

AM/FM RADIO RECEIVER CIRCUIT

GENERAL DESCRIPTION

The TEA5592 is a 24-pin integrated radio circuit designed for use in all personal audio and car radio sets especially those sets with in- and out-door aerials that have to fulfill the FTZ (Amtsblatt) requirements.

The AM-IF and FM-IF stages are designed for the application of lumped selectivity. The main advantage of the TEA5592 is its ability to operate over a wide range of supply voltages (2.7 to 15 V) without any loss in performance.

The AM circuit incorporates:

- A double balanced mixer
- A 'one-pin' oscillator with amplitude control operating in the 0.6 to 30 MHz frequency range
- An IF amplifier and AM detector
- An AGC circuit which controls the IF amplifier and mixer

The FM circuit incorporates:

- A front-end (designed for FTZ (Amtsblatt) radio sets)
- A 5-stage IF amplifier
- A quadrature demodulator for a ceramic filter
- Internal AFC

Features

- Low distortion on FM
- AM/FM level/indicator circuit
- A DC AM/FM switch facility
- Three separate stabilizers to enable operation over a wide range of supply voltages (2.7 to 15 V)
- All pins are ESD protected

PACKAGE OUTLINE

24-lead shrink DIL; plastic (SOT234).

QUICK REFERENCE DATA

parameter	conditions	symbol	min.	typ.	max.	unit
Supply voltage (pin 5)		V_p	2.7	—	15	V
Total current consumption						
AM part		I_p	—	13	—	mA
FM part		I_p	—	17	—	mA
Operating ambient temperature range		T_{amb}	−40	—	+85	°C
AM performance (pin 13)	note 1					
Sensitivity	$V_o = 10$ mV	V_i	—	1.5	—	μ V
	$(S+N)/N = 26$ dB	V_i	—	15	—	μ V
Signal-to-noise ratio	$V_i = 1$ mV	$(S+N)/N$	—	48	—	dB
AF output voltage		V_o	—	55	—	mV
Total harmonic distortion		THD	—	0.8	—	%
Signal handling	$m = 80\%$; THD = 8%	V_i	—	100	—	mV
FM performance (pin 22)	note 2					
Limiting sensitivity	−3 dB	V_i	—	1.8	—	μ V
Signal-to-noise ratio	$V_i = 2.5$ μ V	$(S+N)/N$	—	26	—	dB
	$V_i = 1$ mV	$(S+N)/N$	—	60	—	dB
AF output voltage		V_o	—	110	—	mV
Total harmonic distortion		THD	—	0.1	—	%
Maximum signal handling		V_i	—	200	—	mV
AM suppression	100 μ V $< V_i <$ 100 mV	AMS	—	40	—	dB

Notes to the quick reference data

- All parameters are measured in the application circuit (see Fig. 5) at nominal supply voltage $V_p = 6$ V; $T_{amb} = 25$ °C; unless otherwise specified. RF conditions: Input frequency 1 MHz; 30% modulated with $f_{mod} = 1$ kHz; unless otherwise specified.
- All parameters are measured in the application circuit (see Fig. 5) at nominal supply voltage $V_p = 6$ V; $T_{amb} = 25$ °C; unless otherwise specified. RF conditions: Input frequency 100 MHz; frequency deviation $\Delta f = 22.5$ kHz and $f_{mod} = 1$ kHz; unless otherwise specified.

