# DATA SHEET

# TDA5332T
## Double mixer/oscillator for TV and VCR tuners

Preliminary specification
File under Integrated Circuits, IC02

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Philips
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PHILIPS

## GENERAL DESCRIPTION

The TDA5332T is an integrated circuit that performs the mixer/oscillator functions in TV and VCR tuners. This device gives the designer the capability to design an economical and physically small tuner which will be capable of meeting the most stringent requirements e.g. FTZ or FCC. The tuner development time can be drastically reduced by using this device.

### Features

- Balanced mixer with a common emitter input for band A
- Amplitude-controlled oscillator for band A
- Balanced mixer with common base input for band B
- Balanced oscillator for band B
- SAW filter preamplifier with an output impedance of 75 Ω in application
- Bandgap voltage stabilizer for oscillator stability
- Electronic bandswitch

## QUICK REFERENCE DATA

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Supply voltage | | $V_P$ | – | 12 | – | V |
| Band A frequency range | depending on application | $f_A$ | 45 | – | 470 | MHz |
| Band B frequency range | depending on application | $f_B$ | 160 | – | 860 | MHz |
| Band A noise factor | 50 MHz | $NF_A$ | – | 7.5 | – | dB |
| Band B noise factor | 860 MHz | $NF_B$ | – | 9 | – | dB |
| Band A input voltage | 1% cross-modulation | $V_{18-20}$ | – | 100 | – | dBμV |
| Band B input power | 1% cross-modulation note 5 | $P_I$ | – | –21 | – | dBm |
| Band A voltage gain | | $G_{VA}$ | – | 25 | – | dB |
| Band B voltage gain | | $G_{VB}$ | – | 36 | – | dB |

## PACKAGE OUTLINE

20-lead mini-pack, plastic (SO20L; SOT163A); SOT163-1; 1996 November 29.

