

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.

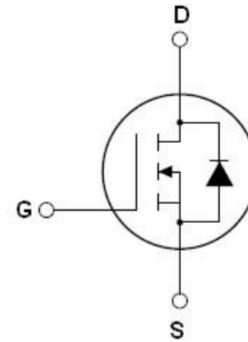
Features

- 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
$R_{DS(ON)TYP}$	60	mΩ
I_D	45	A
Qg	65	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

Package Marking And Ordering Information

Device	Device Package	Marking
NCE65NF068F	T0-220F	NCE65NF068F



GDS
TO-220F

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

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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	45	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	31.5	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	135	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	35.5	W
Derate above 25°C		0.24	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	E_{AS}	400	mJ
Avalanche current(Note 1)	I_{AS}	10	A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.9	mJ
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	50	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}	4.23	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	$^{\circ}\text{C}/\text{W}$

Table 3. Electrical Characteristics ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=1mA$	650			V
Zero Gate Voltage Drain Current($T_c=25^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			10	μA
Zero Gate Voltage Drain Current($T_c=125^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			300	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=500\mu\text{A}$	3.5	4.2	5.0	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=23A$		60	68	m Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0\text{MHz}$		3900	4400	pF
Output Capacitance	C_{oss}			132		pF
Reverse Transfer Capacitance	C_{rss}			14		pF
Total Gate Charge	Q_g	$V_{DS}=480V, I_D=23A,$ $V_{GS}=10V$		65	70	nC
Gate-Source Charge	Q_{gs}			21		nC
Gate-Drain Charge	Q_{gd}			17		nC
Gate plateau voltage	V_{gp}			6.5		V
Intrinsic gate resistance	R_G	$f = 1 \text{ MHz open drain}$		3		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=23A,$ $R_G=1.7\Omega, V_{GS}=10V$		42		nS
Turn-on Rise Time	t_r			14		nS
Turn-Off Delay Time	$t_{d(off)}$			90		nS
Turn-Off Fall Time	t_f			12		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}\text{C}$			45	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				135	A
Forward On Voltage	V_{SD}	$T_J=25^{\circ}\text{C}, I_{SD}=45A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	t_{rr}	$T_J=25^{\circ}\text{C}, I_F=23A,$ $di/dt=100A/\mu\text{s}$		173		nS
Reverse Recovery Charge	Q_{rr}			1.13		μC
Peak Reverse Recovery Current	I_{rrm}			13		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

