



4N65-HC

Preliminary

Power MOSFET

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

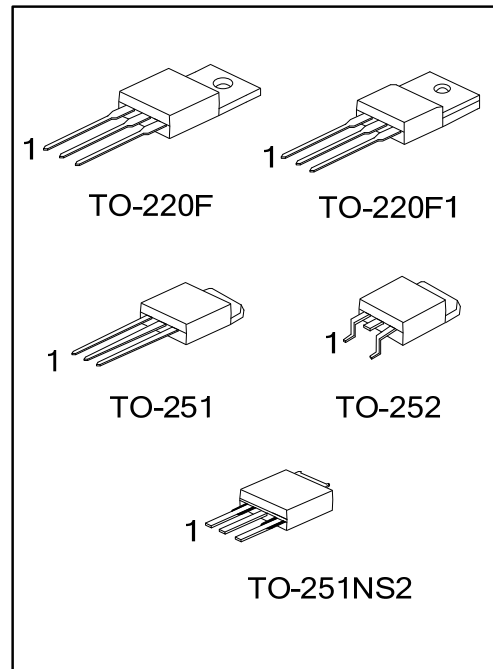
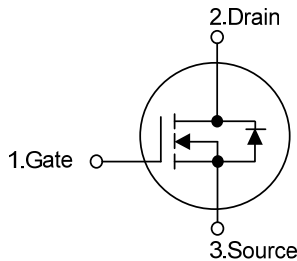
■ DESCRIPTION

The UTC **4N65-HC** 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 of switching power supplies and adaptors.

■ FEATURES

- * $R_{DS(ON)} < 2.4 \Omega @ V_{GS} = 10 V, I_D = 2.0 A$
- * Fast switching capability
- * Avalanche energy tested
- * Improved dv/dt capability, high ruggedness

■ SYMBOL



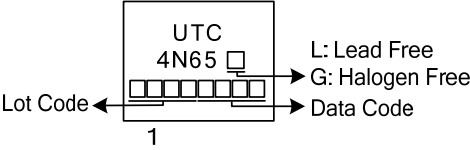
■ ORDERING INFORMATION

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
4N65L-TF3-T	4N65G-TF3-T	TO-220F	G	D	S	Tube
4N65L-TM3-T	4N65G-TM3-T	TO-251	G	D	S	Tube
4N65L-TN3-R	4N65G-TN3-R	TO-252	G	D	S	Tape Reel
4N65L-TMN2-T	4N65G-TMN2-T	TO-251NS2	G	D	S	Tube

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

<p>4N65G-TF1-T</p> <p>(1)Packing Type (2)Package Type (3)Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) TF1: TO-220F1, TF3: TO-220F, TM3: TO-251 TN3: TO-252, TMS2: TO-251NS2 (3) 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}	± 30	V
Continuous Drain Current		I_D	4	A
Pulsed Drain Current (Note 2)		I_{DM}	16	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	80	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	3.36	V/ns
Power Dissipation	TO-220F/TO-220F1	P_D	35	W
	TO-251/TO-252		50	W
	TO-251NS2			
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. $L = 10\text{mH}$, $I_{AS} = 4.0\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 4.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	TO-220F/TO-220F1	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		110	$^\circ\text{C}/\text{W}$
	TO-251NS2			
Junction to Case	TO-220F/TO-220F1	θ_{JC}	3.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-252		2.5	$^\circ\text{C}/\text{W}$
	TO-251NS2			

