TEMIC
Semiconductors

U4253BM

AM/FM Antenna Impedance Matching IC

Description

The U4253BM is an integrated AM/FM antenna impedance matching circuit in BICMOS technology. The device is designed in particular for car application and is suitable for windscreen and roof antennas.

Features

- High dynamic range for AM and FM
- Integrated AGC for FM
- High intercept point 3rd order for FM
- FM amplifier adjustable to various cable impedance
- High intercept point 2nd order for AM
- Low noise output voltage
- Low power consumption

Block Diagram

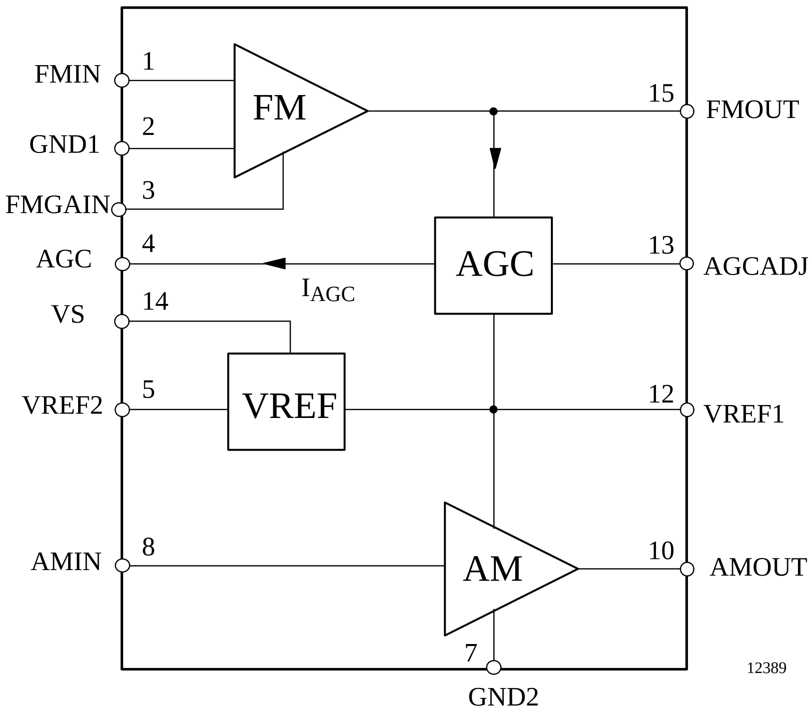


Figure 1. Block diagram

Ordering and Package Information

Extended Type Number	Package	Remarks
U4253BM-AFP	SO16	
U4253BM-AFPG3	SO16	Taping corresponding, ICE-286-3

Pin Description

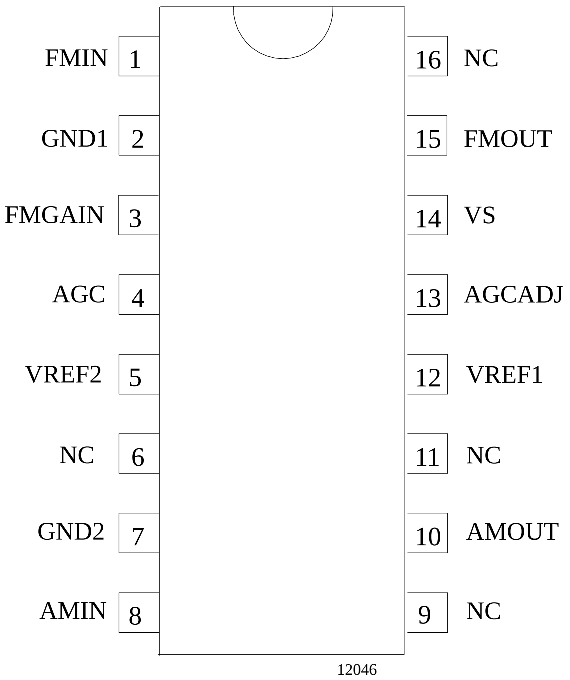


Figure 2. Pinning

Pin	Symbol	Function
1	FMIN	FM input
2	GND1	Ground for FM part
3	FMGAIN	FM gain adjustment
4	AGC	AGC output
5	VREF2	Reference voltage 2 output
6	NC	Not connected
7	GND2	Ground for AM part
8	AMIN	AM input
9	NC	Not connected
10	AMOUT	AM output
11	NC	Not connected
12	VREF1	Reference voltage 1 output
13	AGCADJ	Adjustment FM wide-band AGC threshold
14	VS	Supply voltage
15	FMOUT	FM output
16	NC	Not connected

