DATA SHEET

TDA1572
AM receiver circuit

Product specification
File under Integrated Circuits, IC01

December 1987

Philips
Semiconductors

PHILIPS

GENERAL DESCRIPTION

The TDA1572 integrated AM receiver circuit performs all the active functions and part of the filtering required of an AM radio receiver. It is intended for use in mains-fed home receivers and car radios. The circuit can be used for oscillator frequencies up to 50 MHz and can handle RF signals up to 500 mV.

RF radiation and sensitivity to interference are minimized by an almost symmetrical design. The controlled-voltage oscillator provides signals with extremely low distortion and high spectral purity over the whole frequency range, even when tuning with variable capacitance diodes. If required, band switching diodes can easily be applied. Selectivity is obtained using a block filter before the IF amplifier.

Features

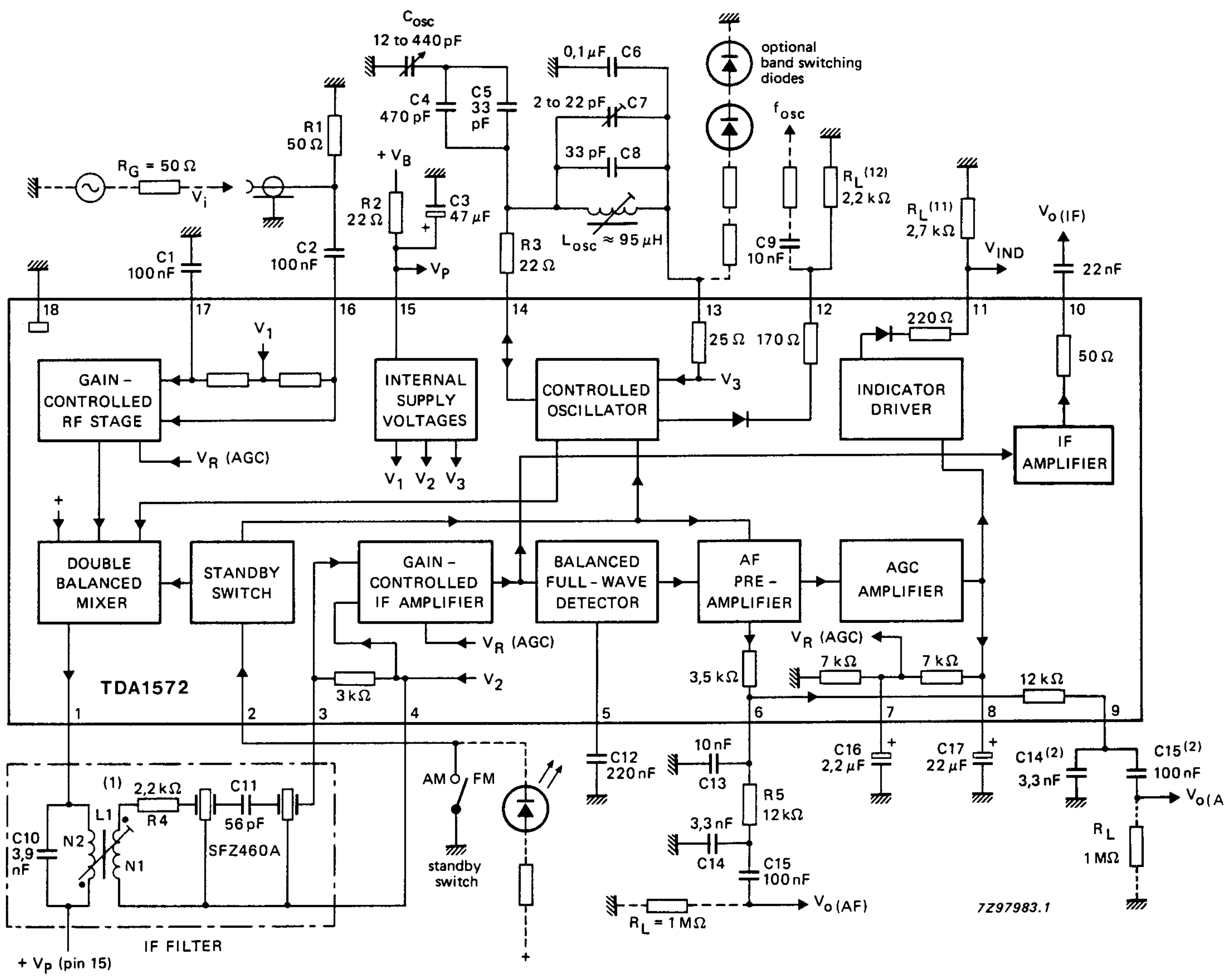
- Inputs protected against damage by static discharge
- Gain-controlled RF stage
- Double balanced mixer
- Separately buffered, voltage-controlled and temperature-compensated oscillator, designed for simple coils
- Gain-controlled IF stage with wide AGC range
- Full-wave, balanced envelope detector
- Internal generation of AGC voltage with possibility of second-order filtering
- Buffered field strength indicator driver with short-circuit protection
- AF preamplifier with possibilities for simple AF filtering
- Electronic standby switch
- IF output for stereo demodulator and search tuning.

QUICK REFERENCE DATA

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage range	V_P	7,5	–	18,0	V
Supply current range	I_P	15	–	30	mA
RF input voltage for (S+N)/N = 6 dB at m = 30%	$V_{i(RF)}$	–	1,5	–	μV
RF input voltage for 3% total harmonic distortion (THD) at m = 80%	$V_{i(RF)}$	–	500	–	mV
IF output voltage with V_i = 2 mV	$V_{o(IF)}$	–	230	–	mV
AF output voltage with V_i = 2 mV; f_i = 1 MHz; m = 30%; f_m = 400 Hz	$V_{o(AF)}$	–	310	–	mV
AGC range: change of V_i for 1 dB change of $V_{o(AF)}$		–	86	–	dB
Field strength indicator voltage at V_i = 500 mV; $R_{L(11)}$ = 2,7 kΩ	V_{IND}	–	2,8	–	V

PACKAGE OUTLINE

18-lead DIL; plastic (SOT102); SOT102-1; 1996 August 12.



