4A, 600V N-CHANNEL POWER MOSFET

■ DESCRIPTION

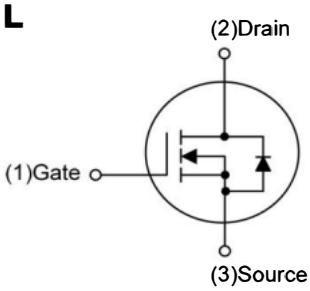
The 4N60 is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.



■ FEATURES

*$R_{DS(ON)}$ ≤ 2.5Ω @ V_{GS} = 10 V, I_D = 2.2A
* Fast Switching Capability
* Avalanche Energy Specified
* Improved dv/dt Capability, high Ruggedness

SYMBOL



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

SYMBOL	PARAMETER		VALUE	UNIT
V_{DS}	Drain-Source Voltage		600	V
V_{GS}	Gate Source Voltage		±30	V
I_{AR}	Avalanche Current (Note 2)		4.4	A
I_D	Continuous Drain Current		4.0	A
I_{DM}	Pulsed Drain Current(Note 2)		16	A
E_{AS}	Avalanche Energy Single Pulsed (Note 3)		260	mJ
E_{AR}	Avalanche Energy Sepetitive (Note 2)		10.6	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 4)		4.5	V/ns
P_D	Power Dissipation	TO-220F	36	W
		TO-252	50	W
T_J	Junction Temperature		150	C
T_{STG}	Storage Temperature		-55 to 150	°C
T_{OPR}	Operating Temperature		-55 to 150	°C

Notes: 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 TJ.

3.L=30mH, I_{AS}=4.0A, 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

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F	θJA	62.5	°C/W
	TO-252		110	
Junction to Case	TO-220F	θJC	3.47	°C/W
	TO-252		2.5	

■ ELECTRICAL CHARACTERISTICS (TA=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	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
			V_{DS}=480V, T_C = 125°C			100	
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS}=+30V, V_{DS}=0V			+100	nA
	Reverse		V_{GS}=-30V, V_{DS}=0V			-100	
Breakdown Voltage Temperature Coefficient		△BV_{DSS}/△TJ	I_D=250μA, Referenced to 25°C		0.6		V/°C
ON CHARACTERISTICS							
Drain-source on-state resistance		$R_{DS(ON)}$	V_{GS}=10V, I_D=2.2A		1.9	2.5	Ω
Gate Threshold Voltage		$V_{GS(TH)}$	V_{GS}=V_{DS},I_D=250μA	2.0		4.0	V
DYNAMIC PARAMETERS							
Input Capacitance		C_{ISS}	V_{GS}=0V,V_{DS}=25V,f=1.0MHz		550	670	pF
Output Capacitance		C_{OSS}			80	100	pF
Reverse Transfer Capacitance		C_{RSS}			30	50	pF
SWITCHING PARAMETERS							
Total gate charge		Qg	V_{DS}=480V,V_{GS}=10V,I_D=4.0A (Note 1, 2)		80	100	nC
Gate-source charge		Qgs			5		
Gate-drain charge		Qgd			20		
Turn-On Delay Time		td(on)	V_{DD}=300V,I_D=4.0A R_G=25Ω(Note 1, 2)		35	55	nS
Rise time		tr			80	110	
Turn-Off Delay Time		td(off)			160	200	
Fall time		tf			120	150	

