DATA SHEET

TDA5634T
9 V UHF mixer/oscillator for TV and VCR tuners

Product specification
Supersedes data of 1995 Mar 21
File under Integrated Circuits, IC02

1996 Nov 7

Philips Semiconductors

PHILIPS

9 V UHF mixer/oscillator for TV and VCR tuners

TDA5634T

FEATURES

- Balanced mixer with a common base input
- 4-pin oscillator
- Local oscillator buffer output for external prescaler
- SAW filter preamplifier with a low output impedance to drive the SAW filter directly
- Band gap voltage stabilizer for oscillator stability
- External IF filter between the mixer output and the IF amplifier input.

APPLICATION

- UHF tuners for TV and VCR
- One band tuners.

GENERAL DESCRIPTION

The TDA5634T is an integrated circuit that performs the UHF mixer/oscillator functions in TV and VCR tuners. This low-power mixer/oscillator requires a power supply of 9 V and is available in a very small package.

The device gives the designer the capability to design an economical and physically small tuner.

The tuner development time can be drastically reduced by using this device.

The frequency band is determined by the external tank circuit. It can be adapted to various standards.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage		–	9.0	–	V
I_P	supply current		–	35	–	mA
f_{RF}	RF frequency	RF input; note 1	430	–	860	MHz
G_v	voltage gain		–	36	–	dB
NF	noise figure	not corrected for image	–	9	–	dB
V_o	output voltage causing 1% cross modulation in channel		–	121	–	dBμV

Note

1. The limits are related to the tank circuits used in Fig.7 and the intermediate frequency. Frequency bands may be adjusted by the choice of external components.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA5634T	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

BLOCK DIAGRAM

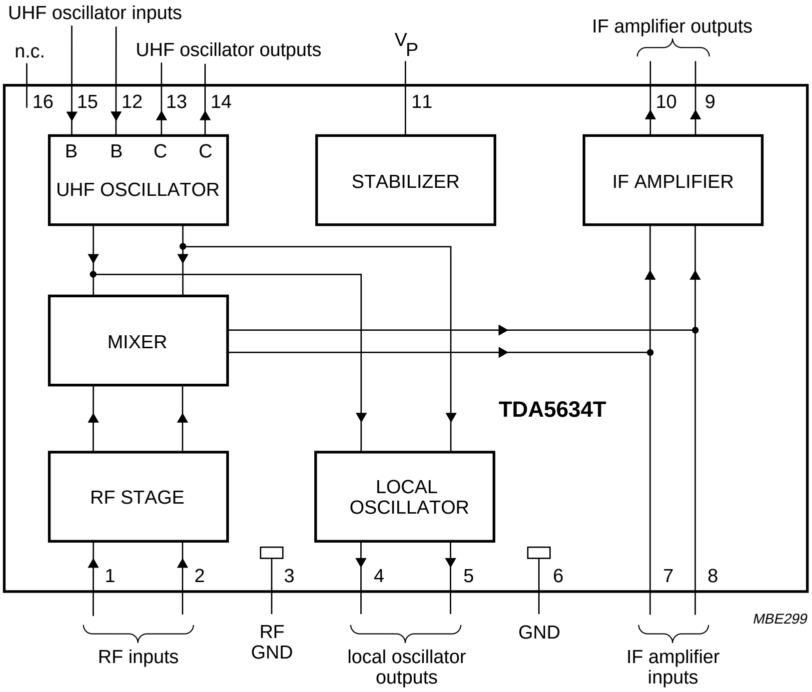


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
CIN1	1	band C input 1
CIN2	2	band C input 2
RFGND	3	ground for RF inputs
LOOUT1	4	local oscillator amplifier output 1
LOOUT2	5	local oscillator amplifier output 2
GND	6	ground (0 V)
IFIN1	7	IF amplifier input 1
IFIN2	8	IF amplifier input 2
IFOUT1	9	IF amplifier output 1
IFOUT2	10	IF amplifier output 2
V_P	11	supply voltage
COSCIB1	12	UHF oscillator input base 1
COSCOC1	13	UHF oscillator output collector 1
COSCOC2	14	UHF oscillator output collector 2
COSCIB2	15	UHF oscillator input base 2
n.c.	16	not connected

