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

purple binder, tab 2

QUICK REFERENCE DATA

Supply voltage range; unstabilized (pin 8)	V_P		10,2 to 18	V
Supply voltage; stabilized (pin 9)*	V_{stab}	typ.	8,2	V
Ambient temperature	T_{amb}	typ.	25	°C
Supply voltage (pin 8)	V_P	typ.	14,4	V
R.F. condition: f_i = 1 MHz; m = 0,3; f_m = 1 kHz				
R.F. input voltage (pin 1)				
V_o = 30 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 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 mV)	V_{i1}/V_{i2}	typ.	86	dB

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

PACKAGE OUTLINE

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

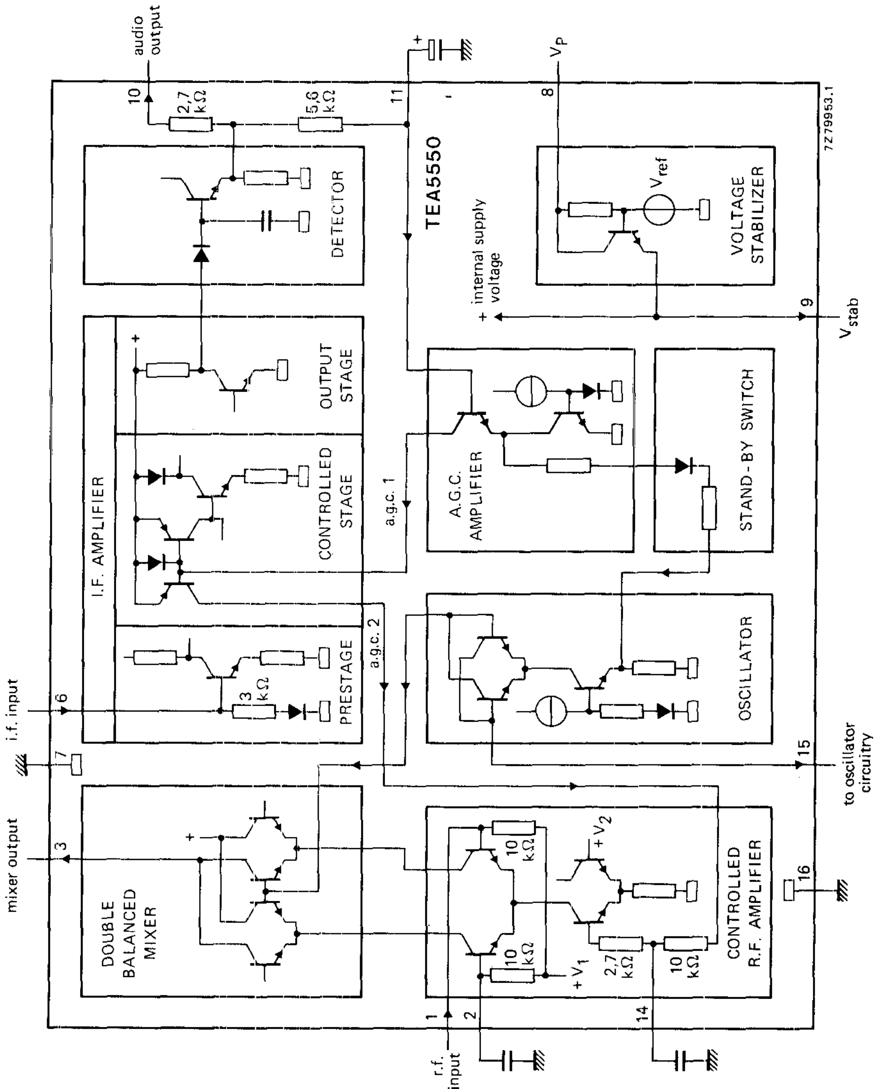


Fig. 1 Block diagram.

