

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.

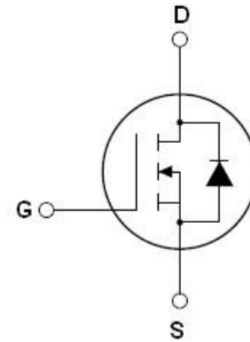
Features

- 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

$V_{DS\ min@T_{jmax}}$	650	V
$R_{DS(ON)TYP}$	145	mΩ
I_D	21	A
Qg	31	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF160K	TO-252	NCE60NF160K



TO-252

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	600	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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	21	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	14.7	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	63	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	194	W
Derate above 25°C		1.29	W/ $^\circ\text{C}$
Avalanche current(Note 1)	I_{AS}	4	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	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}	0.77	$^{\circ}\text{C}/\text{W}$
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}	$V_{GS}=0V, I_D=250\mu\text{A}$	600			V
Zero Gate Voltage Drain Current($T_c=25^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			10	μA
Zero Gate Voltage Drain Current($T_c=125^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			400	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	3.5	4.2	5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=10.5A$		145	160	m Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0\text{MHz}$		1499	1700	pF
Output Capacitance	C_{oss}			80		pF
Reverse Transfer Capacitance	C_{rss}			3.0		pF
Total Gate Charge	Q_g	$V_{DS}=400V, I_D=10A,$ $V_{GS}=10V$		31.6		nC
Gate-Source Charge	Q_{gs}			12.4		nC
Gate-Drain Charge	Q_{gd}			11.4		nC
Gate plateau voltage	V_{gp}			7.2		V
Intrinsic gate resistance	R_G	$f = 1 \text{ MHz open drain}$		2		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=10.5A,$ $R_G=1.7\Omega, V_{GS}=10V$		42		nS
Turn-on Rise Time	t_r			18		nS
Turn-Off Delay Time	$t_{d(off)}$			90		nS
Turn-Off Fall Time	t_f			24		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}\text{C}$			21	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				63	A
Forward On Voltage	V_{SD}	$T_J=25^{\circ}\text{C}, I_{SD}=21A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	t_{rr}	$T_J=25^{\circ}\text{C}, I_F=10.5A,$ $di/dt=100A/\mu\text{s}$		113		nS
Reverse Recovery Charge	Q_{rr}			0.5		μC
Peak Reverse Recovery Current	I_{rm}			8		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

