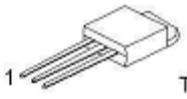
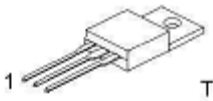
4.4A mps，600Volts N-Channel MOSFET

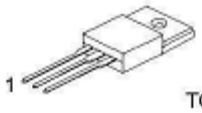


TO-251

TO-252



TO-220



TO-220F

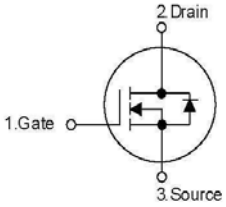
■ Description

The HX4N60 N-Channel enhancement mode silicon gate power MOSFET is designed for high voltage, high speed power switching applications such as switching regulators, switching converters, solenoid, motor drivers, relay drivers.

■ Features

- $R_{DS(ON)}$ =2.50Ω@V_{GS} = 10 V
- Low gate charge (typical 16nC)
- High ruggedness
- Fast switching capability
- Avalanche energy specified
- Improved dv/dt capability

■ Symbol



■ Ordering Information

Order Number		Package	Pin Assignment			Packing
Normal	Lead Free Plating		1	2	3	
HX4N60-TA3-T	HX4N60L-TA3-T	TO-220	G	D	S	Tube
HX4N60-TF3-T	HX4N60L-TF3-T	TO-220F	G	D	S	Tube
HX4N60-TM3-T	HX4N60L-TM3-T	TO-251	G	D	S	Tube
HX4N60-TN3-T	HX4N60L-TN3-T	TO-252	G	D	S	Tube
HX4N60-TN3-R	HX4N60L-TN3-R	TO-252	G	D	S	Tape Reel

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

HX4N60L-TA3-T
（1）Packing Type
（2）Package Type
（3）Lead Plating

(1)T:Tube,R:Tape Reel

(2)TA3:TO-220,TF3:TO-220F, TM3: TO-251,TN3: TO-252

(3)L:Lead Free Plating Blank：Pb/Sn

■ Absolute Maximum Ratings(T_c=25℃,unless otherwise specified)

Parameter		Symbol	Ratings				Units
			TO-220	TO-220F	TO-251	TO-252	
Drain-Source Voltage		V_{DSS}	600				V
Gate-Source Voltage		V_{GSS}	±30				V
Drain Currenet Continuous	T_c=25℃	I_D	4.4	4.4	2.8		A
	T_c=100℃		2.8	2.8	1.8		A
Drain Current Pulsed (Note 1)		I_{DP}	17.6	17.6*	11.2		A
Avalanche Energy	Repetitive (Note 1)	E_{AR}	10.6		4.9		mJ
	Single Pulse (Note 2)	E_{AS}	260				mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	4.5				V/ns
Total Power Dissipation	T_c=25℃	P_D	100	33	49		W
	Derate above 25℃		0.8	0.26	0.39		W/℃
Junction Temperature		T_J	+150				℃
Storage Temperature		T_{STG}	-55~+150				℃

* Drain current limited by maximum junction temperature.

■ Thermal Characteristics

Parameter	Symbol	Ratings				Units
		TO-220	TO-220F	TO-251	TO-252	
Thermal Resistance Junction-Ambient	R_{thJA}	62.5		50*（110）		℃/W
Thermal Resistance, Case-to-Sink Typ.	R_{thCS}	0.5	--	--		
Thermal Resistance Junction-Case	R_{thJC}	1.25	3.79	2.56		

