



4N65

Power MOSFET

4A, 650V N-CHANNEL POWER MOSFET

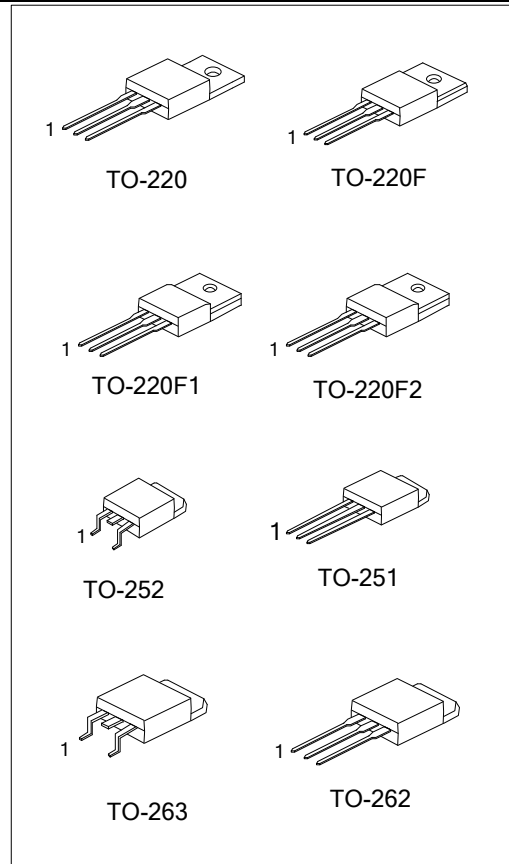
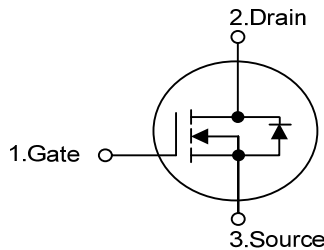
■ DESCRIPTION

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 DC to DC converters and bridge circuits.

■ FEATURES

- * $R_{DS(ON)} = 2.5\Omega @ V_{GS} = 10V$
- * Ultra Low Gate Charge (typical 15 nC)
- * Low Reverse Transfer Capacitance ($C_{RSS} = \text{Typical } 8.0 \text{ pF}$)
- * 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	
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-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-TN3-T	4N65G-TN3-T	TO-252	G	D	S	Tube
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

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

<p>4N65L-TA3-T</p> <p>(1) Packing Type (2) Package Type (3) Lead Free</p>	<p>(1) T: Tube, R: Tape Reel (2) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F, T2Q: TO-262, TF2: TO-220F2, TM3: TO-251, TN3: TO-252, TQ3: TO-263 (3) G: Halogen Free, L: Lead Free</p>
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■ 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 (Note 2)		I_{AR}	4.4	A
Drain Current	Continuous	I_D	4.0	A
	Pulsed (Note 2)	I_{DM}	16	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	260	mJ
	Repetitive (Note 2)	E_{AR}	10.6	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	TO-220/TO-262/TO-263	P_D	106	W
	TO-220F/TO-220F1		36	
	TO-220F2		38	
	TO-251/ TO-252		50	
Junction Temperature		T_J	+150	$^\circ\text{C}$
Operating Temperature		T_{OPR}	-55 ~ +150	$^\circ\text{C}$
Storage Temperature		T_{STG}	-55 ~ +150	$^\circ\text{C}$

