



4N65-R

Preliminary

Power MOSFET

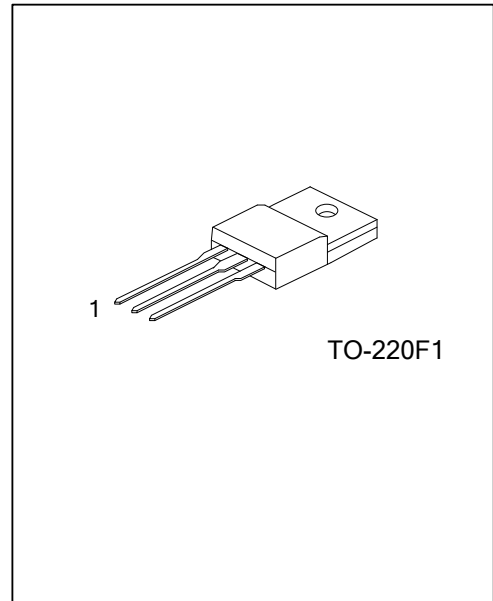
**4A, 650V N-CHANNEL
POWER MOSFET**

■ DESCRIPTION

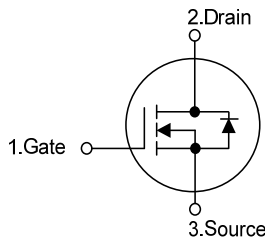
The UTC **4N65-R** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristic. This power MOSFET is usually used in high speed switching applications including power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

■ FEATURES

- * $R_{DS(ON)} = 3.4\Omega @V_{GS}=10V, I_D=2.2A$
- * 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	
4N65L-TF1-T	4N65G-TF1-T	TO-220F1	G	D	S	Tube

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

<p>4N65L-TF1-T</p> <ul style="list-style-type: none"> (1)Packing Type (2)Package Type (3)Lead Free 	<ul style="list-style-type: none"> (1) T: Tube (2) TF1: TO-220F1 (3) L: Lead Free, G: Halogen Free
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■ MARKING INFORMATION

PACKAGE	MARKING
TO-220F1	

■ 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	A
Drain Current	Continuous	I_D	4.0
	Pulsed (Note2)	I_{DM}	16
Avalanche Energy	Single Pulsed (Note3)	E_{AS}	60
Peak Diode Recovery dv/dt (Note4)	dv/dt	4.5	V/ns
Power Dissipation	P_D	36	W
Junction Temperature	T_J	+150	$^\circ\text{C}$
Operating Temperature	T_{OPR}	-55 ~ +150	$^\circ\text{C}$
Storage Temperature	T_{STG}	-55 ~ +150	$^\circ\text{C}$

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. Repetitive Rating: Pulse width limited by maximum junction temperature.

3. $L = 7.5\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, 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	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
Junction to Case	θ_{Jc}	3.47	$^\circ\text{C}/\text{W}$

