

# GSTMMBT3904

## NPN General Purpose Transistor


### Product Description

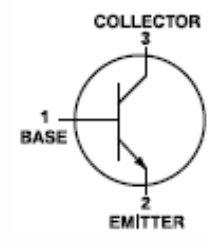
This device is designed as a general purpose amplifier and switch.

### Features

- Lead(Pb)-Free

### Packages & Pin Assignments

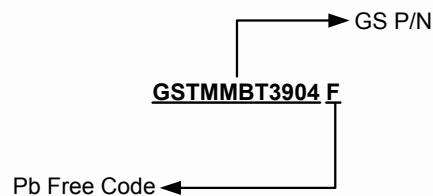
GSTMMBT3904F(SOT-23)	
	
<b>Pin</b>	<b>Description</b>
1	Base
2	Emitter
3	Collector



### Marking Information

P/N	Package	Part Marking
GSTMMBT3904F	SOT-23	1AM

### Ordering Information



Part Number	Package	Quantity
GSTMMBT3904F	SOT-23	3000 PCS

GSTMMBT3904

## Absolute Maximum Ratings

$T_A=25^\circ\text{C}$

Symbol	Conditions	Typical	Unit
$V_{CEO}$	Collector-Emitter Voltage	40	V
$V_{CBO}$	Collector-Base Voltage	60	V
$V_{EBO}$	Emitter-Base Voltage	6.0	V
$I_{C(DC)}$	Collector Current (DC)	200	mA
$P_D$	Total Device Dissipation FR-5 Board (1) $T_A=25^\circ\text{C}$	225	mW
	Derate above $25^\circ\text{C}$	1.8	mW/ $^\circ\text{C}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient	556	$^\circ\text{C}/\text{W}$
$P_D$	Total Device Dissipation Alumina Substrate (2) $T_A=25^\circ\text{C}$	300	mW
	Derate above $25^\circ\text{C}$	2.4	mW/ $^\circ\text{C}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient	417	$^\circ\text{C}/\text{W}$
$T_J$	Junction Temperature Range	-55 to +150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$

Note 1: FR-5=1.0 x 0.75 x 0.062 in

Note 2: Alumina=0.4 x 0.3 x 0.024 in. 99.5% alumina.

## Electrical Characteristics

( $T_A=25^\circ\text{C}$  unless otherwise noted)

Symbol	Conditions	Min	Max	Unit
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage ( $I_C=1.0\text{mA}$ , $I_B=0\text{mA}$ )	40	-	V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage ( $I_C=10\mu\text{A}$ , $I_E=0\text{mA}$ )	60	-	V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage ( $I_E=10\mu\text{A}$ , $I_C=0\text{mA}$ )	6.0	-	V
$I_{CEX}$	Collector Cutoff Current ( $V_{CE}=30\text{V}$ , $V_{EB(off)}=3.0\text{V}$ )	-	50	nA
$I_{BL}$	Base Cutoff Current ( $V_{CE}=30\text{V}$ , $V_{EB(off)}=3.0\text{V}$ )	-	50	nA
$h_{FE}$	DC Current Gain ( $I_C=0.1\text{mA}$ , $V_{CE}=1.0\text{V}$ )	40	-	-
	DC Current Gain ( $I_C=1.0\text{mA}$ , $V_{CE}=1.0\text{V}$ )	70	-	-
	DC Current Gain ( $I_C=10\text{mA}$ , $V_{CE}=1.0\text{V}$ )	100	300	-
	DC Current Gain ( $I_C=50\text{mA}$ , $V_{CE}=1.0\text{V}$ )	60	-	-
	DC Current Gain ( $I_C=100\text{mA}$ , $V_{CE}=1.0\text{V}$ )	30	-	-

## Electrical Characteristics (Continue)

(T<sub>A</sub>=25°C unless otherwise noted)