Pin Description

FMIN

FMIN is the input of the FM amplifier. It is the base of a bipolar transistor. A resistor or a coil is connected between FMIN and VREF2. If a coil is used, noise performance is excellent.

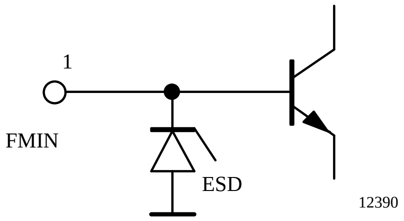


Figure 3.

GND1

To avoid crosstalk between AM and FM signals, the circuit has two separate ground pins. GND1 is the ground for the FM part.

FMGAIN

The DC current of the FM amplifier transistor is adjusted by an external resistor which is connected between FMGAIN and GND1. In order to influence the AC gain of the amplifier, a resistor is connected in series to an capacitor between FMGAIN and GND1. The capacitor has to be a short at frequencies of 100 MHz.

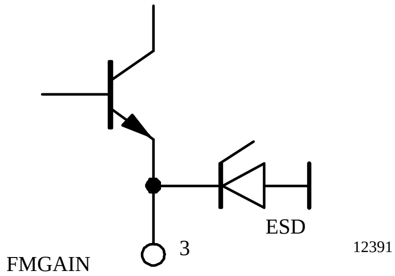


Figure 4.

AGC

DC current flows into the AGC pin at high FM antenna input signals. This current has to be amplified via the current gain of an external PNP transistor that feeds a PIN-diode. This diode dampens the antenna input signal and protects the amplifier input against overload. The maximum current which flows in the AGC pin is approximately 1 mA. In low end applications, the AGC function is not necessary and therefore the external components can be omitted.

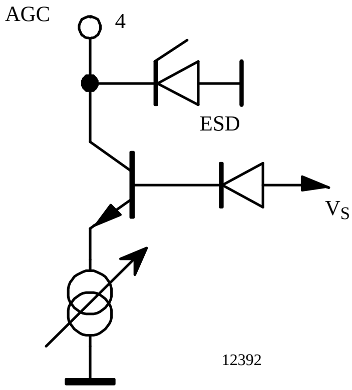


Figure 5.

AGCADJ

The threshold of the AGC can be adjusted by variing the DC current at pin AGCADJ. If pin AGCADJ is connected directly to GND1, the threshold is set to 96 dBµV at the FM amplifier output. If a resistor is connected between AGCADJ and GND1, the threshold is shifted to higher values with increasing resistances. If AGCADJ is open, the threshold is set to 106 dBµV.

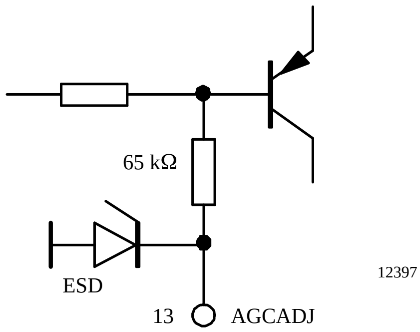


Figure 6.

FMOUT

The FM amplifiers output is an open collector of a bipolar RF-transistor. It should be connected to VS via a coil.

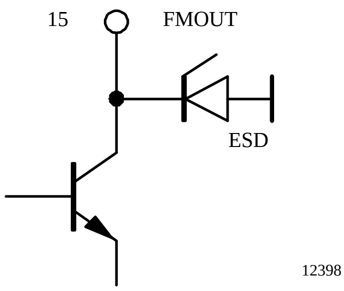


Figure 7.

