

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
FQP12N65C FQPF12N65C	H12N65P H12N65F	12N65	HAOYI	P: TO-220AB F: TO-220FP	条管装 盒装箱装	50Pcs	1000Pcs	5000Pcs

■ Features		I <sub>D</sub> =12A BV <sub>DSS</sub> =650V R <sub>DS(on)</sub> =0.67Ω	12N65 Series Pin Assignment	
Originative New Design				3-Lead Plastic TO-220AB Package Code: P Pin 1: Gate Pin 2 & Tab: Drain Pin 3: Source
Superior Avalanche Rugged Technology				3-Lead Plastic TO-220FP Package Code: F Pin 1: Gate Pin 2: Drain Pin 3: Source
Robust Gate Oxide Technology				
Very Low Intrinsic Capacitances				
Excellent Switching Characteristics				
Unrivalled Gate Charge: 38nC(Typ.)				
Extended Safe Operating Area				
Lower R <sub>DS(ON)</sub> : 0.67Ω(Typ.) @ V <sub>GS</sub> =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)			
Series Symbol:				

■ Absolute Maximum Ratings (T<sub>C</sub>=25°C unless otherwise specified)

Symbol	Parameter	Value		Units
		TO-220AB	TO-220F	
V <sub>DSS</sub>	Drain-Source Voltage	650	600	V
I <sub>D</sub>	Drain Current—Continuous (T <sub>C</sub> =25°C)	12	12*	A
	Drain Current—Continuous (T <sub>C</sub> =100°C)	7.4	7.4*	
I <sub>DM</sub>	Drain Current – Pulsed (Note 1)	48	48*	
V <sub>GS</sub>	Gate-Source Voltage	±30	±30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	860	870	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	12	12	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	22.5	22.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	4.5	V/ns
P <sub>D</sub>	Power Dissipation (T <sub>C</sub> =25°C)	225	51	W
	Power Dissipation - Derate above 25°C	1.78	0.41	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-50 ~ +150		°C
T <sub>L</sub>	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 <sub>θJC</sub>	Junction-to-Case	--	0.56	--	2.43	°C/W
R <sub>θCS</sub>	Case-to-Sink	0.5	--	--	--	
R <sub>θJA</sub>	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	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	2.0	--	4.0	V
$R_{DS(\text{ON})}$	Static Drain-Source On-Resistance	$V_{GS}=10\text{V}$ , $I_D=6\text{A}$	--	0.67	0.78	$\Omega$

## Off Characteristics

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}$ , $I_D=250\mu\text{A}$	650	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D=250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.5	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=650\text{V}$ , $V_{GS}=0\text{V}$	--	--	1	$\mu\text{A}$
		$V_{DS}=520\text{V}$ , $T_C=125^\circ\text{C}$	--	--	10	
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS}=+30\text{V}$ , $V_{DS}=0\text{V}$	--	--	100	$\text{nA}$
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS}=-30\text{V}$ , $V_{DS}=1\text{V}$	--	--	-100	

## Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS}=25\text{V}$ $V_{GS}=0\text{V}$ $f=1.0\text{MHz}$	--	1835	2385	$\text{pF}$
$C_{oss}$	Output Capacitance		--	185	240	
$C_{rss}$	Reverse Transfer Capacitance		--	16	21	

## Switching Characteristics

$t_{d(on)}$	Turn-On Time	$V_{DS}=325\text{V}$ $I_D=12\text{A}$ $R_G=25\Omega$ <b>(Note 4,5)</b>	--	30	70	$\text{nS}$
$t_r$	Turn-On Rise Time		--	85	180	
$t_{d(off)}$	Turn-Off Delay Time		--	140	280	
$t_f$	Turn-Off Fall Time		--	90	190	
$Q_g$	Total Gate Charge	$V_{DS}=520\text{V}$ $I_D=12\text{A}$ , $V_{GS}=10\text{V}$ <b>(Note 4,5)</b>	--	38	49	$\text{nC}$
$Q_{gs}$	Gate-Source Charge		--	8	--	
$Q_{gd}$	Gate-Drain Charge		--	13	--	

## Source-Drain Diode Maximum Ratings and Characteristics

$I_s$	Continuous Source-Drain Diode Forward Current	--	--	12	$\text{A}$	
$I_{SM}$	Pulsed Source-Drain Diode Forward Current	--	--	48		
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_s=12\text{A}$ , $V_{GS}=0\text{V}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$I_s=12\text{A}$ , $V_{GS}=0\text{V}$ $dI/dt=100\mu\text{A}/\mu\text{s}$ <b>(Note 4)</b>	--	420	--	$\text{nS}$
$Q_{rr}$	Reverse Recovery Charge		--	4.9	--	$\mu\text{C}$

## Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L=11\text{mH}$ ,  $I_{AS}=12\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$
3.  $I_{SD} \leq 12\text{A}$ ,  $dI/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , 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

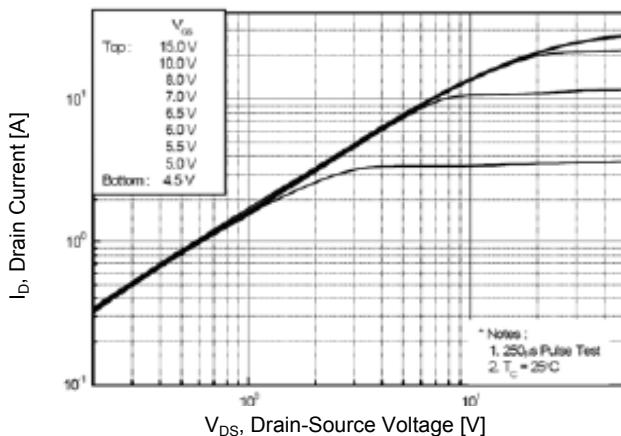


Fig-2. Transfer Characteristics

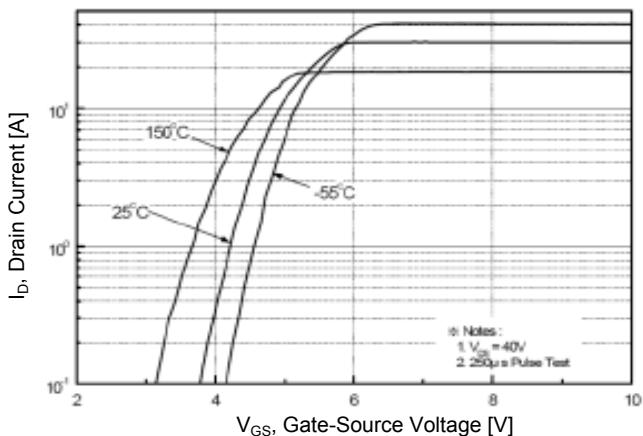


Fig-3. On Resistance Variation vs  
Drain Current and Gate Voltage

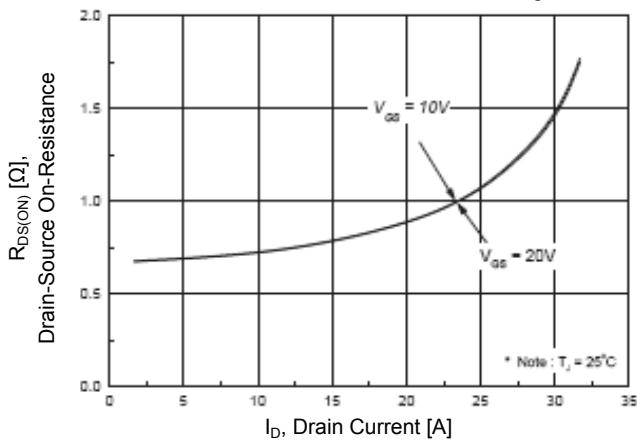


Fig-4. Body Diode Forward Voltage Variation  
with Source Current and Temperature

