DATA SHEET

TEA5594
AM/FM radio receiver circuit

Product specification
File under Integrated Circuits, IC01

March 1991

Philips
Semiconductors

PHILIPS

GENERAL DESCRIPTION

The TEA5594 is a 32-pin integrated radio circuit designed for use in all Electronic Tuned Radio (ETR) sets especially those sets which have to fulfil the immunity requirements of CENELEC.

The AM circuit incorporates:

- A double balanced mixer
- A ‘one-pin’ oscillator with amplitude control operating in the LW/MW 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 (fulfilling the “out of band” CENELEC requirements)
- Two IF amplifiers (for distributed selectivity)
- A quadrature demodulator with a ceramic filter

The TEA5594 also contains:

- Oscillator output buffers for AM and FM
- A combined AM/FM IF counter output buffer with counter “enable” function
- A field strength level detector for AM and FM
- A soft mute circuit at FM, adjustable
- An extra IF amplifier to split up IF filtering

Features

- Low distortion on FM
- AM/FM level/indicator circuit
- A DC AM/FM switch facility
- Supply voltages 2.7 to 15 V
- A local distance switch facility (LOCAL-DX) at FM
- All pins are ESD protected

PACKAGE OUTLINE

32-lead shrink DIL; plastic (SOT232); SOT232-1; 1996 September 9.

QUICK REFERENCE DATA

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage (pin 9)		V_P	2.7	–	15	V
Total current consumption						
AM part		I_P	–	13	–	mA
FM part		I_P	–	24	–	mA
Operating ambient temperature range		T_{amb}	–40	–	+85	°C
AM performance (pin 22)	note 1					
Sensitivity	V_o = 10 mV	V_i	–	3.5	–	μV
	(S + N)/N = 26 dB	V_i	–	16	–	μV
Signal-to-noise ratio	V_i = 1 mV	(S + N)/N	–	48	–	dB
AF output voltage		V_o	–	50	–	mV
Total harmonic distortion		THD	–	0.8	–	%
Signal handling	m = 80%; THD = 8%	V_i	–	100	–	mV
FM performance (pin 30)	note 2					
Limiting sensitivity	–3 dB; note 3	V_i	–	2.5	–	μV
Signal-to-noise ratio	V_i = 3 μV	(S + N)/N	–	26	–	dB
	V_i = 1 mV	(S + N)/N	–	60	–	dB
AF output voltage		V_o	–	90	–	mV
Total harmonic distortion		THD	–	0.1	–	%
Maximum signal handling		V_i	–	200	–	mV
AM suppression	100 μV < V_i <					
	100 mV	AMS	–	50	–	dB

Notes to the quick reference data

1. All parameters are measured in the application circuit (see Fig.5) at nominal supply voltage V_p = 8.5 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 V_p = 8.5 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.
3. Soft mute switched off.

