SEMICONDUCTOR

TECHNI CAL DATA

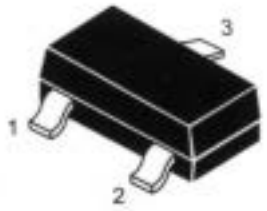
# MMBT2222/A

NPN EPITAXIAL SILICON TRANSISTOR

## DATA GENERAL PURPOSE TRANSISTOR

* Complement to MMBT2907/A
* Collector Dissipation: Pc(max)=225mW

Package:SOT-23




| PIN: / STYLE | 1 | 2 | 3 |
|---|---|---|---|
| NO.1 | B | E | C |

## ABSOLUTE MAXIMUM RATINGS at Ta=25℃

| Characteristic | Symbol | Rating | | Unit |
|---|---|---|---|---|
| | | 2222 | 2222A | |
| Collector-Base Voltage | Vcbo | 60 | 75 | V |
| Collector-Emitter Voltage | Vceo | 30 | 40 | V |
| Emitter-Base Voltage | Vebo | 5 | 6 | V |
| Collector Current | Ic | 600 | | mA |
| Collector Dissipation Ta=25℃* | $P_D$ | 225 | | mW |
| Junction Temperature | Tj | 150 | | ℃ |
| Storage Temperature | Tstg | -55-150 | | ℃ |

## ELECTRICAL CHARACTERISTICS at Ta=25℃

| Characteristic | Symbol | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| Collector-Base Breakdown Voltage MMBT2222<br>MMBT2222A | BVcbo | 60<br>75 | | V | Ic= 10uA Ie=0 |
| Collector-Emitter Breakdown Voltage MMBT2222<br>MMBT2222A | BVceo | 30<br>40 | | V | Ic= 10mA Ib=0 |
| Emitter-Base Breakdown Voltage MMBT2222<br>MMBT2222A | BVebo | 5<br>6 | | V | Ie= 10uA Ic=0 |
| Emitter Cutoff Current MMBT2222A | Icex | | 10 | nA | Vce=60V Veb=3V |
| Collect Cutoff Current MMBT2222<br>MMBT2222A | Icbo | | 10 | nA | Vcb= 50V Ie=0<br>Vcb= 60V Ie=0 |
| Collect Cutoff Current MMBT2222<br>MMBT2222A | Icbo | | 10 | nA | Vcb=50VIe=0 Ta=125℃<br>Vcb=60VIe=0 Ta=125℃ |
| Collect Cutoff Current MMBT2222A | Iebo | | 10 | nA | Vcb=3V Ic=0 |
| DC Current Gain | Hfe1 | 35 | | | Vce=10VIc= 0.1mA |
| DC Current Gain | Hfe2 | 50 | | | Vce= 10V Ic= 1mA |
| DC Current Gain | Hfe3 | 75 | | | Vce=10V Ic= 10mA |
| DC Current Gain | Hfe4 | 100 | 300 | | Vce=10V Ic= 150mA |
| DC Current Gain | Hfe5 | 50 | | | Vce= 1.0V Ic= 150mA |
| DC Current Gain MMBT2222<br>MMBT2222A | Hfe6 | 30<br>40 | | | Vce=10V Ic= 500mA |

## ELECTRICAL CHARACTERISTICS at Ta=25℃(continued)

| Characteristic | Symbol | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| Collector-Emitter Saturation Voltage MMBT2222<br>MMBT2222A | Vce(sat) | | 0.4<br>0.3 | V | Ic=150mA Ib= 15mA |
| Collector-Emitter Saturation Voltage MMBT2222<br>MMBT2222A | Vce(sat) | | 1.6<br>1.0 | V | Ic=500mA Ib= 50mA |
| Base-Emitter Saturation Voltage MMBT2222<br>MMBT2222A | Vbe(sat) | 0.6 | 1.3<br>1.2 | V | Ic=150mA Ib= 15mA |
| Base-Emitter Saturation Voltage MMBT2222<br>MMBT2222A | Vbe(sat) | | 2.6<br>2.0 | V | Ic=500mA Ib= 50mA |
| Iutput Base Capacitance MMBT2222<br>MMBT2222A | Cibo | | 30<br>25 | PF | V EB = 0.5 Vdc,<br>I C = 0, f = 1.0 MHz |
| Output Base Capacitance | Cobo | | 8 | PF | Vcb=10V Ie=0 f=1MHz |
| Noise Figure | NF | | 10 | dB | Vce= 10V Ic= 0.1mA<br>f=1KHz Rs=2KΩ |
| Current Gain-Bandwidth Product MMBT2222<br>MMBT2222A | $f_T$ | 250<br>300 | | MHz | Vce= 20V Ic= 20mA<br>f=100MHz |

