

## 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
<b>AM performance (pin 13)</b>	note 1					
Sensitivity	$V_o = 10$ mV	$V_i$	—	1.5	—	$\mu$ V
	$(S+N)/N = 26$ dB	$V_i$	—	15	—	$\mu$ 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
<b>FM performance (pin 22)</b>	note 2					
Limiting sensitivity	−3 dB	$V_i$	—	1.8	—	$\mu$ V
Signal-to-noise ratio	$V_i = 2.5$ $\mu$ 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	$100$ $\mu$ 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

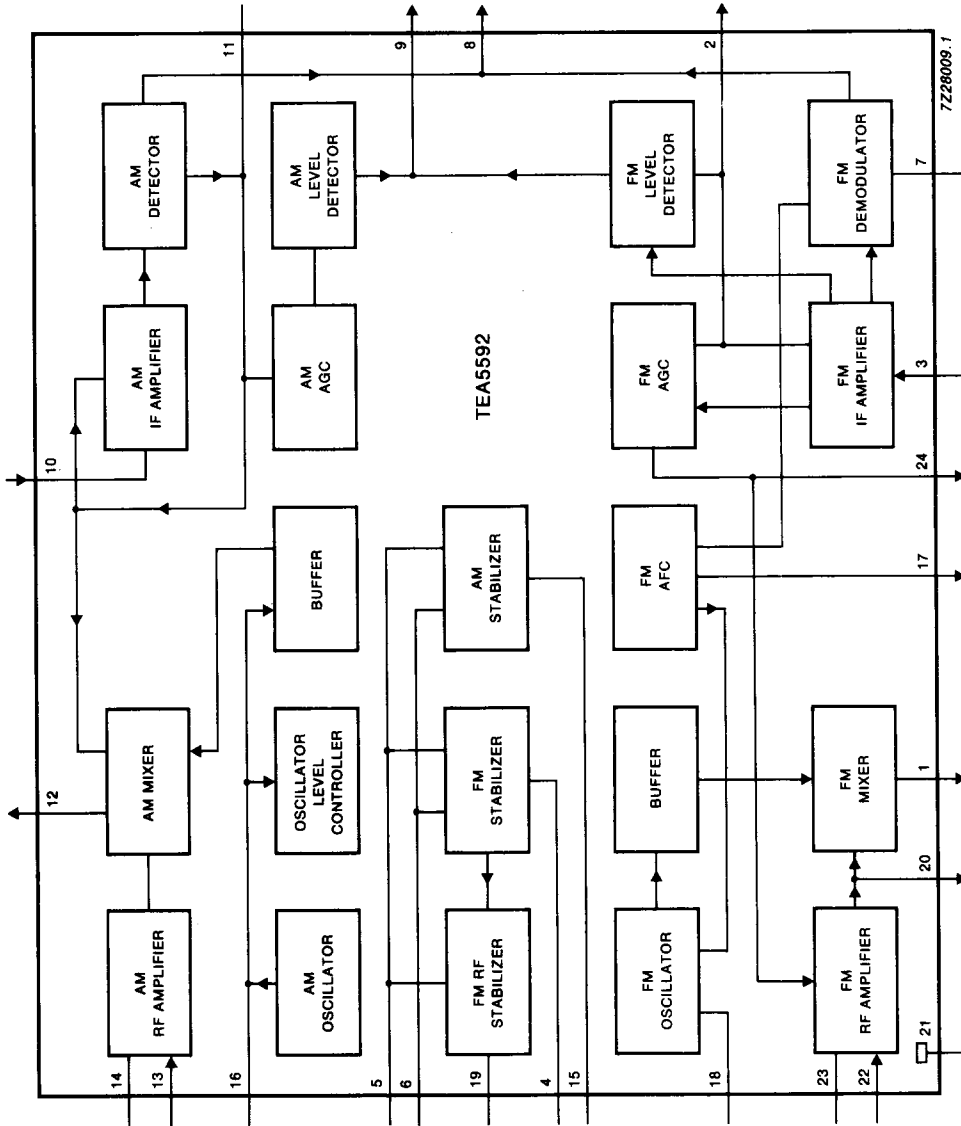


Fig.1 Block diagram.

