



4N65-Q

Power MOSFET

4.0A, 650V N-CHANNEL POWER MOSFET

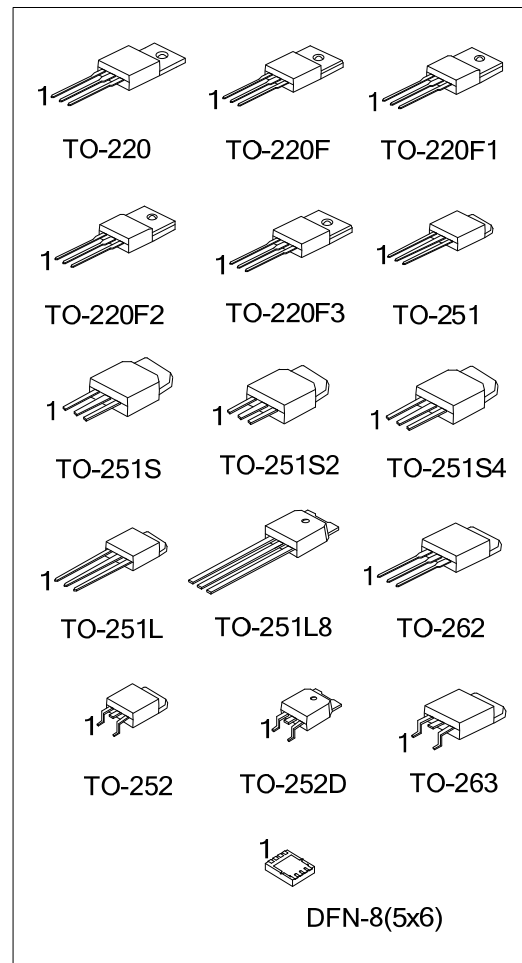
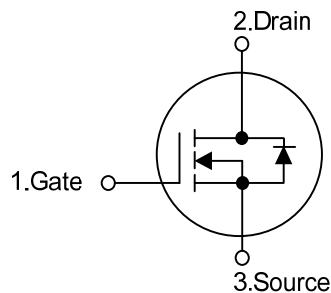
■ DESCRIPTION

The UTC 4N65-Q 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

- * $R_{DS(ON)} < 3.1\Omega$ @ $V_{GS} = 10V$, $I_D = 2.2A$
- * 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	4	5	6	7	8	
4N65L-TA3-T	4N65G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
4N65L-TF1-T	4N65G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
4N65L-TF2-T	4N65G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	Tube
4N65L-TF3T-T	4N65G-TF3T-T	TO-220F3	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-TMA-T	4N65G-TMA-T	TO-251L	G	D	S	-	-	-	-	-	Tube
4N65L-TMA8-T	4N65G-TMA8-T	TO-251L8	G	D	S	-	-	-	-	-	Tube
4N65L-TMS-T	4N65G-TMS-T	TO-251S	G	D	S	-	-	-	-	-	Tube
4N65L-TMS2-T	4N65G-TMS2-T	TO-251S2	G	D	S	-	-	-	-	-	Tube
4N65L-TMS4-T	4N65G-TMS4-T	TO-251S4	G	D	S	-	-	-	-	-	Tube
4N65L-TN3-R	4N65G-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
4N65L-TND-R	4N65G-TND-R	TO-252D	G	D	S	-	-	-	-	-	Tape Reel
4N65L-T2Q-T	4N65G-T2Q-T	TO-262	G	D	S	-	-	-	-	-	Tube
4N65L-TQ2-R	4N65G-TQ2-R	TO-263	G	D	S	-	-	-	-	-	Tape Reel
4N65L-TQ2-T	4N65G-TQ2-T	TO-263	G	D	S	-	-	-	-	-	Tube
-	4N65G-K08-5060-R	DFN-8(5×6)	S	S	S	G	D	D	D	D	Tape Reel