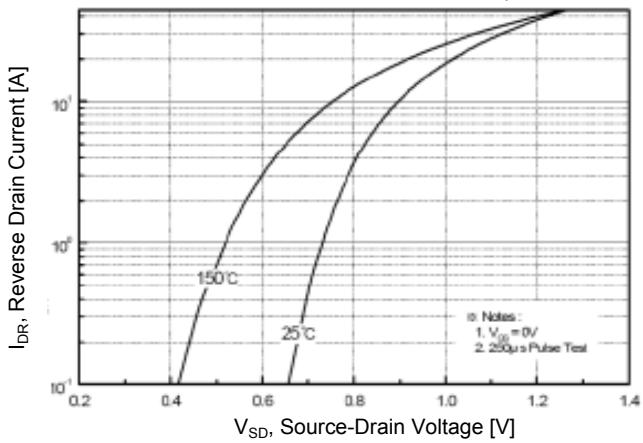


Fig-5. Capacitance Characteristics

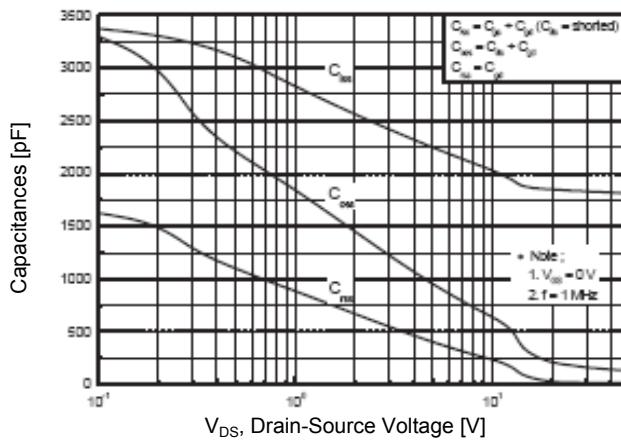
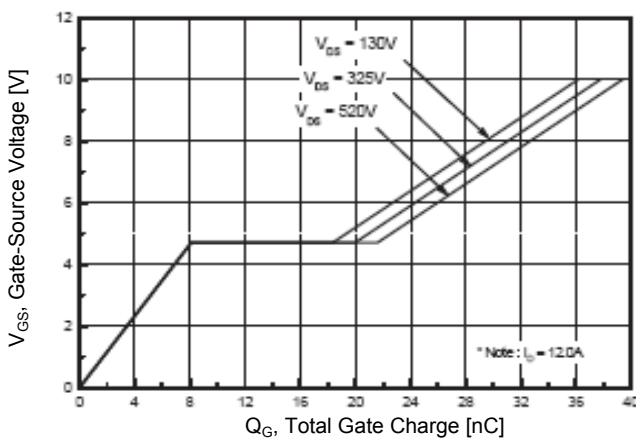