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

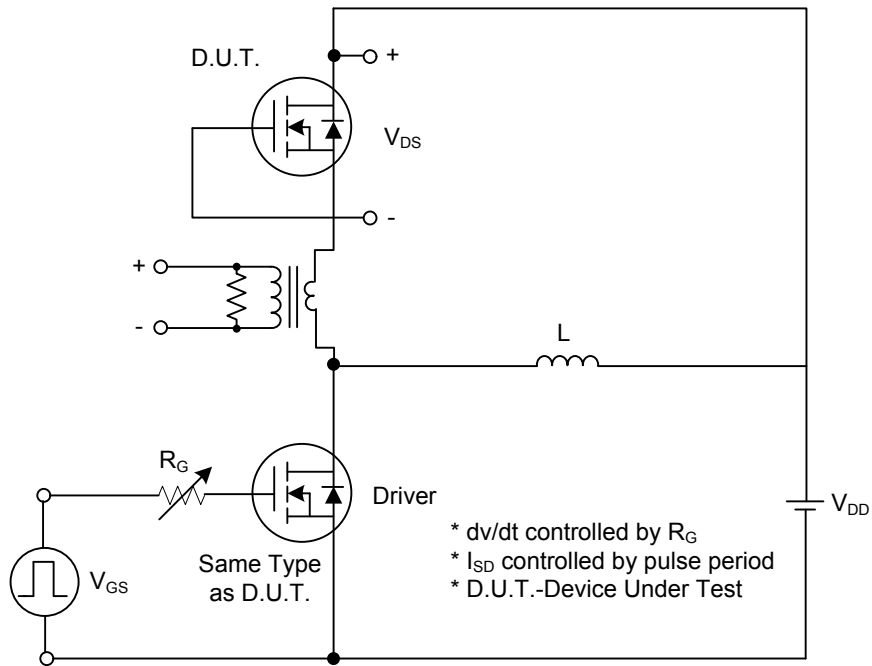
PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-262/TO-263	θ_{JA}	62.5	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		62.5	
	TO-220F2		62.5	
	TO-251/ TO-252		83	
Junction to Case	TO-220/TO-262/TO-263	θ_{Jc}	1.18	$^\circ\text{C}/\text{W}$
	TO-220F/TO-220F1		3.47	
	TO-220F2		3.28	
	TO-251/ TO-252		2.5	

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

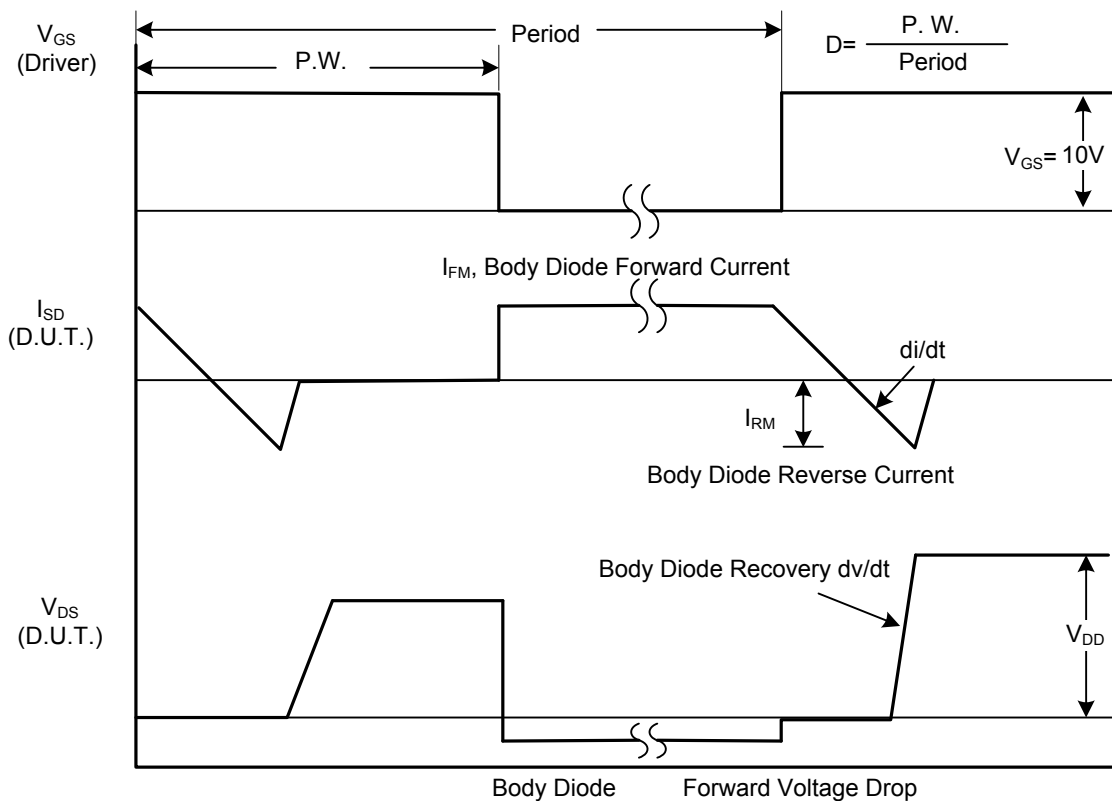
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS} = 0\text{ V}, I_D = 250\mu\text{A}$	650			V
Drain-Source Leakage Current	I_{DSS}	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}			100	nA
	Reverse				$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	-100
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu\text{A}$, Referenced to 25°C		0.6		$\text{V}/^\circ\text{C}$
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 2.2\text{ A}$		2.4	2.5	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$		520	670	pF
Output Capacitance	C_{OSS}			70	90	pF
Reverse Transfer Capacitance	C_{RSS}			8	11	pF
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 325\text{ V}, I_D = 4.0\text{ A},$ $R_G = 25\Omega$ (Note 1, 2)		13	35	ns
Turn-On Rise Time	t_R			45	100	ns
Turn-Off Delay Time	$t_{D(OFF)}$			25	60	ns
Turn-Off Fall Time	t_F			35	80	ns
Total Gate Charge	Q_G	$V_{DS} = 520\text{ V}, I_D = 4.0\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 1, 2)		15	20	nC
Gate-Source Charge	Q_{GS}			3.4		nC
Gate-Drain Charge	Q_{GD}			7.1		nC
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = 4.4\text{ A}$			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	I_S				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current	I_{SM}				17.6	A
Reverse Recovery Time	t_{rr}	$V_{GS} = 0\text{ V}, I_S = 4.4\text{ A},$		250		ns
Reverse Recovery Charge	Q_{RR}	$di_F/dt = 100\text{ A}/\mu\text{s}$ (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