## SWITCHING CHARACTERISTICS

| Characteristic | Symbol | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|
| Delay Time | td | | 10 | ns | (VCC = 30 Vdc, VEB(off) = – 0.5 Vdc |
| Rise Time | tr | | 25 | ns | I C = 150 mAdc, I B1 = 15 mAdc) |
| Storage Time | ts | | 225 | ns | (V CC = 30 Vdc, I C = 150 mAdc |
| Fall Time | tf | | 60 | ns | I B1 = I B2 = 15 mAdc) |

* Total Device Dissipation : FR=1X0.75X0.062in Board,Derate 25℃.

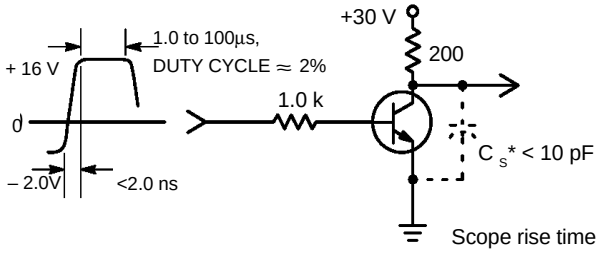
\# Pulse Test : Pulse Width ≤300uS,Duty cycle≤2%

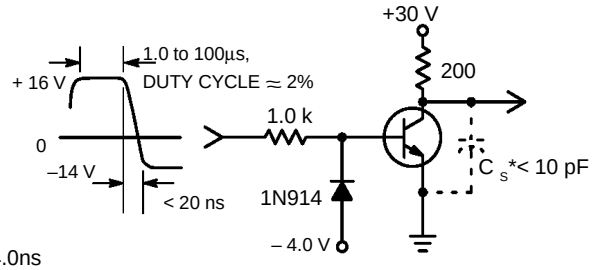
DEVICE MARKING:

MMBT2222=M1B

MMBT2222A=1P

## SWITCHING TIME EQUIVALENT TEST CIRCUITS




Scope rise time < 4.0ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

**Figure 1. Turn–On Time**

**Figure 2. Turn–Off Time**

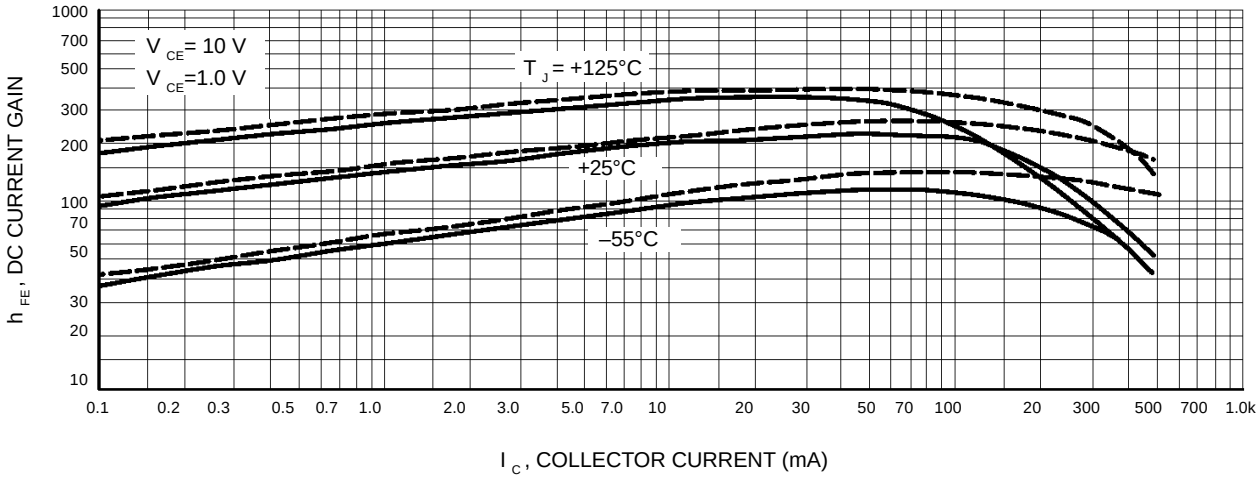



**Figure 3. DC Current Gain**

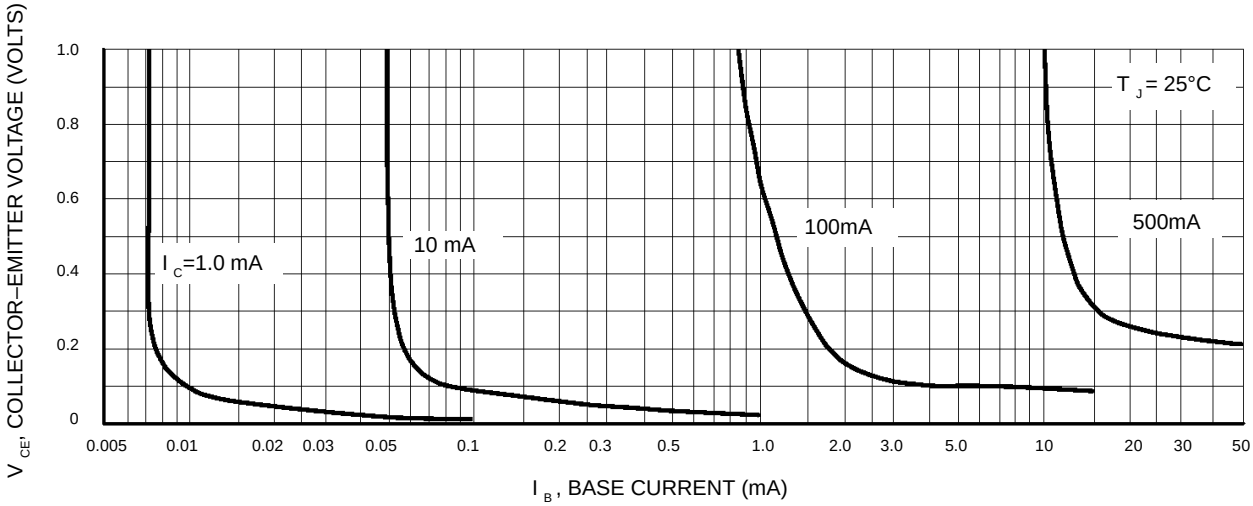



