

650V N-Channel Mosfet

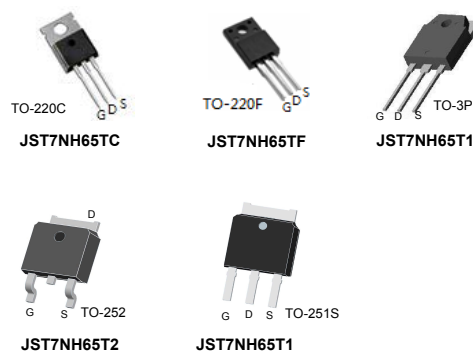
FEATURES

- $R_{DS(ON)} \leq 1.4\Omega$ (1.2Ω Typ.)
@ $V_{GS}=10V$

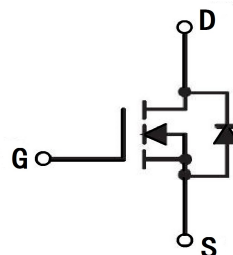
APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

TO-220C/TO-220F/TO-251/TO-252/TO-251S



N-CHANNEL MOSFET



Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter		Max.			Units
			TO-220F	TO-220C	TO-251/TO-252/ TO-251S	
V _{DSS}	Drain-Source Voltage		650			V
V _{GSS}	Gate-Source Voltage		±30			V
I _D	Continuous Drain Current	TC = 25 °C	7			A
		TC = 100 °C	4.5			A
I _{DM}	Pulsed Drain Current ^{note1}		28			A
E _{AS}	Single Pulsed Avalanche Energy ^{note2}		198			mJ
P _D	Power Dissipation	TC = 25 °C	63	97		W
R _{θJC}	Thermal Resistance, Junction to Case		1.98	1.29		°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient		62.5	60		°C/W
T _J , T _{STG}	Operating and Storage Temperature Range		-55 to +150			°C

ELECTRICAL CHARACTERISTICS $T_C=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
Off Characteristic						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V,I _D = 250μA	650	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650V, V _{GS} = 0V, T _J = 25℃	-	-	1	μA
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30V,V _{DS} = 0V	-	-	±100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} ,I _D = 250μA	2	-	4	V
R _{DS(on)}	Static Drain-Source On-Resistance ^{note3}	V _{GS} =10V, I _D =3.5A	-	1.2	1.4	Ω
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} =25V, V _{GS} = 0V f = 1.0MHz	-	891	-	pF
C _{oss}	Output Capacitance		-	110	-	pF
C _{rss}	Reverse Transfer Capacitance		-	14	-	pF
Q _g	Total Gate Charge	V _{DS} =520V, I _D =7A, V _{GS} =10V	-	22	-	nC
Q _{gs}	Gate-Source Charge		-	4.3	-	nC
Q _{gd}	Gate-Drain(“Miller”) Charge		-	13	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DS} =325V, R _G =25Ω I _D =7A	-	15	-	ns
t _r	Turn-On Rise Time		-	18	-	ns
t _{d(off)}	Turn-Off Delay Time		-	80	-	ns
t _f	Turn-Off Fall Time		-	35	-	ns
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain to Source Diode Forward Current	T _C = 25℃	-	-	7	A
I _{SM}	Pulsed Diode Forward Current	T _C = 25℃	-	-	28	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0V, I _{SD} =7A T _J = 25℃	-	-	1.4	V
t _{rr}	Reverse Recovery Time	I _S =7A,V _{GS} =0V di/dt = 100 A/μs	-	300	-	ns
Q _{rr}	Reverse Recovery Charge		-	4.1	-	uC

- Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $V_{DS} = 50V, R_G = 25\Omega, I_{AS} = 4.5A$, starting $T_J = 25^\circ\text{C}$.
3. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 1\%$