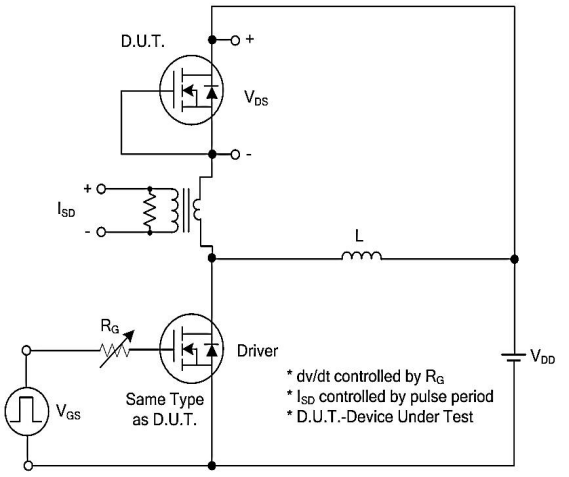
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	IS				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current	ISM				17.6	A
Drain-Source Diode Forward Voltage	VSD	VGS = 0 V, IS =4.4A			1.4	V
Reverse Recovery Time	trr	VGS= 0 V, IS=4.4A, dIF/dt = 100 A/μs (Note 1)		250		ns
Reverse Recovery Charge	Qrr			1.5		μC

Notes:

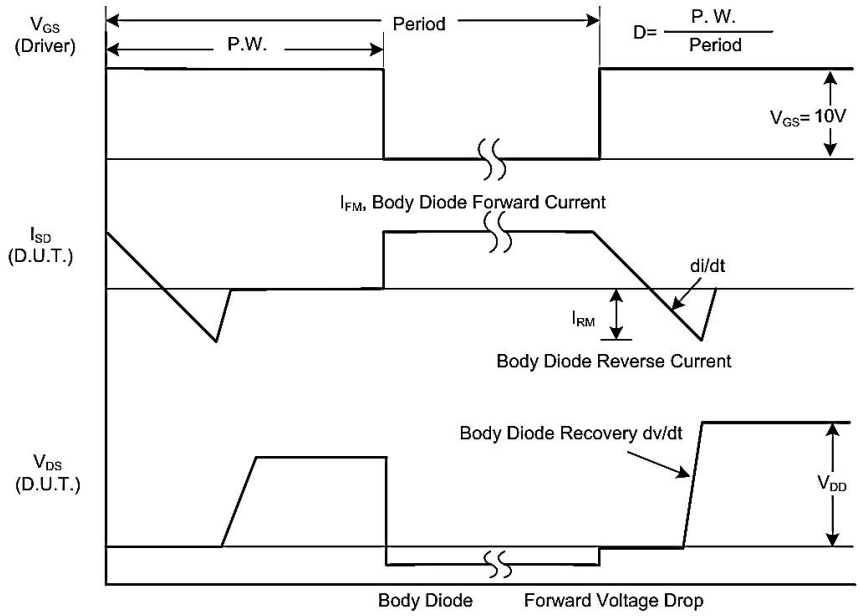
1.Pulse test: pulse width ≤ 300us, duty cycle ≤ 2%;

2.Guaranteed by design, not subject to production testing.

