DATA SHEET

TDA5732M
Low power VHF, UHF mixer/oscillator for TV and VCR 2-band tuners

Preliminary specification
File under Integrated Circuits, IC02

1995 Mar 22

PHILIPS

Low power VHF, UHF mixer/oscillator for TV and VCR 2-band tuners

TDA5732M

FEATURES

- Balanced mixer with a common emitter input for band A
- 2-pin oscillator for band A
- Balanced mixer with a common base input for band C
- 4-pin oscillator for band C
- Local oscillator buffer output for external prescaler
- SAW filter preamplifier with a low output impedance of 75 Ω
- Band gap voltage stabilizer for oscillator stability
- Electronic band switch
- External IF filter connected between the mixer output and the IF amplifier input.

DESCRIPTION

The TDA5732M is a monolithic integrated circuit that performs VHF I, VHF III, hyperband and UHF mixer/oscillator functions in TV and VCR tuners. This low-power mixer/oscillator requires a power supply of 5 V and is available in a very small package.

The device gives the designer the capability to design an economical and physically small 2-band tuner.

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

APPLICATIONS

- 2-band TV tuners
- 2-band VCR tuners.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage		–	5.0	–	V
I_P	supply current		–	50	–	mA
f_R	frequency range	band A	55.25	–	361.25	MHz
		band C	367.25	–	801.25	MHz
N	noise figure	band A	–	9.5	–	dB
		band C	–	10	–	dB
V_o	IF output voltage	band A; R_L = 75 Ω; 1% cross modulation	–	108	–	dBμV
		band C; R_L = 75 Ω; 1% cross modulation	–	108	–	dBm
G_v	voltage gain	band A; R_L = 75 Ω	–	19	–	dB
		band C; R_L = 75 Ω	–	29	–	dB

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA5732M	SSOP20	plastic shrink small outline package; 20 leads; body width 4.4 mm	SOT266-1

BLOCK DIAGRAM

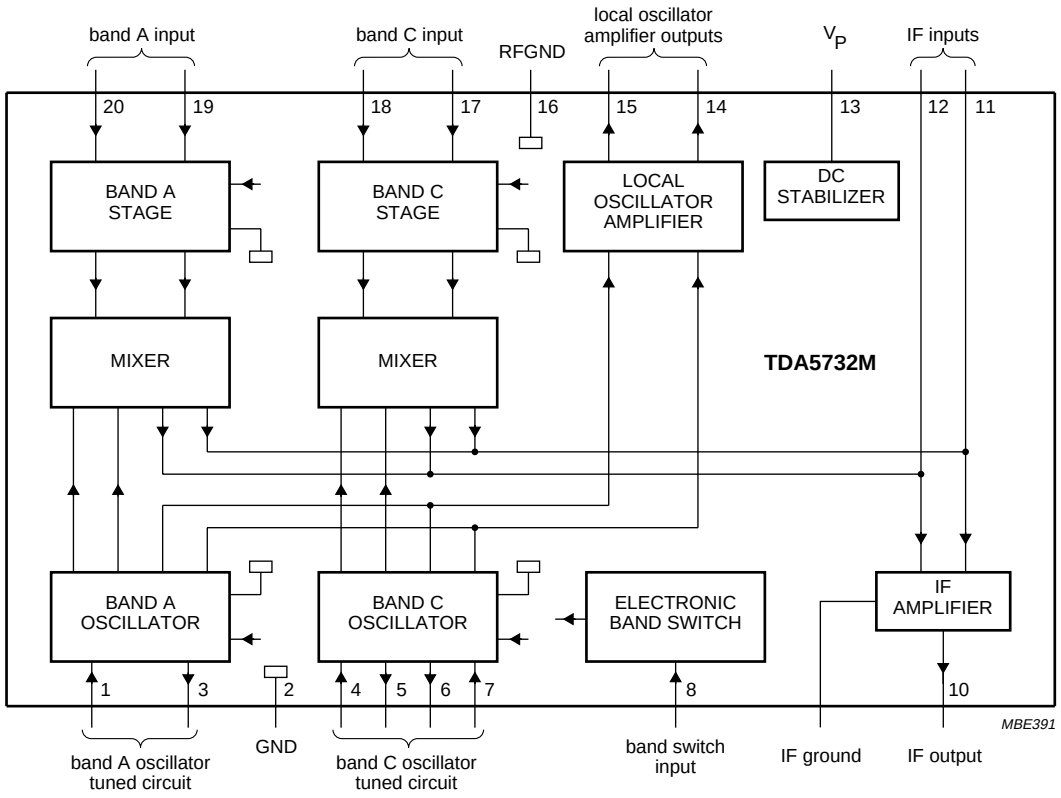


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
AOSCIB	1	band A oscillator input base
GND	2	ground (0 V)
AOSCOC	3	band A oscillator output collector
COSCIB1	4	band C oscillator input base 1
COSCOC1	5	band C oscillator output collector 1
COSCOC2	6	band C oscillator output collector 2
COSCIB2	7	band C oscillator input base 2
BS	8	electronic band switch input
IFGND	9	ground for IF inputs
IFOUT	10	IF amplifier output
IFIN1	11	IF amplifier input 1
IFIN2	12	IF amplifier input 2
V_P	13	supply voltage
LOOUT1	14	local oscillator amplifier output 1
LOOUT2	15	local oscillator amplifier output 2
RFGND	16	ground for RF inputs
CIN1	17	band C input 1
CIN2	18	band C input 2
AIN1	19	band A input 1
AIN2	20	band A input 2

