

# DATA SHEET

## **TDA9821**

**Dual channel TV FM intercarrier  
sound demodulator**

Product specification  
Supersedes data of March 1991  
File under Integrated Circuits, IC02

1996 Nov 20

## Dual channel TV FM intercarrier sound demodulator

## TDA9821

### FEATURES

- Two alignment-free PLL FM demodulators
- Automatic second sound carrier mute
- Mono and dual channel application
- Low power consumption
- Few external components required.

### GENERAL DESCRIPTION

The TDA9821 is a monolithic, integrated, TV FM intercarrier sound demodulator for all FM standards. The circuit contains two separate FM demodulators using Phase Locked Loop (PLL) reference frequency generation. The circuit requires a minimum number of external components.

### QUICK REFERENCE DATA

| SYMBOL          | PARAMETER                                       | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT         |
|-----------------|---|---------------------------------|------|------|------|--------------|
| $V_P$           | supply voltage (pin 14)                         |                                 | 4.5  | 5.0  | 8.8  | V            |
| $I_P$           | supply current (pin 14)                         |                                 | 23   | 30   | 37   | mA           |
| $I_M$           | AC peak current (pins 7 and 8)                  |                                 | –    | –    | 1.5  | mA           |
| $V_{i(rms)}$    | input signal (RMS value)                        | $\frac{S+N}{N} = 40$ dB         | –    | 150  | 250  | $\mu$ V      |
| $V_{o(rms)}$    | output signal (pins 7 and 8; RMS value)         | $\Delta f_i = \pm 50$ kHz       | 0.4  | 0.5  | 0.6  | V            |
| $\frac{S+N}{N}$ | signal plus noise-to-noise ratio (pins 7 and 8) | in accordance with "CCIR 468-3" | 64   | 68   | –    | dB           |
| $\alpha_{8/7}$  | crosstalk attenuation                           | $f = 50$ to $12500$ Hz          | 60   | 70   | –    | dB           |
| RR              | supply voltage ripple rejection (pins 7 and 8)  | $V_{RR} < 200$ mV; $f = 70$ Hz  | 16   | 20   | –    | dB           |
| $T_{amb}$       | operating ambient temperature                   |                                 | 0    | –    | 70   | $^{\circ}$ C |

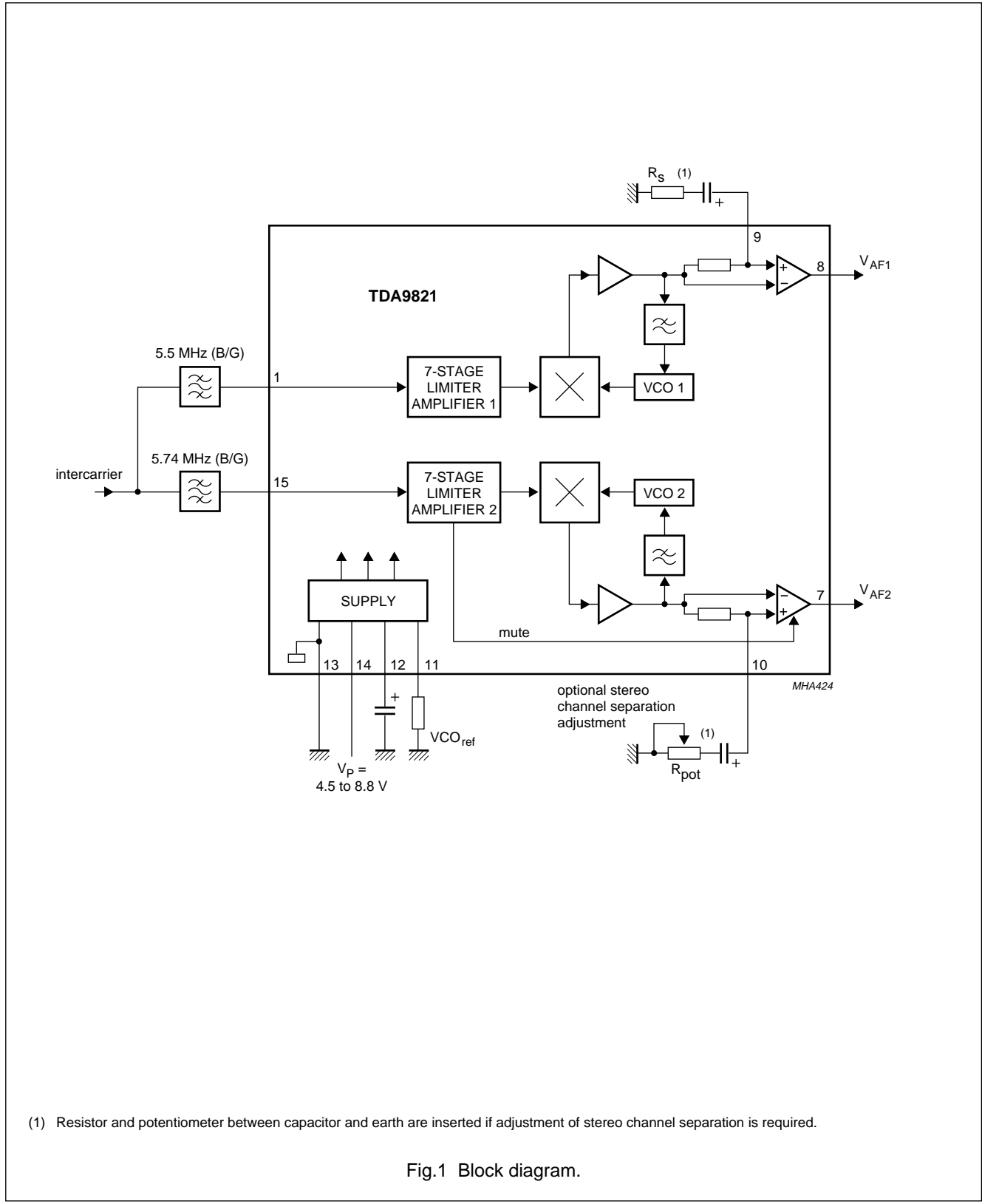
### ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |   |         |
|-------------|---------|---|---------|
|             | NAME    | DESCRIPTION   | VERSION |
| TDA9821     | DIP16   | plastic dual in-line package; 16 leads (300 mil); long body | SOT38-1 |