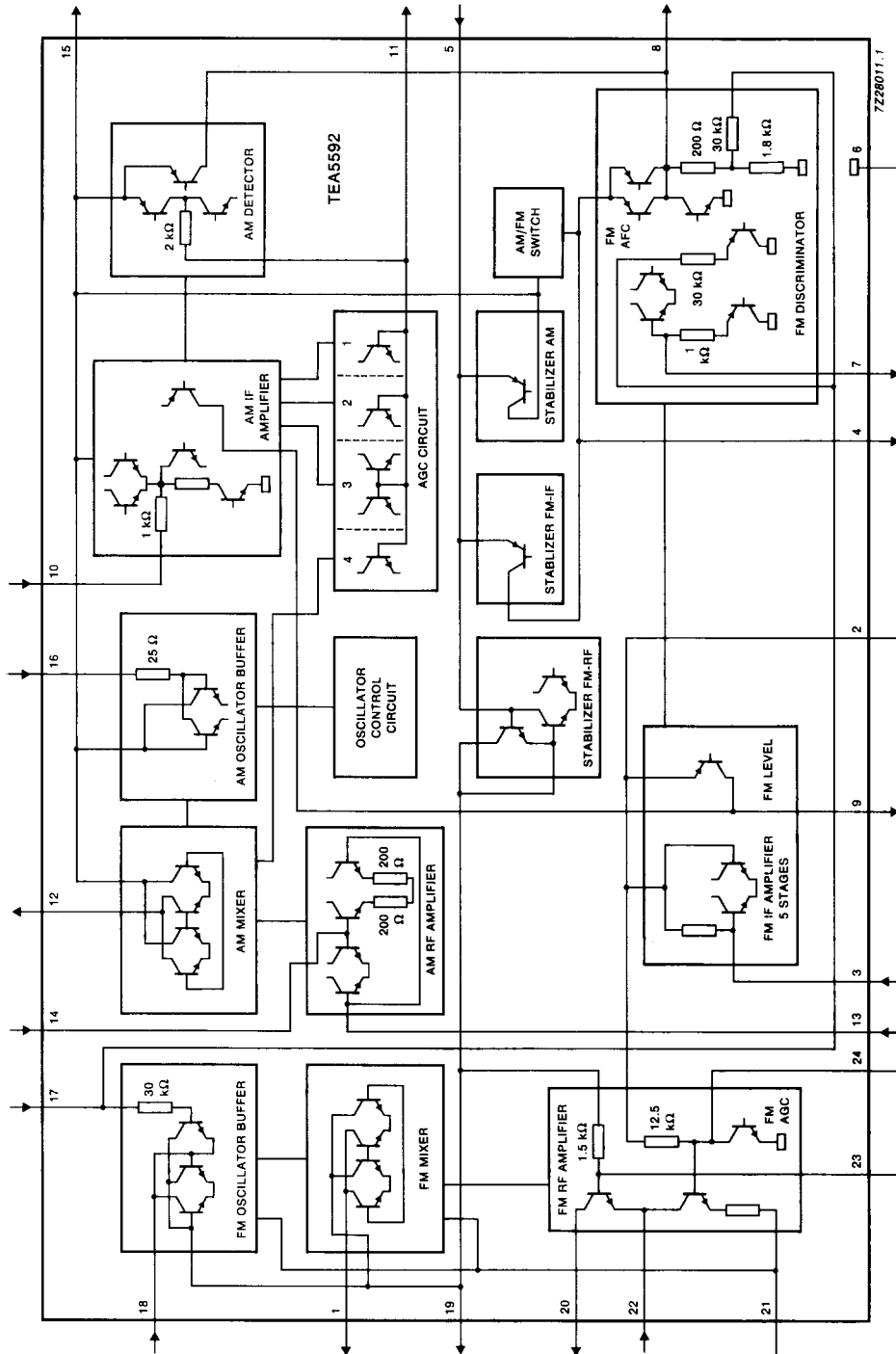


Fig.2 Equivalent circuit diagram.

