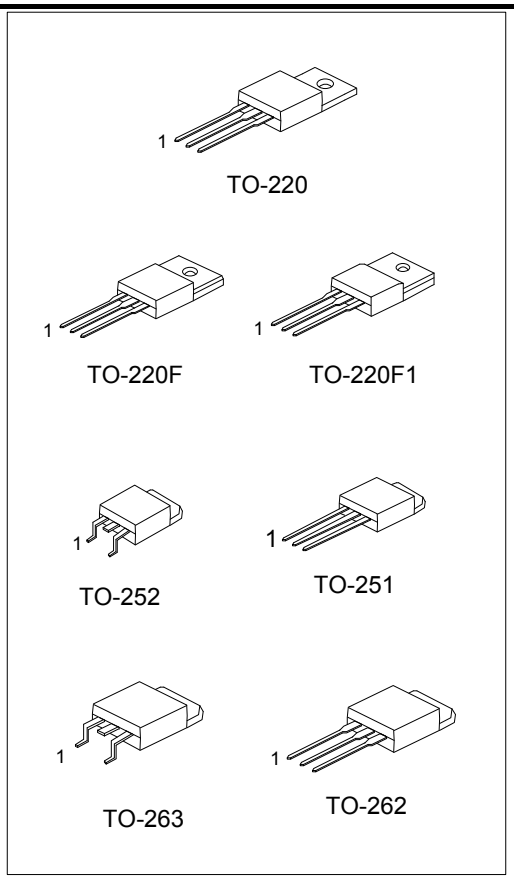
4N65

Power MOSFET

4 Amps, 650 Volts
N-CHANNEL POWER MOSFET



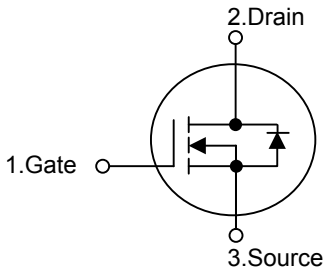
■ DESCRIPTION

The UTC **4N65** is a high voltage 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

* $R_{DS(ON)}$ = 2.5Ω @V_{GS} = 10 V
* Ultra Low Gate Charge (typical 15 nC)
* Low Reverse Transfer Capacitance (C_{RSS} = Typical 8.0 pF)
* Fast Switching Capability
* Avalanche Energy Specified
* Improved dv/dt Capability, High Ruggedness

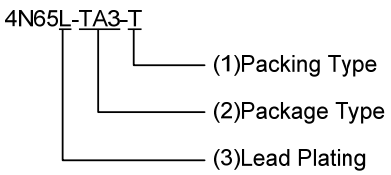
■ SYMBOL



■ 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- 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-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



(1) T: Tube, R: Tape Reel

(2) TA3: TO-220, TF1: TO-220F1, TF3: TO-220F, TM3: TO-251
TN3: TO-252, T2Q: TO-262, TQ3: TO-263

(3)G: Halogen Free, L: Lead Free

■ 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}	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	W
	TO-251		50	W
	TO-252		50	W
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-55 ~ +150	°C
Storage Temperature		T_{STG}	-55 ~ +150	°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 = 30mH, I_{AS} = 4A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
4. I_{SD}≤4.4A, di/dt ≤200A/μs, V_{DD}≤BV_{DSS}, Starting T_J = 25°C

■ 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 = 250 μA	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		$\triangle BV_{DSS}/\triangle T_J$	I_D = 250 μA, Referenced to 25°C		0.6		V/°C
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 250 μA	2.0		4.0	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS} = 10 V, I_D = 2.2 A			2.5	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1MHz		520	670	pF
Output Capacitance		C_{OSS}			70	90	pF
Reverse Transfer Capacitance		C_{RSS}			8	11	pF

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{D(ON)}$	V_{DD} = 300V, I_D = 4.0A, R_G = 25Ω (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}= 480V,I_D= 4.0A, V_{GS}= 10 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 V, I_S = 4.4 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 V, I_S = 4.4 A, dI_F/dt = 100 A/μs (Note 1)		250		ns
Reverse Recovery Charge	Q_{RR}			1.5		μC

