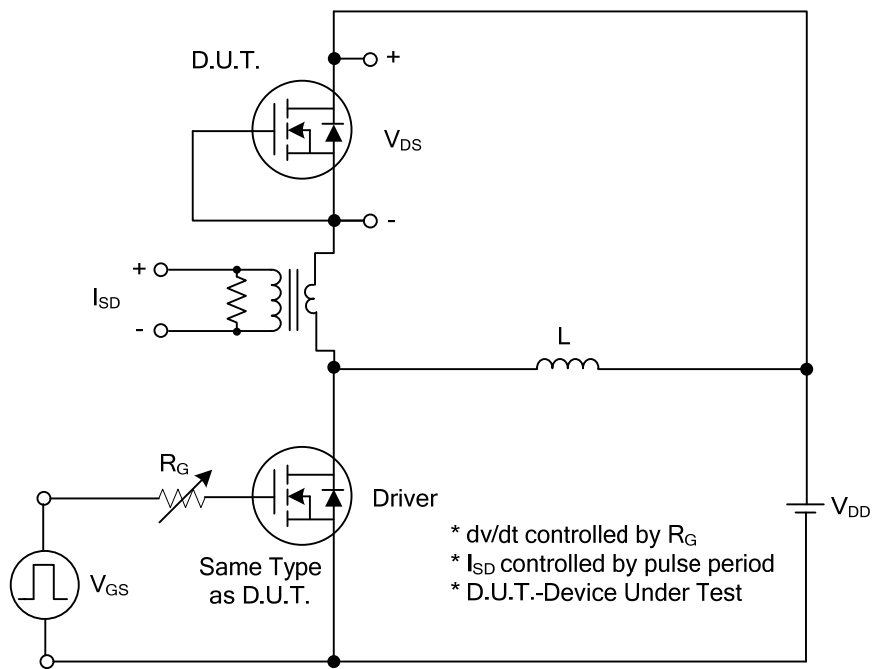
■ ELECTRICAL CHARACTERISTICS (T_C=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} = 0 V, I _D = 250μA	650			V
Drain-Source Leakage Current	I _{DSS}	V _{DS} = 650 V, V _{GS} = 0 V			10	μA
Gate-Source Leakage Current	Forward	I _{GSS}			100	nA
	Reverse				-100	nA
Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /ΔT _J	I _D =250μA, Referenced to 25°C		0.6		V/°C
ON CHARACTERISTICS						
Gate Threshold Voltage	V _{GS(TH)}	V _{DS} = V _{GS} , I _D = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} = 10 V, I _D = 2.2A		1.72	2.5	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ISS}	V _{DS} = 25 V, V _{GS} = 0V, f = 1MHz		670	750	pF
Output Capacitance	C _{OSS}		50	90	pF	
Reverse Transfer Capacitance	C _{RSS}		5	11	pF	
SWITCHING CHARACTERISTICS						
Total Gate Charge	Q _G	V _{DS} =50V, V _{GS} =10V, I _D =1.3A, I _D =100μA (Note 1, 2)		17	20	nC
Gate-Source Charge	Q _{GS}		4.9		nC	
Gate-Drain Charge	Q _{GD}		3.7		nC	
Turn-On Delay Time	t _{D(ON)}	V _{DD} =30V, V _{GS} =10V, I _D =0.5A, R _G =25Ω (Note 1, 2)		44	60	ns
Turn-On Rise Time	t _R		50	100	ns	
Turn-Off Delay Time	t _{D(OFF)}		80	130	ns	
Turn-Off Fall Time	t _F		45	70	ns	
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	I _S				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current	I _{SM}				17.6	A
Drain-Source Diode Forward Voltage	V _{SD}	V _{GS} = 0 V, I _S = 4.4A			1.4	V
Reverse Recovery Time	t _{rr}	I _S =4.4A, V _{GS} = 0 V		440		ns
Reverse Recovery Charge	Q _{rr}	di _F /dt=100A/μs (Note1)		2.5		μC