Symbol	Conditions	Min	Max	Unit
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage (3) (I <sub>C</sub> =10mA, I <sub>B</sub> =1.0mA) (I <sub>C</sub> =50mA, I <sub>B</sub> =5.0mA)	- -	0.2 0.3	V
V <sub>BE(sat)</sub>	Base-Emitter Saturation Voltage (3) (I <sub>C</sub> =10mA, I <sub>B</sub> =1.0mA) (I <sub>C</sub> =50mA, I <sub>B</sub> =5.0mA)	0.65 -	0.85 0.95	V
f <sub>T</sub>	Current-Gain-Bandwidth Product (4) (I <sub>C</sub> =10mA, V <sub>CE</sub> =20V, f=100MHz)	300	-	MHz
C <sub>obo</sub>	Output Capacitance (V <sub>CB</sub> =5V, I <sub>E</sub> =0mA, f=1.0MHz)	-	4.0	pF
C <sub>ibo</sub>	Input Capacitance (V <sub>EB</sub> =0.5V, I <sub>C</sub> =0mA, f=1.0MHz)	-	8.0	pF
h <sub>ie</sub>	Input Impedance (I <sub>C</sub> =1.0mA, V <sub>CE</sub> =10V, f=1.0 kHz)	1.0	10	KΩ
h <sub>re</sub>	Voltage Feedback Ratio (I <sub>C</sub> =1.0mA, V <sub>CE</sub> =10V, f=1.0 kHz)	0.5	8.0	x10 <sup>-4</sup>
h <sub>fe</sub>	Small-Signal Current Gain (I <sub>C</sub> =1.0mA, V <sub>CE</sub> =10V, f=1.0 kHz)	100	400	-
h <sub>oe</sub>	Output Admittance (I <sub>C</sub> =1.0mA, V <sub>CE</sub> =10V, f=1.0kHz)	1.0	40	umhos
NF	Noise Figure (I <sub>C</sub> =100μA, V <sub>CE</sub> =5V, R <sub>S</sub> =1.0kΩ, f=1.0kHz)	-	5.0	dB
t <sub>d</sub>	Delay Time (V <sub>CC</sub> =3.0V, V <sub>BE(off)</sub> =-0.5V, I <sub>C</sub> =10mA, I <sub>B1</sub> =1.0mA)	-	35	ns
t <sub>r</sub>	Rise Time (V <sub>CC</sub> =3.0V, V <sub>BE(off)</sub> =-0.5V, I <sub>C</sub> =10mA, I <sub>B1</sub> =1.0mA)	-	35	ns
t <sub>s</sub>	Storage Time (V <sub>CC</sub> =3.0V, I <sub>C</sub> =10mA, I <sub>B1</sub> =I <sub>B2</sub> =1.0mA)	-	200	ns
t <sub>f</sub>	Fall Time (V <sub>CC</sub> =3.0V, I <sub>C</sub> =10mA, I <sub>B1</sub> =I <sub>B2</sub> =1.0mA)	-	50	ns

Note 3: Pulse Test: Pulse Width ≤ 300 us, Duty Cycle ≤ 2.0%

Note 4: f<sub>T</sub> is defined as the frequency at which h<sub>fe</sub> extrapolates to unity

