

N-Channel Super Junction Power MOSFET IV

General Description

The series of devices use advanced trench gate super junction technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

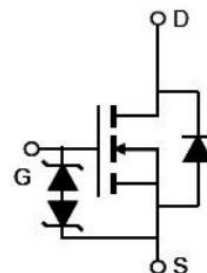
Features

- Optimized body diode reverse recovery performance
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- LLC Half-bridge

$V_{DS \min @ T_{jmax}}$	710	V
$R_{DS(ON)TYP}$	300	mΩ
I_D	11	A
Q_g	17	nC



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE65N330F	TO-220F-3L	NCE65N330F



Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

Parameter	Symbol	Value	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	650	V
Gate-Source Voltage ($V_{DS}=0V$) AC ($f>1\text{ Hz}$)	V_{GS}	± 30	V
Gate-Source Voltage ($V_{DS}=0V$) DC	V_{GS}	± 20	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	11	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	7.7	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	44	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	32.6	W
Derate above 25°C		0.22	W/ $^\circ\text{C}$
Avalanche current(Note 2)	I_{AS}	3	A
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$,	dv/dt	50	V/ns
Reverse diode dv/dt , $V_{DS} \leq 480\text{ V}$, $I_{SD}<I_D$	dv/dt	15	V/ns
Operating Junction and Storage Temperature Range	T_J, T_{STG}	$-55...+175$	$^\circ\text{C}$

* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	4.60	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	$^{\circ}\text{C}/\text{W}$

Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =250μA	650			V
Zero Gate Voltage Drain Current(Tc=25℃)	I _{DSS}	V _{DS} =650V, V _{GS} =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I _{DSS}	V _{DS} =650V, V _{GS} =0V			100	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V, V _{DS} =0V			±200	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	3	3.5	4	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =5.5A		300	330	mΩ
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{DS} =50V, V _{GS} =0V, F=1.0MHz		847		pF
Output Capacitance	C _{oss}			31		pF
Reverse Transfer Capacitance	C _{rss}			4		pF
Total Gate Charge	Q _g	V _{DS} =480V, I _D =5.5A, V _{GS} =10V		17		nC
Gate-Source Charge	Q _{gs}			4.4		nC
Gate-Drain Charge	Q _{gd}			4.9		nC
Gate plateau voltage	V _{gp}			5.4		V
Intrinsic gate resistance	R _G	f = 1 MHz open drain		18		Ω
Switching times						
Turn-on Delay Time	t _{d(on)}	V _{DD} =480V, I _D =5.5A, R _G =1.7Ω, V _{GS} =10V		10		nS
Turn-on Rise Time	t _r			7		nS
Turn-Off Delay Time	t _{d(off)}			55		nS
Turn-Off Fall Time	t _f			8		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I _{SD}	T _C =25℃			11	A
Pulsed Source-drain current(Body Diode)	I _{SDM}				44	A
Forward On Voltage	V _{SD}	T _J =25℃, I _{SD} =11A, V _{GS} =0V		0.9	1.2	V
Reverse Recovery Time	t _{rr}	T _J =25℃, I _F =5.5A, di/dt=100A/μs		200		nS
Reverse Recovery Charge	Q _{rr}			1.6		uC
Peak Reverse Recovery Current	I _{rrm}			16		A

