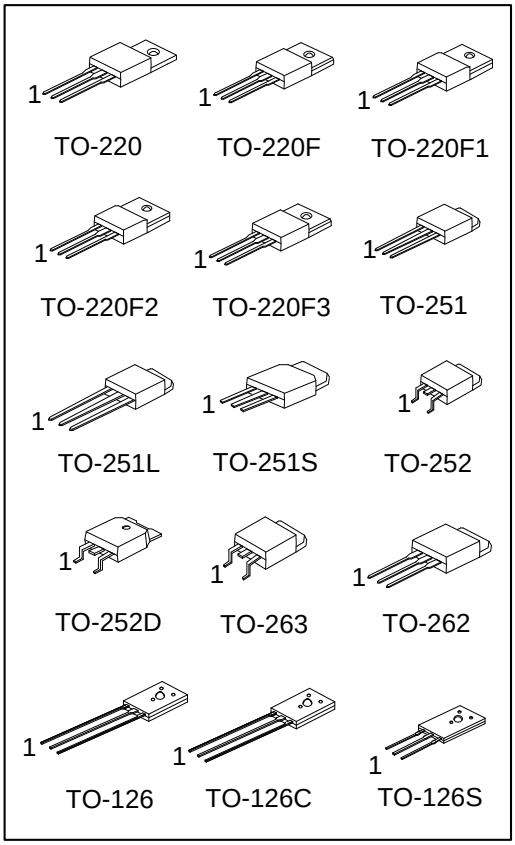
2N65

Power MOSFET

2A, 650V N-CHANNEL POWER MOSFET



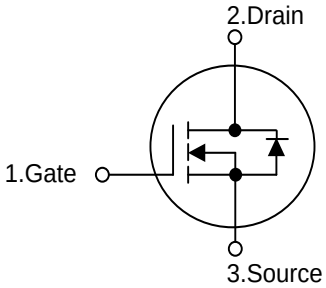
■ DESCRIPTION

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

* $R_{DS(ON)} \leq 5.0\ \Omega$ @ V_{GS} = 10V, I_D =1.0A
* Ultra Low gate charge (typical 45nC)
* Low reverse transfer capacitance (C_{RSS} = typical 9 pF)
* Fast switching capability
* Avalanche energy specified
* Improved dv/dt capability, high ruggedness

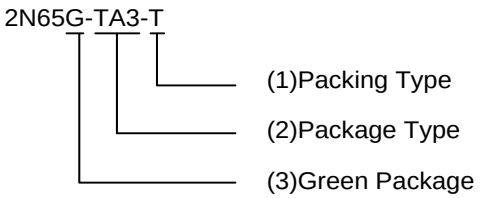
■ SYMBOL



■ ORDERING INFORMATION

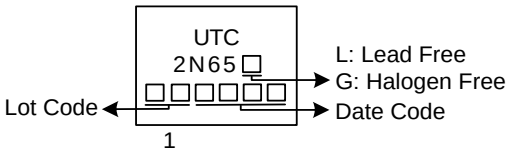
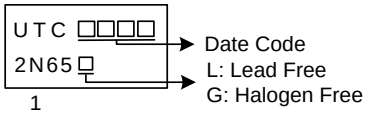
Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
2N65L-TA3-T	2N65G-TA3-T	TO-220	G	D	S	Tube
2N65L-TF1-T	2N65G-TF1-T	TO-220F1	G	D	S	Tube
2N65L-TF2-T	2N65G-TF2-T	TO-220F2	G	D	S	Tube
2N65L-TF3-T	2N65G-TF3-T	TO-220F	G	D	S	Tube
2N65L-TF3T-T	2N65G-TF3T-T	TO-220F3	G	D	S	Tube
2N65L-TM3-T	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-TND-R	2N65G-TND-R	TO-252D	G	D	S	Tape Reel
2N65L-T2Q-T	2N65G-T2Q-T	TO-262	G	D	S	Tube
2N65L-TQ2-T	2N65G-TQ2-T	TO-263	G	D	S	Tube
2N65L-TQ2-R	2N65G-TQ2-R	TO-263	G	D	S	Tape Reel
2N65L-T60-K	2N65G-T60-K	TO-126	G	D	S	Bulk
2N65L-T6C-K	2N65G-T6C-K	TO-126C	G	D	S	Bulk
2N65L-T6S-K	2N65G-T6S-K	TO-126S	G	D	S	Bulk

