



4N65

Power MOSFET

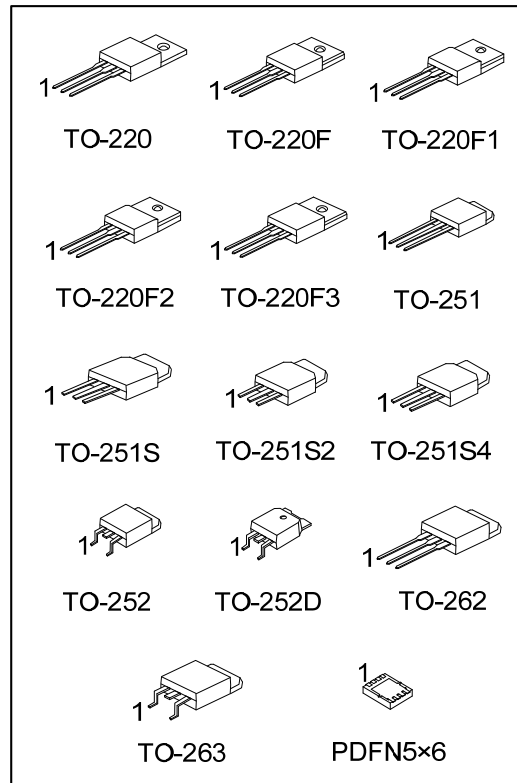
4.0A, 650V N-CHANNEL POWER MOSFET

DESCRIPTION

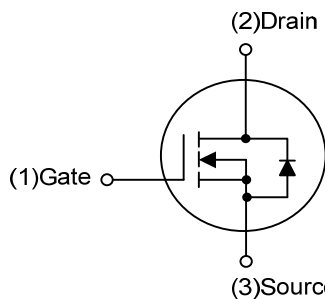
The UTC **4N65** is a high voltage power MOSFET designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristic. This power MOSFET is usually used in high speed switching applications including power supplies,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

FEATURES

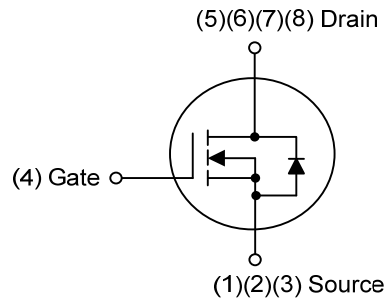
- * $R_{DS(ON)} \leq 2.5 \Omega @ V_{GS}=10V, I_D=2.2A$
- * Fast Switching Capability
- * Avalanche Energy Specified
- * Improved dv/dt Capability, High Ruggedness



SYMBOL



TO-220/TO-220F/TO-220F1
 TO-220F2/TO-220F3/TO-251
 TO-251S/TO-251S2/TO-251S4
 TO-252/TO-252D/TO-262/TO-263



PDFN5x6

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-TF3-T	4N65G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	Tube
4N65L-TF3T-T	4N65G-TF3T-T	TO-220F3	G	D	S	-	-	-	-	-	Tube
4N65L-TM3-T	4N65G-TM3-T	TO-251	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-T	4N65G-TQ2-T	TO-263	G	D	S	-	-	-	-	-	Tube
4N65L-TQ2-R	4N65G-TQ2-R	TO-263	G	D	S	-	-	-	-	-	Tape Reel
4N65L-P5060-R	4N65G-P5060-R	PDFN5×6	S	S	S	G	D	D	D	D	Tape Reel

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

4N65G-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,
 TMS: TO-251S, TMS2: TO-251S2, TN3: TO-252,
 TMS4: TO-251S4, TND: TO-252D, T2Q: TO-262,
 TQ2: TO-263, P5060: PDFN5×6
 (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-251S TO-251S2 TO-251S4 TO-252 TO-252D TO-262 TO-263	<p>UTC 4N65 Lot Code ← [] [] [] [] [] → Date Code</p> <p>1</p> <p>L: Lead Free G: Halogen Free</p>
PDFN5×6	<p>UTC 4N65 Lot Code ← [] [] [] [] [] → Date Code</p>