RATINGS

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

Supply voltages				
pin 8	$V_P = V_{8\text{-}16}$	max.	24	V
pin 3	$V_{3\text{-}16}$	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 V; T_{amb} = 25 °C; measured in Fig. 2

Supply voltage range (unstabilized)*	V_P		10,2 to 18	V
Voltage at pin 9; $-I_9 = 0$	$V_{9\text{-}16} = V_{stab}$	typ.	8,5	V
			7,5 to 9	V
Change in stabilization voltage (pin 9)				
at $-I_9$ = 0 to 20 mA	$\Delta V_{9\text{-}16} = \Delta V_{stab}$	typ.	50	mV
at V_P = 10,2 to 14,4 V	$\Delta V_{9\text{-}16} = \Delta V_{stab}$	typ.	300	mV
Voltage at pin 10	$V_{10\text{-}16}$	typ.	1,1	V
Voltage at pins 1 and 2	$V_{1\text{-}16} = V_{2\text{-}16}$	typ.	5,0	V
Voltage at pin 15	$V_{15\text{-}16}$	typ.	V_{stab}	
Total supply current; $-I_9 = 0$	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	$-I_9$	$<$	20	mA
Power consumption; $-I_9 = 0$	P	typ.	300	mW

DEVELOPMENT SAMPLE DATA

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

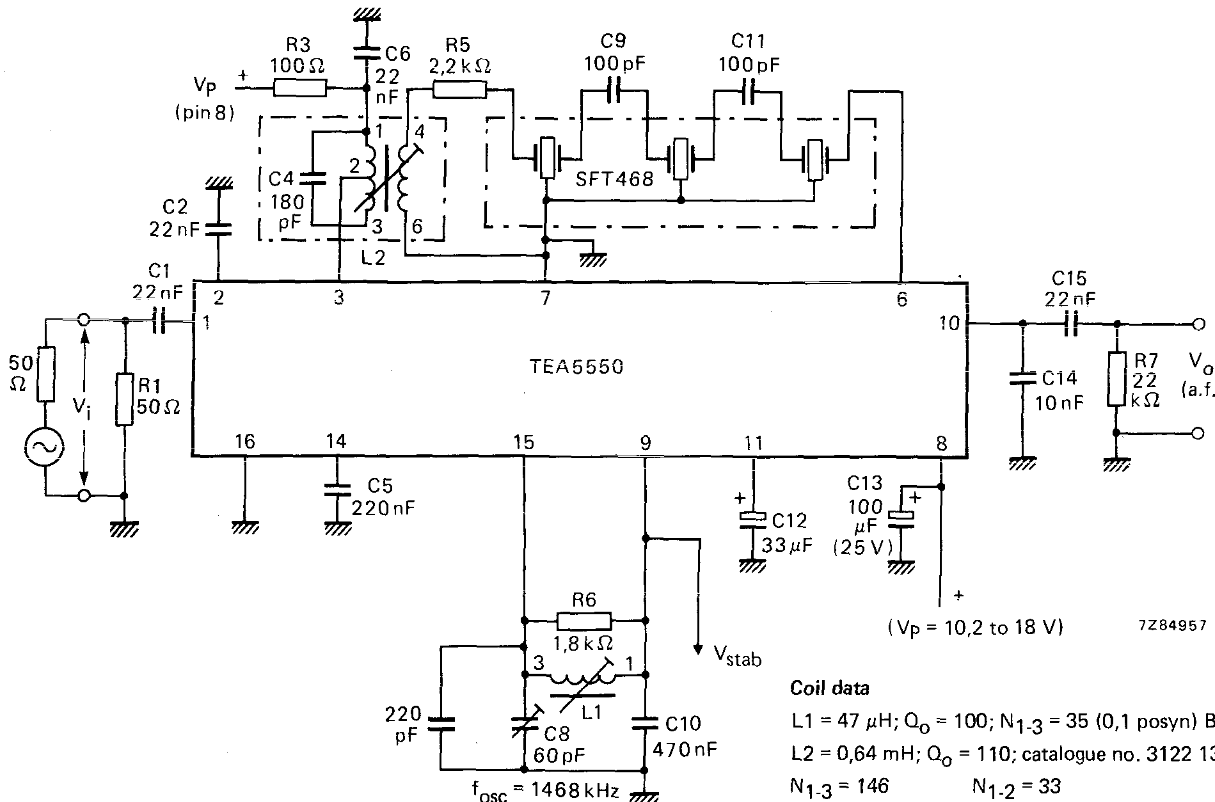
A.C. CHARACTERISTICS

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

R.F. input voltage; V_o = 30 mV	V_i		1,5 to 6,5	μV
R.F. sensitivity at R_S = 25 Ω for:				
S + N/N = 6 dB	V_i	typ.	1,3	μV
S + N/N = 20 dB	V_i	typ.	8	μV
S + N/N = 26 dB	V_i	typ.	16	μV
		<	20	μV
S + N/N = 46 dB	V_i	typ.	160	μV
S + N/N = 50 dB	V_i	typ.	350	μV
Input conductance at pin 1				
V_i = 0,1 mV	g_{ie}	typ.	0,2	mS
V_i = 100 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 mV)	V_{i1}/V_{i2}	typ.	86	dB
A.F. output voltage				
V_i = 10 mV	V_o	>	140	mV
		typ.	180	mV
Spread of a.f. output voltage	ΔV_o	typ.	± 2	dB