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

4N65L-TA3-T (1) Packing Type (2) Package Type (3) Green Package	(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TF3T: TO-220F3, TM3: TO-251, TMA: TO-251L, TMA8: TO-251L8, TMS: TO-251S, TMS2: TO-251S2, TN3: TO-252, TMS4: TO-251S4, TND: TO-252D, T2Q: TO-262, TQ2: TO-263, K08-5060: DFN-8(5×6) (3) L: Lead Free, G: Halogen Free and Lead Free
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MARKING

PACKAGE		MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3 TO-251 TO-251L TO-251L8	TO-251S TO-251S2 TO-251S4 TO-252 TO-252D TO-262 TO-263	UTC 4N65 Lot Code Date Code L: Lead Free G: Halogen Free
DFN-8(5×6)		UTC 4N65 Lot Code Date Code

■ **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}	60	mJ
	Repetitive (Note2)	E_{AR}	10.6	mJ
Peak Diode Recovery dv/dt (Note4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220/TO-262/TO-263	P_D	106	W
	TO-220F/TO-220F1		36	W
	TO-220F3		38	W
	TO-220F2		38	W
	TO-251/TO-251L TO-251L8/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		50	W
	DFN-8(5×6)		30	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. $L = 30\text{mH}$, $I_{AS} = 2.1\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, 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	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-262/TO-263 TO-220F/TO-220F1 TO-220F2/TO-220F3	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L TO-251L8/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		83	$^\circ\text{C}/\text{W}$
	DFN-8(5×6)		75 (Note)	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/TO-262/TO-263	θ_{JC}	1.18	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TP-220F3		3.47	$^\circ\text{C}/\text{W}$
	TO-220F2		3.28	$^\circ\text{C}/\text{W}$
	TO-251/TO-251L TO-251L8/TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		2.5	$^\circ\text{C}/\text{W}$
	DFN-8(5×6)		4.17 (Note)	$^\circ\text{C}/\text{W}$

Note: The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.

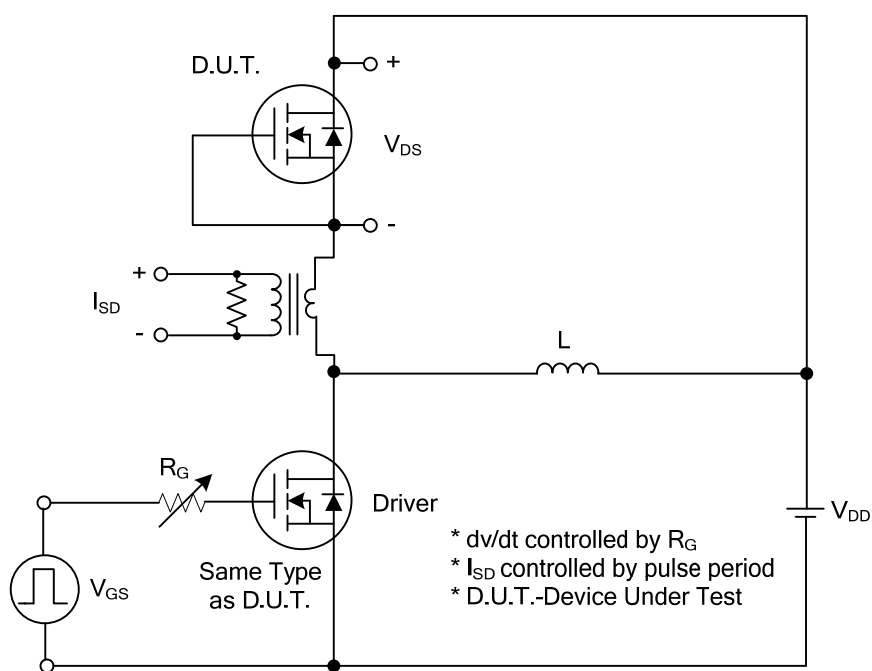
■ **ELECTRICAL CHARACTERISTICS** ($T_C = 25^\circ\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} = 0 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}	V _{GS} = 30 V, V _{DS} = 0 V			100	nA
	Reverse		V _{GS} = -30 V, V _{DS} = 0 V			-100	nA
Breakdown Voltage Temperature Coefficient		△BV _{DSS} /△T _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		2.9	3.1	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{GS} =V, V _{DS} =25V, f=1MHz		470	530	pF
Output Capacitance		C _{OSS}			50	70	pF
Reverse Transfer Capacitance		C _{RSS}			10	13	pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =520V, I _D = 4.0A, V _{GS} =10V (Note 1, 2)		55	75	nC
Gate-Source Charge		Q _{GS}			15	21	nC
Gate-Drain Charge		Q _{GD}			18	24	nC
Turn-On Delay Time (Note 1)		t _{D(ON)}	V _{DS} =325V, I _D 4.0A, R _G =25Ω (Note 1, 2)		38	75	ns
Turn-On Rise Time		t _R			45	85	ns
Turn-Off Delay Time		t _{D(OFF)}			90	130	ns
Turn-Off Fall Time		t _F			35	80	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 (Note 1)		V _{SD}	V _{GS} = 0 V, I _S = 4.4A			1.4	V
Reverse Recovery Time (Note 1)		t _{rr}	V _{GS} = 0V, I _S = 4.4A,		250		ns
Reverse Recovery Charge		Q _{rr}	dl _F /dt = 100 A/μs (Note 1)		1.5		μC

