

工业型号	公司型号	通俗命名	H	封装标识	包装方式	每管数量	每盒数量	每箱数量
FQP4N60C FQPF4N60C	H4N60P H4N60F	4N60	HAOHAI	P: TO-220AB F: TO-220FP	条管装 盒装箱装	50Pcs	1000Pcs	5000Pcs

■ Features
 Originative New Design
 Superior Avalanche Rugged Technology
 Robust Gate Oxide Technology
 Very Low Intrinsic Capacitances
 Excellent Switching Characteristics
 Unrivalled Gate Charge: 15nC(Typ.)
 Extended Safe Operating Area
 Lower $R_{DS(ON)}$: 2.0Ω(Typ.) @ $V_{GS}=10V$
 100% Avalanche Tested
 Package: TO-220AB & TO-220F

■ 特点
 导通电阻低、开关速度快、驱动简单、可并联使用、输入阻抗高、符合RoHS规范

■ 应用范围
 开关电源、LCD电源、LED驱动电源、机箱电源、UPS电源、
 各种充电器、电子整流器、电子变压器、逆变器、控制器、转换器、
 风扇控制板、以及电源适配器、汽车稳压器等线性放大和功率开关电路

■ 封装形式
 TO-220P 或 TO-220AB (半塑封)
 TO-220F 或 TO-220FP (全塑封)

$I_D=4A$
 $BV_{DSS}=600V$
 $R_{DS(on)}=2.0\Omega$

4N60 Series Pin Assignment



3-Lead Plastic TO-220AB
 Package Code: P
 Pin 1: Gate
 Pin 2 & Tab: Drain
 Pin 3: Source



3-Lead Plastic TO-220FP
 Package Code: F
 Pin 1: Gate
 Pin 2: Drain
 Pin 3: Source

Series Symbol: 

■ Absolute Maximum Ratings ($T_C=25^\circ C$ unless otherwise specified)

Symbol	Parameter	Value		Units
		TO-220AB	TO-220F	
V_{DSS}	Drain-Source Voltage	600	600	V
I_D	Drain Current—Continuous ($T_C=25^\circ C$)	4.0	4.0*	A
	Drain Current—Continuous ($T_C=100^\circ C$)	2.5	2.5*	
I_{DM}	Drain Current – Pulsed (Note 1)	16	16*	
V_{GS}	Gate-Source Voltage	± 30	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	240	240	mJ
I_{AR}	Avalanche Current (Note 1)	4.0	4.0	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	10	10	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	5.5	5.5	V/ns
P_D	Power Dissipation ($T_C=25^\circ C$)	100	33	W
	Power Dissipation - Derate above 25°C	0.8	0.26	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range	-50 ~ +150		°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		

* Drain current limited by maximum junction temperature (TO-220F)

■ Thermal Resistance Characteristics

Symbol	Parameter	TO-220AB		TO-220F		Units
		Typ.	Max.	Typ.	Max.	
$R_{\theta JC}$	Junction-to-Case	--	1.25	--	3.79	°C/W
$R_{\theta CS}$	Case-to-Sink	0.5	--	--	--	
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	--	62.5	

Electrical Characteristics ($T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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On Characteristics

V_{GS}	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	2.5	--	4.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}, I_D=2\text{A}$	--	2.0	2.5	Ω

Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_D=250\mu\text{A}$	600	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D=250\mu\text{A}$, Referenced to 25°C	--	0.65	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=600\text{V}, V_{GS}=0\text{V}$	--	--	1	μA
		$V_{DS}=480\text{V}, T_C=125^\circ\text{C}$	--	--	10	
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS}=+30\text{V}, V_{DS}=0\text{V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS}=-30\text{V}, V_{DS}=0\text{V}$	--	--	-100	

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS}=25\text{V}$ $V_{GS}=0\text{V}$ $f=1.0\text{MHz}$	--	600	780	pF
C_{oss}	Output Capacitance		--	65	85	
C_{rss}	Reverse Transfer Capacitance		--	11	14	

