

N-Channel Super Junction Power MOSFET IV

General Description

The series of devices use advanced trench gate super junction technology and design to provide ultra-low $R_{DS(ON)}$ and low gate charge and With a rapid recovery body diode. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, industrial power applications, Fast charger, new energy vehicle charging pile, on-board OBC etc.

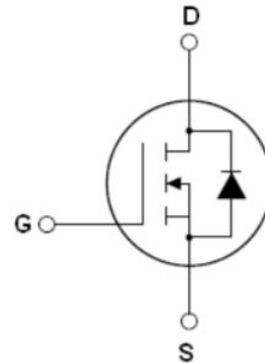
Features

- New technology for high voltage device
- Ultra low on-resistance and ultra low conduction losses
- Ultra Low Gate Charge cause lower driving requirements
- Diode reverse recovery speed is super fast
- 100% Avalanche Tested and 100% T_{rr} Tested
- High reliability
- ROHS compliant

Application

- Power factor correction (PFC)
- Switched mode power supplies (SMPS)
- Uninterruptible Power Supply (UPS)
- On-board charger (OBC)

$V_{DS, min@T_{jmax}}$	650	V
$R_{DS(ON)TYP.}$	23	m Ω
I_D	73	A
Q_g	135	nC

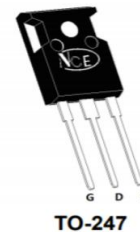


✧ Intrinsic fast-recovery body diode

Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF031T	TO-247	NCE60NF031T



TO-247

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 ($f>1$ Hz)	V_{GS}	± 30	V
Gate-Source Voltage ($V_{DS}=0V$), DC	V_{GS}	± 20	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	73	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	51	A
Pulsed drain current (Note 1)	I_{DM} (pluse)	219	A
Maximum Power Dissipation ($T_c=25^\circ\text{C}$)	P_D	490	W
Derate above 25°C		3.2	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	E_{AS}	484	mJ
Single pulse avalanche current (Note 2)	I_{AS}	11	A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.9	mJ

Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	dv/dt	50	V/ns
Drain Source voltage slope, $V_{DS} \leq 480V$	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}	0.31	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	°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_{DSS}	$V_{GS}=0V, I_D=1mA$	600			V
Zero Gate Voltage Drain Current($T_c=25^\circ C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			5	μA
Zero Gate Voltage Drain Current($T_c=125^\circ C$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			400	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 200	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=3mA$	3	4	5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=37A$		23	31	m Ω
Dynamic Characteristics						
Gate Resistance	R_g	F=1MHZ, D-S short		3.5		Ω
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ F=1MKHZ		8000		pF
Output Capacitance	C_{oss}			249		pF
Reverse Transfer Capacitance	C_{riss}			15		pF
Total Gate Charge	Q_g	$V_{DS}=400V, I_D=40A, V_{GS}=10V$		135	145	nC
Gate-Source Charge	Q_{gs}			54		nC
Gate-Drain Charge	Q_{gd}			46		nC
Gate plateau voltage	V_{gp}			7		V
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=40A,$ $R_G=4\Omega, V_{GS}=10V$		55		nS
Turn-on Rise Time	t_r			16		nS
Turn-Off Delay Time	$t_{d(off)}$			125		nS
Turn-Off Fall Time	t_f			11		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_c=25^\circ C$			73	A
Pulsed-Source-drain current(Body Diode)	I_{SDM}				219	A
Forward on voltage	V_{SD}	$T_j=25^\circ C, I_{SD}=73A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	t_{rr}	$T_j=25^\circ C, I_F=40A,$ $di/dt=100A/\mu s$		170		nS
Reverse Recovery Charge	Q_{rr}			1.3		μC
Peak reverse recovery current	I_{rrm}			15.5		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

