

## 2 Amps, 600Volts N-Channel MOSFET

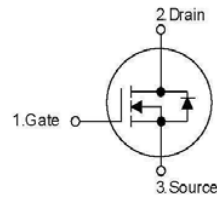
### Description

The HX2N60(C) 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

- $R_{DS(ON)} = 5.0\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 9nC)
- 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	
HX2N60(C)-TA3-T	HX2N60(C)L-TA3-T	TO-220	G	D	S	Tube
HX2N60(C)-TF3-T	HX2N60(C)L-TF3-T	TO-220F	G	D	S	Tube
HX2N60(C)-TM3-T	HX2N60(C)L-TM3-T	TO-251	G	D	S	Tube
HX2N60(C)-TN3-T	HX2N60(C)L-TN3-T	TO-252	G	D	S	Tube
HX2N60(C)-TN3-R	HX2N60(C)L-TN3-R	TO-252	G	D	S	Tape Reel

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

HX2N60(C)L-TA3-T	(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
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### Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ , 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	$V_{GSS}$	$\pm 30$				V
Drain Current Continuous	$I_D$	$T_c=25^\circ\text{C}$	2.0	2.0*	1.9	A
		$T_c=100^\circ\text{C}$	1.35	1.35*	1.14	A
Drain Current Pulsed (Note 1)	$I_{DP}$	8	8*	7.6	A	
Avalanche Energy	Repetitive (Note 1)	5.55			4.4	mJ
	Single Pulse (Note 2)	130			120	mJ
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.5				V/ns
Total Power Dissipation	$P_D$	$T_c=25^\circ\text{C}$	55.5	23.6	44	W
		Derate above $25^\circ\text{C}$	0.44	0.19	0.35	W/ $^\circ\text{C}$
Junction Temperature	$T_J$	+150				$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-55~+150				$^\circ\text{C}$

\* 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)		°C/W
Thermal Resistance, Case-to-Sink Typ.	$R_{thCS}$	0.5	—	—		
Thermal Resistance Junction-Case	$R_{thJC}$	2.32	5.5	2.87		

■ Electrical Characteristics ( $T_J=25^{\circ}\text{C}$ , unless Otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units	
<b>Off Characteristics</b>							
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600	—	—	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$	—	—	1	$\mu A$	
		$V_{DS}=480V, T_C=125^{\circ}\text{C}$	—	—	10	$\mu A$	
Gate-Body 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	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$	—	0.7	—	V/°C	
<b>On Characteristics</b>							
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0	—	4.0	V	
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{DS}=10V, I_D=1.0A(TO220, TO220F), I_D=0.95A(TO251, TO252)$	—	4.1	5.0	$\Omega$	
<b>Dynamic Characteristics</b>							
Input Capacitance	$C_{ISS}$	$V_{DS}=25V, V_{GS}=0V, f=1MHz$	—	200	—	pF	
Output Capacitance	$C_{OSS}$		—	20	—	pF	
Reverse Transfer Capacitance	$C_{RSS}$		—	4	—	pF	
<b>Switching Characteristics</b>							
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=300V, I_D=2.0A, R_G=25\Omega$ (Note 4, 5)	—	10	—	ns	
Rise Time	$t_R$		—	25	—	ns	
Turn-Off Delay Time	$t_{D(OFF)}$		—	25	—	ns	
Fall Time	$t_F$		—	30	—	ns	
Total Gate Charge	$Q_G$	$V_{DS}=480V, I_D=2.0A, V_{GS}=10V$ (Note 4, 5)	—	9	—	nC	
Gate-Source Charge	$Q_{GS}$		—	1.5	—	nC	
Gate-Drain Charge	$Q_{GD}$		—	4.0	—	nC	
<b>Drain-Source Diode Characteristics</b>							
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_{SD}=2.0A(TO220, TO220F), I_{SD}=0.95A(TO251, TO252)$	—	—	1.4	V	
Continuous Drain-Source Current	$I_{SD}$	TO220, TO220F	—	—	2.0	A	
		TO251, TO252	—	—	1.9		
Pulsed Drain-Source Current	$I_{SM}$	TO220, TO220F	—	—	8.0	A	
		TO251, TO-252	—	—	7.6		
Reverse Recovery Time	$t_{RR}$	$I_{SD}=2.0A, di_{SD}/dt=100A/\mu s$	—	230	—	ns	
Reverse Recovery Charge	$Q_{RR}$	(Note 4)	—	1.0	—	$\mu C$	