Switching Characteristics

$t_{d(on)}$	Turn-On Time	$V_{DS}=300\text{V}$ $I_D=4\text{A}, R_G=25\Omega$ (Note 4,5)	--	15	30	nS
t_r	Turn-On Rise Time		--	40	80	
$t_{d(off)}$	Turn-Off Delay Time		--	50	100	
t_f	Turn-Off Fall Time		--	40	80	
Q_g	Total Gate Charge	$V_{DS}=480\text{V}$ $I_D=4\text{A}, V_{GS}=10\text{V}$ (Note 4,5)	--	15	20	nC
Q_{gs}	Gate-Source Charge		--	3.4	--	
Q_{gd}	Gate-Drain Charge		--	6.7	--	

Source-Drain Diode Maximum Ratings and Characteristics

I_S	Continuous Source-Drain Diode Forward Current	--	--	4.0	A	
I_{SM}	Pulsed Source-Drain Diode Forward Current	--	--	16		
V_{SD}	Source-Drain Diode Forward Voltage	$I_S=4\text{A}, V_{GS}=0\text{V}$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$I_S=4\text{A}, V_{GS}=0\text{V}$ $di_F/dt=100\mu\text{A}/\mu\text{s}$ (Note 4)	--	300	--	nS
Q_{rr}	Reverse Recovery Charge		--	2.2	--	μC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature ;
2. $L=27.5\text{mH}, I_{AS}=4\text{A}, V_{DD}=50\text{V}, R_G=25\Omega$, Starting $T_J=25^\circ\text{C}$
3. $I_{SD} \leq 4\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$;
4. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$;
5. Essentially Independent of Operating Temperature

