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	–	μV
	(S+N)/N = 26 dB	V_i	–	15	–	μV
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	–	μV
Signal-to-noise ratio	V_i = 2.5 μV	(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 μV < V_i < 100 mV	AMS	–	40	–	dB

Notes to the quick reference data

1. All parameters are measured in the application circuit (see Fig. 5) at nominal supply voltage Vp = 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.
2. All parameters are measured in the application circuit (see Fig. 5) at nominal supply voltage Vp = 6 V; T_{amb} = 25 °C; unless otherwise specified. RF conditions: Input frequency 100 MHz; frequency deviation Δf = 22.5 kHz and f_{mod} = 1 kHz; unless otherwise specified.

DEVELOPMENT DATA

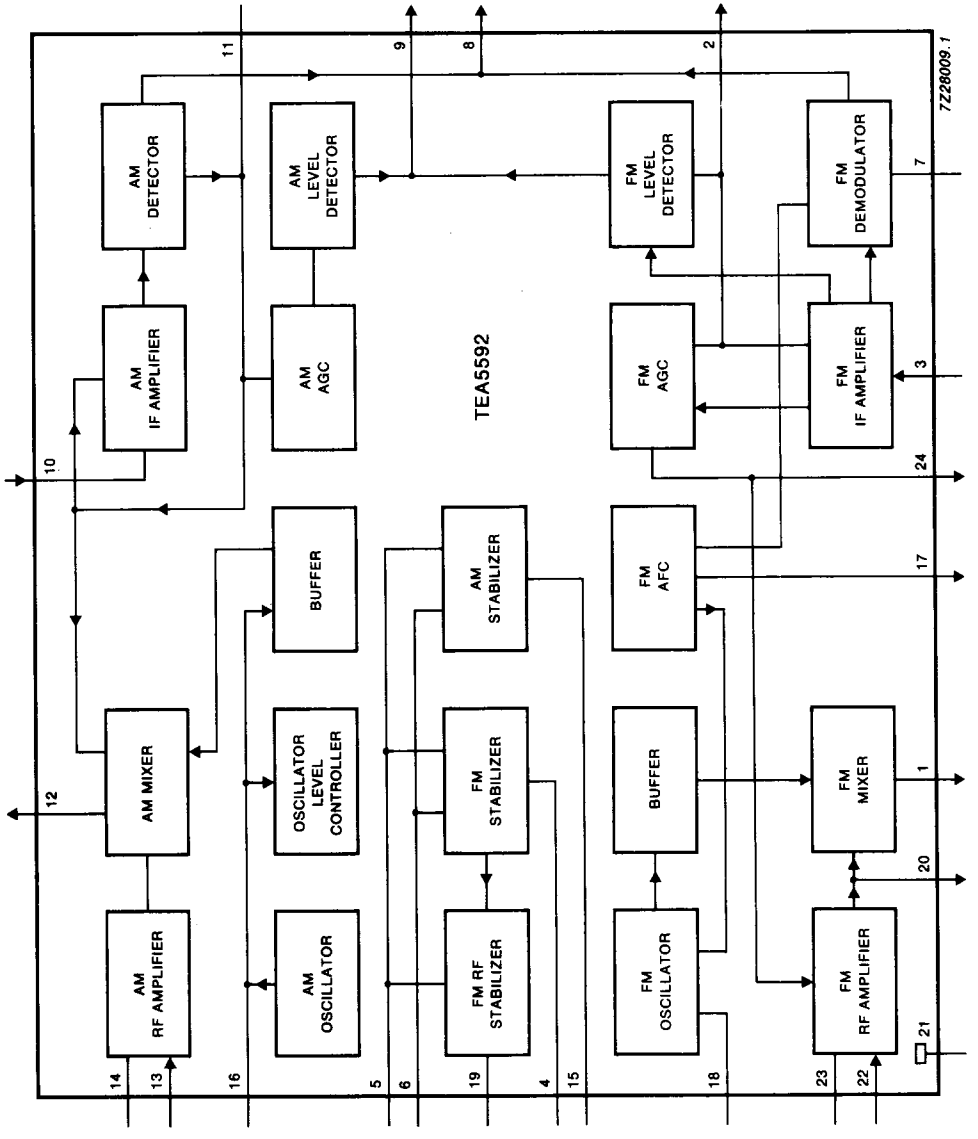


Fig.1 Block diagram.