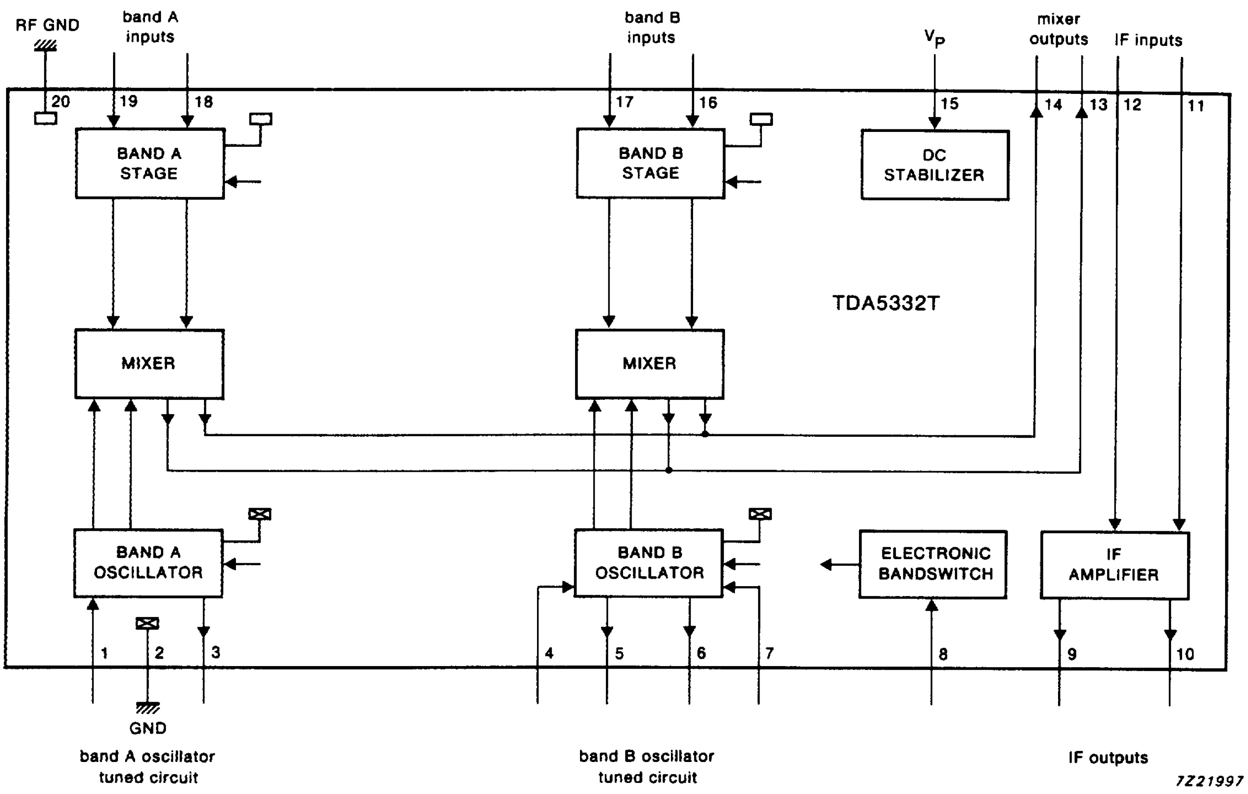



Fig.1 Block diagram.

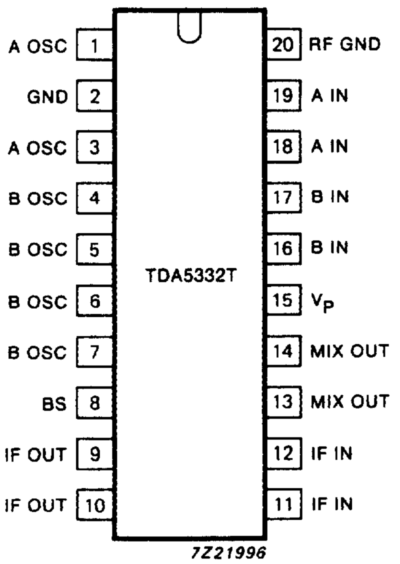



Fig.2 Pinning diagram.

## PINNING

| | | |
|---|---|---|
| 1 | A OSC | band A oscillator input |
| 2 | GND | ground (0 V) |
| 3 | A OSC | band A oscillator output |
| 4 | B OSC | band B oscillator input |
| 5 | B OSC | band B oscillator output |
| 6 | B OSC | band B oscillator output |
| 7 | B OSC | band B oscillator input |
| 8 | BS | electronic bandswitch |
| 9 | IF OUT | IF amplifier output |
| 10 | IF OUT | IF amplifier output |
| 11 | IF IN | IF amplifier input |
| 12 | IF IN | IF amplifier input |
| 13 | MIX OUT | mixer output |
| 14 | MIX OUT | mixer output |
| 15 | $V_P$ | positive supply voltage |
| 16 | B IN | band B input |
| 17 | B IN | band B input |
| 18 | A IN | band A input |
| 19 | A IN | band A input |
| 20 | RF GND | ground for RF inputs |

## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| PARAMETER | CONDITIONS | SYMBOL | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| Supply voltage | | $V_P$ | –0.3 | 14 | V |
| Switching voltage | | $V_8$ | 0 | 14 | V |
| Output current of each pin to ground | | $I_O$ | – | –10 | mA |
| Maximum short-circuit time (all pins) | | $t_{SC}$ | – | 10 | s |
| Storage temperature range | | $T_{stg}$ | –55 | + 150 | °C |
| Operating ambient temperature range | | $T_{amb}$ | –25 | + 80 | °C |
| Junction temperature | | $T_j$ | – | + 150 | °C |

## THERMAL RESISTANCE

| | | | | |
|---|---|---|---|---|
| From junction to ambient in free air | $R_{th\ j\text{-}a}$ | typ. | 100 | K/W |

## HANDLING

Pins 8, 9 and 10 withstand the ESD test in accordance with MIL-STD-883C category B (2000 V).

## CHARACTERISTICS

$V_P$ = 12 V; $T_{amb}$ = 25 °C; all voltages are referenced to ground (pins 2 and 20); measured in Fig.3; unless otherwise specified.