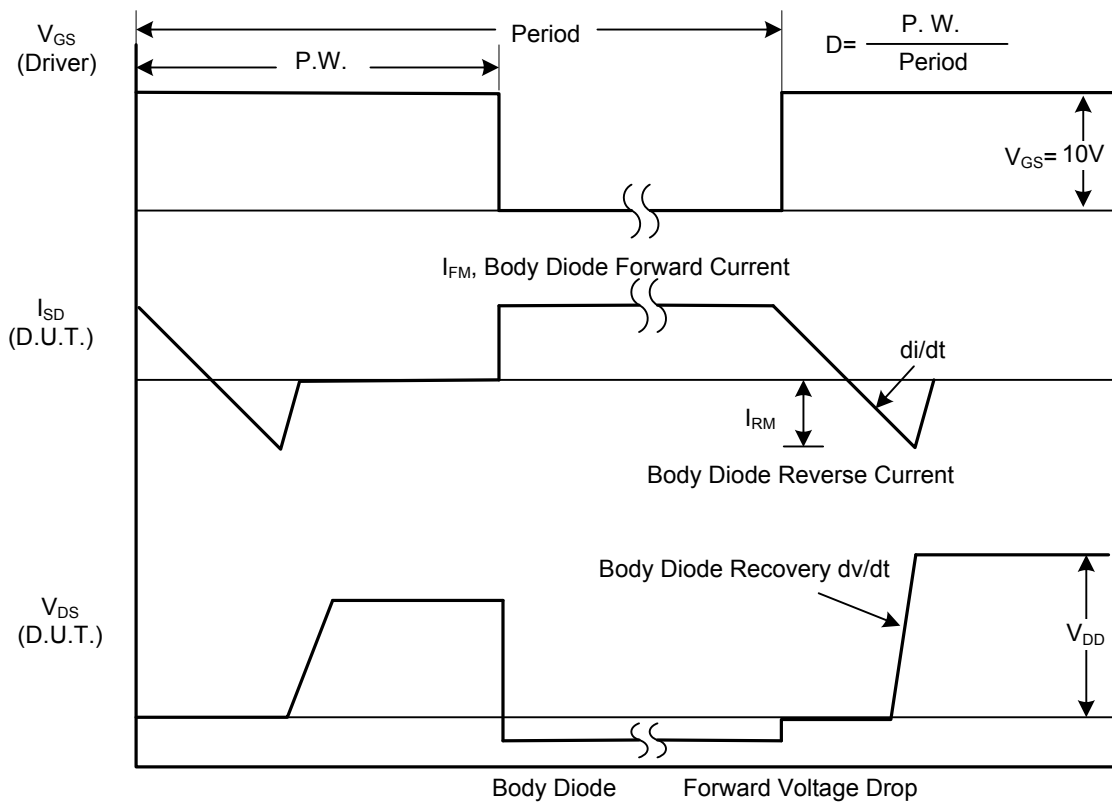
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

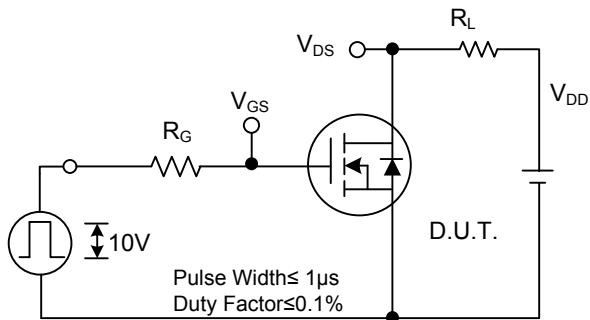


Peak Diode Recovery dv/dt Test Circuit

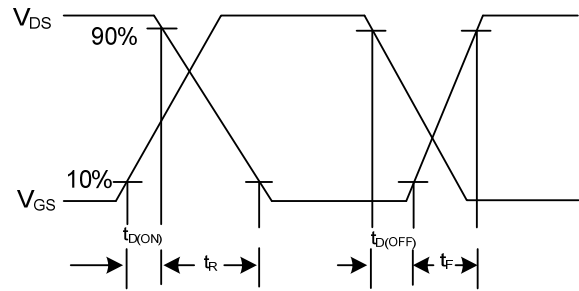


Peak Diode Recovery dv/dt Waveforms

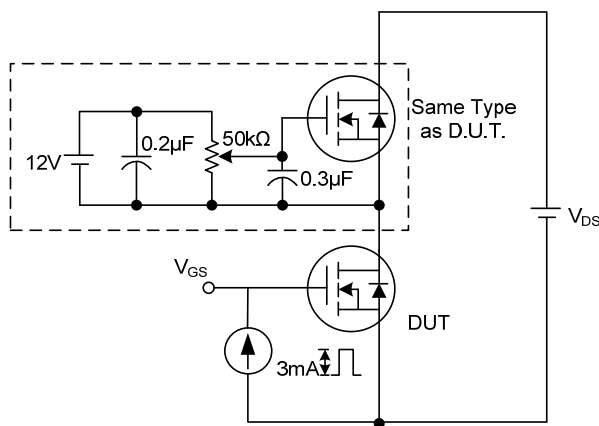
TEST CIRCUITS AND WAVEFORMS (Cont.)



