

AM CAR RADIO RECEIVER CIRCUIT

The TEA5550 is an a.m. radio circuit, primarily intended for use in car radios.

The IC can reduce the costs in a car radio due to the following features:

- minimum periphery
- no extra r.f.-prestage is necessary
- ceramic i.f. filter is used
- simple on/off switching method allows inexpensive band switching in a.m./f.m. radios

The TEA5550 incorporates the following functions:

- a double balanced mixer with large signal handling range and common mode rejection properties
- a 'one-pin' oscillator, permitting the use of variable capacitance diode tuning
- an i.f. amplifier, designed for ceramic filters
- an a.m. envelope detector
- a.g.c. stages
- a voltage stabilizer, for supplying the internal circuit current and an external current up to 20 mA
- a simple d.c. switch for a.m./f.m. radios

QUICK REFERENCE DATA

Supply voltage range; unstabilized (pin 8)	V_p		10,2 to 18 V
Supply voltage; stabilized (pin 9)*	V_{stab}	typ.	7,5 to 9 V
Ambient temperature	T_{amb}	typ.	25 °C
Supply voltage (pin 8)	V_p	typ.	14,4 V
R.F. condition: $f_i = 1 \text{ MHz}$; $m = 0,3$; $f_m = 1 \text{ kHz}$			
R.F. input voltage (pin 1)			
$V_o = 30 \text{ mV}$	V_i	typ.	4 μV
S/N = 26 dB	V_i	typ.	16 μV
S/N = 46 dB	V_i	typ.	160 μV
A.F. output voltage (pin 10)			
$V_i = 10 \text{ mV}$	V_o	typ.	180 mV
Total harmonic distortion over most of the a.g.c. range; $m = 0,8$	THD	typ.	1,2 %
R.F. signal handling			
THD = 10%; $m = 0,8$	V_i	typ.	400 mV
A.G.C. range; change of r.f. input voltage for 10 dB change of a.f. output voltage (reference $V_{i1} = 200 \text{ mV}$)	V_{i1}/V_{i2}	typ.	86 dB

* Pins 8 and 9 have to be short-circuited externally.

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).