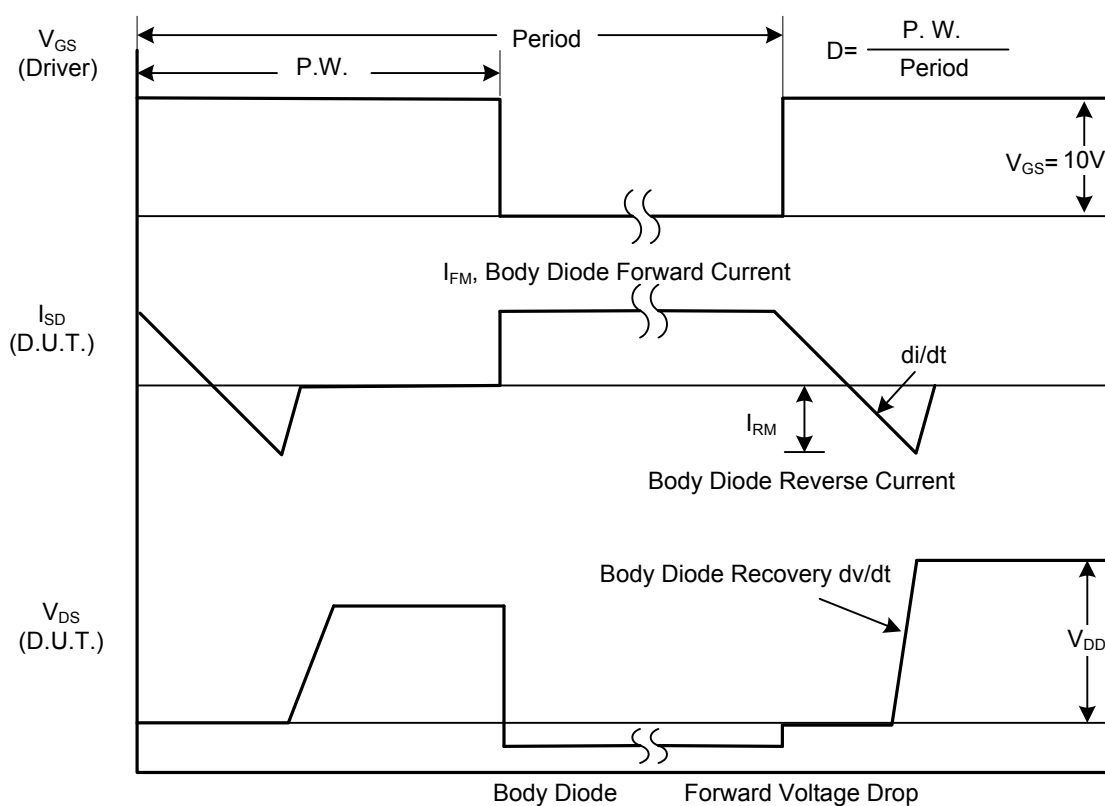
Note: 1. Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