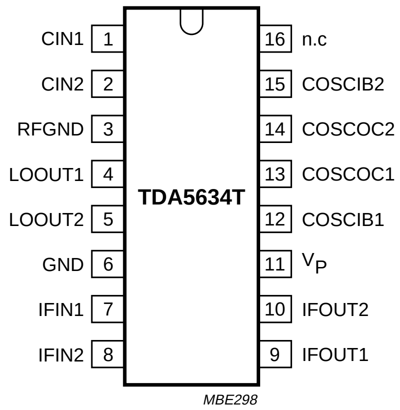


Fig.2 Pin configuration.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	supply voltage	–0.3	+10.5	V
I_O	output current of each pin referenced to ground	–	–10	mA
t_{sc}	maximum short-circuit time (all pins)	–	10	s
T_{stg}	IC storage temperature	–55	+150	°C
T_{amb}	operating ambient temperature	–10	+80	°C
T_j	junction temperature	–	+150	°C

HANDLING

Human body model: the IC withstands 2000 V in accordance with the "*UZW-BO/FQ-A302*", specification equivalent to the *"MIL-STD-883C category B"* (2000 V);
R = 1500 Ω, C = 100 pF.

Machine model: the IC withstands 200 V except pin 11 (175 V) in accordance with the "*UZW-BO/FQ-B302*", specification (date of issue: Nov 6th, 1990);
R = 0 Ω, C = 200 pF.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	120	K/W

CHARACTERISTICS

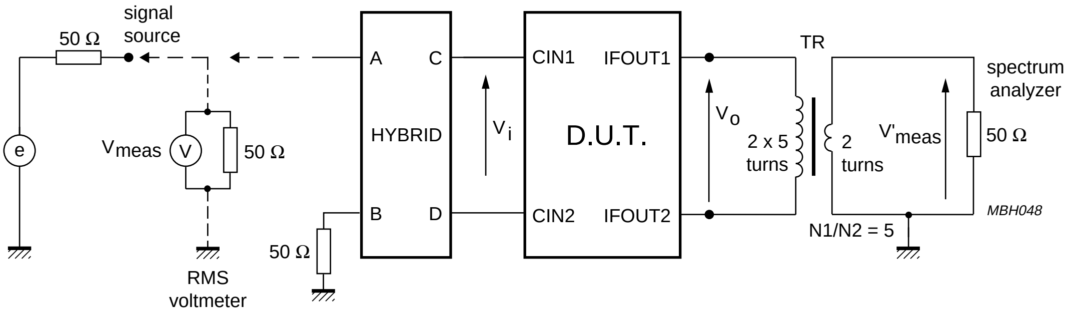
V_P = 9 V; T_{amb} = 25 °C; measured in circuit of Fig.7; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage		8.1	9.0	9.9	V
I_P	supply current	V_P = 8.1 to 9.9 V; T_{amb} = –10 to +80 °C	–	35	45	mA
Mixer (including IF amplifier)						
f_{RF}	RF frequency	note 1	430	–	860	MHz
G_v	voltage gain	f_{RF} = 430 MHz; see Fig.3; note 2	33	36	39	dB
		f_{RF} = 860 MHz; see Fig.3; note 2	33	36	39	dB
NF	noise figure (not corrected for image)	f_{RF} = 430 MHz; see Fig.4	–	9	11	dB
		f_{RF} = 860 MHz; see Fig.4	–	9	11	dB
V_o	output voltage causing 1% cross modulation in channel	f_{RF} = 430 MHz; see Fig.5	115	118	–	dBμV
		f_{RF} = 860 MHz; see Fig.5	118	121	–	dBμV
V_i	input voltage causing 10 kHz pulling in channel	f_{RF} = 860 MHz; note 3	–	87	–	dBμV
	input voltage causing N + 5 – 1 MHz pulling	f_{RF} = 820 MHz; see Fig.6	65	72	–	dBμV
Z_i	input impedance ($R_S + jL_S\omega$)	R_S at f_{RF} = 430 MHz; see Fig.8; note 4	–	28	–	Ω
		R_S at f_{RF} = 860 MHz; see Fig.8; note 4	–	33	–	Ω
		L_S at f_{RF} = 430 to 860 MHz; see Fig.8; note 4	–	8	–	nH
IF amplifier						
S_{11}	input reflection coefficient	magnitude; see Fig.10; note 4	–	–0.6	–	dB
		phase; see Fig.10; note 4	–	–2.5	–	deg
S_{12}	reverse transmission coefficient	magnitude; see Fig.11; note 4	–	–56	–	dB
		phase; see Fig.11; note 4	–	30	–	deg
S_{21}	forward transmission coefficient	magnitude; note 4	–	–9.5	–	dB
		phase; note 4	–	165	–	deg
S_{22}	output reflection coefficient	magnitude; see Fig.11; note 4	–	–7	–	dB
		phase; see Fig.11; note 4	–	6	–	deg
Z_o	output impedance ($R_S + jL_S\omega$)	R_S; see Fig.11; note 4	–	100	–	Ω
		L_S; see Fig.11; note 4	–	32	–	nH
Y_i	input admittance ($G_P + jC_P\omega$)	G_P; see Fig.10; note 4	–	0.8	–	mS
		C_P; see Fig.10; note 4	–	2.5	–	pF