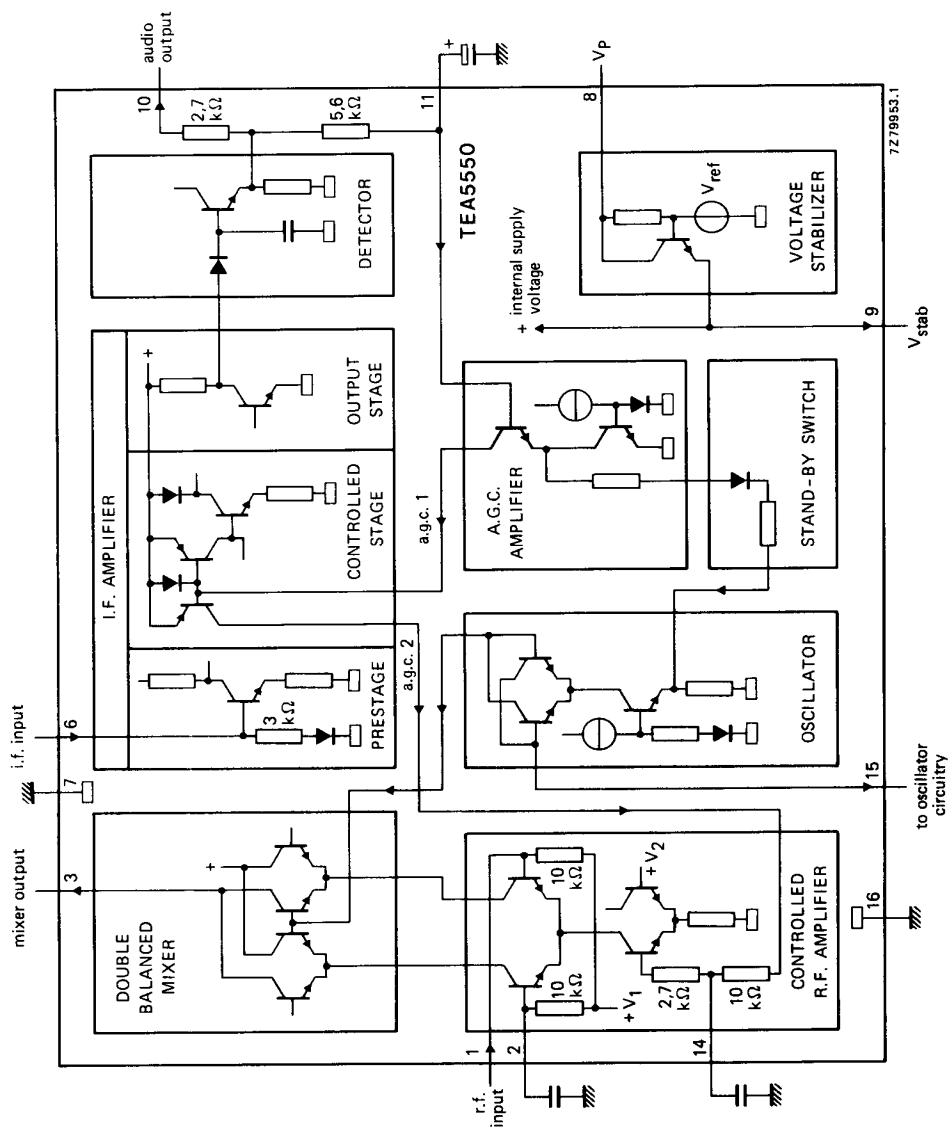


Fig. 1 Block diagram.

RATINGS

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

Supply voltages

pin 8

$V_P = V_{8-16}$

max. 24 V

pin 3

V_{3-16}

max. 24 V

Non-repetitive peak output current (pin 9)

I_{9SM}

max. 100 mA

Total power dissipation

P_{tot}

max. 1100 mW

Storage temperature

T_{stg}

-65 to + 150 °C

Operating ambient temperature

T_{amb}

-30 to + 85 °C

Note

Pins 4, 5, 12 and 13 are not allowed to be connected.

D.C. CHARACTERISTICS at $V_i = 0$ $V_P = 14,4 \text{ V}$; $T_{amb} = 25 \text{ °C}$; measured in Fig. 2

Supply voltage range (unstabilized)*

V_P

10,2 to 18 V

Voltage at pin 9; $-I_g = 0$

$V_{9-16} = V_{stab}$

typ. 8,7 V
8 to 9,2 V

Change in stabilization voltage (pin 9)

at $-I_g = 0$ to 20 mA

$\Delta V_{9-16} = \Delta V_{stab}$

typ. 50 mV

at $V_P = 10,2$ to 14,4 V

$\Delta V_{9-16} = \Delta V_{stab}$

typ. 300 mV

Voltage at pin 10

V_{10-16}

typ. 1,1 V

Voltage at pins 1 and 2

$V_{1-16} = V_{2-16}$

typ. 5,0 V

Voltage at pin 15

V_{15-16}

typ. V_{stab} Total supply current; $-I_g = 0$

I_{tot}

typ. 20 mA

Current drain

pin 3

I_3

typ. 1 mA

pin 15

I_{15}

typ. 0,2 mA

Current supplied from pin 9

$-I_g$

< 20 mA

Power consumption; $-I_g = 0$

P

typ. 300 mW

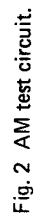
* A stabilized supply voltage of 7,5 to 9 V can also be applied at pin 9 (pin 8 short-circuited to pin 9).

A.C. CHARACTERISTICS

$V_P = 14,4 \text{ V}$; $T_{amb} = 25^\circ\text{C}$; r.f. condition: $f_i = 1 \text{ MHz}$, $m = 0,3$, $f_m = 1 \text{ kHz}$; transfer impedance of the i.f. filter $Z_{tr} = v_6/i_3 = 850 \Omega$ (loaded with $3 \text{ k}\Omega$); measured in Fig. 2; unless otherwise specified