■ TEST CIRCUITS AND WAVEFORMS

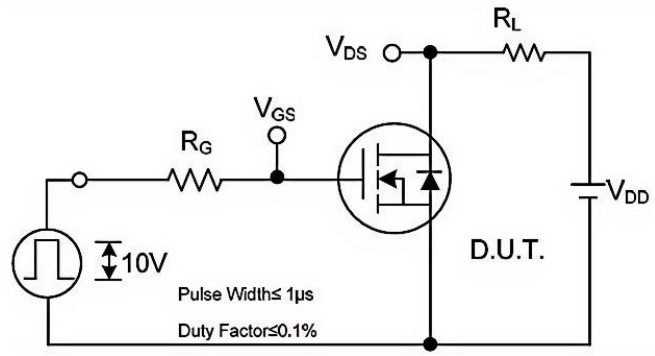


Peak Diode Recovery dv/dt Test Circuit

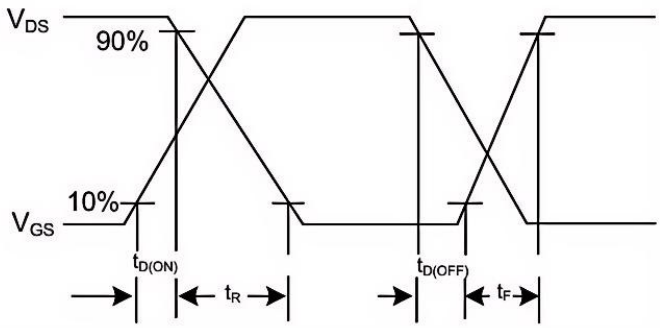


Peak Diode Recovery dv/dt Waveforms

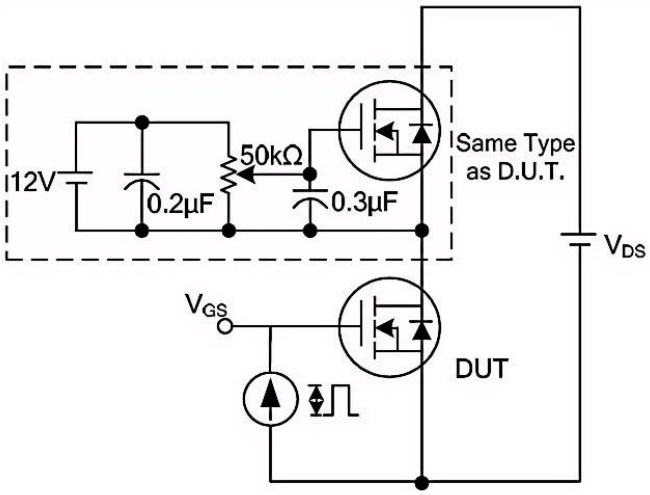
■ TEST CIRCUITS AND WAVEFORMS(Con.t)