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

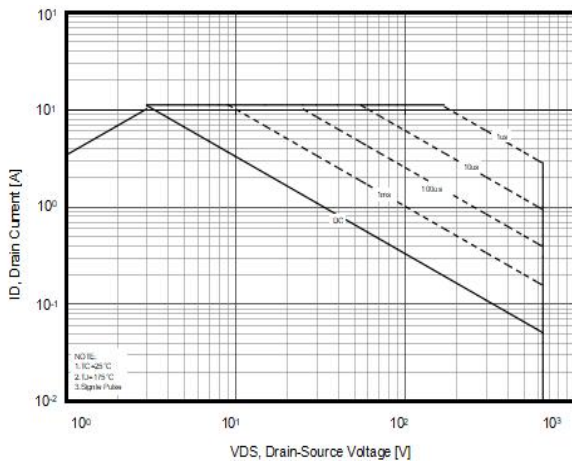


Figure2. Capacitance

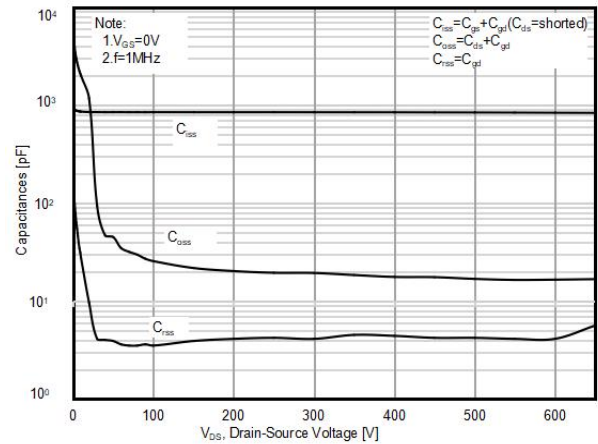


Figure3. Transfer characteristics

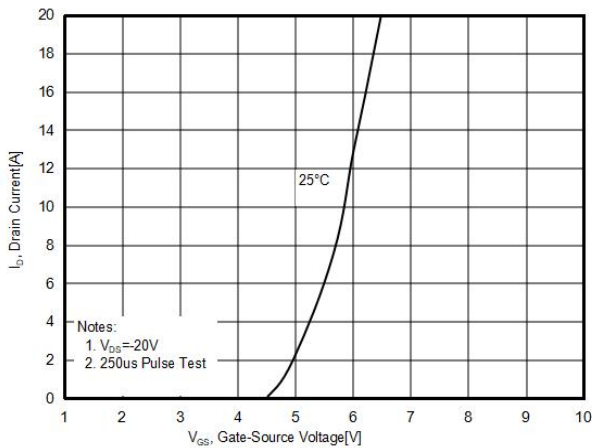


Figure4. Output characteristics

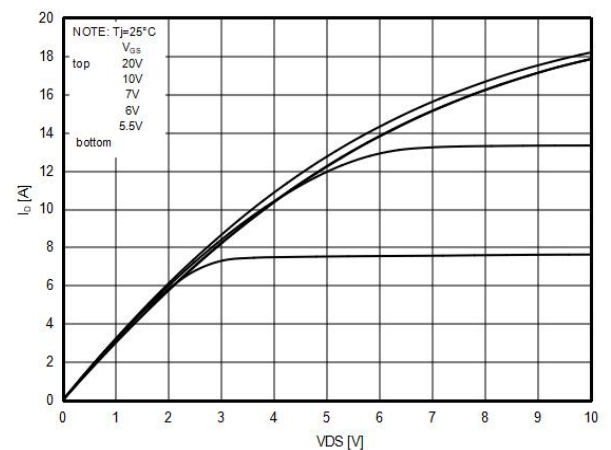


Figure5. $R_{DS(ON)}$ vs Junction Temperature