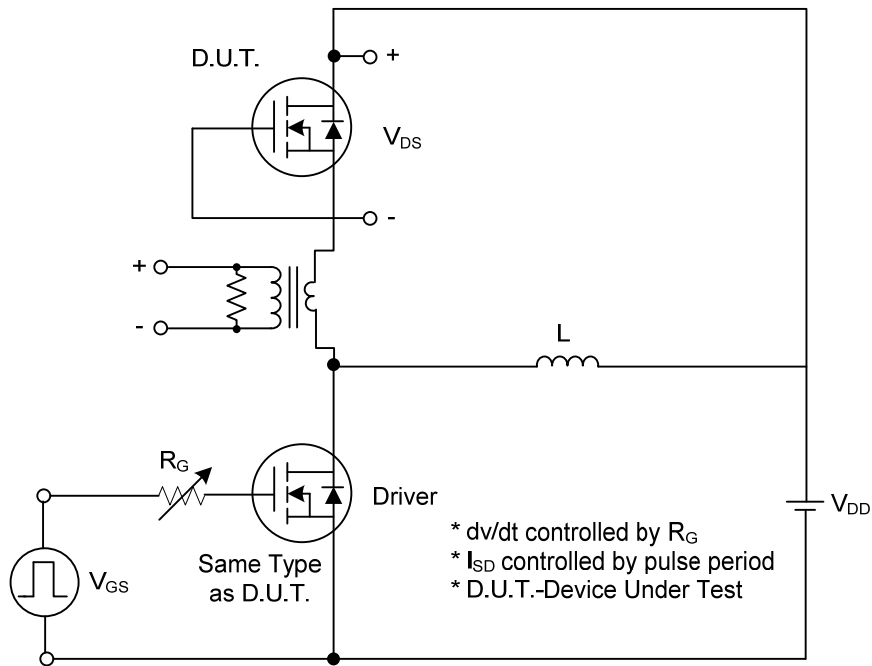
■ ELECTRICAL CHARACTERISTICS ($T_C=25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0\text{ V}, I_D = 250\mu\text{A}$	650			V	
Drain-Source Leakage Current	I_{DSS}	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	μA	
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$			100	μA	
Gate-Source Leakage Current	Forward Reverse	I_{GSS}	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$			100	nA
			$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$			-100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu\text{A}$, Referenced to 25°C		0.6		$\text{V}/^\circ\text{C}$	
ON CHARACTERISTICS							
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	3.0		5.0	V	
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 2.2\text{A}$		2.9	3.4	Ω	
DYNAMIC CHARACTERISTICS							
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{V},$ $f = 1\text{MHz}$		460	700	pF	
Output Capacitance	C_{OSS}			47	90	pF	
Reverse Transfer Capacitance	C_{RSS}			7	22	pF	
SWITCHING CHARACTERISTICS							
Turn-On Delay Time	$t_{D(ON)}$	$V_{DS} = 30\text{V}, I_D = 0.5\text{A},$ $R_G = 25\Omega$ (Note 1, 2)		80	100	ns	
Turn-On Rise Time	t_R			35	55	ns	
Turn-Off Delay Time	$t_{D(OFF)}$			40	60	ns	
Turn-Off Fall Time	t_F			45	65	ns	
Total Gate Charge	Q_G	$V_{DS} = 50\text{V}, I_D = 1.3\text{A},$ $V_{GS} = 10\text{V}$ (Note 1, 2)		16	32	nC	
Gate-Source Charge	Q_{GS}			6	15	nC	
Gate-Drain Charge	Q_{GD}			3.5	10	nC	
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = 4.4\text{A}$			1.4	V	
Maximum Continuous Drain-Source Diode Forward Current	I_S				4.4	A	
Maximum Pulsed Drain-Source Diode Forward Current	I_{SM}				17.6	A	
Reverse Recovery Time	t_{rr}	$V_{GS} = 0\text{V}, I_S = 4.4\text{A},$		250		ns	
Reverse Recovery Charge	Q_{RR}	$di_F/dt = 100\text{ A}/\mu\text{s}$ (Note 1)		1.5		μC	

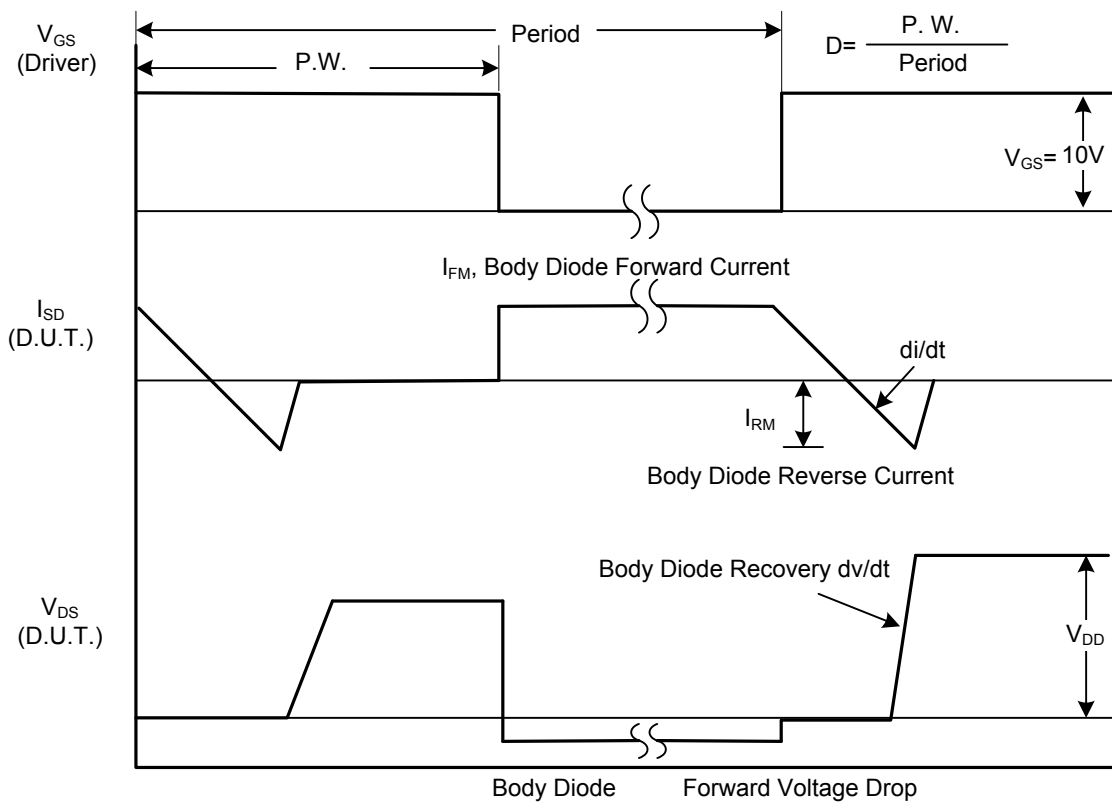
Note: 1. Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

