N-Channel Super Junction Power MOSFET Ⅳ

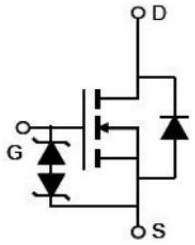
General Description

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.

$V_{DS\ min@Tjmax}$	550	V
$R_{DS(ON)TYP.}$	180	mΩ
I_D	13.5	A
Qg	19	nC

Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant



Schematic diagram

Application

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

✧ **Intrinsic fast-recovery body diode**

Package Marking And Ordering Information

Device	Device Package	Marking
NCE50NF220F	TO-220F	NCE50NF220F

TO-220F

Table 1. Absolute Maximum Ratings (T_C=25℃)

Parameter	Symbol	Value	Unit
Drain-Source Voltage (V_{GS}=0V）	V_{DS}	500	V
Gate-Source Voltage (V_{DS}=0V) ,AC (f>1 Hz)	V_{GS}	±30	V
Gate-Source Voltage (V_{DS}=0V) ,DC	V_{GS}	±20	V
Continuous Drain Current at Tc=25°C	$I_{D\ (DC)}$	13.5	A
Continuous Drain Current at Tc=100°C	$I_{D\ (DC)}$	9.45	A
Pulsed drain current **(Note 1)**	$I_{DM\ (pluse)}$	40.5	A
Maximum Power Dissipation(Tc=25℃) Derate above 25°C	P_D	32.7 0.22	W W/°C
Single pulse avalanche current **(Note 2)**	I_{AS}	3	A
Reverse diode dv/dt， V_{DS} ≤480 V,I_{SD}<I_D	dv/dt	15	V/ns
Drain Source voltage slope， V_{DS} ≤480 V	dv/dt	50	V/ns
Operating Junction and Storage Temperature Range	T_J,T_{STG}	-55...+175	°C

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance，Junction-to-Case（Maximum）	R_{thJC}	4.58	°C /W
Thermal Resistance，Junction-to-Ambient （Maximum）	R_{thJA}	62	°C /W

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V I_D=250uA	500			V
Zero Gate Voltage Drain Current(Tc=25℃)	I_{DSS}	V_{DS}=500V,V_{GS}=0V			10	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I_{DSS}	V_{DS}=500V,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=250uA	3		5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=6.5A		180	220	mΩ
Dynamic Characteristics						
Gate Resistance	Rg	F=1MHZ, D-S short		15		Ω
Input Capacitance	C_{lss}	V_{DS}=50V,V_{GS}=0V, F=1MHz		846		pF
Output Capacitance	C_{oss}			46		pF
Reverse Transfer Capacitance	C_{rss}			1.8		pF
Total Gate Charge	Q_g	V_{DS}=380V,I_D=6.5A, V_{GS}=10V		19		nC
Gate-Source Charge	Q_{gs}			7.3		nC
Gate-Drain Charge	Q_{gd}			5.7		nC
Gate plateau voltage	Vgp			6.6		V
Switching times						
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=380V,I_D=6.5A, R_G=4Ω,V_{GS}=10V		8		nS
Turn-on Rise Time	t_r			10		nS
Turn-Off Delay Time	$t_{d(off)}$			41		nS
Turn-Off Fall Time	t_f			10		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	T_C=25°C			13.5	A
Pulsed-Source-drain current(Body Diode)	I_{SDM}				40.5	A
Forward on voltage	V_{SD}	Tj=25°C,I_{SD}=13.5A,V_{GS}=0V		1.0	1.2	V
Reverse Recovery Time	t_{rr}	Tj=25°C,I_F=6.5A, di/dt=100A/μs		150		nS
Reverse Recovery Charge	Q_{rr}			0.34		uC
Peak reverse recovery current	I_{rrm}			4.5		A