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



(1) T: Tube, R: Tape Reel, K:Bulk
(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, TND: TO-252D, T2Q: TO-262, TQ2: TO-263 T60: TO-126, T6C: TO-126C, T6S: TO-126S
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

PACKAGE		MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3 TO-251	TO-251L TO-251S TO-252D TO-252 TO-262 TO-263	
TO-126 TO-126C TO-126S		

■ ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	±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 TO-263	P_D	40	W
	TO-220F/TO-220F1 TO-220F3		21	W
	TO-220F2		23	W
	TO-251/TO-251L TO-251S/TO-252 TO-252D		28	W
	TO-126/TO-126C TO-126S		12.5	W
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-55 ~ +150	°C
Storage Temperature		T_{STG}	-55 ~ +150	°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=64mH, I_{AS}=2.0A, V_{DD}=50V, R_G=25Ω, Starting T_J = 25°C
4. I_{SD}≤2.4A, di/dt≤200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

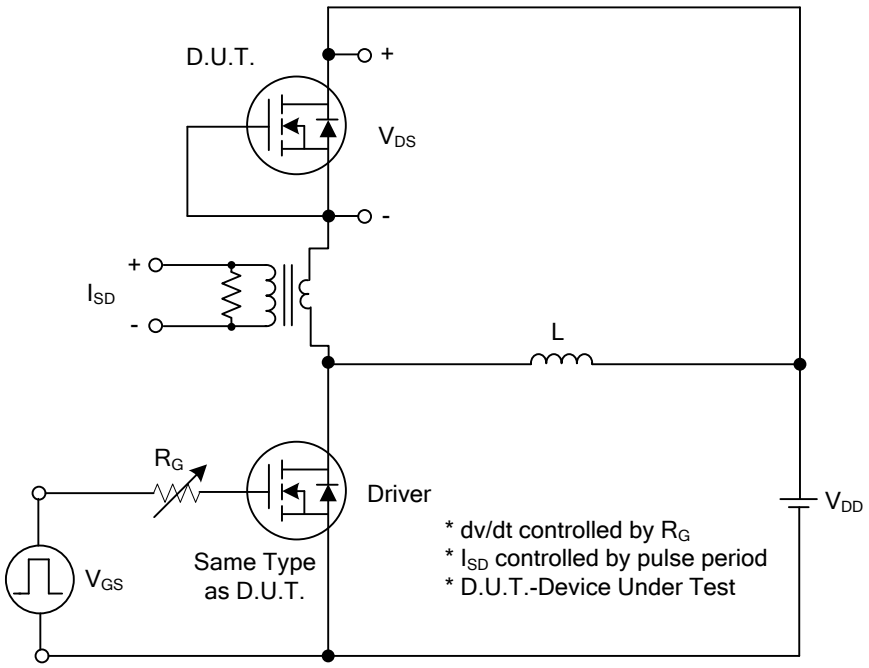
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3/TO-262 TO-263	$θ_{JA}$	62.5	°C/W
	TO-251/TO-251L TO-251S/TO-252 TO-252D		110	°C/W
	TO-126/TO-126C TO-126S		132	°C/W
Junction to Case	TO-220/TO-262 TO-263	$θ_{JC}$	3.13	°C/W
	TO-220F/TO-220F1 TO-220F3		5.95	°C/W
	TO-220F2		5.43	°C/W
	TO-251/TO-251L TO-251S/TO-252 TO-252D		4.53	°C/W
	TO-126/TO-126C TO-126S		10	°C/W

