

## 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.

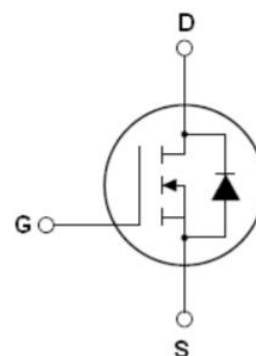
### Features

- 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
$R_{DS(ON)TYP.}$	580	mΩ
$I_D$	6.7	A
$Q_g$	11	nC



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60N640I	TO-251	NCE60N640I



TO-251

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	600	V
Gate-Source Voltage ( $V_{DS}=0V$ ), AC ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	V
Gate-Source Voltage ( $V_{DS}=0V$ ), DC	$V_{GS}$	$\pm 20$	V
Continuous Drain Current at $T_c=25^{\circ}\text{C}$	$I_{D(DC)}$	6.7	A
Continuous Drain Current at $T_c=100^{\circ}\text{C}$	$I_{D(DC)}$	4.69	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	20.1	A
Maximum Power Dissipation( $T_c=25^{\circ}\text{C}$ )	$P_D$	75	W
Derate above $25^{\circ}\text{C}$		0.5	W/ $^{\circ}\text{C}$
Avalanche current(Note 1)	$I_{AS}$	1.5	A
Reverse diode dv/dt, $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$	dv/dt	15	V/ns
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$	dv/dt	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+175	$^{\circ}\text{C}$

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	2	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}C/W$

**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 <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250uA	600			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V,V <sub>GS</sub> =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V,V <sub>GS</sub> =0V			50	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V			±200	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250uA	3	3.5	4	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =3.3A		580	640	mΩ
Dynamic Characteristics						
Gate Resistance	R <sub>g</sub>	F=1MHZ, D-S short		39		Ω
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V, F=1MHz		485		pF
Output Capacitance	C <sub>oss</sub>			12		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			3.72		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =400V,I <sub>D</sub> =3.3A, V <sub>GS</sub> =10V		11.0		nC
Gate-Source Charge	Q <sub>gs</sub>			3.3		nC
Gate-Drain Charge	Q <sub>gd</sub>			2.4		nC
Gate plateau voltage	V <sub>gp</sub>			4.9		V
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V,I <sub>D</sub> =3.3A, R <sub>G</sub> =4Ω,V <sub>GS</sub> =10V		13		nS
Turn-on Rise Time	t <sub>r</sub>			7		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			30		nS
Turn-Off Fall Time	t <sub>f</sub>			12		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			6.7	A
Pulsed-Source-drain current(Body Diode)	I <sub>SDM</sub>				20.1	A
Forward on voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃,I <sub>SD</sub> =6.7A,V <sub>GS</sub> =0V		0.9	1.1	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>j</sub> =25℃,I <sub>F</sub> =3.3A, di/dt=100A/μs		150		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.75		uC
Peak reverse recovery current	I <sub>rrm</sub>			10		A