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

■ TEST CIRCUITS AND WAVEFORMS

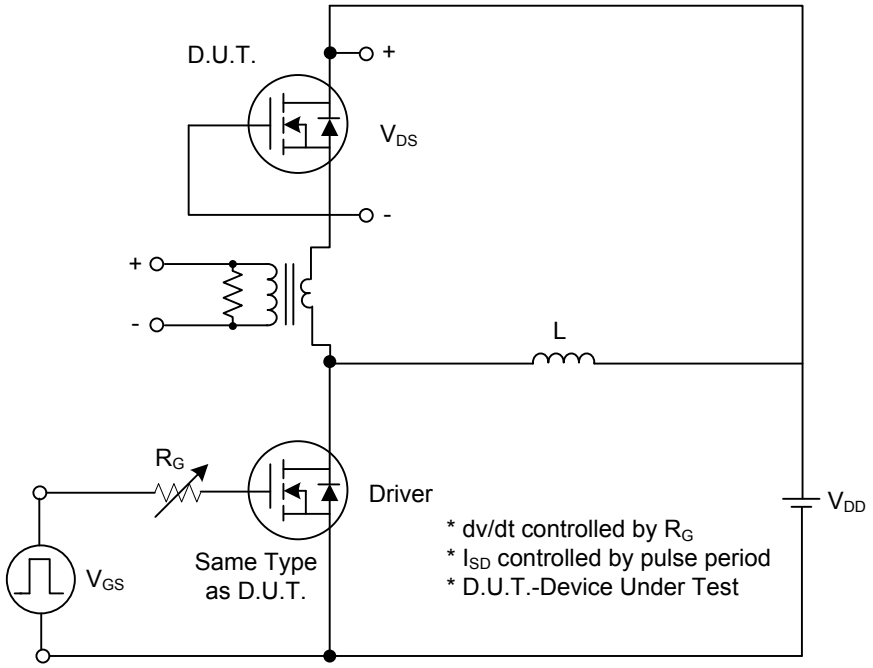


Fig. 1A Peak Diode Recovery dv/dt Test Circuit

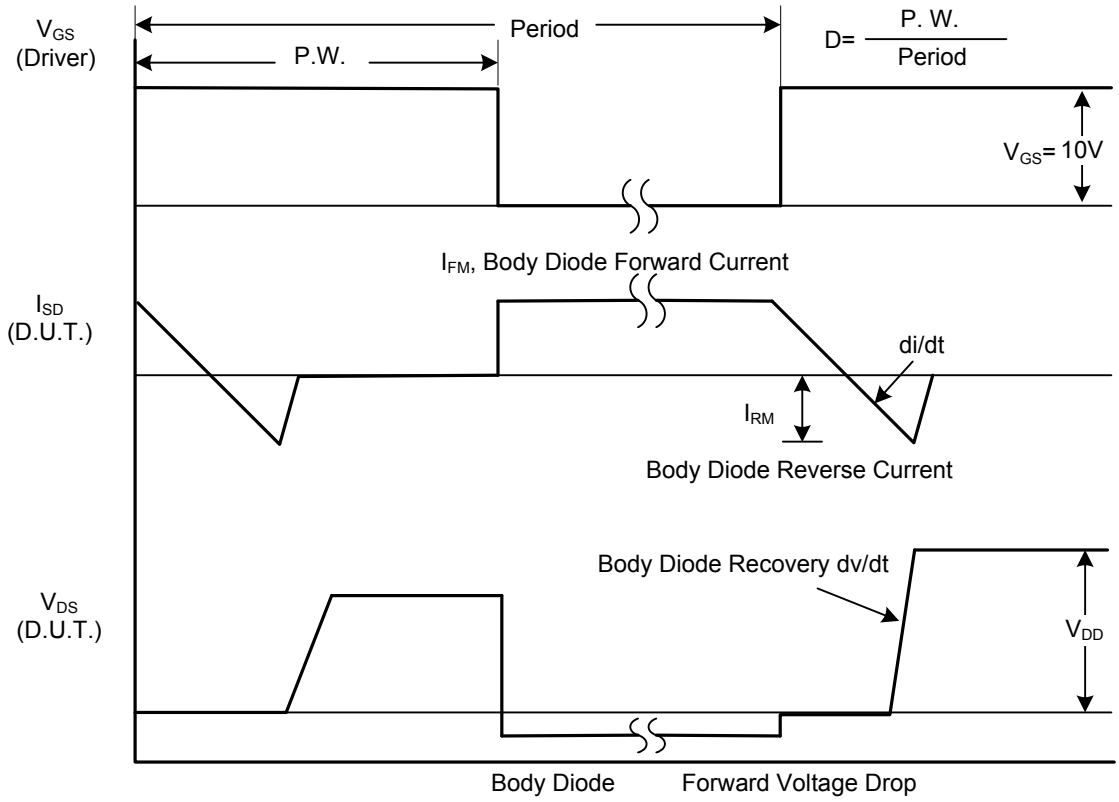


Fig. 1B Peak Diode Recovery dv/dt Waveforms

■ TEST CIRCUITS AND WAVEFORMS (Cont.)