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

2. Tj=25℃,VDD=50V,VG=10V, R_G=25Ω

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Output characteristics

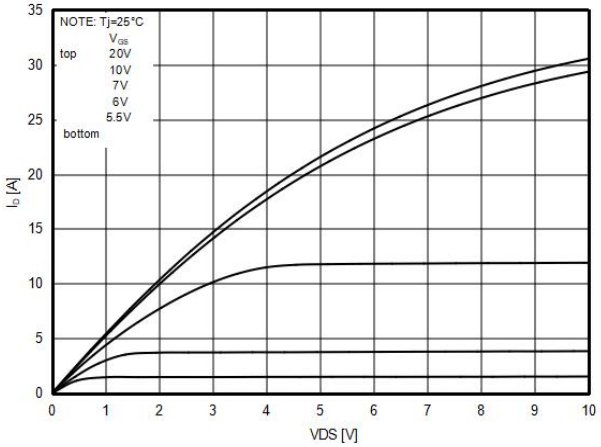


Figure2. Transfer characteristics

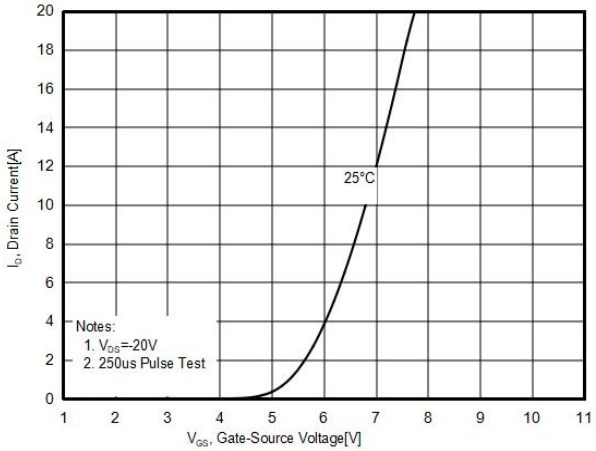


Figure3. $R_{DS(ON)}$ vs Junction Temperature