■ Electrical Characteristics（T_J=25℃,unless Otherwise specified.）

Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Off Characteristics							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V,I_D=250μA	600	--	--	V
Zero Gate Voltage Drain Current		I_{DSS}	V_{DS}=600V,V_{GS}=0V	--	--	1	μA
			V_{DS}=480V,T_C=125℃	--	--	10	μA
Gate-Body Leakage Current	Forward	I_{GSS}	V_{GS}=30V,V_{DS}=0V	--	--	100	nA
	Reverse		V_{GS}=-30V,V_{DS}=0V	--	--	-100	nA
Breakdown Voltage Temperature Coefficient		$\triangle BV_{DSS}/\triangle T_J$	I_D=250μA	--	0.7	--	V/℃
On Characteristics							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=250μA	2.0	--	4.0	V
Static Drain-Source On-Resistance		$R_{DS(ON)}$	V_{GS}=10V, I_D=2.2A(TO220,TO220F) I_D=1.4A(TO251, TO252)	--	2.0	2.5	Ω
Dynamic Characteristics							
Input Capacitance		C_{ISS}	V_{DS}=25V,V_{GS}=0V, f=1MHz	--	515	670	pF
Output Capacitance		C_{OSS}		--	55	72	pF
Reverse Transfer Capacitance		C_{RSS}		--	7.5	8.5	pF
Switching Characteristics							
Turn-On Delay Time		$t_{D(ON)}$	V_{DD}=300V, I_D=4.4A(TO220,TO220F) I_D=2.8A(TO251,TO252) R_G=25Ω (Note 4, 5)	--	10	--	ns
Rise Time		t_R		--	42	--	ns
Turn-Off Delay Time		$t_{D(OFF)}$		--	38	--	ns
Fall Time		t_F		--	46	--	ns
Total Gate Charge		Q_G	V_{DS}=480V, I_D=4.4A(TO220,TO220F) I_D=2.8A(TO251,TO252) V_{GS}=10V (Note 4, 5)	--	15	--	nC
Gate-Source Charge		Q_{GS}		--	2.5	--	nC
Gate-Drain Charge		Q_{GD}		--	6.6	--	nC
Drain-Source Diode Characteristics							
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS}=0V I_{SD}=4.4A(TO220,TO220F) I_{SD}=2.8A(TO251,TO252)	--	--	1.4	V
Continuous Drain-Source Current		I_{SD}	TO220,TO220F	--	--	4.6	A
			TO251,TO252	--	--	2.8	
Pulsed Drain-Source Current		I_{SM}	TO220,TO220F	--	--	18.0	A
			TO251,TO252	--	--	11.2	
Reverse Recovery Time		t_{RR}	I_{SD}=4.4A, dI_{SD}/dt=100A/μs (Note 4)	--	300	--	ns
Reverse Recovery Charge		Q_{RR}		--	2.2	--	μC

Notes：
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L=20mH, I_{AS}= 4.4A, V_{DD}=50V, R_G=25Ω, Starting TJ=25°C
3. I_{SD}≤4.4A, di/dt≤200A/μs, V_{DD}≤BV_{DSS}, Starting TJ=25°C
4. Pulse Test : Pulse width≤300μs, Duty cycle≤2%
5. Essentially independent of operating temperature