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

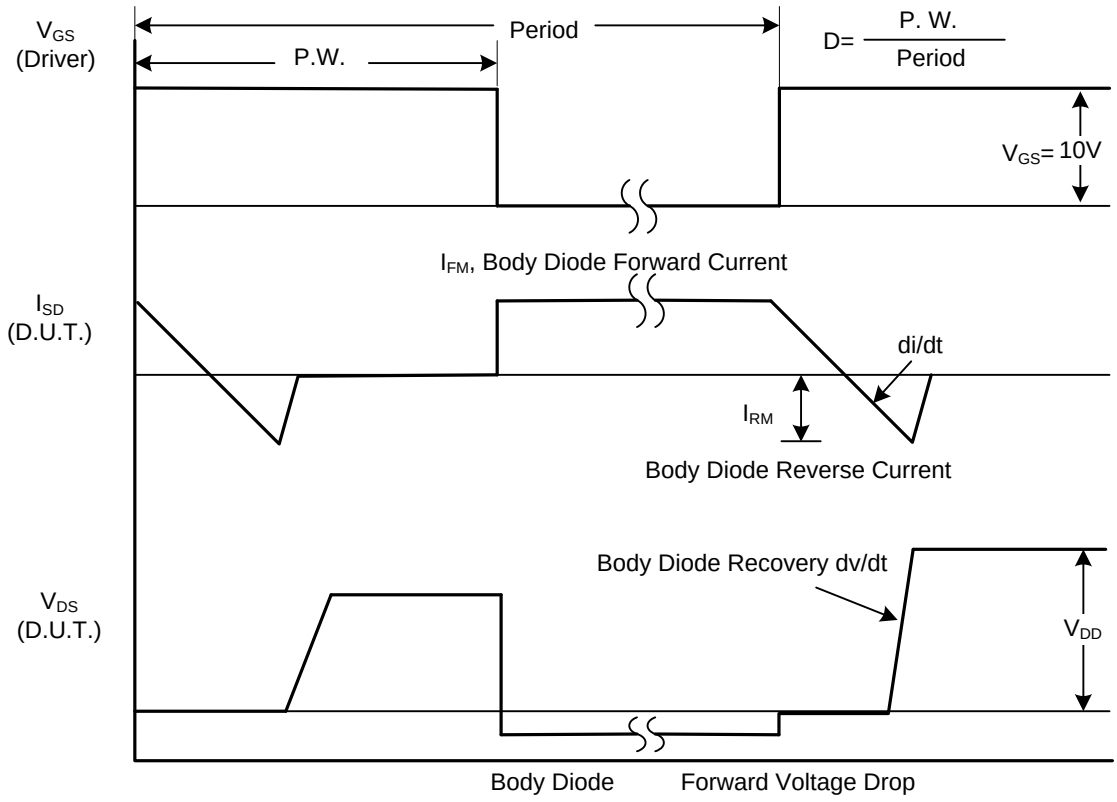
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS} = 0V, I_D = 250μA	650			V
Drain-Source Leakage Current		I_{DSS}	V_{DS} = 650V, V_{GS} = 0V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS} = 30V, V_{DS} = 0V			100	nA
	Reverse		V_{GS} = -30V, V_{DS} = 0V			-100	nA
Breakdown Voltage Temperature Coefficient		$\Delta BV_{DSS}/\Delta T_J$	I_D=250μA, Referenced to 25°C		0.4		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} = 10V, I_D =1.0A		3.9	5.0	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS} =25V, V_{GS} =0V, f =1MHz		320	370	pF
Output Capacitance		C_{OSS}			40	50	pF
Reverse Transfer Capacitance		C_{RSS}			9	12	pF
SWITCHING CHARACTERISTICS							
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
Turn-On Delay Time		$t_{D(ON)}$	V_{DD} =325V, I_D =2.4A, R_G=25Ω (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
DRAIN-SOURCE DIODE CHARACTERISTICS							
Maximum Continuous Drain-Source Diode Forward Current		I_S				2.0	A
Maximum Pulsed Drain-Source Diode Forward Current		I_{SM}				8.0	A
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS} = 0 V, I_{SD} = 2.0 A			1.4	V
Reverse Recovery Time		t_{rr}	V_{GS} = 0 V, I_{SD} = 2.4A, di/dt = 100 A/μs (Note1)		180		ns
Reverse Recovery Charge		Q_{rr}			0.72		μC