(1) Coil data: TOKO sample no. 7XNS-A7523DY; L1 : N1/N2 = 12/32; Q_o = 65; Q_B = 57.
Filter data: Z_F = 700 Ω at R_{3-4} = 3 kΩ; Z_I = 4,8 kΩ.

(2) AF output is pin 6 is not used.

Fig.1 Block diagram and test circuit (connections shown in broken lines are not part of the test circuit).

FUNCTIONAL DESCRIPTION

Gain-controlled RF stage and mixer

The differential amplifier in the RF stage employs an AGC negative feedback network to provide a wide dynamic range. Very good cross-modulation behaviour is achieved by AGC delays at the various signal stages. Large signals are handled with low distortion and the (S+N)/N ratio of small signals is improved. Low noise working is achieved in the differential amplifier by using transistors with low base resistance.

A double balanced mixer provides the IF output signal to pin 1.

Oscillator

The differential amplifier oscillator is temperature compensated and is suitable for simple coil connection. The oscillator is voltage-controlled and has little distortion or spurious radiation. It is specially suitable for electronic tuning using variable capacitance diodes. Band switching diodes can easily be applied using the stabilized voltage $V_{13\text{-}18}$. An extra buffered oscillator output (pin 12) is available for driving a synthesizer. If this is not needed, resistor $R_{L(12)}$ can be omitted.

Gain-controlled IF amplifier

This amplifier comprises two cascaded, variable-gain differential amplifier stages coupled by a band-pass filter. Both stages are gain-controlled by the AGC negative feedback network. The IF output is available at pin 10.

Detector

The full-wave, balanced envelope detector has very low distortion over a wide dynamic range. Residual IF carrier is blocked from the signal path by an internal low-pass filter.

AF preamplifier

This stage preamplifies the audio frequency output signal. The amplifier output has an emitter follower with a series resistor which, together with an external capacitor, yields the required low-pass for AF filtering.

AGC amplifier

The AGC amplifier provides a control voltage which is proportional to the carrier amplitude. Second-order filtering of the AGC voltage achieves signals with very little distortion, even at low audio frequencies. This method of filtering also gives fast AGC settling time which is advantageous for electronic search tuning. The AGC settling time can be further reduced by using capacitors of smaller value in the external filter (C16 and C17). The AGC voltage is fed to the RF and IF stages via suitable AGC delays. The capacitor at pin 7 can be omitted for low-cost applications.

Field strength indicator output

A buffered voltage source provides a high-level field strength output signal which has good linearity for logarithmic input signals over the whole dynamic range. If the field strength information is not needed, $R_{L(11)}$ can be omitted.

Standby switch

This switch is primarily intended for AM/FM band switching. During standby mode the oscillator, mixer and AF preamplifier are switched off.

Short-circuit protection

All pins have short-circuit protection to ground.

RATINGS

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

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Supply voltage	$V_P = V_{15\text{-}18}$	–	20	V
Total power dissipation	P_{tot}	–	875	mW
Input voltage	$\lvert V_{16\text{-}17} \rvert$	–	12	V
	$-V_{16\text{-}18}, -V_{17\text{-}18}$	–	0,6	V
	$V_{16\text{-}18}, V_{17\text{-}18}$	–	V_P	V
Input current	$\lvert I_{16} \rvert, \lvert I_{18} \rvert$	–	200	mA
Operating ambient temperature range	T_{amb}	–40	+ 85	°C
Storage temperature range	T_{stg}	–55	+ 150	°C
Junction temperature	T_j	–	+ 125	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	80	K/W

CHARACTERISTICS

$V_P = V_{15\text{-}18} = 8{,}5$ V; $T_{amb} = 25$ °C; $f_i = 1$ MHz; $f_m = 400$ Hz; m = 30%; $f_{IF} = 460$ kHz; measured in test circuit of Fig.1; all voltages referenced to ground; unless otherwise specified.

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply					
Supply voltage (pin 15)	V_P	7,5	8,5	18,0	V
Supply current (pin 15)	I_P	15	23	30	mA
RF stage and mixer (pins 16 and 17)					
DC input voltage	V_I	–	$V_P/2$	–	V
RF input impedance at V < 300 µV	Z_i	–	5,5	–	kΩ
RF input capacitance	C_i	–	25	–	pF
RF input impedance at V_I > 10 mV	Z_i	–	8	–	kΩ
RF input capacitance	C_i	–	22	–	pF
IF output impedance (pin 1)	Z_o	200	–	–	kΩ
IF output capacitance	C_o	–	6	–	pF
Conversion transconductance before start of AGC	I_1/V_i	–	6,5	–	mA/V
Maximum IF output voltage, inductive coupling to pin 1 (peak-to-peak value)	$V_{1\text{-}15(p\text{-}p)}$	–	5	–	V
DC value of output current; at $V_I = 0$ V (pin 1)	I_O	–	1,2	–	mA
AGC range of input stage		–	30	–	dB
RF signal handling capability: (r.m.s. value): input voltage for THD = 3% at m = 80%	$V_{i(rms)}$	–	500	–	mV
Oscillator					
Frequency range	f_{osc}	0,1	–	60	MHz
Oscillator amplitude (pins 13 to 14)	V	–	130	150	mV
External load impedance (pins 14 to 13)	$R_{(ext)}$	0,5	–	200	kΩ
External load impedance for no oscillation (pins 14 to 13)	$R_{(ext)}$	–	–	60	Ω
Ripple rejection at $V_{P(rms)} = 100$ mV; $f_p = 100$ Hz (SVRR = 20 log $[V_{15}/V_{13}]$)	RR	–	55	–	dB
Source voltage for switching diodes (6 × V_{BE}) (pin 13)	V	–	4,2	–	V
DC output current (for switching diodes) (pin 13)	$-I_O$	0	–	20	mA
Change of output voltage at $\Delta I_{13} = 20$ mA (switch to maximum load) (pin 13)	ΔV_I	–	0,3	–	V