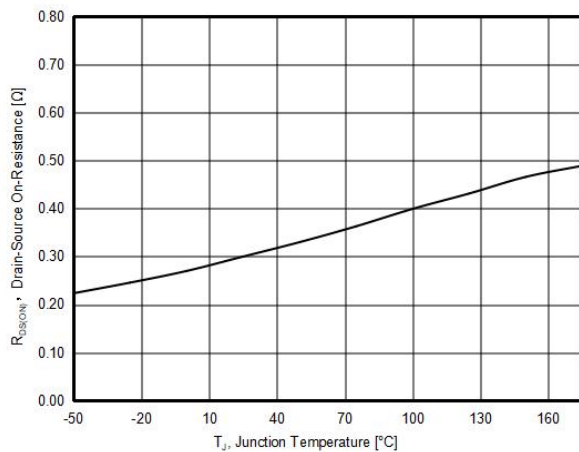


Figure6. BV_{DSS} vs Junction Temperature

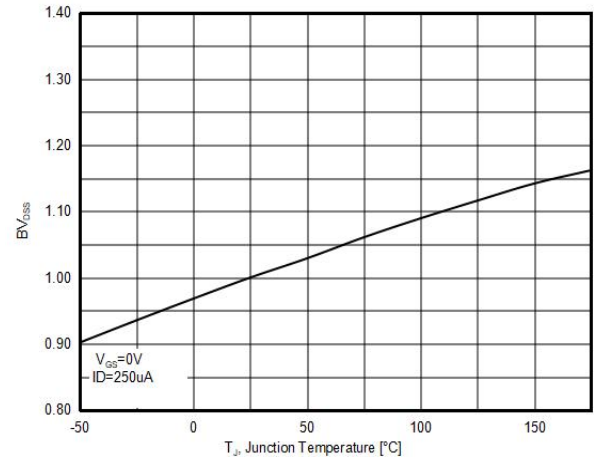


Figure7. Maximum I_D vs Junction Temperature

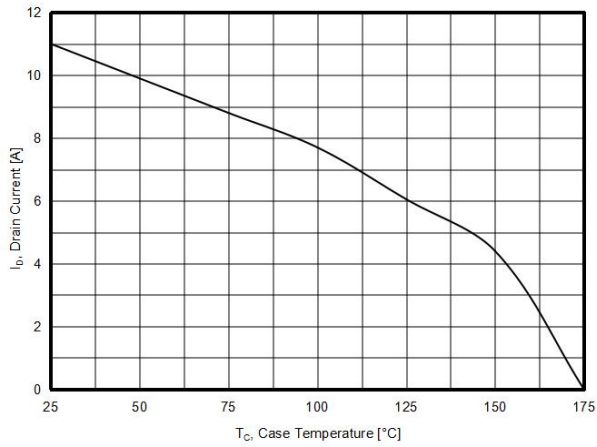


Figure8. Gate charge waveforms

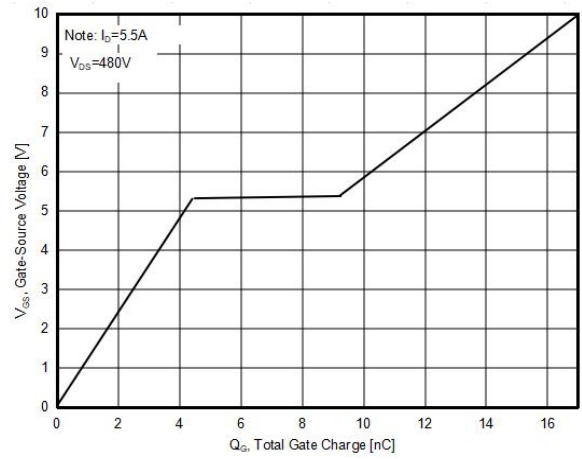


Figure9. Static drain-source on resistance

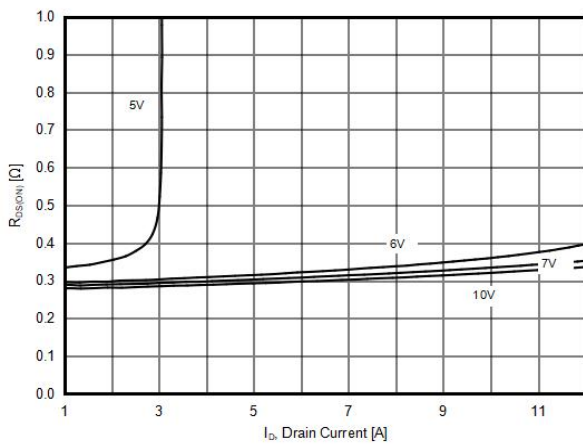