AMIN

The AM input has an internal bias voltage. The DC voltage at this pin is $V_{Ref1}/2$. The input resistance is about 470 kΩ. The input capacitance is less than 10 pF.

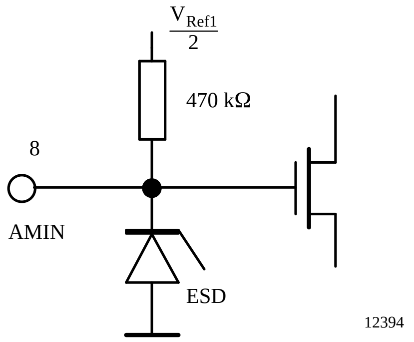


Figure 8.

AMOUT

The DC voltage at this pin is almost $V_{Ref1}/2$. The AC output resistance is about 200 Ω. The output capacitance is less than 10 pF.

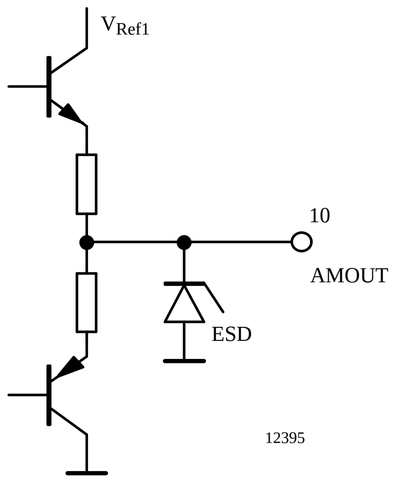


Figure 9.

VREF1

VREF1 is the stabilized voltage for the AM amplifier and the AGC block. To achieve excellent noise performance at LW frequencies, it is recommended that this pin is connected to ground via an external capacitor of about 1 µF.

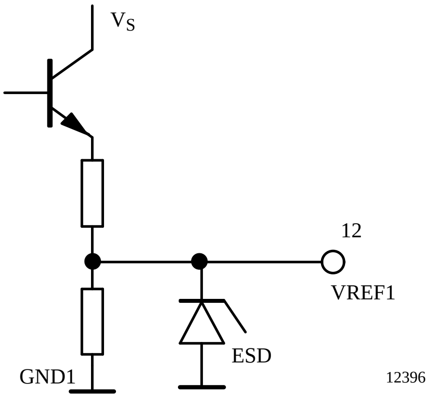


Figure 10.

VREF2

For the DC biasing of the FM amplifier a second voltage reference circuit is integrated. Because of temperature independence of the collector current the output voltage has a negative temperature coefficient of about –1 mV/K. To stabilize this voltage an external capacitor to ground of a few nF is recommended.

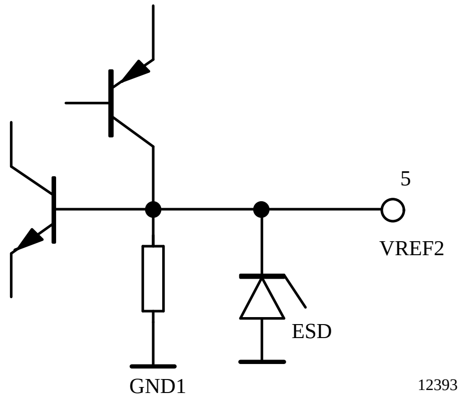


Figure 11.

GND2

GND2 is the ground for the AM amplifier.

Functional Description

The U4253BM is an integrated AM/FM antenna impedance matching circuit. It compensates cable losses between the antenna (for example windscreen, roof or bumper antennas) and the car radio which is usually placed far away from the antenna.

The FM amplifier provides excellent noise performance. External components are used to adjust the gain and the input-output matching impedance. Therefore it is possible to adjust the amplifier to various cable impedances (usually 50, 75 or 150 Ω). To protect the amplifier against input overload an **A**utomatic **G**ain **C**ontrol (AGC) is included on the chip. The AGC observes the AC voltage at the FM amplifier output, rectifies this signal, and delivers DC current to dampen the input antenna signal via an external PIN diode. The threshold for the AGC is adjustable. Simple and temperature compensated biasing is possible due to the integrated voltage reference V_{Ref2}.