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
LO output; R_L = 100 Ω						
Y_o	output admittance ($G_P + jC_P\omega$)	f_{OSC} = 470 MHz; see Fig.9; note 4	–	3	–	mS
			–	0.5	–	pF
		f_{OSC} = 900 MHz; see Fig.9; note 4	–	3.5	–	mS
			–	0.5	–	pF
V_o	output voltage	R_L = 50 Ω; V_P = 8.1 to 9.9 V; T_{amb} = –10 to +80 °C	83	91	100	dBμV
SRF	spurious signal on LO output with respect to LO output signal	R_L = 50 Ω; note 5	–	–	–10	dBc
SHD	LO signal harmonics with respect to LO signal	R_L = 50 Ω	–	–	–10	dBc
Band C oscillator						
f_{OSC}	oscillator frequency	V_t = 0.45 to 28 V; V_P = 8.1 to 9.9 V; T_{amb} = –10 to +80 °C; note 6	470	–	900	MHz
f_{shift}	frequency shift	ΔV_P = 10%; note 7	–	–	400	kHz
f_{drift}	frequency drift	ΔT = 25 °C without compensation; NP0 capacitors; note 8	–	–	2.5	MHz
		ΔT = 25 °C with compensation; note 9	–	–	800	kHz
		5 s to 15 minutes after switch on; without compensation; note 10	–	–	600	kHz

Notes

1. The RF frequency range is defined by the oscillator frequency range and the intermediate frequency.
2. The gain is defined as the transducer gain (measured in Fig.7) plus the voltage transformation ratio of L3 to L2 (10 : 2, 15.4 dB including transformer loss).
3. The input level causing 10 kHz frequency detuning at the LO output; $f_{osc} = f_{RF}$ + 33.4 MHz.
4. All S-parameters are referred to a 50 Ω system.
5. Measured with RF input voltage of 97 dBμV at 430 MHz < f_{RF} < 860 MHz.
6. Limits are related to the tank circuits used in Fig.7. Frequency bands may be adjusted by the choice of external components.
7. The frequency shift is defined as the change in oscillator frequency when the supply voltage varies from V_P = 9 to 8.1 V or from V_P = 9 to 9.9 V.
8. The frequency drift is defined as the change in oscillator frequency when the ambient temperature varies from T_{amb} = 25 °C to 0 °C or from T_{amb} = 25 °C to 50 °C. Without compensation, the capacitors C11 to C15 are NP0.
9. The frequency drift is defined as the change in oscillator frequency when the ambient temperature varies from T_{amb} = 25 °C to 0 °C or from T_{amb} = 25 °C to 50 °C. With compensation, the capacitors C11 to C14 are N750 and C15 is N470.
10. Switch on drift is defined as the change in oscillator frequency between 5 s and 15 min after switch on.



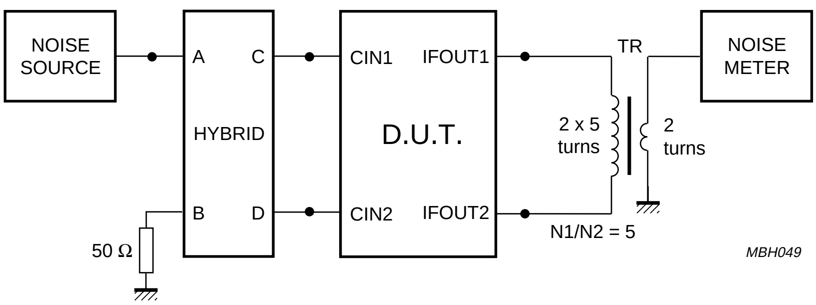
Loss of the hybrid: 1 dB.