R.F. input voltage; $V_o = 30 \text{ mV}$	V_i		1,5 to 6,5 μV
R.F. sensitivity at $R_S = 25 \Omega$ for:			
$S + N/N = 6 \text{ dB}$	V_i	typ.	1,3 μV
$S + N/N = 20 \text{ dB}$	V_i	typ.	8 μV
$S + N/N = 26 \text{ dB}$	V_i	typ.	16 μV
		<	20 μV
$S + N/N = 46 \text{ dB}$	V_i	typ.	160 μV
$S + N/N = 50 \text{ dB}$	V_i	typ.	350 μV
Input conductance at pin 1			
$V_i = 0,1 \text{ mV}$	g_{ie}	typ.	0,2 mS
$V_i = 100 \text{ mV}$	g_{ie}	typ.	0,1 mS
Input conductance at pin 6	g_{ie}	typ.	0,3 mS
Output capacitance at pin 15	C_{oe}	typ.	20 pF
A.G.C. range; change of r.f. input voltage for 10 dB change of a.f. output voltage (reference $V_{i1} = 200 \text{ mV}$)	V_{i1}/V_{i2}	typ.	86 dB
A.F. output voltage			
$V_i = 10 \text{ mV}$	V_o	>	140 mV
		typ.	180 mV
Spread of a.f. output voltage	ΔV_o	typ.	$\pm 2 \text{ dB}$
A.F. output impedance (pin 10)	$ Z_o $	typ.	2,7 $\text{k}\Omega$
Total harmonic distortion at $m = 0,8$			
$V_i = 16 \mu\text{V}$	THD	<	2,5 %
over most of the a.g.c. range (see also Figs 3 and 10)	THD	typ.	1,2 %
$V_i = 25 \text{ mV}$	THD	typ.	3,5 %
R.F. signal handling capability			
THD = 10%; $m = 0,8$	V_i	>	350 mV
		typ.	400 mV
I.F. suppression at $V_o = 30 \text{ mV}$	α	>	20 dB^*
		typ.	35 dB^*
Oscillator voltage			
$V_{9-16} = 8 \text{ V}$; $f_{osc} = 1468 \text{ kHz}$	V_{15-8}	typ.	250 mV
		<	300 mV

* $\alpha = 20 \log \frac{V_{ia}}{V_{ib}}$, where: V_{ia} is input voltage at $f = 468 \text{ kHz}$ and V_{ib} is input voltage at $f = 1 \text{ MHz}$.



APPLICATION INFORMATION

Figures 4 and 7 show the circuit diagrams of single-tuned and double-tuned AM channels respectively, using the TEA5550 and an r.f.-tuning unit (type ALPS). The i.f. filter consists of a single-tuned coil in combination with a ceramic filter (type SFT468).

Typical performance (measured in Figs 4 and 7)

$V_P = 14,4 \text{ V}$; $T_{amb} = 25^\circ \text{C}$; aerial signal conditions: $f_o = 1 \text{ MHz}$; $m = 0,3$; $f_m = 1 \text{ kHz}$ (dummy aerial as shown in Figs 4 and 7)

		Fig. 4 single-tuning	Fig. 6 double-tuning	
R.F. input voltage for:				
$S + N/N = 6 \text{ dB}$	V_i	4	4	μV
$S + N/N = 26 \text{ dB}$	V_i	47	49	μV
A.F. output voltage ($R_L = R_6 = 22 \text{ k}\Omega$)				
$V_i = 1 \text{ mV}$	V_o	160	160	mV
Signal-to-noise ratio				
$V_i = 1 \text{ mV}$	S/N	> 50	> 50	dB
A.G.C. range; change of r.f. input voltage for 10 dB change of a.f. output voltage (reference $V_{i1} = 200 \text{ mV}$); see Figs 3 and 10	V_{i1}/V_{i2}	88	88	dB
R.F. signal handling capability				
$\text{THD} < 10\%$; $m = 0,8$; see Figs 3 and 10	V_i	1,5	1,5	V
Total harmonic distortion (over most of the a.g.c. range); $m = 0,8$; see Figs 3 and 10	THD	1,2	1,2	$\%$
Oscillator voltage measured across the tank circuit	V_{osc}	250	250	mV
Total selectivity (r.f. and i.f.)	S_g	44	46	dB
Total bandwidth (r.f. and i.f.)	$B_{3\text{dB}}$	4,1	4,4	kHz
I.F. suppression at $V_i = 20 \mu\text{V}$				
tuned frequency = 600 kHz	α	55	75	dB
= 1600 kHz	α	58	85	dB
Image rejection at $V_i = 20 \mu\text{V}$				
tuned frequency = 600 kHz		50	72	dB
= 1000 kHz		46	68	dB
= 1400 kHz		42	64	dB
Whistle at $V_i = 5 \text{ mV}$				
2 x i.f.-tweet		-40	-40	dB
3 x i.f.-tweet		-48	-48	dB