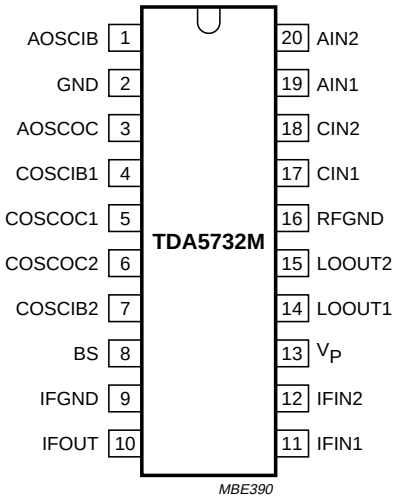


Fig.2 Pin configuration.

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	supply voltage range	–0.3	+7.0	V
$V_{P(op)}$	operating supply voltage	4.5	5.5	V
$V_{n(max)}$	maximum voltage on each pin with a 22 kΩ resistor connected in series	–	35	V
V_{SW}	switching voltage	0	7.0	V
T_{stg}	storage temperature	–55	+150	°C
T_{amb}	operating ambient temperature	–20	+85	°C
T_j	junction temperature	–	+150	°C

THERMAL CHARACTERISTICS

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

HANDLING

Human body model: the IC withstands 2000 V (except pins 17 and 18 which withstand 1000 V) in accordance with *UZW-BO-FQ-A302*; R = 1.5 kΩ; C = 100 pF.

Machine model: the IC withstands 200 V in accordance with *UZW-BO-FQ-B302*; R = 0 Ω; C = 200 pF.

CHARACTERISTICS

V_P = 5 V; T_{amb} = 25 °C; unless otherwise specified.

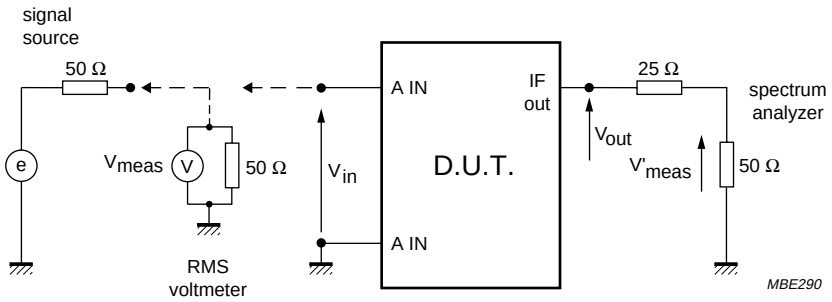
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage		4.5	5.0	5.5	V
I_P	supply current	$I_{P(max)}$ measured at $V_{P(max)}$	–	50	64	mA
V_{SW}	switching voltage	band A	0	–	2.0	V
		band C	3.0	–	V_P	V
I_{SW}	switching current	band A; V_{SW} = 0 V	–	–	2	µA
		band C; V_{SW} = 5 V	–	4.5	10	µA
		$V_{P(max)}$	–	6	–	µA
IF amplifier						
S_{22}	output reflection coefficient	f_i = 43.5 MHz; see Fig.12	–	–13.1	–	dB
		f_i = 43.5 MHz; see Fig.12	–	2.9	–	deg
		f_i = 58.75 MHz; see Fig.12	–	–13.1	–	dB
		f_i = 58.75 MHz; see Fig.12	–	2.2	–	deg
Z_O	output impedance	f_i = 43.5 MHz; see Fig.12	–	78.4	–	Ω
		f_i = 43.5 MHz; see Fig.12	–	1.8	–	Ω
		f_i = 58.75 MHz; see Fig.12	–	78.4	–	Ω
		f_i = 58.75 MHz; see Fig.12	–	–1.4	–	Ω
SLO	visibility of the LO frequency at the IF output (worst case in the frequency range of band A and band C)	R_L = 75 Ω	–	85	–	dBµV
Band A mixer (including IF amplifier)						
f_R	frequency range	VHFI	55.25	–	127.25	MHz
		VHFIII	133.25	–	361.25	MHz
N_A	noise figure	f_i = 50 MHz; see Fig.7	–	8.5	9.5	dB
		f_i = 150 MHz; see Fig.7	–	8.5	10.5	dB
		f_i = 300 MHz; see Fig.7	–	9.5	12.5	dB
g_{os}	optimum source conductance	f_i = 50 MHz; see Fig.7	–	0.7	–	mS
		f_i = 150 MHz; see Fig.7	–	0.9	–	mS
		f_i = 300 MHz; see Fig.7	–	1.5	–	mS
Y_I	input admittance (G_P//C_P)	G_P; f_i = 55.25 MHz; see Fig.9	–	0.25	–	mS
		G_P; f_i = 361.25 MHz; see Fig.9	–	0.5	–	mS
		C_P; f_i = 55.25 to 361.25 MHz; see Fig.9	–	1.3	–	pF
$V_{oA(IF)}$	IF output voltage	1% cross modulation; in channel; f_i = 55.25 to 361.25 MHz; R_L = 75 Ω; wanted frequency sound carrier; unwanted frequency picture carrier; see Fig.5	105	108	–	dBµV