PINNING

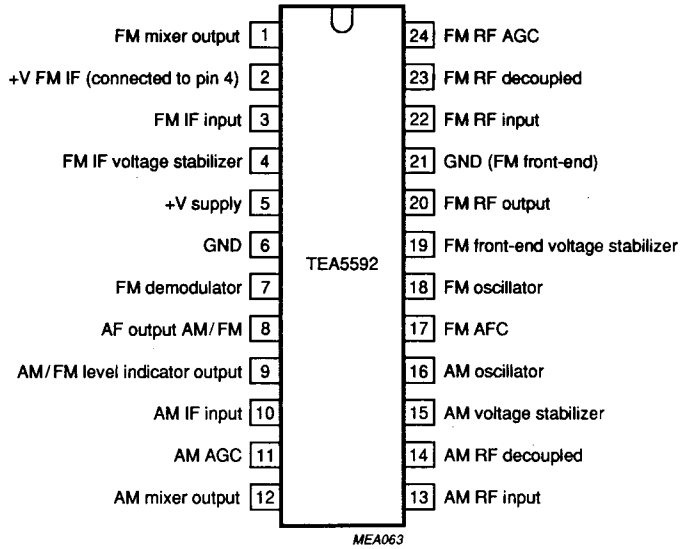


Fig.3 Pinning diagram.

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

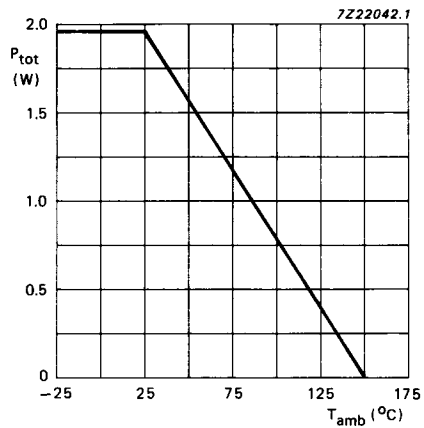


Fig.4 Power derating curve.

\* Equivalent to discharging a 200 pF capacitor through a 1.5 k $\Omega$  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
<b>Voltages (FM)</b>						
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
<b>Voltages (AM)</b>						
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
<b>Total current consumption</b>						
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
<b>AM section</b>						
<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	$\text{mA/V}$
	$V_{\text{AGC}} = V_{15} - 0.45\text{ V}$	$S_C$	0.78	1.1	1.39	$\text{mA/V}$
IF suppression	note 2; $V_o = 10\text{ mV}$	$\alpha$	20	30	—	dB
<i>Oscillator</i> (pin 16)						
Voltage	$f = 1.5\text{ MHz}$ $f = 1.5\text{ MHz};$ $V_p = 2.25\text{ V}$	$V_{\text{osc}}$	110	160	200	mV
		$V_{\text{osc}}$	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
<b>Overall performance</b> (pin 13 to 8)						
note 4						
Total harmonic distortion	$V_i = 50\text{ mV}$	THD	—	1.5	4	%