A.F. output impedance (pin 10)	$\|Z_o\|$	typ.	2,7	kΩ
Total harmonic distortion at m = 0,8				
V_i = 16 μV	THD	<	2,5	%
over most of the a.g.c. range (see also Figs 3 and 10)	THD	typ.	1,2	%
V_i = 25 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 mV	α	>	20	dB*
		typ.	35	dB*
Oscillator voltage				
$V_{9\text{-}16}$ = 8 V; f_{osc} = 1468 kHz	$V_{15\text{-}8}$	typ.	250	mV
		<	300	mV

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

DEVELOPMENT SAMPLE DATA



Coil data

L1 = 47 μH; Q_o = 100; $N_{1\text{-}3}$ = 35 (0,1 posyn) BR7

L2 = 0,64 mH; Q_o = 110; catalogue no. 3122 138 91481

$N_{1\text{-}3}$ = 146 $N_{1\text{-}2}$ = 33

$N_{2\text{-}3}$ = 113 $N_{4\text{-}6}$ = 9

The transfer impedance of the i.f. filter is:

$Z_{tr} = v_6/i_3$ = 850 Ω (R_L = 3 kΩ).

Fig. 2 AM test circuit.

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 V; T_{amb} = 25 °C; aerial signal conditions: f_o = 1 MHz; m = 0,3; f_{m} = 1 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 dB	V_i	4	4	μV
S + N/N = 26 dB	V_i	47	49	μV
A.F. output voltage (R_L = R6 = 22 kΩ) V_i = 1 mV	V_o	160	160	mV
Signal-to-noise ratio V_i = 1 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 mV); see Figs 3 and 10	V_{i1}/V_{i2}	88	88	dB
R.F. signal handling capability 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_9	44	46	dB
Total bandwidth (r.f. and i.f.)	B_{3dB}	4,1	4,4	kHz
I.F. suppression at V_i = 20 μV				
tuned frequency = 600 kHz	α	55	75	dB
= 1600 kHz	α	58	85	dB
Image rejection at V_i = 20 μV				
tuned frequency = 600 kHz		50	72	dB
= 1000 kHz		46	68	dB
= 1400 kHz		42	64	dB
Whistle at V_i = 5 mV				
2 x i.f.-tweet		−40	−40	dB
3 x i.f.-tweet		−48	−48	dB