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Buffered oscillator output (pin 12)					
DC output voltage	V_O	–	0,8	–	V
Output signal amplitude (peak-to-peak value)	$V_{o(p-p)}$	–	320	–	mV
Output impedance	Z_O	–	170	–	Ω
Output current	$-I_{O(peak)}$	–	–	3	mA
IF, AGC and AF stages					
DC input voltage (pins 3 and 4)	V_I	–	2,0	–	V
IF input impedance (pins 3 to 4)	Z_i	2,4	3,0	3,9	kΩ
IF input capacitance	C_i	–	7	–	pF
IF input voltage for THD = 3% at m = 80% (pins 3 and 4)	V_i	–	90	–	mV
IF output impedance (pin 10)	Z_o	–	50	–	Ω
Unloaded IF output voltage at V_i = 10 mV (pin 10)	V_o	180	230	290	mV
Voltage gain before start of AGC (pins 3 to 4; 6 to 18)	G_v	–	68	–	dB
AGC range of IF stages: change of V_{3-4} for 1 dB change of $V_{o(AF);}$ $V_{3-4\ (ref)}$ = 75 mV	ΔV_v	–	55	–	dB
AF output voltage at $V_{3-4(IF)}$ = 50 µV	$V_{o(AF)}$	–	130	–	mV
AF output voltage at $V_{3-4(IF)}$ = 1 mV	$V_{o(AF)}$	–	310	–	mV
AF output impedance (pin 6)	$\lvert Z_o \rvert$	2,8	3,5	4,2	kΩ
Indicator driver (pin 11)					
Output voltage at V_i = 0 mV; R_L = 2,7 kΩ	V_o	–	–	140	mV
Output voltage at V_i = 500 mV; R_L = 2,7 kΩ	V_o	2,5	2,8	3,1	V
Load resistance	R_L	1,5	–	–	kΩ
Standby switch					
Switching threshold at; V_P = 7,5 to 18 V T_{amb} = –40 to +80 °C					
ON-voltage	V_{2-1}	0	–	2,0	V
OFF-voltage	V_{2-1}	3,5	–	20,0	V
ON-current at V_{2-1} = 0 V	$-I_2$	–	100	200	µA
OFF-current at V_{2-1} = 20 V	$\lvert I_2 \rvert$	–	–	10	µA

OPERATING CHARACTERISTICS

V_P = 8,5 V; f_i = 1 MHz; m = 30%; f_m = 400 Hz; T_{amb} = 25 °C; measured in Fig.1; unless otherwise specified

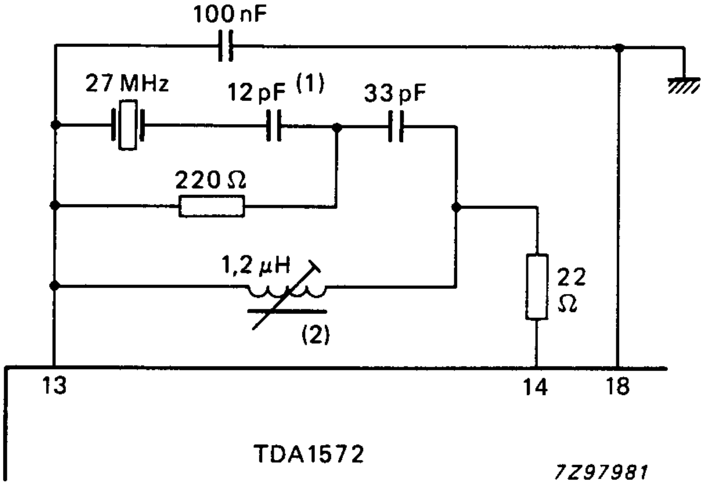
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
RF sensitivity					
RF input required for (S+N)/N = 6 dB	V_i	–	1,5	–	μV
RF input required for (S+N)/N = 26 dB	V_i	–	15	–	μV
RF input required for (S+N)/N = 46 dB	V_i	–	150	–	μV
RF input at start of AGC	V_i	–	30	–	μV
RF large signal handling					
RF input at THD = 3%; m = 80%	V_i	–	500	–	mV
RF input at THD = 3%; m = 30%	V_i	–	700	–	mV
RF input at THD = 10%; m = 30%	V_i	–	900	–	mV
AGC range					
Change of V_i for 1 dB change of $V_{o(AF)}$; $V_{i(ref)}$ = 500 mV	ΔV_i	–	86	–	dB
Change of V_i for 6 dB change of $V_{o(AF)}$; $V_{i(ref)}$ = 500 mV	ΔV_i	–	91	–	dB
Output signal					
IF output voltage at V_i = 2 mV	$V_{o(IF)}$	180	230	290	mV
AF output voltage at V_i = 4 μV; m = 80%	$V_{o(AF)}$	–	130	–	mV
AF output voltage at V_i = 2 mV	$V_{o(AF)}$	240	310	390	mV
THD at V_i = 1 mV	d_{tot}	–	0,5	–	%
THD at V_i = 500 mV	d_{tot}	–	1	–	%
Signal plus noise-to-noise ratio at V_i = 100 mV	(S+N)/N	–	58	–	dB
Ripple rejection at V_i = 2 mV; $V_{P(rms)}$ = 100 mV; f_p = 100 Hz (SVRR = 20 log [$V_P/V_{o(AF)}$])	RR	–	38	–	dB
a) additional AF signal at IF output	RR	–	0*	–	dB
b) add modulation at IF output (m_{ref} = 30%)	RR	–	40	–	dB

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Unwanted signals					
Suppression of IF whistles at					
V_i = 15 µV; m = 0% related to AF signal					
of m = 30%					
at $f_i \approx 2 \times f_{IF}$	α_{2IF}	–	**	–	dB
at $f_i \approx 3 \times f_{IF}$	α_{3IF}	–	**	–	dB
IF suppression at RF input;					
for symmetrical input	α_{IF}	–	40	–	dB
for asymmetrical input	α_{IF}	–	40	–	dB
Residual oscillator signal at mixer output;					
at f_{osc}	$I_{1(osc)}$	–	1	–	µA
at $2 \times f_{osc}$	$I_{1(2osc)}$	–	1,1	–	µA

* AF signals at the IF output will be suppressed by a coupling capacitor to the demodulator and by full wave-detection in the demodulator.

** Value to be fixed.

APPLICATION INFORMATION



(1) Capacitor values depend on crystal type.

(2) Coil data: 9 windings of 0,1 mm dia laminated Cu wire on TOKO coil set 7K 199CN; Q_o = 80.

Fig.2 Oscillator circuit using quartz crystal; centre frequency = 27 MHz.