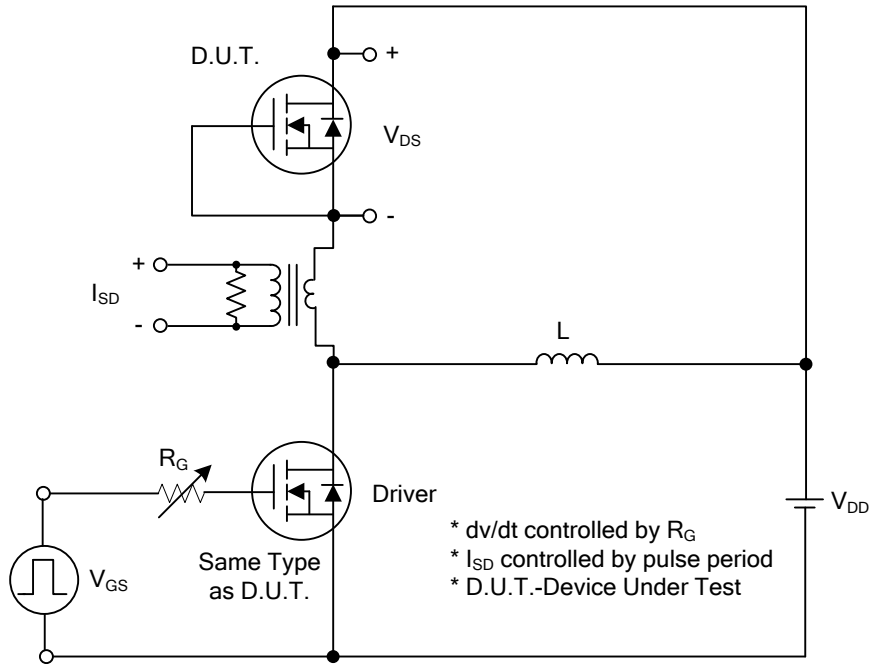
■ ELECTRICAL CHARACTERISTICS ($T_J=25^\circ\text{C}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0V, I_D = 250\mu A$	650			V
Drain-Source Leakage Current	I_{DSS}	$V_{DS} = 650V, V_{GS} = 0V$			10	μA
Gate- Source Leakage Current	Forward	$V_{GS} = 30V, V_{DS} = 0V$			100	nA
	Reverse		$V_{GS} = -30V, V_{DS} = 0V$		-100	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 2.0A$		1.91	2.4	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	$V_{DS}=25V, V_{GS}=0V, f=1.0\text{ MHz}$		520	720	pF
Output Capacitance	C_{OSS}			75	90	pF
Reverse Transfer Capacitance	C_{RSS}			13	20	pF
SWITCHING CHARACTERISTICS						
Total Gate Charge (Note 1)	Q_G	$V_{DS}=300V, V_{GS}=10V, I_D=3.0A$ (Note 1, 2)		19	25	nC
Gate-Source Charge	Q_{GS}			3.5		nC
Gate-Drain Charge	Q_{GD}			5.8		nC
Turn-On Delay Time (Note 1)	$t_{D(ON)}$	$V_{DD}=50V, V_{GS}=10V, I_D=0.5A,$ $R_G=25\Omega$ (Note 1, 2)		9.0		ns
Turn-On Rise Time	t_R			22		ns
Turn-Off Delay Time	$t_{D(OFF)}$			53		ns
Turn-Off Fall Time	t_F			42		ns
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Maximum Continuous Drain-Source Diode Forward Current	I_S				4	A
Maximum Pulsed Drain-Source Diode Forward Current	I_{SM}				16	A
Drain-Source Diode Forward Voltage	V_{SD}	$I_S=4.0A, V_{GS}=0V$			1.4	V
Body Diode Reverse Recovery Time	t_{rr}	$I_S=4.0A, V_{GS}=0V, di/dt=100A/\mu s$		290		ns
Body Diode Reverse Recovery Charge	Q_{rr}			1.65		μC

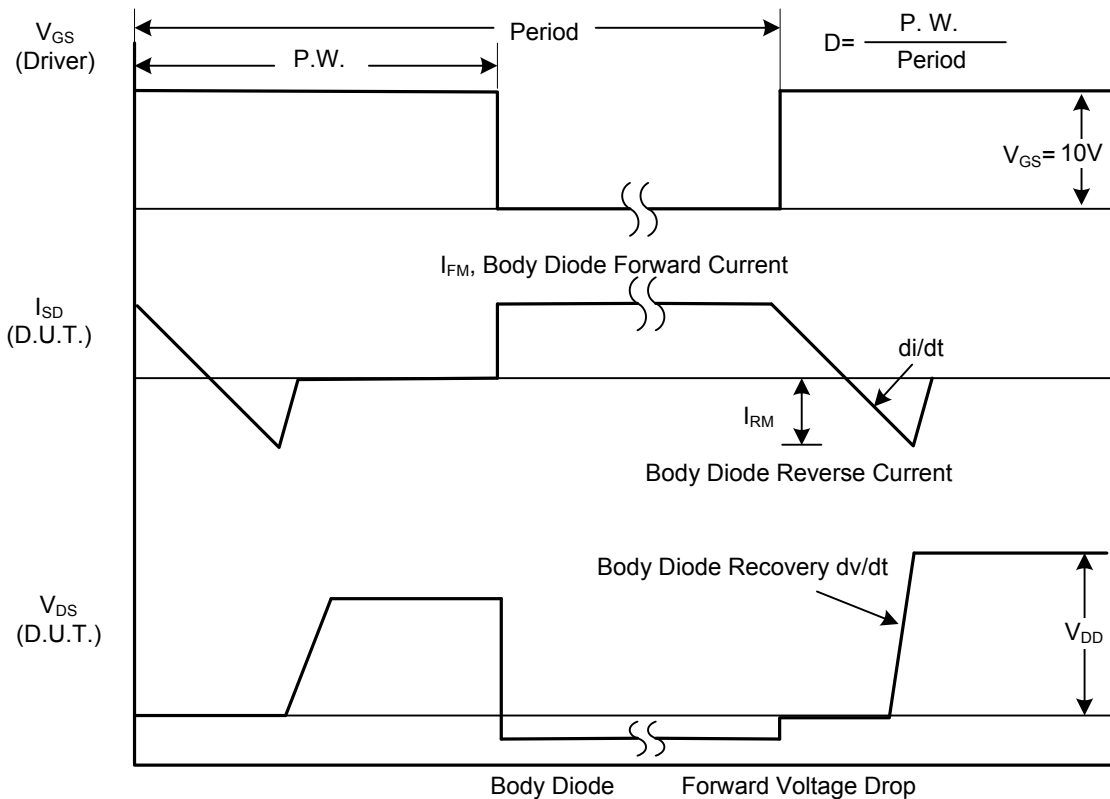
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