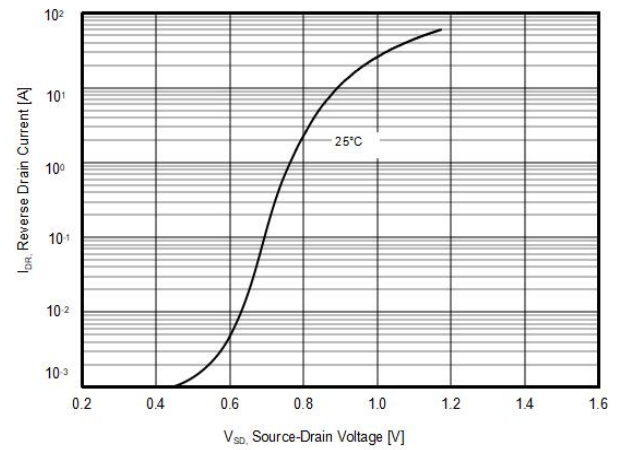
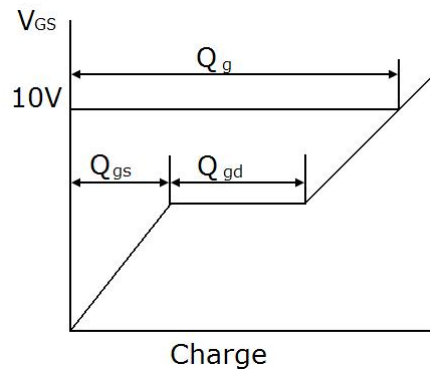
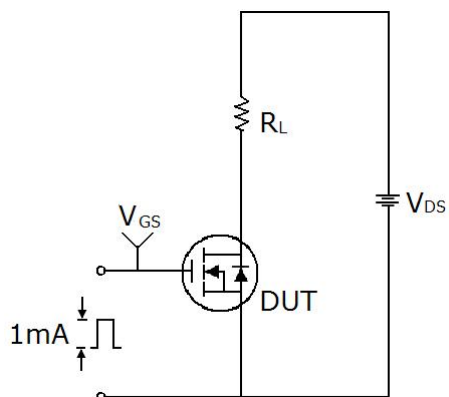


Figure10. Source-Drain Diode Forward Voltage

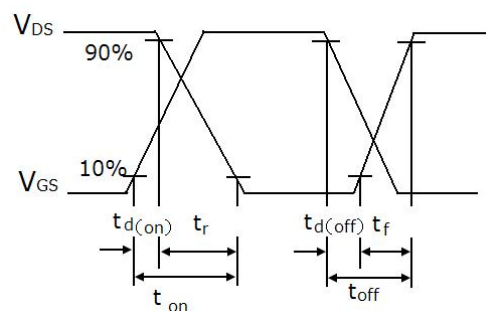
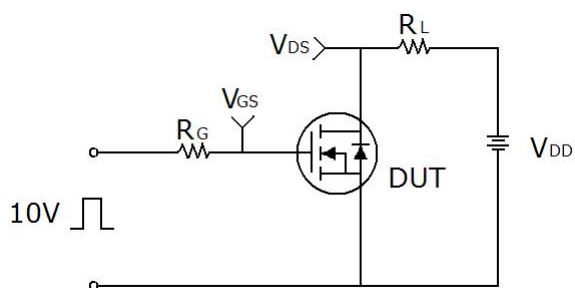


Test circuit

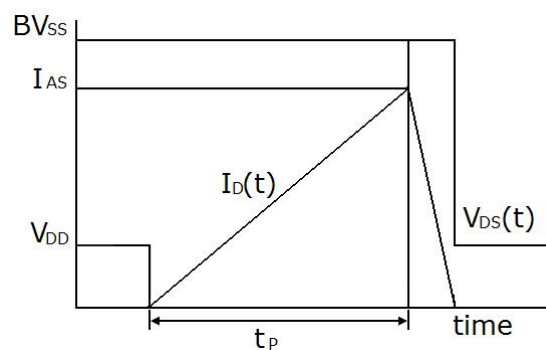
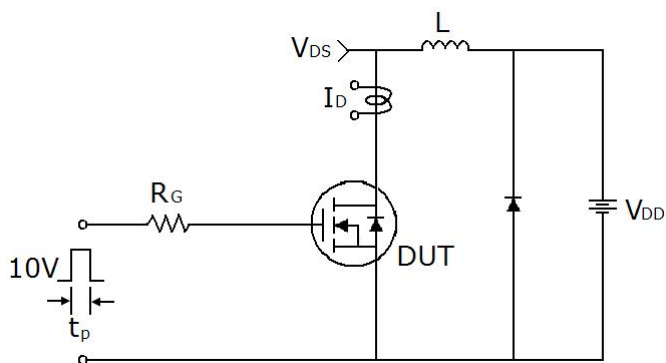
1) Gate charge test circuit & Waveform