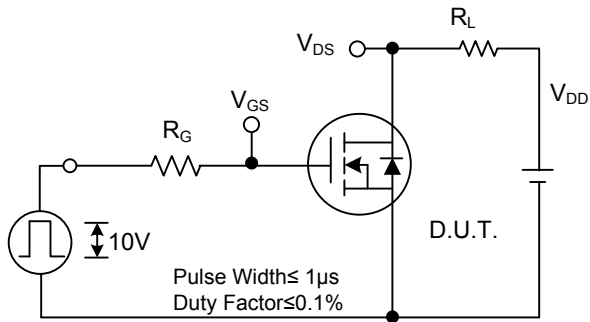


Peak Diode Recovery dv/dt Test Circuit

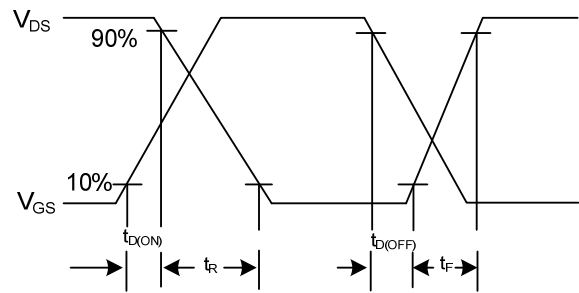


Peak Diode Recovery dv/dt Waveforms

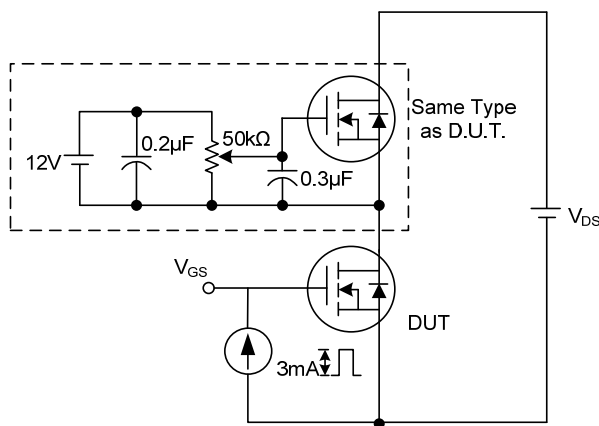
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



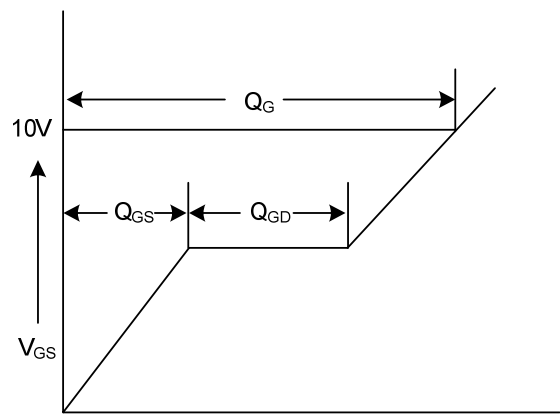
Switching Test Circuit



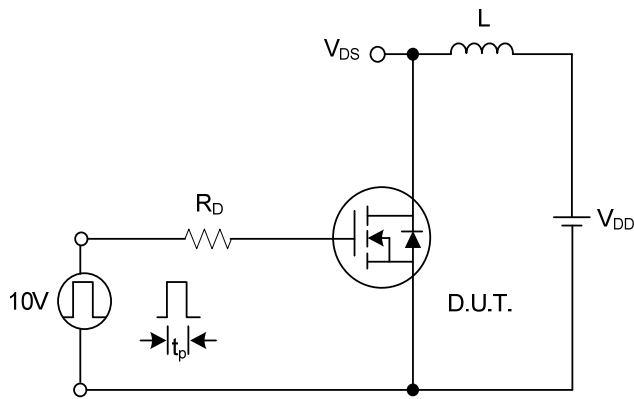
Switching Waveforms



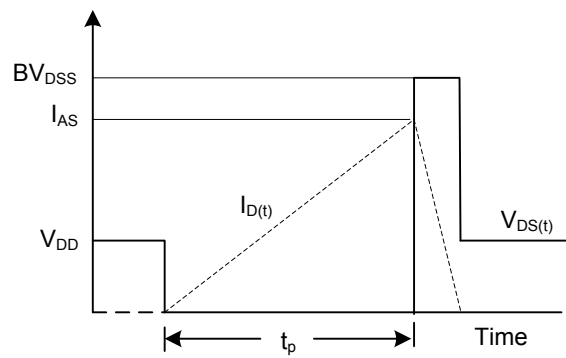
Gate Charge Test Circuit



Charge Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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