## Typical Application Circuit

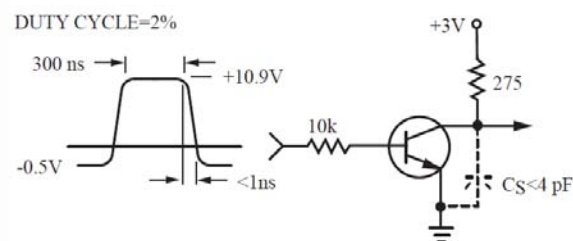


FIG.1 Delay and Rise Time  
Equivalent Test Circuit

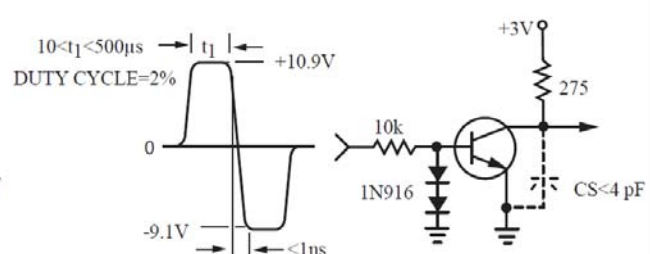


FIG.2 Storage and Fall Time  
Equivalent Test Circuit

\*Total shunt capacitance of test jig and connectors

## Typical Performance Characteristics

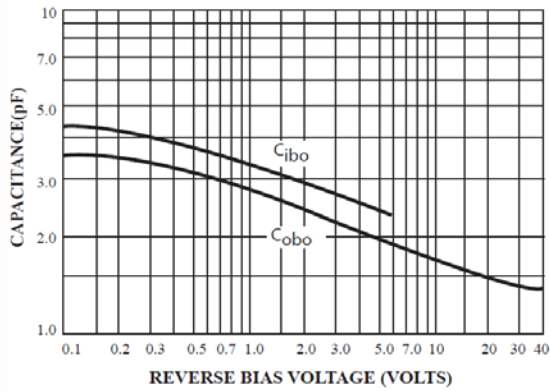


FIG.3 Capacitance

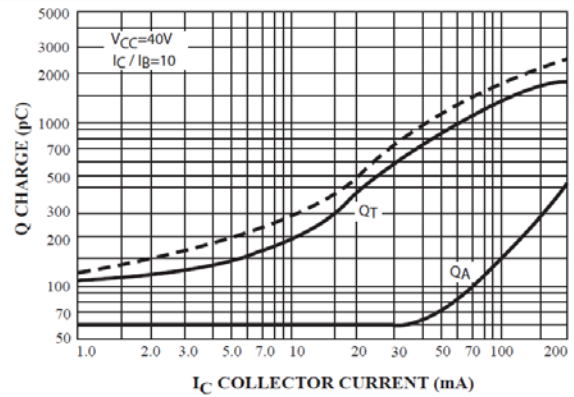


FIG.4 Charge Data

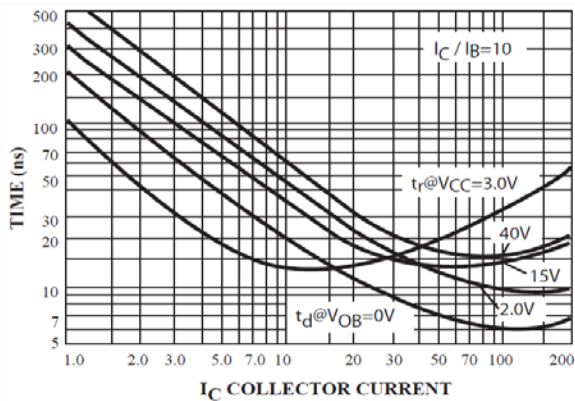


FIG.5 Turn-On Time

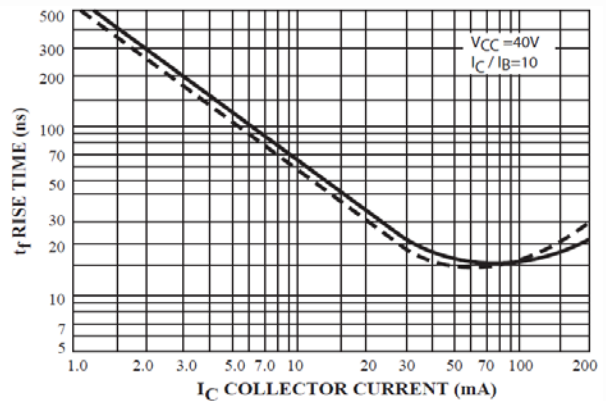