■ Typical Characteristics

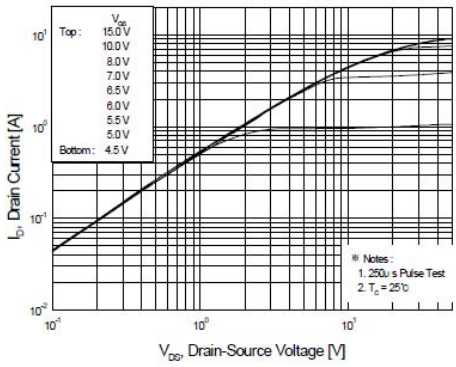


Figure 1. On-Region Characteristics

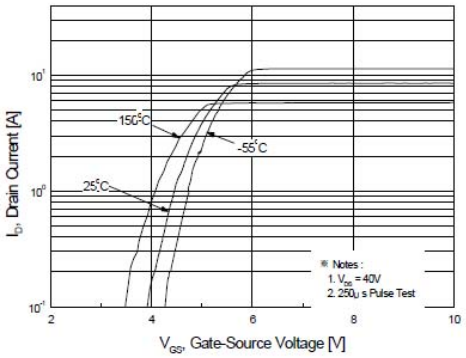


Figure 2. Transfer Characteristics

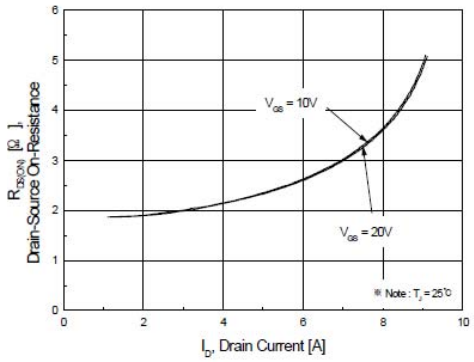


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

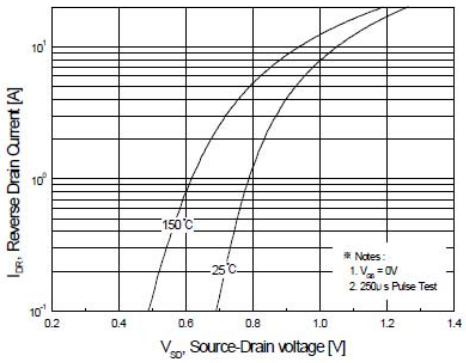


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

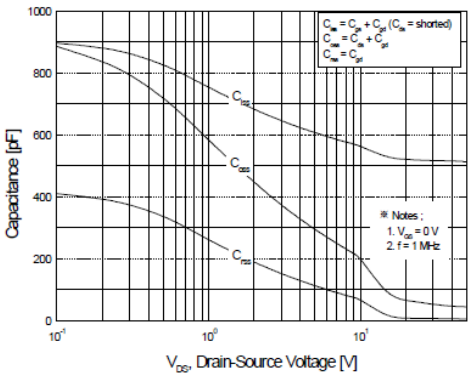


Figure 5. Capacitance Characteristics

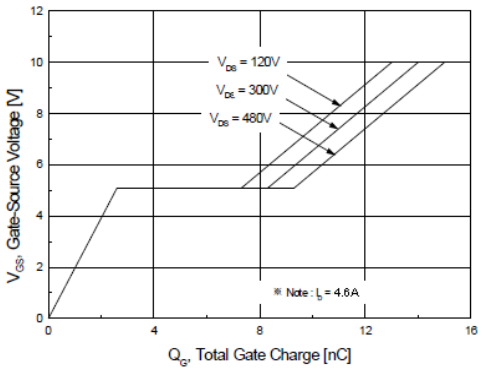


Figure 6. Gate Charge Characteristics

■ Typical Characteristics (Continued)

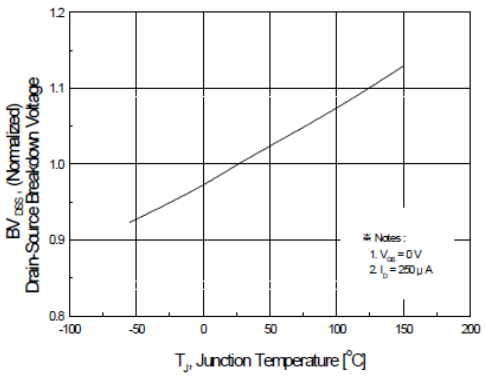


Figure 7. Breakdown Voltage Variation vs Temperature

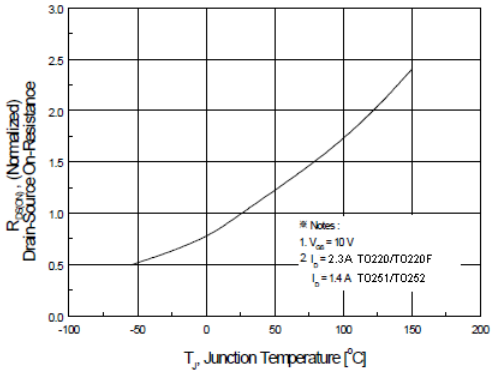


Figure 8. On-Resistance Variation vs Temperature

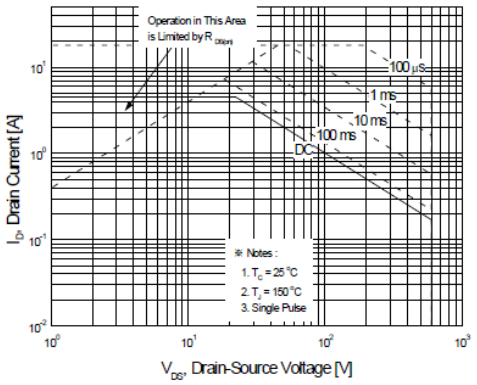


Figure 9-1. Maximum Safe Operating Area for TO220

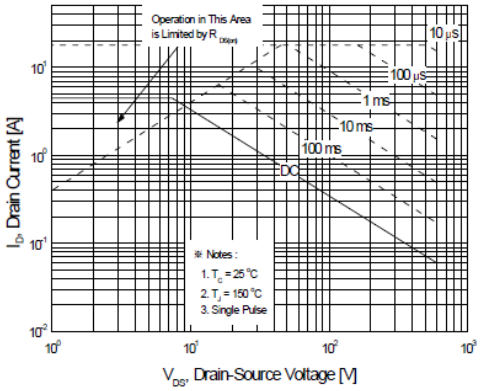


Figure 9-2. Maximum Safe Operating Area for TO220F

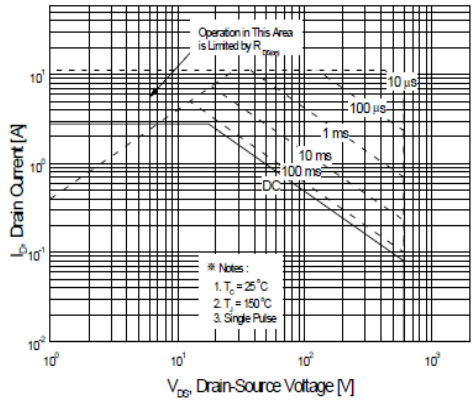


Figure 9-3. Maximum Safe Operating Area for TO251, TO252

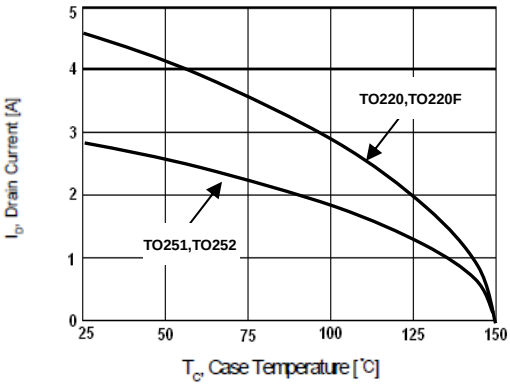


Figure 10. Maximum Drain Current vs Case Temperature

■ Typical Characteristics (Continued)