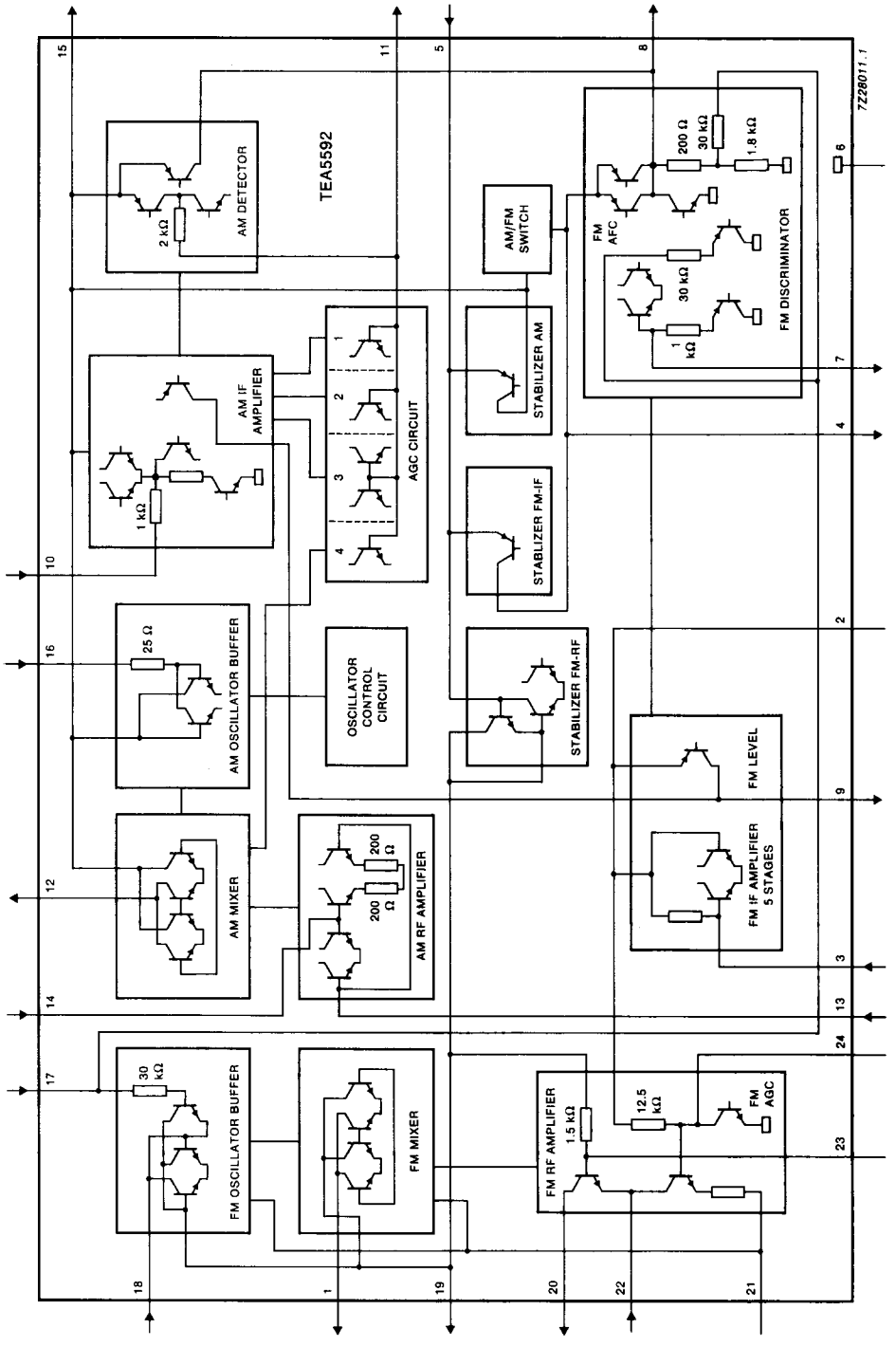


Fig.2 Equivalent circuit diagram.

PINNING

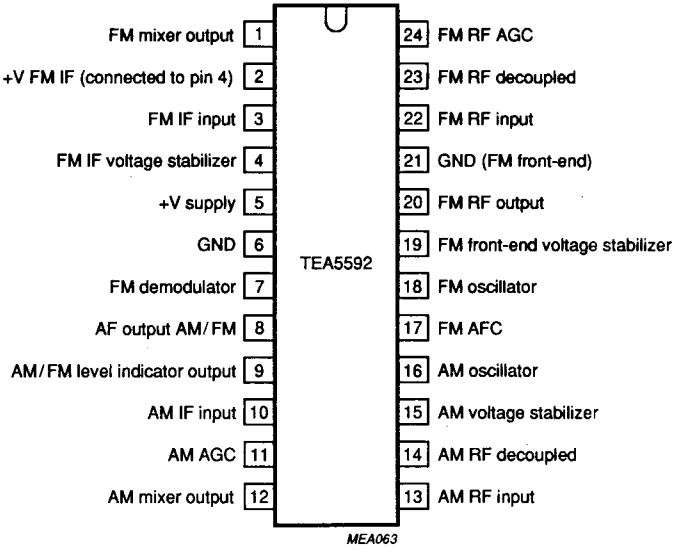


Fig.3 Pinning diagram.