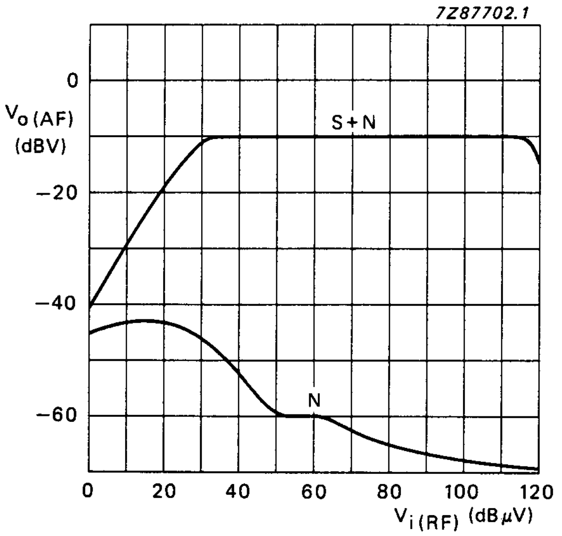


Fig.3 AF output as a function of RF input in the circuit of Fig.1; f_i = 1 MHz; f_m = 400 Hz; m = 30%.

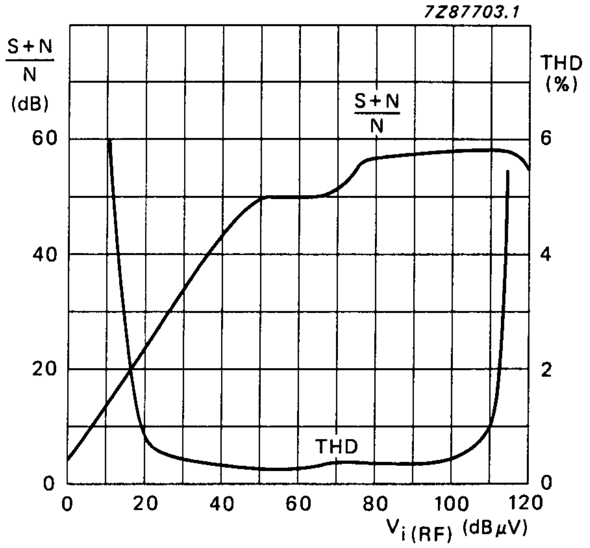


Fig.4 Total harmonic distortion and (S + N)/N as functions of RF input in the circuit of Fig.1; m = 30% for (S + N)/N curve and m = 80% for THD curve.

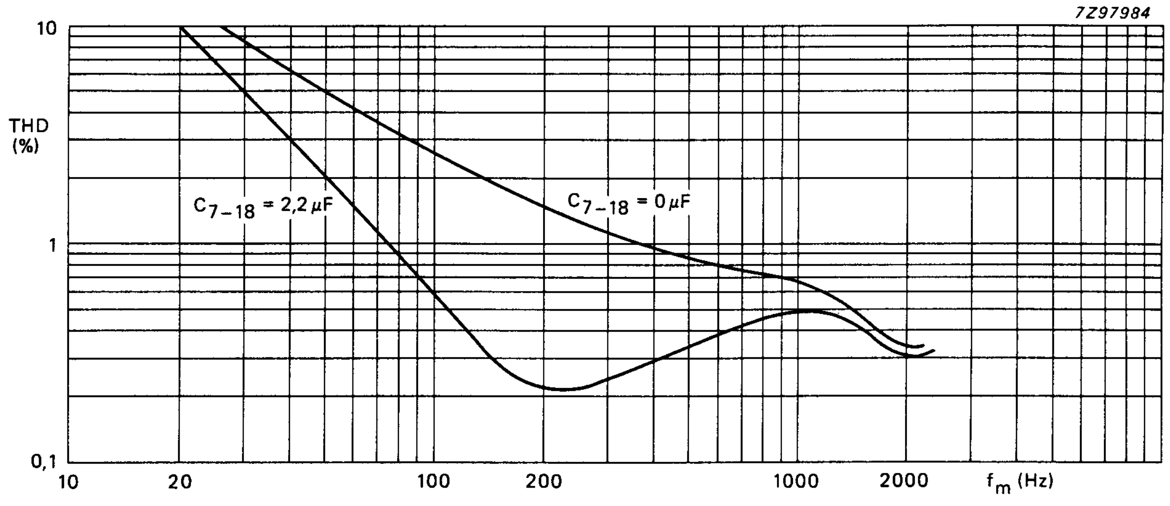


Fig.5 Total harmonic distortion as a function of modulation frequency at V_i = 5 mV; m = 80%; measured in the circuit of Fig.1 with $C_{7\text{-}18(ext)}$ = 0 μF and 2,2 μF.

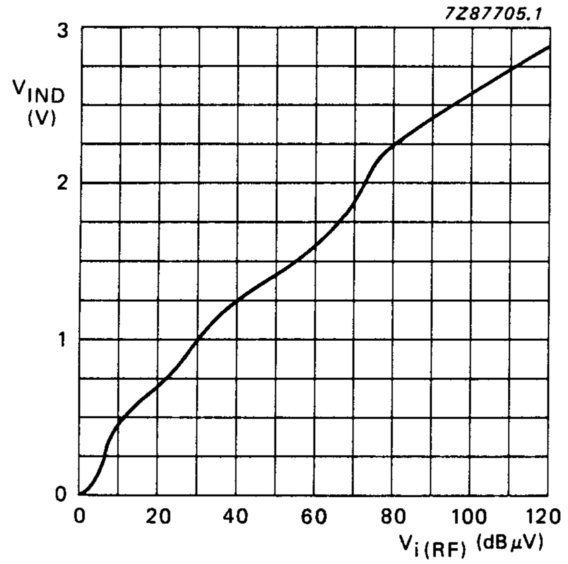


Fig.6 Indicator driver voltage as a function of RF input in the circuit of Fig.1.