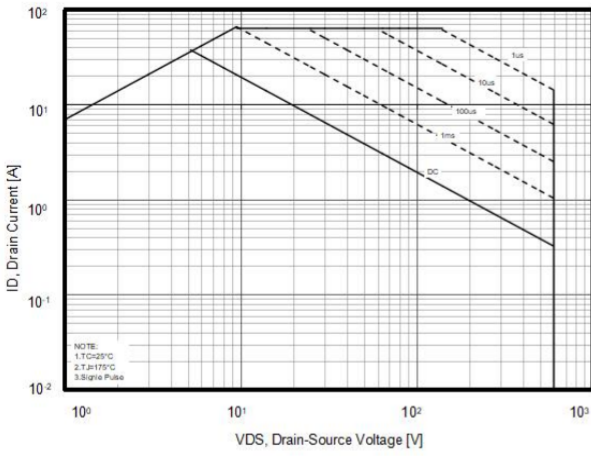


Figure2. Capacitance

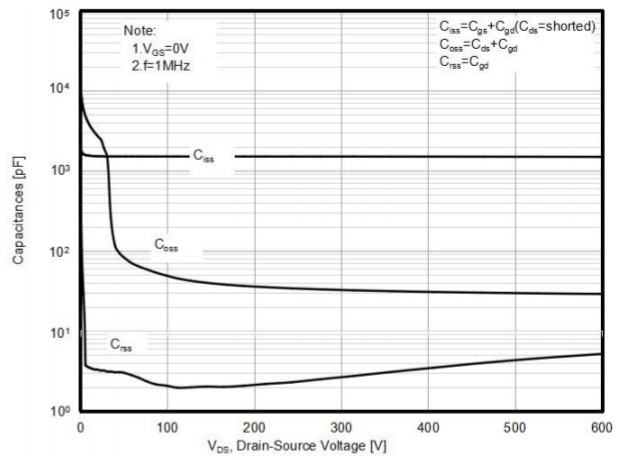


Figure3. Transfer characteristics

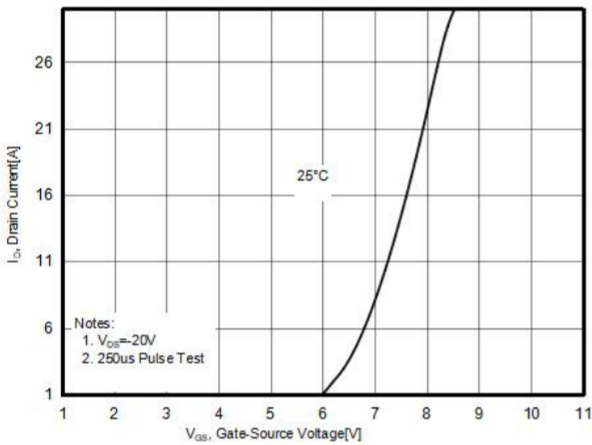


Figure4. Output characteristics

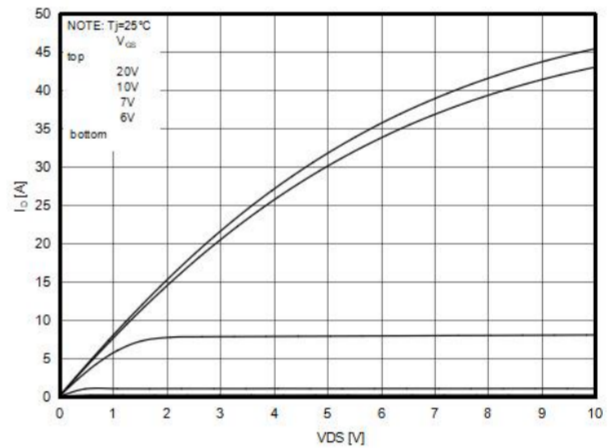


Figure5. RDS(ON) vs Junction Temperature

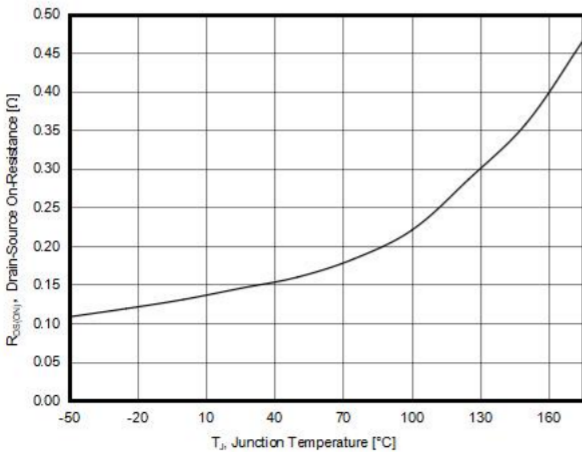


Figure6. BVDS vs Junction Temperature