$V_i = V_{meas}$ – loss of the hybrid.

$V_o = V'_{meas}$ + 15.4 dB (transformer ratio N1/N2 = 5 and transformer loss).

$$G_v = 20\log\frac{V_o}{V_i} = 20\log\frac{V'_{meas}}{V_{meas}} + 15.4\text{ dB} + \text{loss of the hybrid.}$$

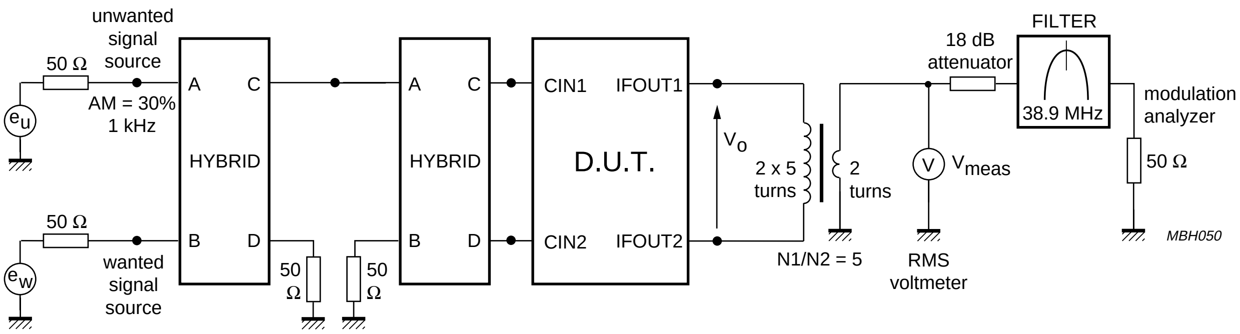
Fig.3 Gain measurement in band C.



Loss of the hybrid: 1 dB.

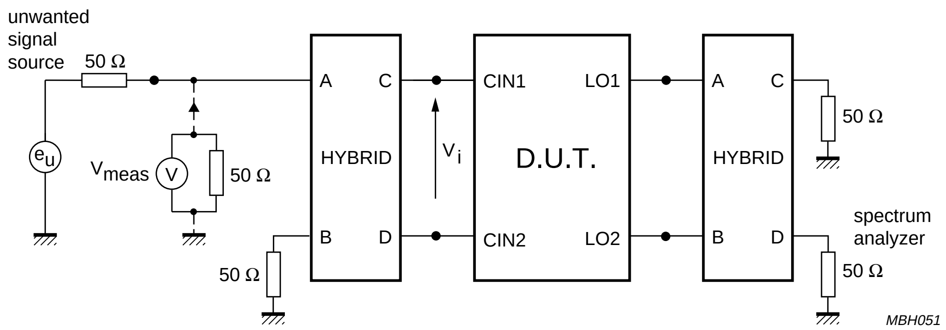
NF = NF_{meas} – loss of the hybrid.

Fig.4 Noise figure measurement in band C.