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L=60mH, I_{AS}=2.0A, V_{DD}=50V, R_G=25\Omega, \text{Starting } T_J=25^{\circ}\text{C}$
3.  $I_{SD}\leq 2.0A, di/dt\leq 200A/\mu s, V_{DD}\leq BV_{DSS}, \text{Starting } T_J=25^{\circ}\text{C}$
4. Pulse Test : Pulse width  $\leq 300\mu s, \text{Duty cycle}\leq 2\%$
5. Essentially independent of operating temperature

■ Typical Characteristics

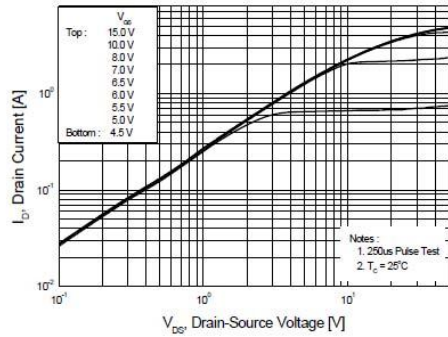


Figure 1. On-Region Characteristics

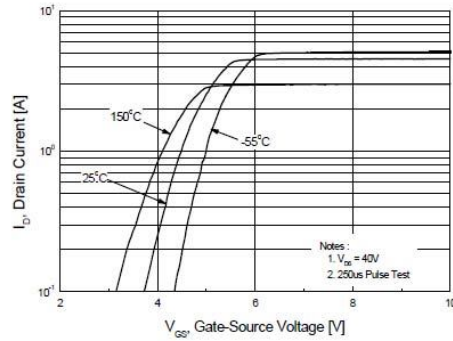


Figure 2. Transfer Characteristics

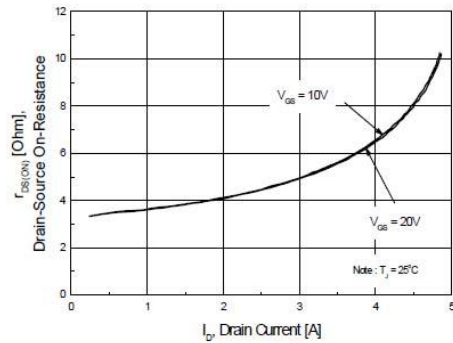


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

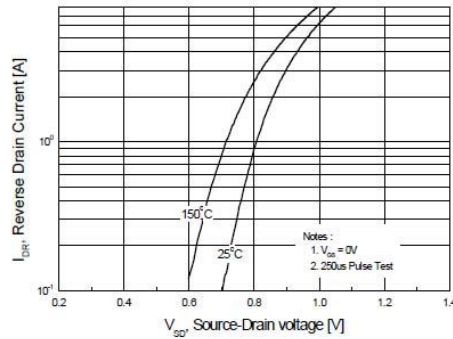