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

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

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

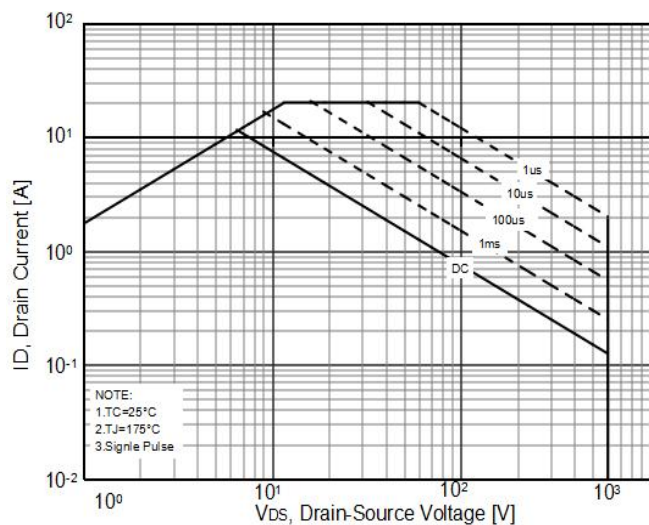


Figure2. Source-Drain Diode Forward Voltage

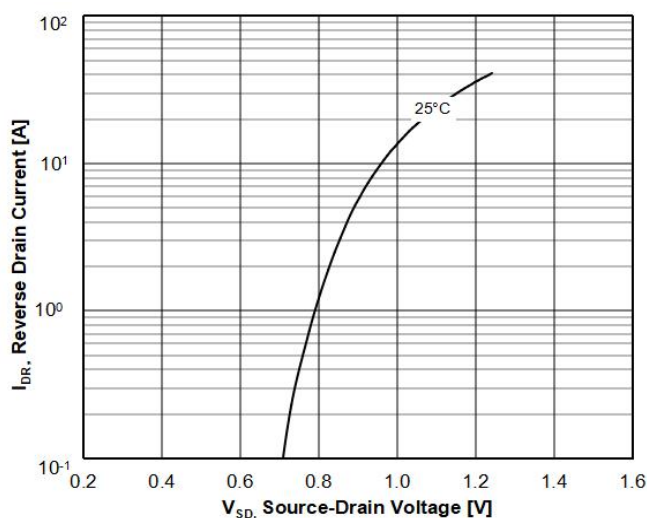


Figure3. Transfer characteristics

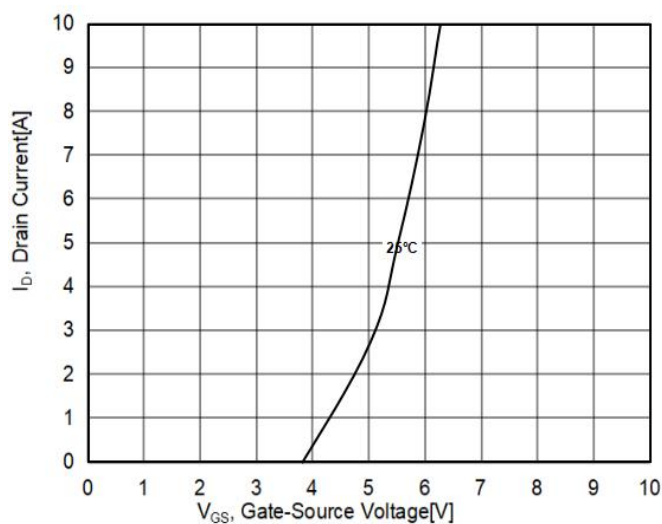


Figure4. Output characteristics