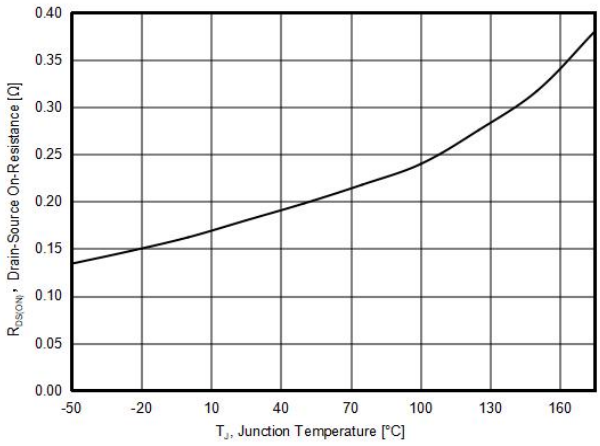


Figure4. BV_{DSS} vs Junction Temperature

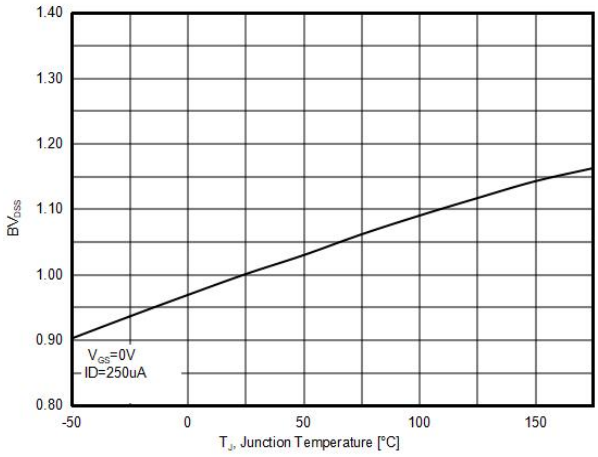


Figure5. Maximum I_D vs Junction Temperature

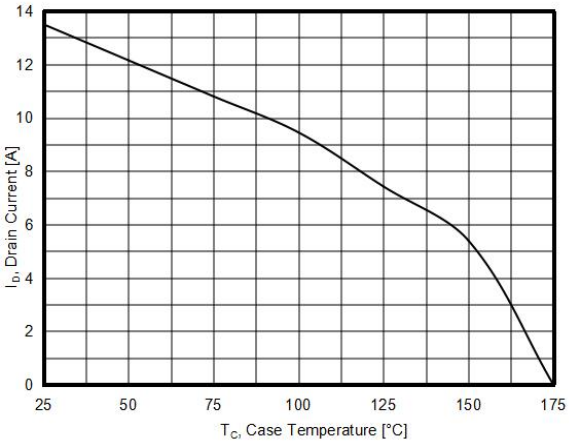


Figure6. Gate charge waveforms

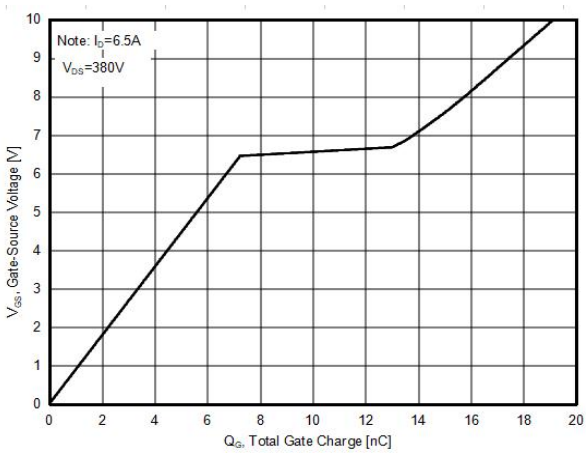