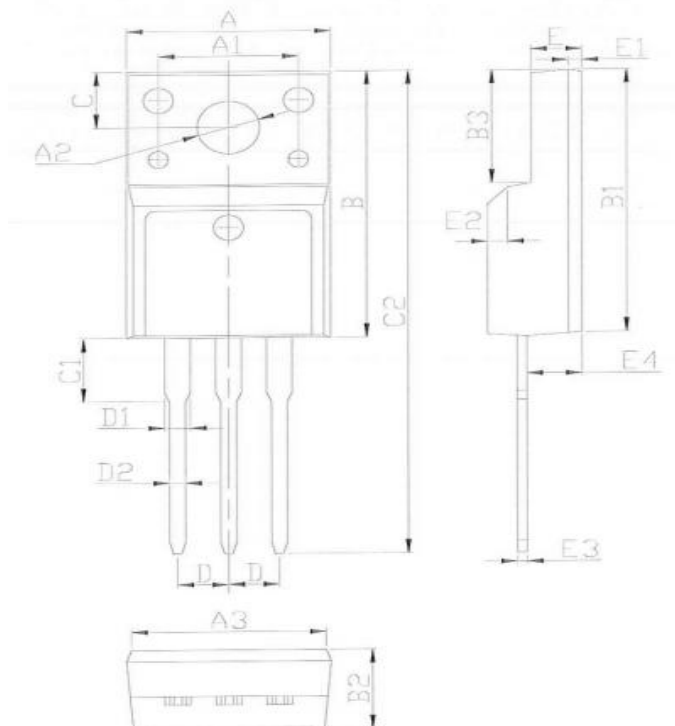
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

