

DATA SHEET

TDA1576

FM/IF amplifier/demodulator circuit

Product specification
Supersedes data of March 1985
File under Integrated Circuits, IC01

1998 Nov 18

FM/IF amplifier/demodulator circuit

TDA1576

FEATURES

- Symmetrical limiting IF amplifier
- Symmetrical quadrature demodulator
- Internal muting circuit
- Symmetrical AFC output
- Field strength indication output
- Detune detector
- Reference voltage output
- Electronic smoothing of the supply voltage
- Standby on/off switching circuit.

GENERAL DESCRIPTION

The TDA1576 is a monolithic integrated FM/IF amplifier circuit for use in mono and stereo FM-receivers of car radios or home sets.

QUICK REFERENCE DATA

$f_o = 10.7$ MHz; $\Delta f = \pm 22.5$ kHz; $f_m = 400$ Hz; $Q_L = 20$; 50 μ s de-emphasis.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------------|------------------------------------|--|------|---------|---------|--------------|
| V_P | supply voltage (pin 1) | | 7.5 | – | 20 | V |
| I_P | supply current | $V_P = 8.5$ V | – | 16 | – | mA |
| | | $V_P = 15$ V | – | 18 | – | mA |
| $V_{iIF(rms)}$ | input sensitivity (RMS value) | –3 dB before limiting | – | 22 | – | μ V |
| | | $\frac{S+N}{N} = 26$ dB | – | 8 | – | μ V |
| | | $\frac{S+N}{N} = 46$ dB | – | 35 | – | μ V |
| $V_{oAF(rms)}$ | AF output voltage (RMS value) | $V_P = 8.5$ V | – | 67 | – | mV |
| | | $V_P = 15$ V | – | 135 | – | mV |
| THD | total harmonic distortion | | | | | |
| | single tuned circuit | | – | 0.1 | – | % |
| | two tuned circuits | | – | 0.02 | – | % |
| $\frac{S+N}{N}$ | signal plus noise-to-noise ratio | $V_{iIF} > 1$ mV (RMS); $V_P = 8.5$ V | – | 76 | – | dB |
| | | $V_{iIF} > 1$ mV (RMS); $V_P = 15$ V | – | 80 | – | dB |
| α_{AM} | AM suppression | | – | 50 | – | dB |
| Δf_i | AFC offset drift | | – | ± 3 | ± 6 | kHz |
| ΔV_i | field strength indication | | – | 90 | – | dB |
| I_L | permissible indicator load current | | – | – | 2 | mA |
| T_{amb} | operating ambient temperature | | –30 | – | +80 | $^{\circ}$ C |

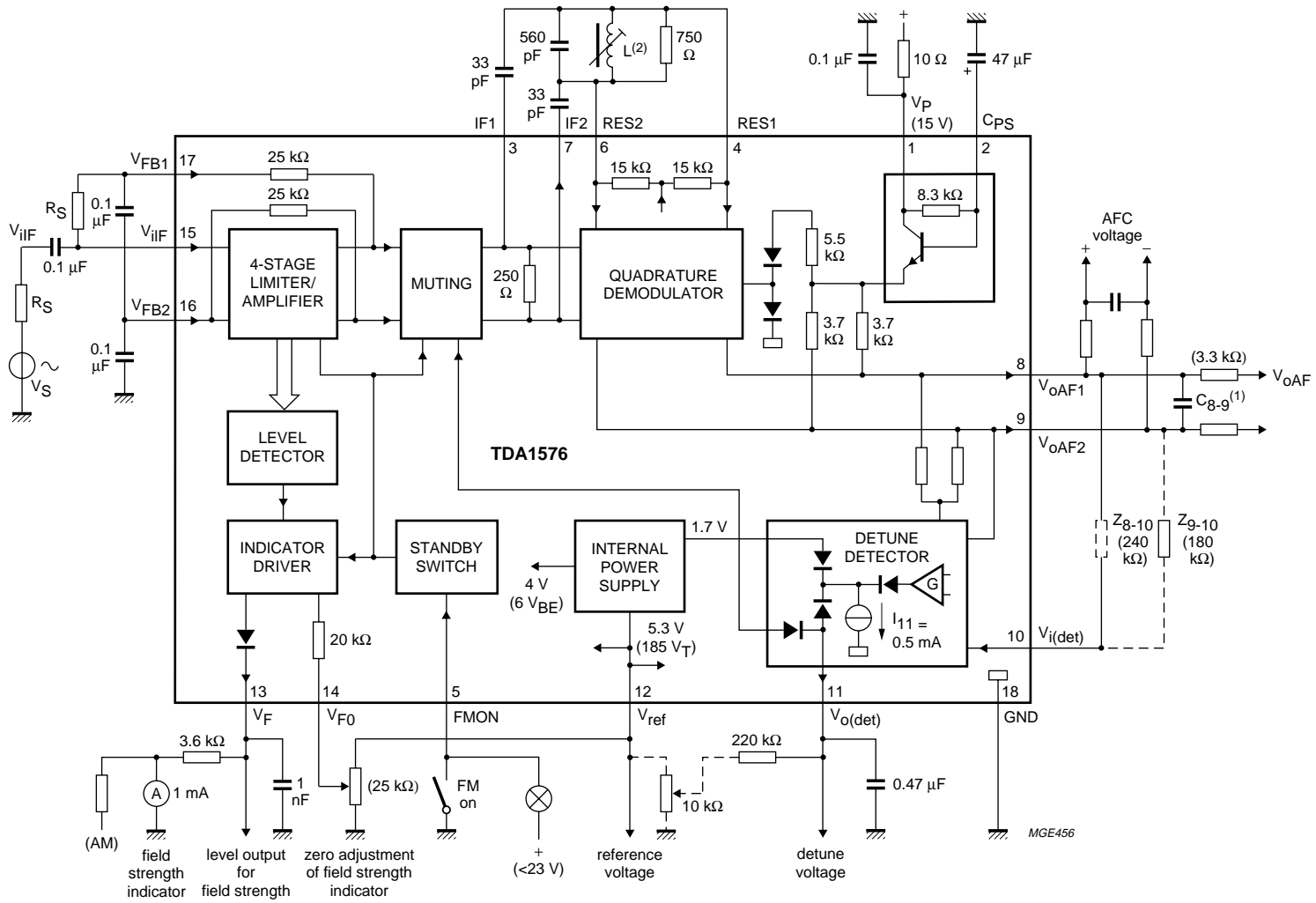
ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|-------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| TDA1576 | DIP18 | plastic dual in-line package; 18 leads (300 mil) | SOT102-1 |

FM/IF amplifier/demodulator circuit

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BLOCK DIAGRAM



(1) For 50 μs de-emphasis: $C_{8-9} = 6.8 \text{ nF}$; for stereo operation $C_{8-9} = 56 \text{ pF}$.