Figure7. Static drain-source on resistance

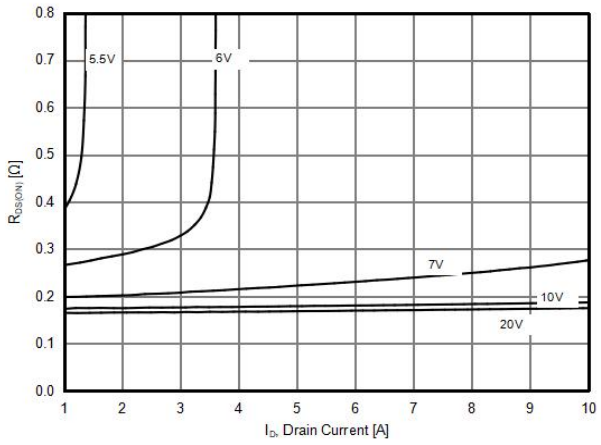


Figure8. Source-Drain Diode Forward Voltage

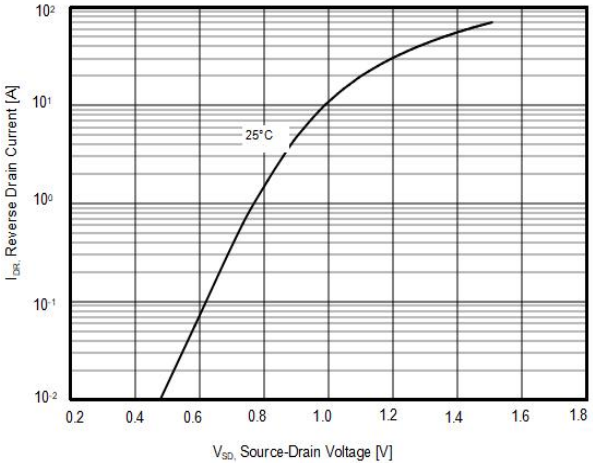


Figure9. Capacitance

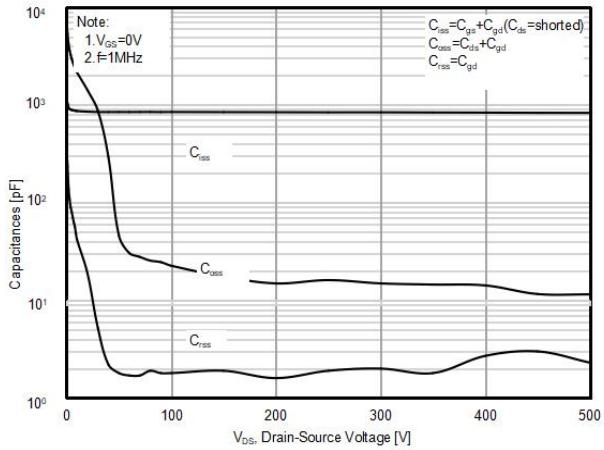
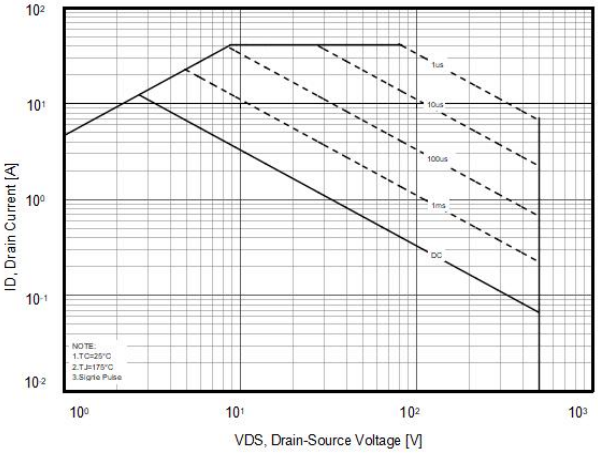
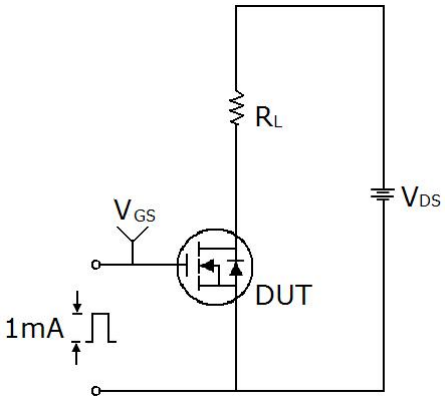