**Figure 4. Collector Saturation Region**

MMBT2222/ALT1

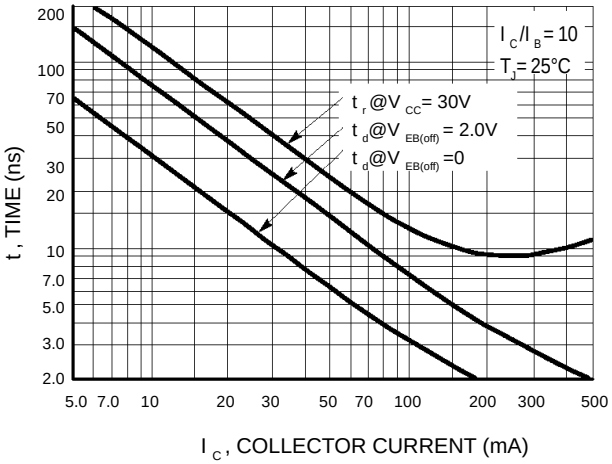



**Figure 5. Turn–On Time**

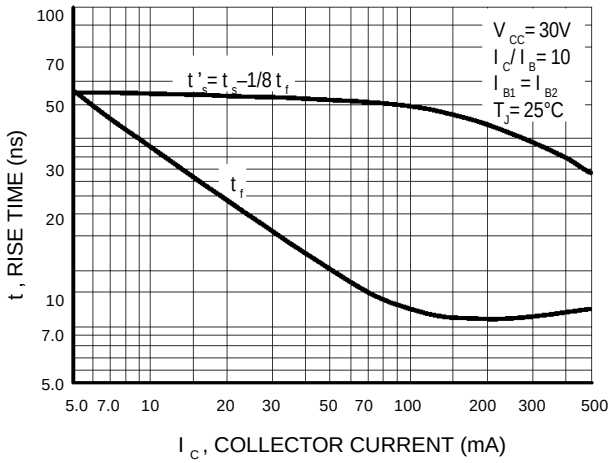



**Figure 6. Turn - Off Time**

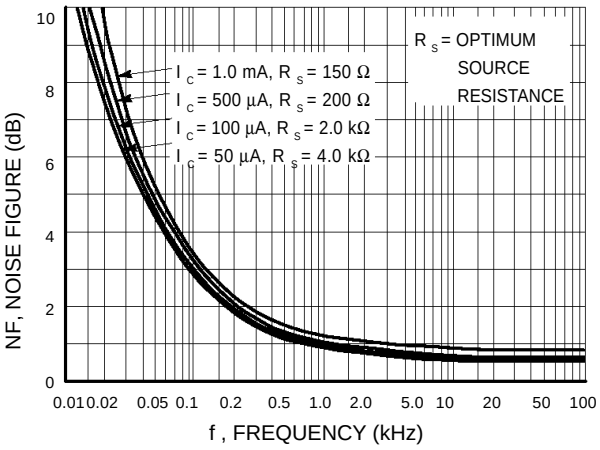



**Figure 7. Frequency Effects**

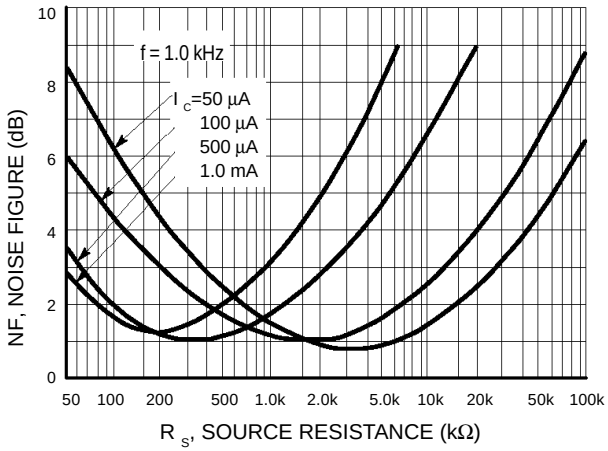