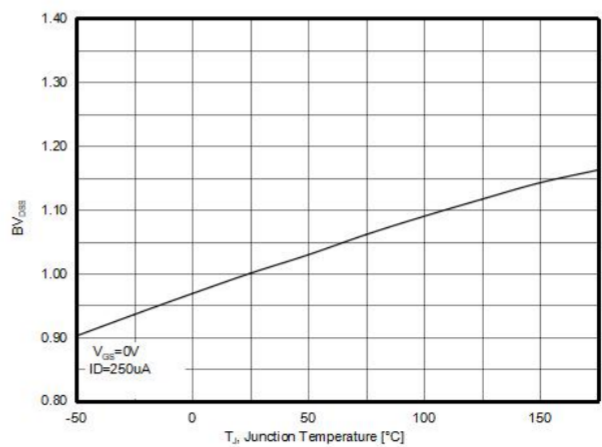


Figure7. Maximum I_D vs Junction Temperature

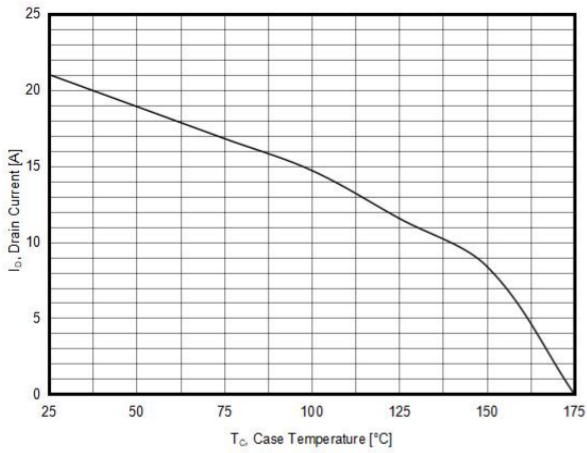


Figure8. Gate charge waveforms

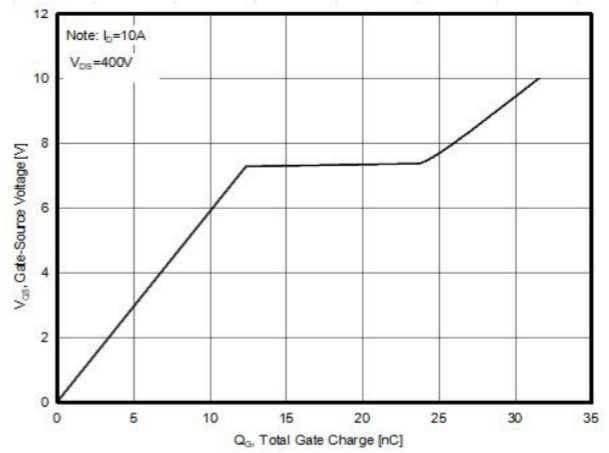


Figure9. Static drain-source on resistance

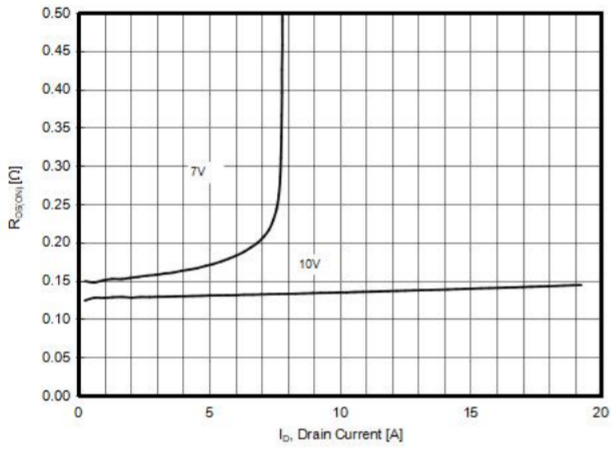
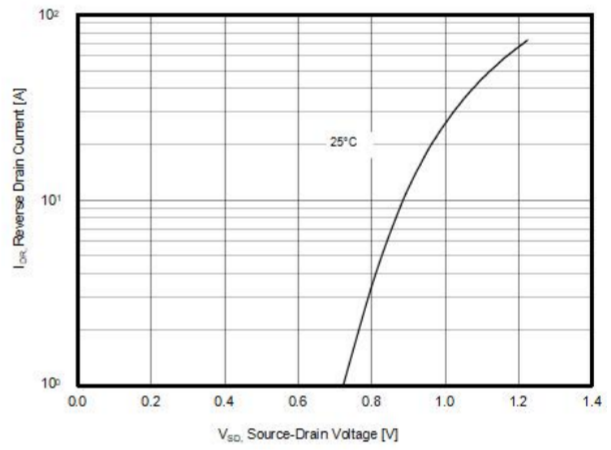
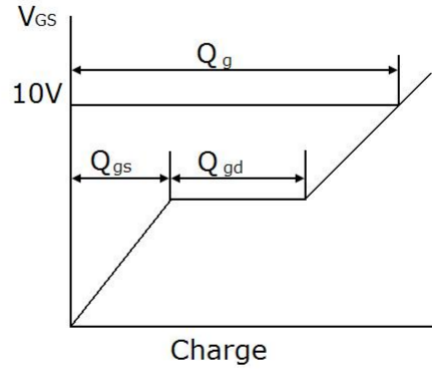
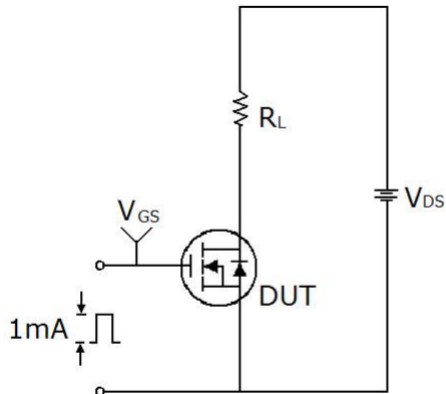