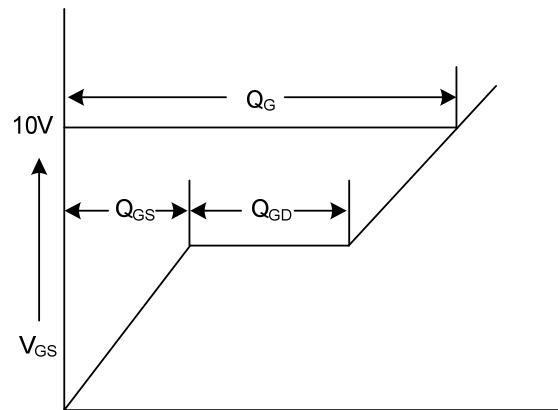
Switching Test Circuit



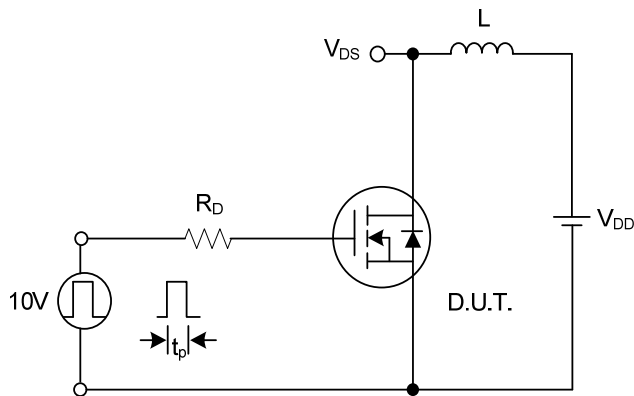
Switching Waveforms



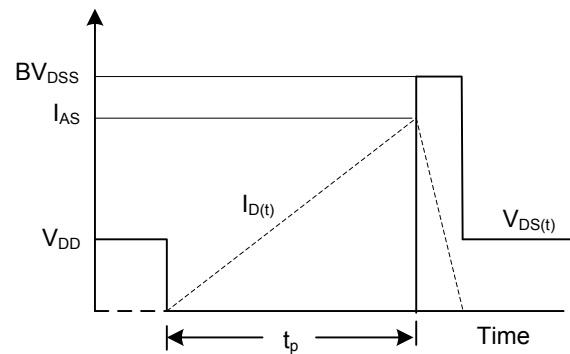
Gate Charge Test Circuit



Gate Charge Waveform

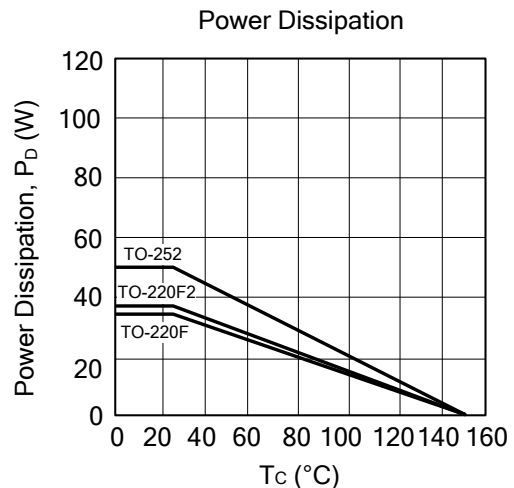
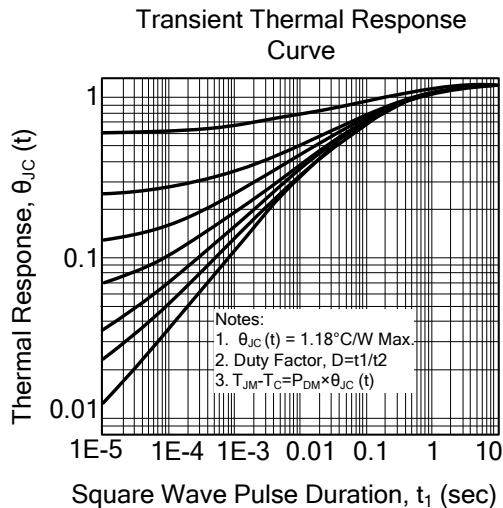