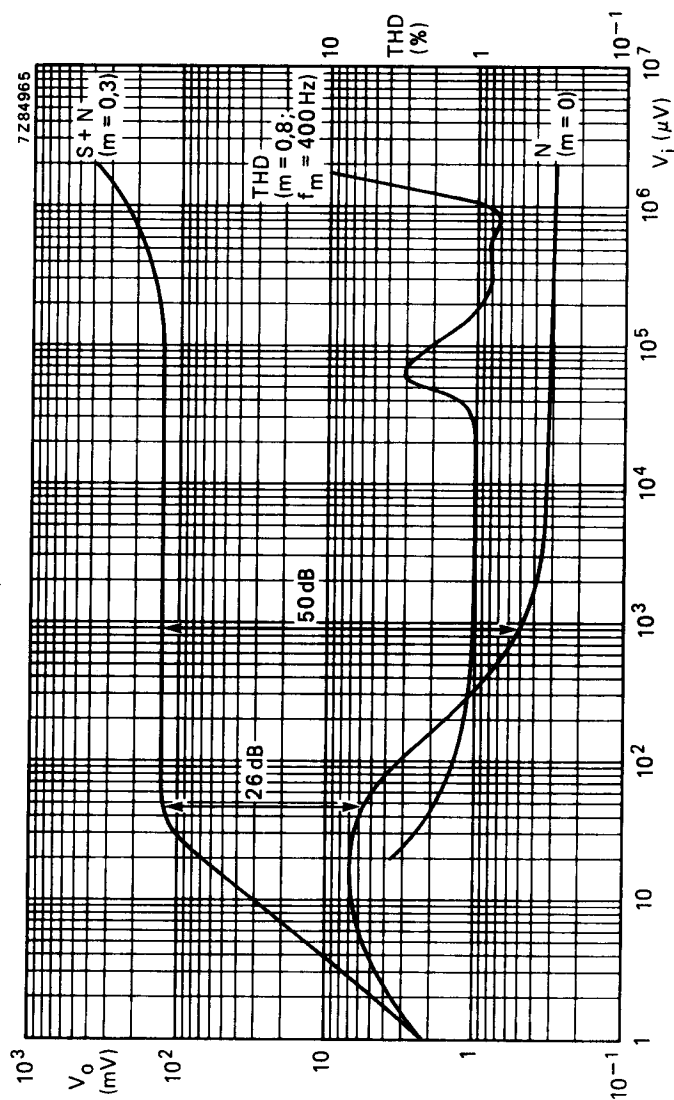


Fig. 3 Typical signal and noise output voltages (V_o is a.f. output voltage) as a function of the input voltage V_i . Also shown is the total harmonic distortion (THD). These curves are for a single-tuned AM channel; the dummy aerial is as shown in Fig. 4; $f_o = 1$ MHz; $f_m = 1$ kHz; $m = 0.3$ (unless otherwise specified).

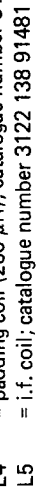


Fig. 4 Typical application circuit diagram for a single-tuned AM channel in car radio receivers using the TEA5550. S is AM/FM switch; for printed-circuit board see Figs 5 and 6.

Coil data: L1: L2 = tuning coils. ALPS unit MMK IIEI (for coil connections see Fig. 5)