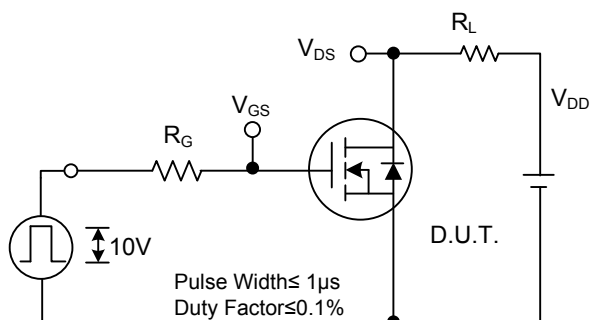


Peak Diode Recovery dv/dt Test Circuit

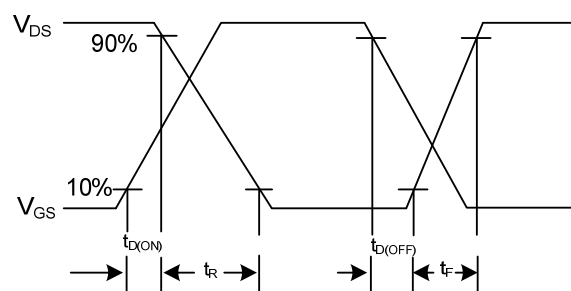


Peak Diode Recovery dv/dt Waveforms

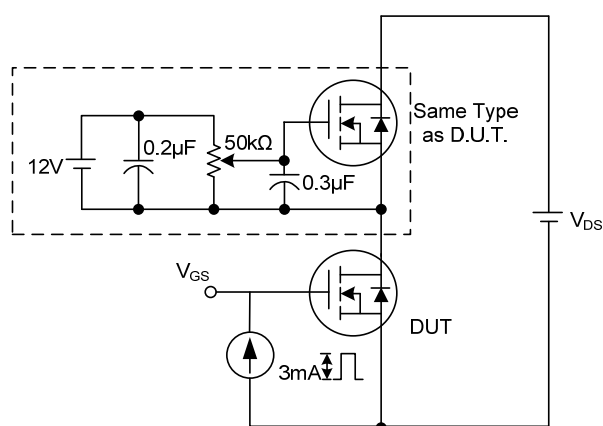
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