DEVELOPMENT DATA

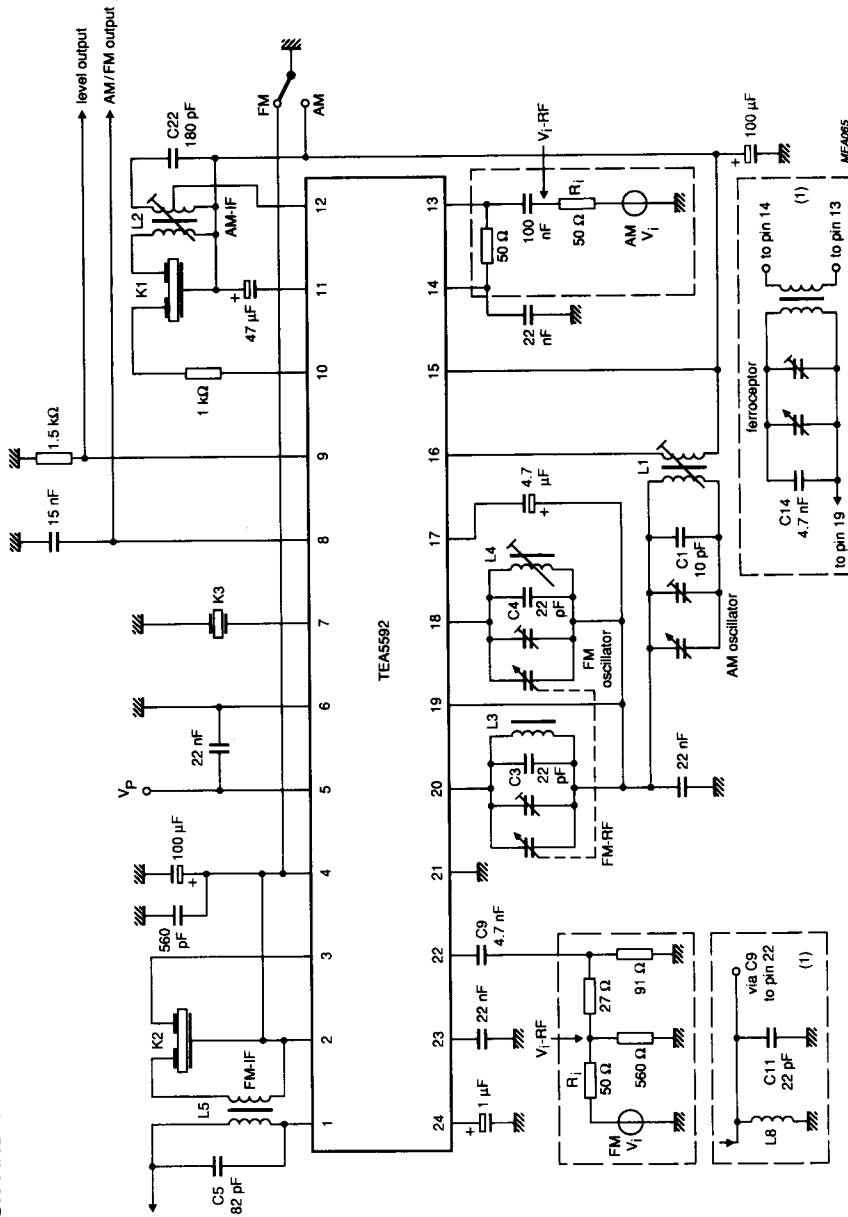
parameter	conditions	symbol	min.	typ.	max.	unit
<b>FM section</b>						
<i>FM front end</i> (pin 22 to 1)						
Conversion transconductance	note 5 $V_i = 1 \text{ mV}$ ; $V_{AGC} (\text{pin } 24) = 1.1 \text{ V}$	$S_c$	9	14	19	mA/V
	$V_i = 1 \text{ mV}$ ; $V_{AGC} (\text{pin } 24) = 0.8 \text{ V}$	$S_c$	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
	$\Delta V_{AFC} = -0.6 \text{ V}$	$\Delta f$	—	+420	—	kHz
	$\Delta V_{AFC} = +0.6 \text{ V}$	$\Delta f$	—	-620	—	kHz
<i>IF and demodulator section</i> (pin 3 to 8)						
IF sensitivity;						
AF output voltage	$V_{i(IF)} = 70 \mu\text{V}$	$V_o$	-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

**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



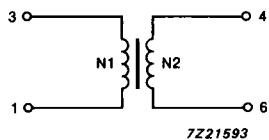
(1) In application the input circuits can be replaced by ferroresonant and aerial input circuit.

Fig. 5 Application circuit.

## APPLICATION AND TEST INFORMATION (continued)

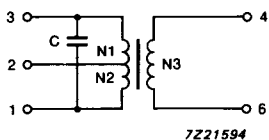
## Component data

## COILS



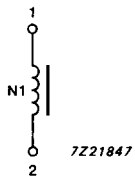
$N1 = 86$   
 $N2 = 11$   
 $L_{\text{prim}} = 270 \mu\text{H}$   
 Wire = 0.07 mm diameter  
 Coil type TOKO 7BRS

Fig.6 AM oscillator coil (L1).



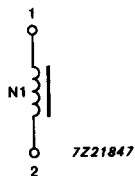
$N1 = 135$   
 $N2 = 13$   
 $N3 = 5$   
 $C = 180 \text{ pF (internal)}$   
 $L_{\text{prim}} = 660 \mu\text{H}$   
 $f_0 = 468 \text{ kHz}$   
 Wire = 0.07 mm diameter  
 Coil type TOKO 7MCS

Fig.7 AM-IF coil (L2).