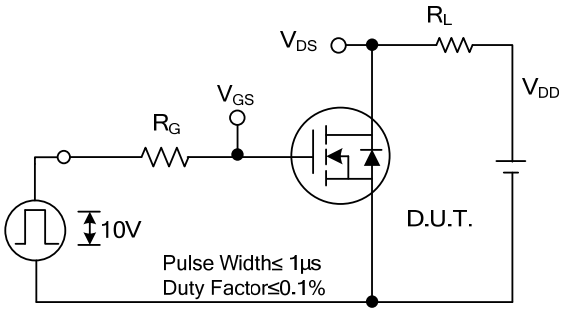


Fig. 2A Switching Test Circuit

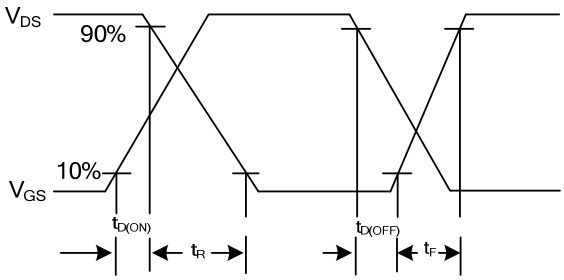


Fig. 2B Switching Waveforms

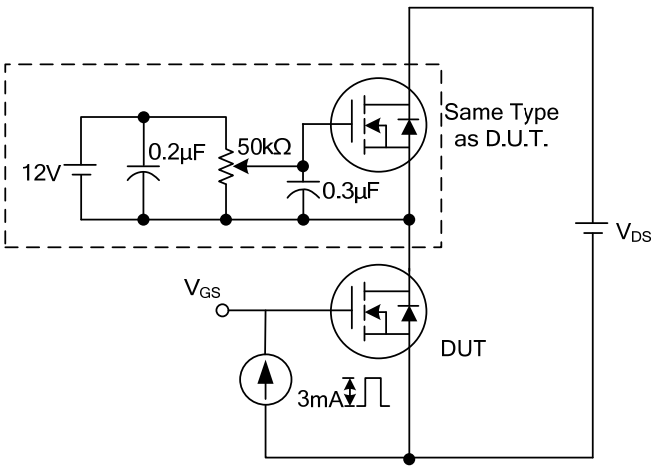


Fig. 3A Gate Charge Test Circuit

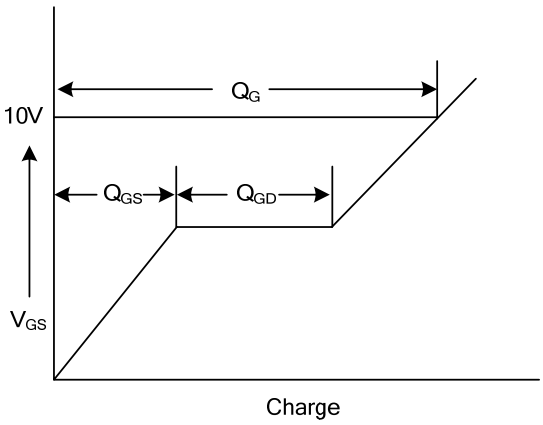


Fig. 3B Gate Charge Waveform