DEVELOPMENT SAMPLE DATA

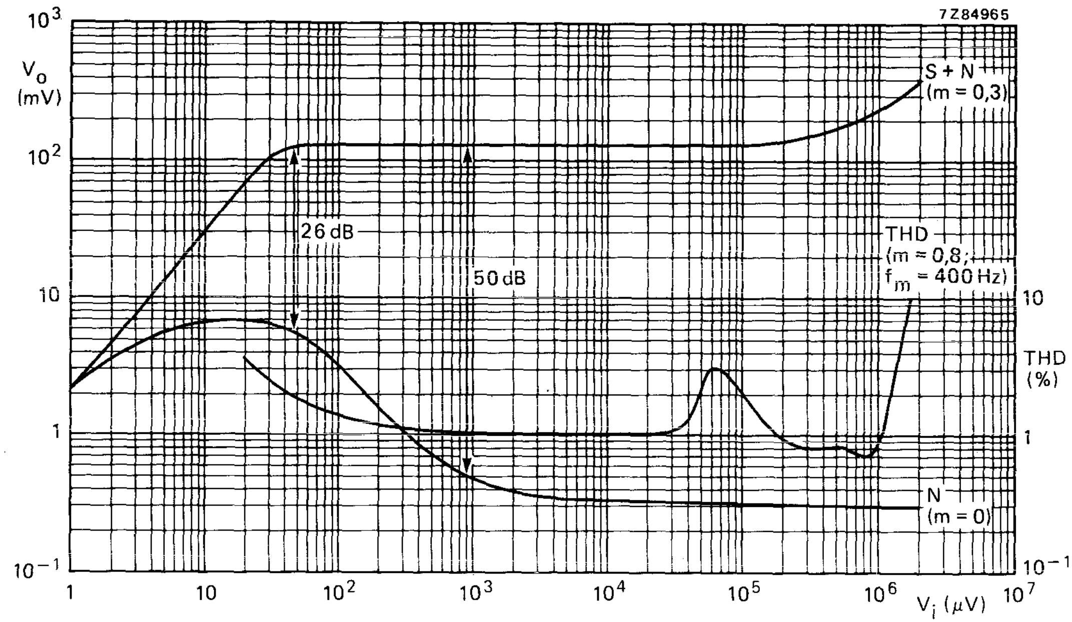


Fig. 3 Typical signal and noise output voltages (V_o is a.f. output voltage) as a function of the input voltage V_i. Also shown is the total harmonic distortion (THD). These curves are for a single-tuned AM channel; the dummy aerial is as shown in Fig. 4; f_o = 1 MHz; f_m = 1 kHz; m = 0,3 (*unless otherwise specified*).