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{i(RF)}$	RF input voltage	f_i = 173 MHz; note 1	–	91	–	dBµV
		f_i = 407 MHz; note 1	–	83	–	dBµV
$G_{v(A)}$	voltage gain at the channel centre	f_{IF} = 43.5 MHz; R_L = 75 Ω; see Fig.3	16.5	19	21.5	dB
Band A oscillator						
f_R	frequency range	VHFI	101	–	173	MHz
		VHFIII	179	–	407	MHz
f_{shift}	frequency shift (worst case in the frequency range)	ΔV_P = 5%; note 2	–	44	100	kHz
		ΔV_P = 10%; note 2	–	220	–	kHz
$\chi_{ripple(p-p)}$	ripple susceptibility of the supply voltage (peak-to-peak value	V_P = 4.75 to 5.25 V; f_i = 101 MHz; note 3	–	78	–	mV
		V_P = 4.75 to 5.25 V; f_i = 173 MHz; note 3	–	34	–	mV
		V_P = 4.75 to 5.25 V; f_i = 179 MHz; note 3	–	8.0	–	mV
		V_P = 4.75 to 5.25 V; f_i = 407 MHz; note 3	–	10	–	mV
f_{drift}	frequency drift (worst case in the frequency range)	ΔT = 25 °C with no compensation; NP0 capacitors; note 4	–	1800	2200	kHz
		5 s to 15 min after switch on; note 5	–	630	1100	kHz
Φ_N	phase noise, carrier-to-noise sideband (worst case in the frequency range)	±50 kHz; frequency offset; B = 3 kHz	–	60	–	dBc
Band C mixer (including IF amplifier)						
f_R	frequency range, picture carrier		367.25	–	801.25	MHz
N_C	noise figure (not corrected for image)	f_i = 367.25 MHz	–	9	11	dB
		f_i = 801.25 MHz	–	10	12	dB
Z_I	input impedance (R_s + L_s)	R_s; f_i = 367.25 MHz; see Fig.10	–	30	–	Ω
		L_s; f_i = 367.25 MHz; see Fig.10	–	9	–	nH
		R_s; f_i = 801.25 MHz; see Fig.10	–	38	–	Ω
		L_s; f_i = 801.25 MHz; see Fig.10	–	6	–	nH
$V_{oC(IF)}$	IF output voltage	1% cross modulation; in channel; f_i = 365.25 to 801.25 MHz; R_L = 75 Ω; wanted frequency sound carrier; unwanted frequency picture carrier; see Fig.6	105	108	–	dBµV
$V_{i(RF)}$	RF input voltage	f_i = 847 MHz; note 1	–	66	–	dBµV
$G_{v(C)}$	voltage gain	f_{IF} = 43.5 MHz; R_L = 75 Ω; see Fig.4	26	29	32	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Band C oscillator						
f_R	frequency range		413	–	847	MHz
f_{shift}	frequency shift	ΔV_P = 5%; note 2	–	46	200	kHz
		ΔV_P = 10%; note 2	–	200	–	kHz
$\chi_{ripple(p-p)}$	ripple susceptibility of the supply voltage (peak-to-peak value	V_P = 4.75 to 5.25 V; f_i = 413 MHz	–	203	–	mV
		V_P = 4.75 to 5.25 V; f_i = 847 MHz; note 3	–	22	–	mV
f_{drift}	frequency drift (worst case in the frequency range)	ΔT = 25 °C with compensation; note 4	–	1100	2500	kHz
		5 s to 15 min after switching on; note 5	–	300	1300	kHz
Φ_N	phase noise, carrier-to-noise sideband (worst case in the frequency range)	±50 kHz; frequency offset; B = 3 kHz	–	64	–	dBc
LO output						
Y_O	output admittance (G_P//C_P)	G_P; f_i = 101 MHz; see Fig.11	–	2.4	–	mS
		G_P; f_i = 847 MHz; see Fig.11	–	3.1	–	mS
		C_P; f_i = 101 to 847 MHz; see Fig.11	–	0.5	–	pF
V_O	output voltage	R_L = 50 Ω; V_P = 4.5 to 5.5 V; V_t = 0 to 28 V	83	90	100	dBμV
SRF	spurious signal on LO output with respect to LO output signal	R_L = 50 Ω; note 6	–	–15	–10	dB
HLO	LO signal harmonics w.r.t. LO signal	R_L = 50 Ω	–	–10.5	–9.5	dB