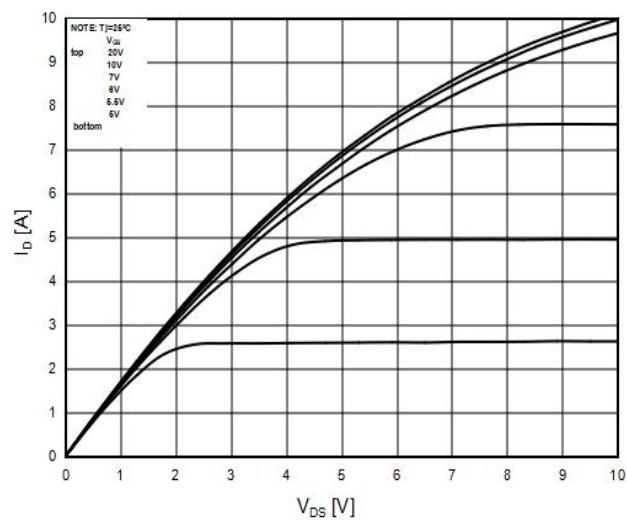


Figure5. Static drain-source on resistance

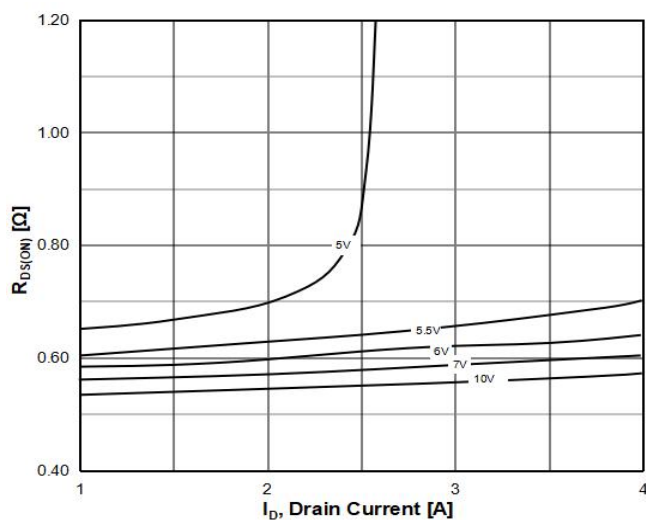
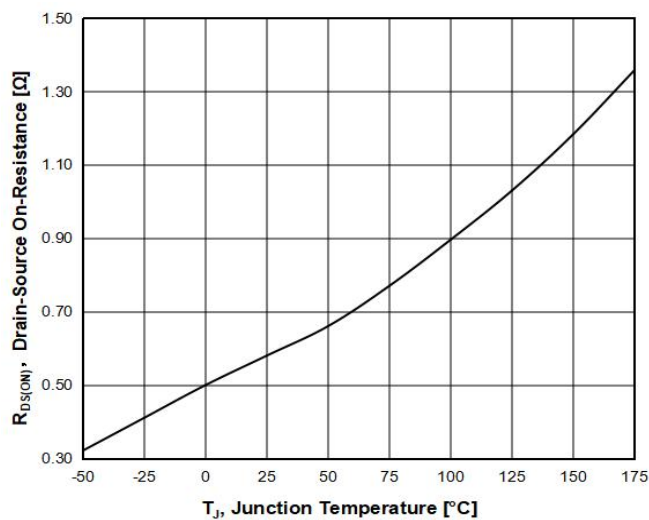
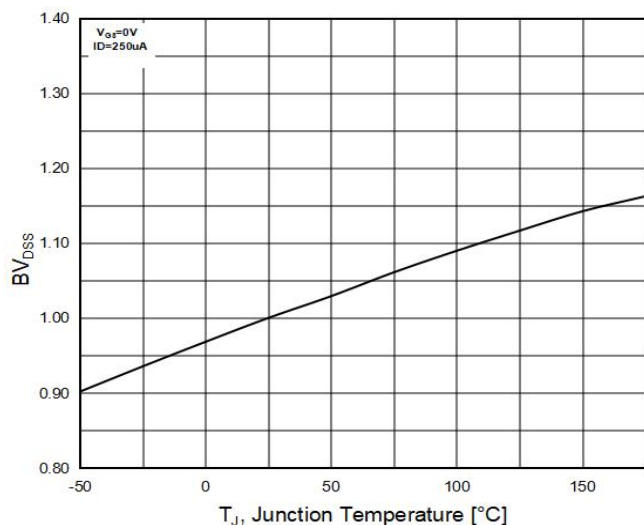


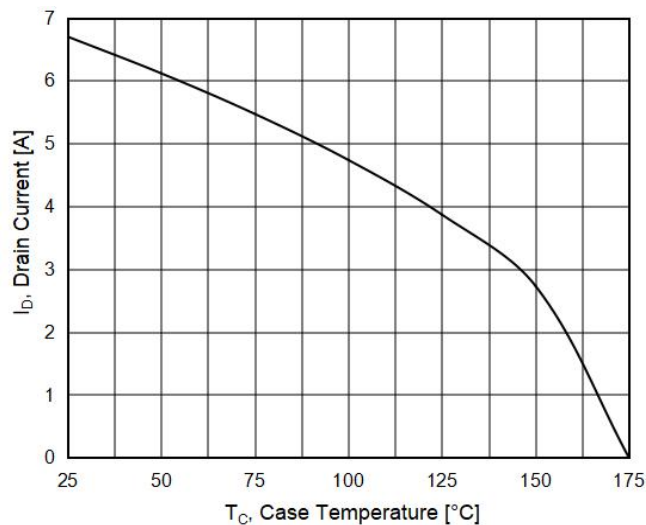
Figure6. RDS(on) vs Junction Temperature



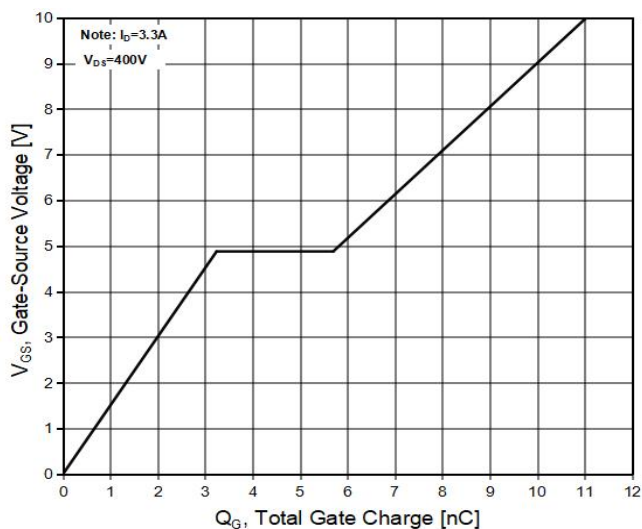
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