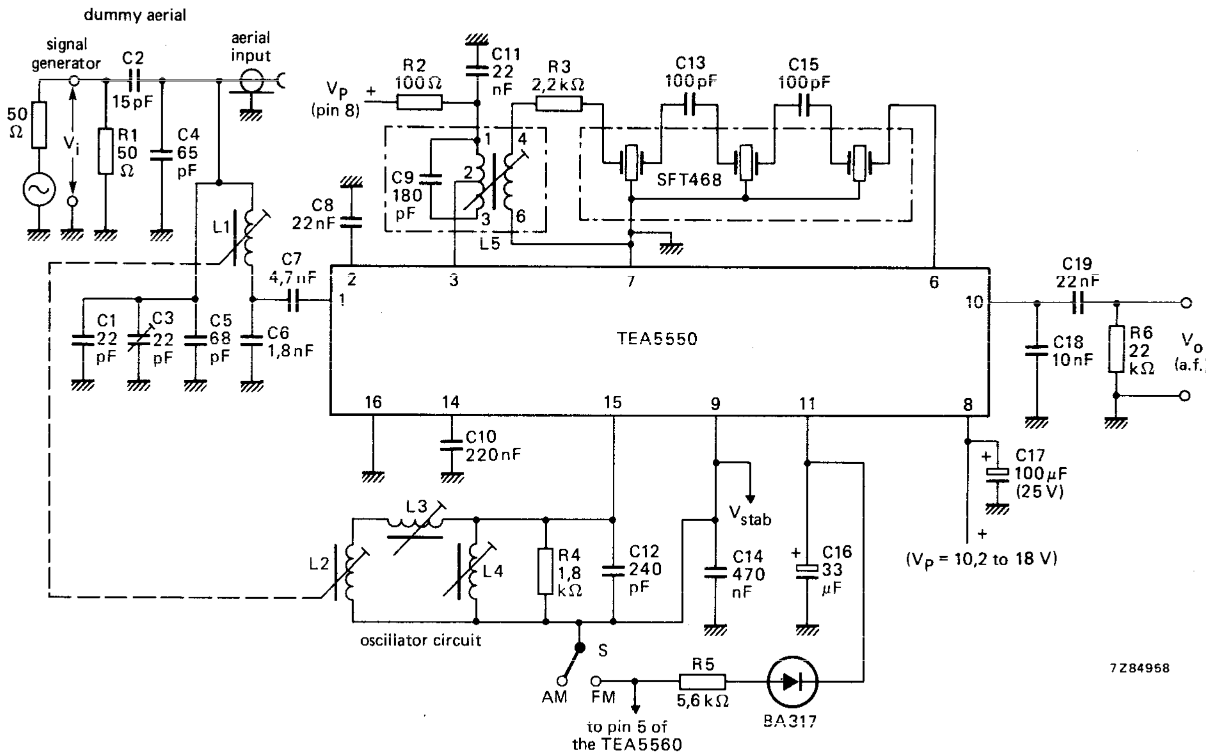


Fig. 4 Typical application circuit diagram for a single-tuned AM channel in car radio receivers using the TEA5550; S is AM/FM switch; for printed-circuit board see Figs 5 and 6.

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

DEVELOPMENT SAMPLE DATA

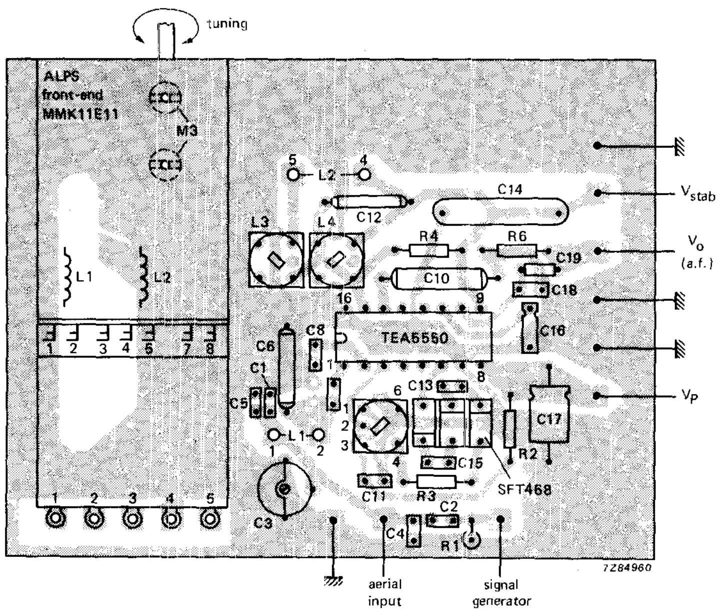


Fig. 5 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 4.