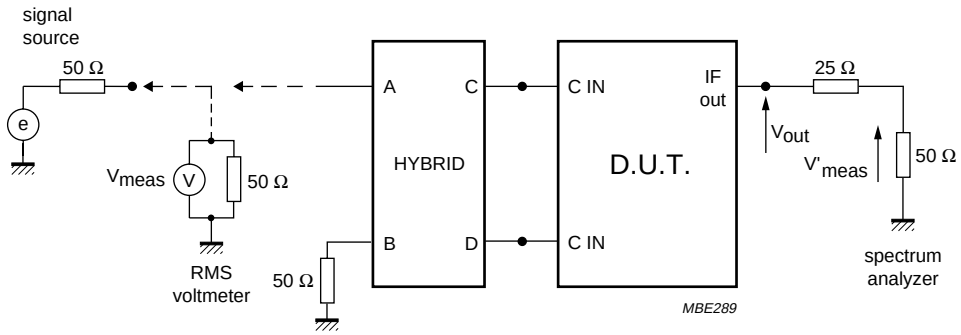
Notes

1. The RF signal is modulated with 50% AM at 15 kHz: The level of the RF signal is increased until there is a 23 dB difference between the LO carrier and the sideband components.
2. The frequency shift is defined as a variation in oscillator frequency when the supply voltage varies from V_P = 5 to 4.75 V or from V_P = 5 to 5.75 V.
3. The ripple susceptibility is measured for a 500 kHz ripple at the LO output with the set-up as illustrated in Fig.8. The level of the ripple signal is increased until there is a 53.5 dB difference between the LO carrier and the sideband components.
4. The frequency shift is defined as a variation in oscillator frequency when the supply voltage varies from T_{amb} = 25°C to 0°C or from T_{amb} = 25°C to 50°C.
5. The switching on drift is defined as the variation in oscillator frequency between 5 seconds and 15 minutes after switching on.
6. SRF: spurious signal on LO with respect to LO output signal;
   a) RF voltage level = 1 V at f_i = 55.25 to 225 MHz.
   b) RF level = 2.5 dBm at f_i = 225 to 361.25 MHz.
   c) RF level = –10 dBm at f_i = 367.25 to 801.25 MHz.



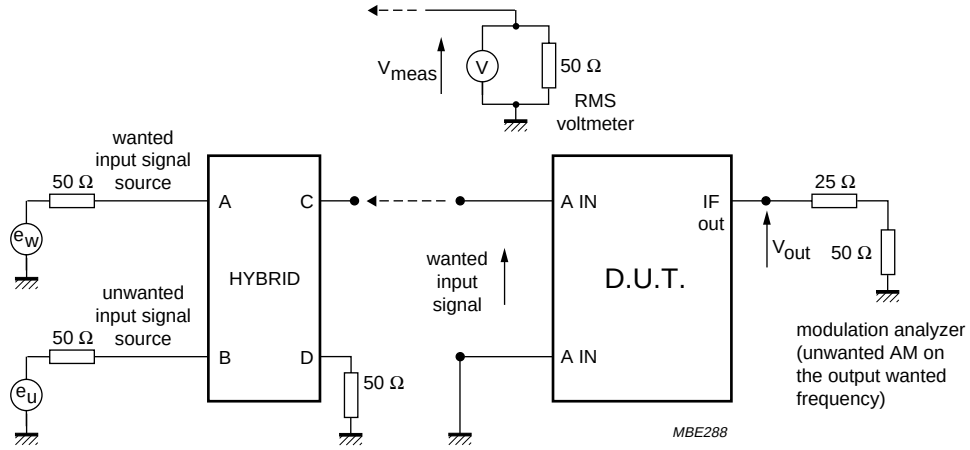
$Z_i >> 50\ \Omega \geq V_i = 2V_{meas}$ (V_i = 80 dBµV); $V_o = V'_{meas} \times (50 + 25)/50$; voltage gain for band A = $20\log(V_o/V_i)$.

Fig.3 Band A gain measurement.



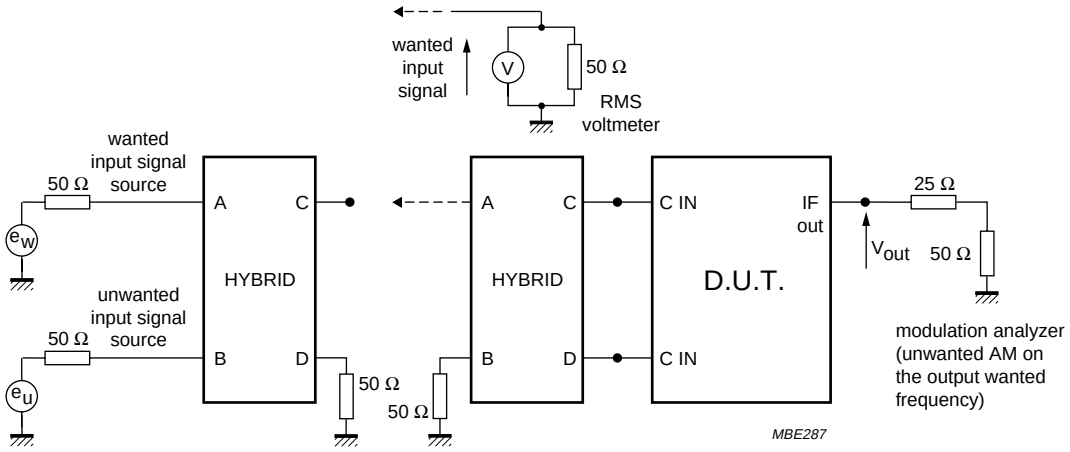
$V_i = V_{meas}$ (V_i = 70 dBµV); $V_o = V'_{meas} \times (50 + 25)/50$; voltage gain for band C = $20\log(V_o/V_i)$.