The AM part consists of a buffer amplifier. The voltage gain of this stage is approximately one. The input resistance is 470 kΩ, the input capacitance less than 10 pF. The output resistance is 150 Ω. An excellent dynamic range is achieved due to a special push-pull circuit technique.

Absolute Maximum Ratings

Reference point is ground (Pins 2 and 7)

Parameters	Symbol	Value	Unit
Supply voltage	V_S	8.8	V
Power dissipation, P_{tot} at T_{amb} = 85°C	P_{tot}	460	mW
Junction temperature	T_j	150	°C
Ambient temperature	T_{amb}	–40 to +85	°C
Storage temperature	T_{stg}	–50 to +150	°C
Electrostatic handling (HBM)	$\pm V_{ESD}$	2000	V

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	R_{thJA}	140	K/W

Electrical Characteristics

See test circuit
V_S = 8 V, T_{amb} = 25°C, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Pin 14	Vs	7.2	8	8.8	V
Supply currents	Pin 14	Is		4		mA
Reference voltage 1 output (I_{12} = 0)	Pin 12	V_{Ref1}		5.5		V
Reference voltage 2 output (I_5 = 0)	Pin 5	V_{Ref2}		2.6		V
Temperature dependence of VREF2	Pin 5	$V_{Ref2}/\Delta T$		–1		mV/K
AM amplifier						
Input resistance	Pin 8	R_{AMIN}		470		kΩ
Input capacitance	Pin 8	C_{AMIN}			10	pF
Output resistance	Pin 10	R_{OUT}		200		Ω
Voltage gain	Pin 10 / Pin 8	a		0.85		
Output noise voltage (rms value)	Pin 10 S1 switched to 2; B = 6 kHz 150 kHz to 300 kHz 500 kHz to 6.5 kHz	 V_{N1} V_{N2}		 –2 –6		 dBµV dBµV
2nd harmonic	Pin 10 S2 switched to 1 f_{AMIN} = 500 kHz, Output voltage = 110 dBµV		–60			dBc
FM amplifier						
Supply current limit	I_{AGC}, I_{AGCADJ} = 0 A, Pin 15	I_{15}		33	35	mA
Input resistance	f = 100 MHz Pin 1	R_{FMIN}		50		Ω
Output resistance	f = 100 MHz Pin 15	R_{FMOUT}		50		Ω
Power gain	f = 100 MHz Pin 15/ Pin 1	G		5		dB
Output noise voltage	Pin 15 f = 100 MHz, B = 120 kHz	V_N		0		dBµV
3rd order output intercept	f = 100 MHz Pin 15			132		dBµV
AGC						
AGC input voltage threshold	f = 100 MHz Pin 15 S2 switched to 1; AGC threshold DC current is 10 µA at Pin 4	V_{th1}		96		dBµV
AGC input voltage threshold	f = 100 MHz Pin 15 S2 switched to 2; AGC threshold DC current is 10 µA at Pin 4	V_{th2}		106		dBµV
AGC output current	AGC active	I_{AGC}			1.2	mA