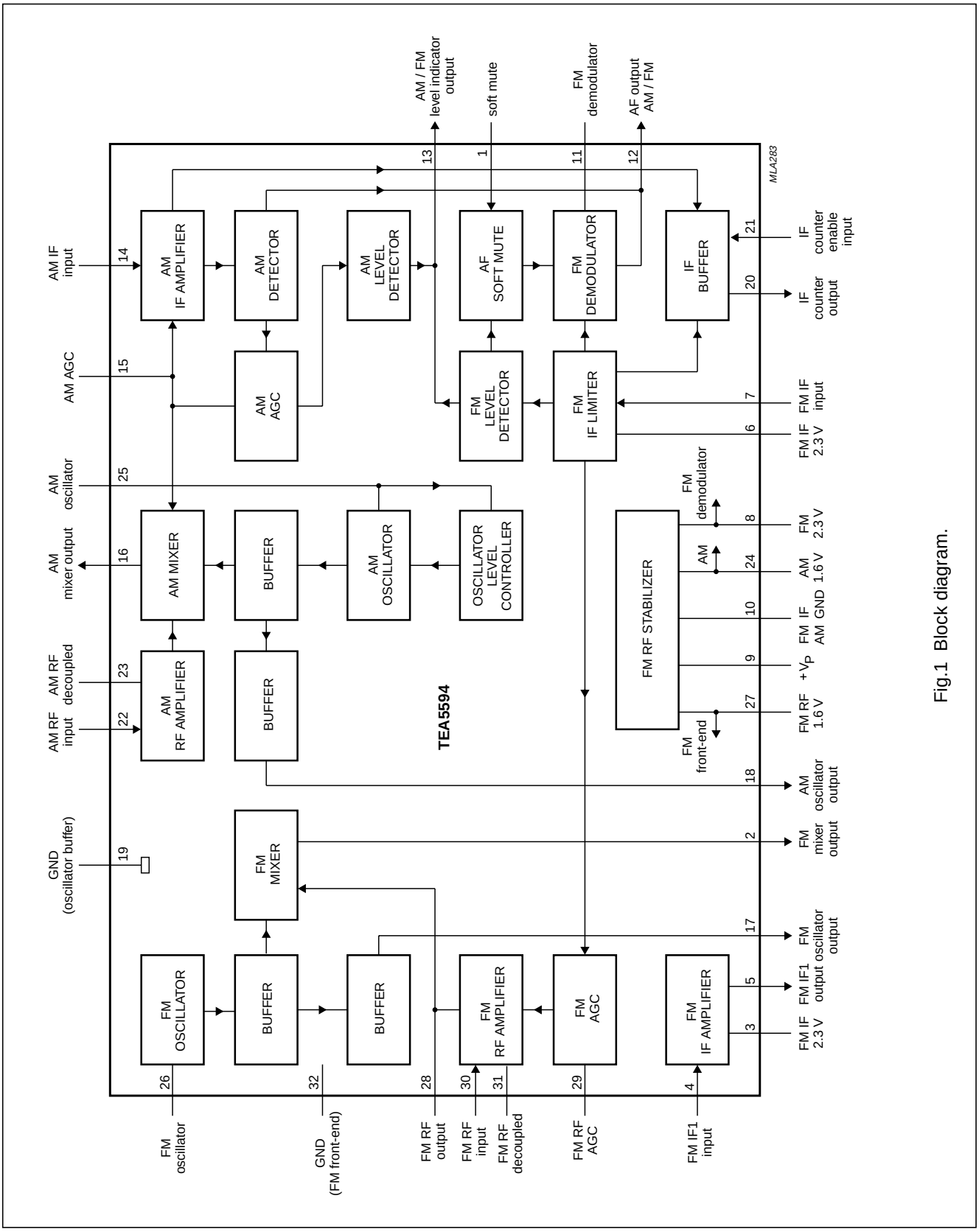


Fig.1 Block diagram.