TYPICAL PERFORMANCE CHARACTERISTICS

Figure1: Output Characteristics

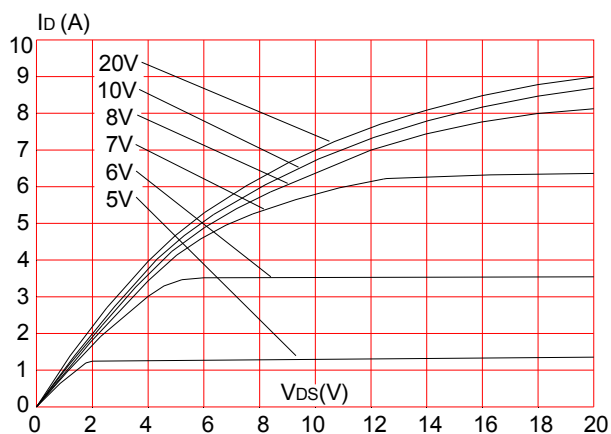


Figure 2: Typical Transfer Characteristics

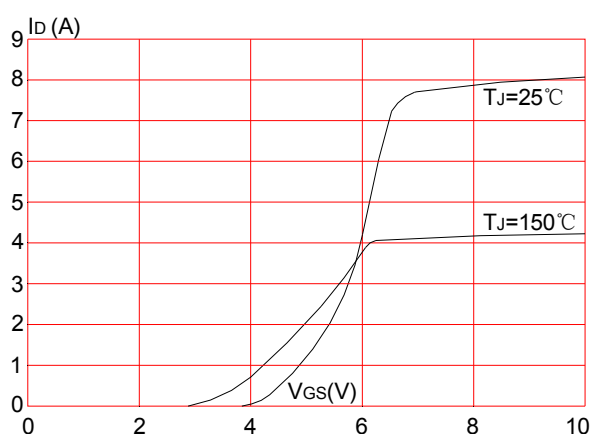


Figure 3: On-resistance vs. Drain Current

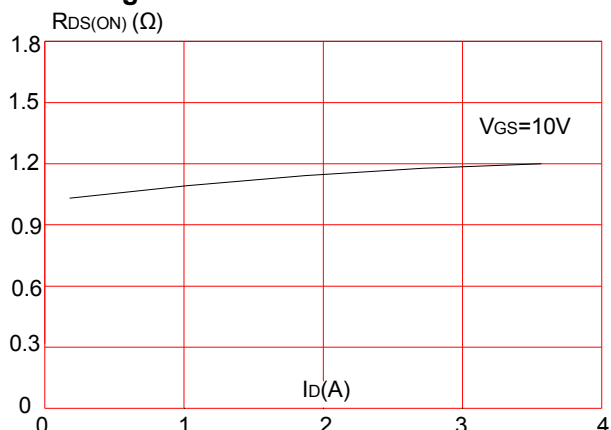


Figure 4: Body Diode Characteristics

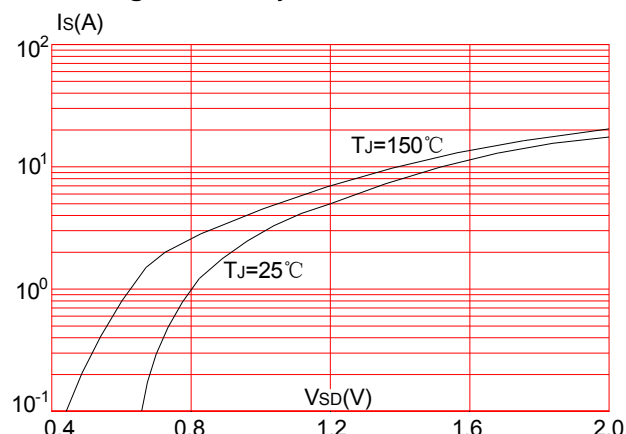


Figure 5: Gate Charge Characteristics

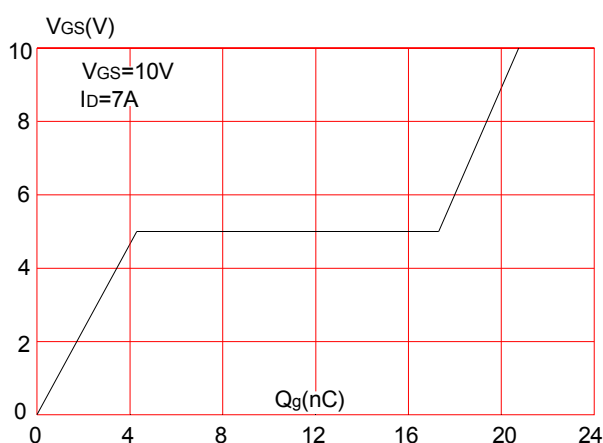
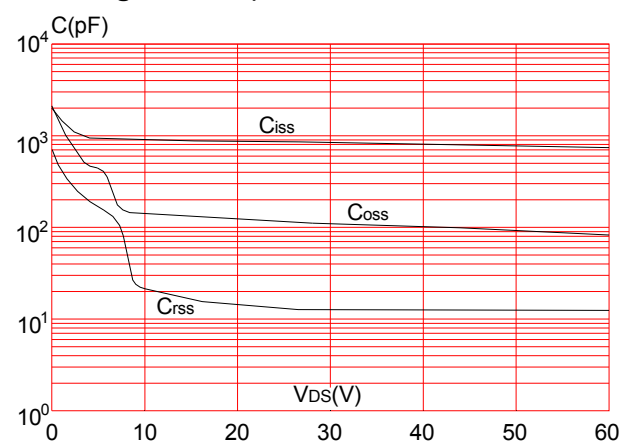