Typical Performance Characteristics

Fig-1. On Region Characteristics

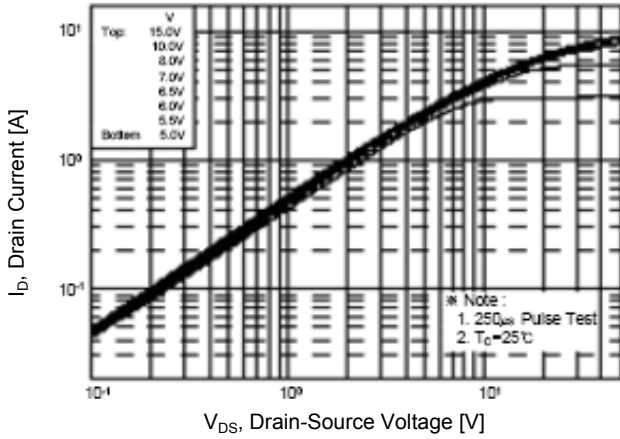


Fig-2. Transfer Characteristics

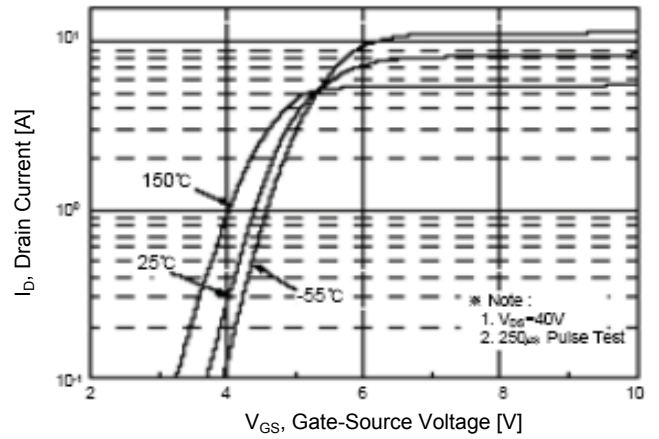


Fig-3. On Resistance Variation vs Drain Current and Gate Voltage

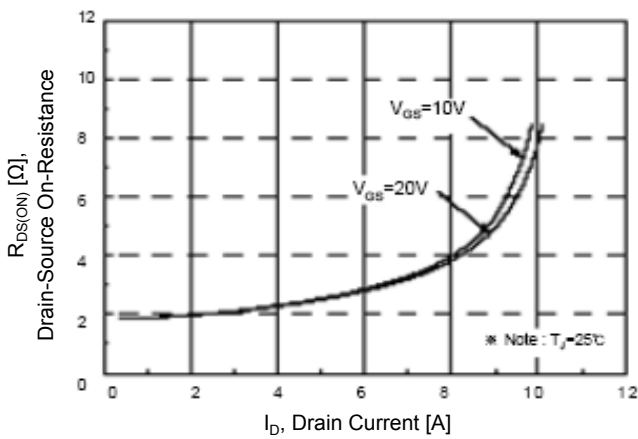


Fig-4. Body Diode Forward Voltage Variation with Source Current and Temperature

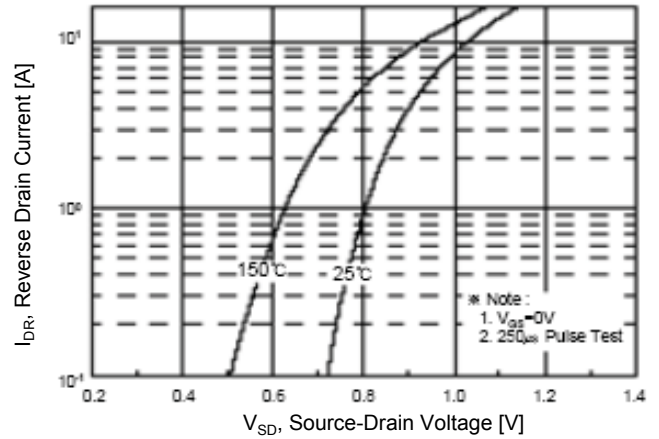


Fig-5. Capacitance Characteristics

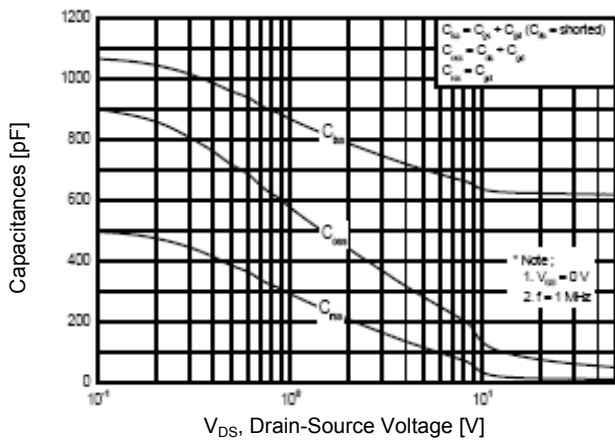
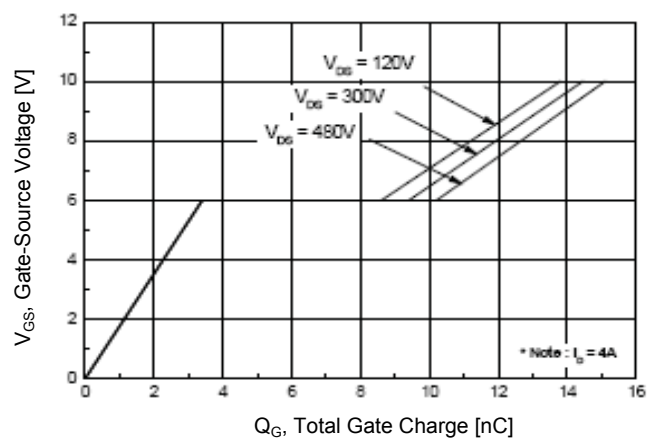


Fig-6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Fig-7. Breakdown Voltage Variation vs Temperature