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

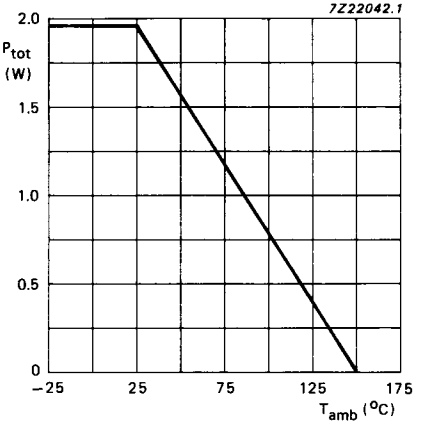


Fig.4 Power derating curve.

* Equivalent to discharging a 200 pF capacitor through a 1.5 kΩ 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 Vp = 6 V; T_{amb} = 25 °C unless otherwise specified.

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

DEVELOPMENT DATA

AC CHARACTERISTICS

All parameters are measured in test circuit (see Fig.11) at nominal supply voltage Vp = 6 V; T_{amb} = 25 °C unless otherwise specified

parameter	conditions	symbol	min.	typ.	max.	unit
AM section						
AM front end (pin 13 to 12)	note 1					
Conversion transconductance	V_i = 10 mV V_{AGC} (pin 11) = V_{15} - 0.1 V	S_C	9.1	11.5	14	mA/V
	$V_{AGC} = V_{15}$ - 0.45 V	S_C	0.78	1.1	1.39	mA/V
IF suppression	note 2; V_o = 10 mV	α	20	30	–	dB
Oscillator (pin 16)						
Voltage	f = 1.5 MHz	V_{osc}	110	160	200	mV
	f = 1.5 MHz; V_P = 2.25 V	V_{osc}	60	–	–	mV
IF and detector section (pin 10 to 8)	note 3					
IF sensitivity;						
AF output voltage	no AGC; $V_{i(IF)}$ = 70 μV	V_o	27	40	55	mV
Signal + noise to noise ratio for an IF input	no AGC; $V_{i(IF)}$ = 70 μV	S+N/N	20	26	–	dB
AF output voltage	$V_{i(IF)}$ = 1 mV	V_o	40	55	70	mV
Total harmonic distortion	$V_{i(IF)}$ = 10 mV; m = 80%	THD	–	1	3	%
Indicator/level detector (pin 9)						
Output voltage	$V_{i(IF)}$ = 0 V	V_9	–	–	95	mV
	$V_{i(IF)}$ = 200 μV	V_9	–	200	–	mV
	$V_{i(IF)}$ = 10 mV	V_9	–	450	600	mV
Overall performance (pin 13 to 8)	note 4					
Total harmonic distortion	V_i = 50 mV	THD	–	1.5	4	%