Fig-6. Gate Charge Characteristics



### Typical Performance Characteristics (Continued)

Fig-7. Breakdown Voltage Variation vs Temperature

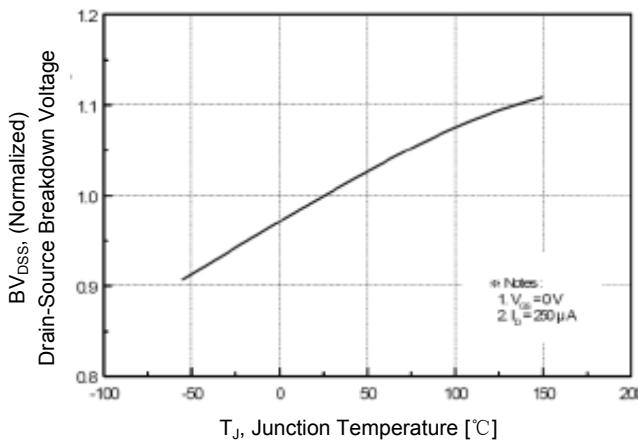


Fig-8. On-Resistance Variation vs Temperature

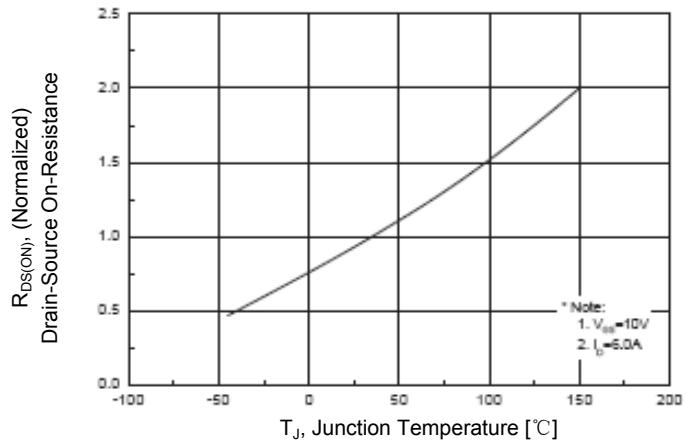


Fig-9. Maximum Safe Operating Area

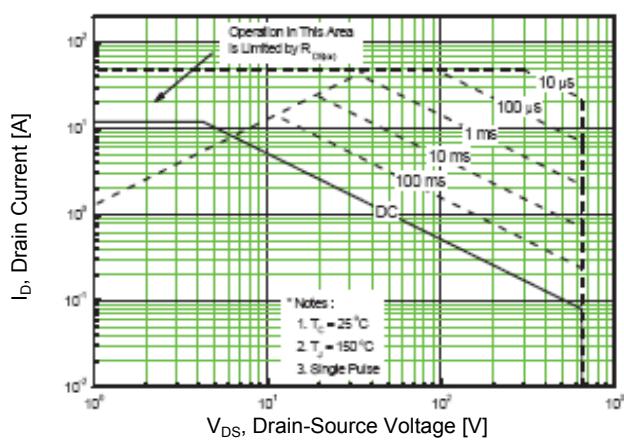


Fig-10. Maximum Drain Current vs Case Temperature

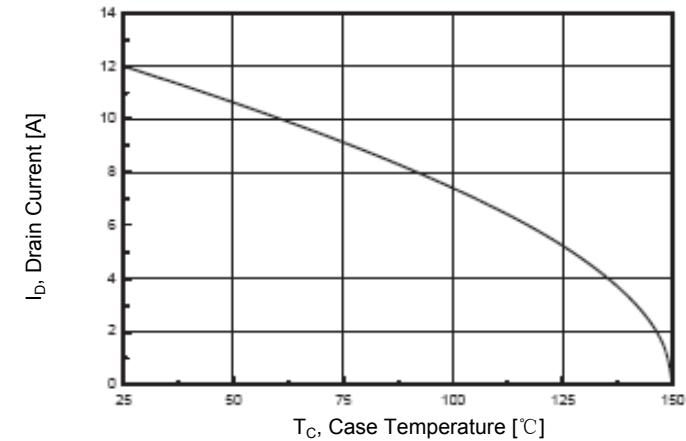


Fig-11. Transient Thermal Response Curve

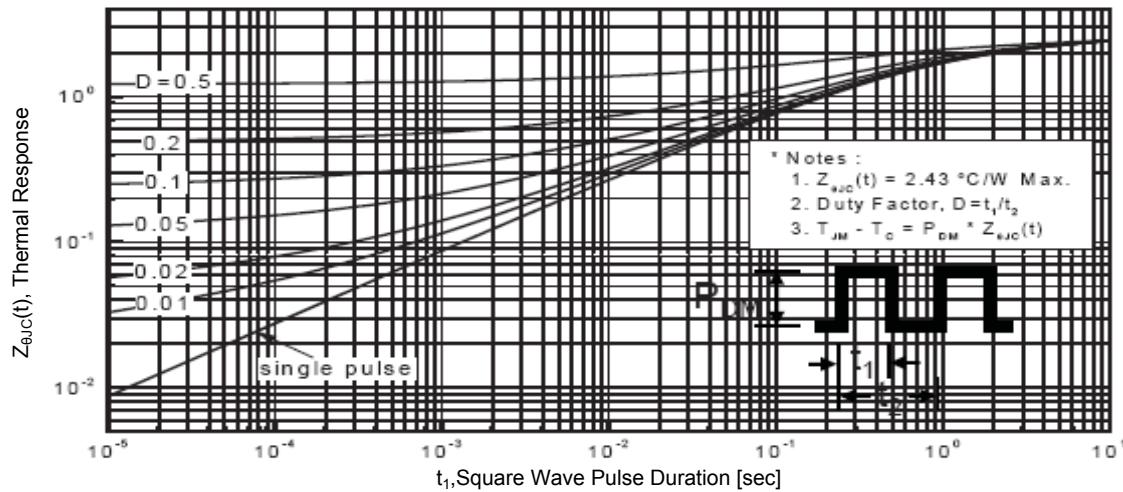


Fig-12. Gate Charge Test Circuit & Waveform

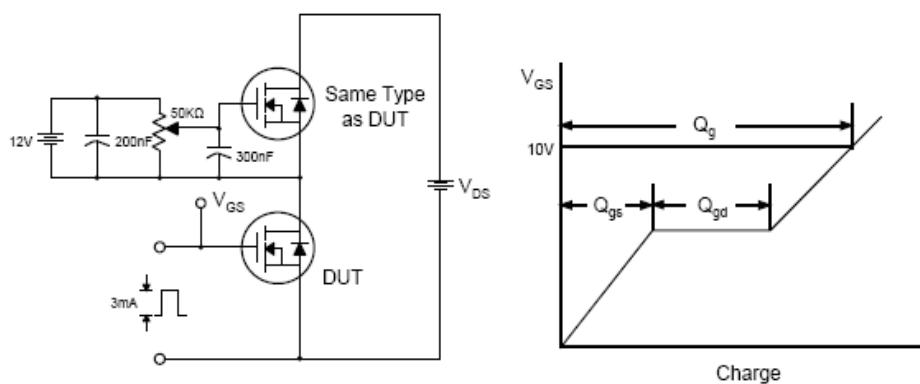


Fig-13. Resistive Switching Test Circuit & Waveforms

