



## 2N65

Power MOSFET

### 2A, 650V N-CHANNEL POWER MOSFET

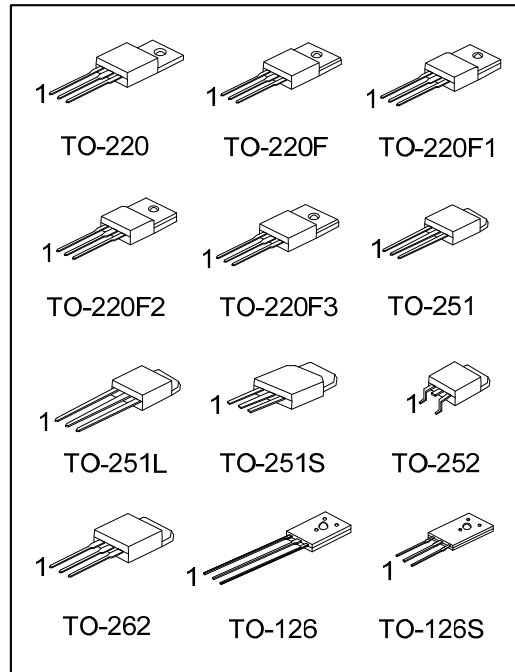
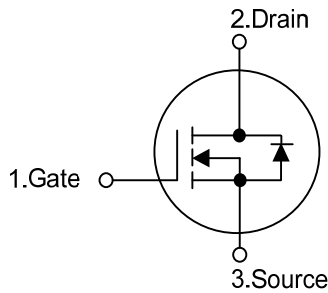
#### DESCRIPTION

The UTC **2N65** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 5.0\Omega @ V_{GS} = 10V$
- \* Ultra Low gate charge (typical 45nC)
- \* Low reverse transfer capacitance ( $C_{RSS} = \text{typical } 9 \text{ pF}$ )
- \* 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	
2N65L-TA3-T	2N65G-TA3-T	TO-220	G	D	S	Tube
2N65L-TF1-T	2N65G-TF1-T	TO-220F1	G	D	S	Tube
2N65L-TF2-T	2N65G-TF2-T	TO-220F2	G	D	S	Tube
2N65L-TF3-T	2N65G-TF3-T	TO-220F	G	D	S	Tube
2N65L-TF3T-T	2N65G-TF3T-T	TO-220F3	G	D	S	Tube
2N65L-TM3-T	2N65G-TM3-T	TO-251	G	D	S	Tube
2N65L-TMA-T	2N65G-TMA-T	TO-251L	G	D	S	Tube
2N65L-TMS-T	2N65G-TMS-T	TO-251S	G	D	S	Tube
2N65L-TN3-R	2N65G-TN3-R	TO-252	G	D	S	Tape Reel
2N65L-TN3-T	2N65G-TN3-T	TO-252	G	D	S	Tube
2N65L-T2Q-T	2N65G-T2Q-T	TO-262	G	D	S	Tube
2N65L-T60-K	2N65G-T60-K	TO-126	G	D	S	Bulk
2N65L-T6C-K	2N65G-T6C-K	TO-126C	G	D	S	Bulk

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

	<p>(1) T: Tube, R: Tape Reel, K: Bulk</p> <p>(2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TF3T: TO-220F3, TM3: TO-251, TMA: TO-251L, TMS: TO-251S, TN3: TO-252, T2Q: TO-262, T60: TO-126, T6C: TO-126C</p> <p>(3) L: Lead Free, G: Halogen Free</p>
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### MARKING INFORMATION

PACKAGE	MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3  TO-251 TO-251L TO-251S TO-252 TO-262	
TO-126 TO-126C	

■ 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)		$I_{AR}$	2.0	A
Drain Current	Continuous	$I_D$	2.0	A
	Pulsed (Note 2)	$I_{DM}$	8.0	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	140	mJ
	Repetitive (Note 2)	$E_{AR}$	4.5	mJ
Peak Diode Recovery $dv/dt$ (Note 4)		$dv/dt$	4.5	V/ns
Power Dissipation	TO-220/TO-262	$P_D$	40	W
	TO-220F/TO-220F1		21	W
	TO-220F3		23	W
	TO-220F2		28	W
	TO-251/TO-251L		12.5	W
	TO-252/TO-251S			
TO-126/TO-126C				
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  $T_J$ .