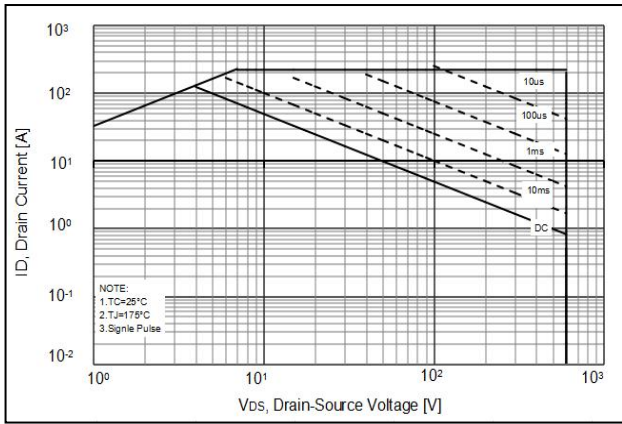


Figure2. Source-Drain Diode Forward Voltage

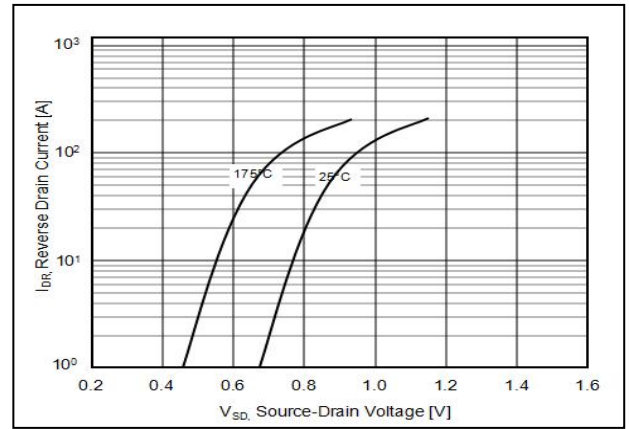


Figure3. Output characteristics

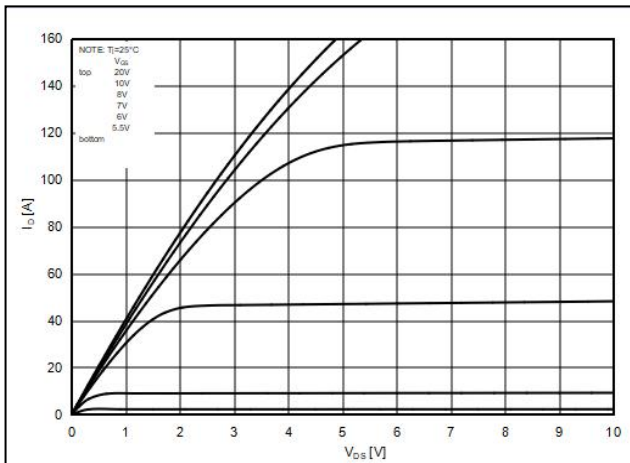


Figure4. Transfer characteristics

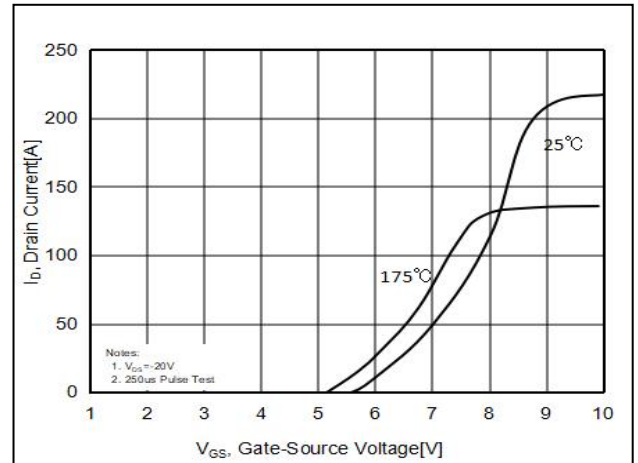


Figure5. Static drain-source on resistance