Test Circuit

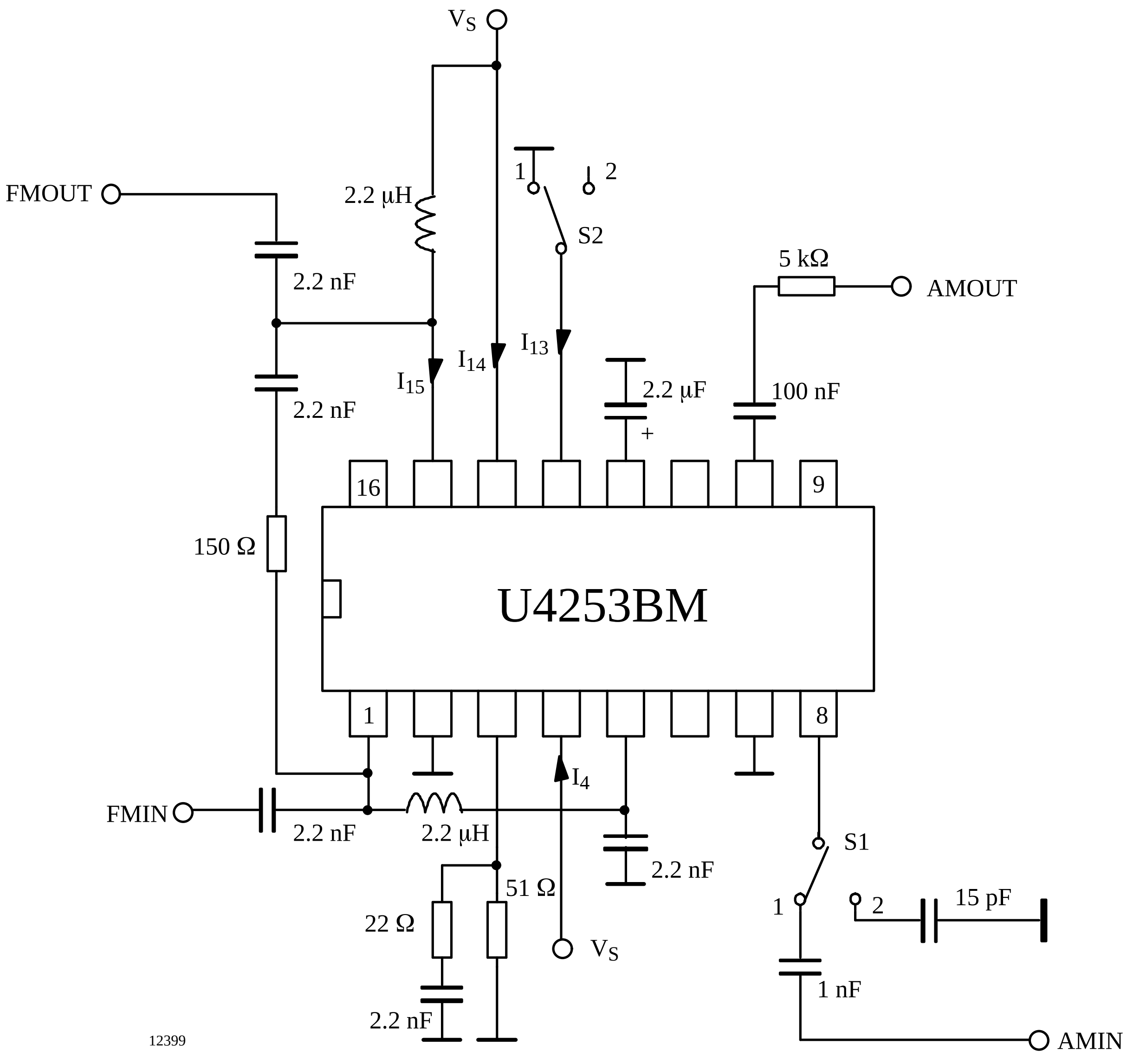


Figure 12.