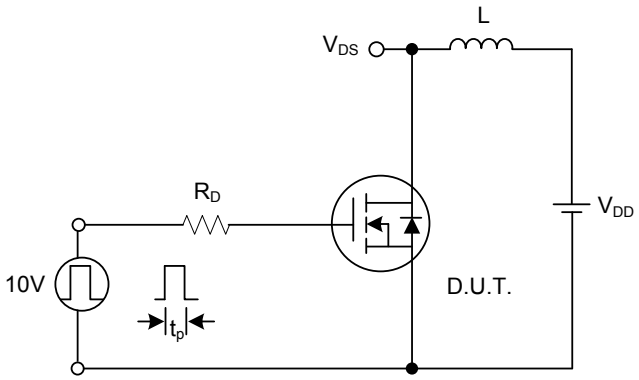


Fig. 4A Unclamped Inductive Switching Test Circuit

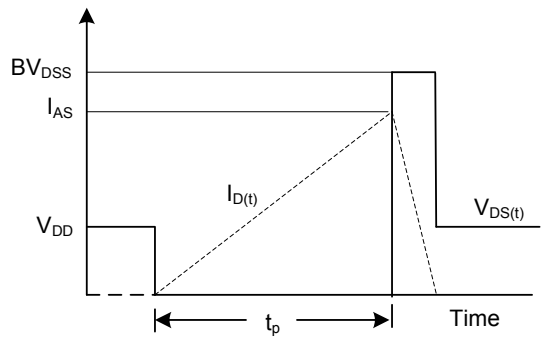
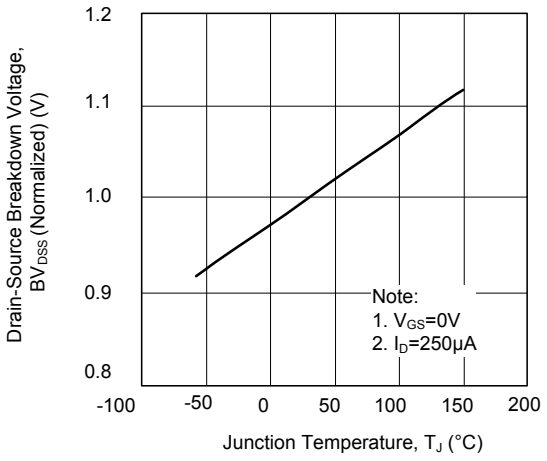


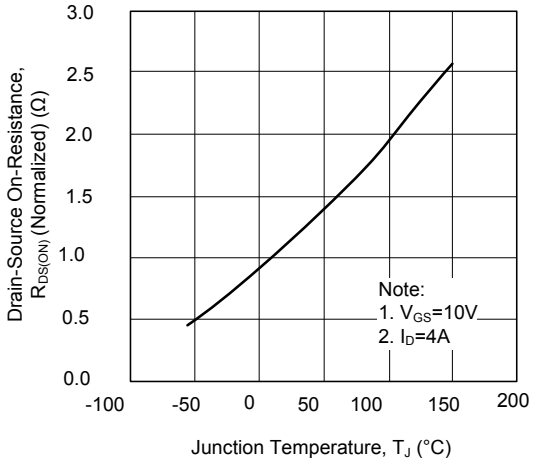
Fig. 4B Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