FIG.6 Rise Time

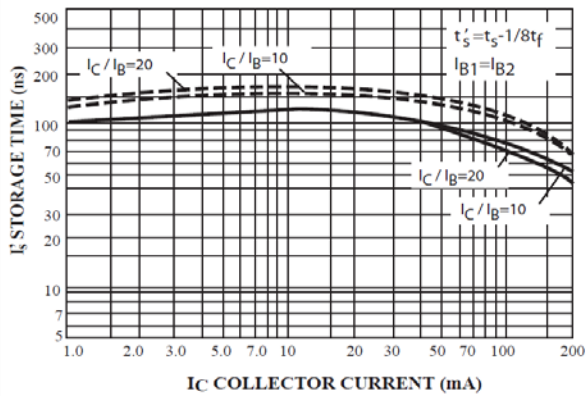


FIG.7 Storage Time

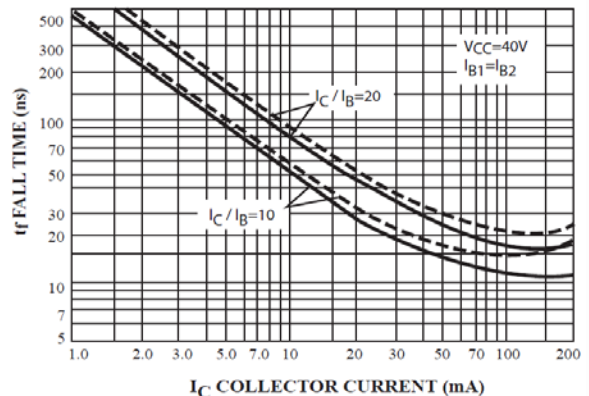


FIG.8 Fall Time

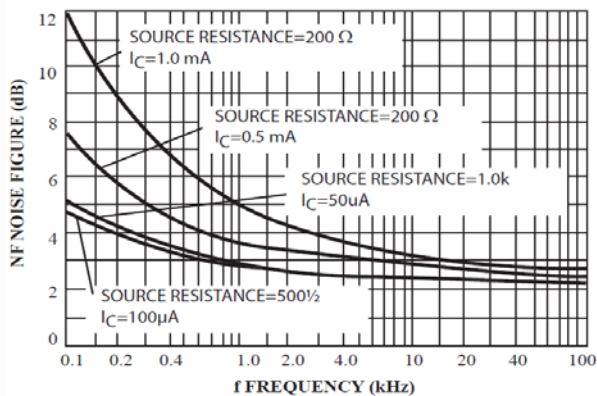


FIG.9

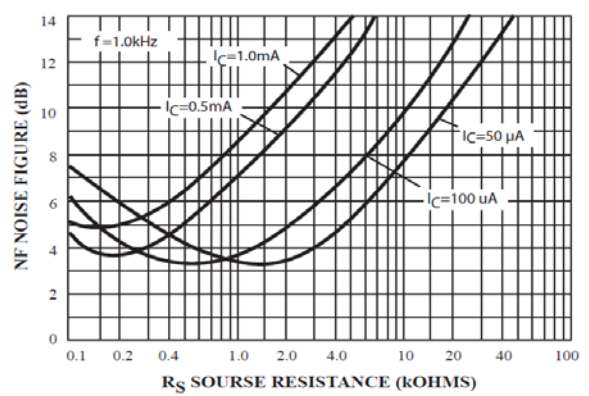


FIG.10

## Typical Performance Characteristics (Continue)

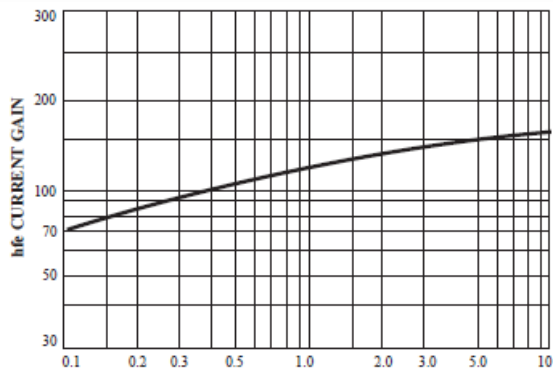


FIG.11 Current Gain

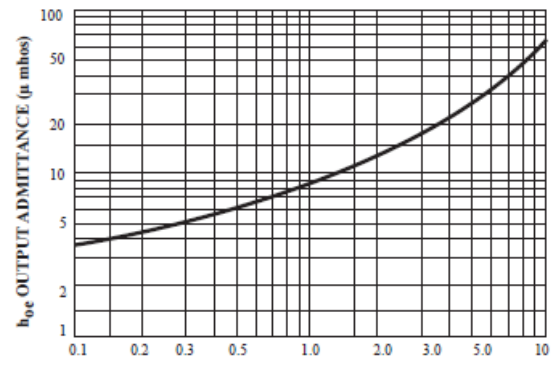


FIG.12 Output Admittance

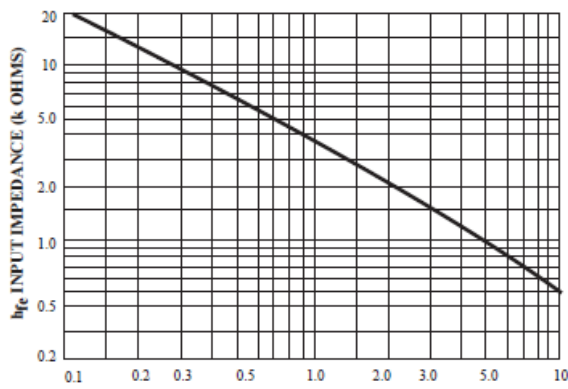


FIG.13 Input Impedance