DEVELOPMENT DATA

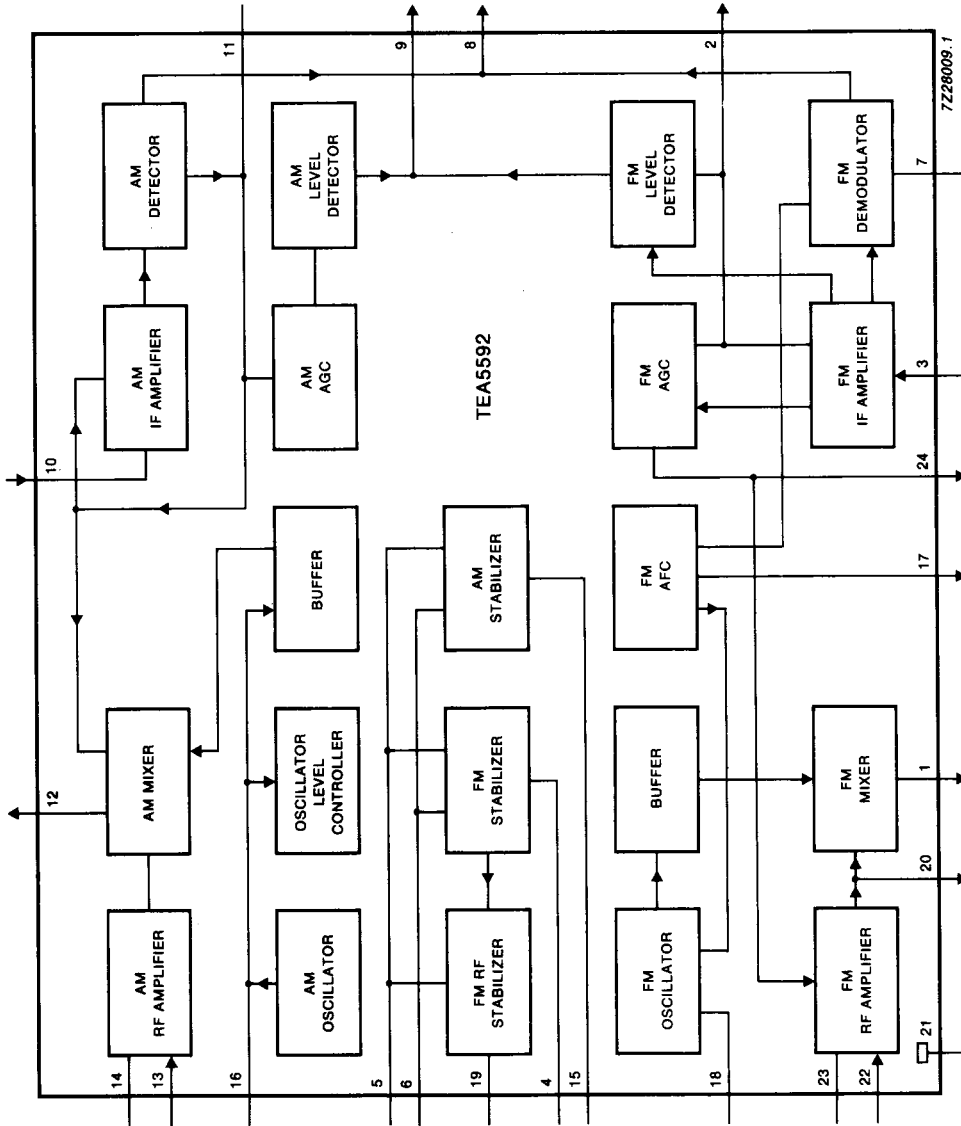


Fig.1 Block diagram.