L3 = trimming coil (4.7 μ H); catalogue number 3122 138 27460

L4 = padding coil (200 μ H); catalogue number 3111 118 23510

L5 = i.f. coil; catalogue number 3122 138 91481

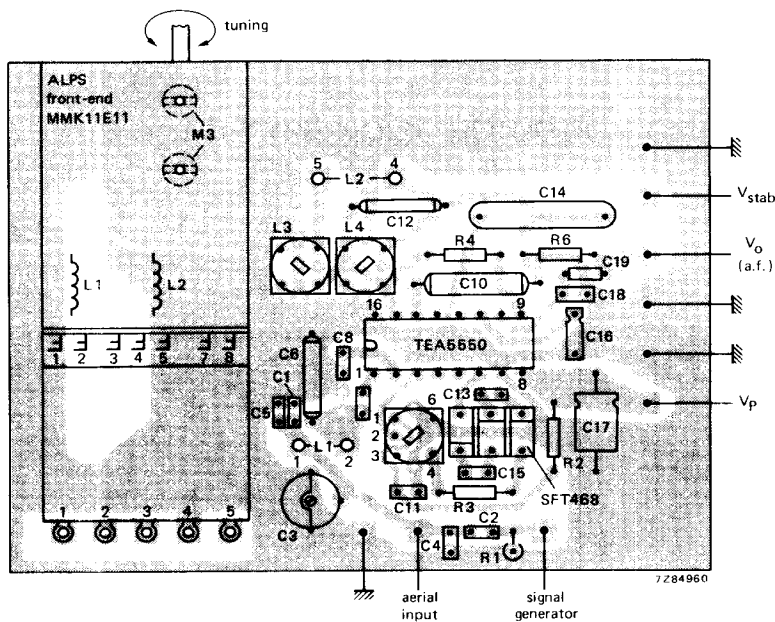


Fig. 5 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 4.

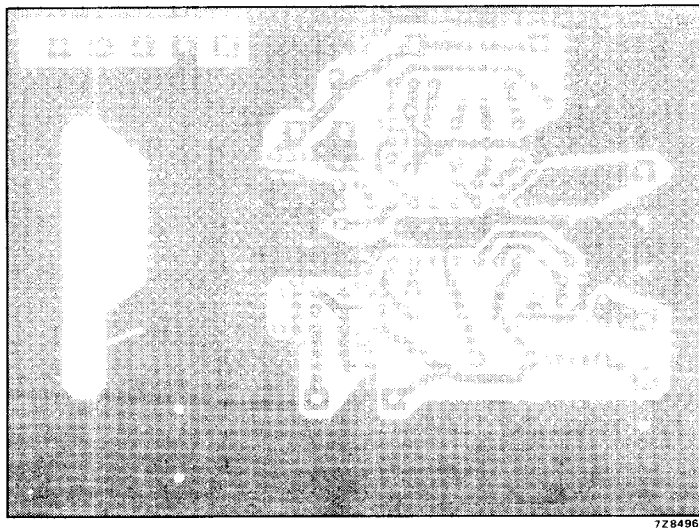


Fig. 6 Printed-circuit board showing track side.