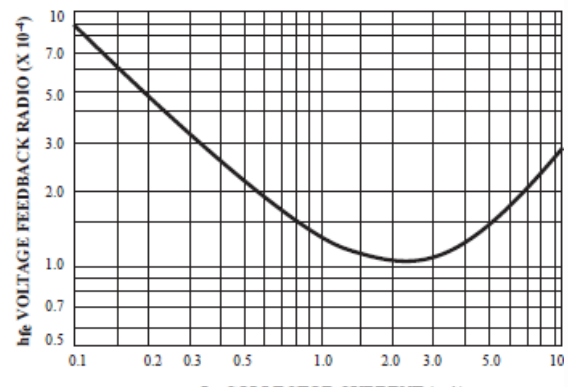


FIG.14 Voltage Feedback Ratio

### TYPICAL STATIC CHARACTERISTICS

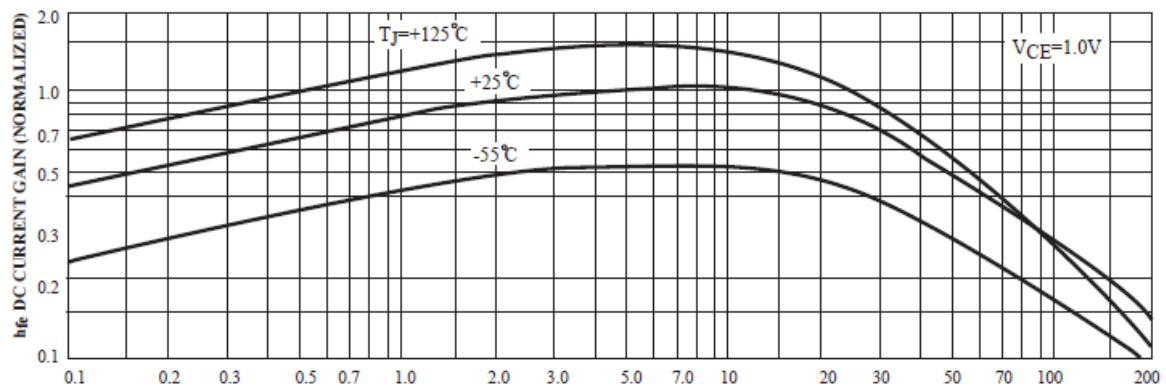


FIG.15 DC Current Gain

## Typical Performance Characteristics (Continue)

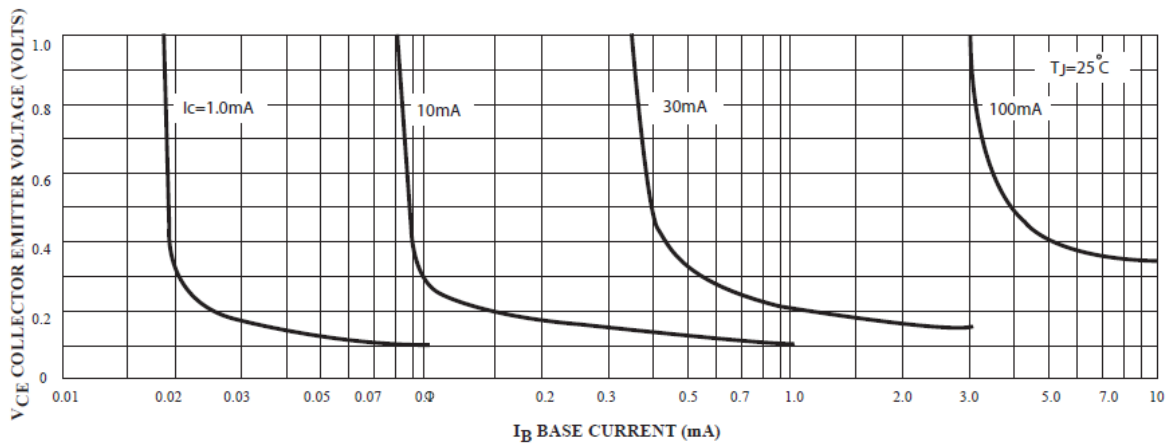


FIG.16 Collector Saturation Region

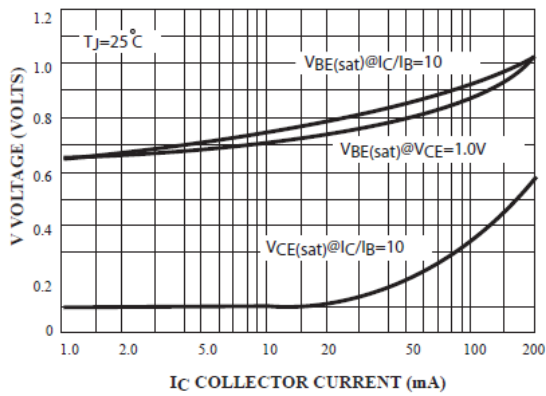


FIG.17 "ON" Voltage

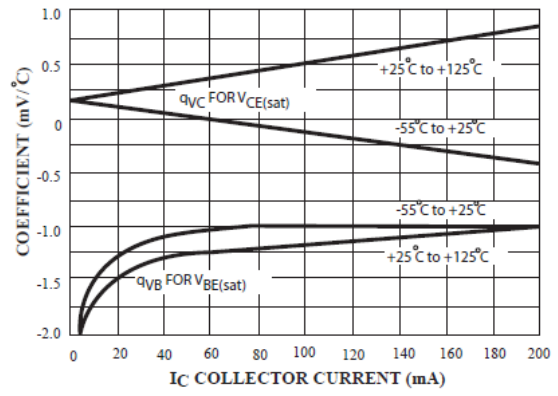
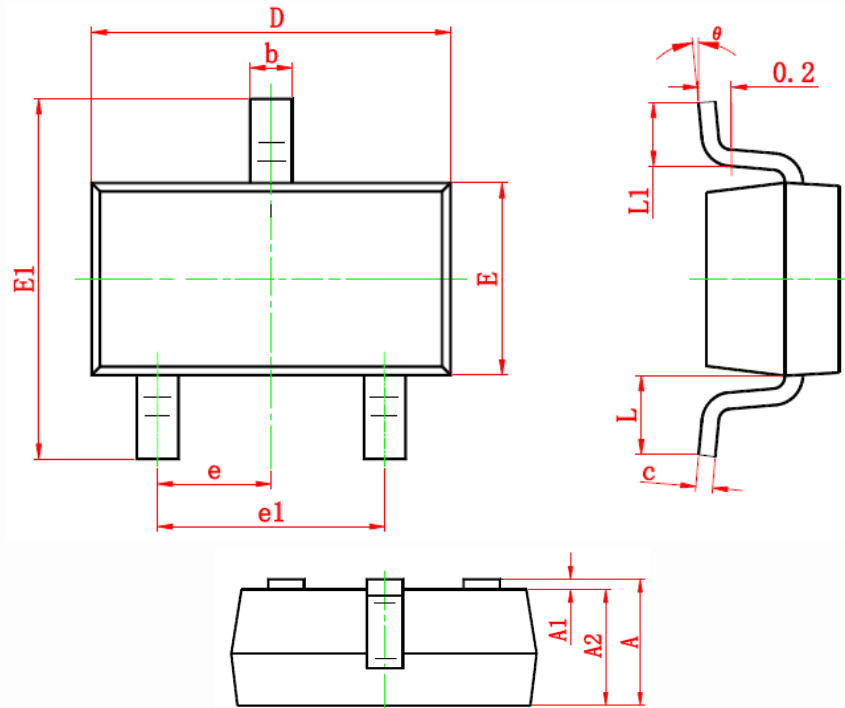


FIG.18 Temperature Coefficients

## Package Dimension

### SOT-23







Dimensions				
Symbol	Millimeters		Inches	
	Min	Max	Min	Max
<b>A</b>	0.900	1.200	0.035	0.043
<b>A1</b>	0.000	0.100	0.000	0.004
<b>A2</b>	0.900	1.100	0.035	0.039
<b>b</b>	0.350	0.510	0.014	0.020
<b>c</b>	0.080	0.150	0.003	0.006
<b>D</b>	2.800	3.000	0.110	0.118
<b>E</b>	1.200	1.400	0.047	0.055
<b>E1</b>	2.100	3.000	0.083	0.118
<b>e</b>	0.950 TYP		0.037 TYP	
<b>e1</b>	1.800	2.000	0.071	0.079
<b>L</b>	0.550 REF		0.022 REF	
<b>L1</b>	0.300	0.500	0.012	0.020
<b><math>\theta</math></b>	0°	8°	0°	6°





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