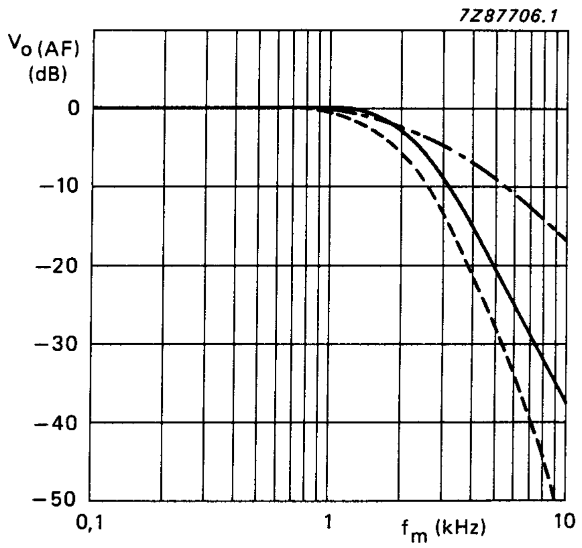


Fig.7 Typical frequency response curves from Fig.1 showing the effect of filtering as follows:

——————— with IF filter;

—·—·— with AF filter;

– – – – – – with IF and AF filters.

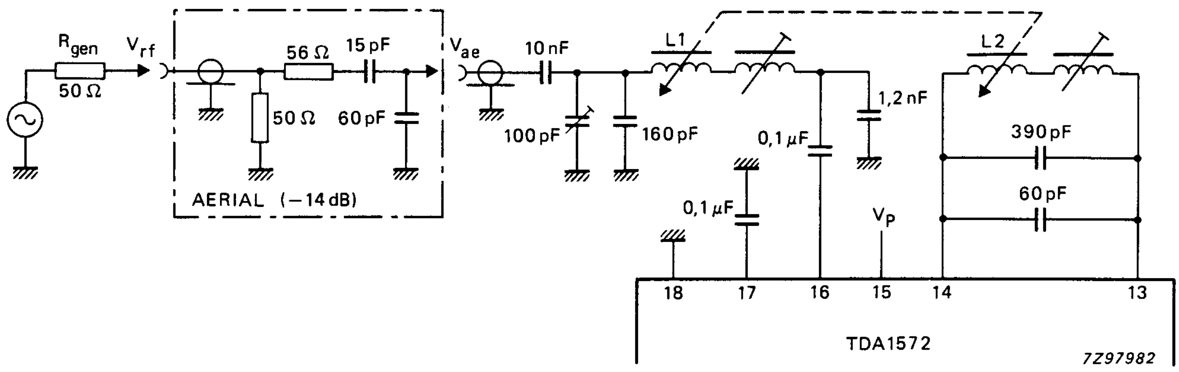


Fig.8 Car radio application with inductive tuning.

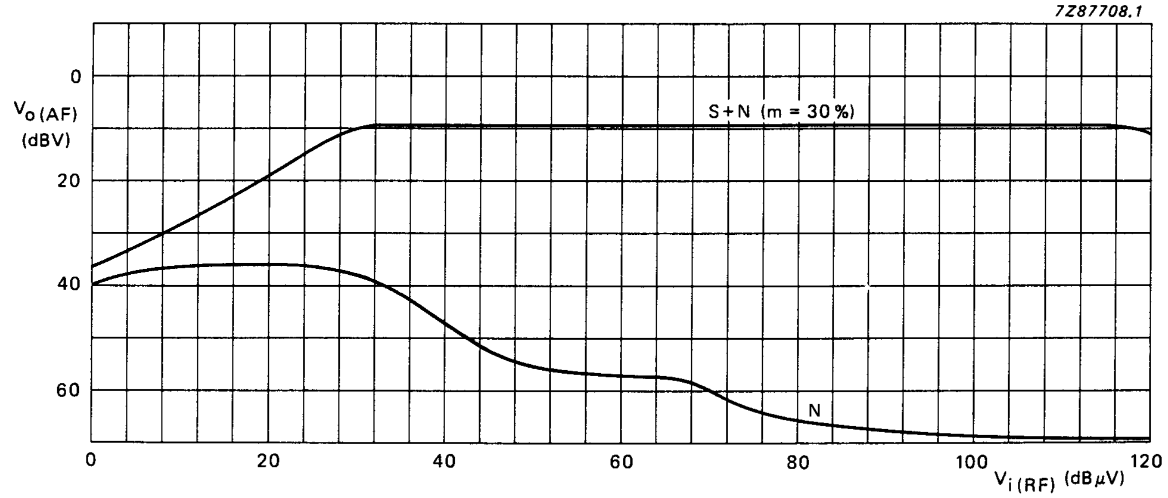


Fig.9 AF output as a function of RF input using the circuit of Fig.8 with that of Fig.1.

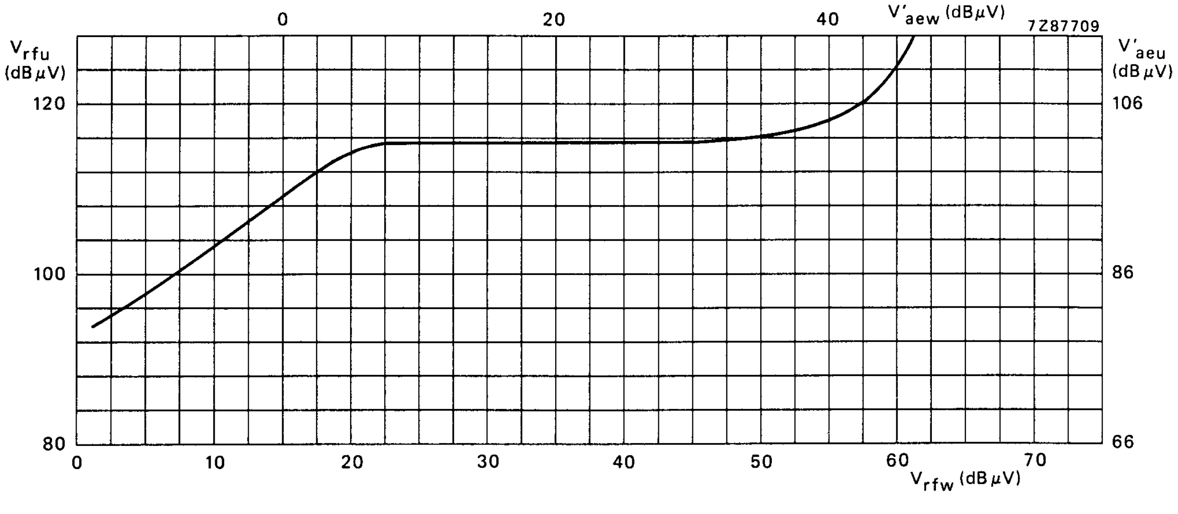


Fig.10 Suppression of cross-modulation as a function of input signal, measured in the circuit of Fig.8 with the input circuit as shown in Fig.11. Curve is for Wanted $V_{o(AF)}$/Unwanted $V_{o(AF)}$ = 20 dB; V_{rfw},V_{rfu} are signals at the aerial input, V'_{aew}, V'_{aeu} are signals at the unloaded output of the aerial.
Wanted signal (V'_{aew}, V_{rfw}): f_i = 1 MHz; f_m = 400 Hz; m = 30%.
Unwanted signal (V'_{aeu}, V'_{rfu}): f_i = 900 kHz; f_m = 400 Hz; m = 30%.
Effective selectivity of input tuned circuit = 21 dB.