**Figure 8. Source Resistance Effects**

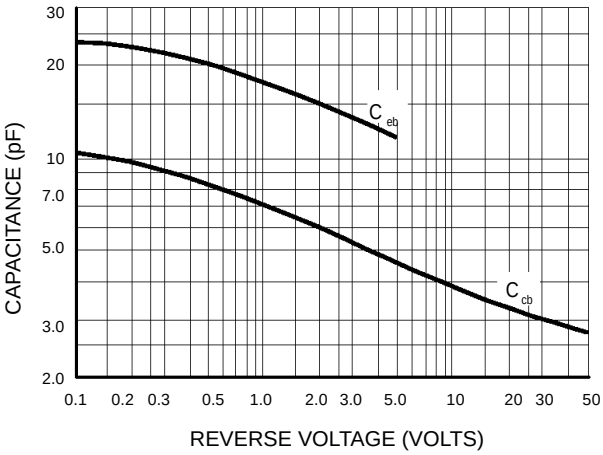



**Figure 9. Capacitance**

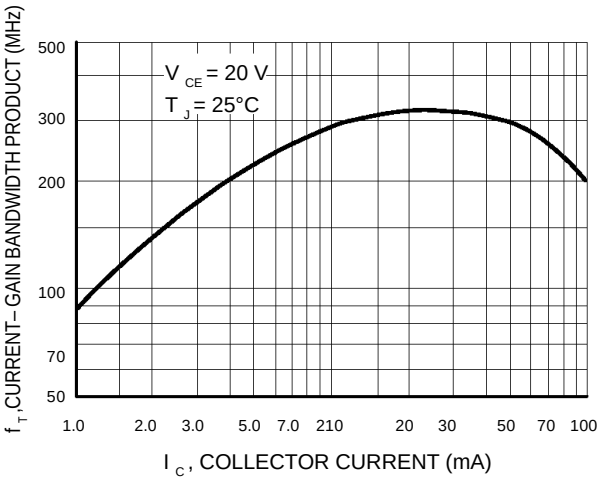
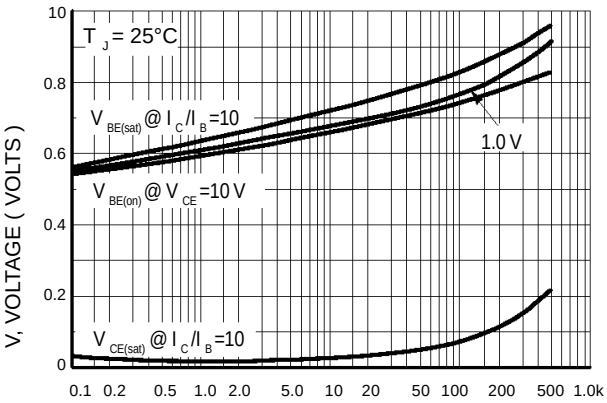


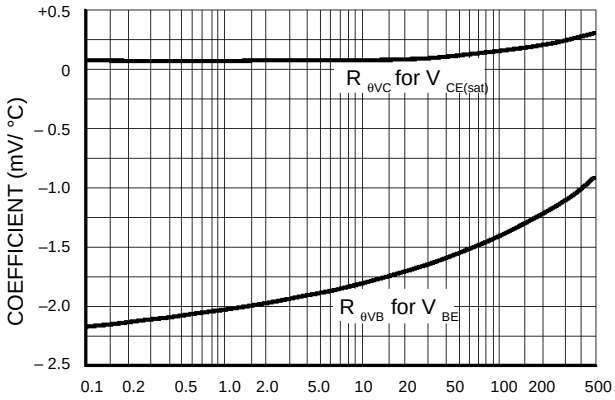

**Figure 10. Current– Gain Bandwidth Product**

MMBT2222/ALT1




I C , COLLECTOR CURRENT (mA)