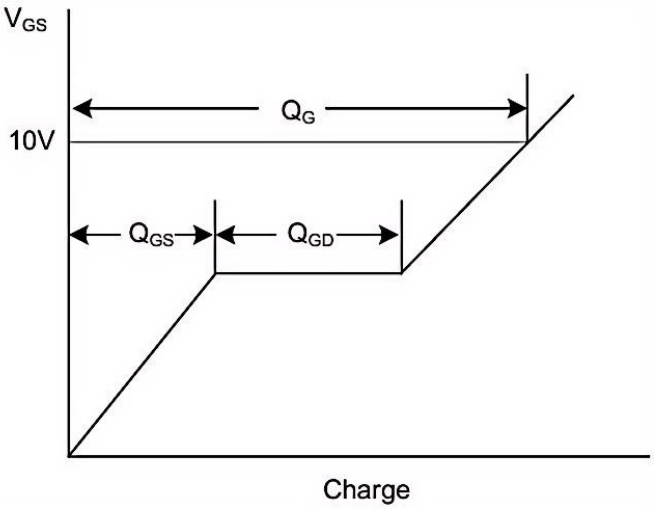
Switching Test Circuit



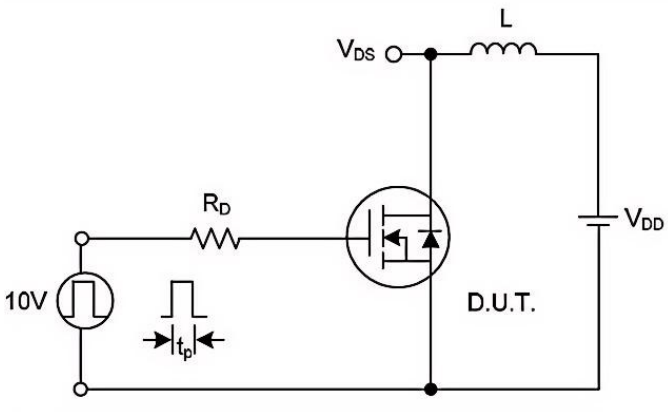
Switching Waveforms



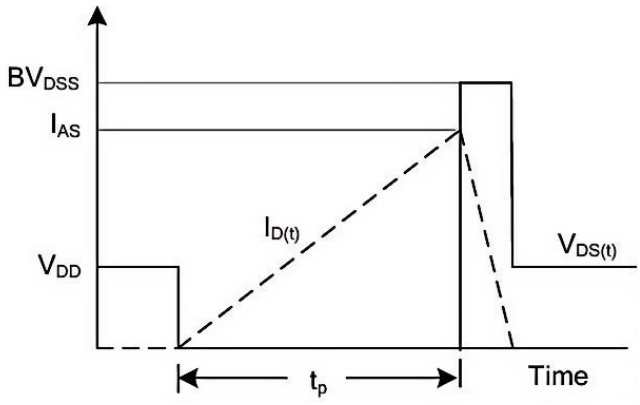
Gate Charge Test Circuit



Gate Charge Waveform



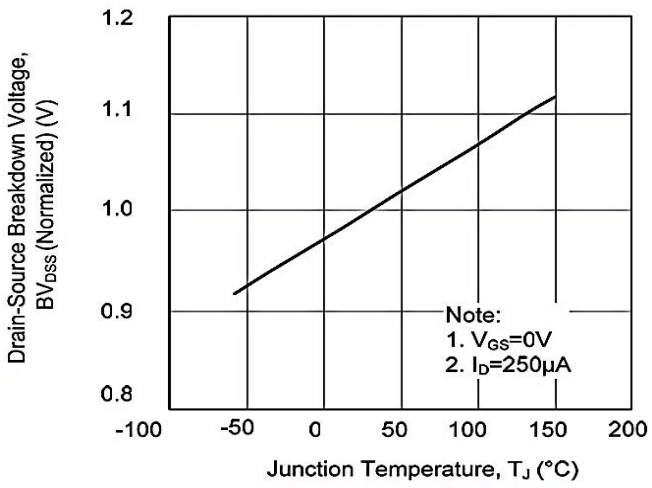
Unclamped Inductive Switching Test Circuit



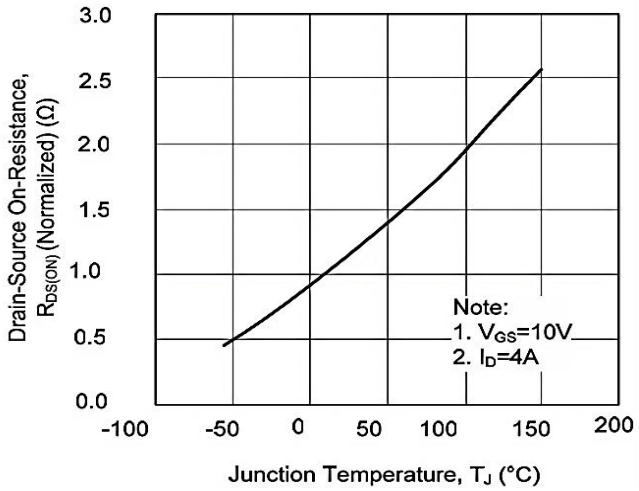
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

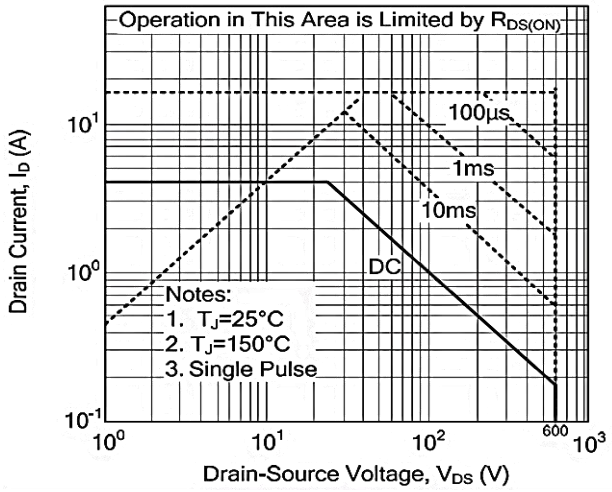
Breakdown Voltage Variation vs. Temperature