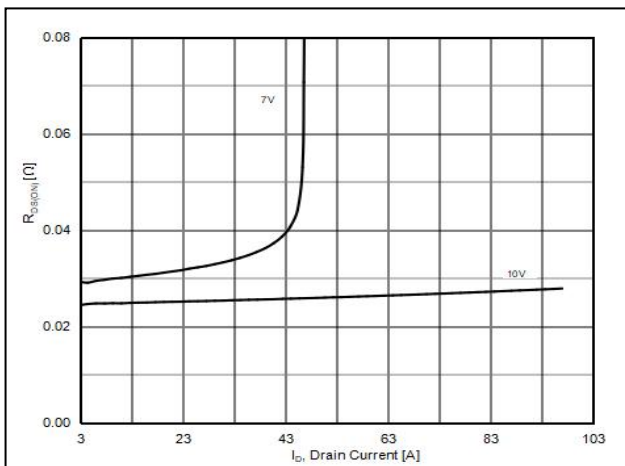


Figure6. $R_{DS(ON)}$ vs Junction Temperature

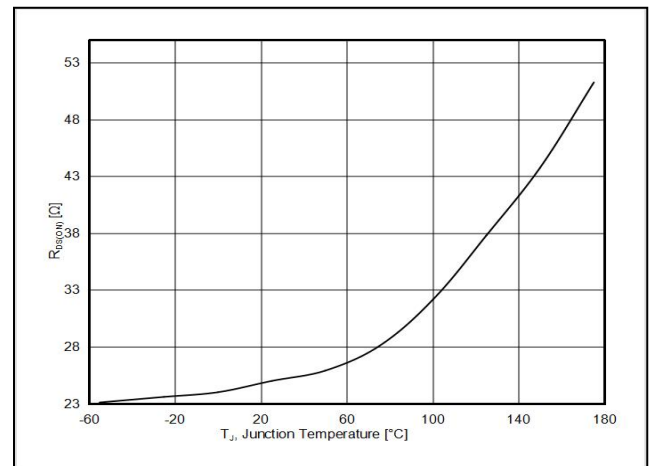


Figure7. BV_{DSS} vs Junction Temperature

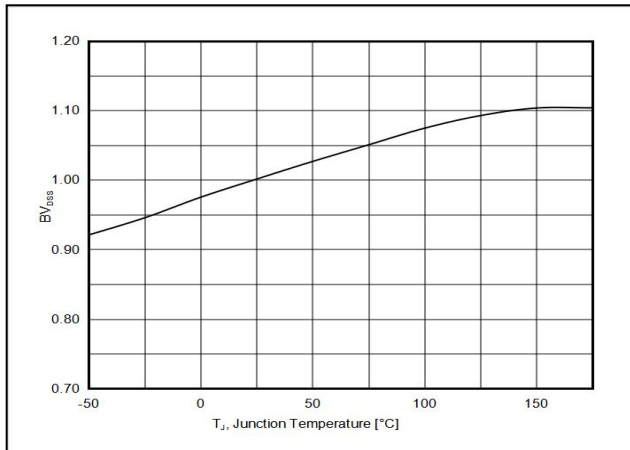


Figure8. Maximum I_D vs Junction Temperature

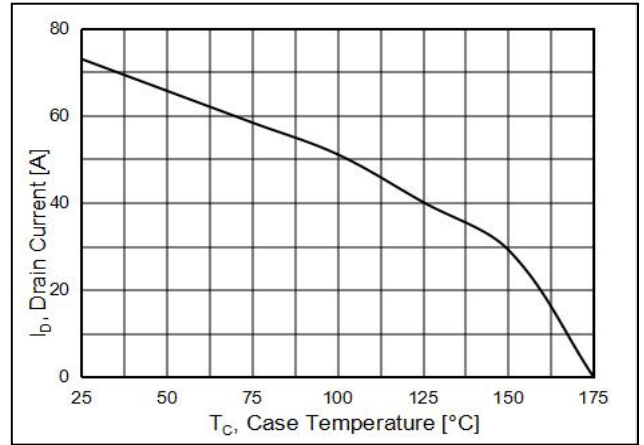