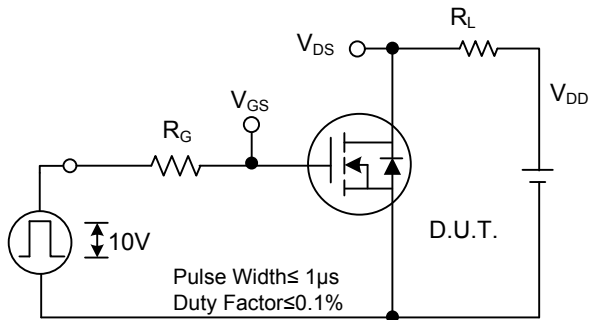


Peak Diode Recovery dv/dt Test Circuit

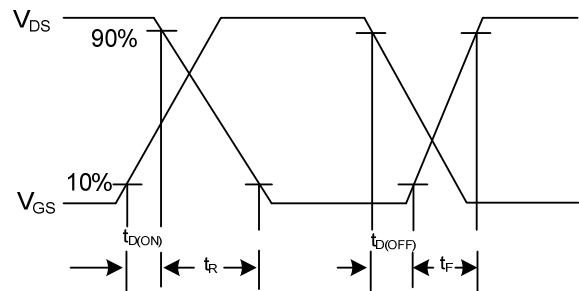


Peak Diode Recovery dv/dt Waveforms

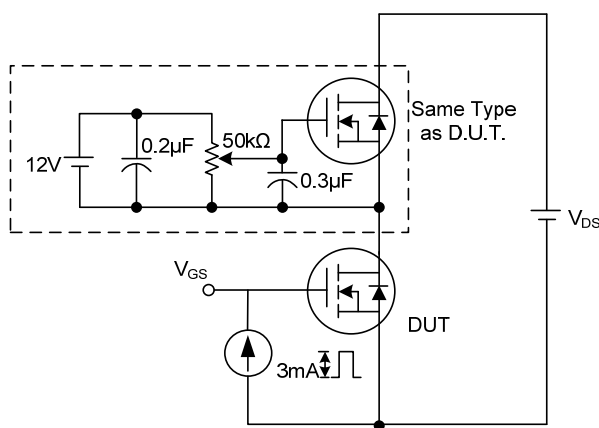
TEST CIRCUITS AND WAVEFORMS (Cont.)