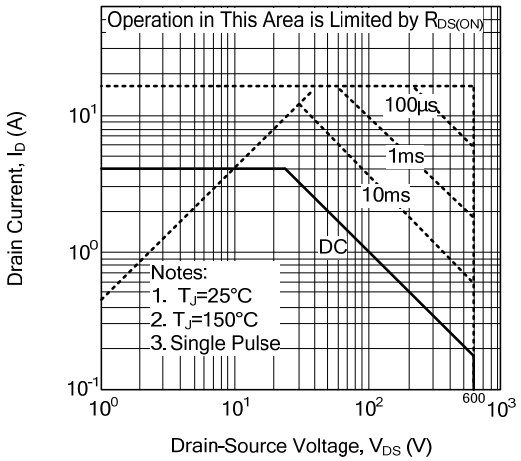
Breakdown Voltage Variation vs. Temperature



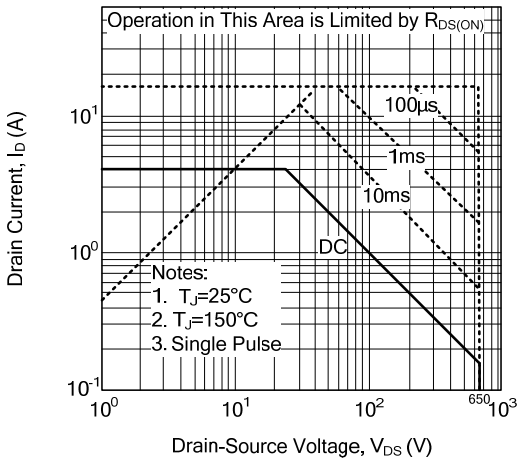
On-Resistance Junction Temperature



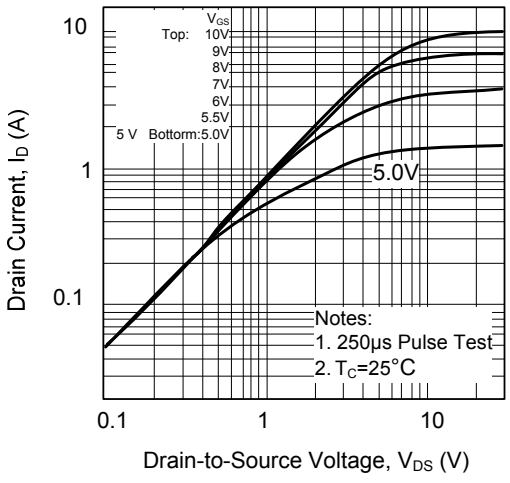
Safe Operating Area – 600V for 4N60-A



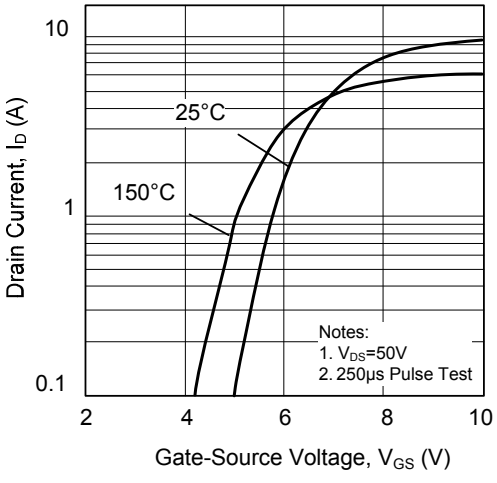
Safe Operating Area – 650V for 4N60-B



On-State Characteristics

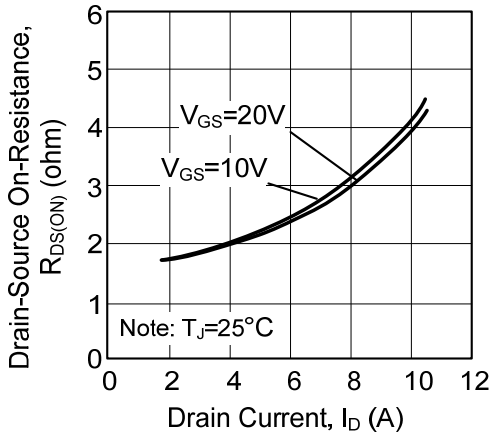


Transfer Characteristics

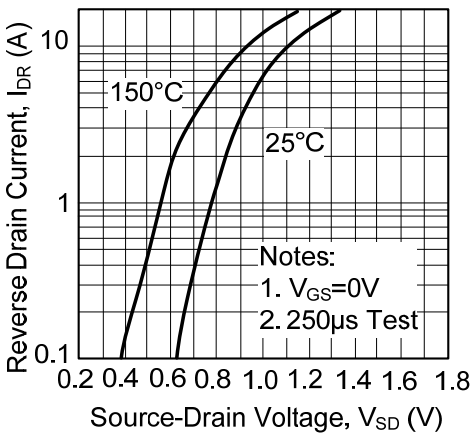