(2) $L = 0.38 \mu H$; $Q_0 = 70$; $Q_L = 20$; adjusted to minimum 2nd harmonic distortion (d_2); at $V_i = 1 \text{ mV}$; coil: 6 turns CuL (0.25 mm) on coil former KAN (C).

Fig.1 Block diagram and test circuit.

FM/IF amplifier/demodulator circuit

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PINNING

| SYMBOL | PIN | DESCRIPTION |
|--------------|-----|--|
| V_P | 1 | positive supply voltage |
| C_{PS} | 2 | smoothing capacitor of power supply |
| IF1 | 3 | IF signal to resonant circuit |
| RES1 | 4 | resonant circuit input 1 |
| FMON | 5 | FM-ON, standby switch |
| RES2 | 6 | resonant circuit input 2 |
| IF2 | 7 | IF signal to resonant circuit |
| V_{oAF1} | 8 | AF output voltage 1 (0° phase) |
| V_{oAF2} | 9 | AF output voltage 2 (180° phase) |
| $V_{i(det)}$ | 10 | detune detector input voltage for external audio reference |
| $V_{o(det)}$ | 11 | detune detector output voltage |
| V_{ref} | 12 | reference voltage output |
| V_F | 13 | level output for field strength |
| V_{F0} | 14 | zero adjust voltage for field strength |
| V_{iIF} | 15 | FM/IF input signal voltage |
| V_{FB2} | 16 | DC feedback 2 |
| V_{FB1} | 17 | DC feedback 1 |
| GND | 18 | ground (0 V) |

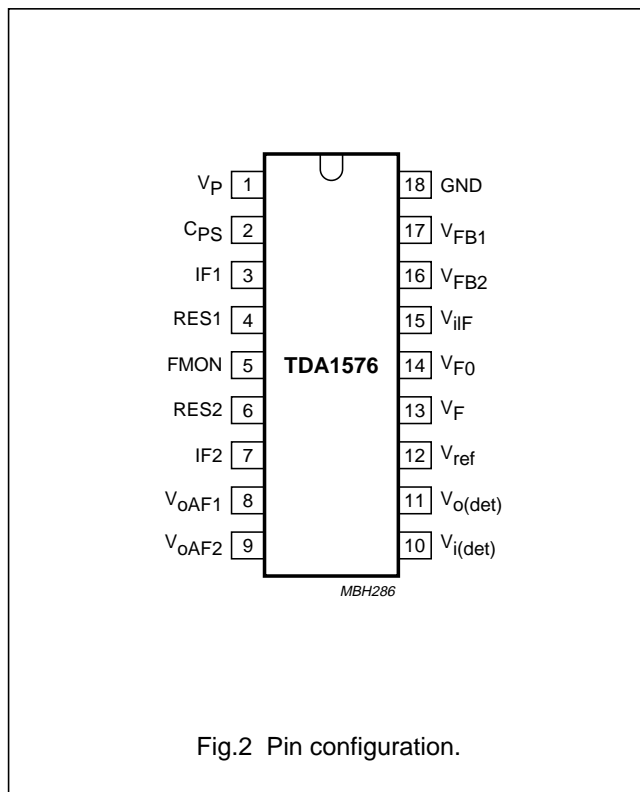


Fig.2 Pin configuration.

FM/IF amplifier/demodulator circuit

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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|-------------|-------------------------------|------|-------|------|
| V_P | supply voltage (pin 1) | 0 | 23 | V |
| V_2 | voltage on pin 2 | 0 | V_P | V |
| $V_{5, 14}$ | voltage on pins 5 and 14 | 0 | 23 | V |
| V_{12} | voltage on pin 12 | 0 | 7 | V |
| V_{13} | voltage on pin 13 | 0 | 6 | V |
| P_{tot} | total power dissipation | 0 | 800 | mW |
| T_{stg} | storage temperature | -55 | +150 | °C |
| T_{amb} | operating ambient temperature | -30 | +80 | °C |

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---------------|---|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient in free air | 80 | K/W |