Figure9. Gate charge waveforms

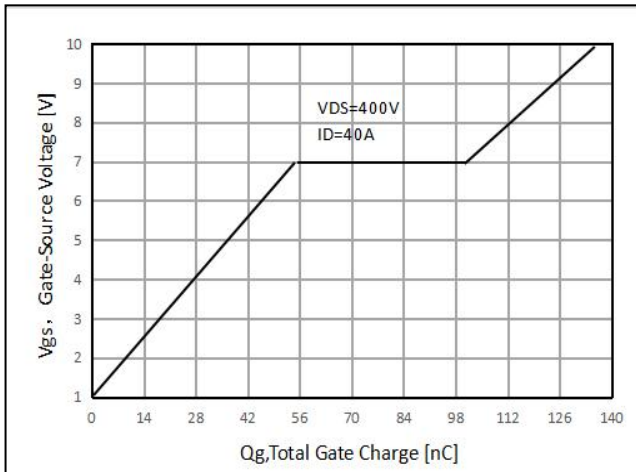
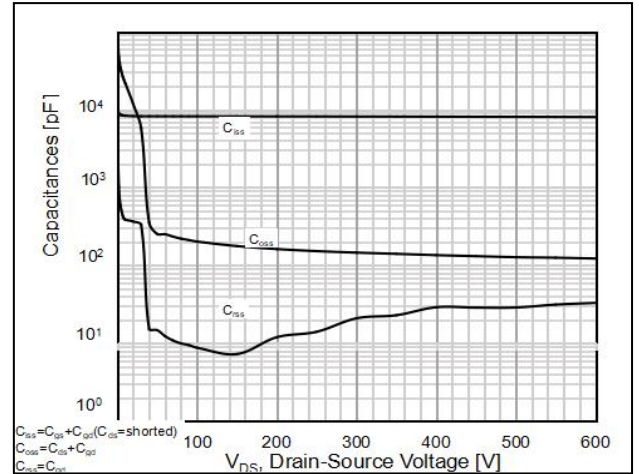
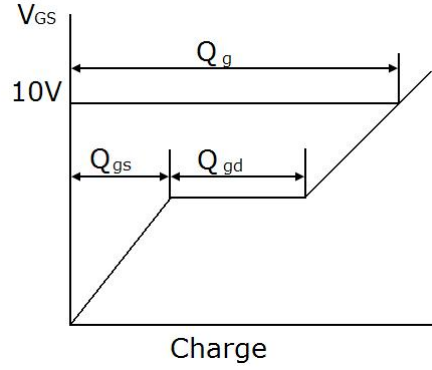
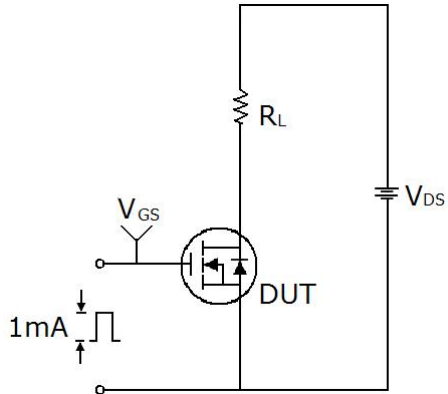


Figure10. Capacitance

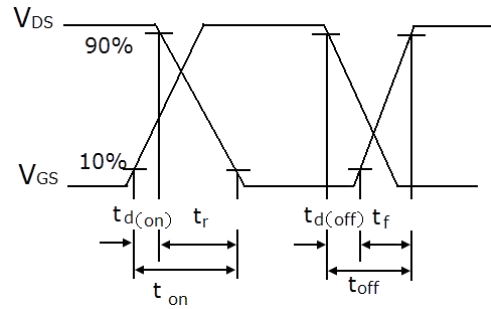
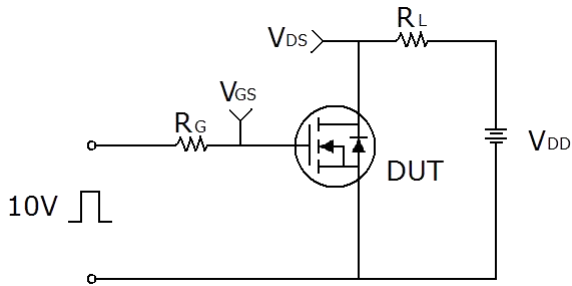