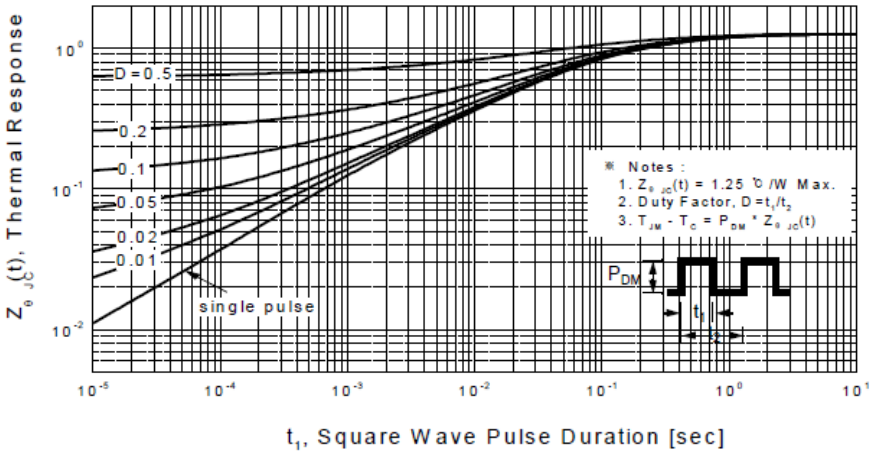


Figure 11-1. Transient Thermal Response Curve TO220

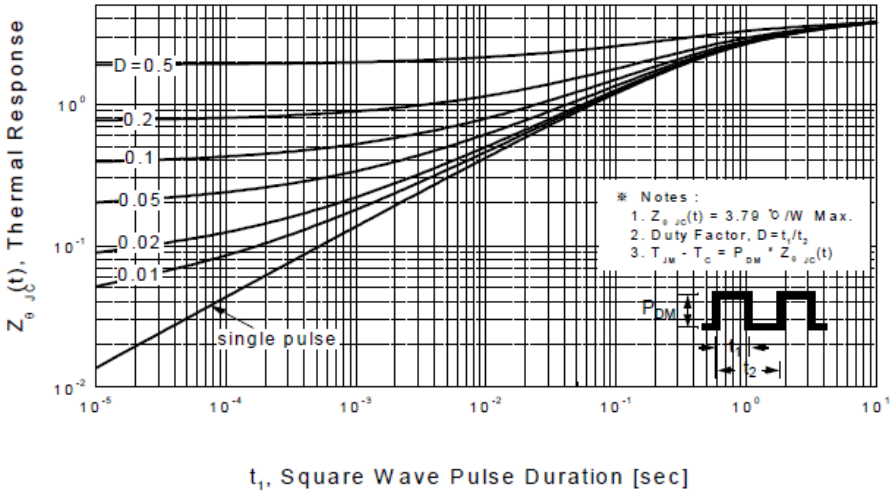


Figure 11-2. Transient Thermal Response Curve for TO220F

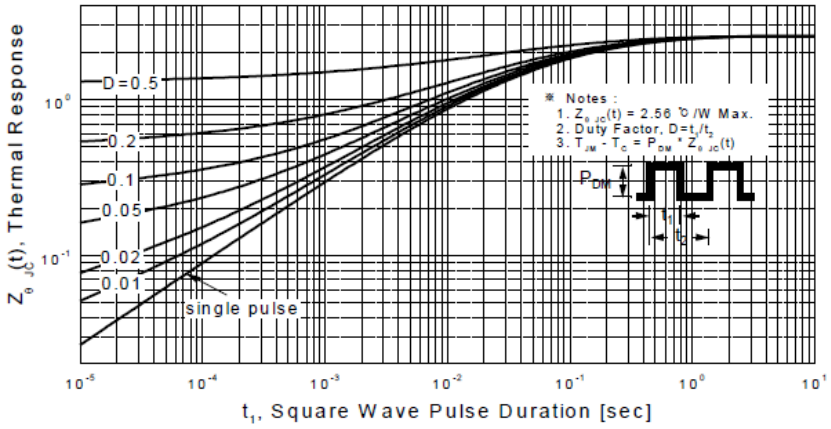


Figure 11-3. Transient Thermal Response Curve for TO251/ TO252