FM/IF amplifier/demodulator circuit

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CHARACTERISTICS

$V_P = 7.5$ to 20 V; $f_{IF} = 10.7$ MHz; $R_S = 60$ Ω ; $f_m = 400$ Hz with $\Delta f = \pm 22.5$ kHz; 50 μ s de-emphasis ($C_{8-9} = 6.8$ nF); $T_{amb} = 25$ °C and measurements taken in Fig.1; unless otherwise specified. The demodulator circuit is adjusted at minimum second harmonic distortion for $V_{iIF} = 1$ mV and a deviation $\Delta f = \pm 75$ kHz.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|---|---|------|------|------|------------|
| Supply | | | | | | |
| I_P | supply current without load | $I_{12} = I_{13} = 0$; $V_P = 8.5$ V | 10 | 16 | 23 | mA |
| | | $I_{12} = I_{13} = 0$; $V_P = 15$ V | 12 | 18 | 25 | mA |
| IF amplifier/detector | | | | | | |
| $V_{iIF(rms)}$ | input sensitivity (RMS value; pin 15) | -3 dB before limiting | - | 22 | 30 | μ V |
| | | $\frac{S+N}{N} = 26$ dB | - | 8 | - | μ V |
| | | $\frac{S+N}{N} = 46$ dB | - | 35 | - | μ V |
| $V_{oIF(p-p)}$ | output voltage at pins 3 and 7 (peak-to-peak value) | $Z_{3,7} = 10$ pF parallel to 1 M Ω | - | 680 | - | mV |
| R_{3-7} | output resistance | | - | 250 | - | Ω |
| Z_{4-6} | input impedance | | - | 30 | - | k Ω |
| C_{4-6} | input capacitance | | - | 1 | - | pF |
| $R_{8,9}$ | output resistance | | - | 3.7 | - | k Ω |
| $V_{8,9}$ | DC output voltage | $V_P = 8.5$ V | - | 5.5 | - | V |
| | | $V_P = 15$ V | - | 9.8 | - | V |
| $V_{oAF(rms)}$ | AF output voltage (RMS value) | $Q_L = 20$; $V_P = 8.5$ V | 60 | 67 | 75 | mV |
| | | $Q_L = 20$; $V_P = 15$ V | 120 | 135 | 150 | mV |
| THD | total harmonic distortion single tuned circuit two tuned circuits | $Q_L = 20$ | - | 0.1 | - | % |
| | | | - | 0.02 | - | % |
| $\frac{S+N}{N}$ | signal plus noise-to-noise ratio (pins 8 and 9) | $B = 250$ Hz to 15 kHz; $V_i > 1$ mV (RMS); $V_P = 8.5$ V | - | 76 | - | dB |
| | | $B = 250$ Hz to 15 kHz; $V_i > 1$ mV (RMS); $V_P = 15$ V | - | 80 | - | dB |
| α_{AM} | AM suppression | $V_{iIF} = 10$ mV; FM: 70 Hz; $\Delta f = \pm 22.5$ kHz; AM: 1 kHz; $m = 30\%$; note 1 | - | 54 | - | dB |
| V_{iIF} | IF input voltage | $\alpha > 40$ dB | 0.5 | - | 500 | mV |
| α_{100} | hum suppression at $f = 100$ Hz | $V_P = 100$ mV (RMS); $C_2 = 47$ μ F | 43 | 48 | - | dB |