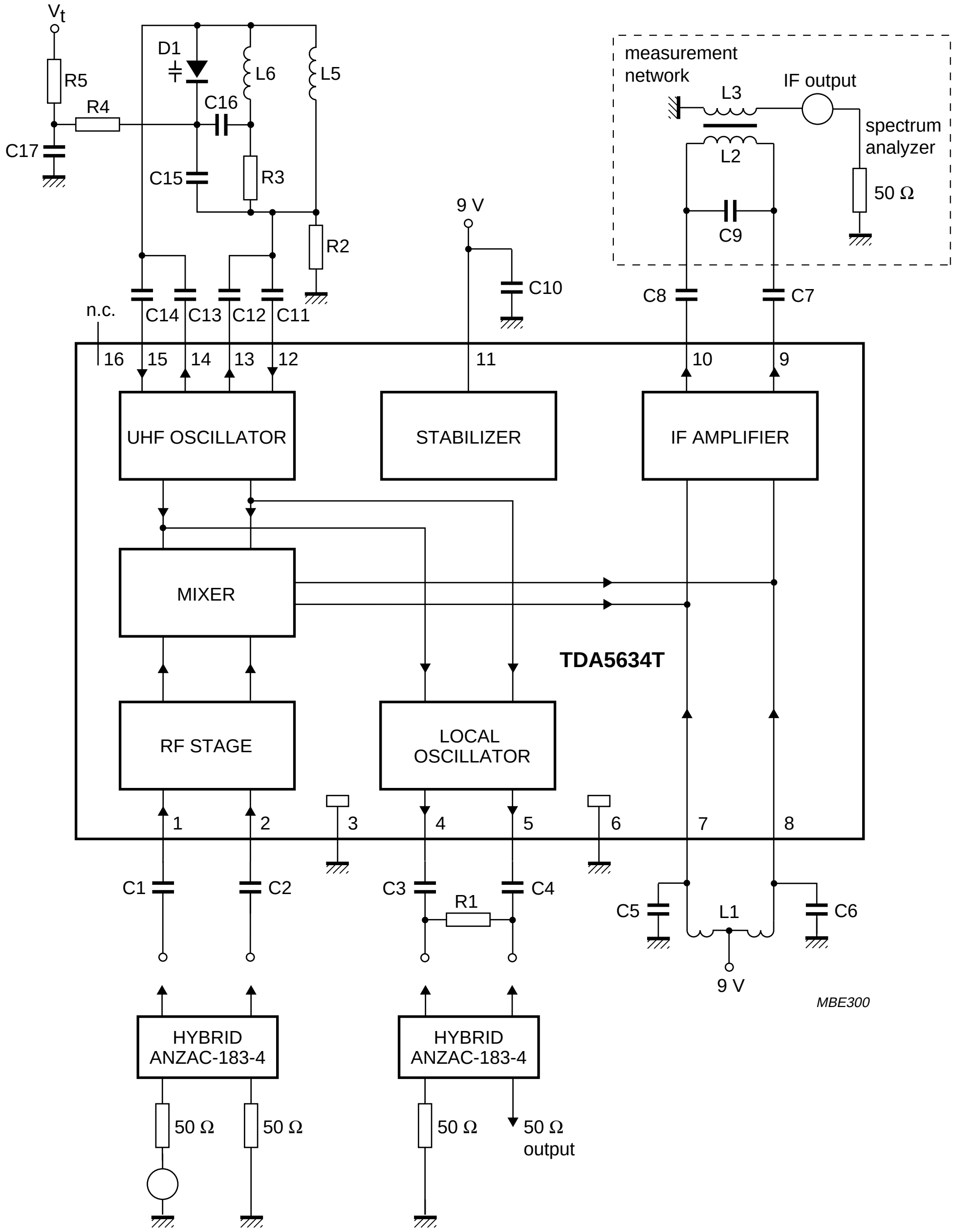
$V_{meas} = V_o$ – 15.4 dB (transformer ratio N1/N2 = 5 and transformer loss).
Wanted output signal at f_{RFW}: V_{ow} = 108 dBμV, V_{meas} = 92.6 dBμV.
Measuring the level of the unwanted output signal V_{ou} causing 0.3 % AM modulation in the wanted output signal.
$V_{ou} = V_{meas}$ + 15.4 dB.
$f_{RFU} = f_{RFW}$ + 5.5 MHz; $f_{osc} = f_{RF}$ + 38.9 MHz.
Filter characteristics: f_c = 38.9 MHz; f_{-3dBBW} = 1.2 MHz; $f_{-30dBBW}$ = 2.64 MHz.

Fig.5 Cross modulation measurement in band C.



Loss of the hybrid: 1 dB.
In band C: f_{RFW} = 781 MHz. These wanted signals are not used during the measurement.
In band C: f_{osc} = 819.9 MHz.
In band C: f_{RFU} = 820 MHz = f_{RFW} + 5 × 8 MHz – 1 MHz.
Measuring the level of the unwanted signal V_{iu} causing FM sidebands 30 dB below the oscillator carrier at the LO output.
$V_{iu} = V_{meas}$ – loss of the hybrid.

Fig.6 N + 5 – 1 MHz pulling measurement in band C.



L2, L3 and C9 are only required for measurement purposes; they are not used in a tuner.

Fig.7 Measurement circuit.