■ 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}	260	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 TO-220F3		35	W
	TO-220F2		36	W
	TO-251/ TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		50	W
	PDFN5×6		30	W
	Junction Temperature		T_J	+150
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. $L = 30\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\ \Omega$, 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	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-251S TO-251S2/TO-251S4 TO-252/TO-252D		110	$^\circ\text{C}/\text{W}$
	PDFN5×6		75	$^\circ\text{C}/\text{W}$
	TO-220/TO-262/TO-263		1.18	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220/TO-262/TO-263	θ_{JC}	1.18	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1 TO-220F3		3.5	$^\circ\text{C}/\text{W}$
	TO-220F2		3.4	$^\circ\text{C}/\text{W}$
	TO-251/ TO-251S TO-251S2/TO-251S4 TO-252/TO-252D		2.5	$^\circ\text{C}/\text{W}$
	PDFN5×6		4.17	$^\circ\text{C}/\text{W}$

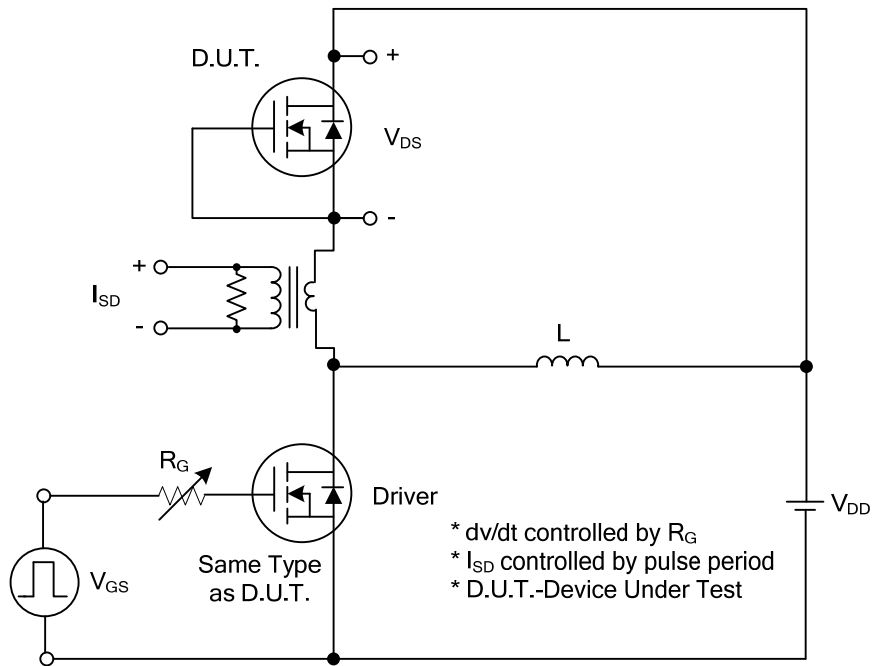
■ ELECTRICAL CHARACTERISTICS (T_C=25°C, unless otherwise specified)

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
		V _{DS} = 480 V, T _C = 125°C			100	μA
Gate-Source Leakage Current	Forward	I _{GSS}				
	Reverse					
		V _{GS} = 30 V, V _{DS} = 0 V			100	nA
		V _{GS} = -30 V, V _{DS} = 0 V			-100	nA
Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /ΔT _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		2.4	2.5	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C _{ISS}	V _{DS} = 25 V, V _{GS} = 0V, f = 1MHz		670	750	pF
Output Capacitance	C _{OSS}			70	90	pF
Reverse Transfer Capacitance	C _{RSS}			23	26	pF
SWITCHING CHARACTERISTICS						
Total Gate Charge	Q _G	V _{DS} = 520V, I _D = 4.0A, V _{GS} = 10V (Note 1, 2)		100	120	nC
Gate-Source Charge	Q _{GS}			17	19	nC
Gate-Drain Charge	Q _{GD}			20	26	nC
Turn-On Delay Time	t _{D(ON)}	V _{DS} = 325V, I _D = 4.0A, R _G = 25Ω (Note 1, 2)		45	85	ns
Turn-On Rise Time	t _R			100	140	ns
Turn-Off Delay Time	t _{D(OFF)}			200	240	ns
Turn-Off Fall Time	t _F			130	150	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	V _{SD}	V _{GS} = 0 V, I _S = 4.4A			1.4	V
Reverse Recovery Time	t _{rr}	V _{GS} = 0V, I _S = 4.4A,		250		ns
Reverse Recovery Charge	Q _{rr}	di _F /dt = 100 A/μs (Note 1)		1.5		μC