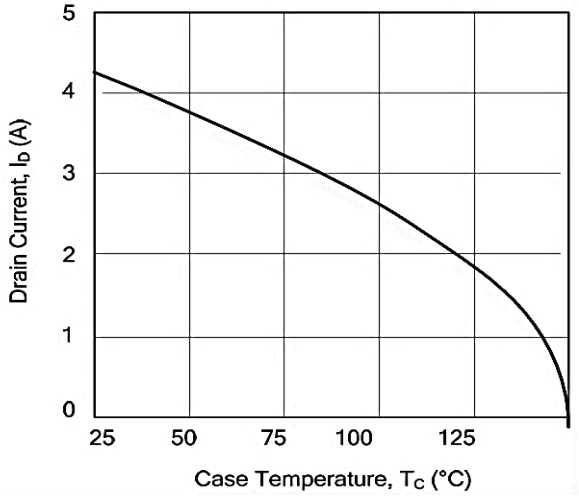
On-Resistance Junction Temperature



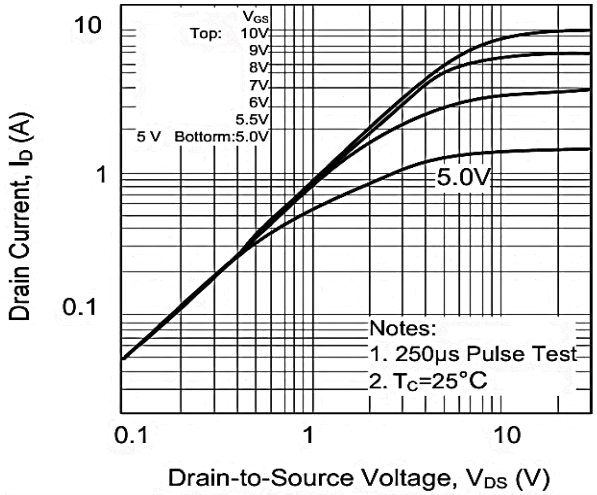
Safe Operating Area - 600V



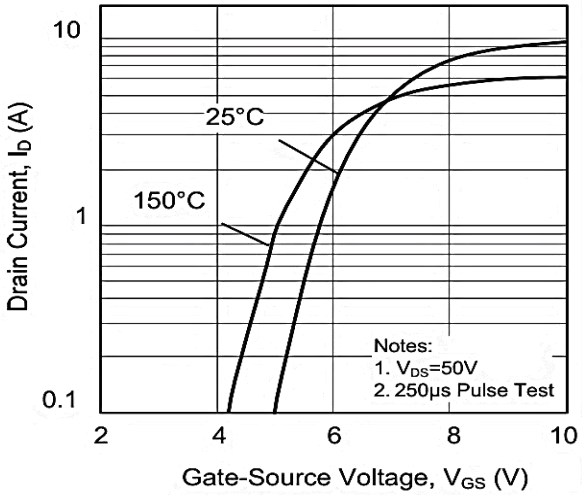
Maximum Drain Current vs. Case Temperature