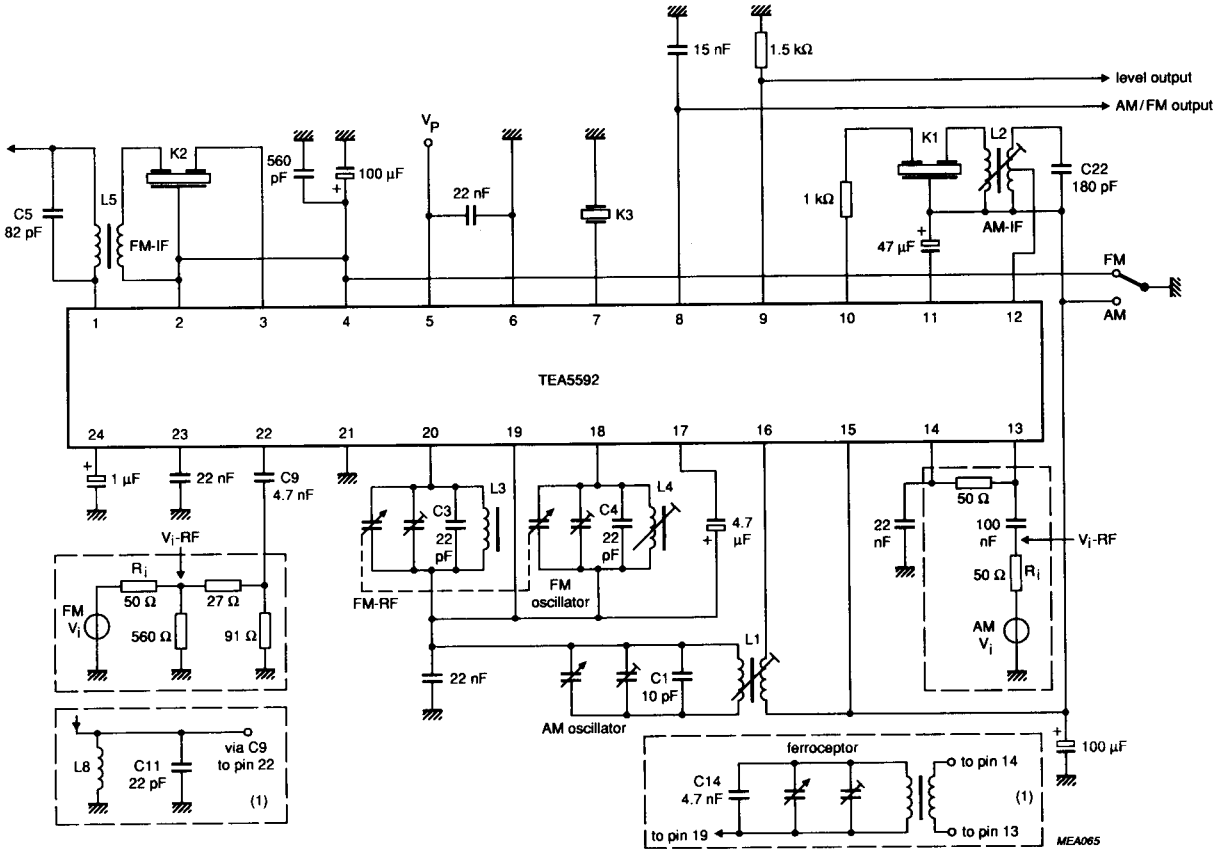
DEVELOPMENT DATA

parameter	conditions	symbol	min.	typ.	max.	unit
FM section						
FM front end (pin 22 to 1)	note 5					
Conversion transconductance	V_i = 1 mV; V_{AGC} (pin 24) = 1.1 V	S_c	9	14	19	mA/V
	V_i = 1 mV; V_{AGC} (pin 24) = 0.8 V	S_c	4	8	10	mA/V
Oscillator (pin 18)						
Voltage	V_{AFC} = 0.8 V	V_{osc}	–	–	310	mV
	V_{AFC} = 0.8 V; V_P = 2.25 V	V_{osc}	95	200	–	mV
AFC control; change in oscillator frequency	V_{AFC} (pin 17) = 0.8 V	f	–	111.2	–	MHz
	ΔV_{AFC} = –0.6 V	Δf	–	+420	–	kHz
	ΔV_{AFC} = +0.6 V	Δf	–	–620	–	kHz
IF and demodulator section (pin 3 to 8)	note 6					
IF sensitivity;	note 7					
AF output voltage	$V_{i(IF)}$ = 70 μV	V_o	–3	–1	0	dB
Signal + noise-to-noise ratio for an IF input	$V_{i(IF)}$ = 70 μV no limiting	S+N/N	20	30	–	dB
AF output voltage	$V_{i(IF)}$ = 1 mV	V_o	80	110	130	mV
Total harmonic distortion	Δf = 75 kHz; $V_{i(IF)}$ = 50 mV	THD	–	1	–	%
Indicator/level detector (pin 9)						
Output voltage	$V_{i(IF)}$ = 0 V	V_9	–	–	20	mV
	$V_{i(IF)}$ = 500 μV	V_9	–	260	–	mV
	$V_{i(IF)}$ = 10 mV	V_9	–	550	670	mV

Notes to the AC characteristics

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

APPLICATION AND TEST INFORMATION



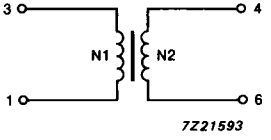
(1) In application the input circuits can be replaced by ferroceptor and aerial input circuit.

Fig. 5 Application circuit.

APPLICATION AND TEST INFORMATION (continued)

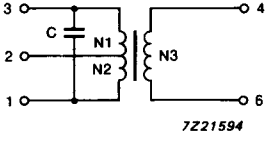
Component data

COILS



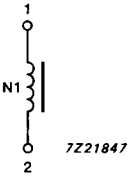
N1 = 86
N2 = 11
Lprim = 270 μH
Wire = 0.07 mm diameter
Coil type TOKO 7BRS

Fig.6 AM oscillator coil (L1).