3.  $L=64\text{mH}$ ,  $I_{AS}=2.0\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 2.4\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/ TO-262	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1			
	TO-220F2/TO-220F3			
	TO-251/TO-251L		110	$^\circ\text{C}/\text{W}$
	TO-252/TO-251S			
TO-126/TO-126C			132	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/ TO-262	$\theta_{JC}$	3.13	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		5.95	$^\circ\text{C}/\text{W}$
	TO-220F3			
	TO-220F2		5.43	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L		4.53	$^\circ\text{C}/\text{W}$
	TO-251S/TO-252			
	TO-126/TO-126C			

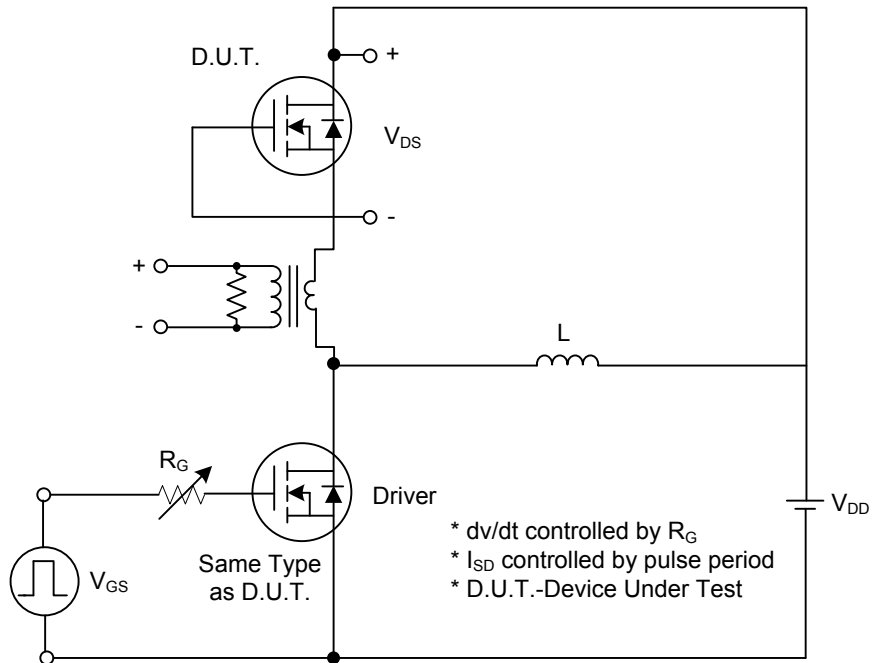
■ ELECTRICAL CHARACTERISTICS ( $T_J=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
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	$\mu A$
Gate-Source Leakage Current	Forward	$I_{GSS}$			100	nA
	Reverse				$V_{GS} = 30V, V_{DS} = 0V$	-100
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$ , Referenced to $25^\circ\text{C}$		0.4		$V/^\circ\text{C}$
<b>ON CHARACTERISTICS</b>						
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	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 1A$		3.9	5.0	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1\text{MHz}$		320	370	pF
Output Capacitance	$C_{OSS}$		40	50	pF	
Reverse Transfer Capacitance	$C_{RSS}$		9	12	pF	
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 325V, I_D = 2.4A,$ $R_G = 25\Omega$ (Note 1, 2)		35	50	ns
Turn-On Rise Time	$t_R$		40	60	ns	
Turn-Off Delay Time	$t_{D(OFF)}$		130	160	ns	
Turn-Off Fall Time	$t_F$		40	60	ns	
Total Gate Charge	$Q_G$	$V_{DS} = 520V, V_{GS} = 10V,$ $I_D = 2.4A$ (Note 1, 2)		45	55	nC
Gate-Source Charge	$Q_{GS}$		4		nC	
Gate-Drain Charge	$Q_{GD}$		8.4		nC	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0V, I_{SD} = 2.0A$			1.4	V
Continuous Drain-Source Current	$I_{SD}$				2.0	A
Pulsed Drain-Source Current	$I_{SM}$				8.0	A
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0V, I_{SD} = 2.4A,$ $di/dt = 100A/\mu s$ (Note1)		180		ns
Reverse Recovery Charge	$Q_{RR}$		0.72		$\mu C$	