Test circuit

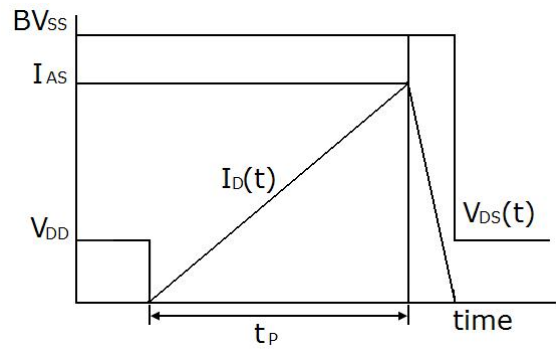
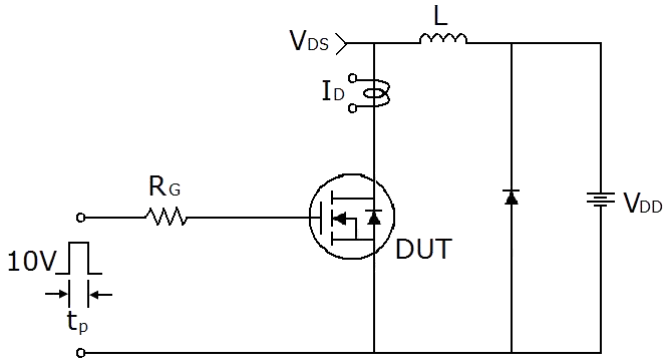
1) Gate charge test circuit & Waveform



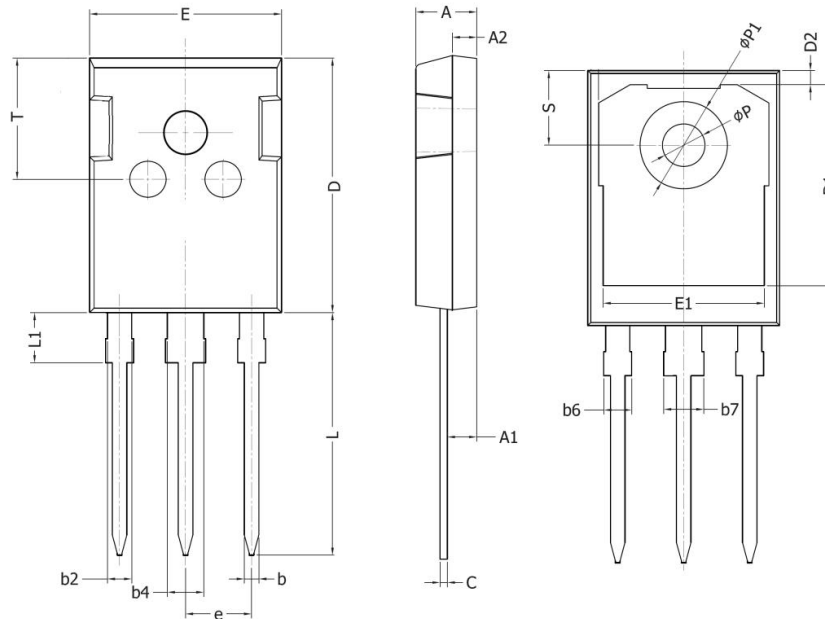
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