Figure 6: Capacitance Characteristics



TYPICAL PERFORMANCE CHARACTERISTICS (cont.)

Figure 7: Normalized Breakdown Voltage vs. Junction Temperature

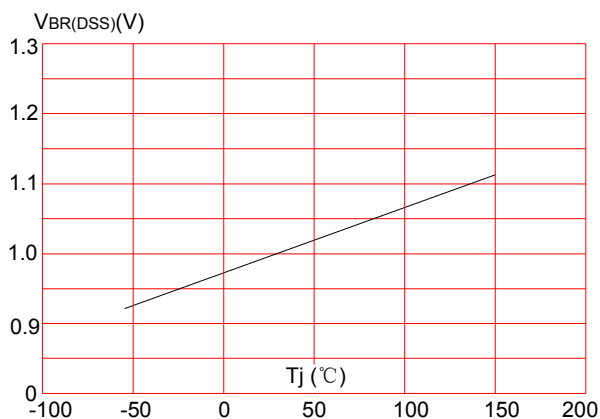


Figure 8: Normalized on Resistance vs. Junction Temperature

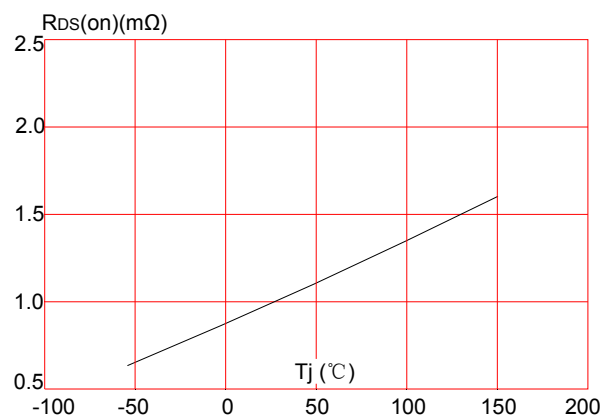


Figure 9: Maximum Safe Operating Area

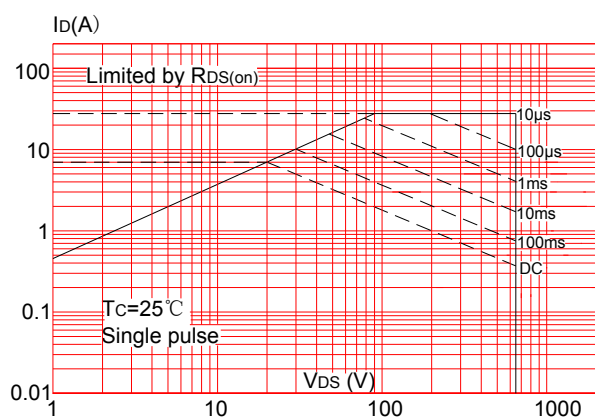


Figure 10: Maximum Continuous Drain Current vs. Case Temperature

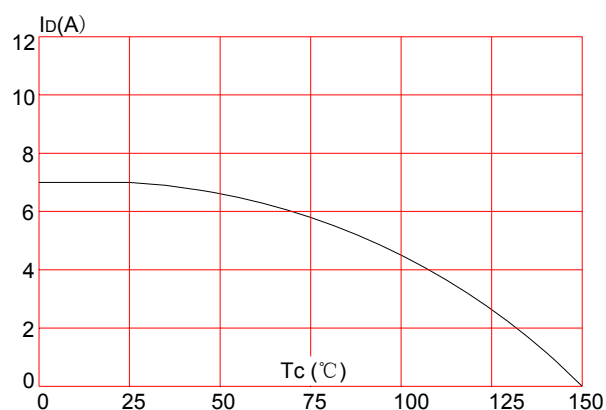


Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case (TO-220F)