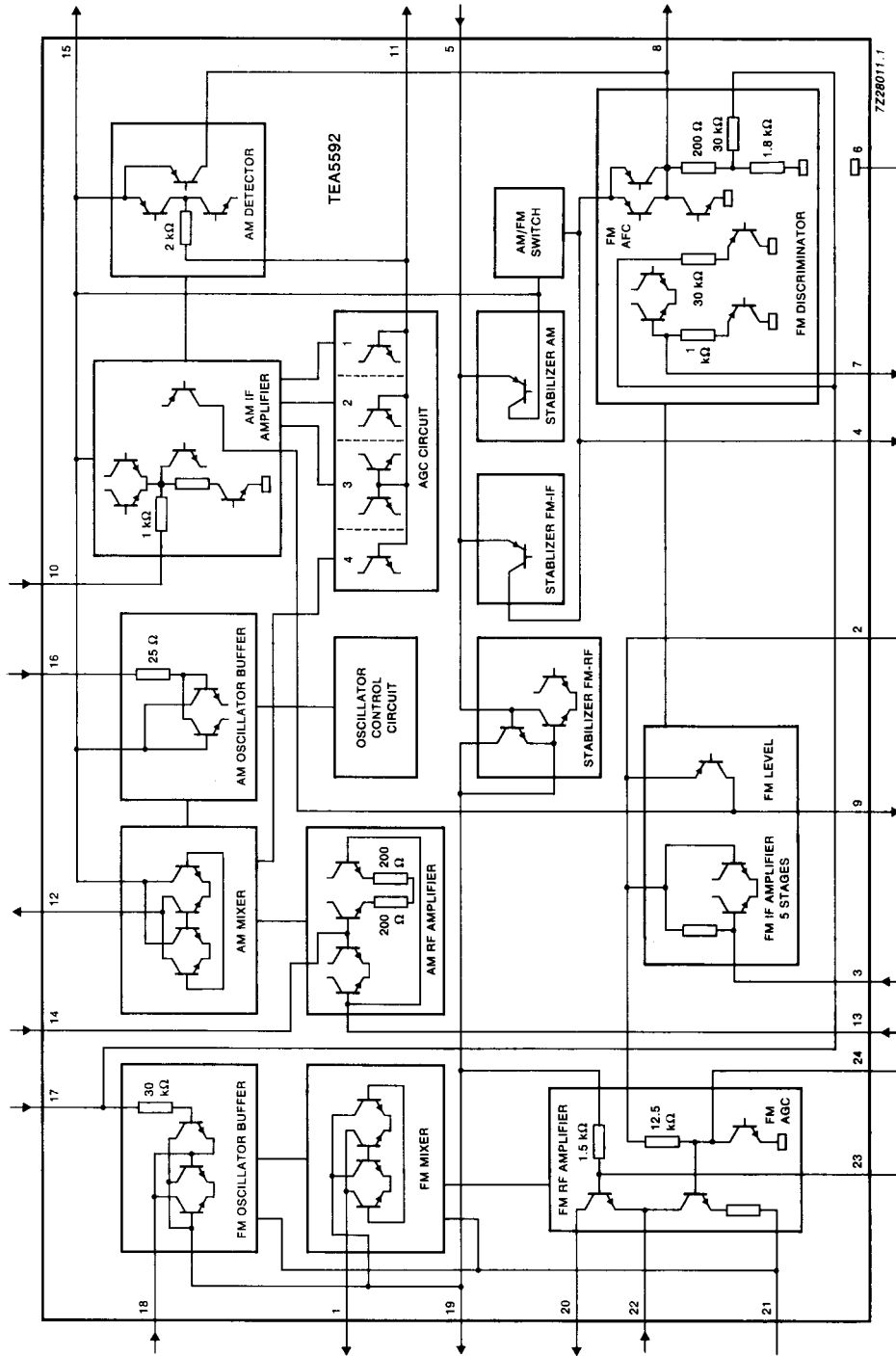


Fig.2 Equivalent circuit diagram.

PINNING

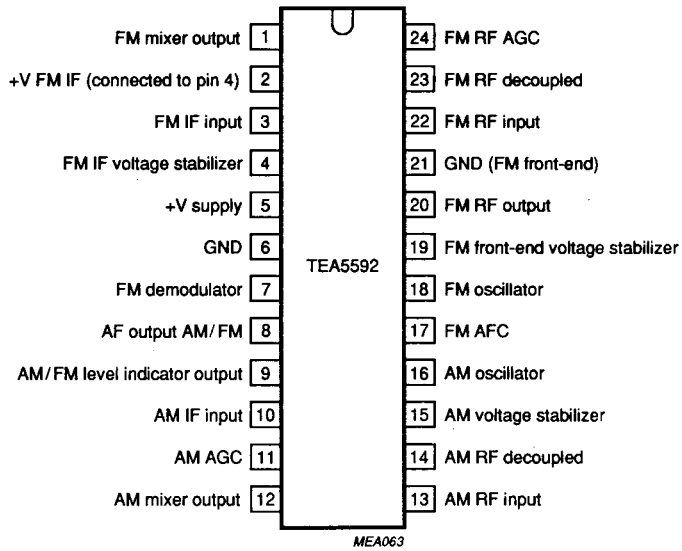


Fig.3 Pinning diagram.