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.
2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

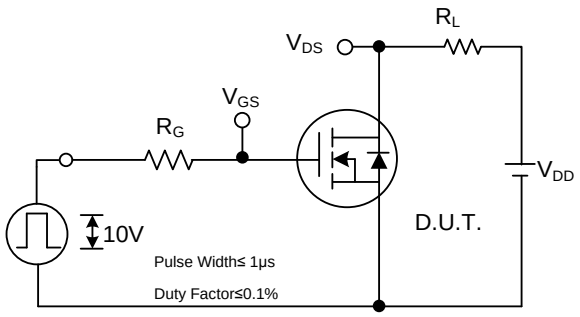


Peak Diode Recovery dv/dt Test Circuit

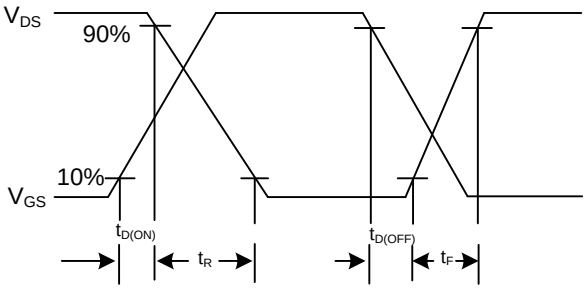


Peak Diode Recovery dv/dt Waveforms

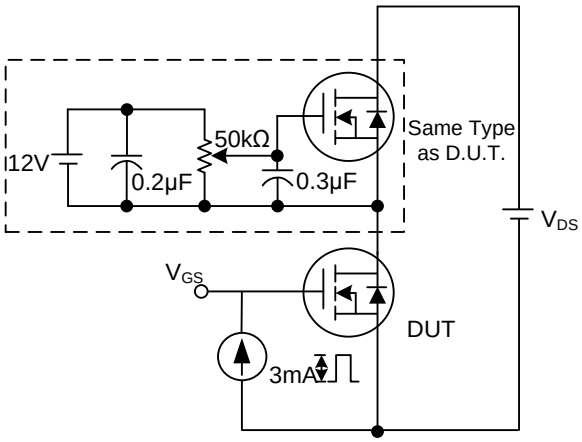
■ TEST CIRCUITS AND WAVEFORMS



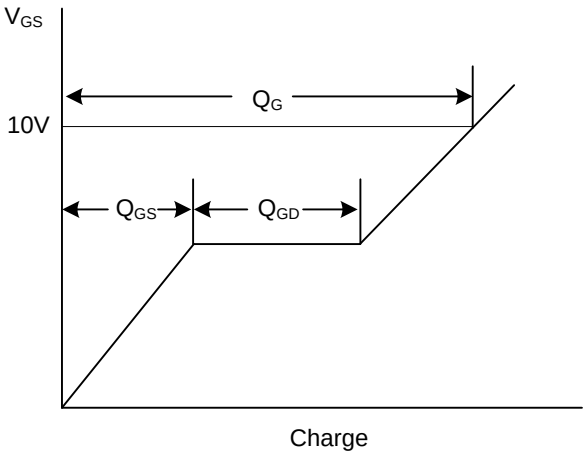
Switching Test Circuit



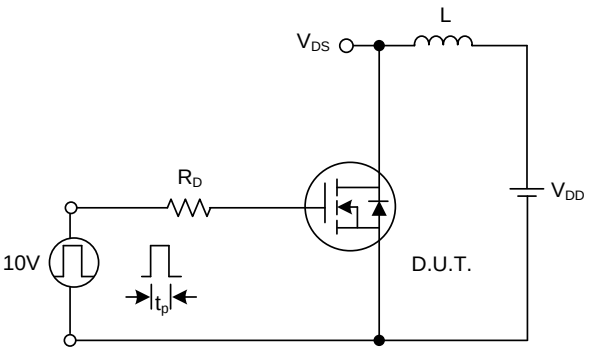
Switching Waveforms