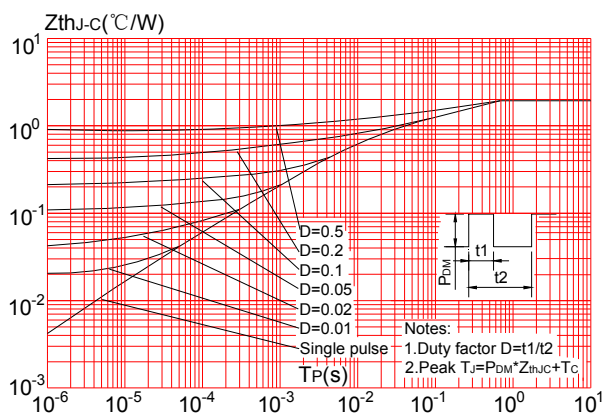
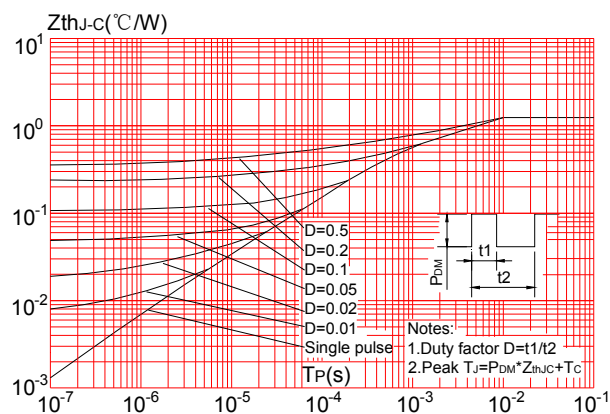
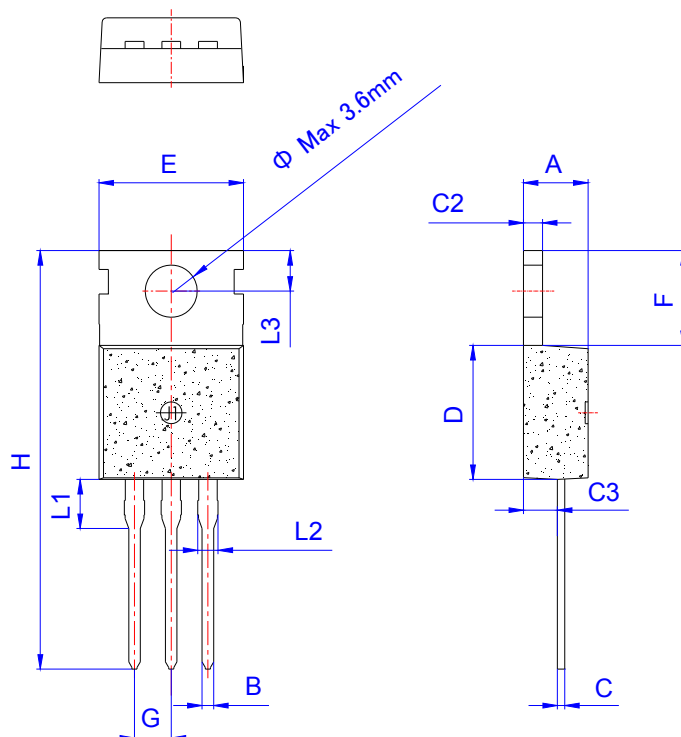


Figure.12: Maximum Effective Transient Thermal Impedance, Junction-to-Case (TO-220C, TO-251, TO-251S, TO-252)