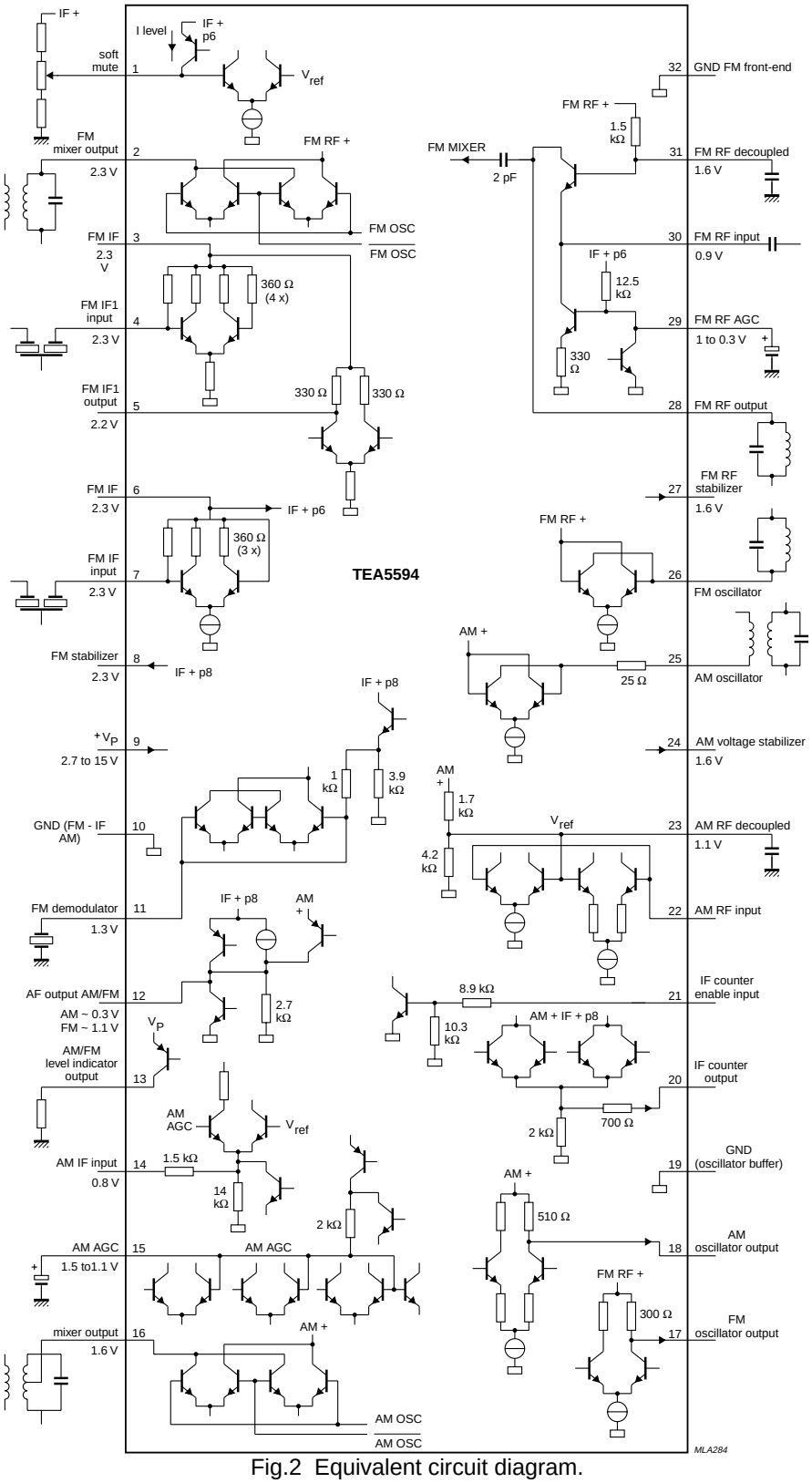


Fig.2 Equivalent circuit diagram.

PINNING

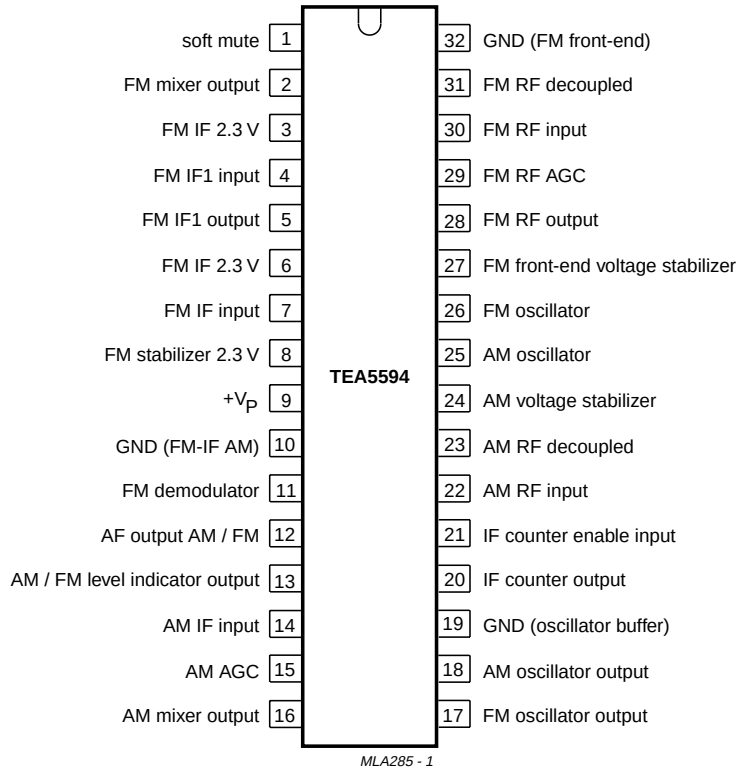


Fig.3 Pinning diagram.