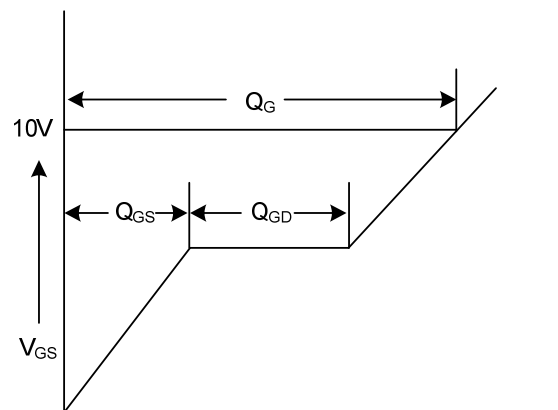
Switching Test Circuit



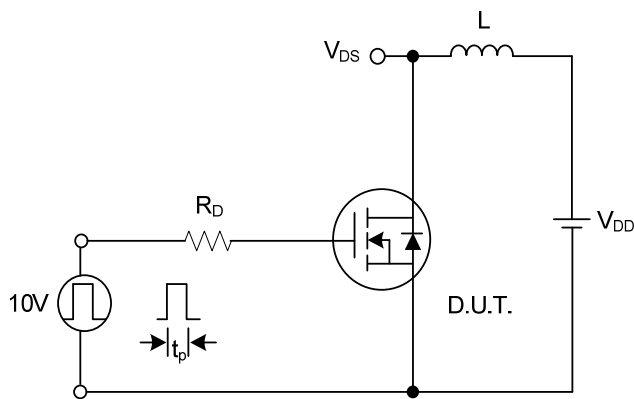
Switching Waveforms



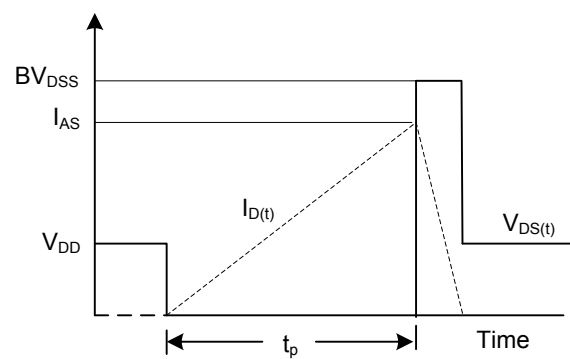
Gate Charge Test Circuit



Gate Charge Waveform