Figure10. Source-Drain Diode Forward Voltage

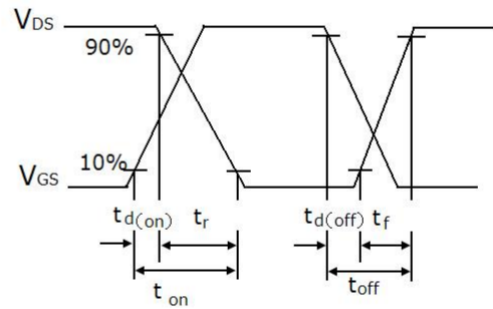
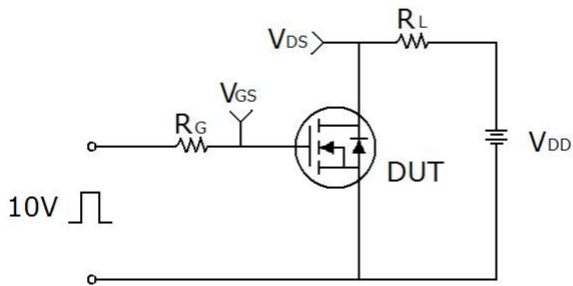


Test circuit

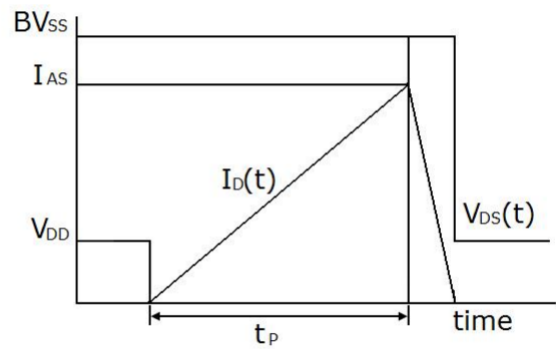
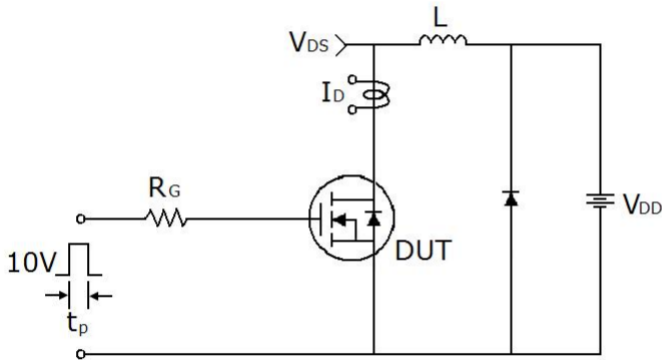
1) Gate charge test circuit & Waveform