DEVELOPMENT DATA

RATINGS

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

parameter	conditions	symbol	min.	max.	unit
Supply voltage (pin 5)		V_p	—	15	V
Total power dissipation		P_{tot}	see Fig.3		
Storage temperature range		T_{stg}	-65	+150	°C
Operating ambient temperature range		T_{amb}	-40	+85	°C
Electrostatic handling *		V_{es}	-2000	+2000	V

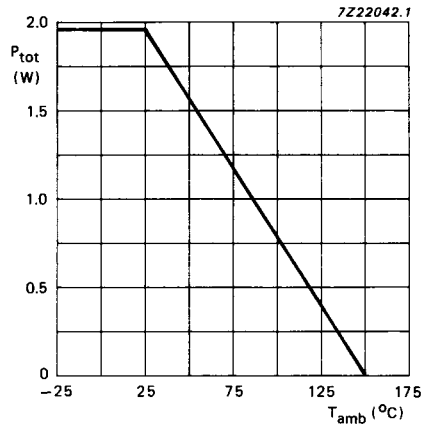


Fig.4 Power derating curve.

* Equivalent to discharging a 200 pF capacitor through a 1.5 k Ω series resistor.

DC CHARACTERISTICS

All voltages are referenced to pin 6 and pin 21; all input currents are positive; all parameters are measured in application circuit (see Fig.5) at nominal supply voltage $V_p = 6\text{ V}$; $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

DEVELOPMENT DATA

parameter	conditions	symbol	min.	typ.	max.	unit
Supply voltage		V_p	2.7	8.5	15	V
Voltages (FM)						
Pin 2		V_2	—	2.4	—	V
Pin 4		V_4	—	2.4	—	V
Pin 7		V_7	—	1.15	—	V
Pin 8		V_8	—	1.15	—	V
Pin 17		V_{17}	—	0.8	—	V
Pin 19		V_{19}	—	1.6	—	V
Pin 22		V_{22}	—	0.9	—	V
Pin 23		V_{23}	—	1.6	—	V
Pin 24		V_{24}	—	1.0	—	V
Voltages (AM)						
Pin 8		V_8	—	0.2	—	V
Pin 10		V_{10}	—	0.8	—	V
Pins 13 and 14		V_{13}, V_{14}	—	1.1	—	V
Pin 15		V_{15}	—	1.6	—	V
Total current consumption						
AM part		I_p	—	13	19	mA
FM part		I_p	—	17	23	mA

AC CHARACTERISTICS

All parameters are measured in test circuit (see Fig.11) at nominal supply voltage $V_p = 6\text{ V}$; $T_{\text{amb}} = 25\text{ }^\circ\text{C}$ unless otherwise specified

parameter	conditions	symbol	min.	typ.	max.	unit
AM section						
<i>AM front end</i> (pin 13 to 12)	note 1					
Conversion transconductance	$V_i = 10\text{ mV}$ $V_{\text{AGC}} \text{ (pin 11)}$ $= V_{15} - 0.1\text{ V}$	S_C	9.1	11.5	14	mA/V
	$V_{\text{AGC}} = V_{15} - 0.45\text{ V}$	S_C	0.78	1.1	1.39	mA/V
IF suppression	note 2; $V_o = 10\text{ mV}$	α	20	30	—	dB
<i>Oscillator</i> (pin 16)						
Voltage	$f = 1.5\text{ MHz}$ $f = 1.5\text{ MHz};$ $V_p = 2.25\text{ V}$	V_{osc}	110	160	200	mV
		V_{osc}	60	—	—	mV
<i>IF and detector section</i> (pin 10 to 8)	note 3					
IF sensitivity;						
AF output voltage	no AGC; $V_{i(\text{IF})} = 70\text{ }\mu\text{V}$	V_o	27	40	55	mV
Signal + noise to noise ratio for an IF input	no AGC; $V_{i(\text{IF})} = 70\text{ }\mu\text{V}$	S+N/N	20	26	—	dB
AF output voltage	$V_{i(\text{IF})} = 1\text{ mV}$	V_o	40	55	70	mV
Total harmonic distortion	$V_{i(\text{IF})} = 10\text{ mV};$ $m = 80\%$	THD	—	1	3	%
<i>Indicator/level detector</i> (pin 9)						
Output voltage	$V_{i(\text{IF})} = 0\text{ V}$	V_g	—	—	95	mV
	$V_{i(\text{IF})} = 200\text{ }\mu\text{V}$	V_g	—	200	—	mV
	$V_{i(\text{IF})} = 10\text{ mV}$	V_g	—	450	600	mV
Overall performance (pin 13 to 8)	note 4					
Total harmonic distortion	$V_i = 50\text{ mV}$	THD	—	1.5	4	%