RATINGS

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

PARAMETER	CONDITIONS	SYMBOL	MIN.	MAX.	UNIT
Supply voltage (pin 9)		V_P	–	18	V
Total power dissipation		P_{tot}	see Fig.4		
Storage temperature range		T_{stg}	–65	+150	°C
Operating ambient temperature range		T_{amb}	–40	+85	°C
Electrostatic handling(1)		V_{es}	–2000	+2000	V

Note

1. Equivalent to discharging a 200 pF capacitor through a 1.5 kΩ series resistor.

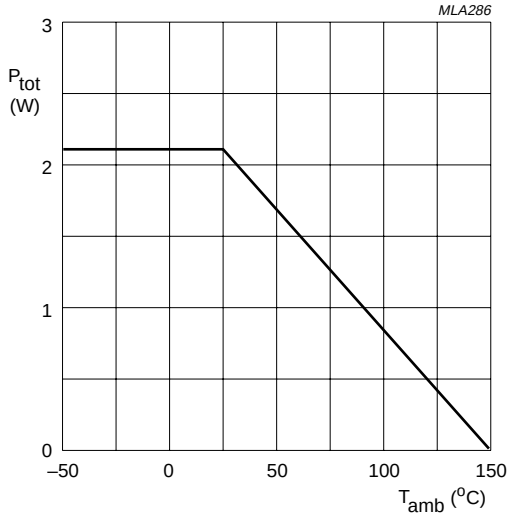


Fig.4 Power derating curve.

DC CHARACTERISTICS

All voltages are referenced to pin 10, pin 19 and pin 32; all input currents are positive; all parameters are measured in application circuit (see Fig.5) at nominal supply voltage V_P = 8.5 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 4		V_4	–	2.3	–	V
Pin 5		V_5	–	2.2	–	V
Pin 7		V_7	–	2.3	–	V
Pin 8		V_8	–	2.3	–	V
Pin 12		V_{12}	–	1.15	–	V
Pin 27		V_{27}	–	1.6	–	V
Pin 29		V_{29}	–	1.0	–	V
Pin 30		V_{30}	–	0.9	–	V
Pin 31		V_{31}	–	1.6	–	V
Voltages (AM)						
Pin 12		V_{12}	–	0.2	–	V
Pin 14		V_{14}	–	0.8	–	V
Pin 15		V_{15}	–	1.54	–	V
Pins 22 and 23		V_{22}, V_{23}	–	1.1	–	V
Pin 24		V_{24}	–	1.6	–	V
Total current consumption						
AM part		I_P	–	13	(1)	mA
FM part		I_P	–	24	(1)	mA

Note

1. Value to be fixed.

AC CHARACTERISTICS

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

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
AM SECTION						
AM front end	note 1					
Conversion transconductance	V_i = 10 mV					
	V_{AGC} (pin 15)					
	= V_{24} - 0.1 V	S_C	(9)	13.5	(9)	mA/V
	V_{AGC} = V_{24} - 0.45 V	S_C	(9)	1.2	(9)	mA/V
IF suppression	note 2	α	20	30	–	dB
Oscillator (pin 25)						
Voltage	f = 1.5 MHz	V_{osc}	–	160	(9)	mV
Oscillator buffer						
Output voltage						
(peak-to-peak value)		V_{18}	(9)	140	–	mV
IF and detector part	note 3					
IF sensitivity;						
AF output voltage	no AGC;					
	$V_{i(IF)}$ = 90 µV	V_o	30	40	60	mV
Signal + noise to noise	no AGC;					
ratio for an IF input	$V_{i(IF)}$ = 90 µV	S+N/N	22	24	30	dB
AF output voltage	$V_{i(IF)}$ = 1 mV	V_o	35	50	70	mV
Total harmonic distortion	$V_{i(IF)}$ = 10 mV;					
	m = 80%	THD	0.75	2	5	%
	$V_{i(IF)}$ = (9) to (9) mV;					
	m = 30%	THD	–	(9)	–	%
Indicator/level detector						
Output voltage	$V_{i(IF)}$ = 0 V	V_{13}	(9)	560	(9)	mV
	$V_{i(IF)}$ = 200 µV	V_{13}	(9)	3200	(9)	mV
	$V_{i(IF)}$ = 10 mV	V_{13}	(9)	6600	(9)	mV
AM IF counter output buffer						
Counter “enable”						
Output voltage						
(peak-to-peak value)		V_{20}	100	125	–	mV
Counter “disable”						
Suppression of 468 kHz		V_{20}	–40	–	–	dB
Overall performance	note 4					
Total harmonic distortion	$V_{i(RF)}$ = 50 mV	THD	–	–	8	%
Signal handling	THD = (9) %; m = 0.8%		–	(9)	–	