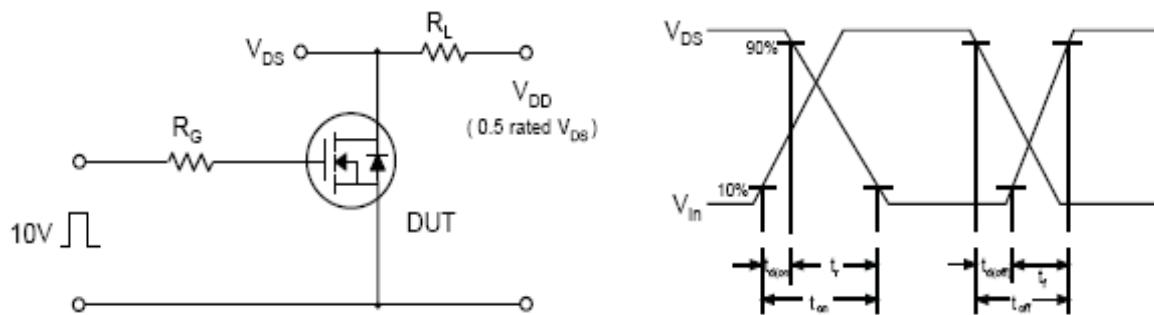


Fig-14. Unclamped Inductive Switching Test Circuit & Waveforms

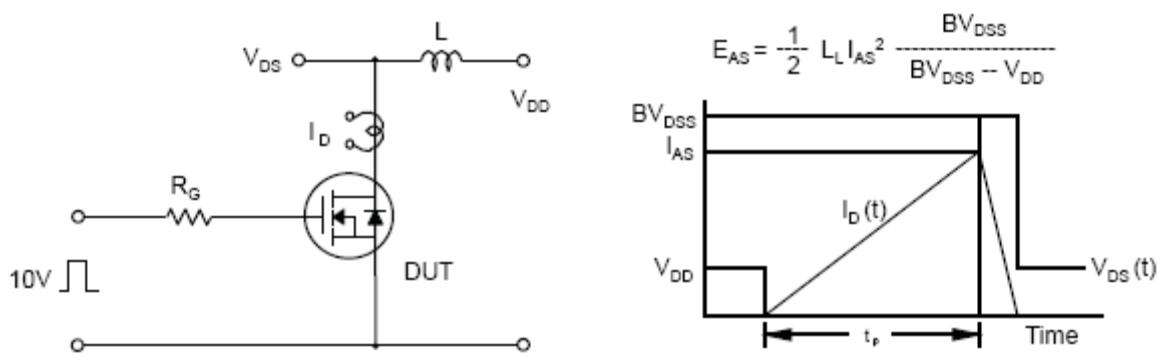
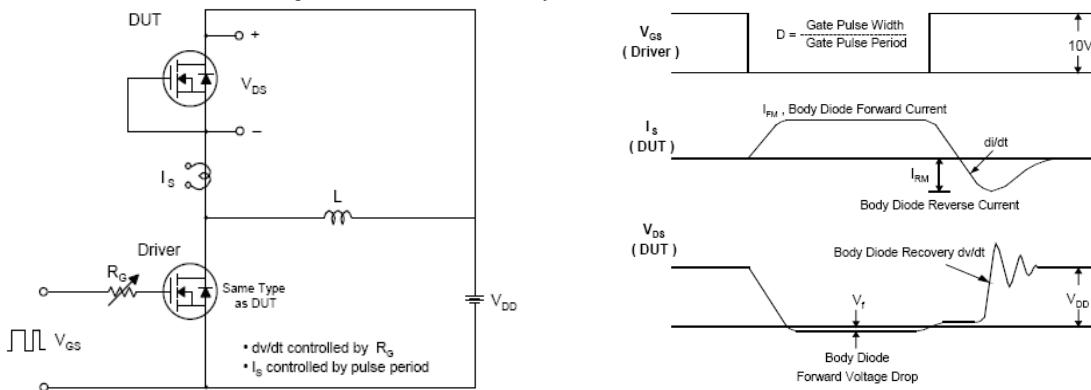


Fig-15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## 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.
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	
α1/2/4/5	-	*5°	
α3	-	*27°	



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

■ TO-220F (TO-220FP) Dimension (封装尺寸数据, 单位: mm)			元件打印标识
	DIM	Min.	Max.
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	



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)