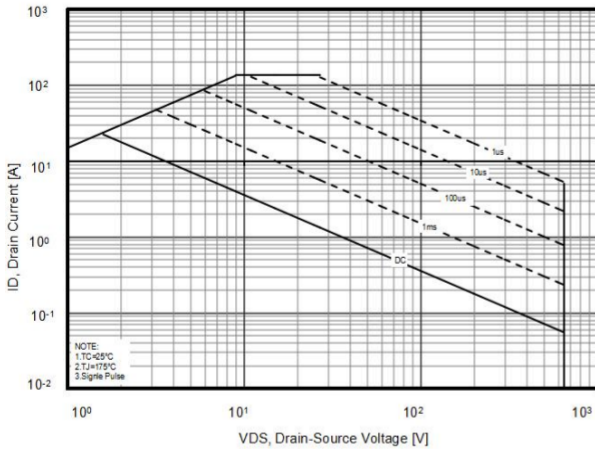


Figure2. Capacitance

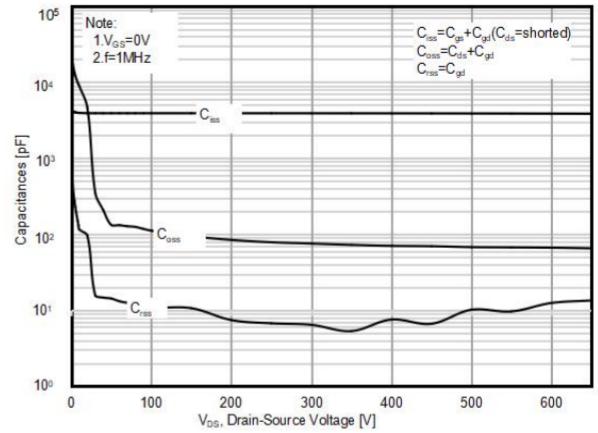


Figure3. Source-Drain Diode Forward Voltage

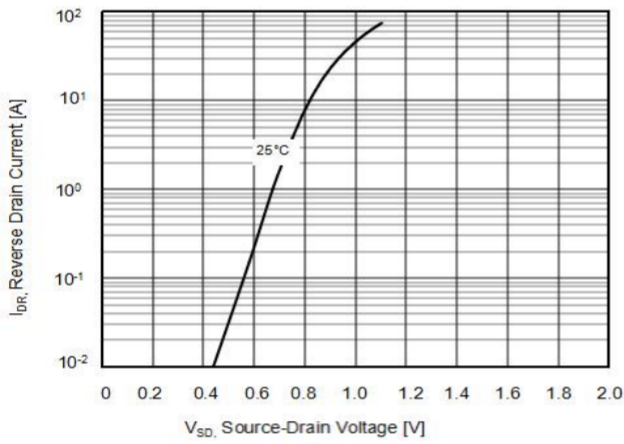


Figure4. Output characteristics

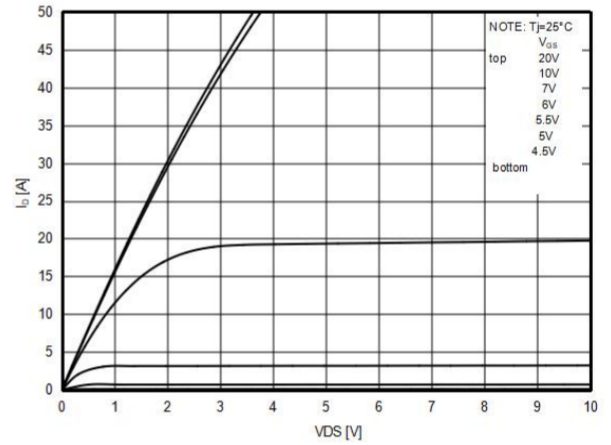


Figure5. $R_{DS(ON)}$ vs Junction Temperature

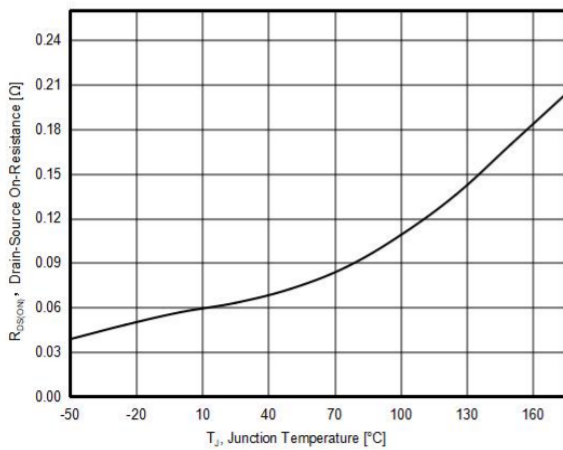


Figure6. BV_{DSS} vs Junction Temperature