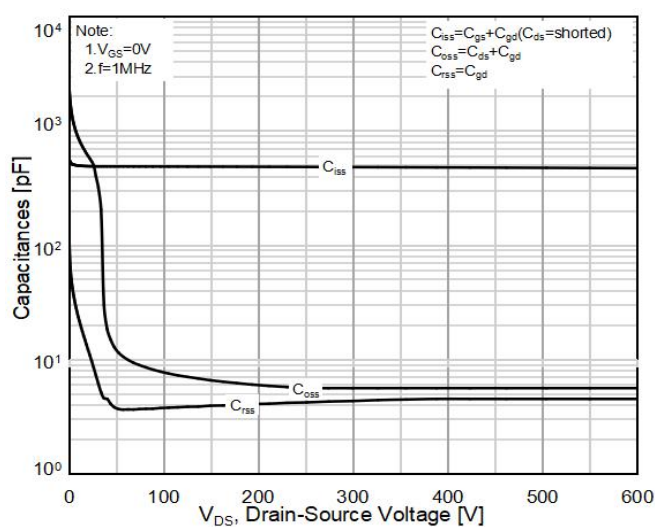
**Figure8. Maximum  $I_D$  vs Junction Temperature**



**Figure9. Gate charge waveforms**

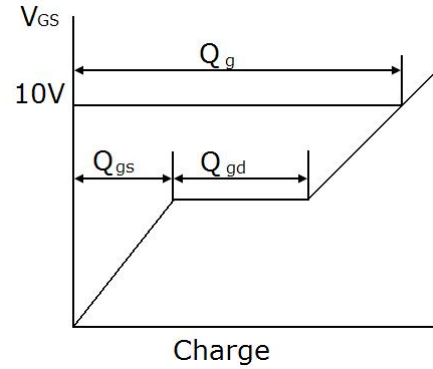
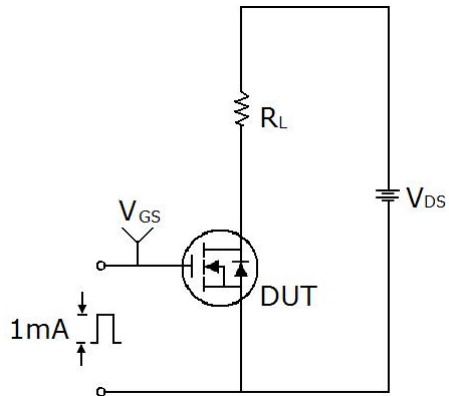


**Figure10. Capacitance**

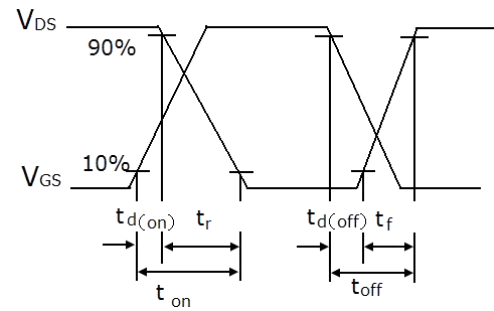


## Test circuit

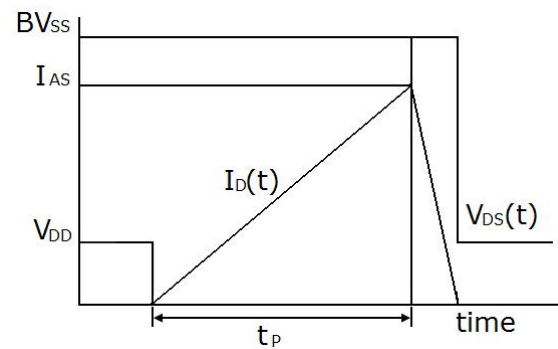
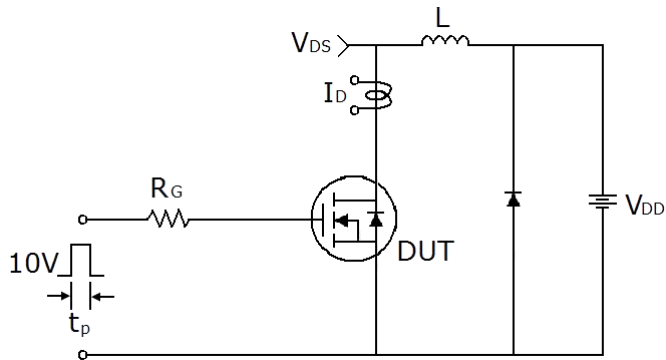
### 1) Gate charge test circuit & Waveform