Component values for measurement circuit

Table 1 Capacitors (all SMD and NP0 except C11 to C15)

COMPONENT	VALUE
C1	1 nF
C2	1 nF
C3	1 nF
C4	1 nF
C5	18 pF
C6	18 pF
C7	1 nF
C8	1 nF
C9	18 pF
C10	22 nF
C11	1 pF (N750)
C12	1 pF (N750)
C13	1 pF (N750)
C14	1 pF (N750)
C15	6 pF (N470)
C16	100 pF
C17	1 µF (40 V electrolytic capacitor)

Table 2 Resistors (all SMD)

COMPONENT	VALUE
R1	100 Ω
R2	22 kΩ
R3	2.2 kΩ
R4	22 kΩ
R5	47 kΩ

Table 3 Diodes and IC

COMPONENT	VALUE
D1	BB215
IC	TDA5634T

Table 4 Coils (wire size 0.4 mm)

COMPONENT	VALUE
L5	2.5 turns; diameter 3 mm
L6	2.5 turns; diameter 2.5 mm

Table 5 Transformers; note 1

COMPONENT	VALUE
L1	2 × 6 turns
L2	2 × 5 turns
L3	2 turns

Note

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

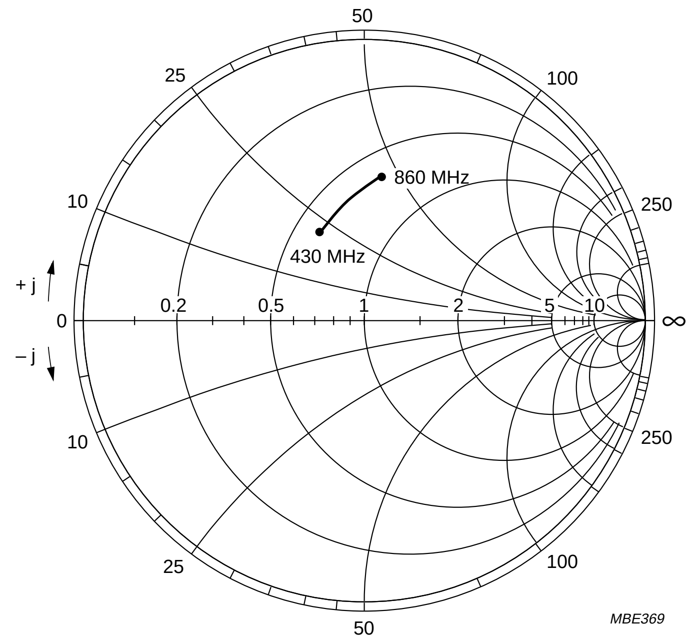


Fig.8 Input impedance (S_{11}) of the mixer input (430 to 860 MHz) (Z chart).

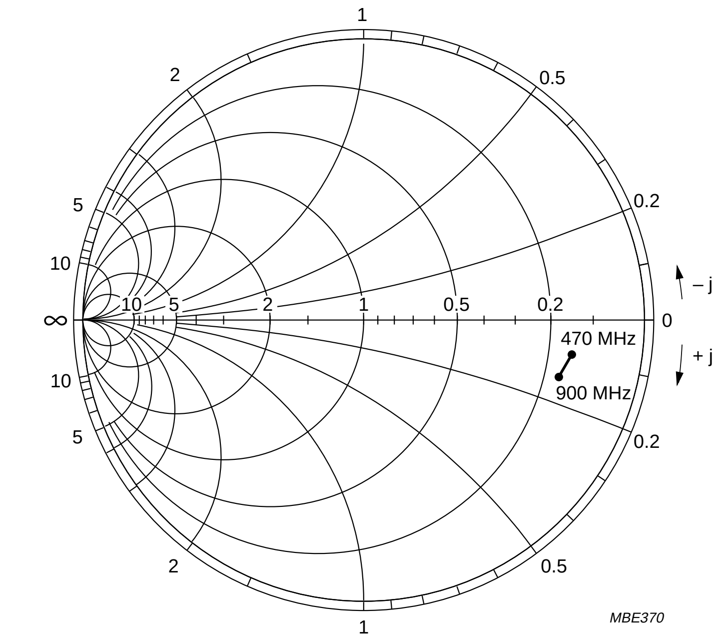


Fig.9 Output admittance (S_{22}) of the LO output (470 to 900 MHz) (Y chart).