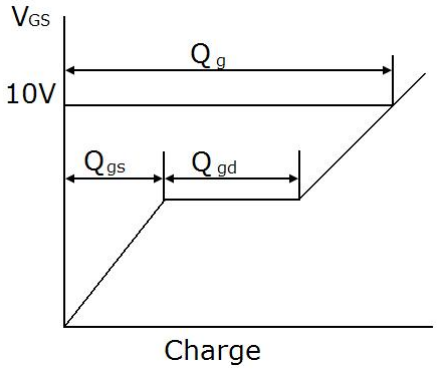
Figure10. Safe operating area



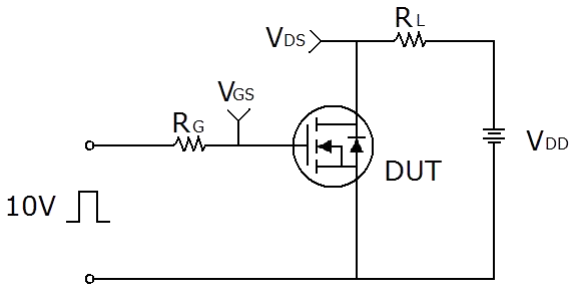
Test circuit

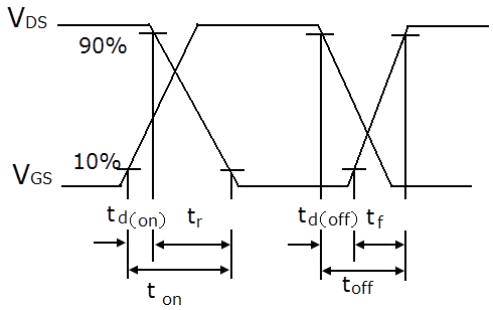
1）Gate charge test circuit & Waveform



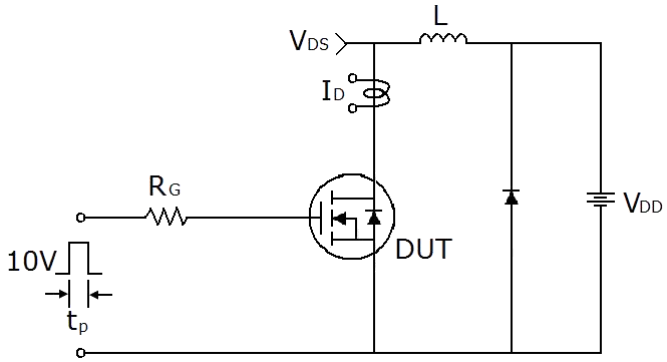


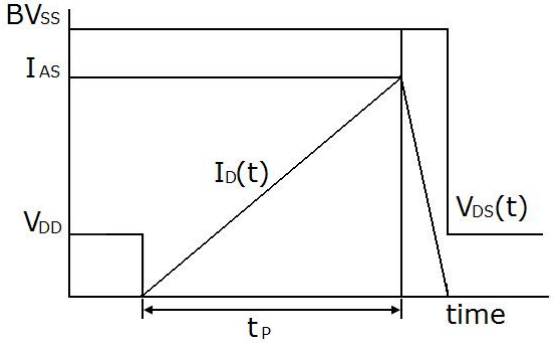
2）Switch Time Test Circuit：



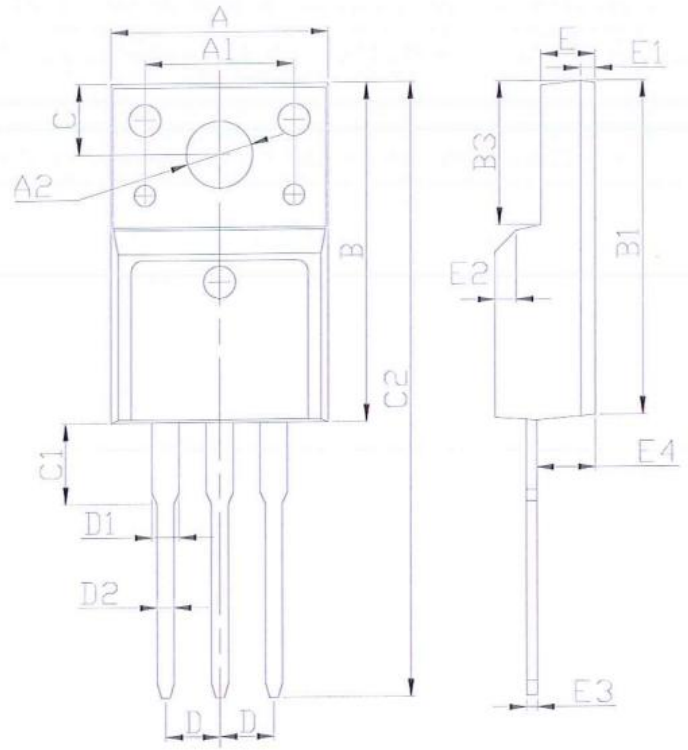


3）Unclamped Inductive Switching Test Circuit & Waveforms



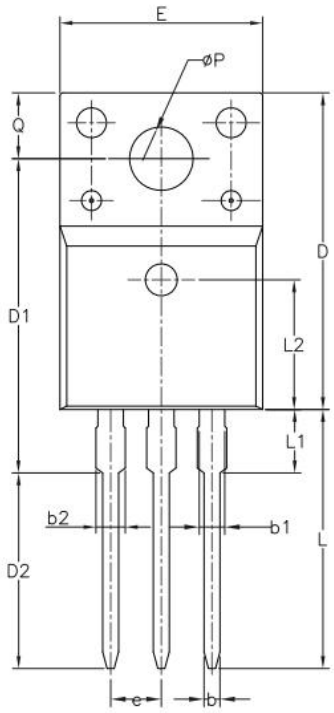


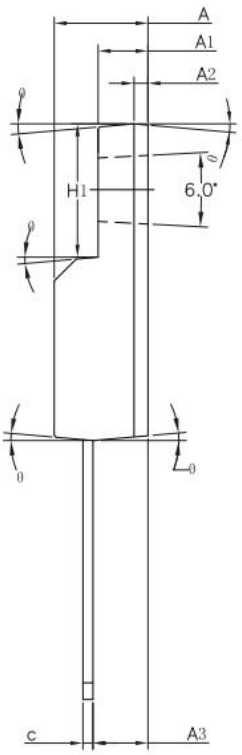