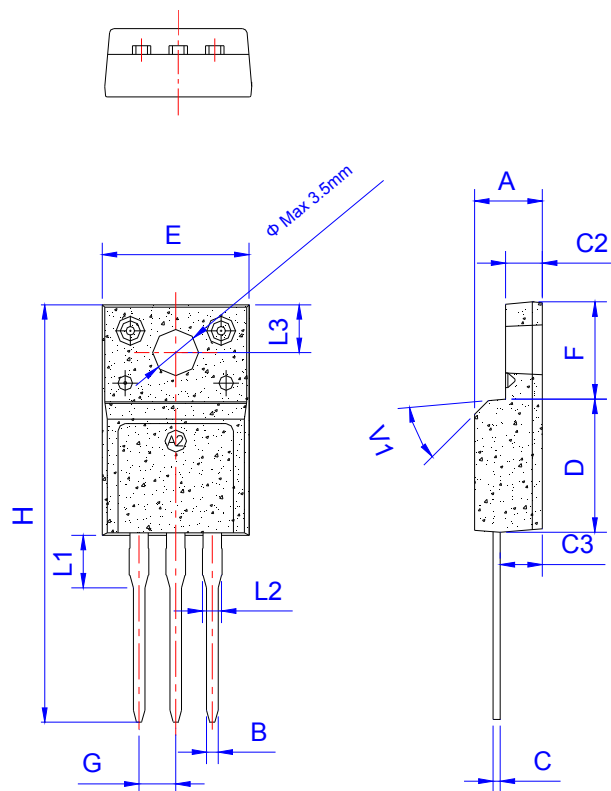


TO-220C PACKAGE OUTLINE DRAWING



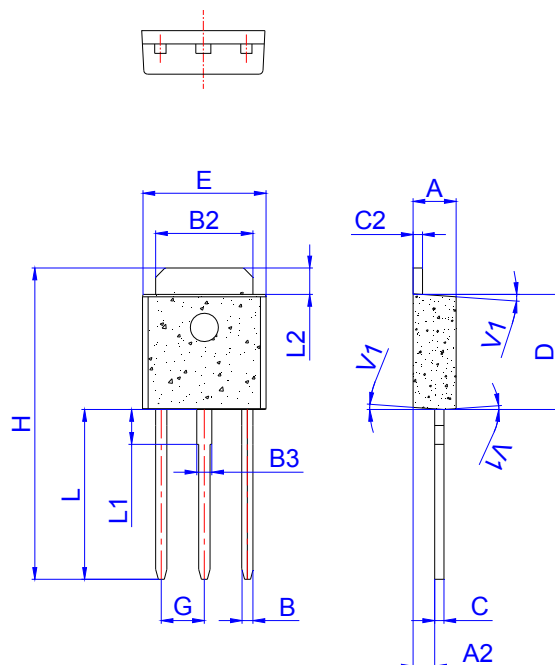
Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
B	0.70		0.90	0.028		0.035
C	0.45		0.60	0.018		0.024
C2	1.23		1.32	0.048		0.052
C3	2.20		2.60	0.087		0.102
D	8.90		9.90	0.350		0.390
E	9.90		10.3	0.390		0.406
F	6.30		6.90	0.248		0.272
G		2.54			0.1	
H	28.0		29.8	1.102		1.173
L1		3.39			0.133	
L2	1.14		1.70	0.045		0.067
L3	2.65		2.95	0.104		0.116
Φ		3.6			0.142	

TO-220F PACKAGE OUTLINE DRAWING



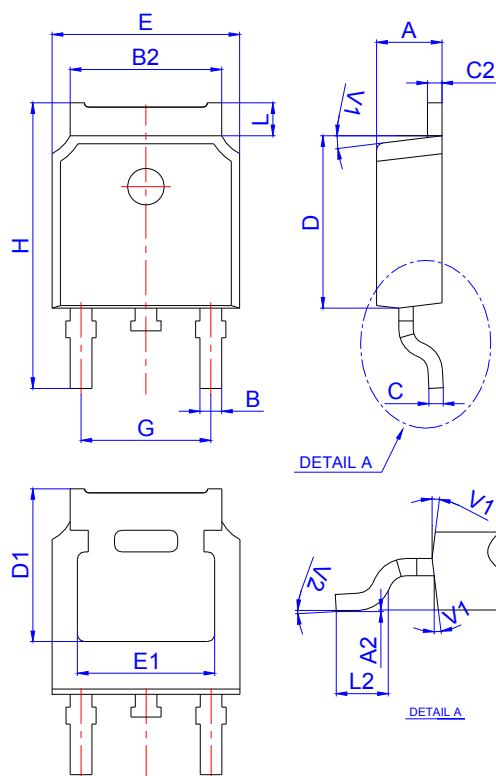
Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.50		4.90	0.177		0.193
B	0.74	0.80	0.83	0.029	0.031	0.033
C	0.47		0.65	0.019		0.026
C2	2.45		2.75	0.096		0.108
C3	2.60		3.00	0.102		0.118
D	8.80		9.30	0.346		0.366
E	9.80		10.4	0.386		0.410
F	6.40		6.80	0.252		0.268
G		2.54			0.1	
H	28.0		29.8	1.102		1.173
L1		3.63			0.143	
L2	1.14		1.70	0.045		0.067
L3		3.30			0.130	
V1		45°			45°	