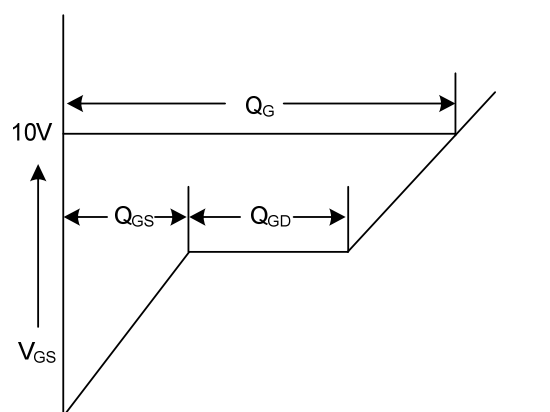
Switching Test Circuit



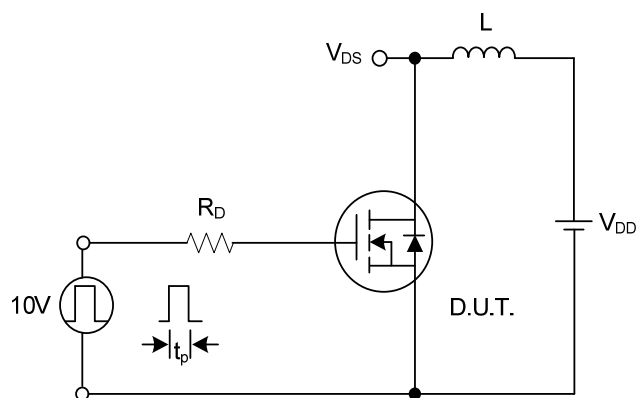
Switching Waveforms



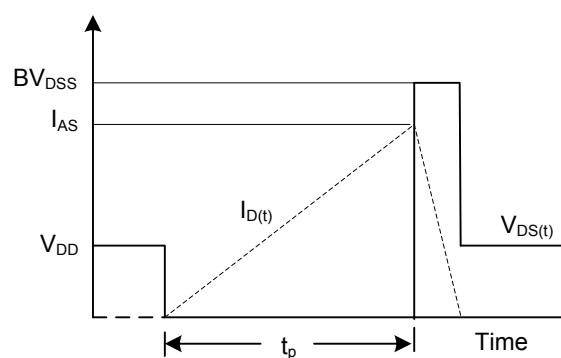
Gate Charge Test Circuit



Gate Charge Waveform