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Counter enable circuit						
IF counter output OFF		V_{21}	–	–	0.8	V
IF counter output ON		V_{21}	2	–	V_P	V
FM SECTION						
FM front end	note 5					
Conversion transconductance	$V_{i(RF)}$ = 1 mV;					
	V_{AGC} = 1.1 V	S_c	16	24	32	mA/V
	$V_{i(RF)}$ = 1 mV;					
	V_{AGC} = 0.8 V	S_c	5	10	15	mA/V
Oscillator (pin 26)						
Voltage		V_{osc}	–	250	-	mV
Oscillator buffer						
Output voltage						
(peak-to-peak value)		V_{17}	(9)	270	–	mV
IF and demodulator part	note 6					
IF sensitivity	note 7					
AF output voltage	$V_{i(IF)}$ = 40 μV					
	no mute	V_o	–3	–1	0	dB
	with mute	V_o	–20	–30	–40	dB
AM suppression	note 8	α	–	(9)	-	dB
Signal + noise-to-noise	no mute;					
ratio for an IF input	$V_{i(IF)}$ = 40 μV	S+N/N	28	46	50	dB
	$V_{i(IF)}$ = 1 mV	S+N/N	–	(9)	–	dB
AF output voltage	$V_{i(IF)}$ = 1 mV	V_o	(9)	85	(9)	mV
Total harmonic distortion	$V_{i(IF)}$ = 50 mV					
	Δf = 75 kHz	THD	–	1	–	%
	Δf = 22.5 kHz	THD	–	(9)	–	%
Indicator/level detector						
Output voltage	$V_{i(IF)}$ = 0 V	V_{13}	(9)	2600	(9)	mV
	$V_{i(IF)}$ = 50 μV	V_{13}	(9)	5750	(9)	mV
	$V_{i(IF)}$ = 1 mV	V_{13}	(9)	6250	(9)	mV
AM/FM IF counter output buffer						
Counter “enable”	note 5					
Output voltage						
(peak-to-peak value)		V_{20}	–	130	–	mV
Counter “disable”						
Suppression of 10.7 MHz		V_{20}	–40	-	–	dB

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Counter enable circuit				V		
IF counter output OFF		V_{21}	–	–	0.8	V
IF counter output ON		V_{21}	2	–	V_P	V
AM/FM switch						
FM OFF/AM ON		$V_{8\text{-}10}$	–	0	0	V
FM ON/AM OFF		$V_{24\text{-}10}$	–	0	0	V

Notes to the characteristics

1. Input frequency = 1 MHz, output frequency = 468 kHz;

   $$S_C = \frac{V_{o(IF)}}{V_{i(RF)}} \times \frac{N2/N3}{R}$$ (see TR2 Component data)

   Where R = 1.2 kΩ (total impedance at pin 16).
2. α = 20 log (V_i at f_i = 468 kHz)/(V_i at f_i = 1 MHz); V_o = 10 mV; no AGC.
3. Input frequency = 468 kHz; m = 30% modulated with f_{mod} = 1 kHz; R_{source} = 800 Ω unless otherwise specified.
4. Front-end connected to IF plus detector part (see Fig.5). Input frequency = 1 MHz; m = 80% modulated with f_{mod} = 1 kHz.
5. Input frequency = 100 MHz, output frequency = 10.7 MHz;

   $$S_c = \frac{V_{o(IF)}}{V_{i(RF)}} \times \frac{N1/N2}{R}$$ (see TR3 Component data)

   Where R = 6.6 kΩ (total impedance at pin 2).
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 $V_{i(IF)}$ = 1 mV;
   No mute: $V_1 = V_8$;
   With mute: V_1 = 0 V.
8. AM suppression is measured with AM only: m = 0.8% and f_{mod} = 1 kHz referred to AF output at FM only: Δf = 75 kHz and f_{mod} = 1 kHz.
9. Value to be fixed.