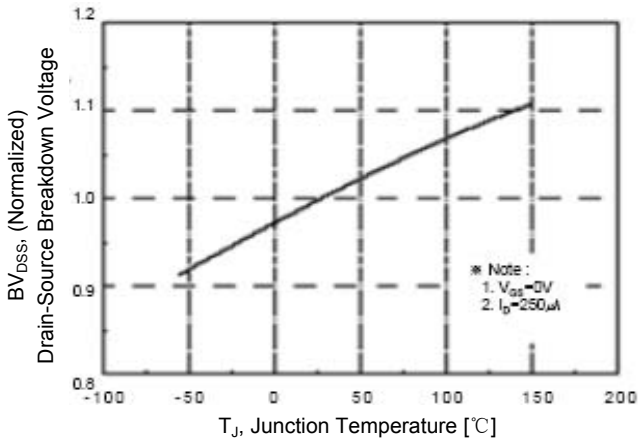


Fig-8. On-Resistance Variation vs Temperature

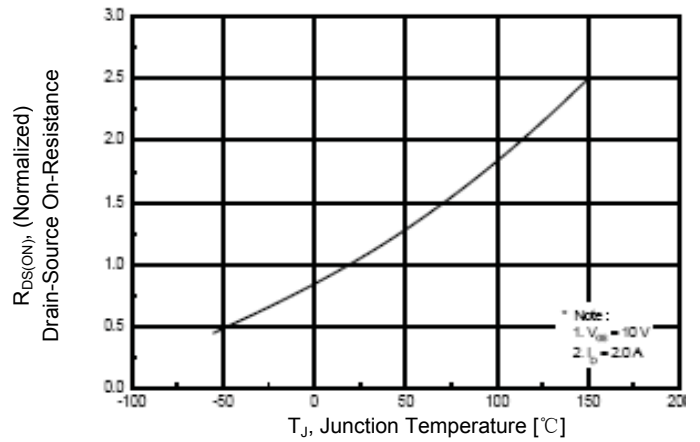


Fig-9. Maximum Safe Operating Area

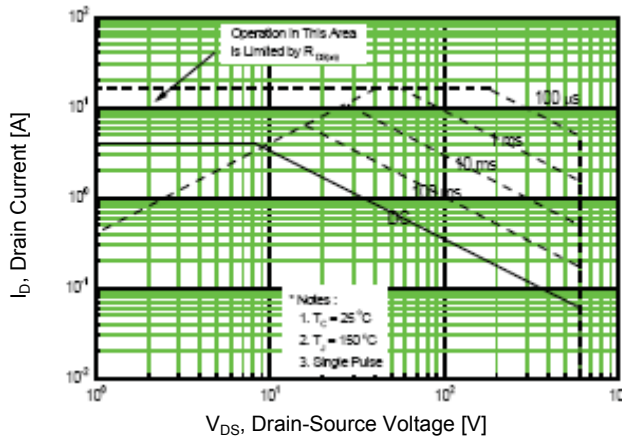


Fig-10. Maximum Drain Current vs Case Temperature

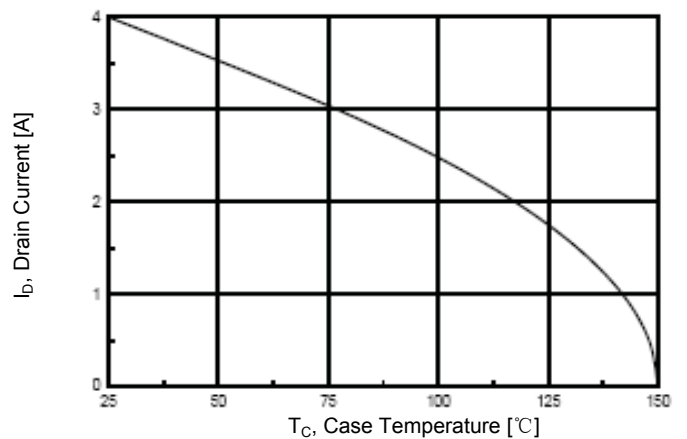


Fig-11. Transient Thermal Response Curve

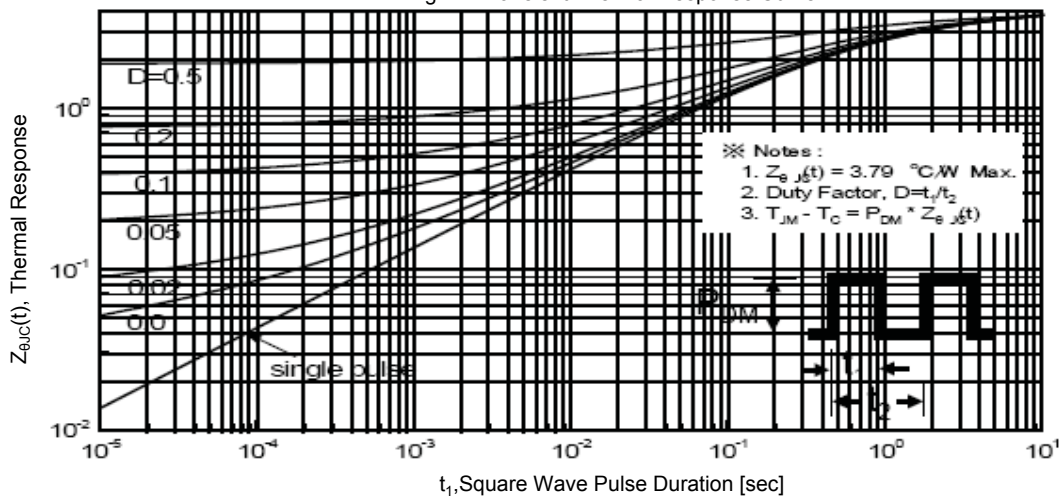


Fig-12. Gate Charge Test Circuit & Waveform

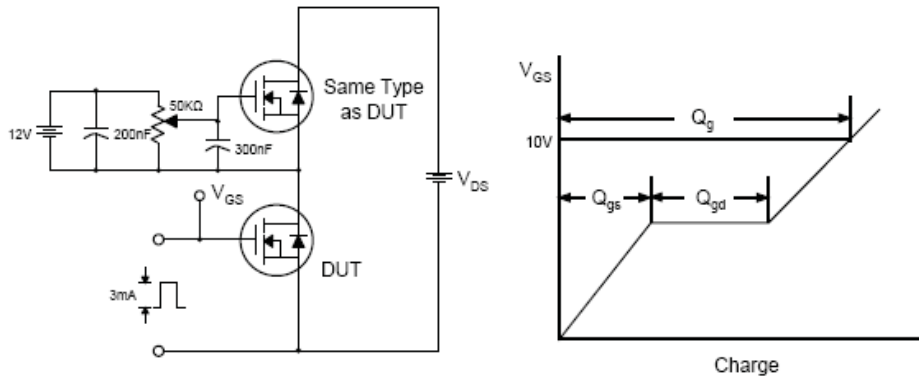


Fig-13. Resistive Switching Test Circuit & Waveforms

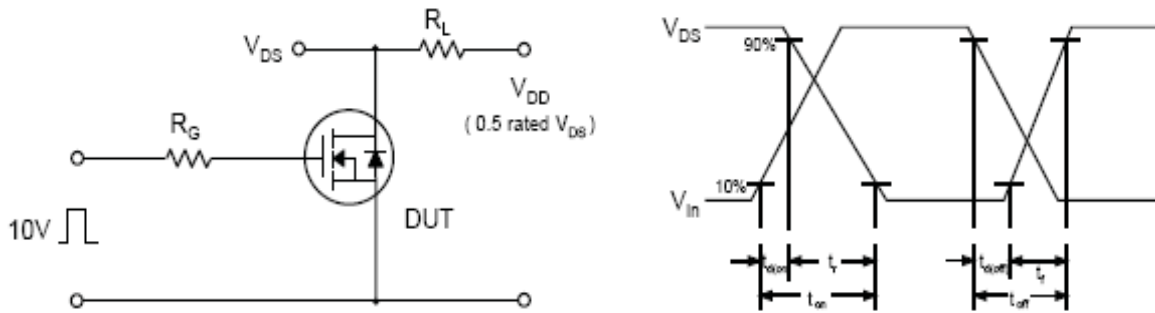