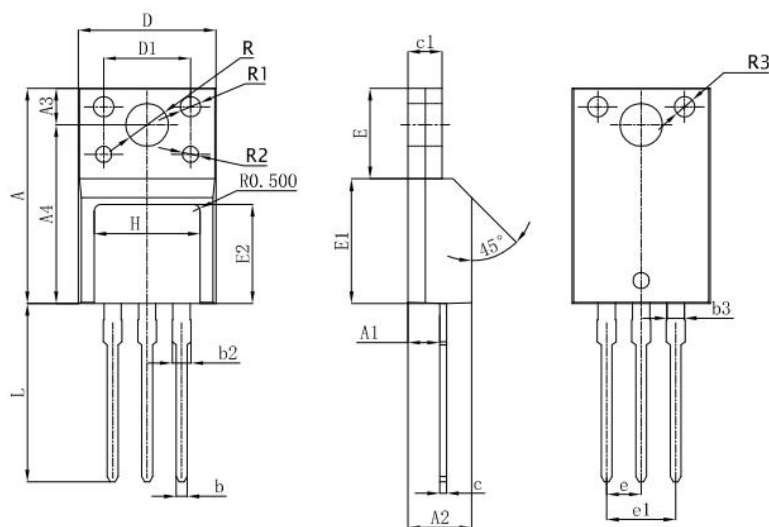


TO-220F-L Package Information



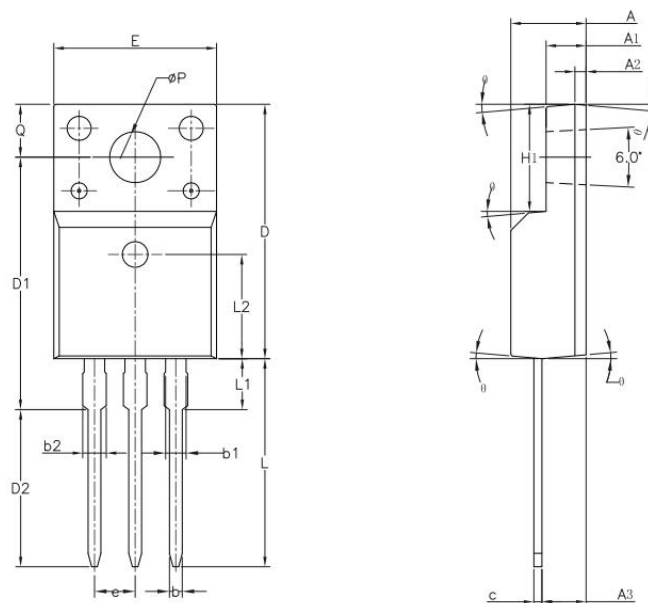
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.86	10.46	0.387	0.411
A1	6.80	7.20	0.267	0.283
A2	2.92	3.32	0.115	0.130
A3	9.40	10.00	0.369	0.393
B	15.40	16.40	0.605	0.644
B1	15.10	16.10	0.593	0.633
B2	4.40	5.00	0.173	0.196
B3	6.40	7.00	0.251	0.275
C	3.05	3.55	0.120	0.139
C1	2.95	3.55	0.116	0.139
C2	28.20	29.20	1.108	1.147
D	2.54 BSC		0.100 BSC	
D1	--	1.47	--	0.058
D2	0.60	1.00	0.024	0.039
E	2.30	2.80	0.090	0.110
E1	0.45	0.95	0.018	0.037
E2	45°		45°	
E3	0.30	0.70	0.012	0.028
E4	2.45	3.05	0.096	0.120

TO-220F-S Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	15.67	15.87	0.616	0.623
A1	2.15	2.35	0.084	0.092
A2	4.50	4.70	0.177	0.185
A3	3.10	3.50	0.122	0.138
A4	12.27	12.87	0.482	0.506
b	0.77	0.83	0.030	0.033
b2	1.20	1.40	0.047	0.055
b3	1.20 BSC		0.047 REF	
c	0.40	0.60	0.016	0.024
c1	2.44	2.64	0.096	0.104
D	9.86	10.46	0.387	0.411
D1	6.90	7.10	0.271	0.279
E	6.48	6.88	0.255	0.270
E1	8.99	9.39	0.353	0.369
E2	7.10	7.50	0.279	0.295
e	2.54 BSC		0.100 BSC	
e1	5.08 BSC		0.200 BSC	
L	13.14	13.54	0.516	0.532
R	3.10	3.50	0.122	0.138
R1	1.500 REF		0.059 REF	
R2	1.200 REF		0.047 REF	
R3	1.500 REF		0.059 REF	
H	7.60	8.00	0.299	0.314
θ1	4.0°	5.0°	4.00°	5.00°

TO-220F-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.83	0.177	0.190
A1	2.34	2.74	0.092	0.108
A2	0.70 REF		0.028 REF	
A3	2.56	2.93	0.101	0.115
b	0.70	0.90	0.028	0.035
b1	1.18	1.38	0.046	0.054
b2	--	1.47	--	0.058
c	0.45	0.60	0.018	0.024
D	15.67	16.07	0.616	0.631
D1	15.55	15.95	0.611	0.627
D2	9.60	10.00	0.377	0.393
E	9.96	10.36	0.391	0.407
e	2.54 BSC		0.100 BSC	
H1	6.48	6.88	0.255	0.270
L	12.68	13.28	0.498	0.522
L1	--	3.50	--	0.138
L2	6.50 REF		0.255 REF	
ϕP	3.08	3.28	0.121	0.129
Q	3.20	3.40	0.126	0.134
θ	1.0°	5.0°	1.00°	5.00°

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