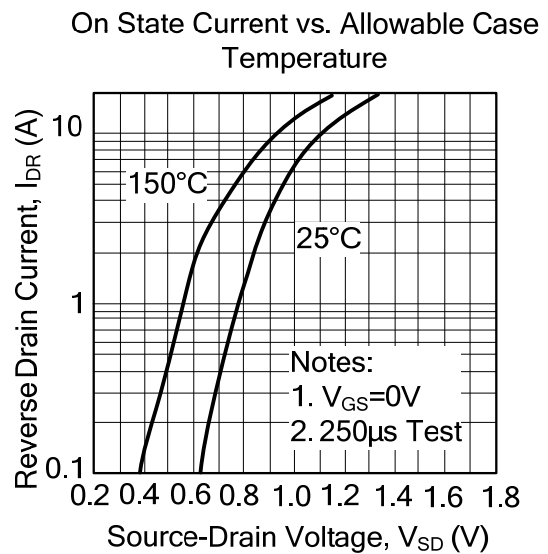
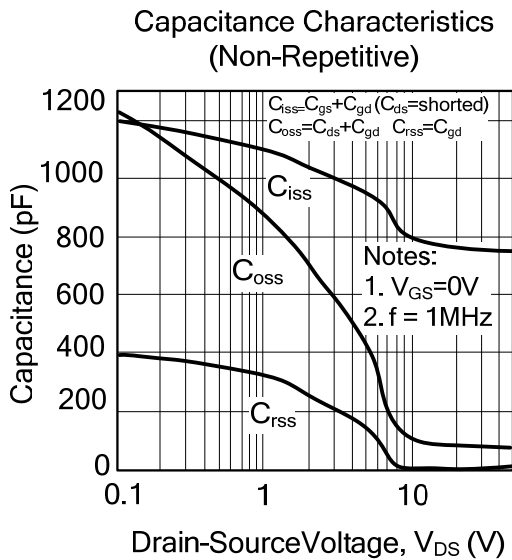
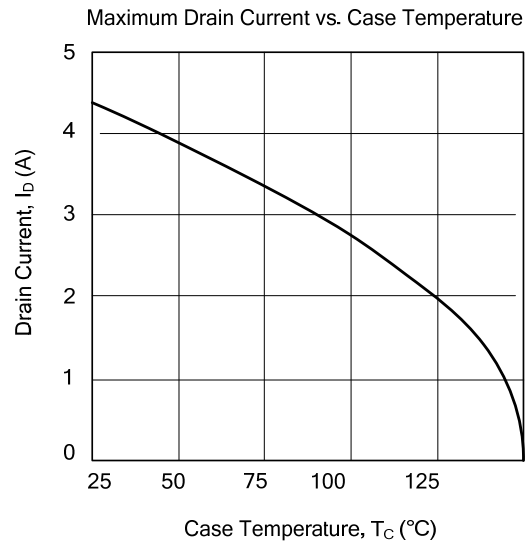
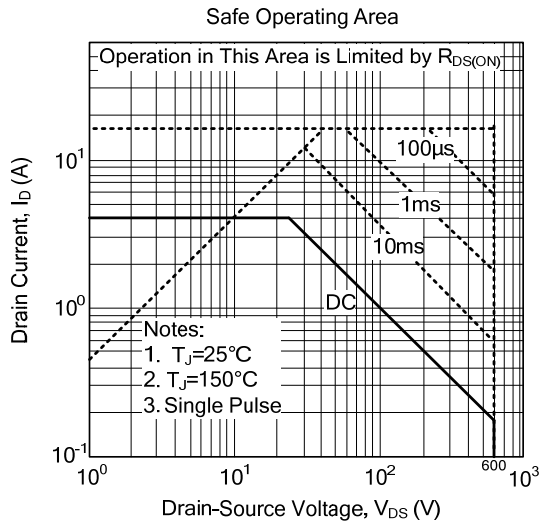


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS



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