Fig-14. Unclamped Inductive Switching Test Circuit & Waveforms

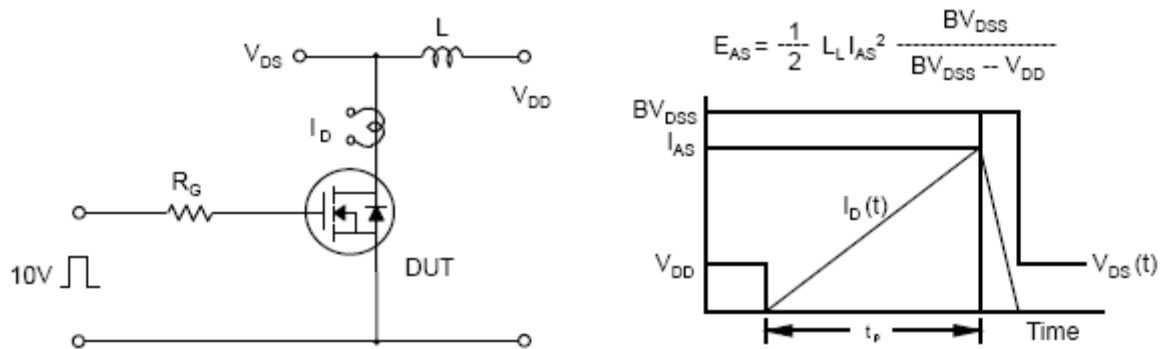
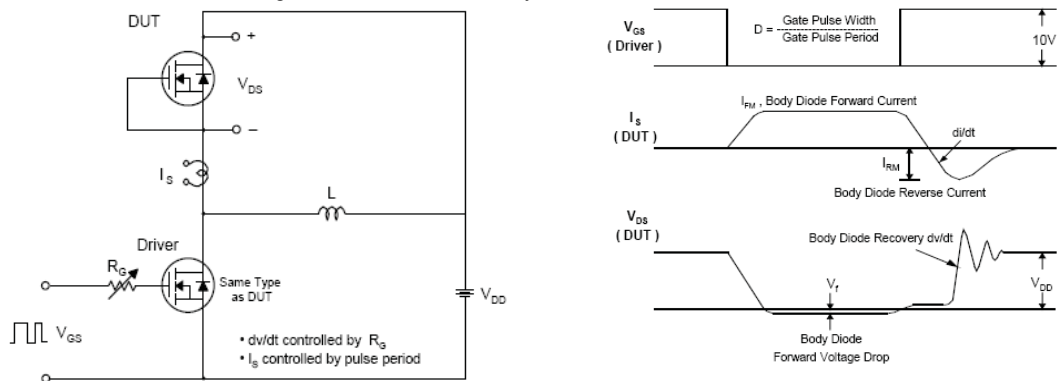


Fig-15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



PACKAGE DIMENSIONS

■ TO-220P (TO-220AB) Dimension (封装尺寸数据, 单位: mm)				元件打印标识
	DIM	Min.	Max.	<p>左上角: LOGO AAA: 芯片代码 BBBBB: 批次识别码 aabb: 生产批号 其中: aa: 出厂年份 bb: 出厂自然周 (01~53) XXXXXXXX: 器件型号</p>
	A	6.48	7.40	
	C	4.40	4.90	
	D	2.34	3.00	
	E	0.45	0.80	
	F	9.80	10.36	
	G	3.10	3.60	
	I	2.70	3.43	
	J	0.60	1.00	
	K	2.34	2.74	
	L	12.48	13.60	
	M	15.67	16.20	
	N	0.90	1.47	
	O	2.00	2.96	
	$\alpha 1/2/4/5$	-	*5°	
	$\alpha 3$	-	*27°	

■ TO-220F (TO-220FP) Dimension (封装尺寸数据, 单位: mm)				元件打印标识
	DIM	Min.	Max.	<p>左上角: LOGO AAA: 芯片代码 XXXXXXXX: 器件型号 BBBBB: 批次识别码 aabb: 生产批号 其中: aa: 出厂年份 bb: 出厂自然周 (01~53)</p>
	A	5.58	7.49	
	B	8.38	8.90	
	C	4.40	4.70	
	D	1.15	1.39	
	E	0.35	0.60	
	F	2.03	2.92	
	G	9.66	10.28	
	H	--	*16.25	
	I	--	*3.83	
	J	3.00	4.00	
	K	0.75	0.95	
	L	2.54	3.42	
	M	1.14	1.40	
	N	--	*2.54	
	O	12.70	14.27	
P	14.48	15.87		

Manufacturers version information

2010-01-05, HAOHAI™ Product Data-S1.0

2013-05-21, HAOHAI™ Product Data-S1.1

2014-06-05, HAOHAI™ Product Data-S1.2



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