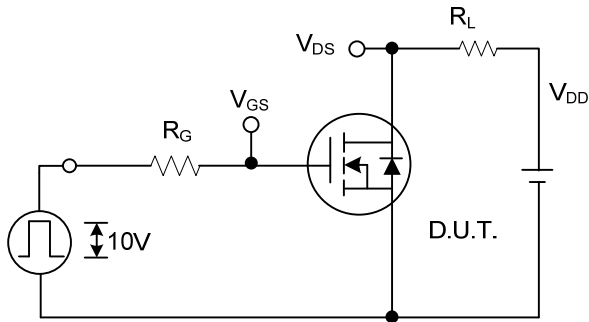


Peak Diode Recovery dv/dt Test Circuit

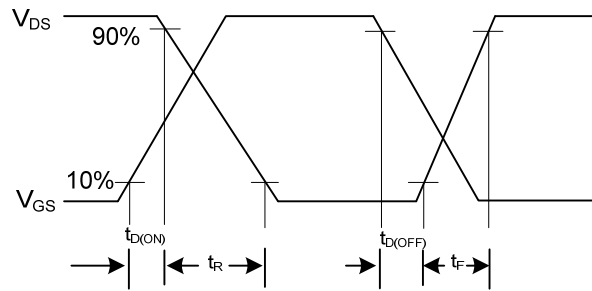


Peak Diode Recovery dv/dt Waveforms

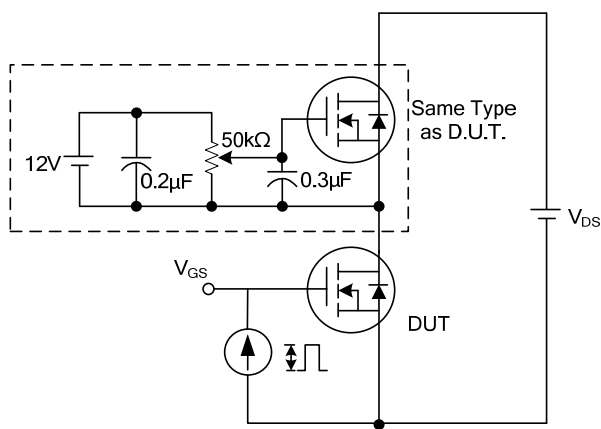
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



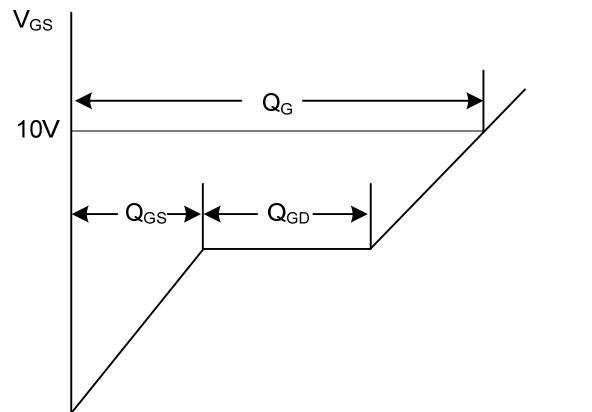
Switching Test Circuit



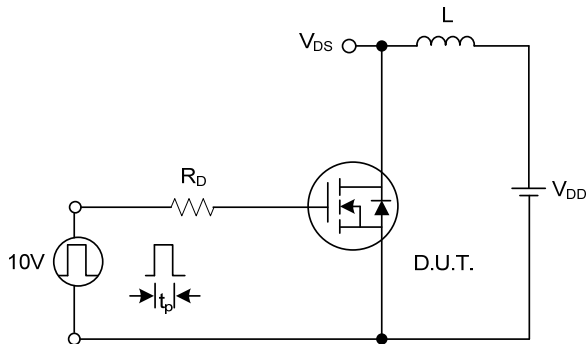
Switching Waveforms



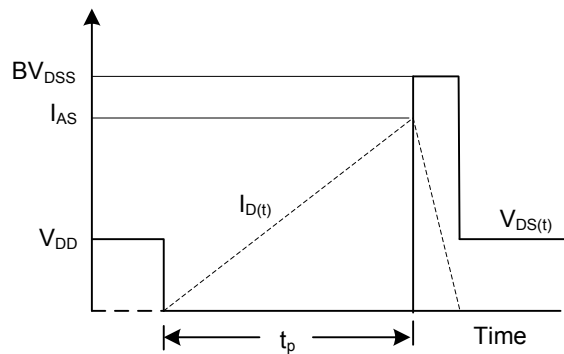
Gate Charge Test Circuit



Charge
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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