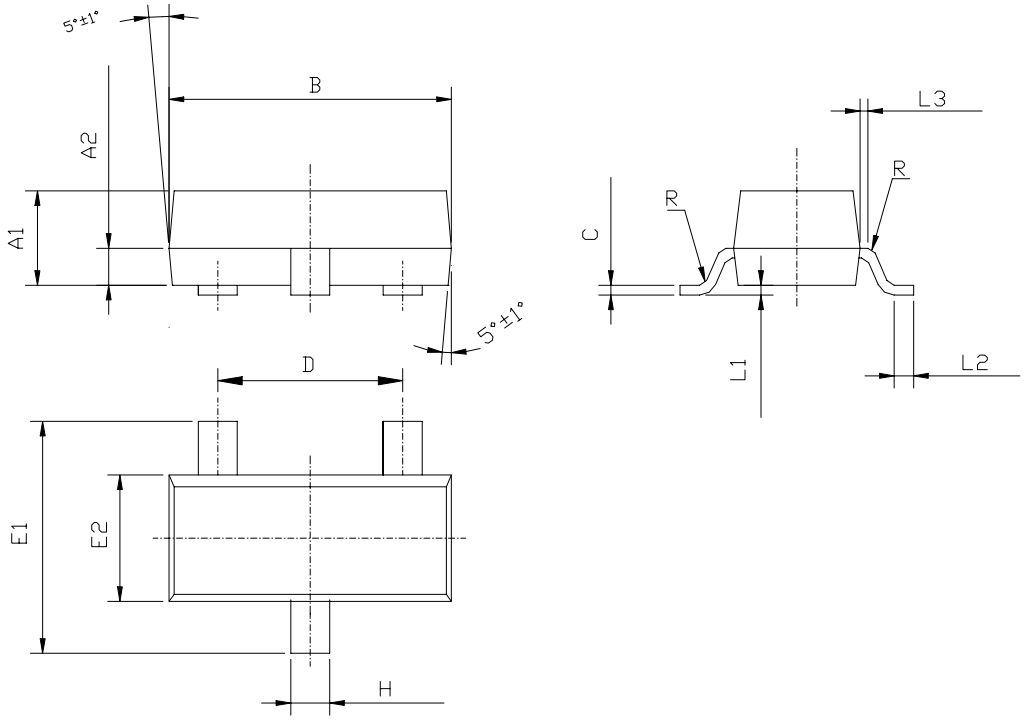
**Figure 11. "On" Voltages**




I C , COLLECTOR CURRENT (mA)

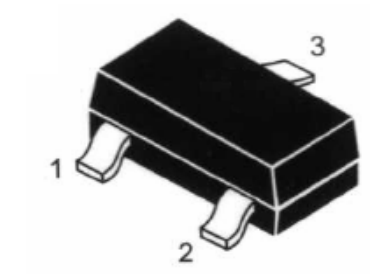
**Figure 12. Temperature Coefficients**

# 外型尺寸及内部结构图
# OUTSIDE DEMENSION AND INTERNAL CONFIGURATION (SOT-23)

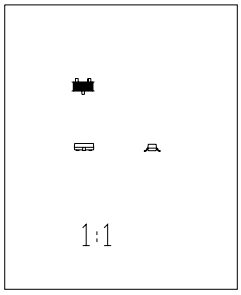



| Symbol | Dimensions in Millimeters | | | 内部结构 STYLS | 管脚 PIN | | |
|---|---|---|---|---|---|---|---|
| | Min | Nominal | Max | | 1 脚 | 2 脚 | 3 脚 |
| A1 | 0.900 | 0.970 | 1.000 | 6 | 基极 BASE | 发射极 EMITTER | 集电极 COLLCTOR |
| A2 | 0.350 | 0.380 | 0.410 | | | | |
| B | 2.800 | 2.900 | 3.000 | 8 | 阳极 ANODE | 不连接 NO-CONNECTION | 阴极 CATHODE |
| C | 0.085 | 0.100 | 0.150 | | | | |
| D | 1.800 | 1.900 | 2.000 | 9 | 阳极 ANODE | 阳极 ANODE | 阴极 CATHODE |
| E1 | 2.200 | 2.400 | 2.600 | | | | |
| E2 | 1.200 | 1.300 | 1.400 | 11 | 阳极 ANODE | 阴极 CATHODE | 阳极-阴极 ANODE-CATHODE |
| H | 0.300 | 0.400 | 0.500 | | | | |
| L1 | 0.000 | | 0.100 | 12 | 阴极 CATHODE | 阴极 CATHODE | 阳极 ANODE |
| L2 | 0.200 | | | | | | |
| L3 | 0.030 | 0.080 | 0.130 | 18 | 不连接 NO-CONNECTION | 阴极 CATHODE | 阳极 ANODE |
| R | 0.080TYP | | | | | | |
| | | | | 19 | 阴极 CATHODE | 阳极 ANODE | 阴极-阳极 CATHODE-ANODE |

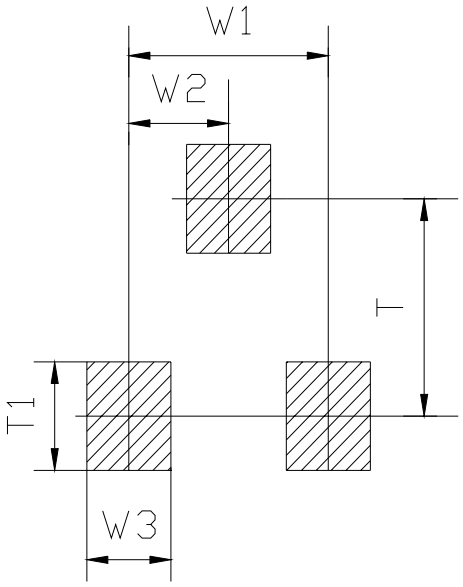
# 外型尺寸及内部结构图
# OUTSIDE DEMENSION AND INTERNAL CONFIGURATION (SOT-23)