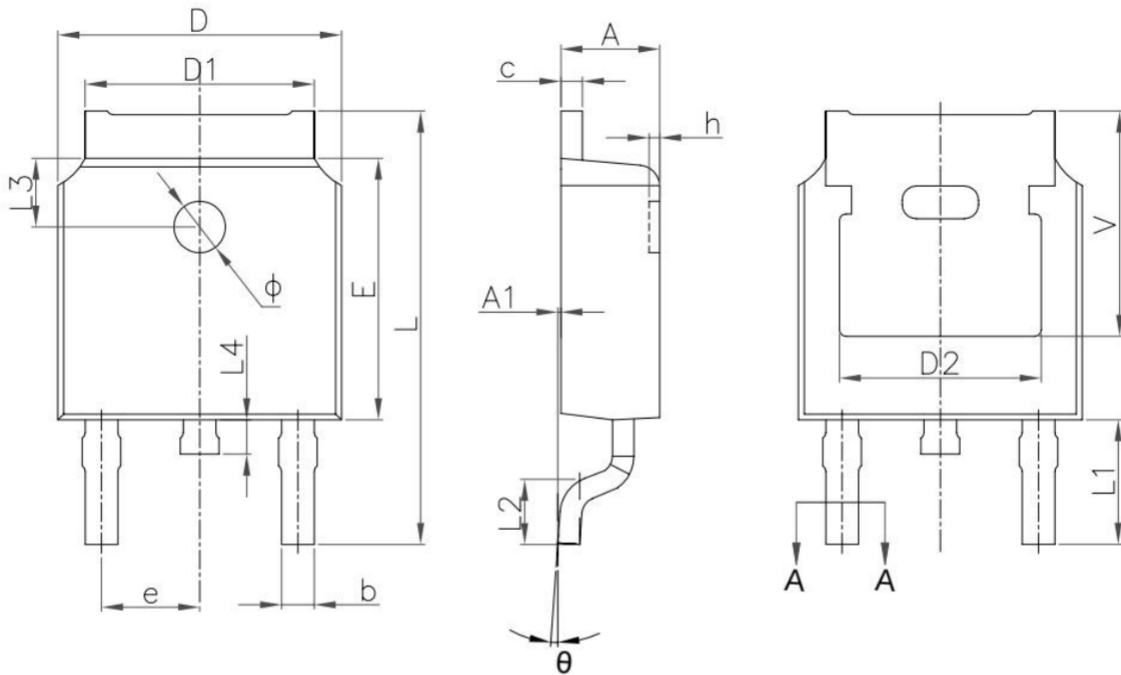
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