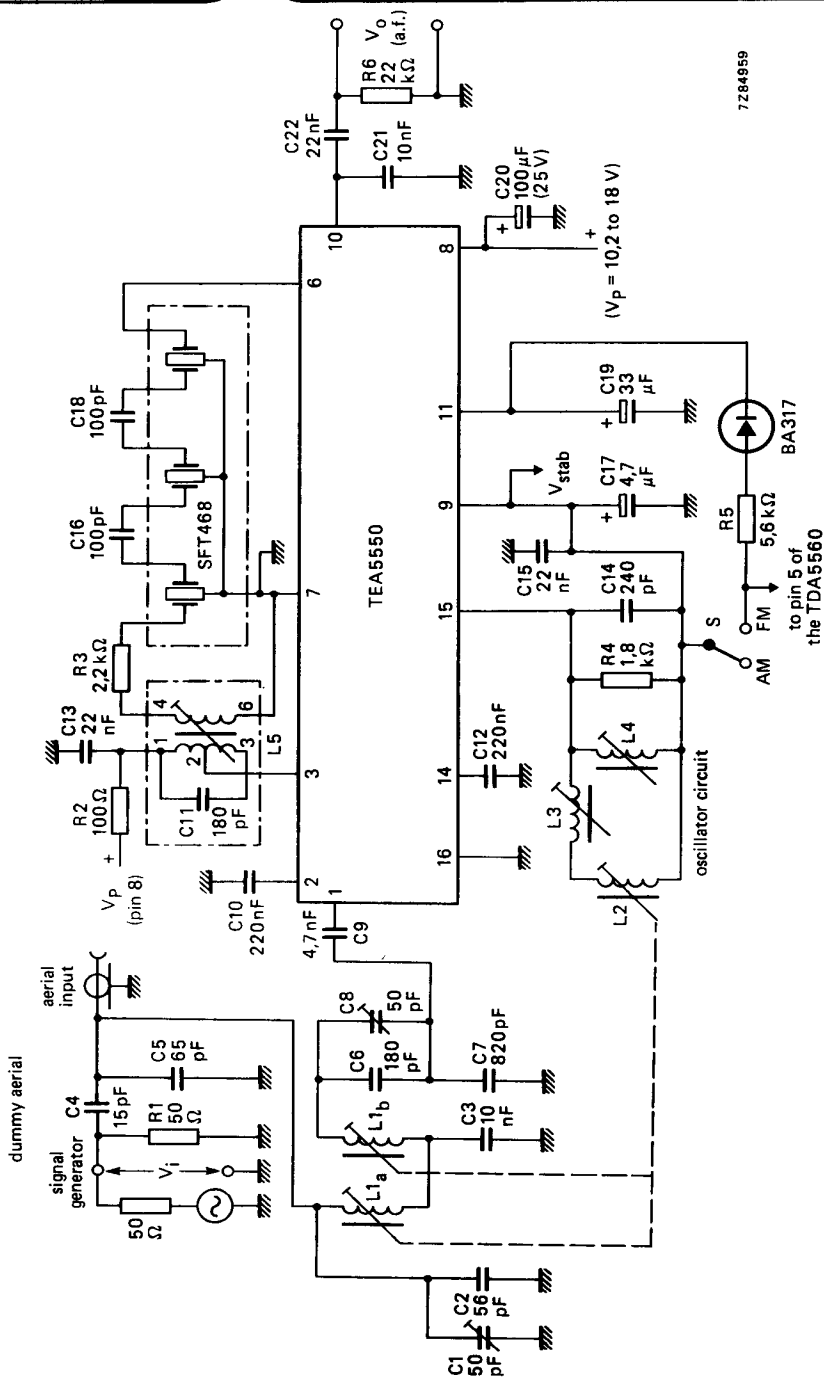


Fig. 7 Typical application circuit diagram for a double-tuned AM channel in car radio receivers using the TEA5550; S is AM/FM switch; for printed-circuit board see Figs 8 and 9.

Coil data: L1_a, L1_b, L2 = tuning coils, ALPS unit MMK IIEII (for coil connections see Fig. 8)

L3 = trimming coil (4,7 μH); catalogue number 3122 138 27460

L4 = padding coil (200 μH); catalogue number 3111 118 23510

L5 = i.f. coil; catalogue number 3122 138 91481

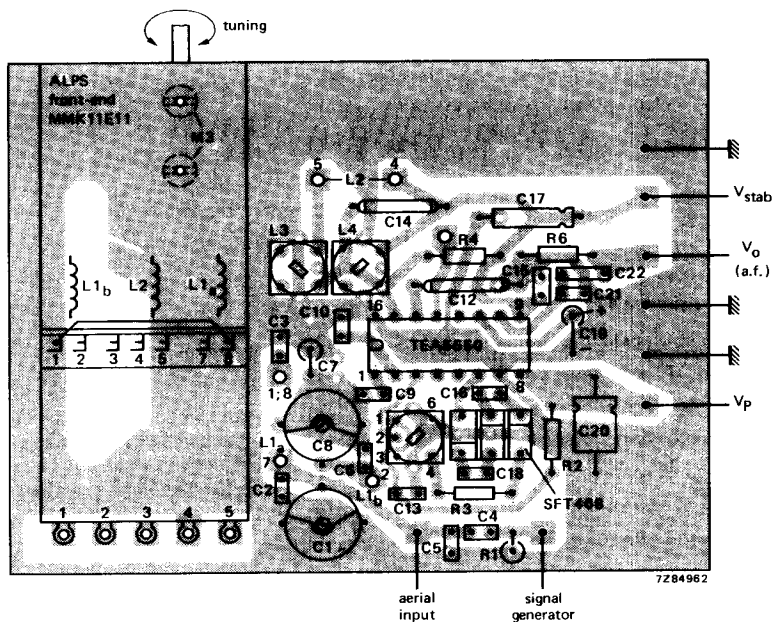


Fig. 8 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 7.