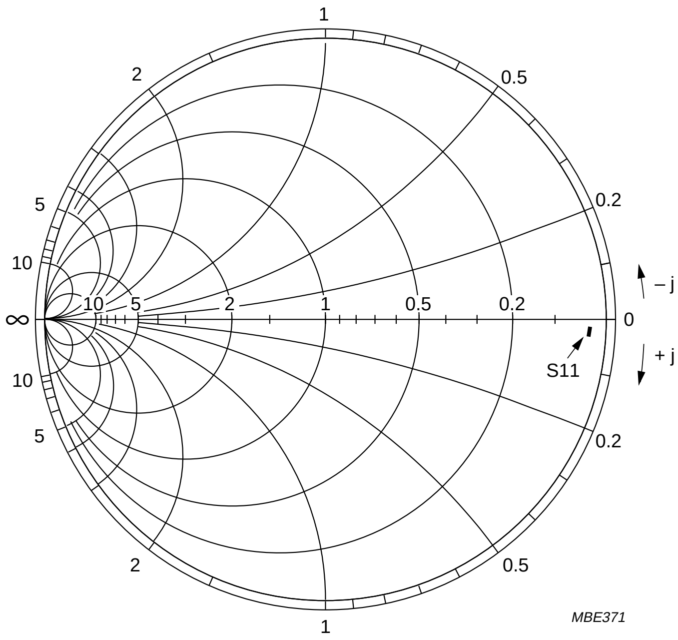


Fig.10 Input admittance (S_{11}) of the IF amplifier (25 to 45 MHz) (Y chart).

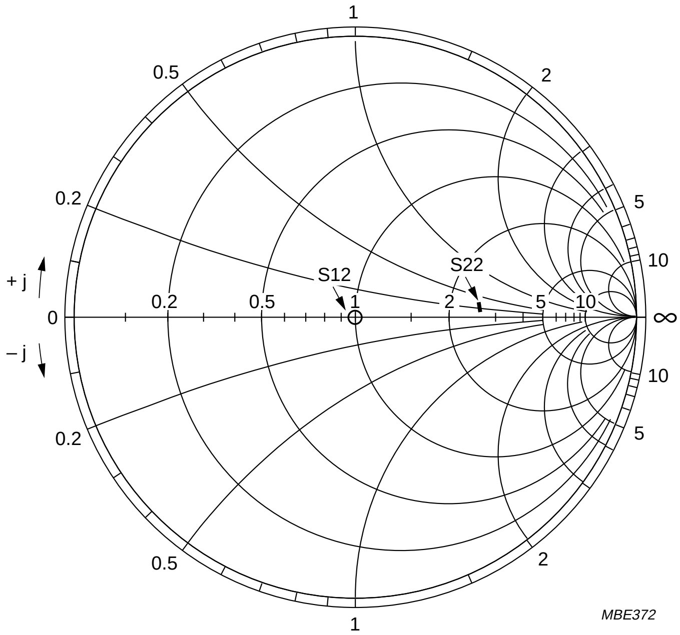
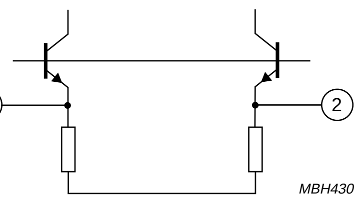
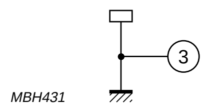
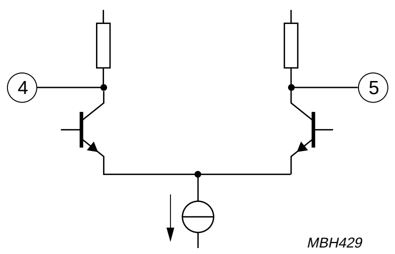
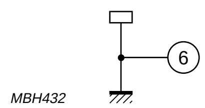
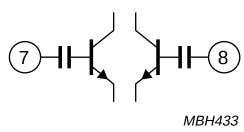
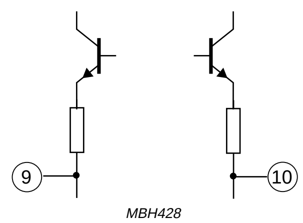
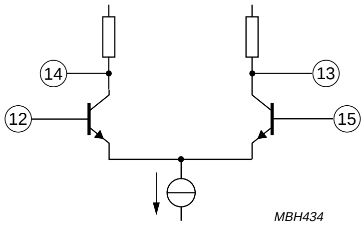


Fig.11 Reverse transmission and output reflection coefficient (S_{12} and S_{22}) of the IF amplifier (25 to 45 MHz) (Z chart).