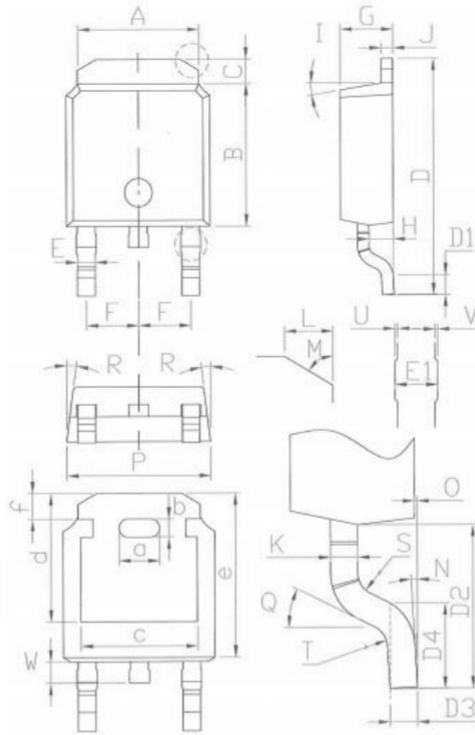


TO-252-E Package Information



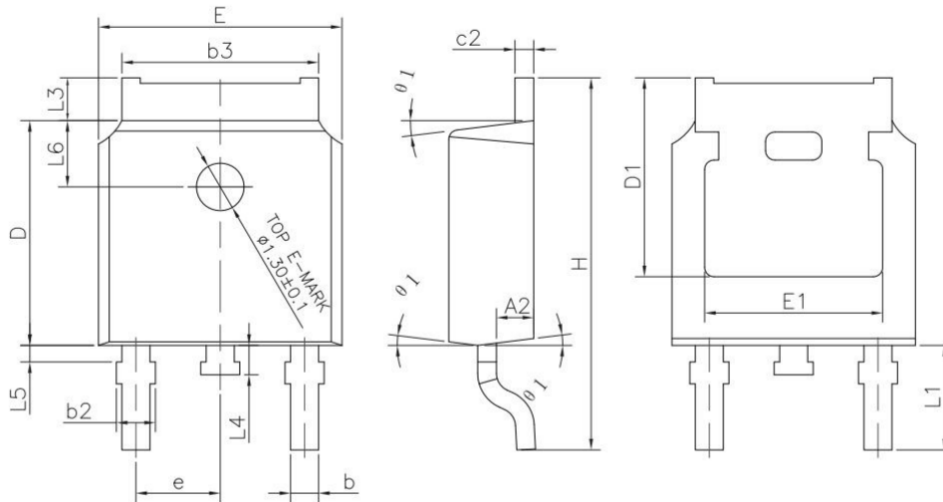
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.40	0.087	0.094
A1	0.00	0.13	0.000	0.005
b	0.66	0.86	0.026	0.033
b1	0.73	0.79	0.029	0.031
c	0.46	0.58	0.018	0.023
c1	0.50	0.52	0.020	0.020
D	6.50	6.70	0.256	0.264
D1	5.10	5.46	0.201	0.215
D2	4.83 REF		0.19REF	
E	6.00	6.20	0.236	0.244
e	2.19	2.39	0.086	0.094
L	9.80	10.40	0.386	0.409
L1	2.90 REF		0.11REF	
L2	1.40	1.70	0.055	
L3	1.60 REF		0.06REF	
L4	0.60	1.00	0.024	0.039
φ	1.10	1.30	0.043	0.051
θ	0°	8°	0°	8°
h	0.00	0.30	0.000	0.012

TO-252-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	5.14	5.54	0.202	0.218
B	5.80	6.20	0.228	0.244
C	0.85	1.25	0.033	0.049
D1	0.00	1.40	0.000	0.055
D2	2.75	3.05	0.108	0.120
D3	0.41	0.61	0.016	0.024
D4	1.35	1.65	0.053	0.065
E	0.66	0.86	0.026	0.034
E1	0.71	1.01	0.028	0.040
F	2.18	2.38	0.086	0.094
G	2.10	2.50	0.083	0.098
H	0.86	1.26	0.034	0.050
J	0.41	0.61	0.016	0.024
K	0.42	0.62	0.017	0.024
L	0.60	1.00	5.40	0.04
O	0.00	0.10	0.00	0.00
P	6.40	6.80	0.25	0.27
S	R0.40			
T	R0.40			
W	0.70	1.10	0.03	0.04

TO-252-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	2.2	2.38	0.087	0.094
A2	0.9	1.1	0.035	0.043
b	0.72	0.85	0.028	0.033
b1	0.71	0.81	0.028	0.032
b2	0.72	0.9	0.028	0.035
b3	5.13	5.46	0.202	0.215
c	0.47	0.6	0.019	0.024
c1	0.46	0.56	0.018	0.022
c2	0.47	0.6	0.019	0.024
D	6	6.2	0.236	0.244
D1	5.25		0.207	
E	6.5	6.7	0.256	0.264
E1	4.7		0.185	
e	2.186	2.386	0.086	0.094
H	9.8	10.4	0.386	0.409
L1	2.90 REF		0.114REF	
θ	0°	8°	0°	8°

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