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

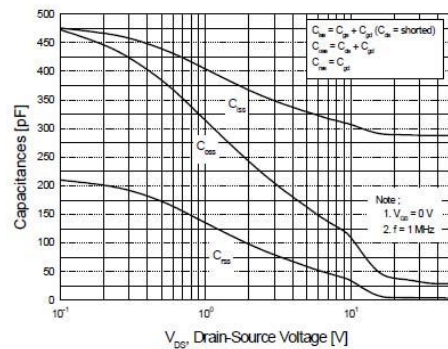


Figure 5. Capacitance Characteristics

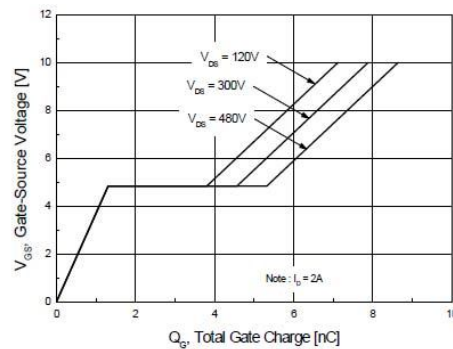
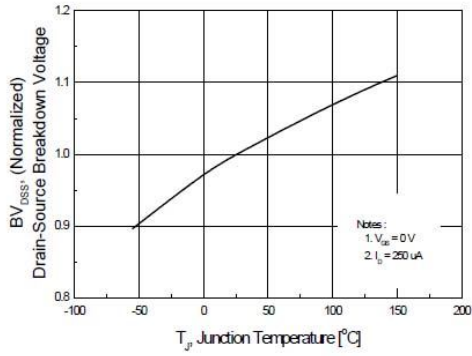
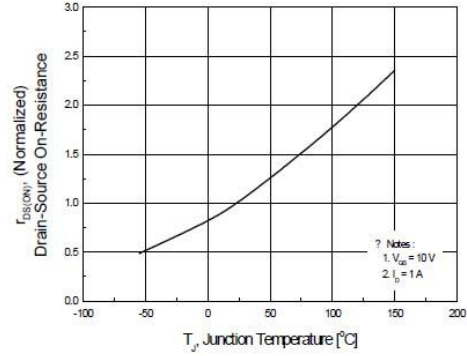


Figure 6. Gate Charge Characteristics

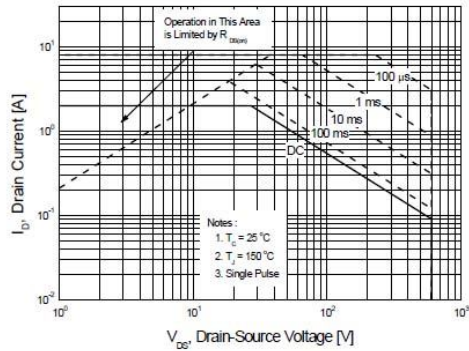
■ **Typical Characteristics** (Continued)



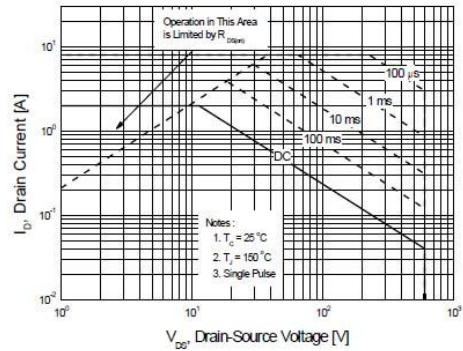
**Figure 7. Breakdown Voltage Variation vs Temperature**



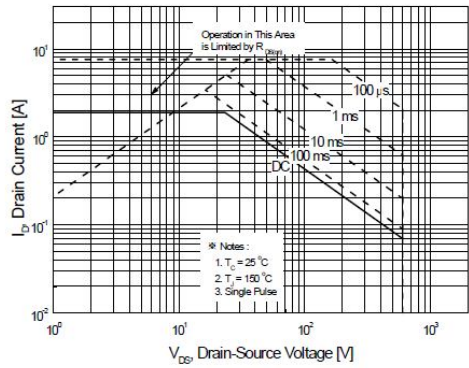
**Figure 8. On-Resistance Variation vs Temperature**



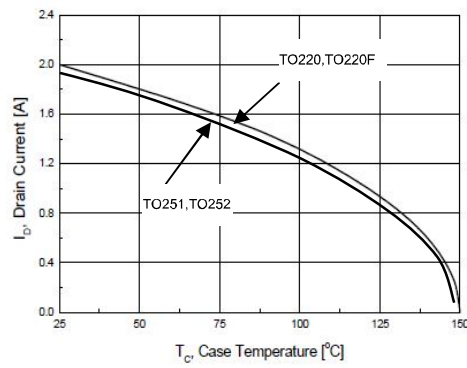
**Figure 9-1. Maximum Safe Operating Area for TO220**