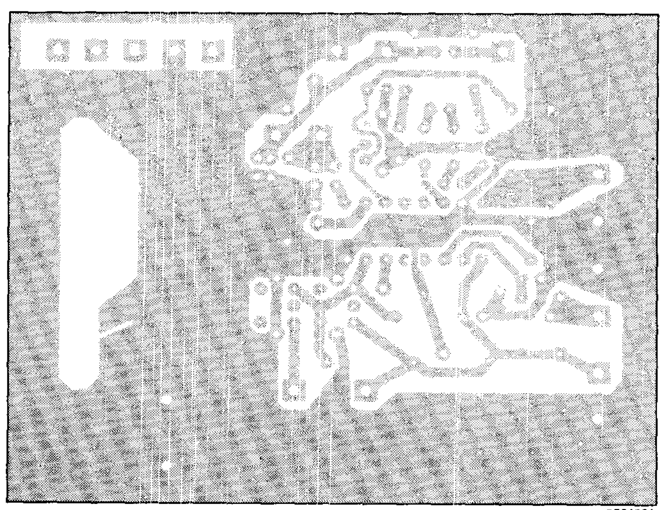


Fig. 6 Printed-circuit board showing track side.

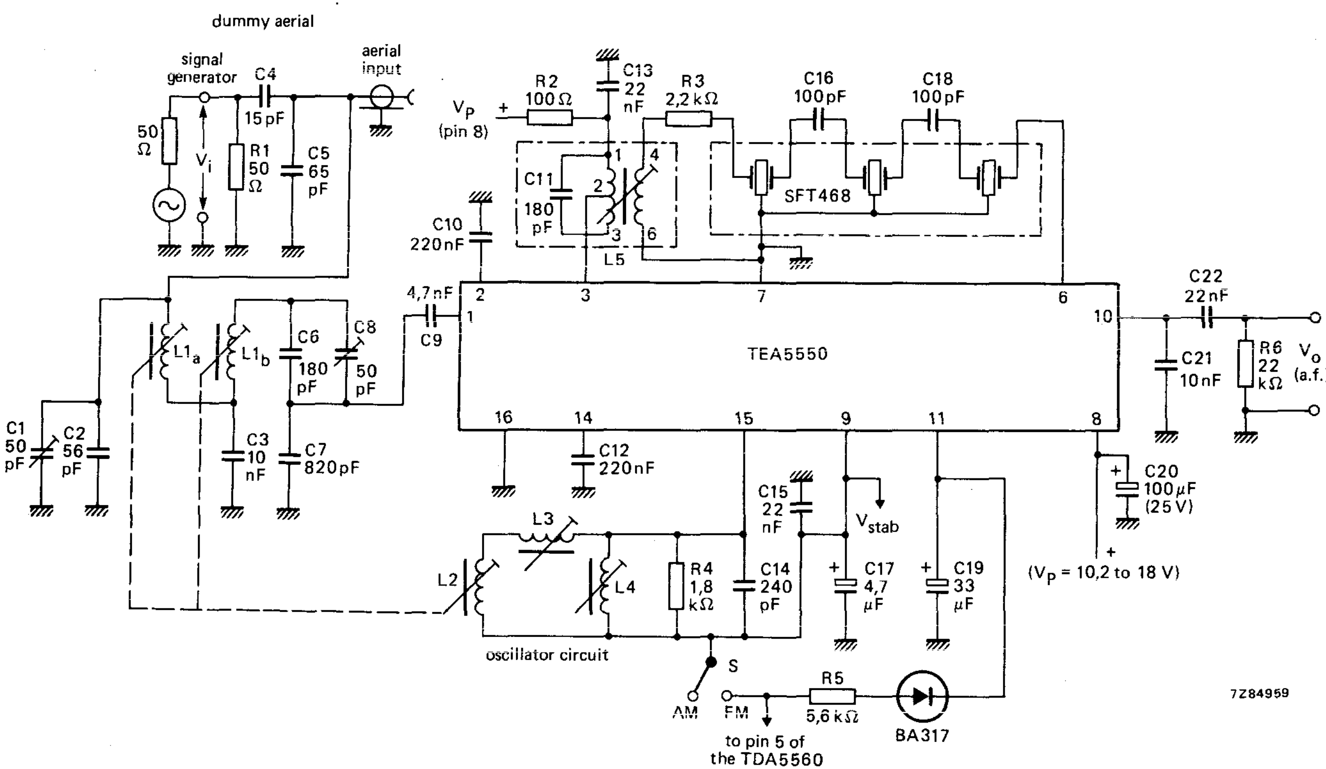


Fig. 7 Typical application circuit diagram for a double-tuned AM channel in car radio receivers using the TEA5550; S is AM/FM switch; for printed-circuit board see Figs 8 and 9.