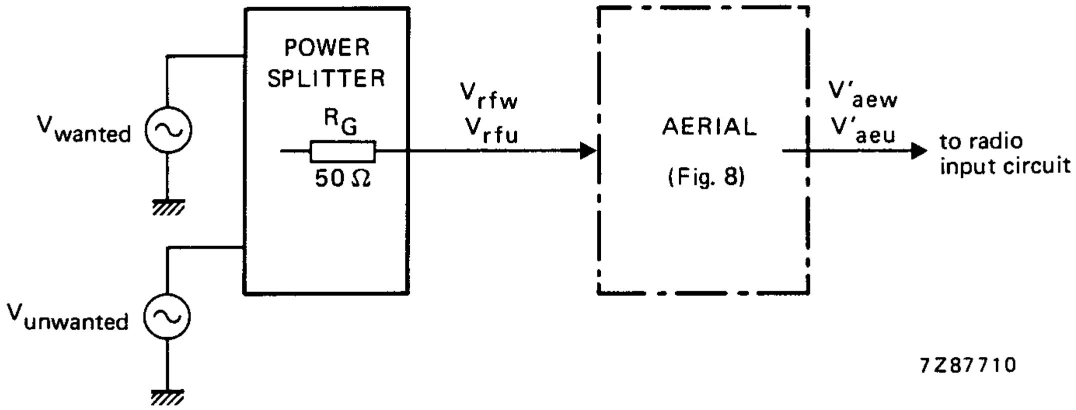


Fig.11 Input circuit to show cross-modulation suppression (see Fig.10).

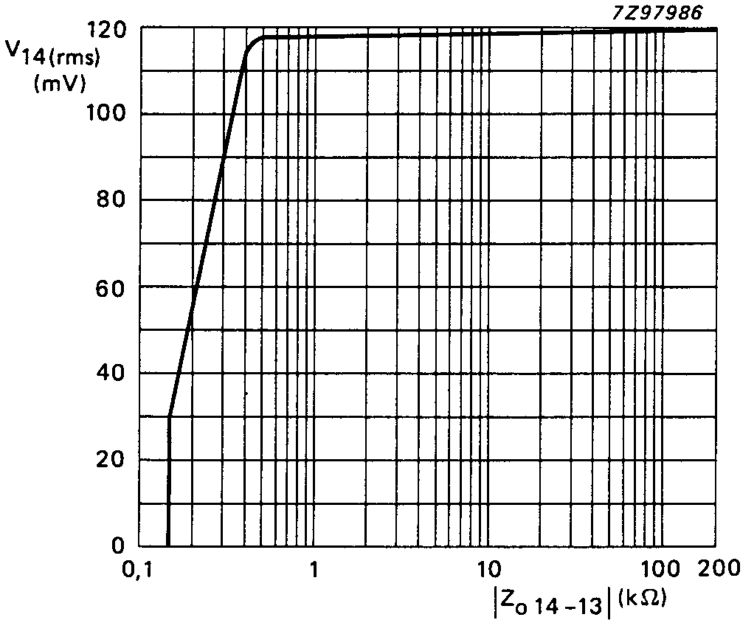


Fig.12 Oscillator amplitude as a function of pin 13, 14 impedance in the circuit of Fig.8.

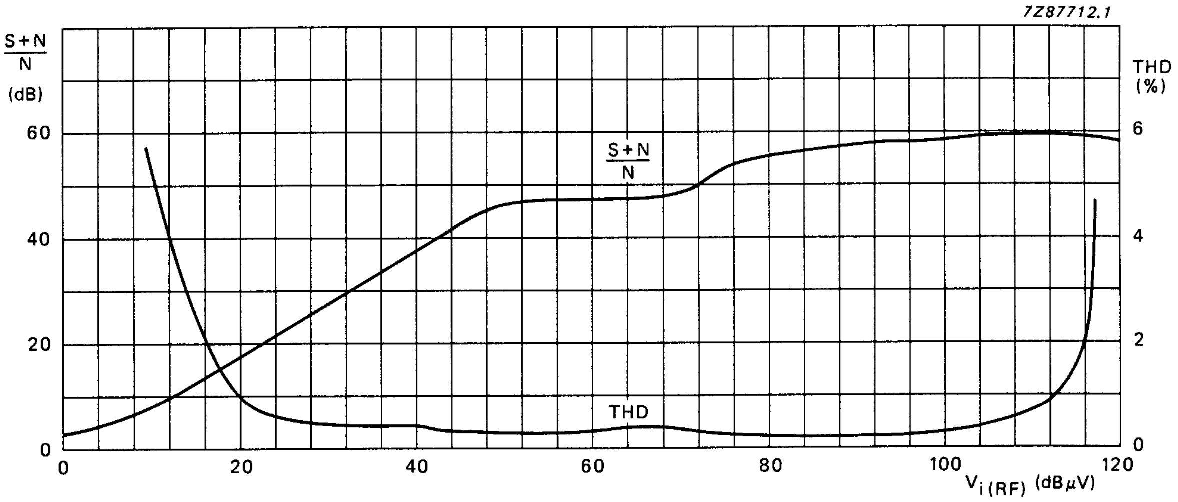


Fig.13 Total harmonic distortion and (S + N)/N as functions of RF input using the circuit of Fig.8 with that of Fig.1.