INTERNAL PIN CONFIGURATION

SYMBOL	PIN	DESCRIPTION	AVERAGE DC VOLTAGE(1) IN (V)
	TDA5634T		BAND C
CIN1	1		2.2
CIN2	2		2.2
RFGND	3		0.0
LOOUT1	4		7.3
LOOUT2	5		7.3
GND	6		0
IFIN1	7		9.0
IFIN2	8		9.0
IFOUT1	9		3.8
IFOUT2	10		3.8

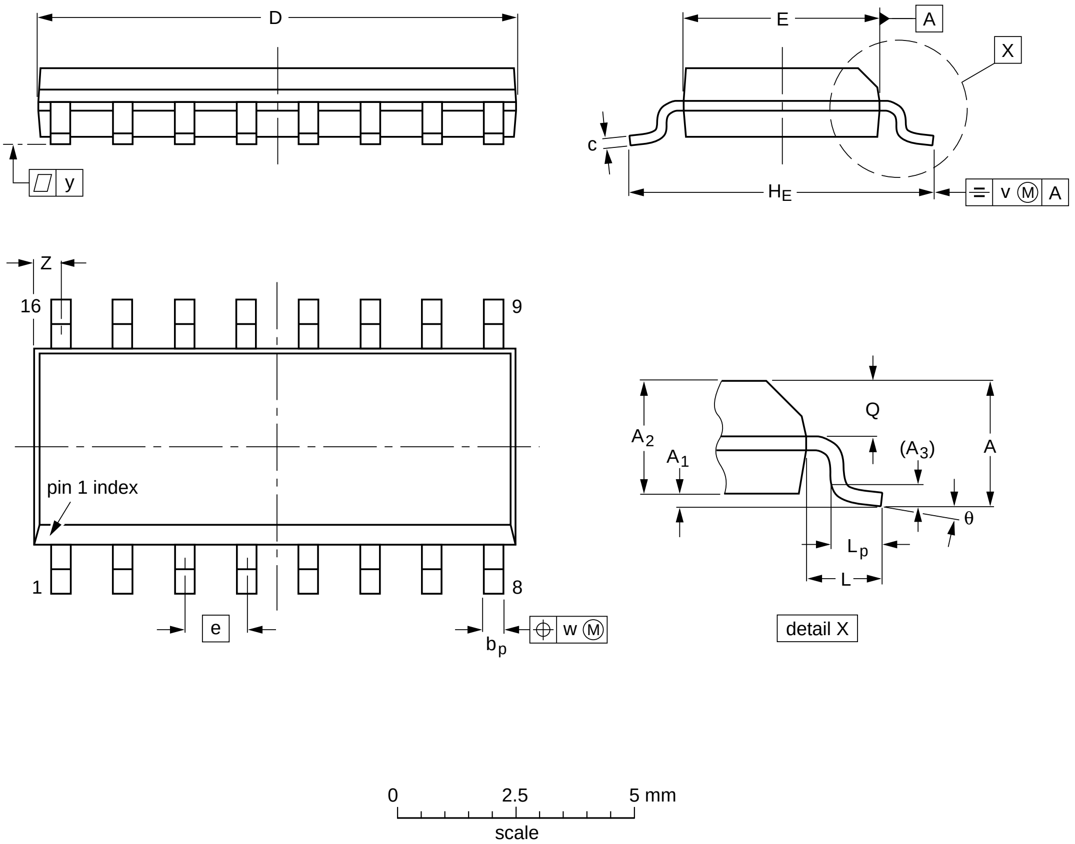
SYMBOL	PIN	DESCRIPTION	AVERAGE DC VOLTAGE(1) IN (V)
	TDA5634T		BAND C
V_P	11	supply voltage	9.0
COSCIB1	12		2.3
COSCOC1	13		4.4
COSCOC2	14		4.4
COSCIB2	15		2.3
n. c.	16	not connected	N.R.(2)

Notes

1. Average DC voltage measured in circuit of Fig.7.
2. N.R. = Not Relevant.

PACKAGE OUTLINE

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



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	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

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			
SOT109-1	076E07S	MS-012AC				~~91-08-13~~ 95-01-23

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.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.