TO-251 PACKAGE OUTLINE DRAWING



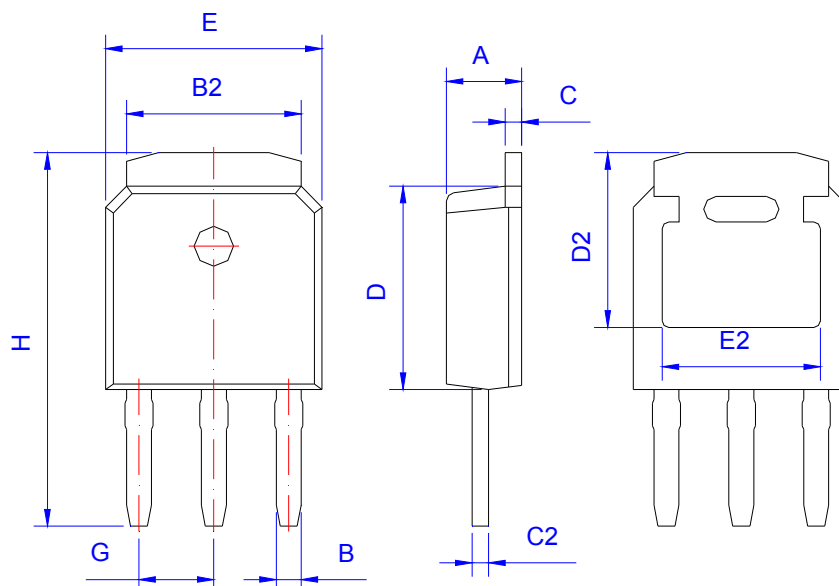
Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.20		2.40	0.086		0.095
A2	0.90		1.20	0.035		0.047
B	0.55		0.65	0.022		0.026
B2	5.10		5.40	0.200		0.213
B3	0.76		0.85	0.030		0.033
C	0.45		0.62	0.018		0.024
C2	0.48		0.62	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.70	0.252		0.264
G		2.30			0.091	
H	16.0		17.0	0.630		0.669
L	8.90		9.40	0.350		0.370
L1	1.80		1.90	0.071		0.075
L2	1.37		1.50	0.054		0.059
V1		4°			4°	

TO-252 PACKAGE OUTLINE DRAWING



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10		2.50	0.083		0.098
A2	0		0.10	0		0.004
B	0.66		0.86	0.026		0.034
B2	5.18		5.48	0.202		0.216
C	0.40		0.60	0.016		0.024
C2	0.44		0.58	0.017		0.023
D	5.90		6.30	0.232		0.248
D1	5.30REF			0.209REF		
E	6.40		6.80	0.252		0.268
E1	4.63			0.182		
G	4.47		4.67	0.176		0.184
H	9.50		10.70	0.374		0.421
L	1.09		1.21	0.043		0.048
L2	1.35		1.65	0.053		0.065
V1		7°			7°	
V2	0°		6°	0°		6°

TO-251S PACKAGE OUTLINE DRAWING



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10	2.30	2.50	0.083	0.091	0.098
B	0.66	0.76	0.86	0.026	0.030	0.034
B2	5.15	5.33	5.48	0.203	0.210	0.216
C	0.44	0.51	0.58	0.017	0.020	0.023
C2	0.44	0.51	0.58	0.017	0.020	0.023
D	5.90	6.10	6.30	0.232	0.240	0.248
D2	5.30 REF			0.209 REF		
E	6.40	6.60	6.80	0.252	0.260	0.268
E2	4.83 REF			0.190 REF		
G	2.19	2.29	2.39	0.086	0.090	0.094
H	10.60	11.20	11.80	0.417	0.441	0.465