parameter	conditions	symbol	min.	typ.	max.	unit
FM section						
<i>FM front end</i> (pin 22 to 1)						
Conversion transconductance	note 5 $V_i = 1 \text{ mV};$ $V_{AGC} (\text{pin } 24) = 1.1 \text{ V}$	S_c	9	14	19	mA/V
	$V_i = 1 \text{ mV};$ $V_{AGC} (\text{pin } 24) = 0.8 \text{ V}$	S_c	4	8	10	mA/V
<i>Oscillator</i> (pin 18)						
Voltage	$V_{AFC} = 0.8 \text{ V}$	V_{osc}	—	—	310	mV
	$V_{AFC} = 0.8 \text{ V};$ $V_P = 2.25 \text{ V}$	V_{osc}	95	200	—	mV
AFC control; change in oscillator frequency	$V_{AFC} (\text{pin } 17) = 0.8 \text{ V}$	f	—	111.2	—	MHz
	$\Delta V_{AFC} = -0.6 \text{ V}$	Δf	—	+420	—	kHz
	$\Delta V_{AFC} = +0.6 \text{ V}$	Δf	—	-620	—	kHz
<i>IF and demodulator section</i> (pin 3 to 8)						
IF sensitivity; note 6						
AF output voltage	note 7 $V_{i(IF)} = 70 \mu\text{V}$	V_o	-3	-1	0	dB
Signal + noise-to-noise ratio for an IF input	$V_{i(IF)} = 70 \mu\text{V}$ no limiting	S+N/N	20	30	—	dB
AF output voltage	$V_{i(IF)} = 1 \text{ mV}$	V_o	80	110	130	mV
Total harmonic distortion	$\Delta f = 75 \text{ kHz};$ $V_{i(IF)} = 50 \text{ mV}$	THD	—	1	—	%
<i>Indicator/level detector</i> (pin 9)						
Output voltage	$V_{i(IF)} = 0 \text{ V}$	V_g	—	—	20	mV
	$V_{i(IF)} = 500 \mu\text{V}$	V_g	—	260	—	mV
	$V_{i(IF)} = 10 \text{ mV}$	V_g	—	550	670	mV

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Notes to the AC characteristics

1. Input frequency = 1 MHz, output frequency = 468 kHz.
2. $\alpha = 20 \log (V_i \text{ at } f_i = 468 \text{ kHz}) / (V_i \text{ at } f_i = 1 \text{ MHz})$.
3. Input frequency = 468 kHz; m = 30% modulated with $f_{\text{mod}} = 1 \text{ kHz}$; unless otherwise specified.
4. Front-end connected to IF plus detector part. Input frequency = 1 MHz; m = 80% modulated with $f_{\text{mod}} = 1 \text{ kHz}$.
5. Input frequency = 100 MHz; output frequency = 10.7 MHz.
6. Input frequency = 10.7 MHz; frequency deviation, $\Delta f = 22.5 \text{ kHz}$ and $f_{\text{mod}} = 1 \text{ kHz}$; unless otherwise specified.
7. Reference: AF output voltage = 0 dB at $V_i = 1 \text{ mV}$.