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Supply voltage | | $V_{15}$ | 10 | – | | 13.2 | V |
| Supply current | | $I_{15}$ | – | 42 | | 55 | mA |
| Switching voltage; | | | | | | | |
| band A | | $V_{SA}$ | 0 | – | | 1.1 | V |
| band B | | $V_{SB}$ | 3 | – | | 5 | V |
| Switching current | | | | | | | |
| band A | | $I_{SA}$ | – | – | | 10 | μA |
| band B | | $I_{SB}$ | – | – | | 50 | μA |
| **IF Amplifier** | differentially measured at 36 MHz | | | mod. | phase | | |
| Input reflection coefficient | note 4 | $S_{11}$ | – | –0.5 | –2 | – | dB/° |
| Reverse transmission coefficient | | $S_{12}$ | – | –41 | –7 | – | dB/° |
| Forward transmission coefficient | | $S_{21}$ | – | 12 | 160 | – | dB/° |
| Output reflection coefficient | | $S_{22}$ | – | –9 | 10 | – | dB/° |
| Input admittance in application | | $Y_I$ | – | – | 1.4 | – | mS |
| | | | | | 0.9 | – | pF |
| Output admittance in application | | $Z_O$ | – | – | 55 | – | Ω |
| | | | | | 230 | – | nH |
| **Band A mixer (including IF amplifier)** | measured using circuit shown in Fig.3 | | | | | | |
| Frequency range | | $f_A$ | 45 | – | | 470 | MHz |
| Noise factor | 50 MHz | NF | – | 7.5 | | 9 | dB |
| | 225 MHz | NF | – | 9 | | 11 | dB |
| | 300 MHz | NF | – | 10 | | 12 | dB |
| | 470 MHz | NF | – | 11 | | 13 | dB |
| Optimum source conductance | 50 MHz | $G_{18-20}$ | – | 0.5 | | – | mS |
| | 225 MHz | $G_{18-20}$ | – | 1.1 | | – | mS |
| | 300 MHz | $G_{18-20}$ | – | 1.2 | | – | mS |
| | 470 MHz | $G_{18-20}$ | – | 1.9 | | – | mS |