FM Intermodulation Distortion

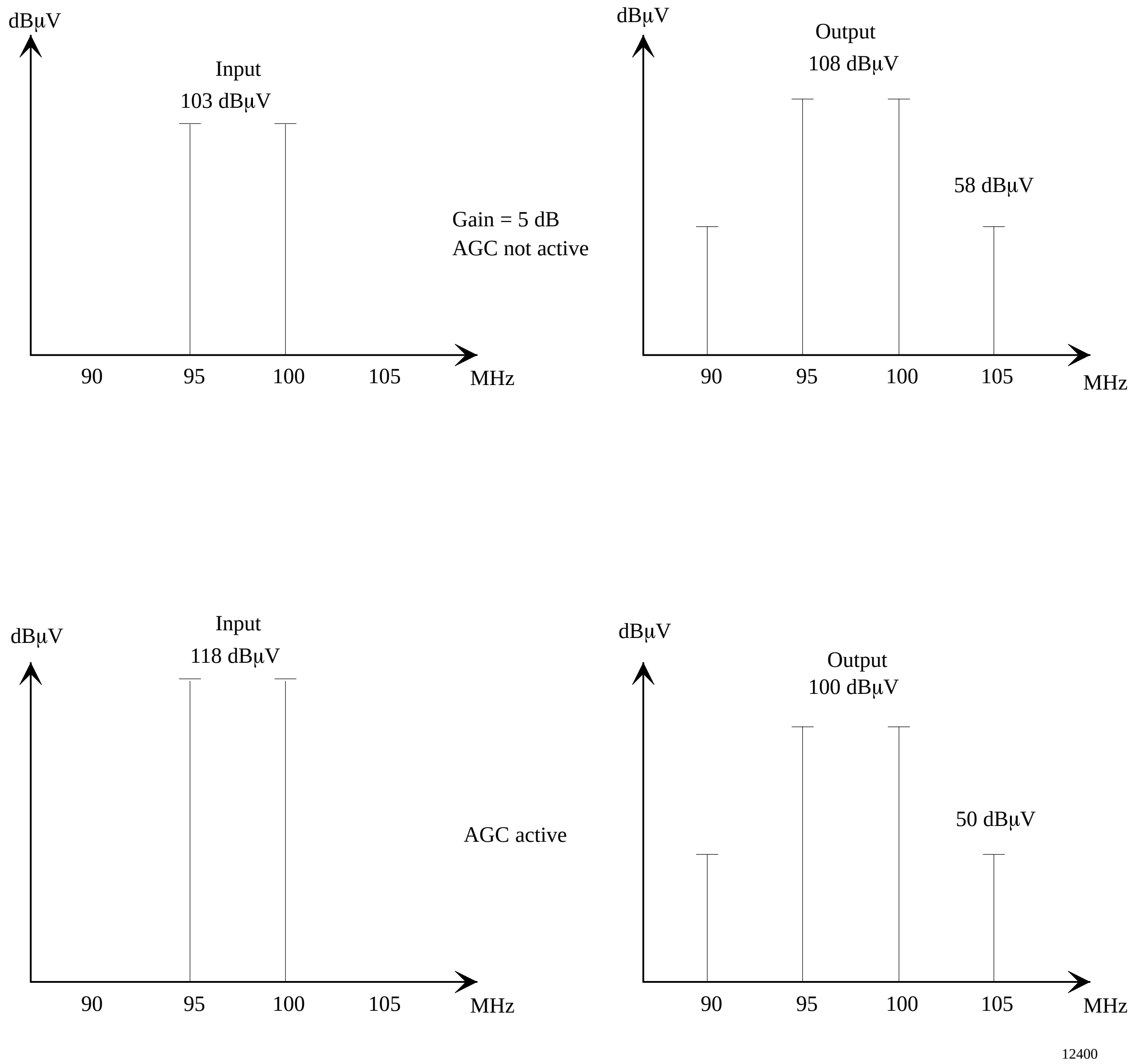


Figure 13.

Test Circuit for AM Large Signal Behavior

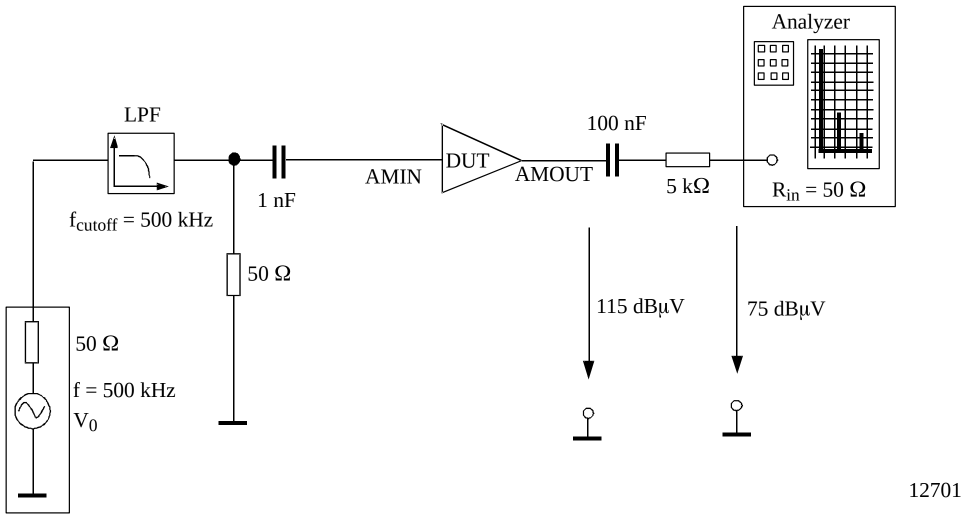


Figure 14.