APPLICATION AND TEST INFORMATION

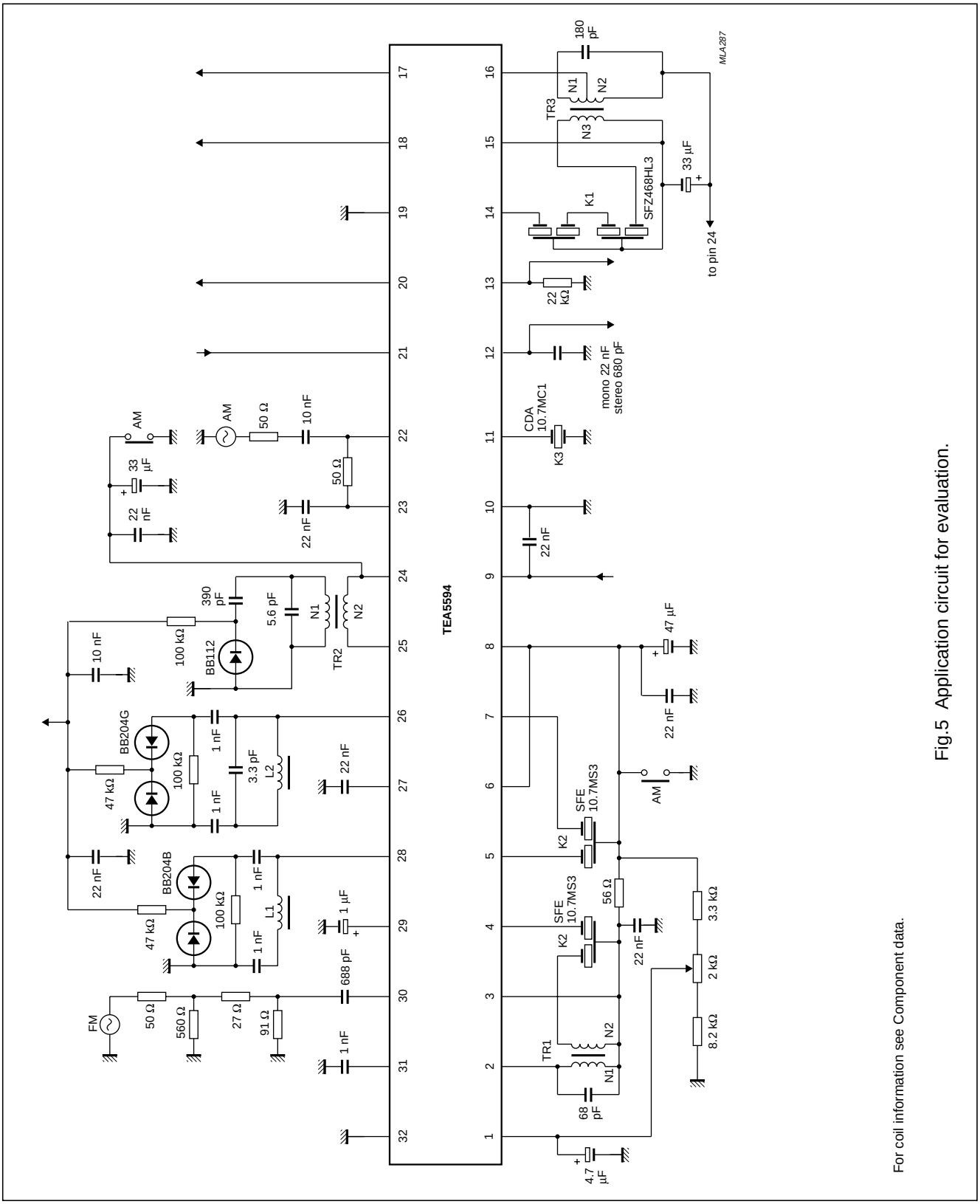


Fig.5 Application circuit for evaluation.