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

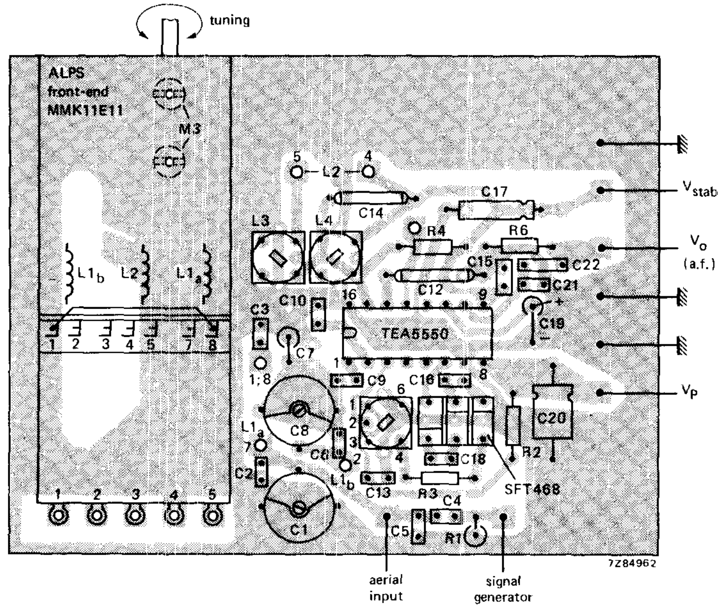


Fig. 8 Printed-circuit board component side, showing component layout.
For circuit diagram see Fig. 7.

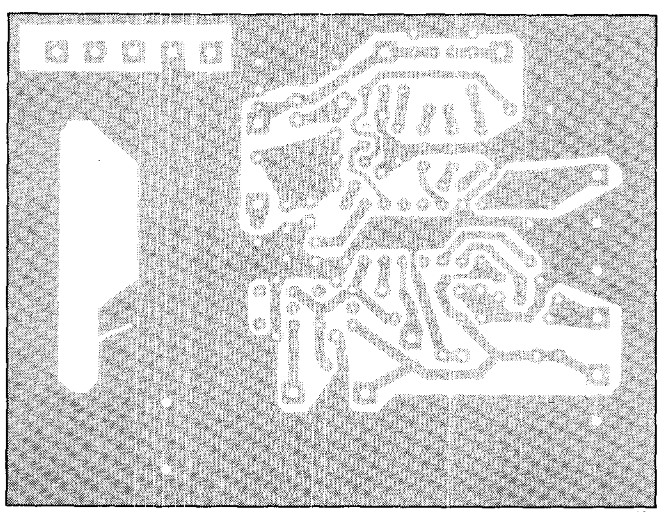


Fig. 9 Printed-circuit board showing track side.