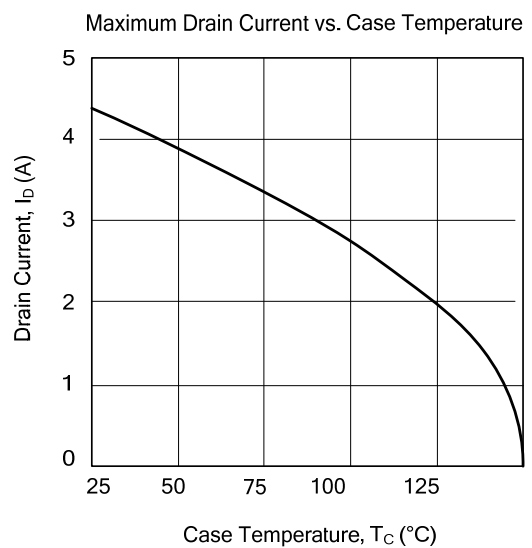
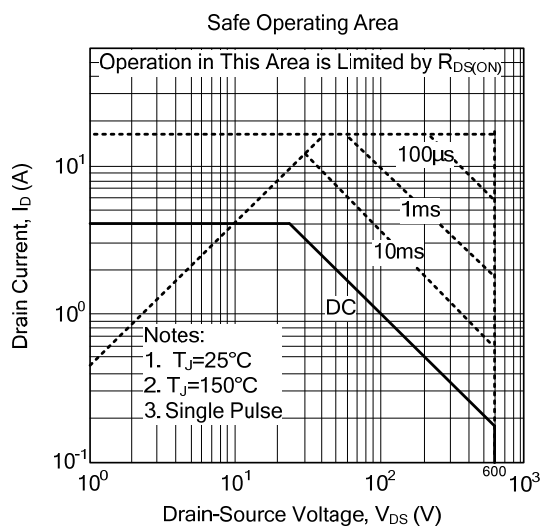
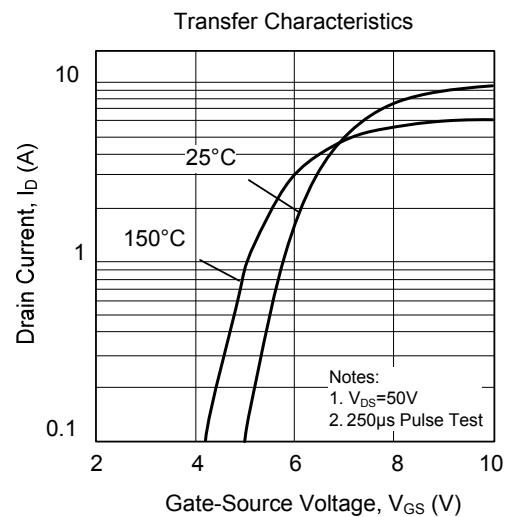
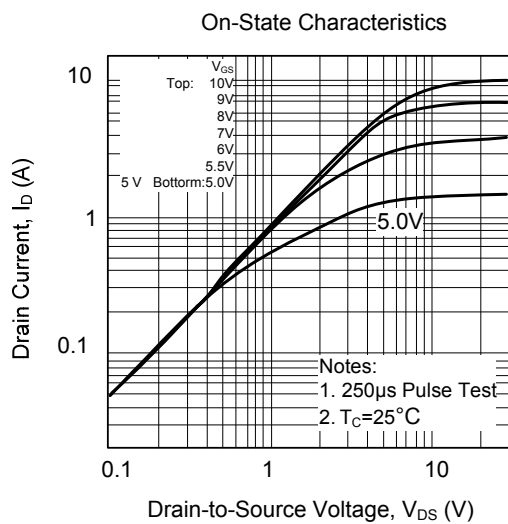
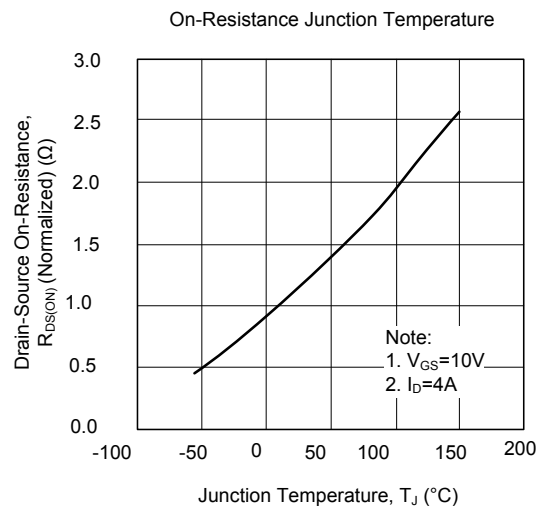
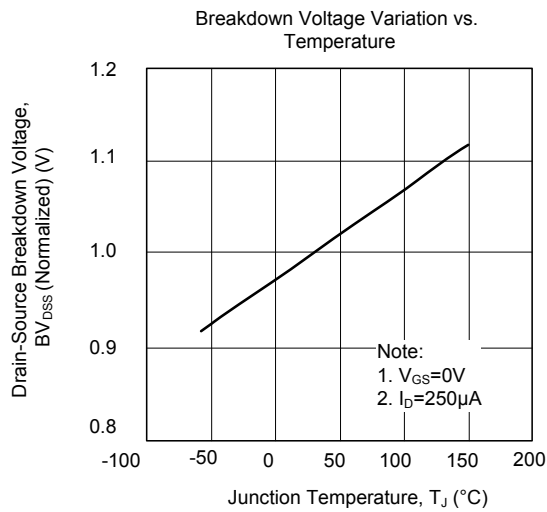