DEVELOPMENT DATA

APPLICATION AND TEST INFORMATION

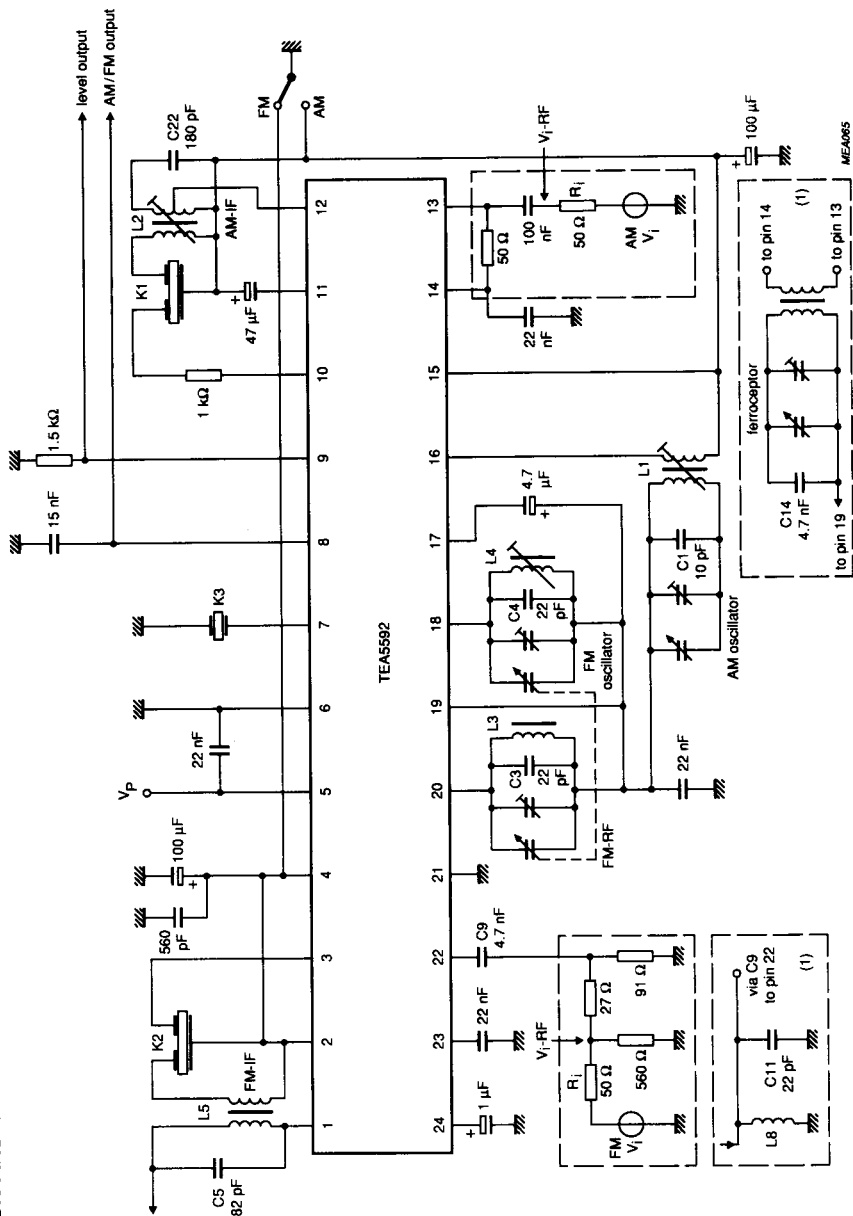


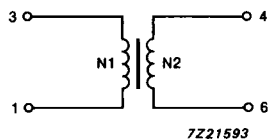
Fig. 5 Application circuit.

(1) In application the input circuits can be replaced by ferroceptor and aerial input circuit.

APPLICATION AND TEST INFORMATION (continued)

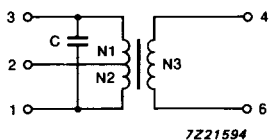
Component data

COILS



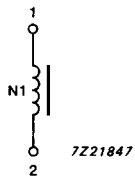
$N1 = 86$
 $N2 = 11$
 $L_{\text{prim}} = 270 \mu\text{H}$
 Wire = 0.07 mm diameter
 Coil type TOKO 7BRS

Fig.6 AM oscillator coil (L1).



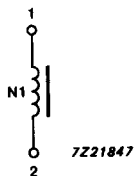
$N1 = 135$
 $N2 = 13$
 $N3 = 5$
 $C = 180 \text{ pF}$ (internal)
 $L_{\text{prim}} = 660 \mu\text{H}$
 $f_o = 468 \text{ kHz}$
 Wire = 0.07 mm diameter
 Coil type TOKO 7MCS

Fig.7 AM-IF coil (L2).



$N1 = 2.5$
 $L = 0.066 \mu\text{H}$

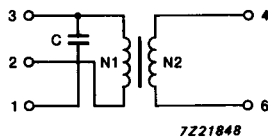
Fig.8 FM-RF coil (L3). TOKO equivalent no. 301SN-0200.



N1 = 1.5
L = 0.04 μ H

Fig.9 FM oscillator coil (L4). TOKO equivalent no 301SN-0100.

DEVELOPMENT DATA



N1 = 11
N2 = 2
C = 82 pF (internal)
 f_o = 10.7 MHz

Fig.10 FM-IF coil (L5). TOKO equivalent no. 301-20N

CERAMIC FILTERS

AM-IF (K1). SFU468B.