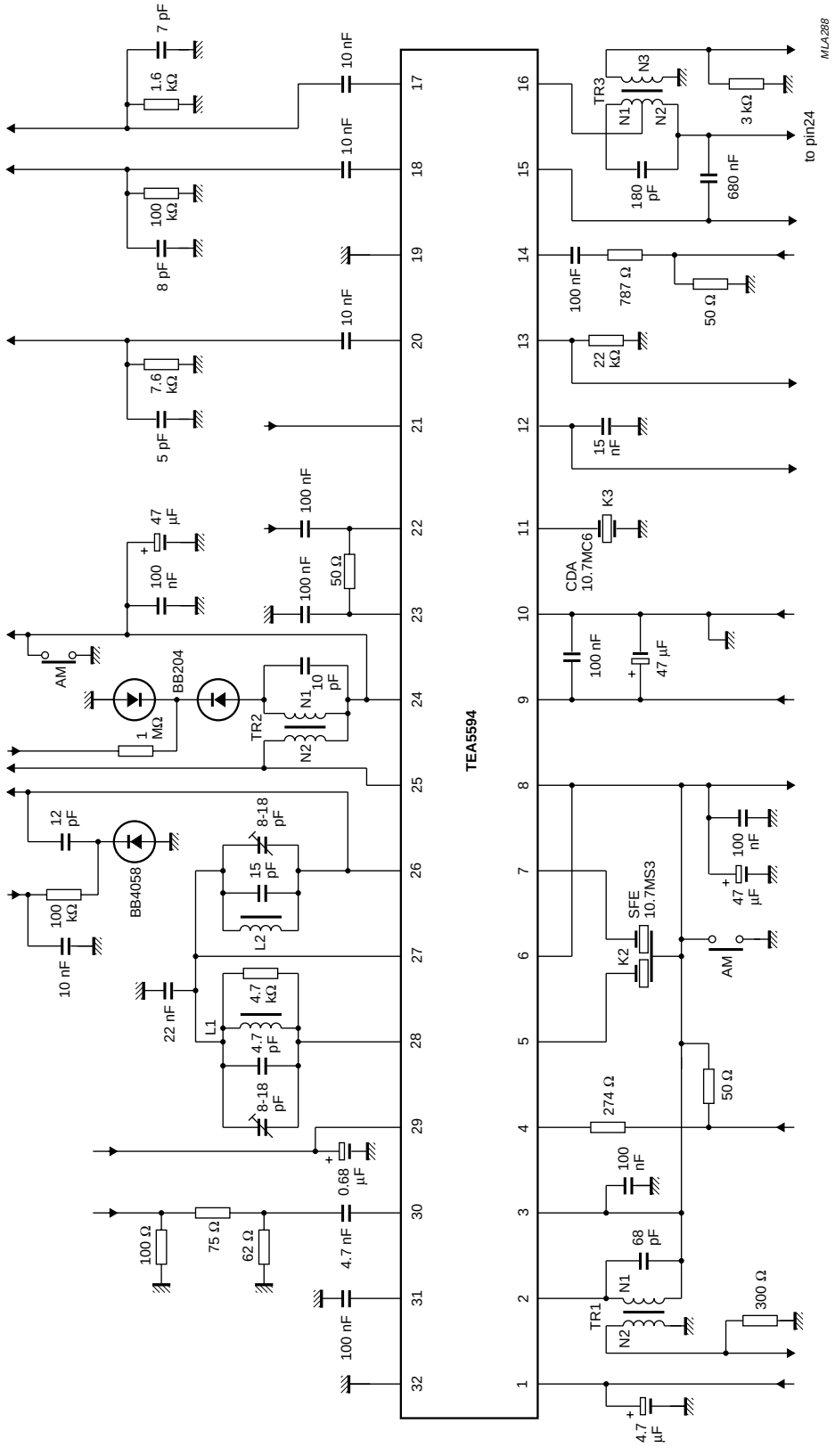


Fig.6 Factory test circuit.

For coil information see Component data.

Component data

COILS

N1 = 4.5
L = 100 µH

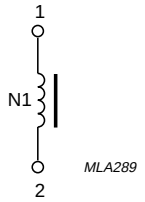


Fig.7 FM-RF coil (L1). TOKO equivalent no. MC115.

N1 = 4.5
L = 94 µH

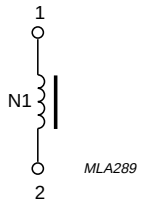


Fig.8 FM oscillator coil (L2). TOKO equivalent no. A294SNS-1004NK.

N1 = 12
N2 = 2
C= 68 pF (internal)
f_o = 10.7 MHz
Wire = 0.07 mm diameter
Coil type TOKO 119BCS-A6515BQG

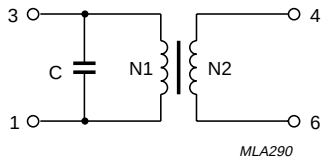


Fig.9 FM-IF coil (TR1).

N1 = 55
N2 = 55
Lprim = 106 µH
Wire = 0.05 mm diameter
Coil type TOKO 7MCS

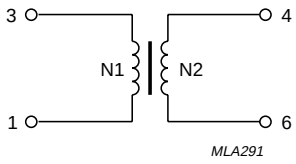


Fig.10 AM oscillator coil (TR2).

N1 = 139
N2 = 15
N3 = 9
C = 180 pF (internal)
Lprim = 660 μH
f_o= 468 MHz
Wire = 0.07 mm diameter
Coil type TOKO 7MC

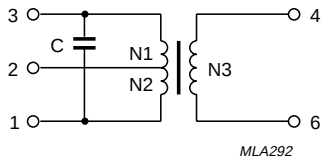


Fig.11 AM-IF coil (TR3).