On-State Characteristics

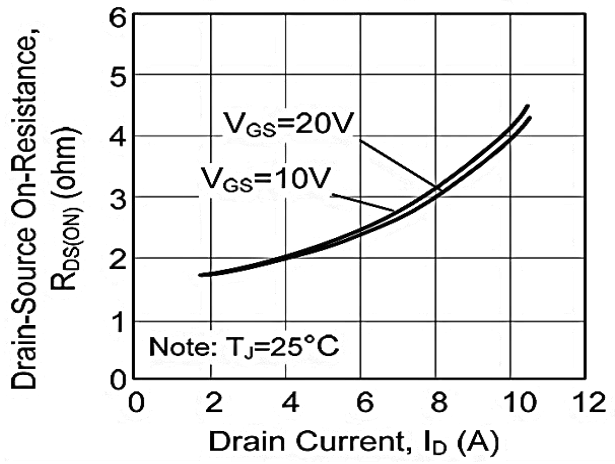


Transfer Characteristics

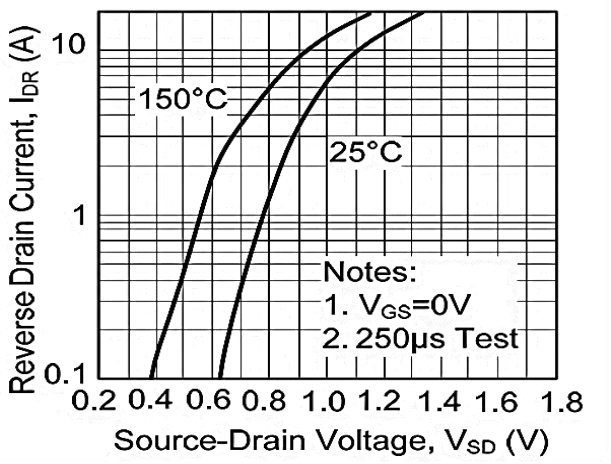


■ TYPICAL CHARACTERISTICS(Con.t)

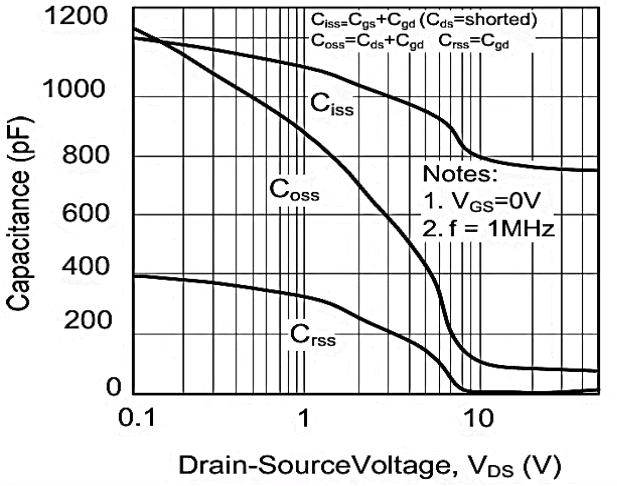
On-Resistance Variation vs. Drain Current and Gate Voltage



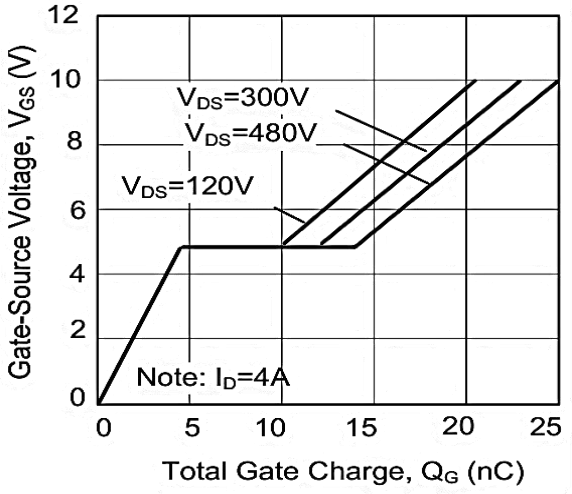
On State Current vs. Allowable Case Temperature



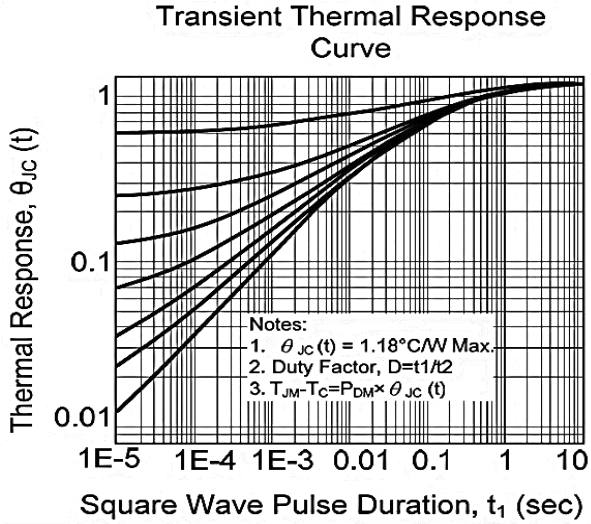
Capacitance Characteristics (Non-Repetitive)