Fig.4 Band C gain measurement.



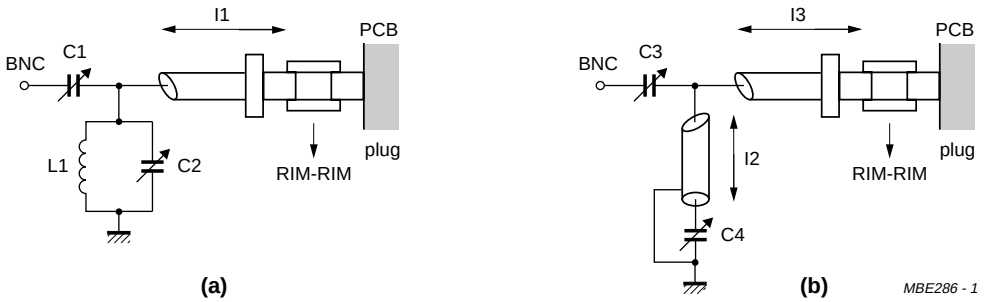
Wanted input signal = 80 dBµV; Zi >> 50 Ω ≥ wanted input signal = $2V_{meas}$; unwanted input signal modulated with 30% AM; $V_{oA(IF)}$ = unwanted output signalV_o when the output wanted signal is modulated with 0.3% AM.

Fig.5 Band A 1% cross modulation.



Wanted input signal = 70 dBµV; unwanted input signal modulated with 30% AM; $V_{oA(IF)}$ = unwanted output signal V_o when the output wanted signal is modulated with 0.3% AM.

Fig.6 Band C 1% cross modulation.



(a) For f_R = 50 MHz:
mixer A frequency response measured = 57 MHz, loss = 0 dB
image suppression = 16 dB
C1 = 9 pF
C2 = 15 pF
L1 = 7 turns (5.5mm, wire diam. = 0.5 mm)
l1 = rigid cable (RIM): 5 cm long
(rigid cable (RIM); 33 dB/100 m; 50 Ω, 96 pF/m).

(b) For f_R = 180 MHz:
mixer A frequency response measured = 150.3 MHz, loss = 1.3 dB
image suppression = 13 dB
C3 = 5 pF
C4 = 25 pF
l2 = rigid cable (RIM): 30 cm long
l3 = rigid cable (RIM): 5 cm long
(rigid cable (RIM); 33 dB/100 m; 50 Ω; 96 pF/m).

Fig.7 Input circuit for minimum noise figure.

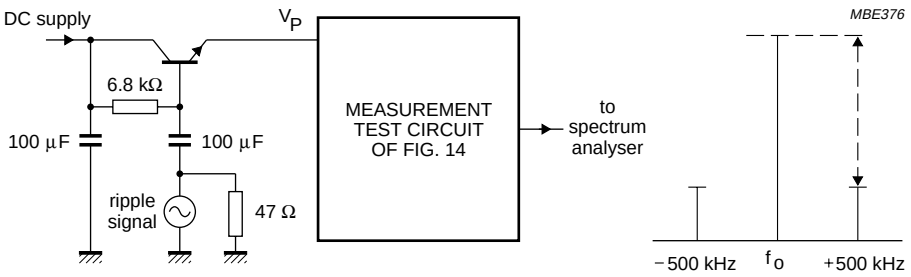


Fig.8 Measurement set-up for ripple measurement,

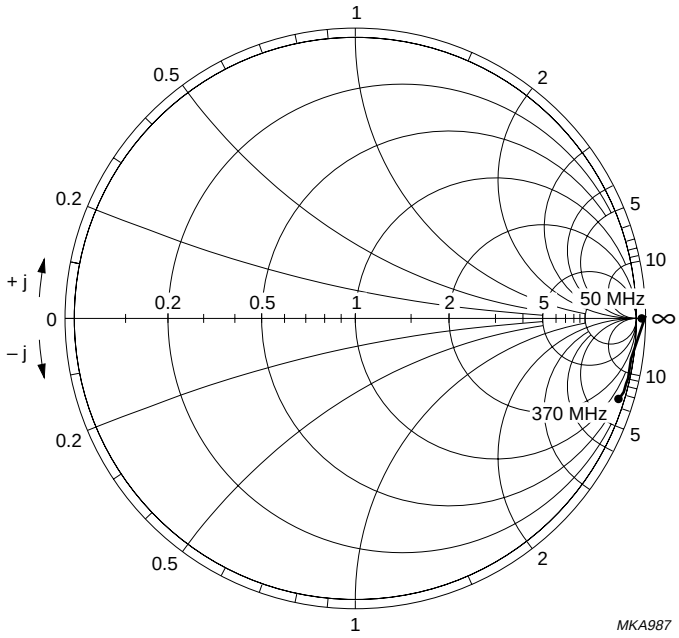


Fig.9 S_{11} on VHF mixer input (Z chart; Z_o = 50 Ω).