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

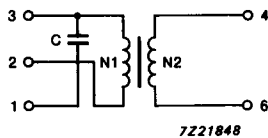
Fig.8 FM-RF coil (L3). TOKO equivalent no. 301SN-0200.



N1 = 1.5  
L = 0.04  $\mu$ 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.

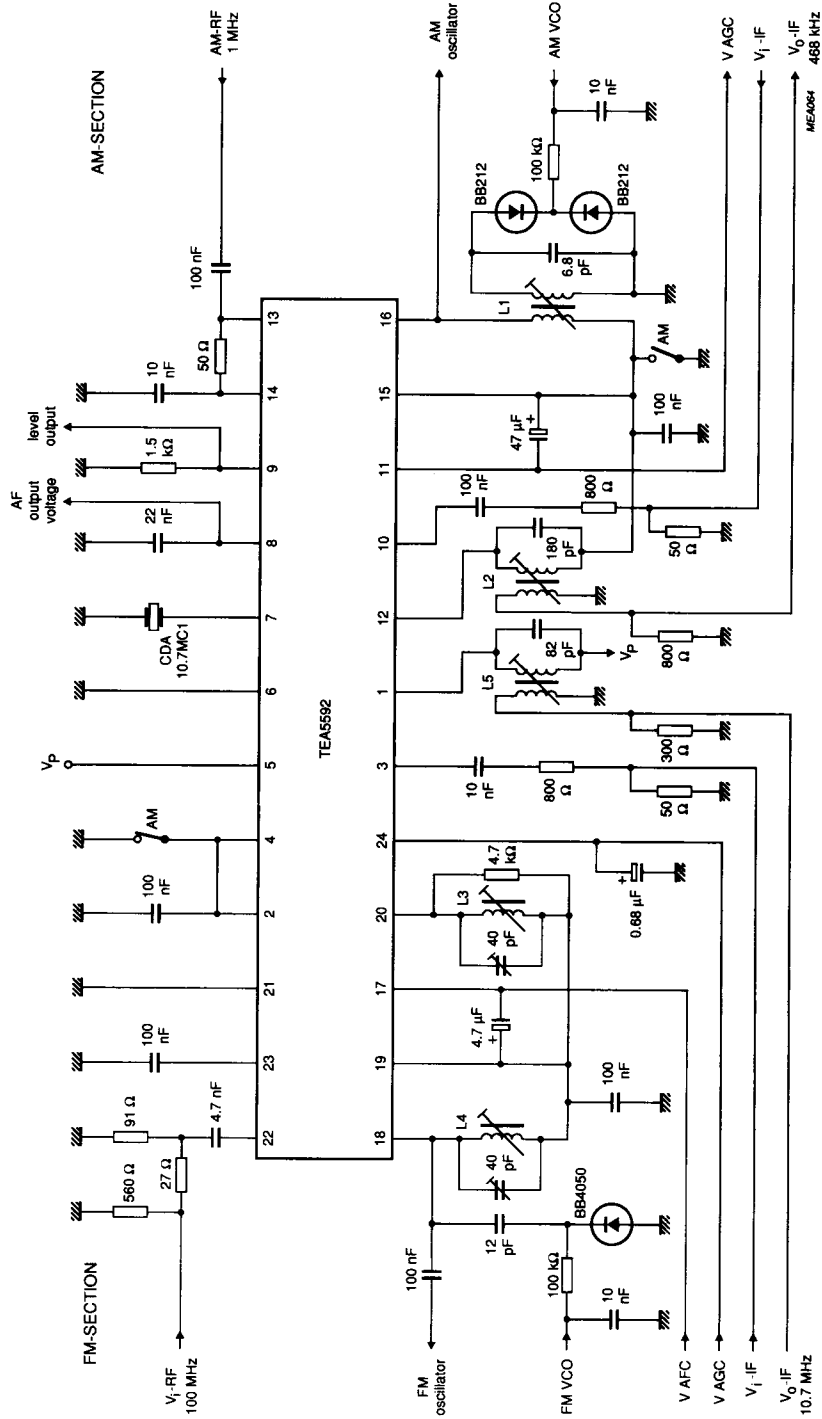


Fig. 11 Factory test circuit.