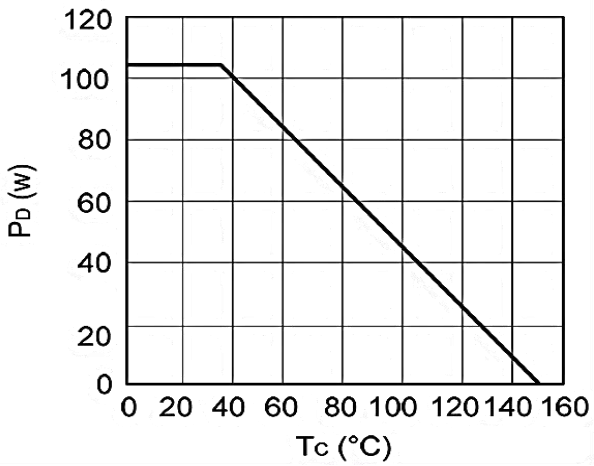
Gate Charge Characteristics



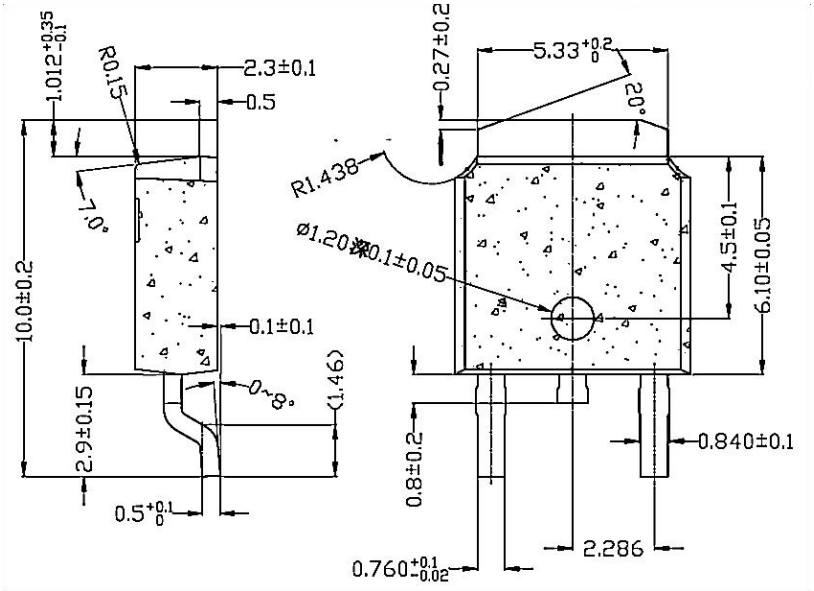
Transient Thermal Response Curve

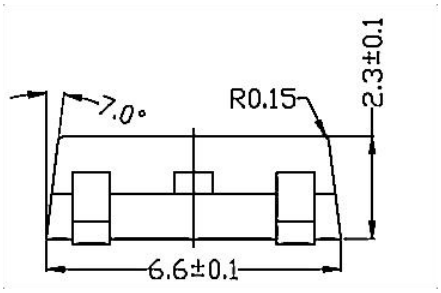


Power Dissipation



■ TO - 252 PACKAGE OUTLINE DIMENSIONS





■ TO - 252 PACKING INFORMATION

Package version	Reel dimensions Φ×H (mm)	Per Reel (pcs)	Reels per box	Inner box dimensions L×W×H(mm)	Outer box (pcs)	Outer box dimensions L×W×H (mm)
TO-252	Φ330*20	2500	2	360*340*50	25000	375*375*280