AM Harmonic Distortion

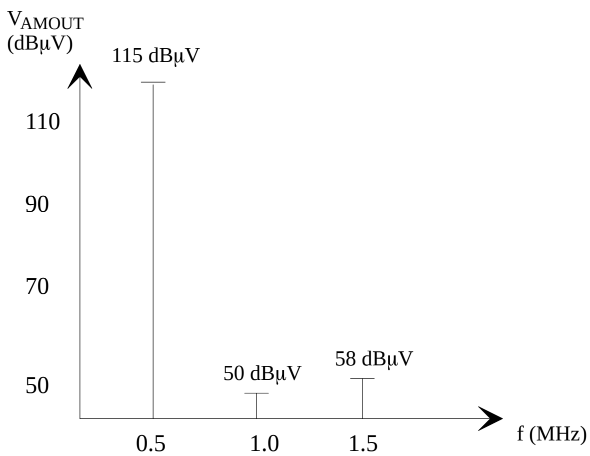
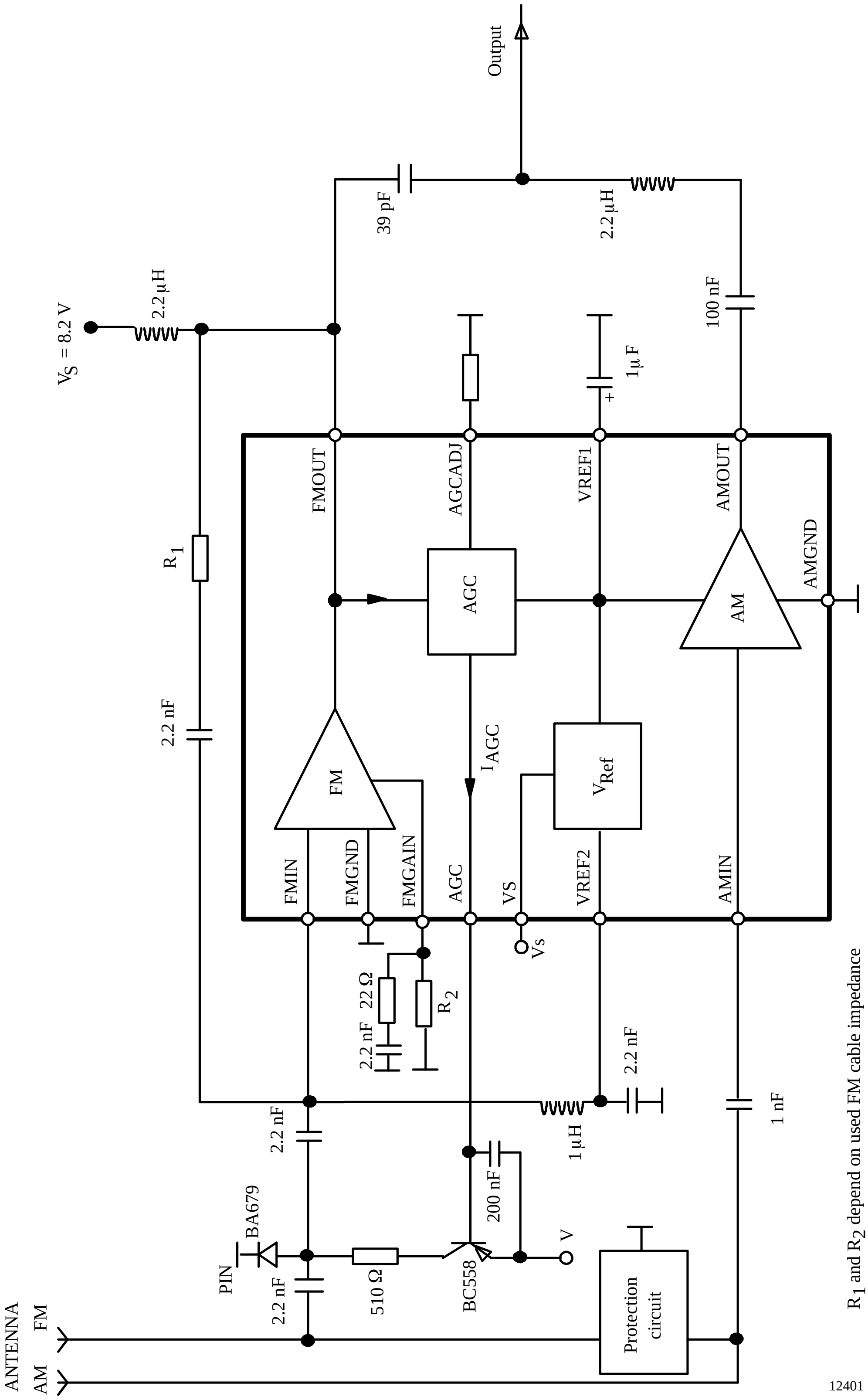