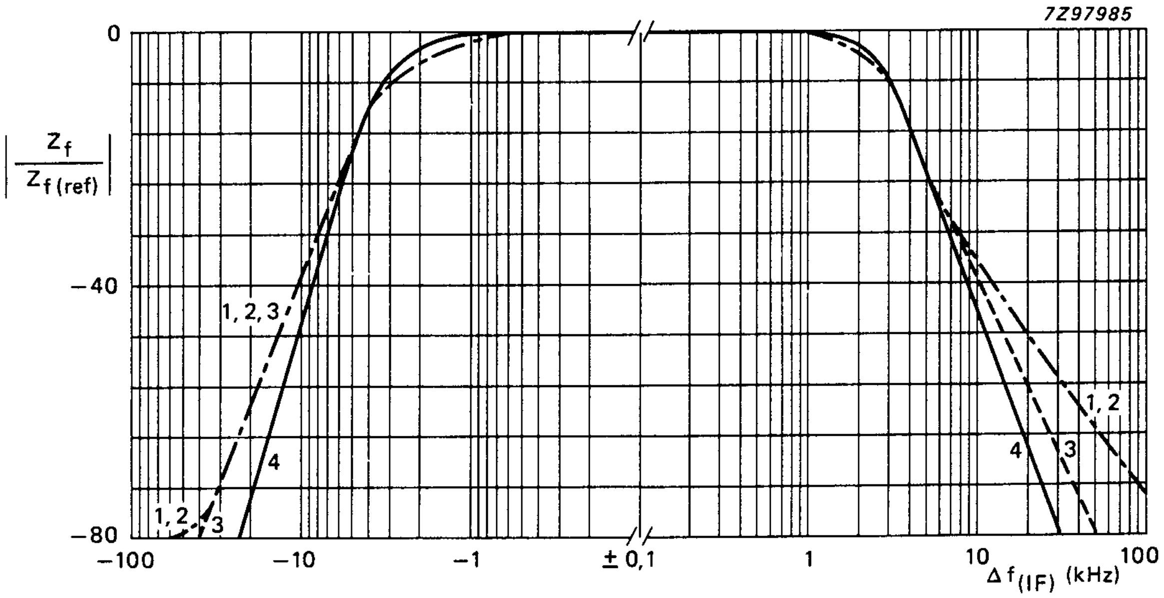


Fig.14 Forward transfer impedance as a function of intermediate frequency for filters 1 to 4 shown in Fig.15; centre frequency = 455 kHz.

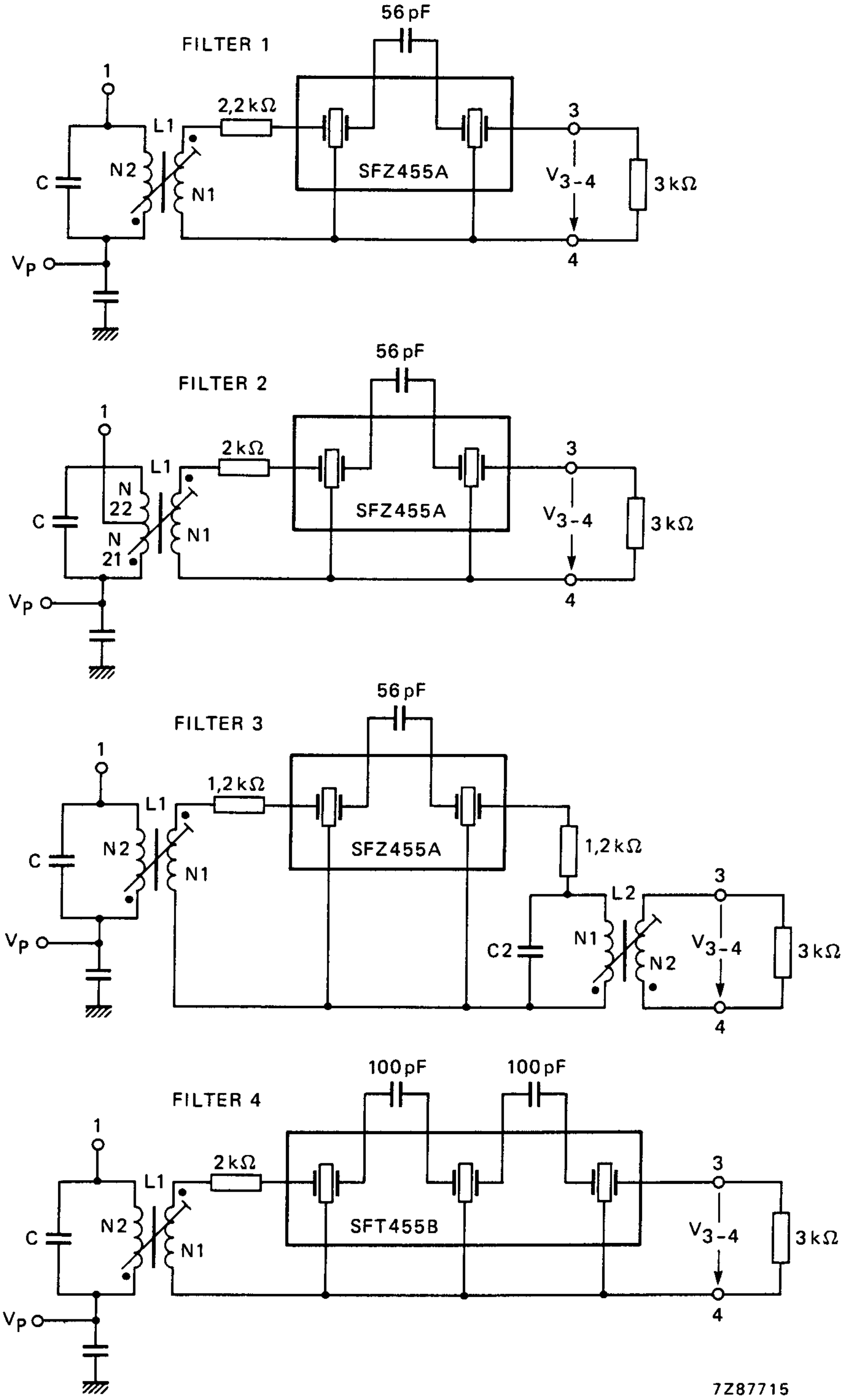


Fig.15 IF filter variants applied to the circuit of Fig.1. For filter data, refer to Table 1.