OUTSIDE



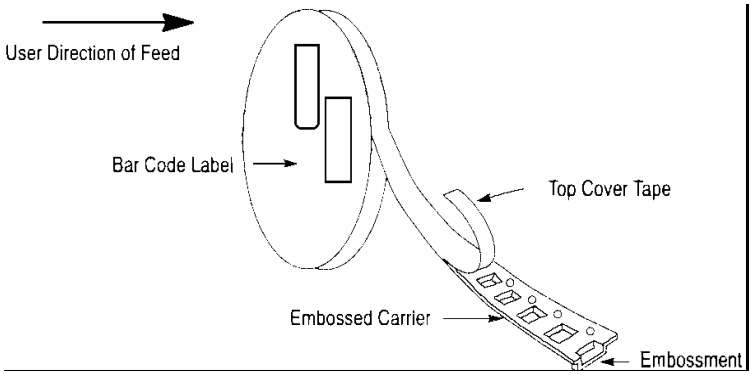

Scale 1:1 on letter size paper



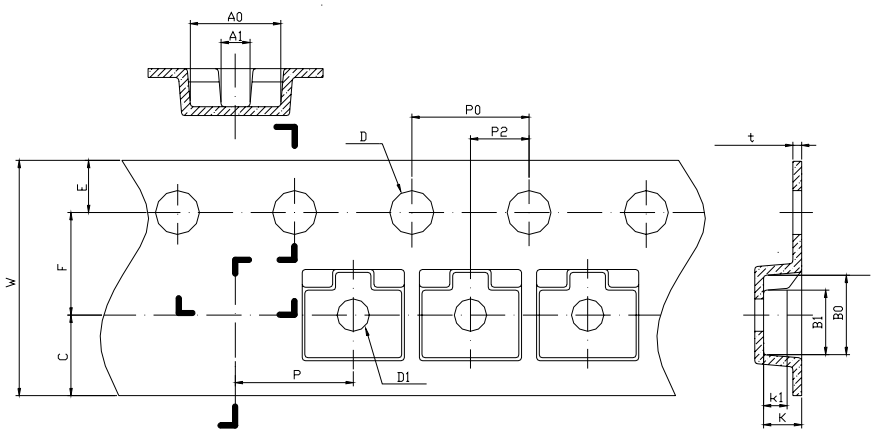

FOOTPRINTS FOR SOLDERING

| Symbol | Dimensions in Millimeters | Dimensions in Inches |
|---|---|---|
| | Nominal | Nominal |
| W1 | 1.900 | 0.0748 |
| W2 | 0.950 | 0.0374 |
| W3 | 0.800 | 0.0315 |
| T | 2.000 | 0.0787 |
| T1 | 1.000 | 0.0394 |