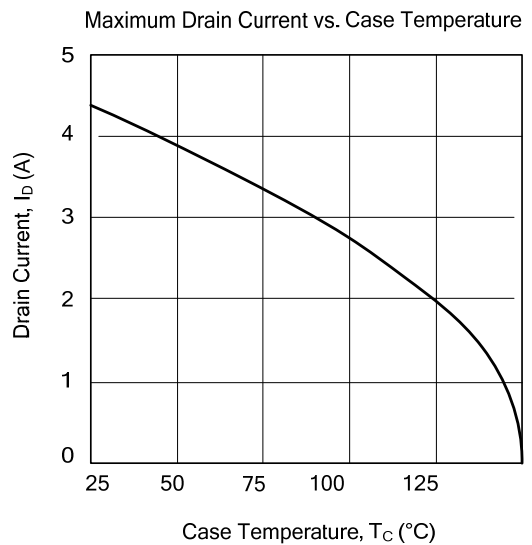
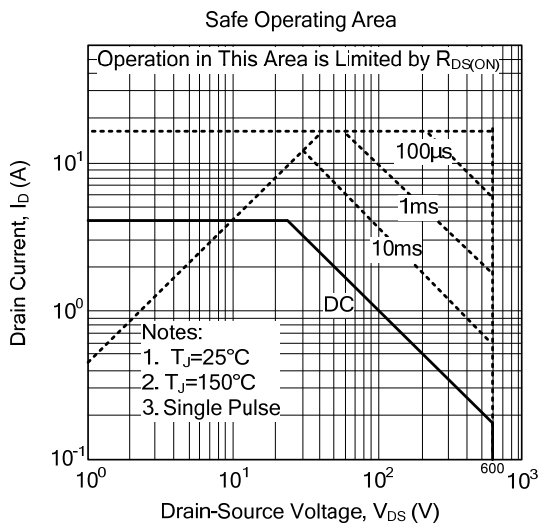
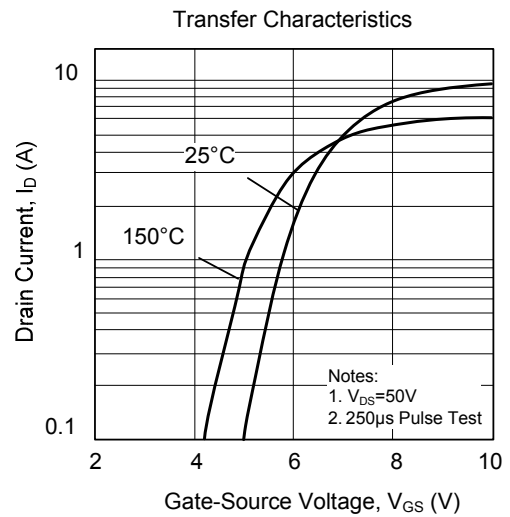
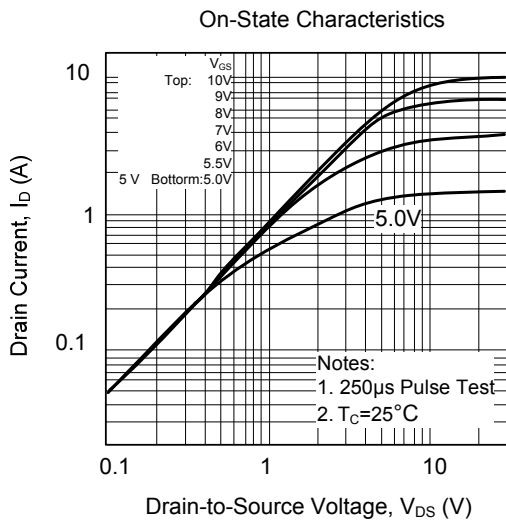
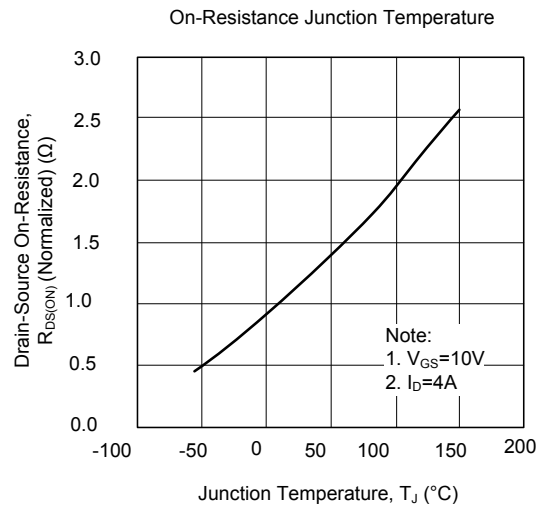
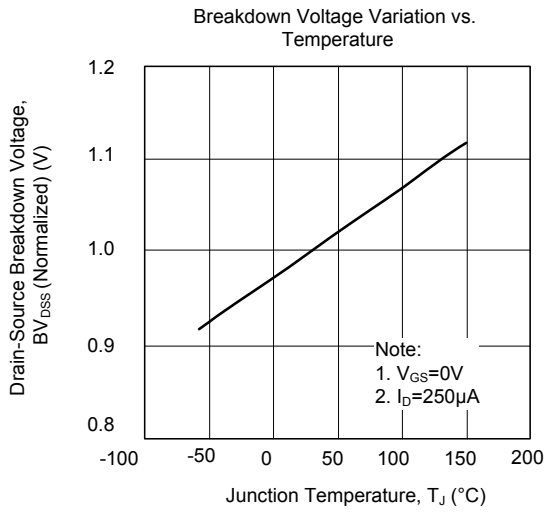