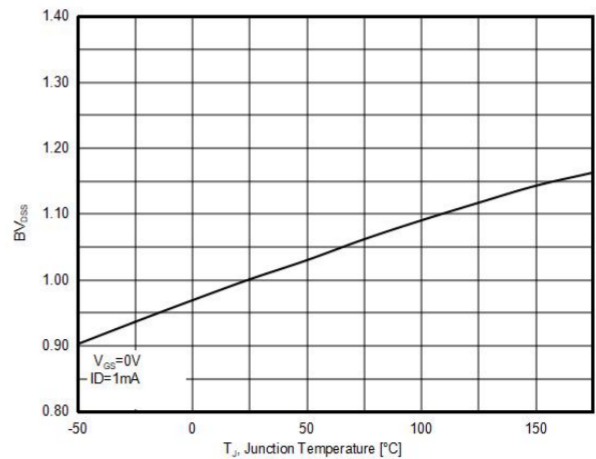


Figure7. Maximum I_D vs Junction Temperature

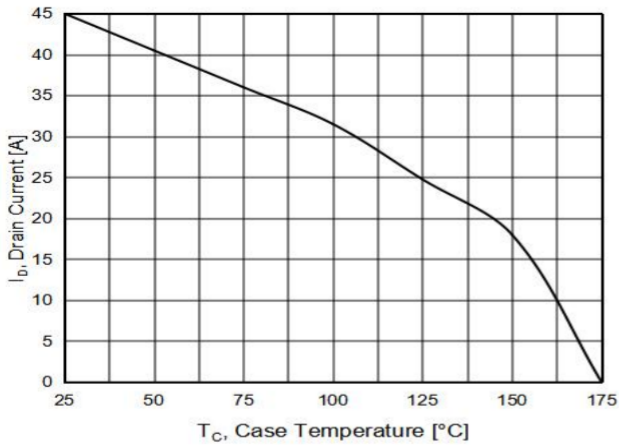


Figure8. Gate charge waveforms

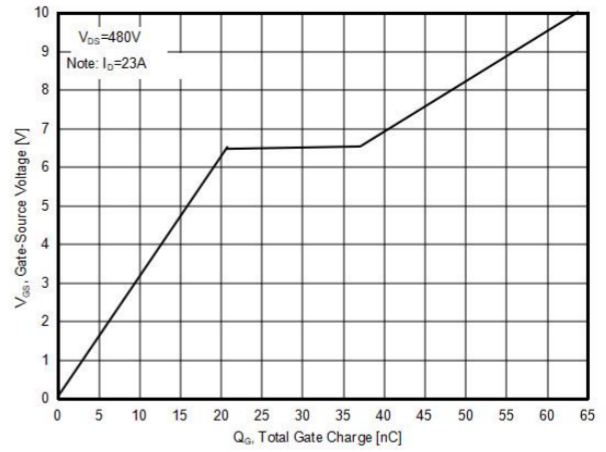


Figure9. Static drain-source on resistance

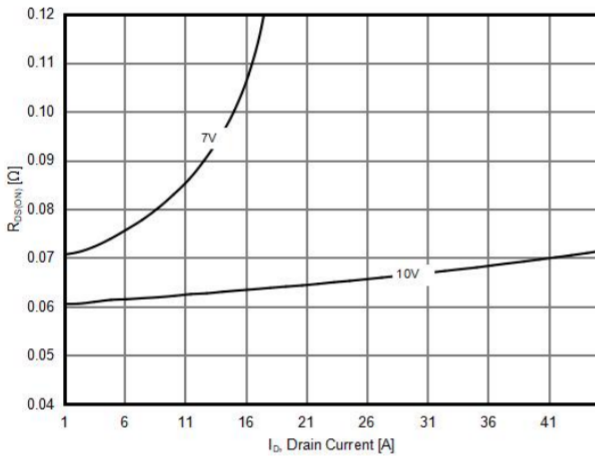
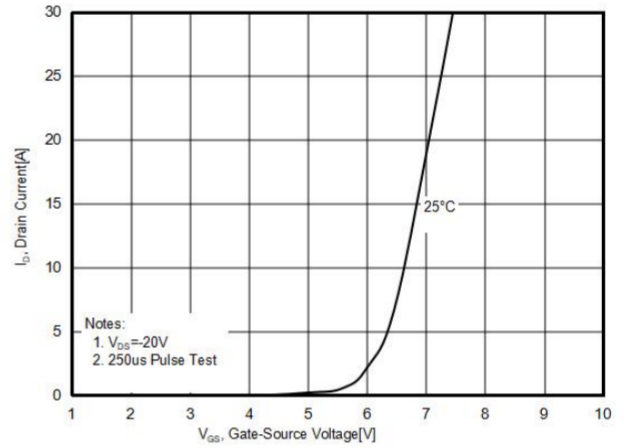
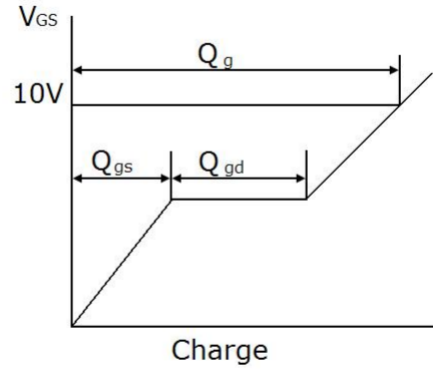
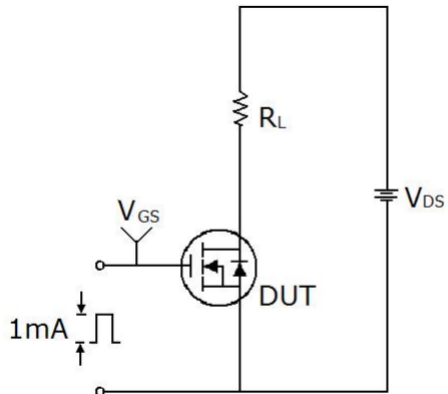