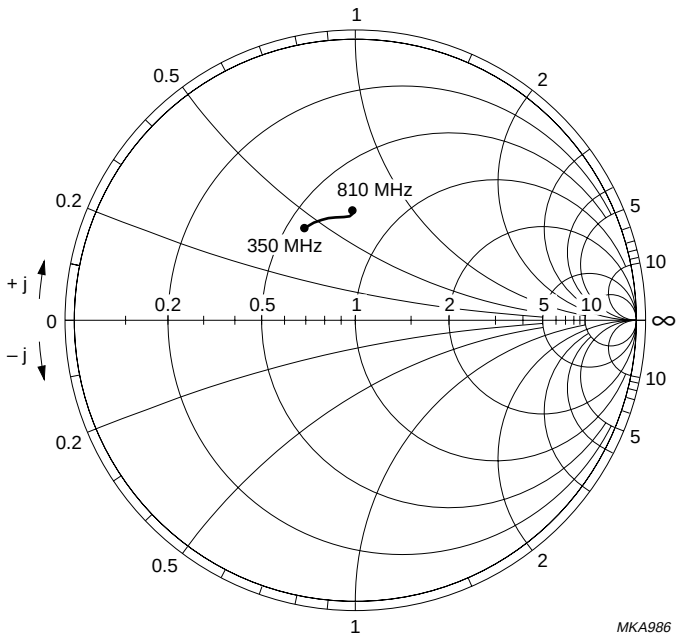


Fig.10 S_{11} on UHF mixer input (Z chart; Z_o = 50 Ω).

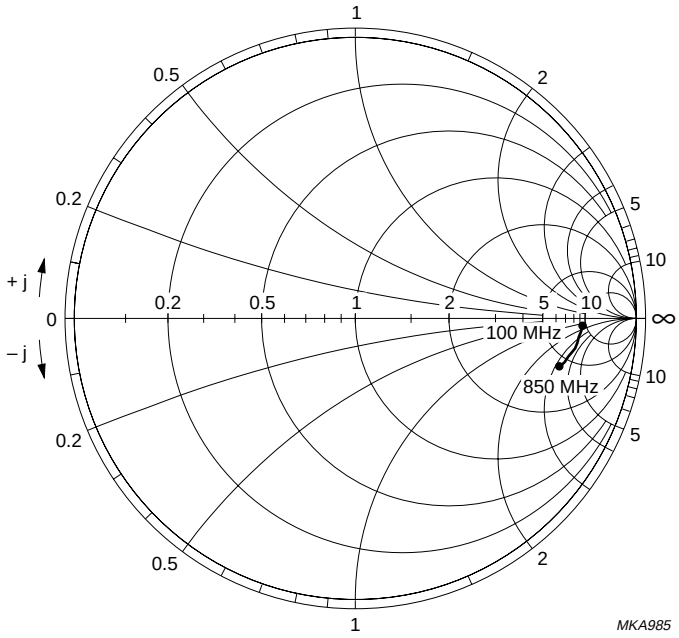


Fig.11 S_{22} on LO output (Z chart; Z_o = 50 Ω).

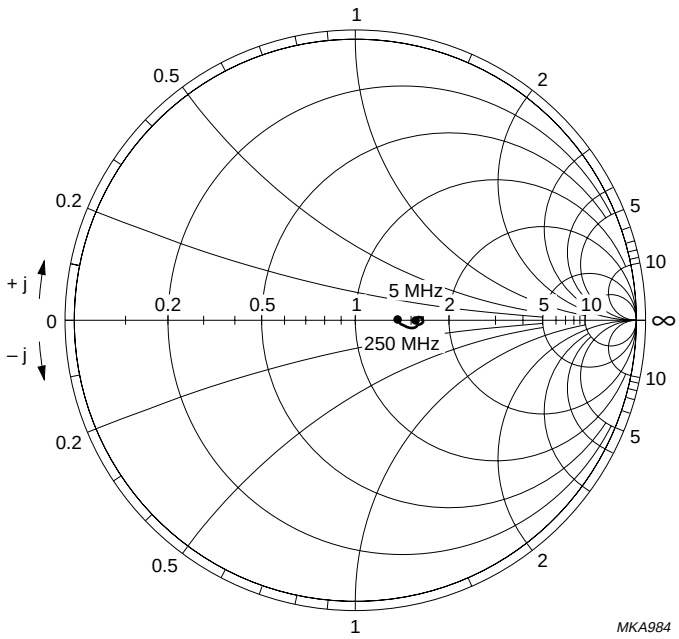


Fig.12 S_{22} on IFoutput (Z chart; Z_o = 50 Ω).