Unclamped Inductive Switching Test Circuit

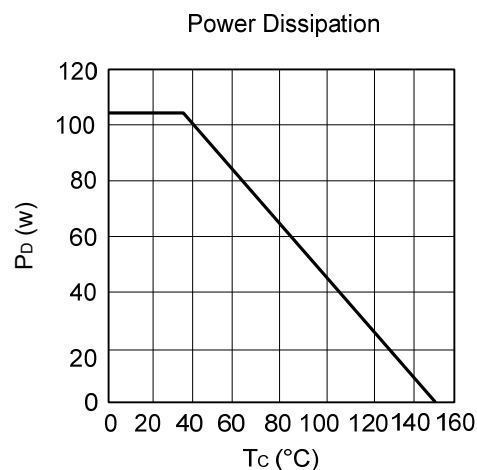
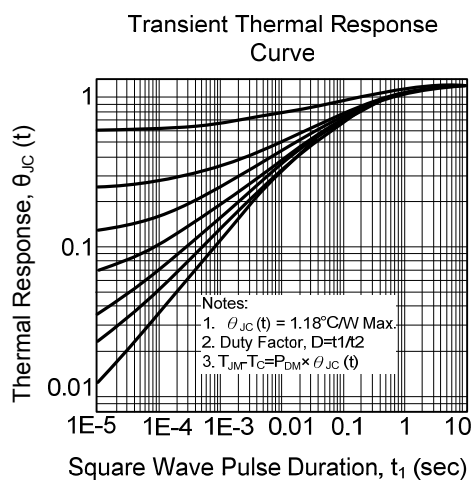
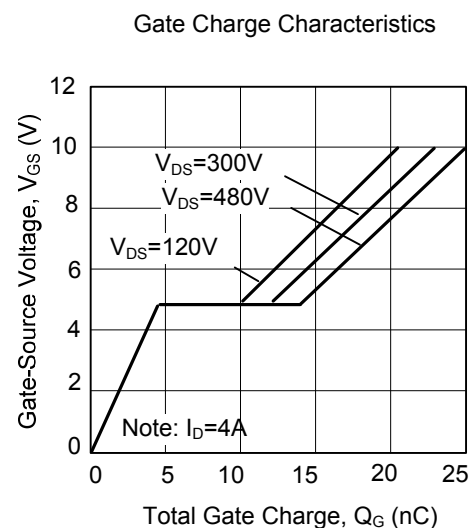
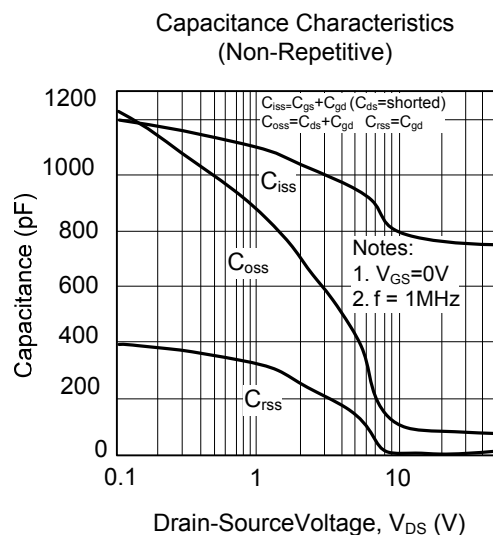
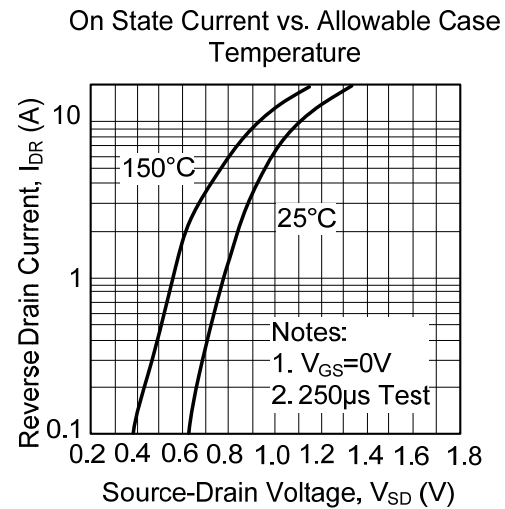
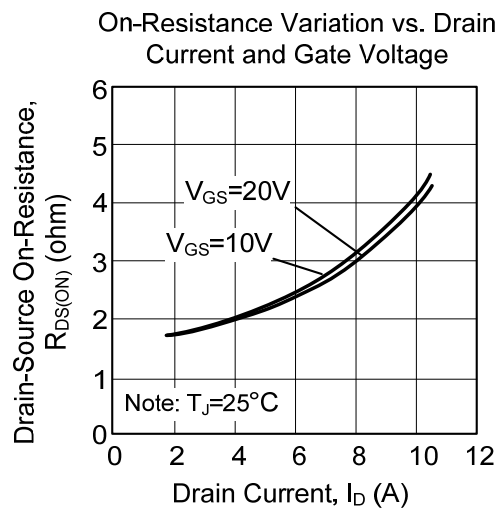


Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS(Cont.)



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