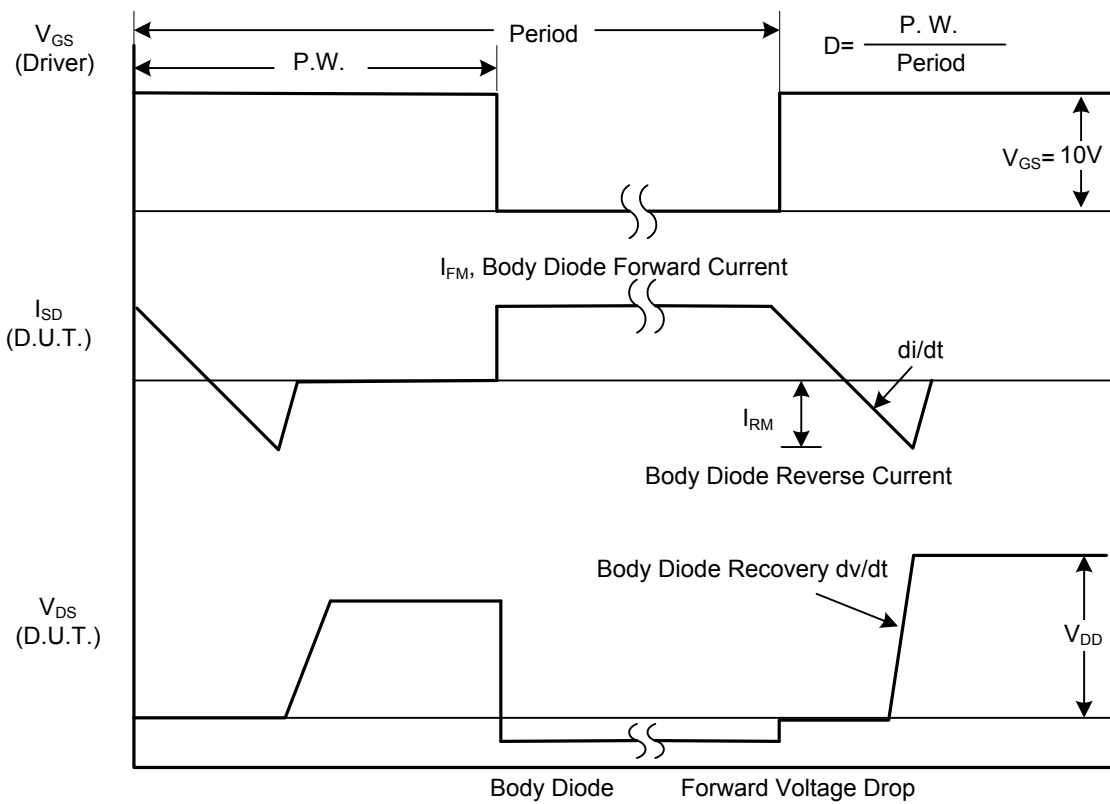
Note: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