| $\frac{\Delta V_{8-9}}{\Delta f_0}$ | AFC tuning slope at $Q_L = 20$ | $V_P = 8.5$ V | - | 8.5 | - | mV/kHz |
| | | $V_P = 15$ V | - | 17 | - | mV/kHz |

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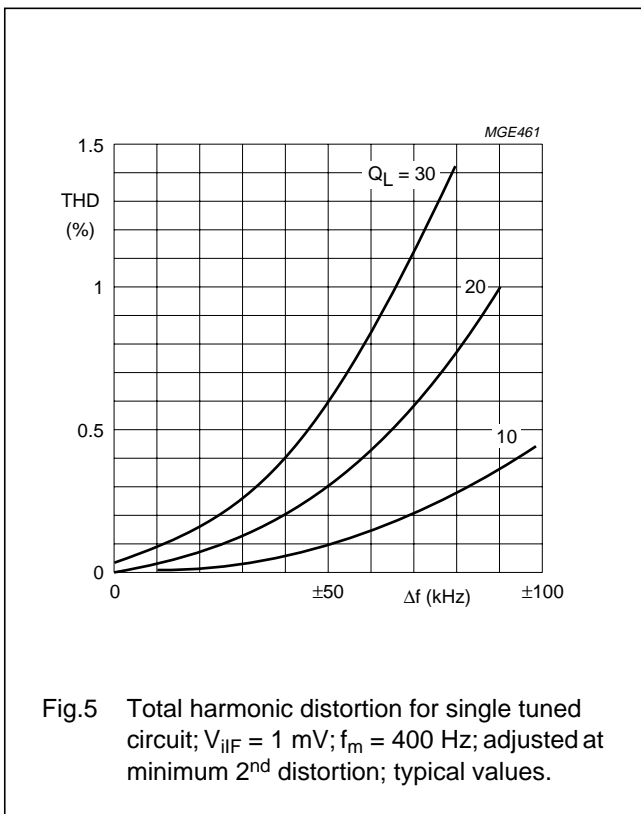
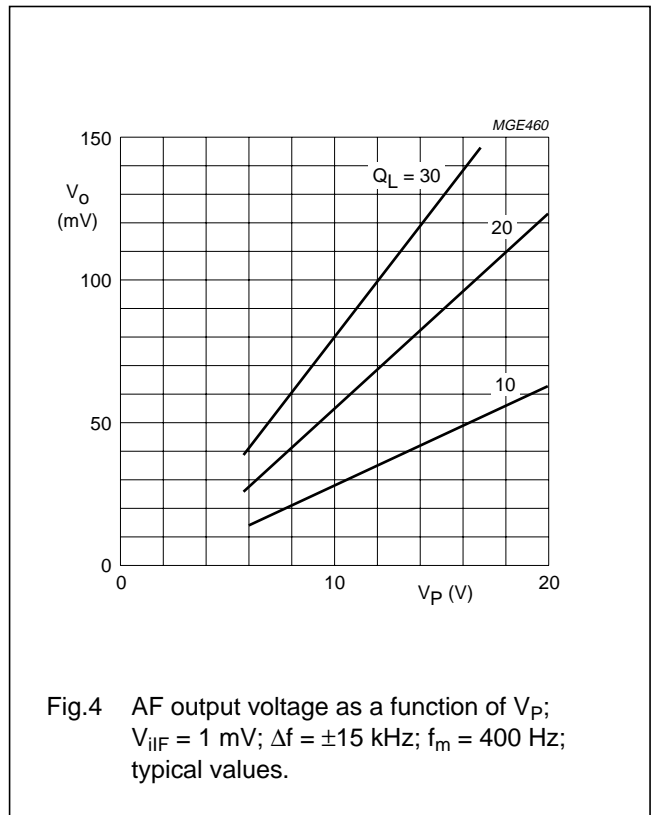
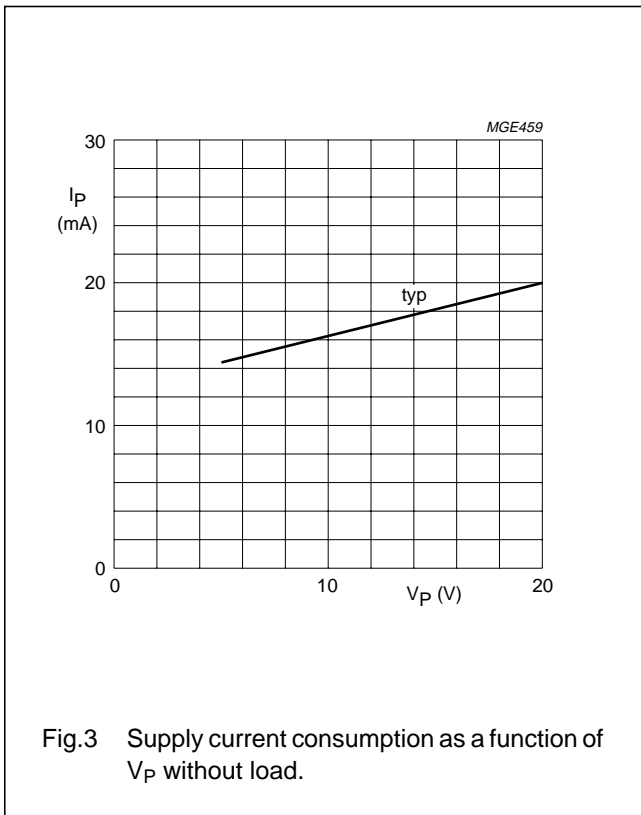
| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|--------------------------------------|--|------|----------|-----------|---------------|
| ΔV_{8-9} | AFC offset voltages at $Q_L = 20$ | $V_i = 1 \text{ mV}; V_P = 8.5 \text{ V}$ | – | – | ± 100 | mV |
| | | $V_i = 1 \text{ mV}; V_P = 15 \text{ V}$ | – | – | ± 200 | mV |
| | | $V_i = 30 \mu\text{V to } 500 \text{ mV}$ ($V_{\text{ref}} = 1 \text{ mV}$ and muting); $V_P = 8.5 \text{ V}$ | – | ± 25 | ± 50 | mV |
| | | $V_i = 30 \mu\text{V to } 500 \text{ mV}$ ($V_{\text{ref}} = 1 \text{ mV}$ and muting); $V_P = 15 \text{ V}$ | – | ± 50 | ± 100 | mV |
| Field strength output; see Fig.7 | | | | | | |
| V_i | indicator sensitivity | $I_{14} = 0$ | 0.02 | – | 600 | mV |
| V_{13} | output voltage | $R_{13} = 3.6 \text{ k}\Omega; I_{14} = 0$ $V_{\text{ilF}} = 0$ | – | 0 | 200 | mV |
| | | $V_{\text{ilF}} = 250 \text{ mV (RMS)}$ | 3.2 | 3.6 | 4.1 | V |
| I_{13} | available output current | | –2 | – | – | mA |
| V_{13} | reverse voltage at output for FM off | $V_5 > 3.5 \text{ V}$ | 5 | – | – | V |
| Detuning detector | | | | | | |
| I_{10} | quiescent input current | $V_{10-9} = 0$ | – | 20 | 100 | nA |
| V_{11} | output voltage | | 1.8 | – | 5.0 | V |
| I_{11} | maximum output current | | 0.35 | 0.5 | 0.65 | mA |
| G_v | voltage gain | $\Delta V_{11}/\Delta(\pm V_{10-9})$ at $I_{11} = 0.25 \text{ mA}; V_P = 15 \text{ V}$ | – | 3.3 | – | |
| V_{10-9} | input offset voltage (pin 10) | $V_{11} = 2.5 \text{ V}$ | – | 20 | – | mV |
| Reference voltage | | | | | | |
| V_{ref} | reference voltage (pin 12) | $I_{12} = -1 \text{ mA}; V_P = 8.5 \text{ V}$ | – | 5.1 | – | V |
| | | $I_{12} = -1 \text{ mA}; V_P = 15 \text{ V}$ | – | 5.3 | – | V |
| I_{12} | available output current | | – | –2.5 | – | mA |
| Standby switch | | | | | | |
| V_5 | input voltage for FM on | | – | – | 2 | V |
| | input voltage for FM off | | 3.5 | – | – | V |
| I_5 | input current for FM on | | – | – | –100 | μA |