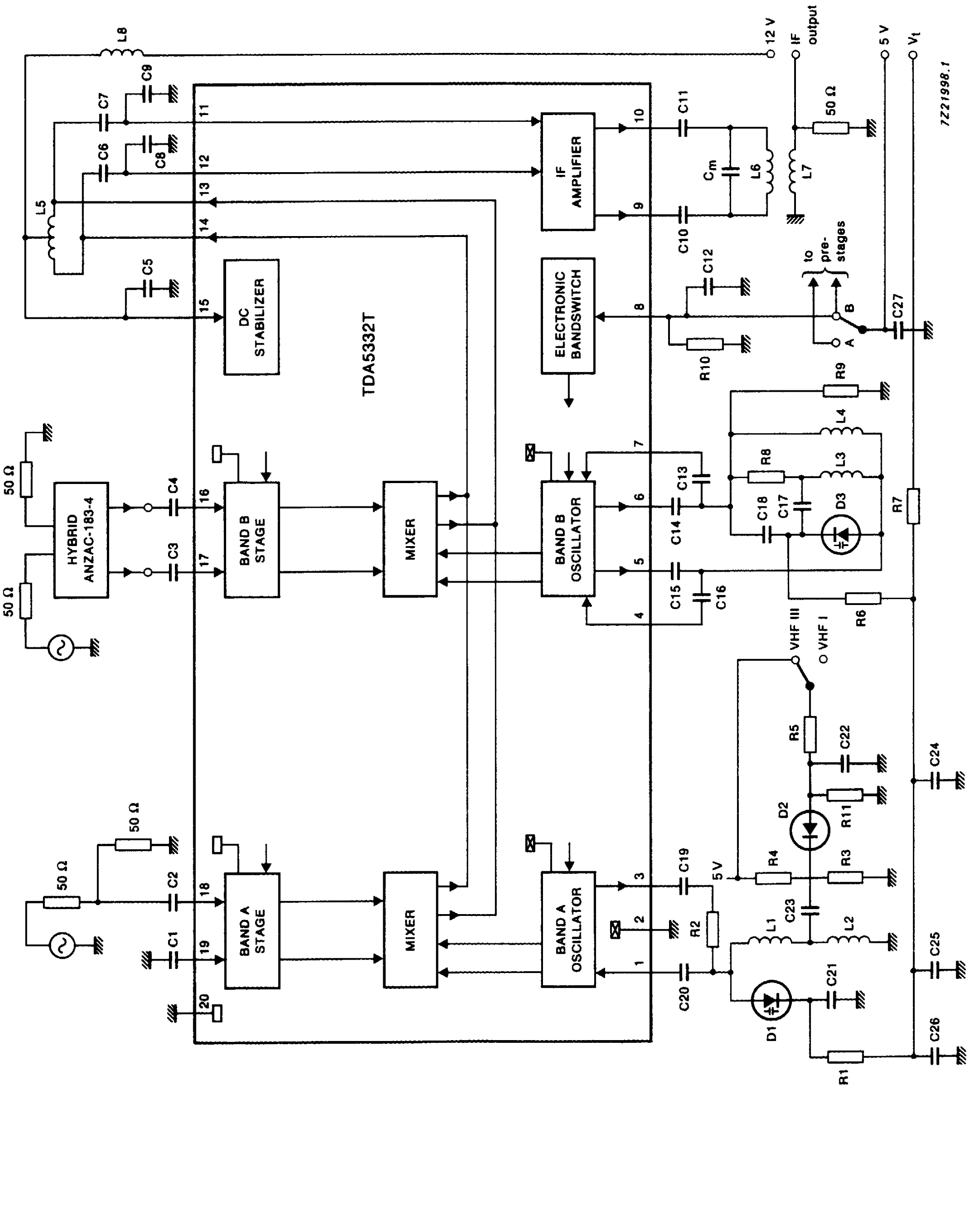
| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input capacitance | 50 – 470 MHz | $C_{18\text{-}20}$ | – | 2.5 | – | pF |
| Input voltage | 1% cross-modulation; in channel; | $V_{18\text{-}20}$ | 97 | 100 | – | dBμV |
| Input voltage | 10 kHz pulling; in channel; f < 300 MHz | $V_{18\text{-}20}$ | 100 | 108 | – | dBμV |
| Voltage gain | 20 log ($V_{9\text{-}10}/V_{18}$) | $G_V$ | 22.5 | 25.0 | 27.5 | dB |
| **Band A mixer** | | | | | | |
| Conversion transadmittance mixer | $I_{13}/V_{18} = -I_{14}/V_{18}$ | $C_t$ | – | 3.5 | – | mS |
| Mixer output admittance | pins 13 and 14 | | – | 0.1 | – | mS |
| Mixer output capacitance | | $C_{13\text{-}14}$ | – | 2 | – | pF |
| **Band A oscillator** | | | | | | |
| Frequency range | | $f_A$ | 80 | – | 520 | MHz |
| Frequency shift | $\Delta V_P$ = 10% note 6; f = 330 MHz | Δf | – | – | 200 | kHz |
| Frequency drift | ΔT = 25 °C note 7; f = 330 MHz | Δf | – | – | 400 | kHz |
| Frequency drift | 5 s to 15 min after switching on; f = 330 MHz | Δf | – | – | 200 | kHz |
| **Band B mixer (including IF)** | measured using circuit shown in Fig.3; measurements using hybrid; note 1 | | | | | |
| Frequency range | | $f_B$ | 160 | – | 860 | MHz |
| Noise factor not corrected for image | pins 16 and 17 | | | | | |
| | 160 MHz | $NF_B$ | – | 9 | 11 | dB |
| | 860 MHz | $NF_B$ | – | 9 | 11 | dB |
| Available input power | note 5; 1% cross-modulation; in channel; pins 16 and 17; | | | | | |
| | 160 MHz | $P_{IB}$ | –25 | –21 | – | dBm |
| | 860 MHz | $P_{IB}$ | –25 | –21 | – | dBm |
| 10 kHz pulling | note 5; pins 16 and 17; in channel | | | | | |
| | 860 MHz | | – | –20 | – | dBm |