# SOT-23 PACKAGING:

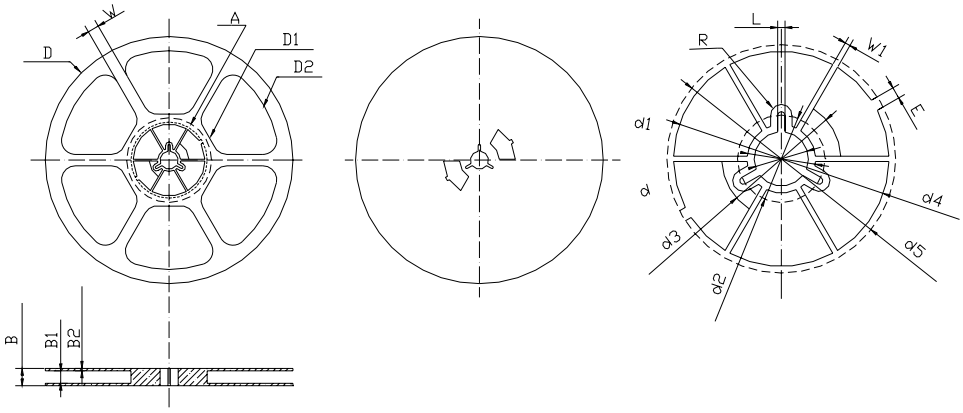



## SOT-23EMBOSSED CARRIER TAPE:




| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|---|---|---|---|---|---|---|
| | Minimum | Nominal | Maximum | Minimum | Nominal | Maximum |
| A0 | 3.050 | 3.150 | 3.250 | 0.1201 | 0.1240 | 0.1280 |
| A1 | 0.900 | 1.000 | 1.100 | 0.0354 | 0.0394 | 0.0433 |
| B0 | 2.669 | 2.769 | 2.869 | 0.1051 | 0.1090 | 0.1130 |
| B1 | 2.100 | 2.200 | 2.300 | 0.0827 | 0.0866 | 0.0906 |
| C | 2.750TYP | | | 0.1083TYP | | |
| D | 1.500 | 1.500 | 1.600 | 0.0591 | 0.0591 | 0.0630 |
| D1 | 0.900 | 1.000 | 1.100 | 0.0354 | 0.0394 | 0.0433 |
| E | 1.650 | 1.750 | 1.850 | 0.0650 | 0.0689 | 0.0728 |
| F | 3.450 | 3.500 | 3.550 | 0.1358 | 0.1378 | 0.1398 |
| K | 1.119 | 1.219 | 1.319 | 0.0441 | 0.0480 | 0.0519 |
| K1 | 0.850TYP | | | 0.03346TYP | | |
| P | 3.900 | 4.000 | 4.100 | 0.1535 | 0.1575 | 0.1614 |
| P0 | 3.900 | 4.000 | 4.100 | 0.1535 | 0.1575 | 0.1614 |
| P010 | 39.800 | 40.000 | 40.200 | 1.5669 | 1.5748 | 1.5827 |
| P2 | 1.950 | 2.000 | 2.050 | 0.0768 | 0.0787 | 0.0807 |
| t | 0.216 | 0.229 | 0.242 | 0.0085 | 0.0090 | 0.0095 |
| W | 7.900 | 8.000 | 8.300 | 0.3110 | 0.3150 | 0.3268 |

## SOT-23 REEL DATA:




| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|---|---|---|---|---|---|---|
| | Minimum | Nominal | Maximum | Minimum | Nominal | Maximum |
| B | - | - | 12.500 | - | - | 0.4921 |
| B1 | 8.900 | 9.000 | 9.100 | 0.3504 | 0.3543 | 0.3583 |
| B2 | 1.700 | 1.750 | 1.800 | 0.0669 | 0.0689 | 0.0709 |
| D | ϕ177.000 | ϕ178.000 | ϕ179.000 | Φ6.9685 | Φ7.0079 | Φ7.0472 |
| D1 | Φ67.600TYP | | | Φ2.6614TYP | | |
| D2 | Φ157.600TYP | | | Φ6.2047 TYP | | |
| d | Φ12.800 | Φ13.000 | Φ13.200 | Φ0.5039 | Φ0.5118 | Φ0.5197 |
| d1 | Φ16.40 TYP | | | Φ0.6457 TYP | | |
| d2 | Φ21.000 TYP | | | Φ0.8268 TYP | | |
| d3 | Φ25.200 TYP | | | Φ0.99221TYP | | |
| d4 | Φ50.600 | Φ51.600 | Φ52.600 | Φ1.9921 | Φ2.0315 | Φ2.0709 |
| d5 | Φ53.800 | Φ54.800 | Φ55.800 | Φ2.1181 | Φ2.1575 | Φ2.1969 |
| E | 2.800 TYP | | | 0.1102TYP | | |
| L | 1.750 TYP | | | 0.0689 TYP | | |
| R | 2.575 TYP | | | 0.1014 TYP | | |
| W | 15.000 TYP | | | 0.5906 TYP | | |
| W1 | 1.300 TYP | | | 0.0512 TYP | | |