Note

1. Simultaneously measured.

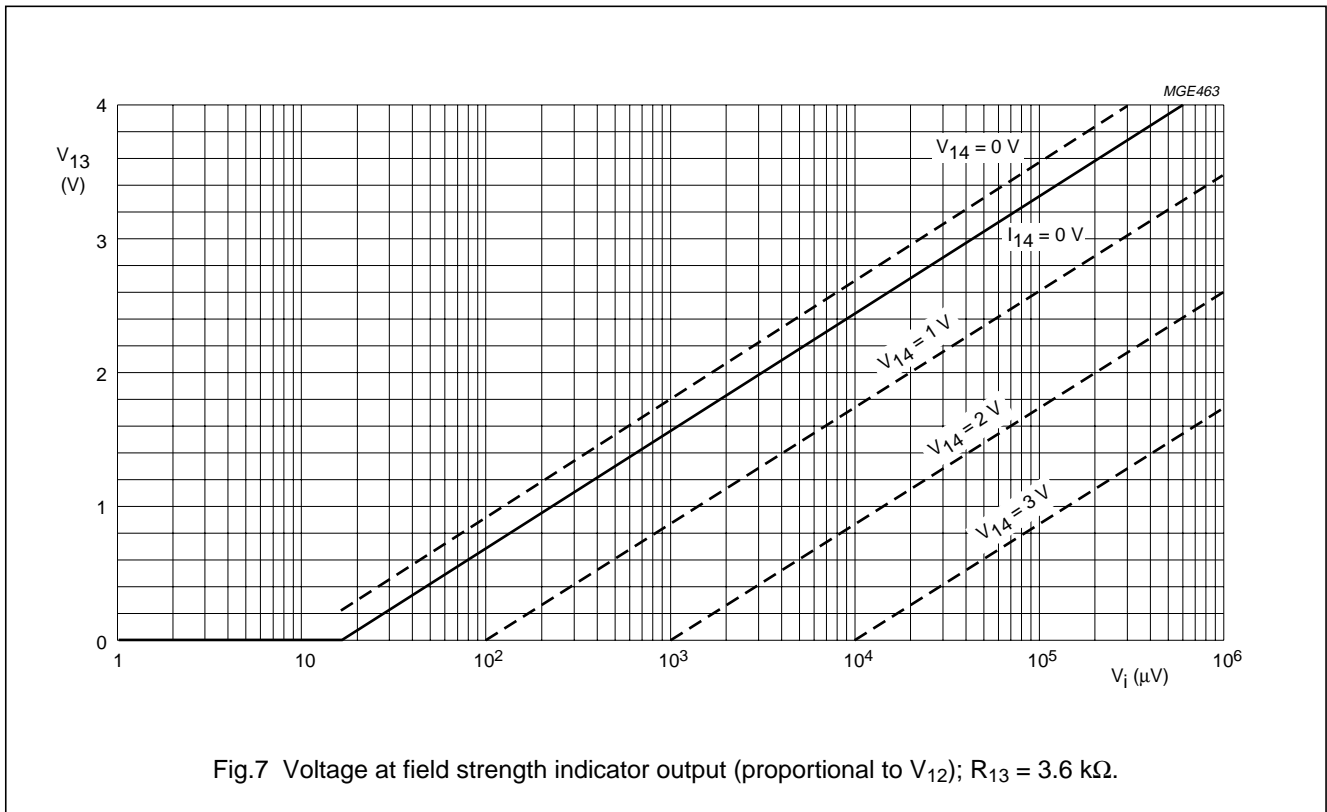
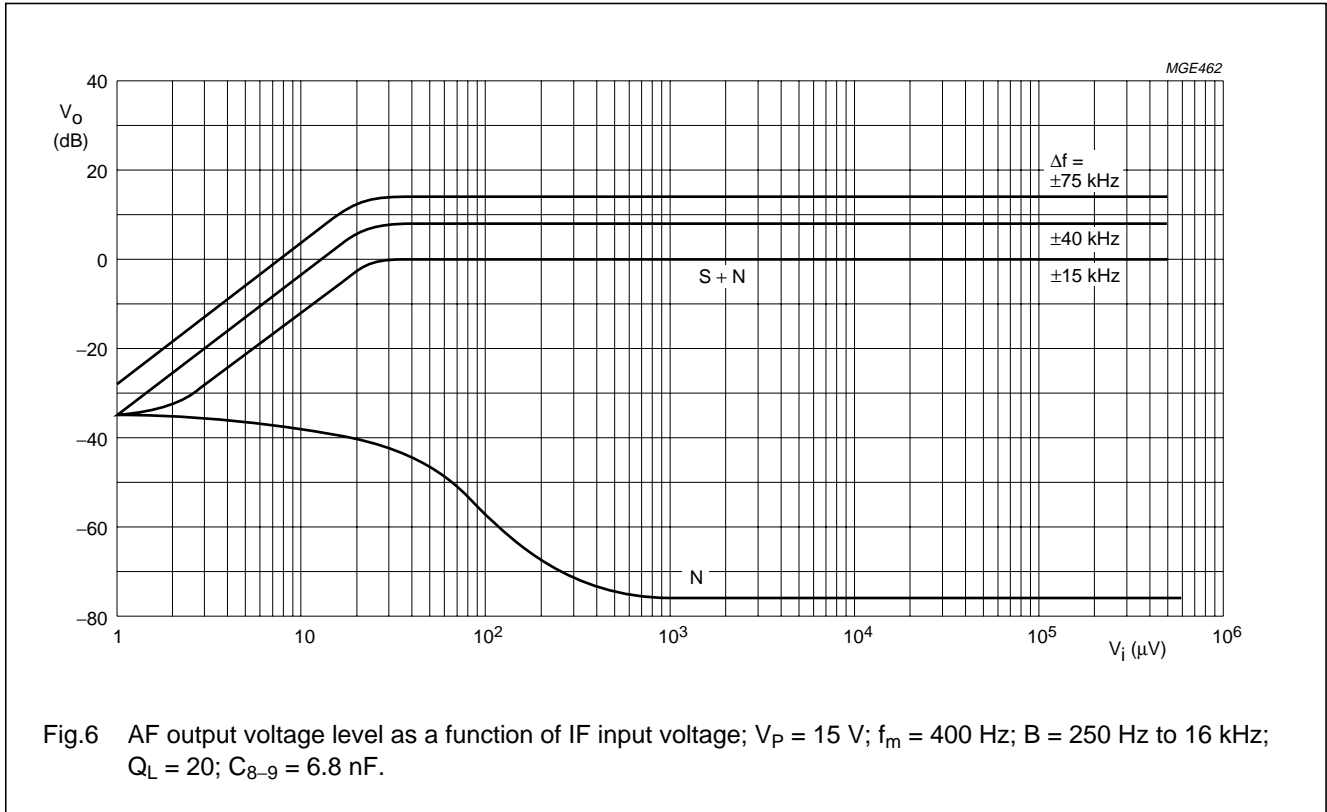
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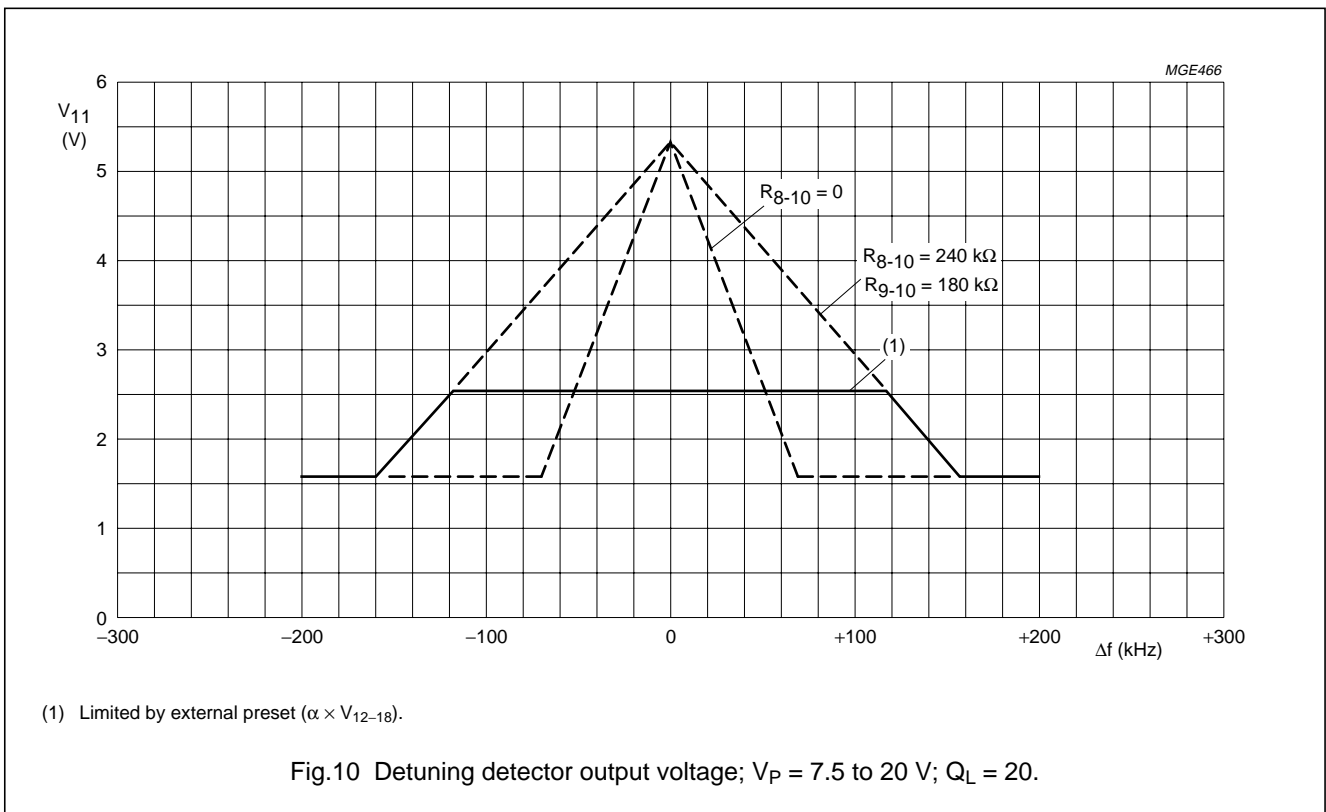
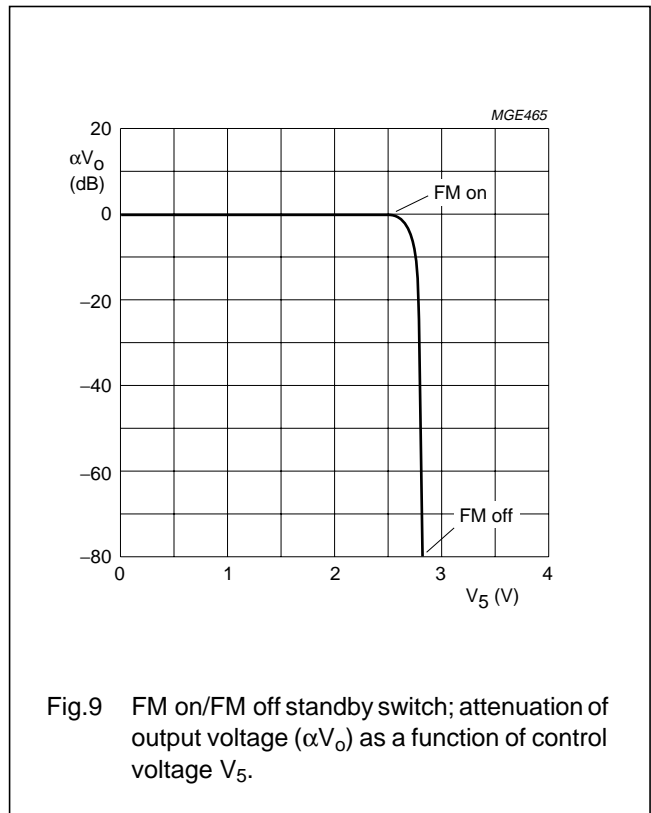