INTERNAL PIN CONFIGURATION

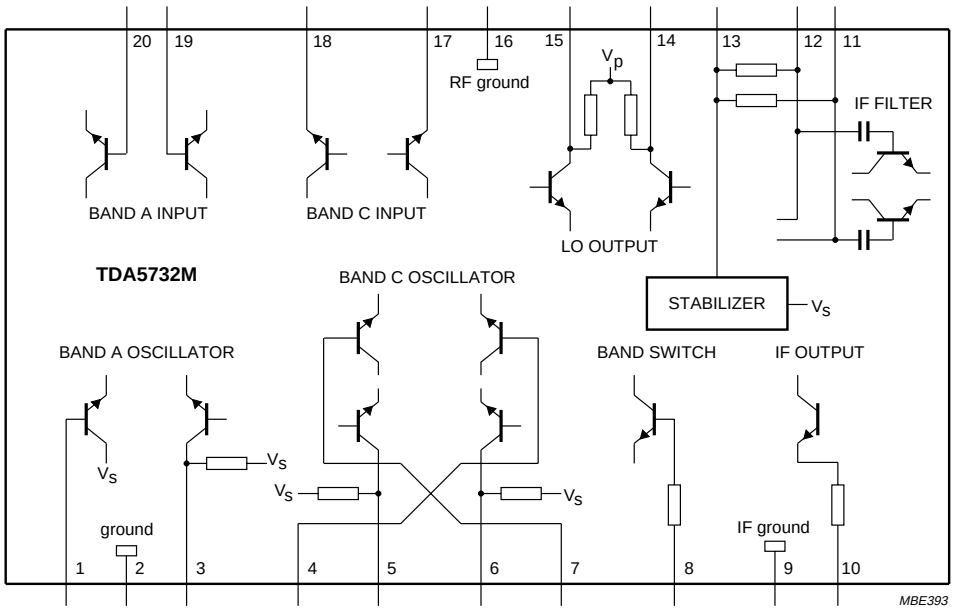


Fig.13 Internal pin configuration.

Table 1 Average DC voltage on pins

UHF/ VHF	PINS																			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
VHF	1.8	0	3	–	3.6	3.6	–	0	0	2.1	3.6	3.6	5	4.2	4.2	0	–	–	1.8	1.8
UHF	–	0	3.6	1.9	2.9	2.9	1.9	5	0	2.1	3.6	3.6	5	4.2	4.2	0	1	1	–	–

APPLICATION INFORMATION

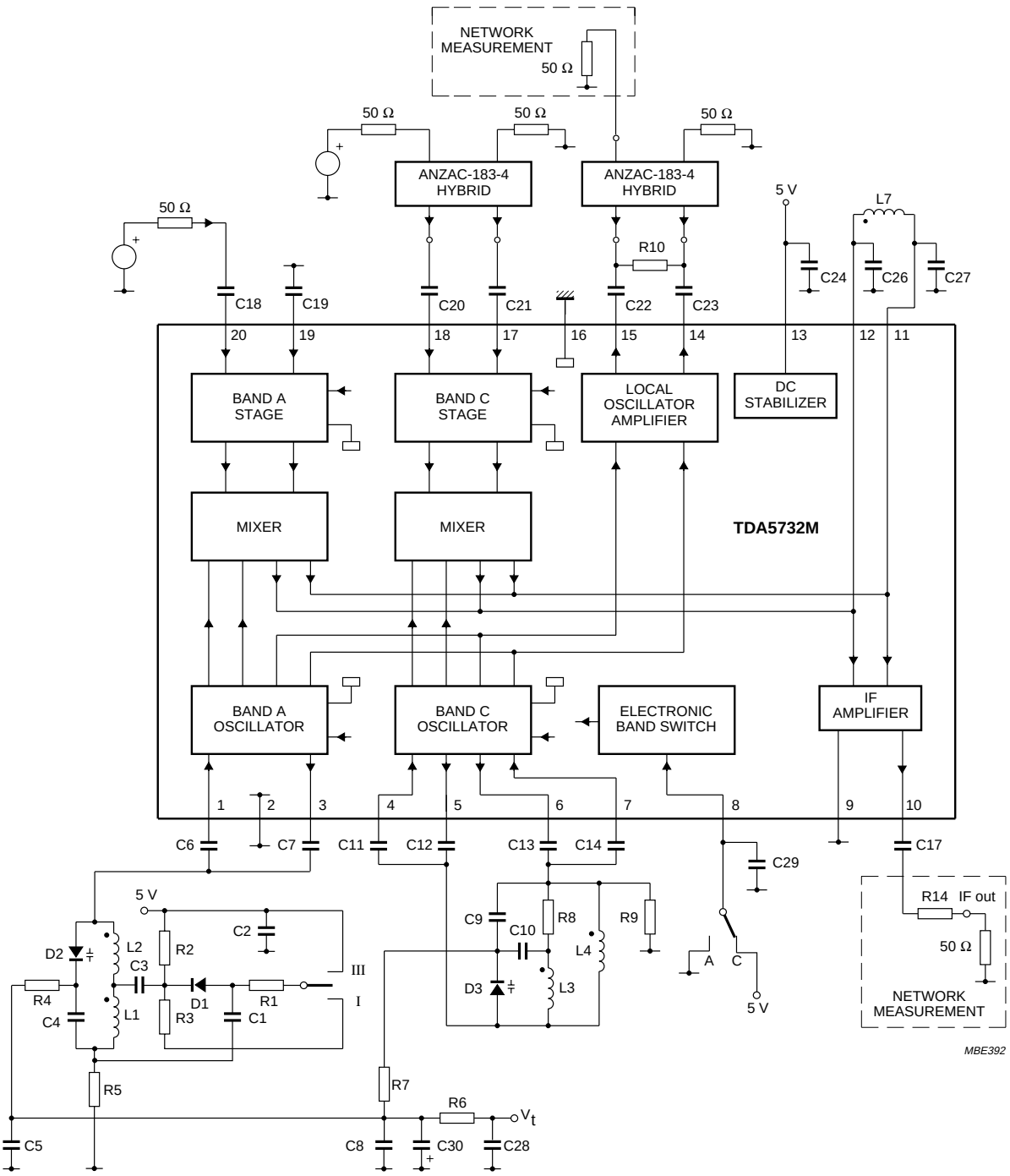


Fig.14 Measurement test circuit.