CERAMIC FILTERS

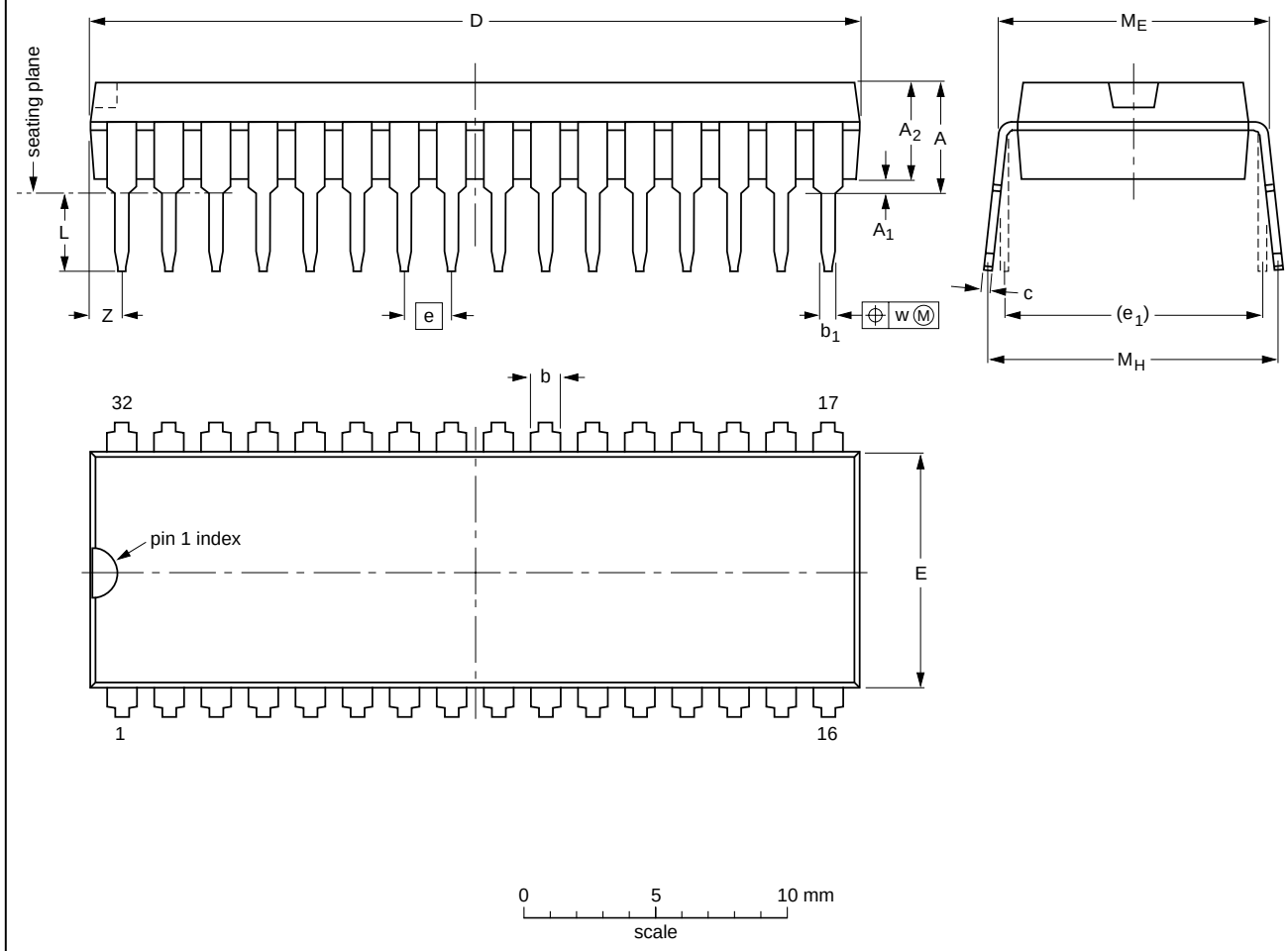
AM-IF (K1). SFZ468HL3.

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

FM detector (K3). CDA10.7MC1 (MC6).

PACKAGE OUTLINE

SDIP32: plastic shrink dual in-line package; 32 leads (400 mil) **SOT232-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	29.4 28.5	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT232-1						~~92-11-17~~ 95-02-04

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at 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 maximum storage temperature ($T_{stg\ max}$). 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.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.