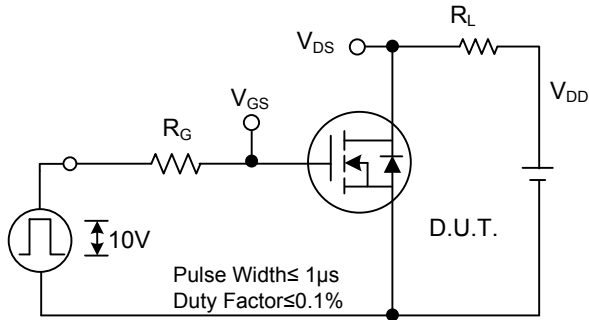


Peak Diode Recovery dv/dt Test Circuit

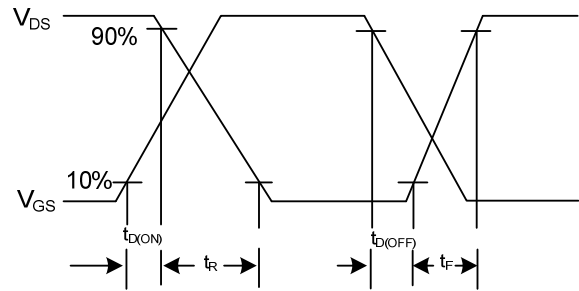


Peak Diode Recovery dv/dt Waveforms

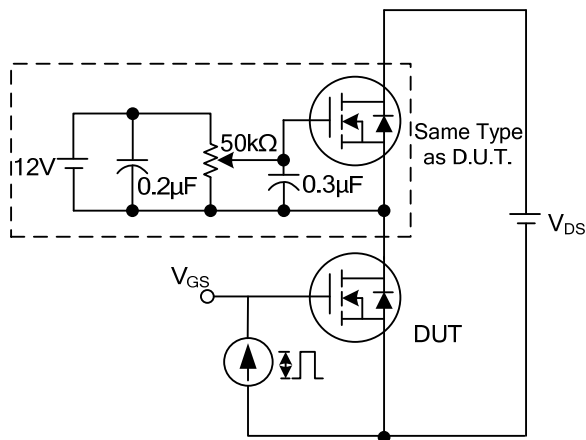
■ TEST CIRCUITS AND WAVEFORMS



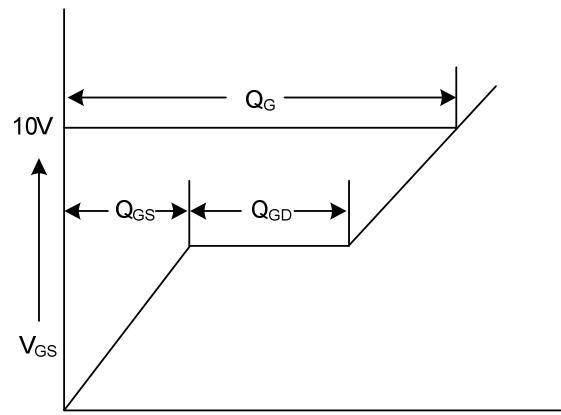
Switching Test Circuit



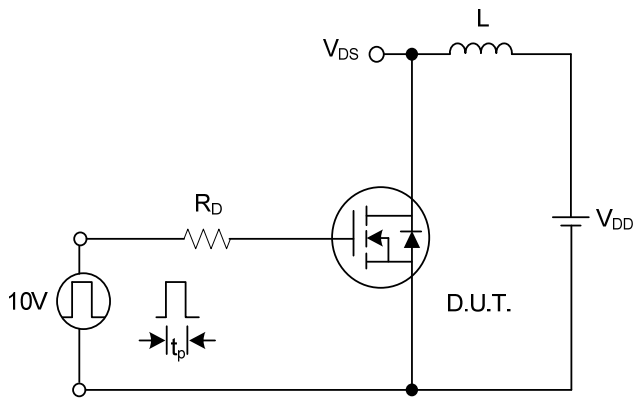
Switching Waveforms