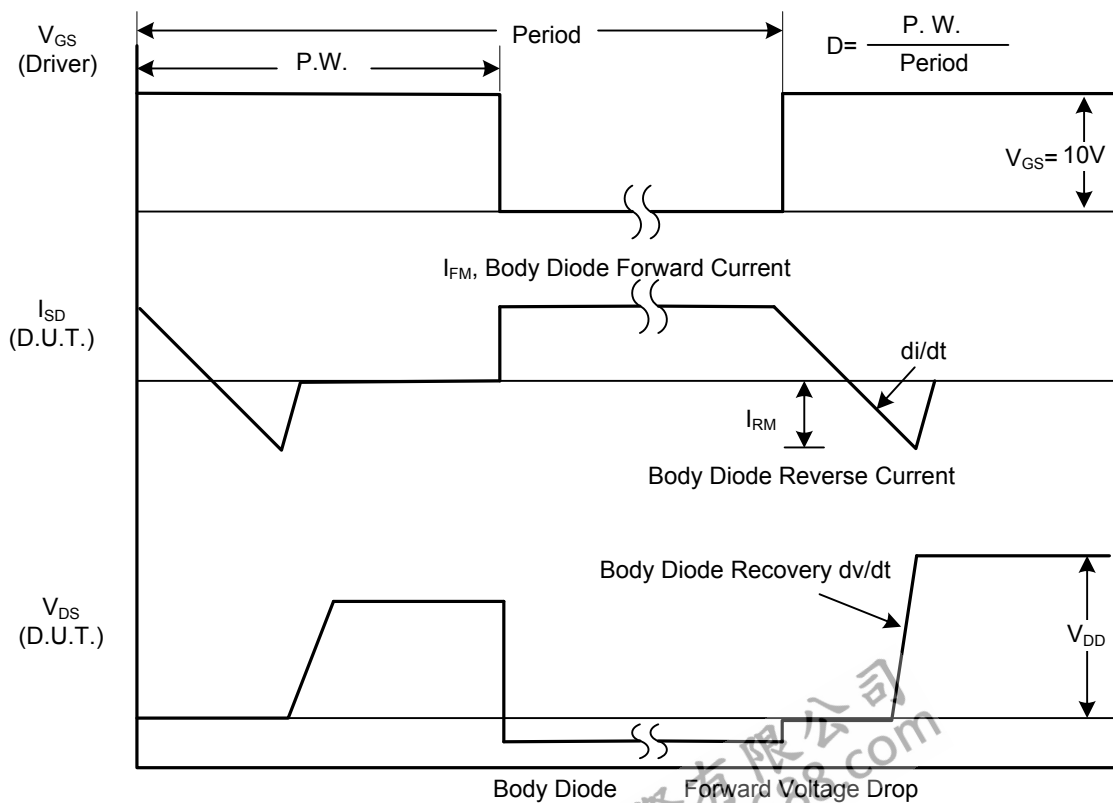
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$

2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

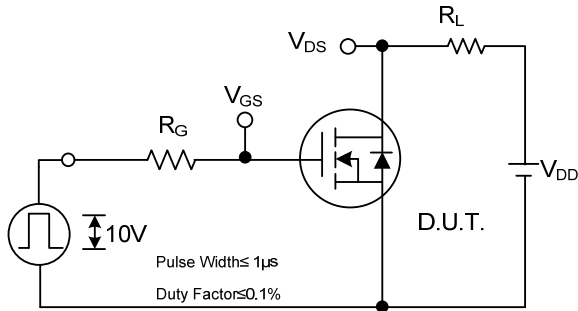


Peak Diode Recovery dv/dt Test Circuit

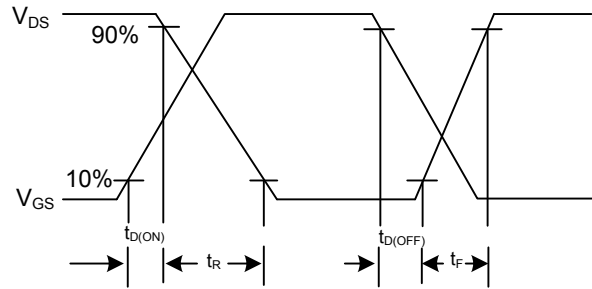


Peak Diode Recovery dv/dt Waveforms

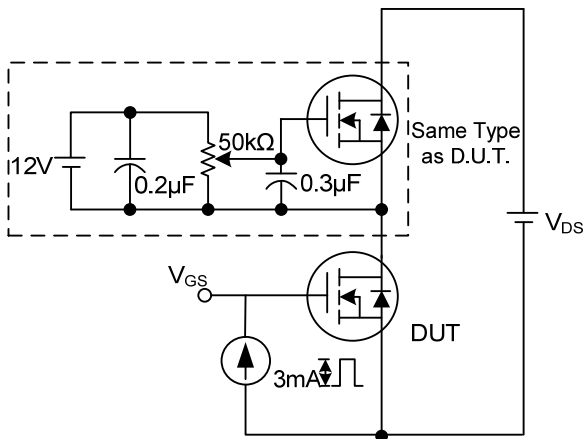
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