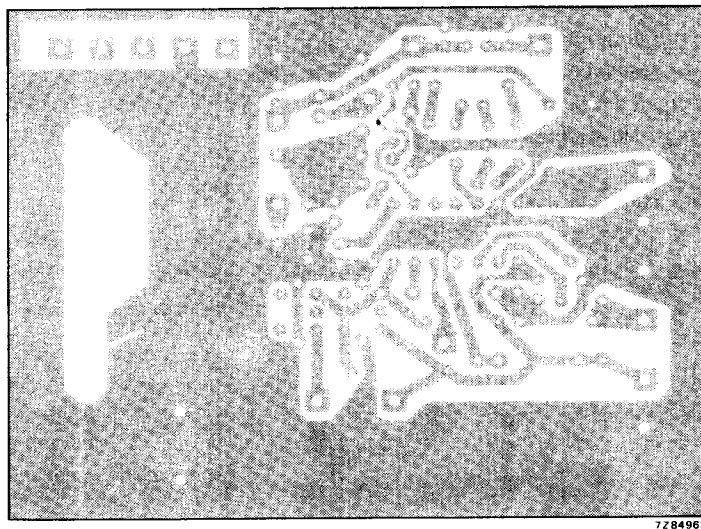


Fig. 9 Printed-circuit board showing track side.

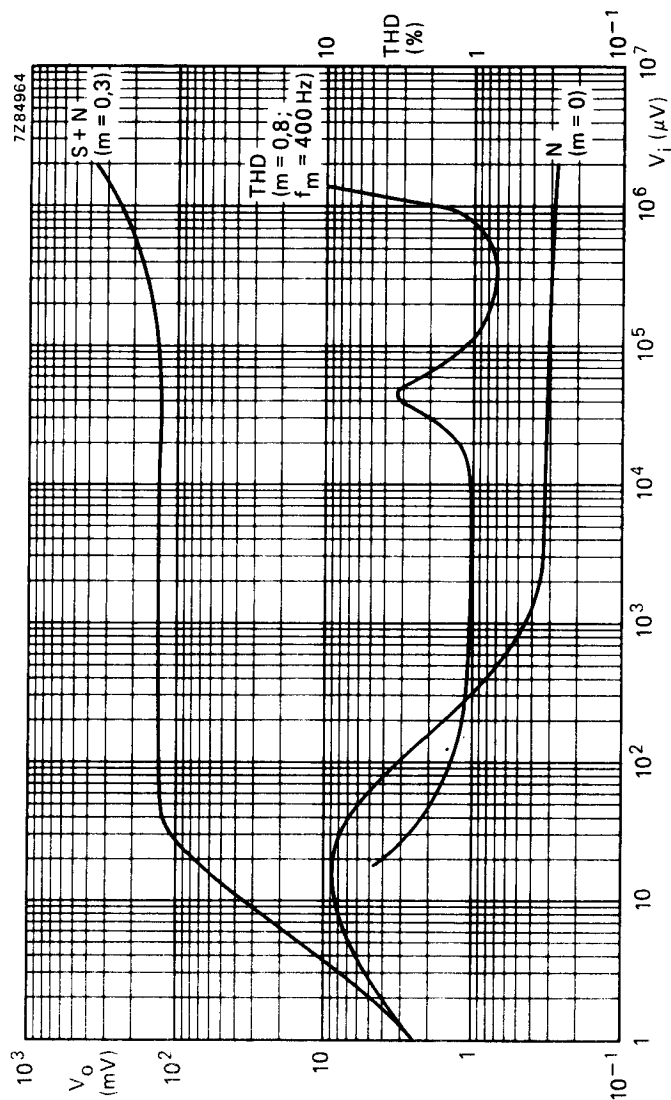


Fig. 10 Typical signal and noise output voltages (V_o is a.f. output voltage) as a function of the input voltage V_i . Also shown is the total harmonic distortion (THD). These curves are for a double-tuned AM channel; the dummy aerial is shown in Fig. 7; $f_o = 1$ MHz; $f_m = 1$ kHz; $f_m = 0.3$ (unless otherwise specified).