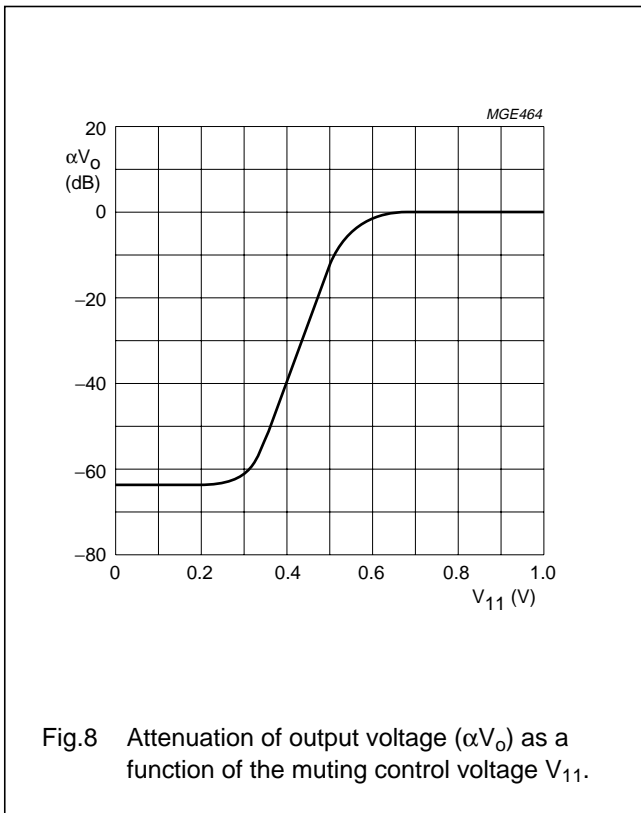
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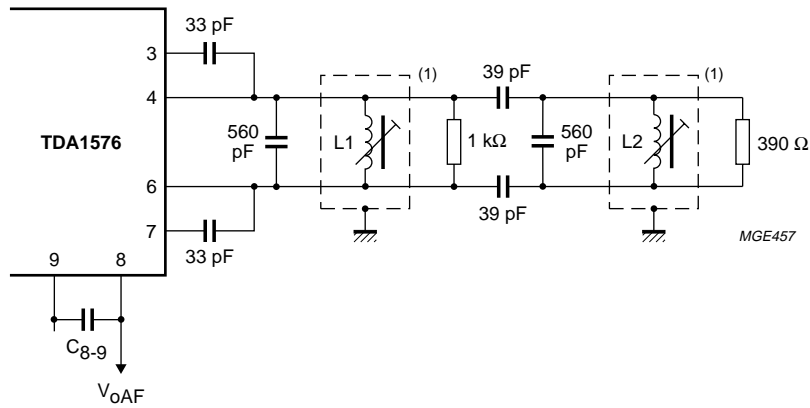
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FM/IF amplifier/demodulator circuit