TO-220F-L Package Information



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	45.0°		45.00°	
E3	0.30	0.70	0.012	0.028
E4	2.45	3.05	0.096	0.120

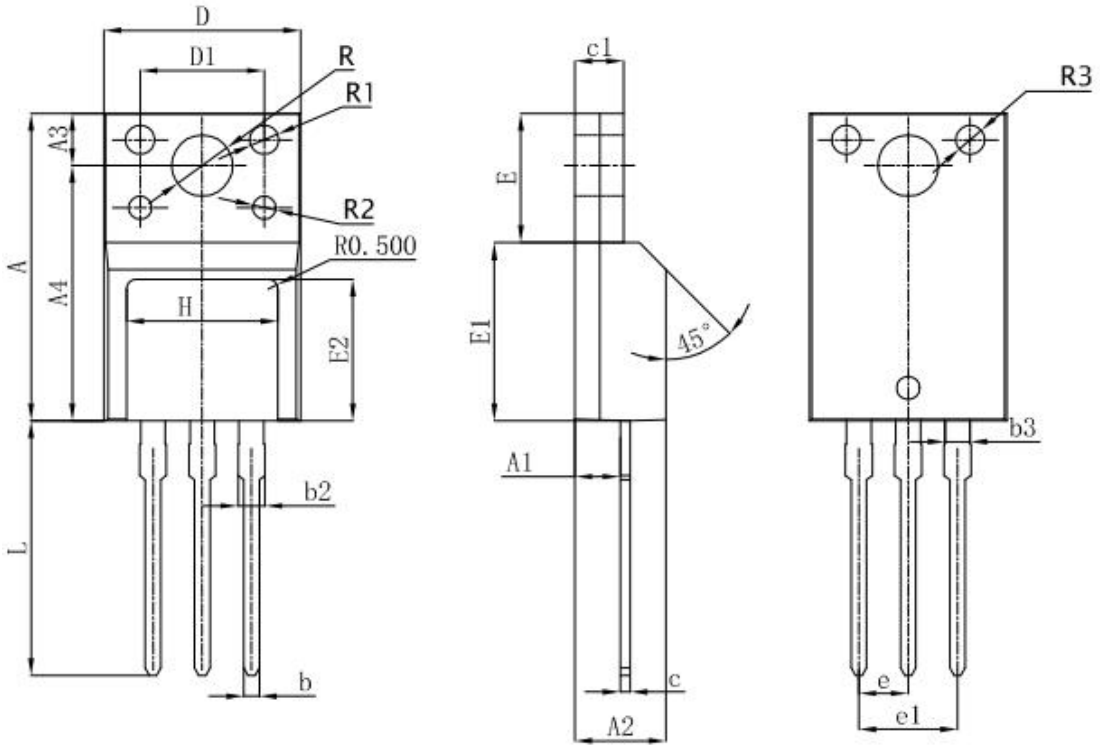
TO-220F-P Package Information





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	
⌀ P	3.08	3.28	0.121	0.129
Q	3.20	3.40	0.126	0.134
θ1	1.0°	5.0°	1.00°	5.00°

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
H	7.60	8.00	0.299	0.314
θ1	4.0°	5.0°	4.00°	5.00°

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