Unclamped Inductive Switching Test Circuit



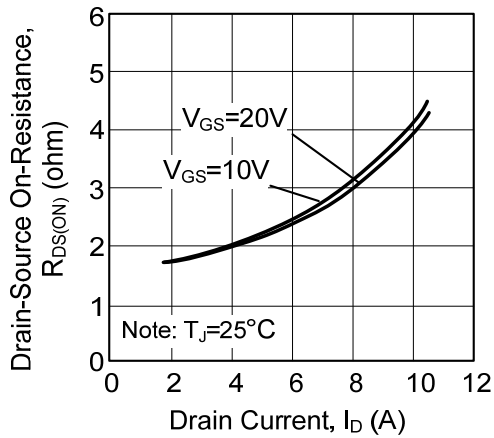
Unclamped Inductive Switching Waveforms

TYPICAL CHARACTERISTICS

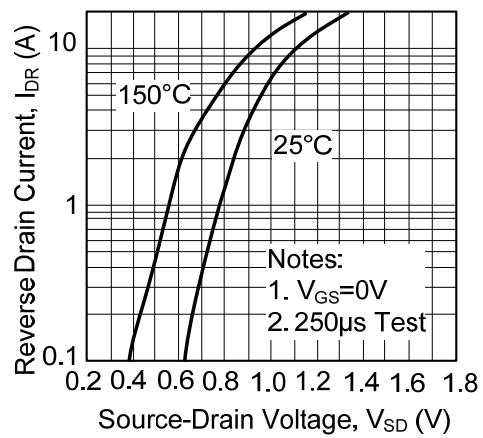


■ TYPICAL CHARACTERISTICS(Cont.)

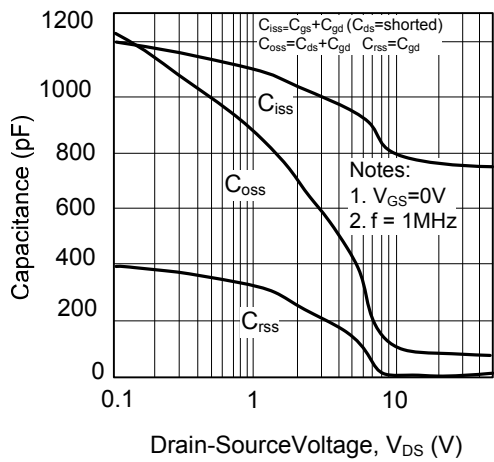
On-Resistance Variation vs. Drain Current and Gate Voltage



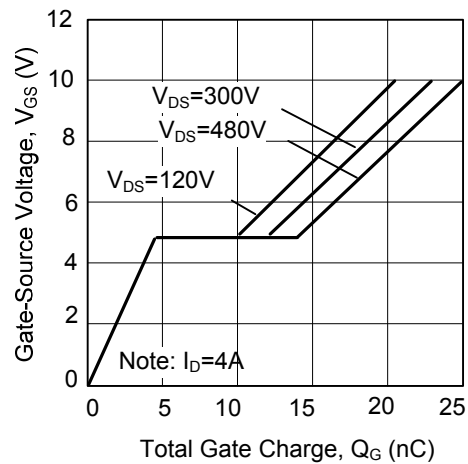
On State Current vs. Allowable Case Temperature



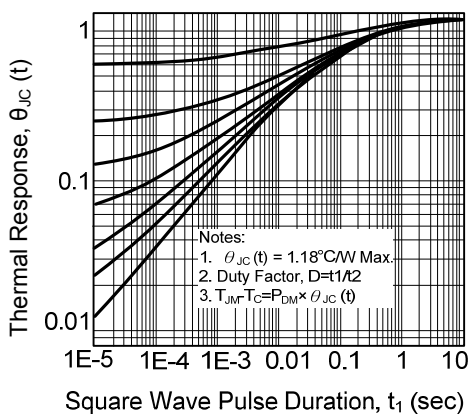
Capacitance Characteristics (Non-Repetitive)



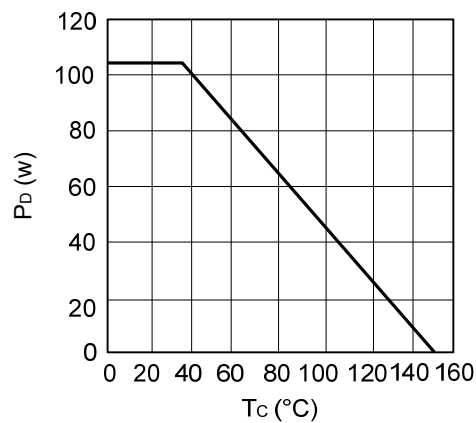
Gate Charge Characteristics



Transient Thermal Response Curve



Power Dissipation



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