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Adjustment of the demodulator circuit is obtained with an IF signal which is higher than the 3 dB limiting level; L2 should be short-circuited or detuned; L1 should be adjusted to minimum d_2 distortion, and then L2 to minimum d_2 distortion.

(1) Coil data: L1 = L2 = 0.38 μ H; Q_o = 70; coil former KAN (C).

Fig.11 An example of the TDA1576 when using a demodulator with two tuned circuits.

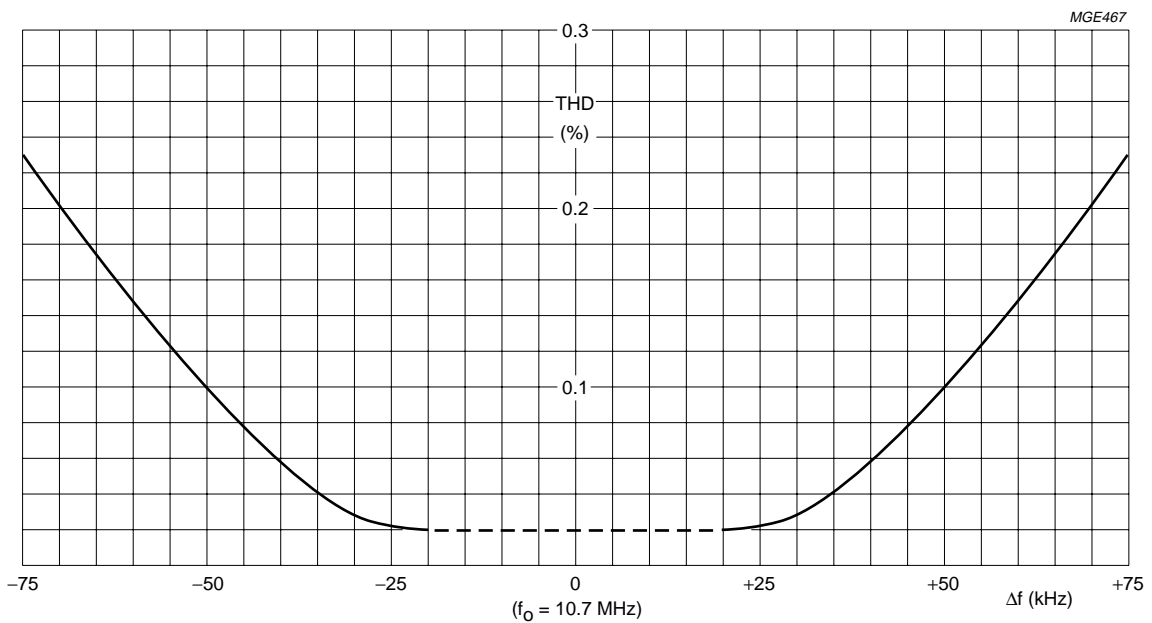
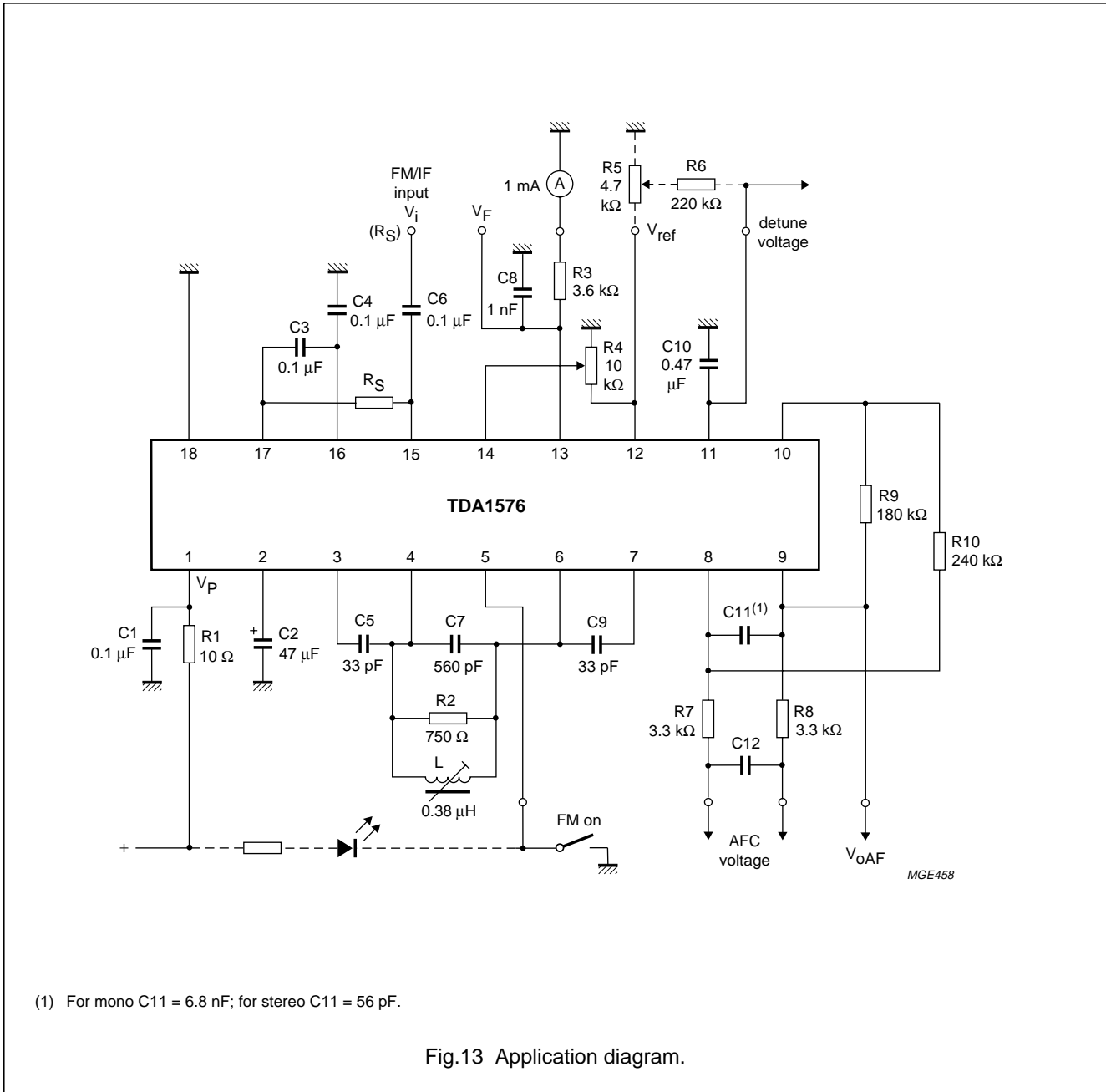


Fig.12 Total harmonic distortion as a function of detuning; $f_m = 400$ Hz; $C_{8-9} = 6.8$ nF; $\Delta f = \pm 75$ kHz; $V_o = 330$ mV for a frequency deviation $\Delta f = \pm 75$ kHz.