Application diagram components values

Table 2 Capacitors (all SMD and NP0 except C9 to C11 to C14 and C29)

NUMBER	VALUE
C1	1 nF
C2	1 nF
C3	1 nF
C4	82 pF
C5	2.2 nF
C6	2.2 nF
C7	1.5 pF
C8	2.2 nF
C9	6 pF (N750)
C10	100 pF
C11	1 pF (N1500)
C12	2 pF (N750)
C13	2 pF (N750)
C14	1 pF (N1500)
C17	1 nF
C18	1 nF
C19	1 nF
C20	1 nF
C21	1 nF
C22	1 nF
C23	1 nF
C24	1 nF
C26	15 pF
C27	15 pF
C28	2.2 nF
C29	1 nF
C30	1 µF (40 V electrolytic capacitor)

Table 3 Resistors (all SMD)

NUMBER	VALUE
R1	10 Ω
R2	12 kΩ
R3	2.7 kΩ
R4	47 kΩ
R5	10 Ω
R6	47 kΩ
R7	22 kΩ
R8	2.2 kΩ
R9	22 kΩ
R10	100 Ω
R14	27 Ω

Table 4 Diodes and coils

NUMBER	VALUE
Diodes	
D1	BA792
D2	BB133
D3	BB134
Coils(1)	
L1	6 t (3.5 mm)
L2	3 t (2.5 mm)
L3	2 t (2.5 mm)
L4	3 t (3 mm)

Note

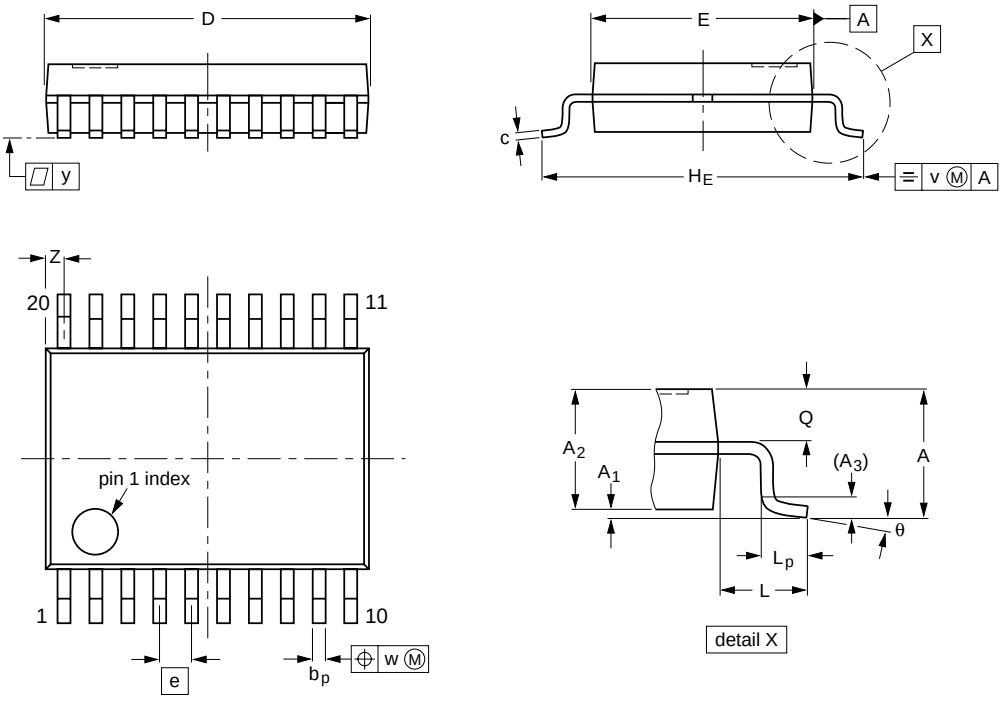
1. Wire size for L1 to L4 is 0.4 mm

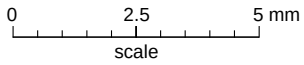
Transformer (L7 = 2 turns)

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

PACKAGE OUTLINE

SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm **SOT266-1**





DIMENSIONS (mm are the original 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	1.5	0.15 0	1.4 1.2	0.25	0.32 0.20	0.20 0.13	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10^o 0^o

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES					EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ				
SOT266-1							~~90-04-05~~ 95-02-25

SOLDERING

Plastic small outline packages

BY WAVE

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

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

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

BY SOLDER PASTE REFLOW

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

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to 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 min at 45 °C.

REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

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.