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| N + 5 – 1 MHz | | | | | | |
| pulling | notes 2 and 5; 820 MHz | | –42 | –35 | – | dBm |
| Voltage gain | note 3; 160 MHz | $G_{VB}$ | 33 | 36 | 39 | dB |
| | 860 MHz | $G_{VB}$ | 33 | 36 | 39 | dB |
| **Band B oscillator** | | | | | | |
| Frequency range | | $f_B$ | 200 | – | 900 | MHz |
| Frequency shift | note 6; $\Delta V_P$ = 10% | $\Delta f$ | – | – | 400 | kHz |
| Frequency drift | note 7; $\Delta T$ = 25 °C | $\Delta f$ | – | – | 800 | kHz |
| Frequency drift | 5 s to 15 min after switching on | $\Delta f$ | – | – | 400 | kHz |

**Notes to the characteristics**

1. The values have been corrected for hybrid and cable losses. The symmetrical output impedance of the circuit is 100 Ω.
2. The input level of a N + 5 – 1 MHz signal (just visible).
3. The gain is defined as the transducer gain (measured in Fig.3) plus the voltage transformation ratio of L6 to L7 (6:1, 16 dB).
4. All S parameters are referred to a 50 Ω system.
5. The input power is defined as the power delivered by the generator on a 50 Ω load.
6. The frequency shift is defined for a variation of power supply from;
   a) $V_P$ = 12 V to $V_P$ = 10.8 V
   b) $V_P$ = 12 V to $V_P$ = 13.2 V.
   In both cases the frequency shift is below the specified value.
7. The frequency drift is defined for a variation of ambient temperature from;
   a) $T_{amb}$ = 25 °C to $T_{amb}$ = 0 °C
   b) $T_{amb}$ = 25 °C to $T_{amb}$ = 50 °C
   In both cases the frequency shift is below the specified value.

## APPLICATION INFORMATION




Proposal of VHF/UHF tuner

band A = VHF I + VHF III (45 to 300 MHz)
band B = UHF (470 to 900 MHz)

Fig.3 Application diagram.