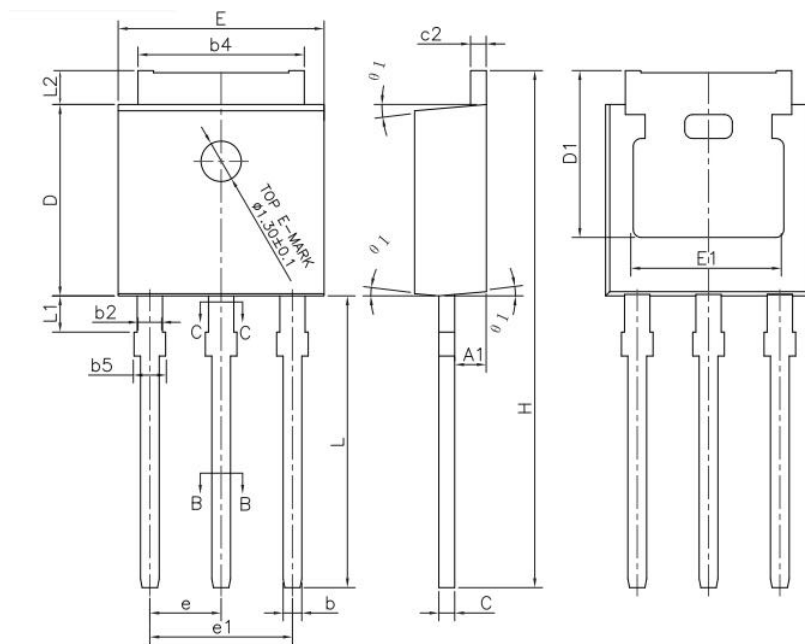
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

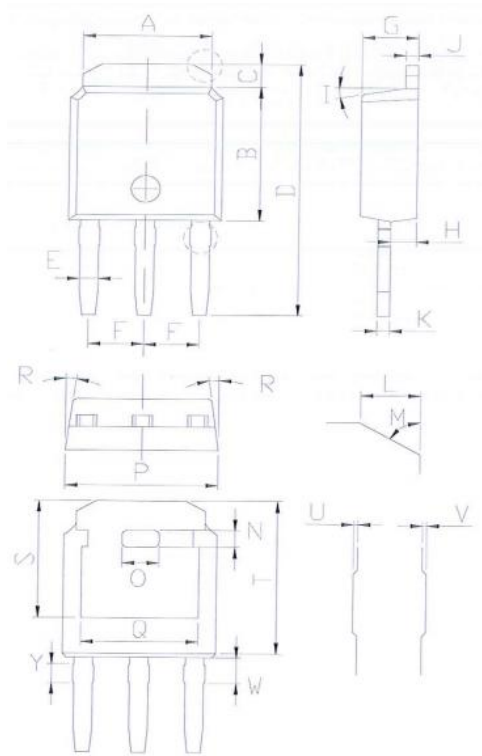


## TO-251-3L-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.35	0.087	0.093
A1	0.90	1.10	0.035	0.043
b	0.56	0.69	0.022	0.027
b1	0.55	0.65	0.022	0.026
b2	0.77	0.90	0.030	0.035
b3	0.76	0.86	0.030	0.034
b4	5.23	5.43	0.206	0.214
b5		1.05		0.041
c	0.46	0.59	0.018	0.023
c1	0.45	0.55	0.018	0.022
c2	0.46	0.59	0.018	0.023
D	6.00	6.20	0.236	0.244
D1	5.20		0.205	
E	6.50	6.70	0.256	0.264
E1	4.60	5.00	0.181	0.197
e	2.24	2.34	0.088	0.092
e1	4.47	4.67	0.176	0.184
H	16.18	16.78	0.637	0.661
L	9.00	9.60	0.354	0.378
L1	0.95	1.35	0.037	0.053
L2	0.90	1.25	0.035	0.049

## TO-251-3L-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	5.04	5.64	0.198	0.222
B	5.70	6.30	0.224	0.248
C	0.75	1.35	0.030	0.053
D	11.01	11.61	0.433	0.457
E	0.61	0.91	0.024	0.036
F	2.13	2.43	0.084	0.096
G	2.00	2.60	0.079	0.102
H	0.76	1.36	0.030	0.054
J	0.36	0.66	0.014	0.026
K	0.37	0.67	0.015	0.026
L	0.50	1.10	0.020	0.043
N	0.45	1.05	0.018	0.041
O	1.50	2.10	0.059	0.083
P	6.30	6.90	0.248	0.272
Q	4.55	5.15	0.179	0.203
S	5.00	5.60	0.197	0.220
T	6.60	7.20	0.260	0.283
W	0.90	1.40	0.035	0.055
Y	0.60	1.10	0.024	0.043

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