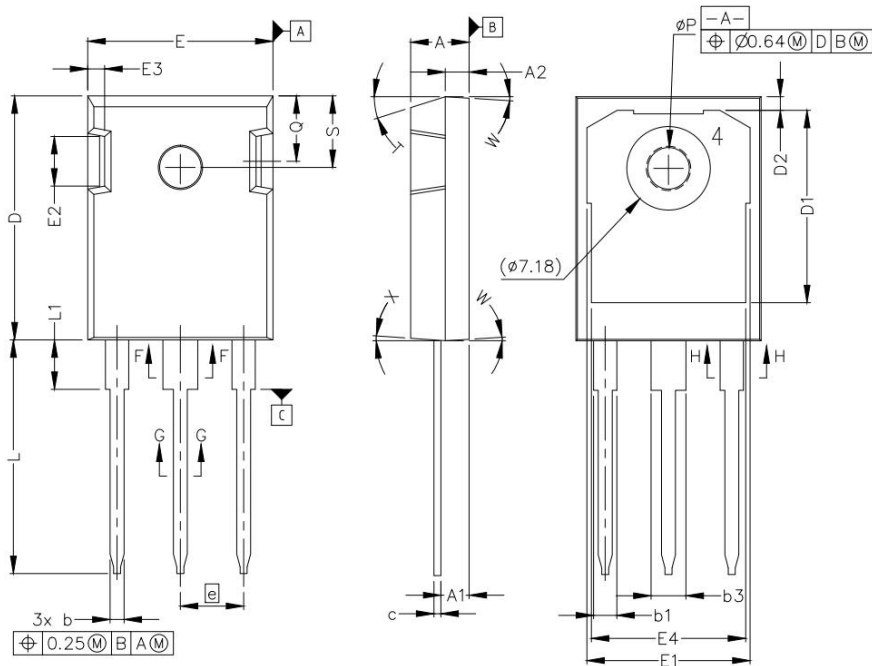


TO-247 (P) Package Information



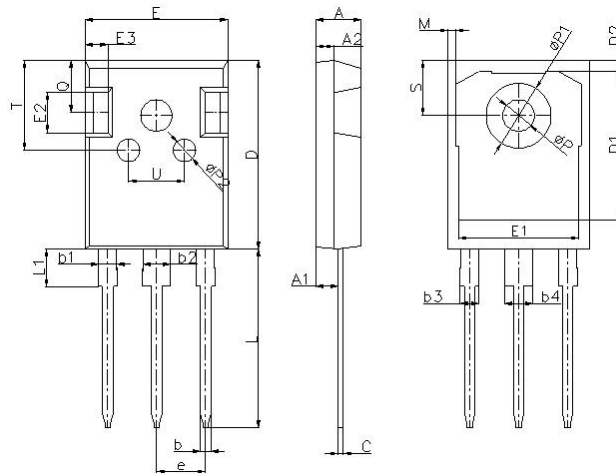
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b2	1.96	2.06	0.077	0.081
b4	2.96	3.06	0.117	0.120
b6	-	2.25	-	0.089
b7	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
e	5.436 BSC		0.214 BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402

TO-247-B Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.190	0.205
A1	2.29	2.54	0.090	0.100
A2	1.91	2.16	0.075	0.085
b	1.07	1.33	0.042	0.052
b1	1.91	2.41	0.075	0.095
b3	2.87	3.38	0.113	0.133
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.25	0.037	0.049
E	15.75	16.13	0.620	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	1.90	0.039	0.075
E4	12.38	13.43	0.487	0.529
e	5.44 BSC		0.214 BSC	
N	3.00		0.118	
L	19.81	20.32	0.780	0.800
L1	4.10	4.40	0.161	0.173
P	3.51	3.65	0.138	0.144
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

TO-247-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.077	0.081
b2	2.96	3.06	0.117	0.120
b3	-	2.25	-	0.089
b4	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
E2	4.40	4.60	0.173	0.181
E3	2.40	2.60	0.094	0.102
e	5.436BSC		0.214BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
M	0.35	0.95	0.014	0.037
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
P2	2.40	2.60	0.094	0.102
Q	5.60	6.00	0.220	0.236
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402
U	6.00	6.40	0.236	0.252

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