Switching Test Circuit



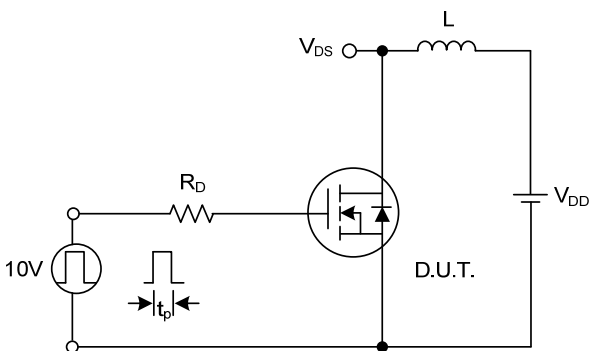
Switching Waveforms



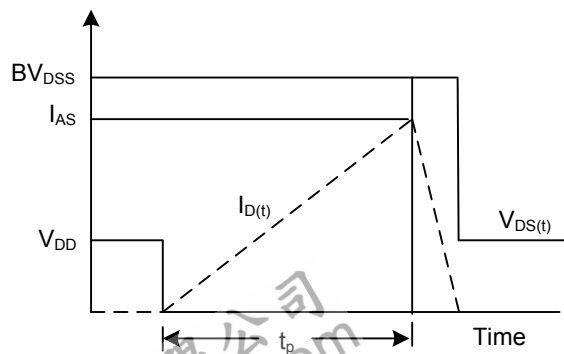
Gate Charge Test Circuit



Gate Charge Waveform

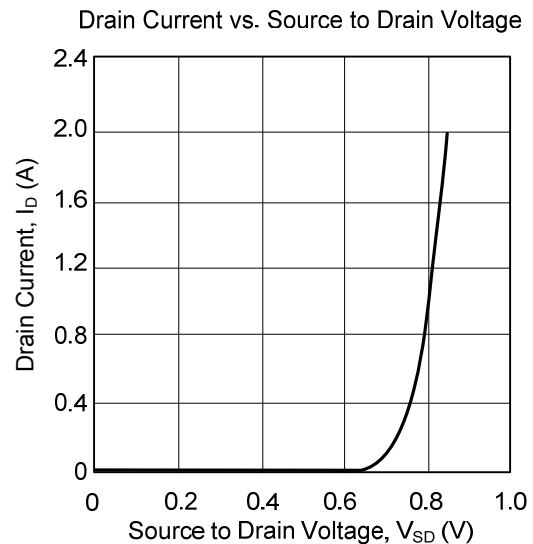
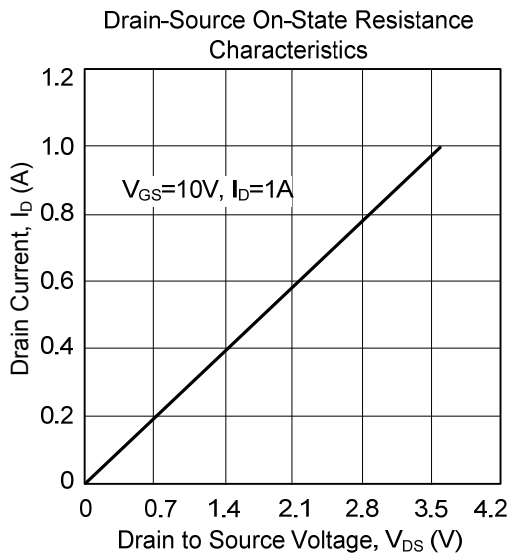
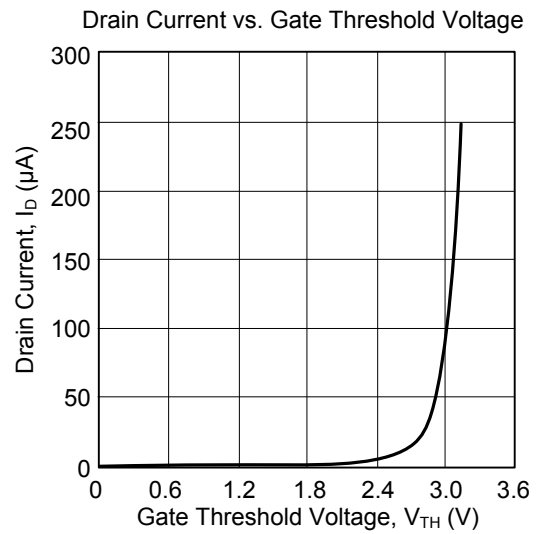
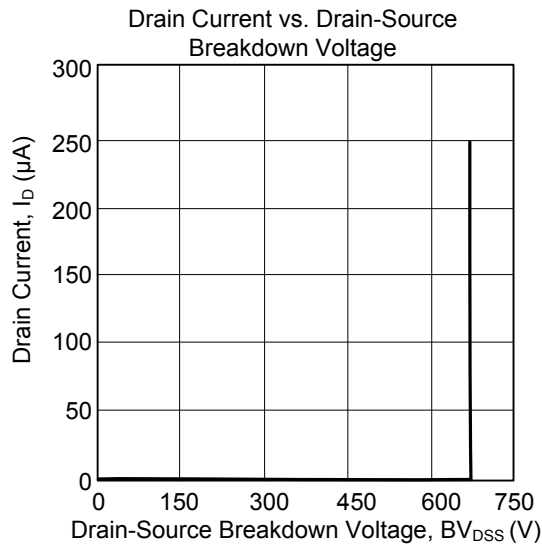


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS



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