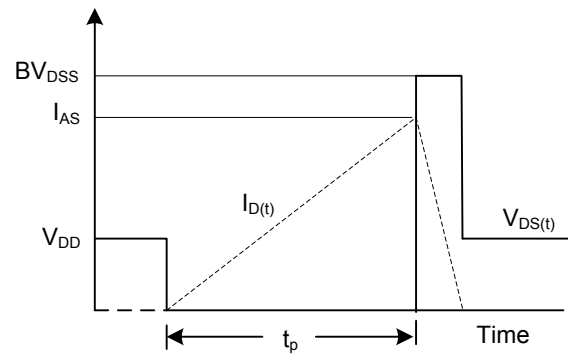
Gate Charge Test Circuit



Charge
Gate Charge Waveform

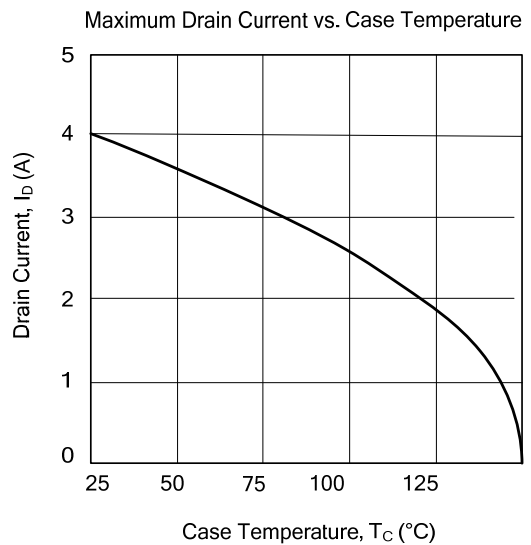
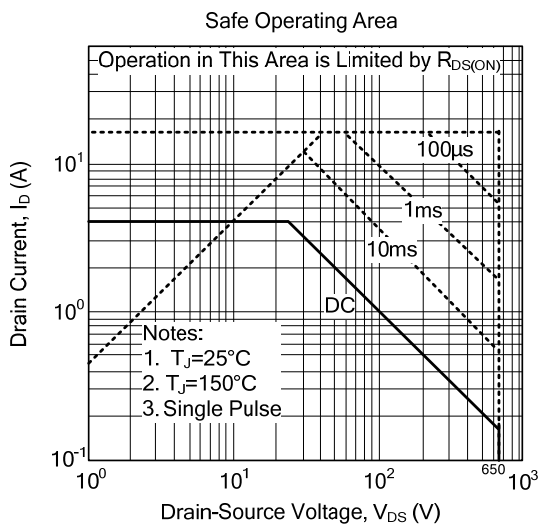
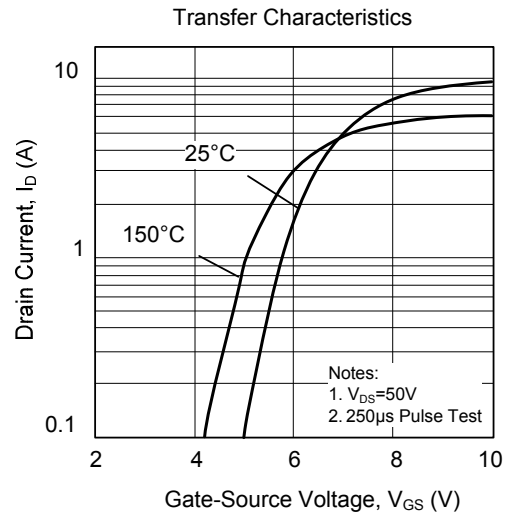
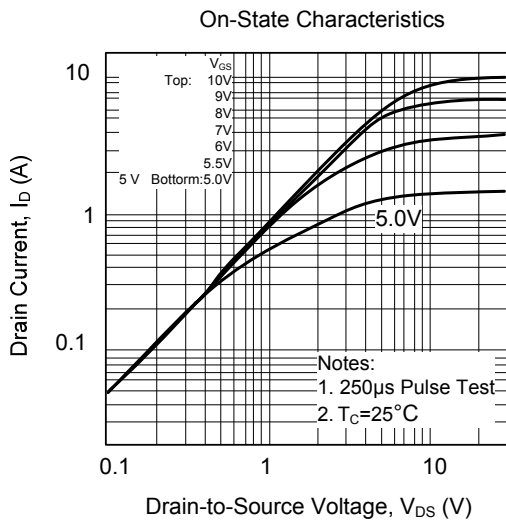
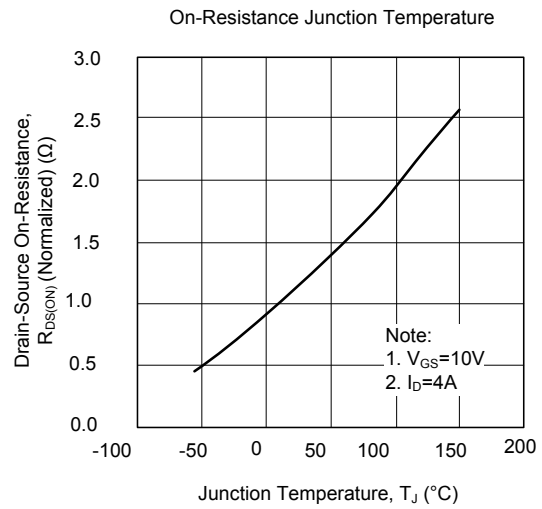
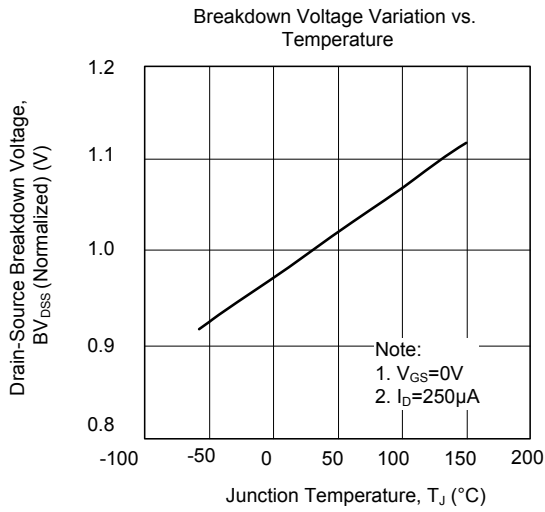