Figure 15.

Application Circuit



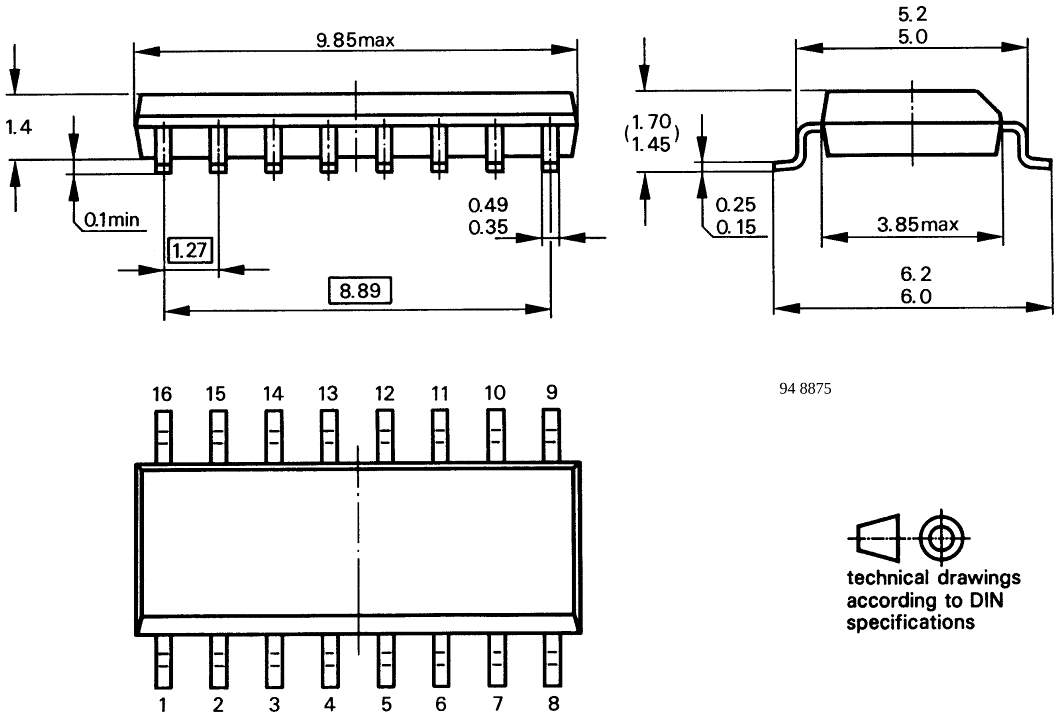
R_1 and R_2 depend on used FM cable impedance

FM cable impedance	R_1 (Ω)	R_2 (Ω)
50	150	22
75	270	33
100	390	51
125	470	86
150	620	160

Figure 16.

Package Information

Package SO16
Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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