Figure10. Transfer characteristics

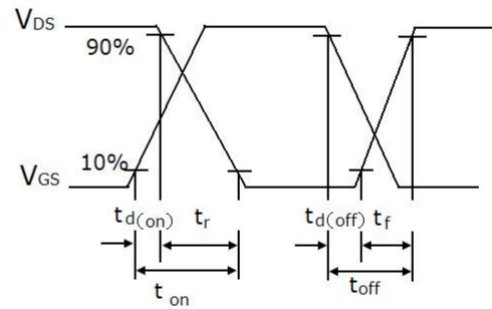
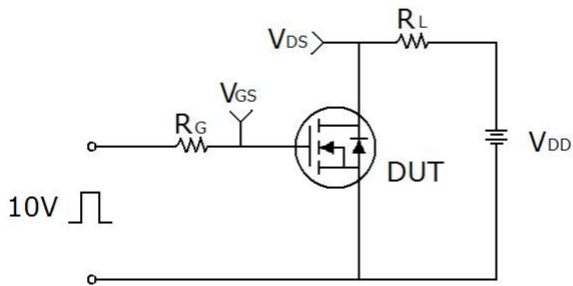


Test circuit

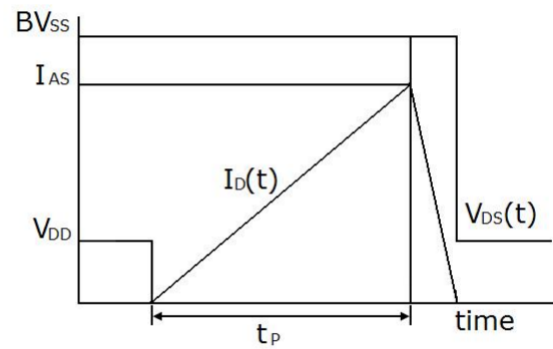
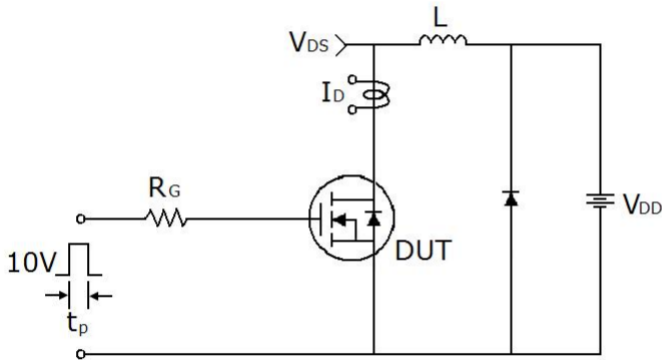
1) Gate charge test circuit & Waveform



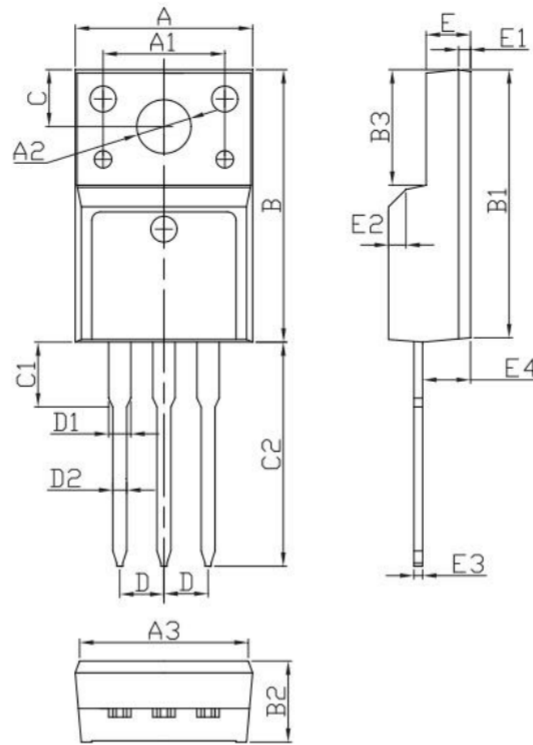
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