**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)

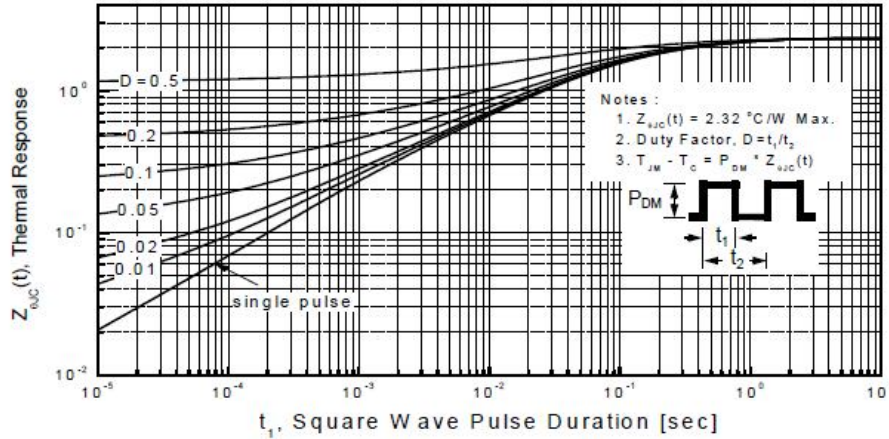


Figure 11-1. Transient Thermal Response Curve TO220

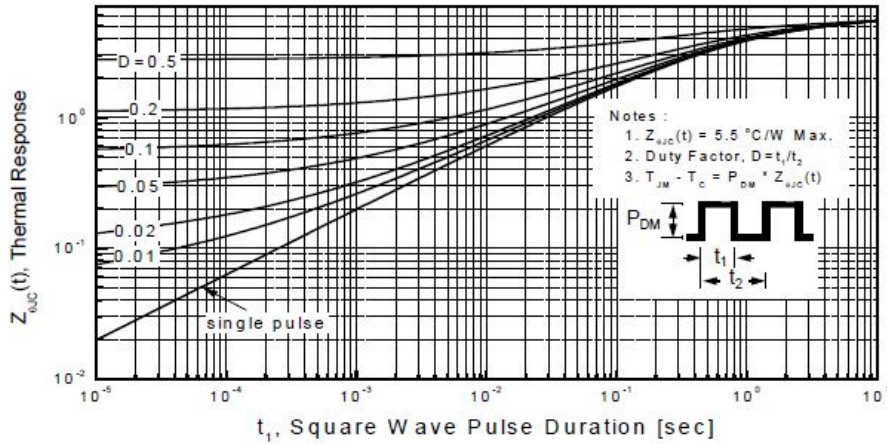


Figure 11-2. Transient Thermal Response Curve for TO220F

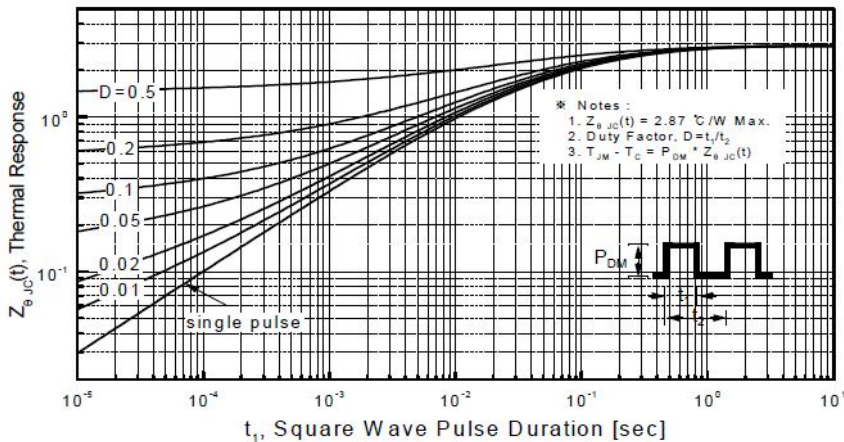


Figure 11-3. Transient Thermal Response Curve for TO251/ TO252