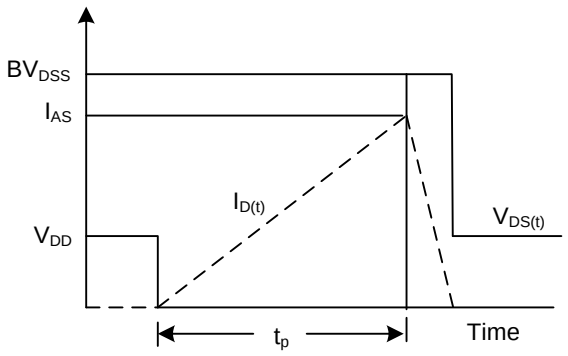
Gate Charge Test Circuit



Gate Charge Waveform



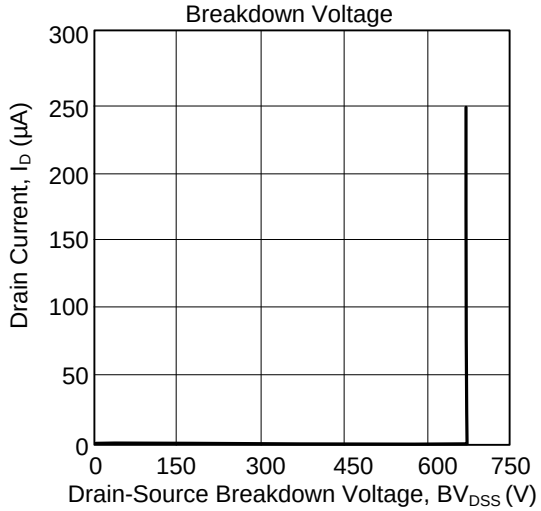
Unclamped Inductive Switching Test Circuit



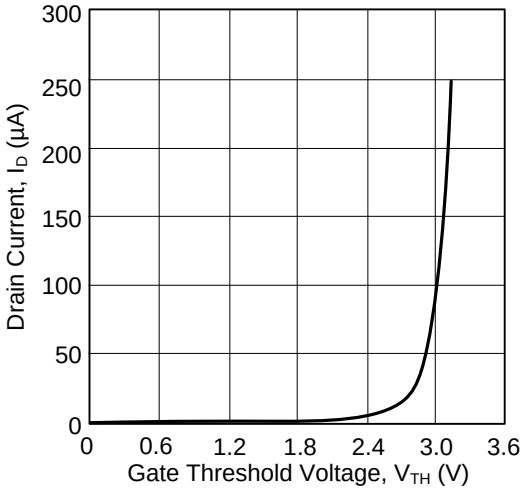
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

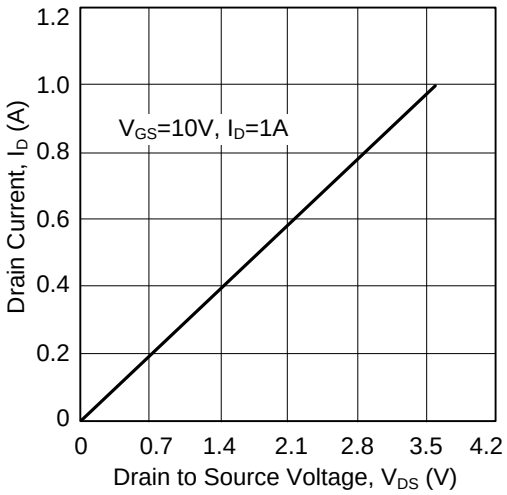
Drain Current vs. Drain-Source Breakdown Voltage



Drain Current vs. Gate Threshold Voltage



Drain-Source On-State Resistance Characteristics



Drain Current vs. Source to Drain Voltage