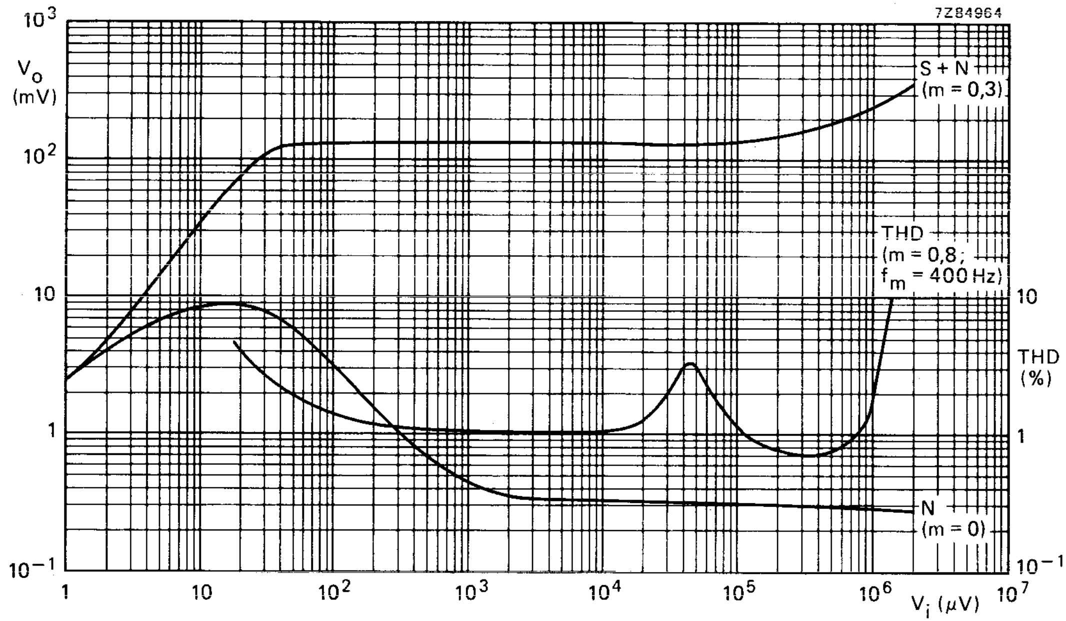
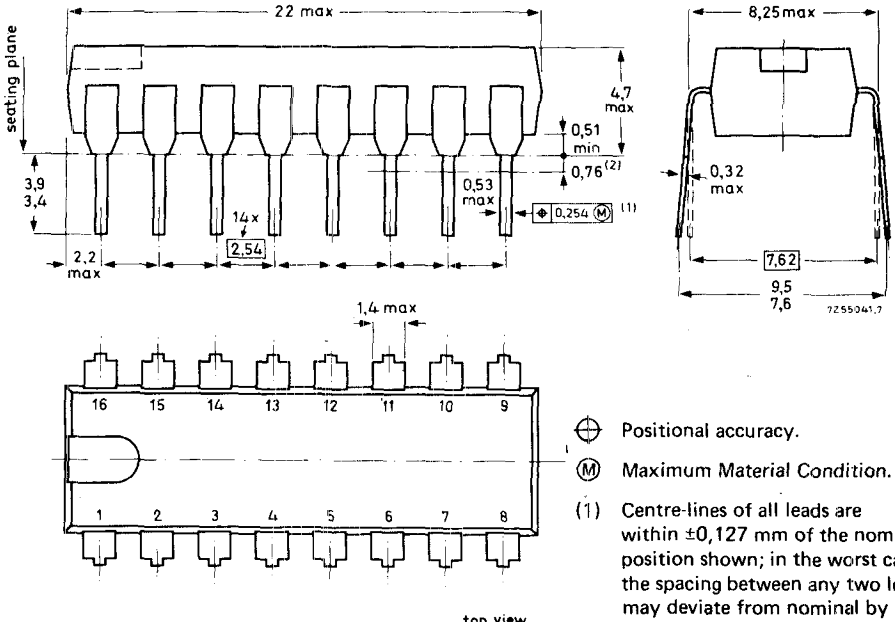


Fig. 10 Typical signal and noise output voltages (V_o is a.f. output voltage) as a function of the input voltage V_i. Also shown is the total harmonic distortion (THD). These curves are for a double-tuned AM channel; the dummy aerial is shown in Fig. 7; f_o = 1 MHz; f_m = 1 kHz; m = 0,3 (unless otherwise specified).

16-LEAD DUAL IN-LINE; PLASTIC (SOT-38)



Dimensions in mm

⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ±0,127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0,254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.

DEVELOPMENT SAMPLE DATA

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; 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 storage maximum. 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.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.