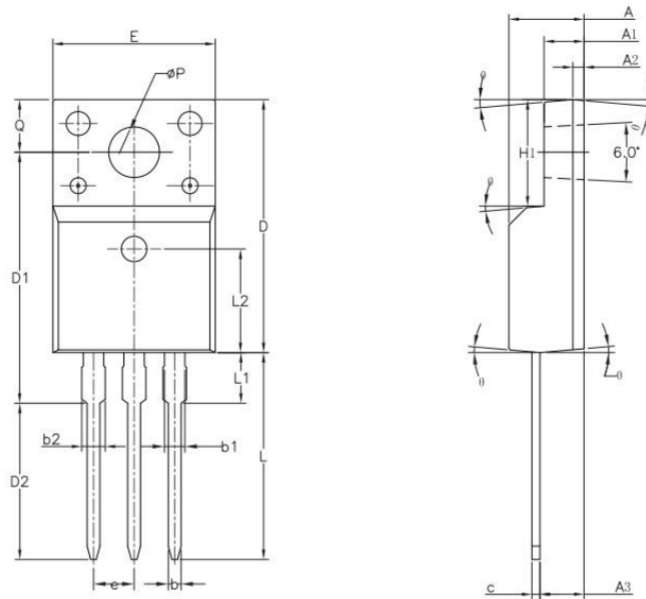


TO-220F-3L-L Package Information



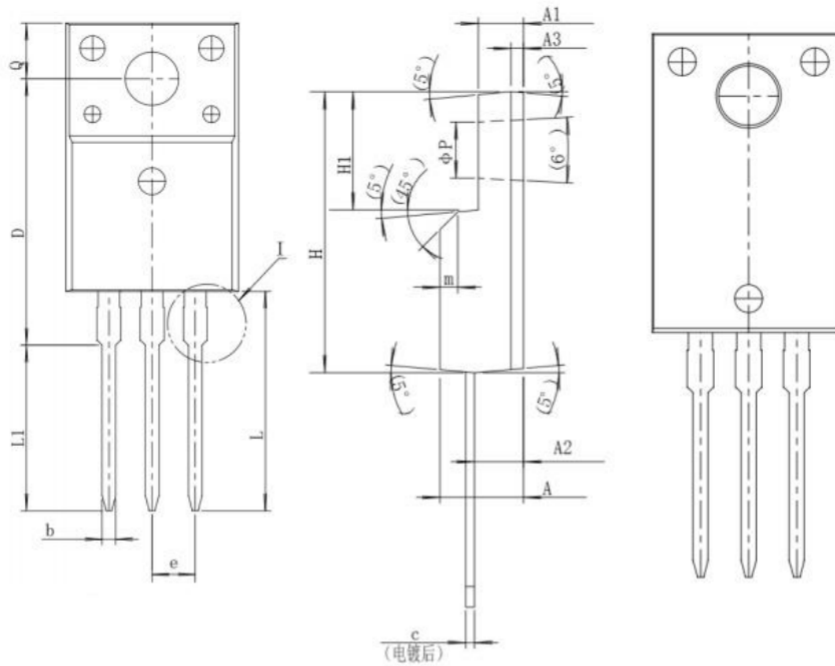
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.96	10.36	0.391	0.407
A1	6.85	7.15	0.269	0.281
A2	2.97	3.27	0.117	0.128
A3	9.50	9.90	0.373	0.389
B	15.70	16.10	0.617	0.633
B1	15.40	15.80	0.605	0.621
B2	4.50	4.90	0.177	0.193
B3	6.50	6.90	0.255	0.271
C	3.10	3.50	0.122	0.138
C1	3.05	3.45	0.120	0.136
C2	12.80	13.20	0.503	0.519
D	2.54 BSC		0.100 BSC	
D1	1.13	1.43	0.044	0.056
D2	0.65	0.95	0.026	0.037
E	2.35	2.75	0.092	0.108
E1	0.55	0.85	0.022	0.033
E2	45.0°		45.00°	
E3	0.35	0.65	0.014	0.026
E4	2.55	2.95	0.100	0.116

TO-220F-3L-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-3L-M Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.60	4.80	0.181	0.189
A1	2.44	2.64	0.096	0.104
A2	2.65	2.85	0.104	0.112
A3	0.70 REF		0.028 REF	
b	0.70	0.90	0.028	0.035
b2	1.18	1.39	0.046	0.055
b1	1.28	1.47	--	0.058
c	0.45	0.60	0.018	0.024
D	15.64	15.85	0.614	0.623
E	10.06	10.26	0.395	0.403
e	2.54 BSC		0.100 BSC	
H	15.77	15.97	0.620	0.627
H1	6.58	6.78	0.259	0.266
L	12.68	13.28	0.498	0.522
L1	9.60	10.00	0.377	0.393
ϕP	3.08	3.28	0.121	0.129
Q	3.20	3.40	0.126	0.134

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