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APPLICATION INFORMATION



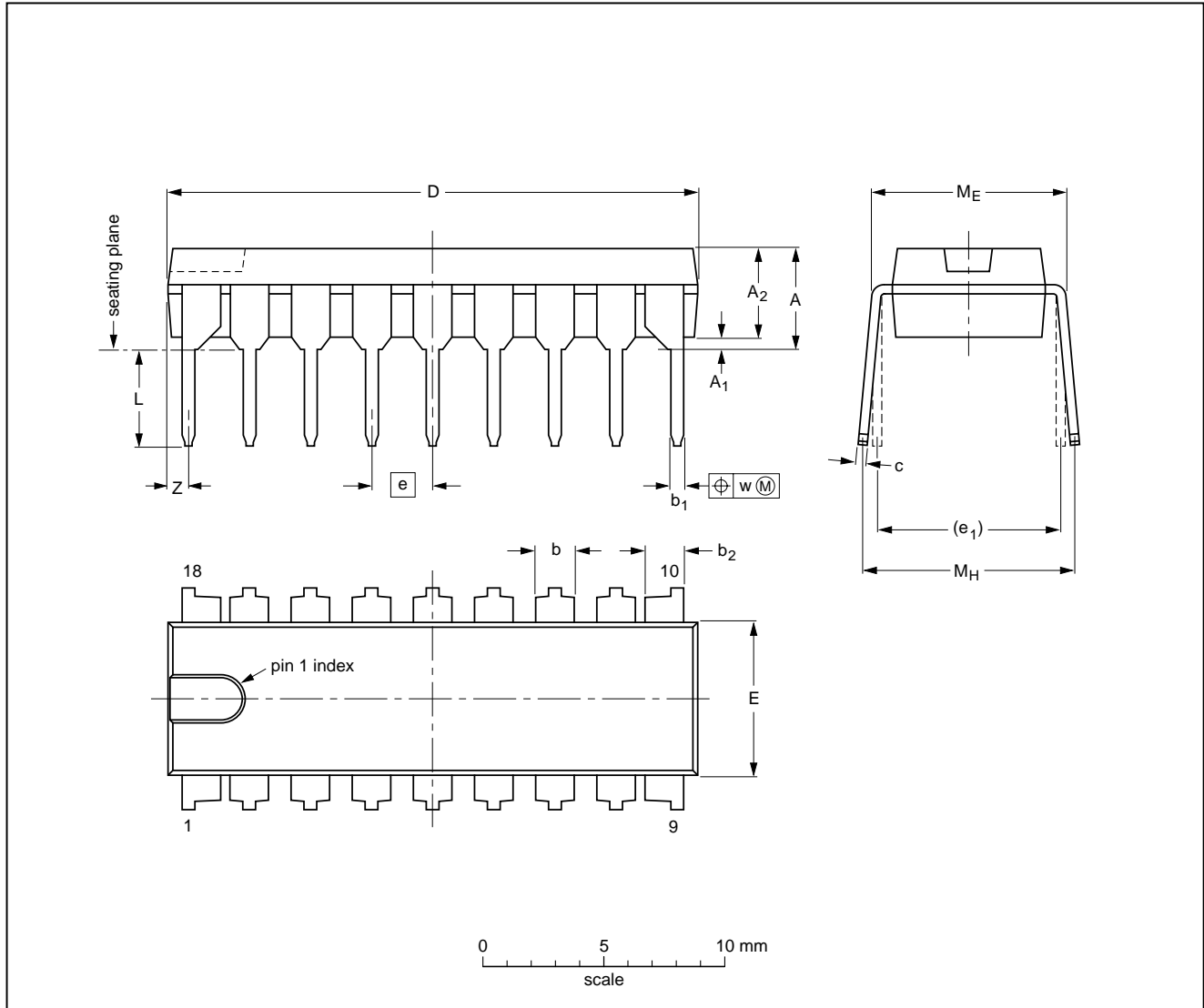
FM/IF amplifier/demodulator circuit

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PACKAGE OUTLINE

DIP18: plastic dual in-line package; 18 leads (300 mil)

SOT102-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ min. | A ₂ max. | b | b ₁ | b ₂ | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | L | M _E | M _H | w | Z ⁽¹⁾ max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|-----------------------|
| mm | 4.7 | 0.51 | 3.7 | 1.40 1.14 | 0.53 0.38 | 1.40 1.14 | 0.32 0.23 | 21.8 21.4 | 6.48 6.20 | 2.54 | 7.62 | 3.9 3.4 | 8.25 7.80 | 9.5 8.3 | 0.254 | 0.85 |
| inches | 0.19 | 0.020 | 0.15 | 0.055 0.044 | 0.021 0.015 | 0.055 0.044 | 0.013 0.009 | 0.86 0.84 | 0.26 0.24 | 0.10 | 0.30 | 0.15 0.13 | 0.32 0.31 | 0.37 0.33 | 0.01 | 0.033 |

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 | | | |
| SOT102-1 | | | | | | 93-10-14 95-01-23 |

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SOLDERING

Introduction to soldering through-hole mount packages

This text gives a brief insight to wave, dip and manual soldering. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

Wave soldering is the preferred method for mounting of through-hole mount IC packages on a printed-circuit board.

Soldering by dipping or by solder wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joints 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.

Manual soldering

Apply the soldering iron (24 V or less) to the lead(s) of the package, either 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.

Suitability of through-hole mount IC packages for dipping and wave soldering methods

| PACKAGE | SOLDERING METHOD | |
|---------------------------|------------------|-------------------------|
| | DIPPING | WAVE |
| DBS, DIP, HDIP, SDIP, SIL | suitable | suitable ⁽¹⁾ |

Note

- For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.

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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. | |

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