■ TYPICAL CHARACTERISTICS(Cont.)

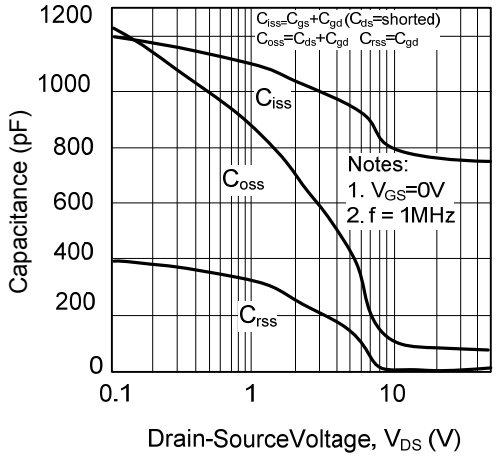
On-Resistance Variation vs. Drain Current and Gate Voltage



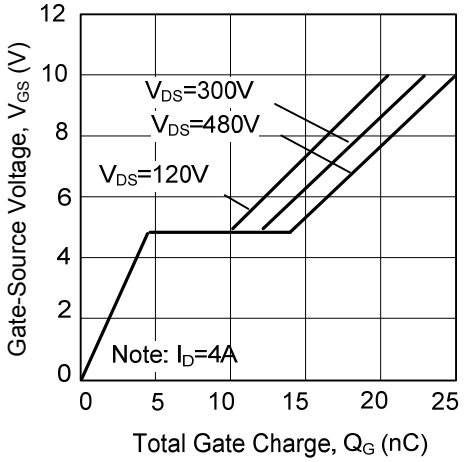
On State Current vs. Allowable Case Temperature



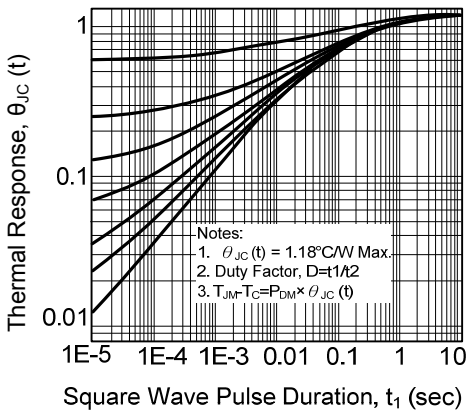
Capacitance Characteristics (Non-Repetitive)



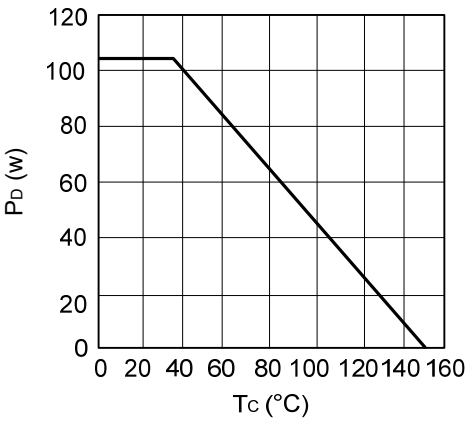
Gate Charge Characteristics



Transient Thermal Response Curve



Power Dissipation



■ TYPICAL CHARACTERISTICS(Cont.)