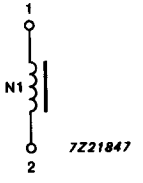
N1 = 135
N2 = 13
N3 = 5
C = 180 pF (internal)
Lprim = 660 μH
f_o = 468 kHz
Wire = 0.07 mm diameter
Coil type TOKO 7MCS

Fig.7 AM-IF coil (L2).



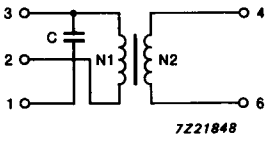
N1 = 2.5
L = 0.066 μH

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



N1 = 1.5
L = 0.04 μH

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



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.

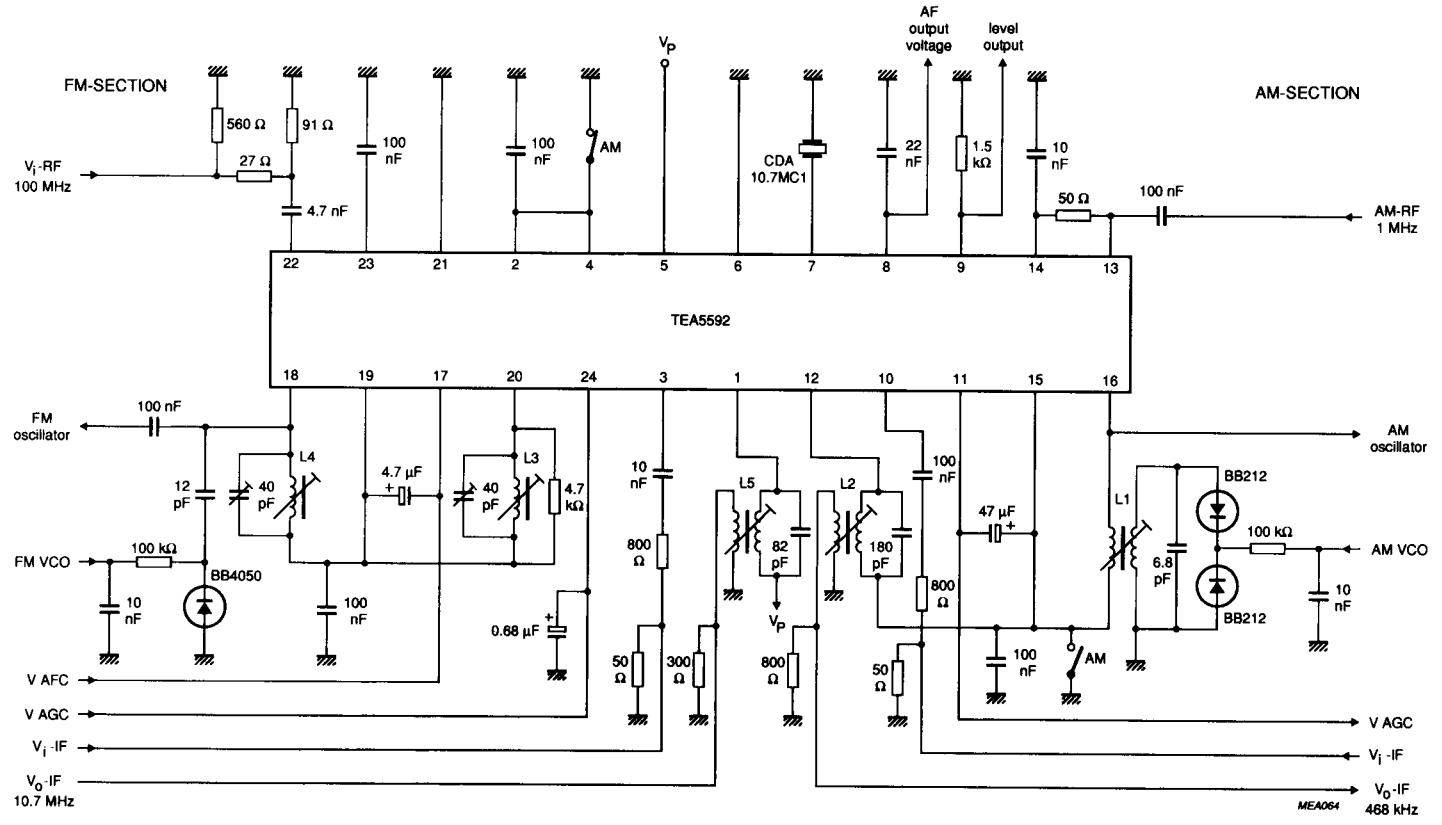


Fig.11 Factory test circuit.