FM-IF (K2). SFE10.7MS3.

FM detector (K3). CDA10.7MC1.

TUNING CAPACITORS

AM section - 140/82 pF

FM section - 2 x 20 pF

APPLICATION AND TEST INFORMATION (continued)
For coil information see Component data.

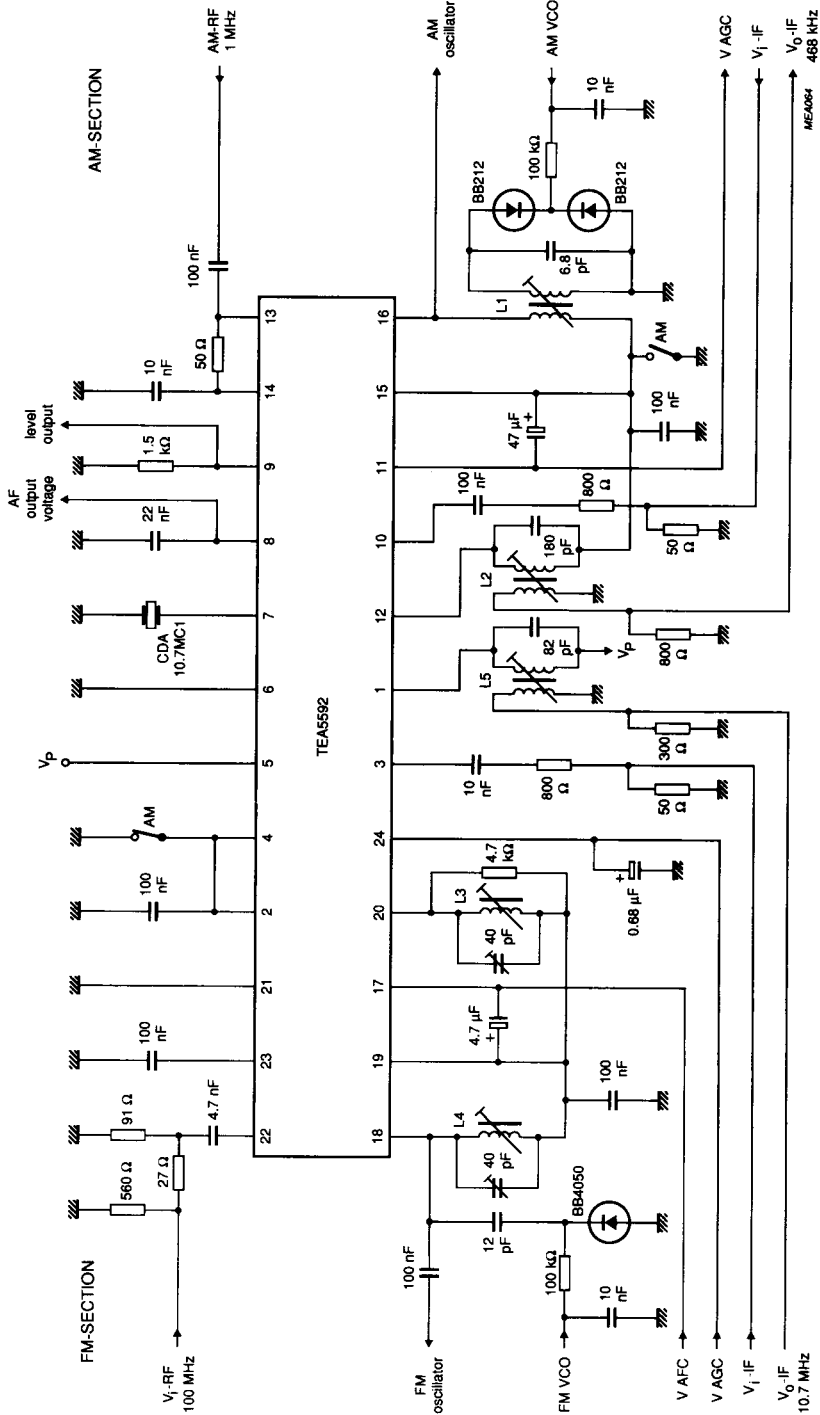


Fig. 11 Factory test circuit.