**Component values of the application diagram**

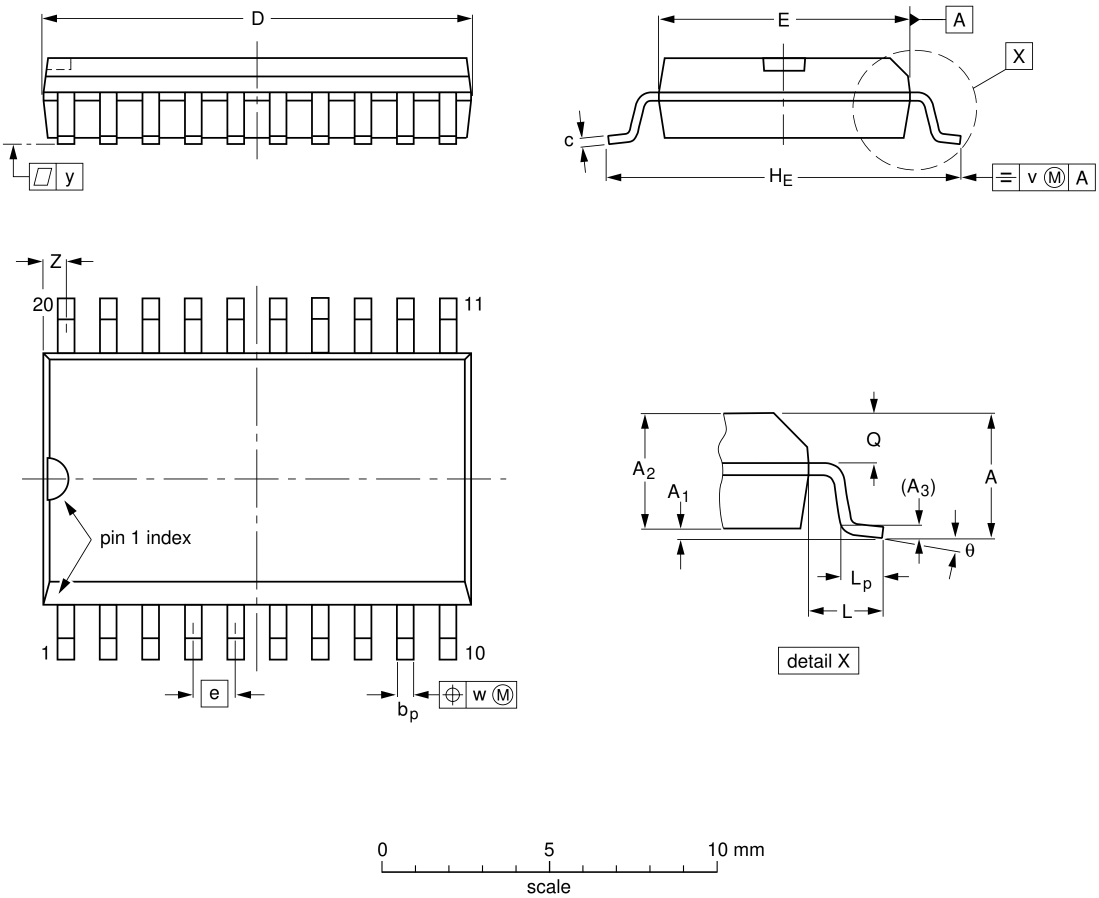
| | | | |
|---|---|---|---|
| resistors | | | |
| R1 = 47 kΩ | R2 = 18 Ω | R3 = 1.2 kΩ | R4 = 4.7 kΩ |
| R5 = 100 Ω | R6 = 22 kΩ | R7 = 1 kΩ | R8 = 2.2 kΩ |
| R9 = 22 kΩ | R10 = 15 kΩ | R11 = 47 kΩ | |
| capacitors | | | |
| C1 = 1 nF | C2 = 1 nF | C3 = 1 nF | C4 = 1 nF |
| C5 = 1 nF | C6 = 1 nF | C7 = 1 nF | C8 = 15 pF (N750) |
| C9 = 15 pF (N750) | C10 = 1 nF | C11 = 1 nF | C12 = 1 nF |
| C13 = 0.68 pF (SMD) | C14 = 1 pF (SMD) | C15 = 1 pF (SMD) | |
| C16 = 0.68 pF (SMD) | C17 = 100 pF (SMD) | C18 = 5.6 pF (SMD) | C19 = 1 pF (NPO) |
| C20 = 1 pF (NPO) | C21 = 82 pF (N750) | C22 = 1 nF | C23 = 1 nF |
| C24 = 1 nF | C25 = 1 nF | C26 = 1 µF (40V) | C27 = 1 nF |
| Cm = 18 pF (N750) | | | |
| diodes and IC | | | |
| D1 = BB911 | D2 = BA482 | D3 = BB405B | IC = TDA5332T |
| coils | | | |
| L1 = 2.5 t (ϕ3) | L2 = 8.5 t (ϕ3) | L3 = 1.5 t (ϕ3) | |
| L4 = 1.5 t (ϕ3) | L5 = 2 × 5 t (note 1) | L8 = 5 µH (choke coil) | |
| transformer | | | |
| L6 = 12t (note 1) | L7 = 2 t | | |
| wire size for L1 to L4 = 0.4 and for L5 to L7 = 0.1 mm. | | | |

**Note**

1. Coil type: TOKO 7 kN; material: 113 kN, screw core (03-0093), pot core (04-0026).

## PACKAGE OUTLINE

**SO20: plastic small outline package; 20 leads; body width 7.5 mm** **SOT163-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.65 | 0.30<br>0.10 | 2.45<br>2.25 | 0.25 | 0.49<br>0.36 | 0.32<br>0.23 | 13.0<br>12.6 | 7.6<br>7.4 | 1.27 | 10.65<br>10.00 | 1.4 | 1.1<br>0.4 | 1.1<br>1.0 | 0.25 | 0.25 | 0.1 | 0.9<br>0.4 | 8°<br>0° |
| inches | 0.10 | 0.012<br>0.004 | 0.096<br>0.089 | 0.01 | 0.019<br>0.014 | 0.013<br>0.009 | 0.51<br>0.49 | 0.30<br>0.29 | 0.050 | 0.419<br>0.394 | 0.055 | 0.043<br>0.016 | 0.043<br>0.039 | 0.01 | 0.01 | 0.004 | 0.035<br>0.016 | |

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT163-1 | 075E04 | MS-013AC | | | | ~~95-01-24~~<br>97-05-22 |

## SOLDERING

### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

### Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

### Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

### Repairing soldered joints

Fix the component by first soldering two diagonally- opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

## DEFINITIONS

| Data sheet status | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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