Unclamped Inductive Switching Test Circuit



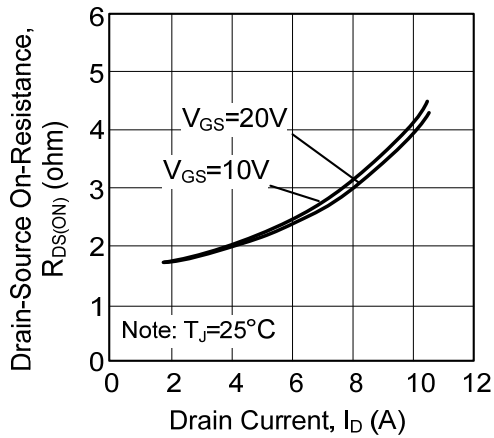
Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

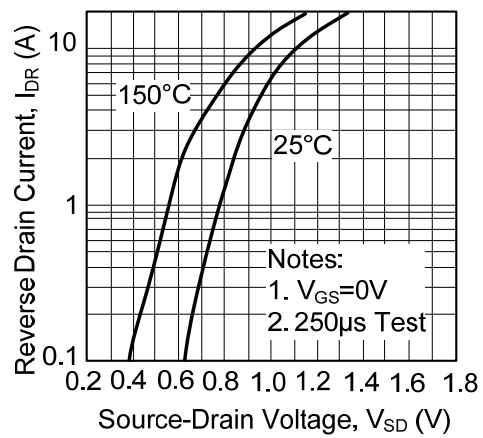


■ TYPICAL CHARACTERISTICS (Cont.)

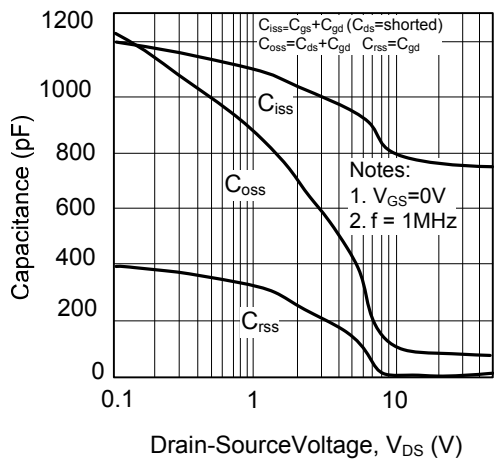
On-Resistance Variation vs. Drain Current and Gate Voltage



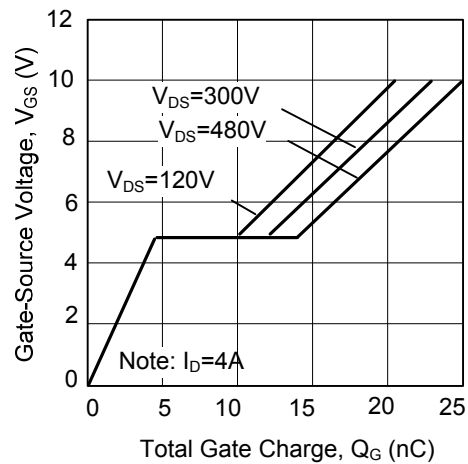
On State Current vs. Allowable Case Temperature



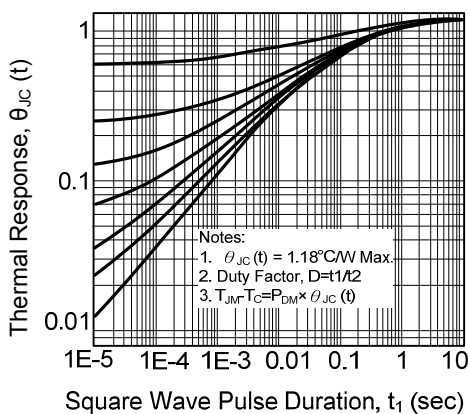
Capacitance Characteristics (Non-Repetitive)



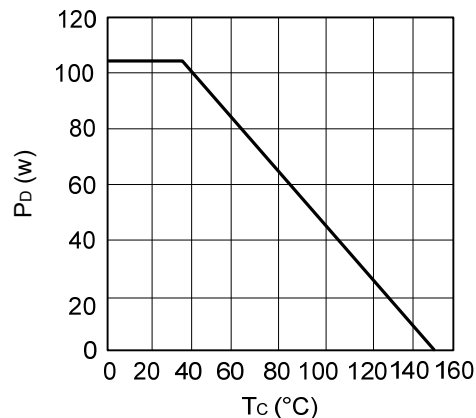
Gate Charge Characteristics



Transient Thermal Response Curve



Power Dissipation



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