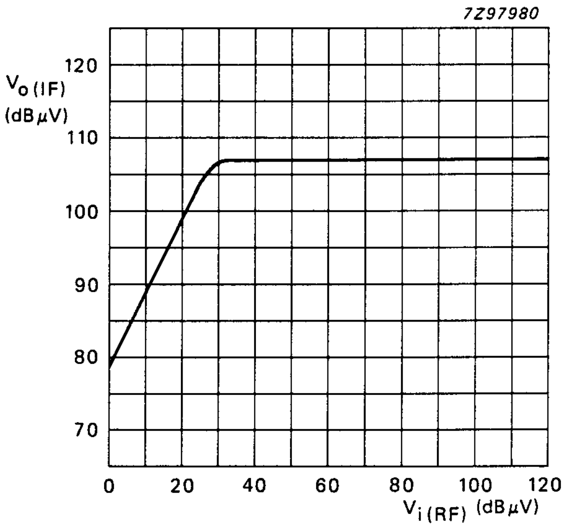
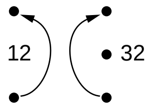
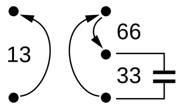
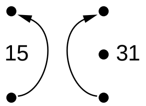
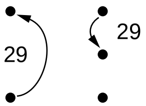
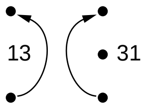


Fig.16 IF output voltage as a function of RF input in the circuit of Fig.1; f_i = 1 MHz.

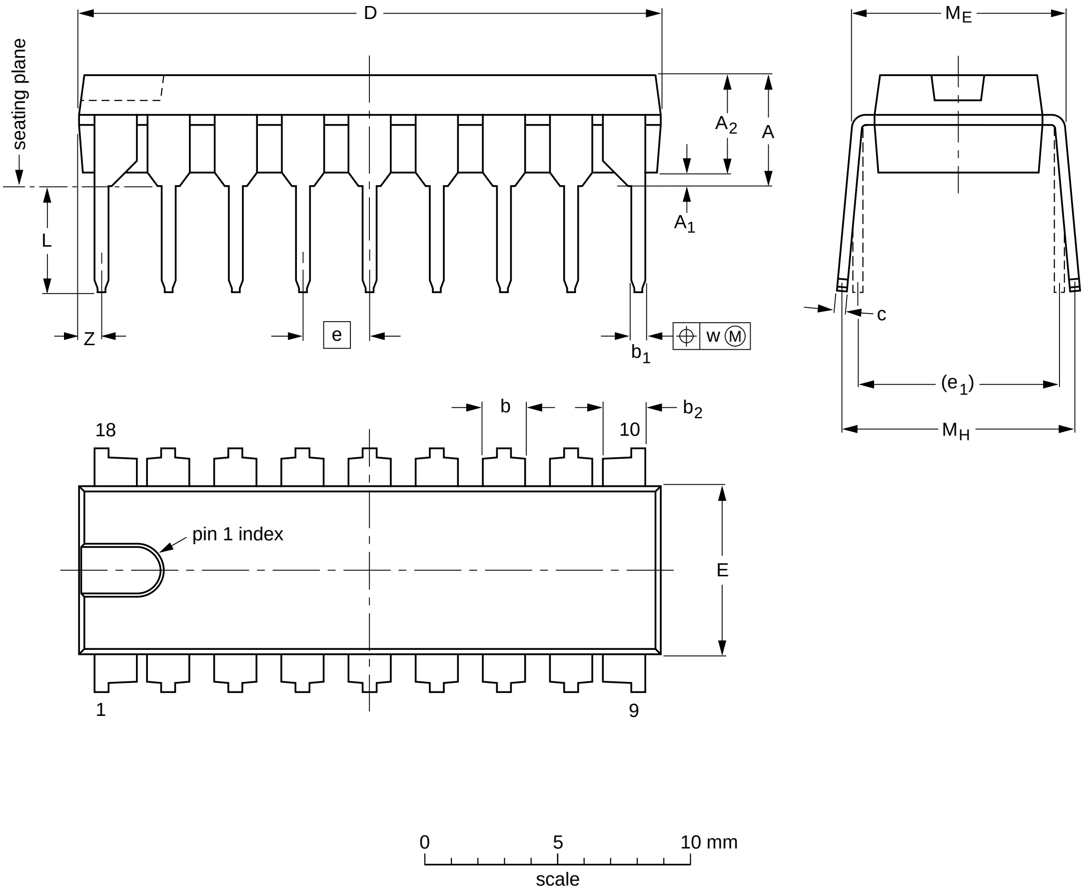
Table 1 Data for IF filters shown in Fig.15. Criteria for adjustment is Z_F = maximum (optimum selectivity curve at centre frequency f_0 = 455 kHz). See also Fig.14.

FILTER NO.	1	2	3		4	UNIT
Coil data	L1	L1	L1	L2	L1	
Value of C	3900	430	3900	4700	3900	pF
N1: N2	12 : 32	13 : (33 + 66)	15 : 31	29 : 29	13 : 31	
Diameter of Cu laminated wire	0,09	0,08	0,09	0,08	0,09	mm
Q_o	65 (typ.)	50	75	60	75	
Schematic* of windings				 (N1) (N2)		
Toko order no.	7XNS-A7523DY	L7PES-A0060BTG	7XNS-A7518DY	7XNS-A7521AIH	7XNS-A7519DY	
Resonators						
Murata type	SFZ455A	SFZ455A	SFZ455A		SFT455B	
D (typical value)	4	4	4		6	dB
R_G, R_L	3	3	3		3	kΩ
Bandwidth (–3 dB)	4,2	4,2	4,2		4,5	kHz
S_{9kHz}	24	24	24		38	dB
Filter data						
Z_I	4,8	3,8	4,2		4,8	kΩ
Q_B	57	40	52 (L1)	18 (L2)	55	
Z_F	0,70	0,67	0,68		0,68	kΩ
Bandwidth (–3 dB)	3,6	3,8	3,6		4,0	kHz
S_{9kHz}	35	31	36		42	dB
S_{18kHz}	52	49	54		64	dB
S_{27kHz}	63	58	66		74	dB

* The beginning of an arrow indicates the beginning of a winding; N1 is always the inner winding, N2 the outer winding.

PACKAGE OUTLINE

DIP18: plastic dual in-line package; 18 leads (300 mil) SOT102-1



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

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-1						~~93-10-14~~ 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).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

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.