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BLOCK DIAGRAM



(1) Resistor and potentiometer between capacitor and earth are inserted if adjustment of stereo channel separation is required.

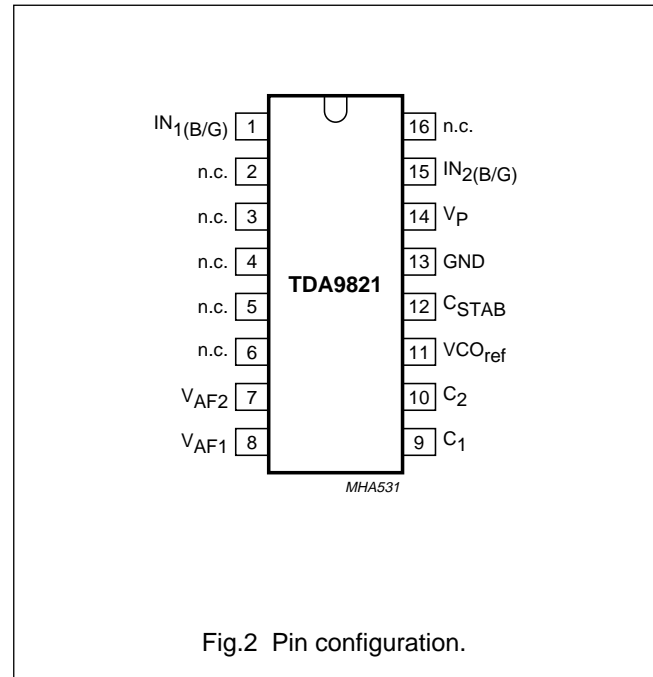
Fig.1 Block diagram.

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## PINNING

| SYMBOL               | PIN | DESCRIPTION                     |
|----------------------|-----|---------------------------------|
| IN <sub>1(B/G)</sub> | 1   | intercarrier input 1 at 5.5 MHz |
| n.c.                 | 2   | not connected                   |
| n.c.                 | 3   | not connected                   |
| n.c.                 | 4   | not connected                   |
| n.c.                 | 5   | not connected                   |
| n.c.                 | 6   | not connected                   |
| V <sub>AF2</sub>     | 7   | audio output voltage 2          |
| V <sub>AF1</sub>     | 8   | audio output voltage 1          |
| C <sub>1</sub>       | 9   | decoupling capacitor 1          |
| C <sub>2</sub>       | 10  | decoupling capacitor 2          |
| VCO <sub>ref</sub>   | 11  | VCO reference                   |
| C <sub>STAB</sub>    | 12  | supply voltage stabilization    |
| GND                  | 13  | ground                          |
| V <sub>P</sub>       | 14  | supply voltage                  |
| IN <sub>2(B/G)</sub> | 15  | intercarrier input 2            |
| n.c.                 | 16  | not connected                   |



## FUNCTIONAL DESCRIPTION

The complete circuit consists of two separate channels, each consisting of a limiter-amplifier, FM demodulator and AF amplifier. Circuit operation is also described in Fig.1.

### FM demodulators

The intercarrier signal is fed through external ceramic band-pass filters which are tuned to the sound carrier frequencies.

Each limiter-amplifier is AC-coupled into a FM demodulator. The integrated FM demodulator PLLs are alignment-free. The FM demodulator outputs are amplified to 500 mV (RMS value). High amplification and DC error signals of the PLLs, which are superimposed on the FM demodulator outputs, require DC decoupling at pins 9 and 10 of the AF amplifier inputs.

### Stereo channel separation adjustment (optional)

Optimal stereo channel separation is achieved by adjusting V<sub>AF1</sub> (pin 8) and V<sub>AF2</sub> (pin 7) as follows:

1. V<sub>AF1</sub> by a resistor in series with the DC decoupling capacitor at pin 9
2. V<sub>AF2</sub> by a variable resistor in series with the DC decoupling capacitor on pin 10 to the same voltage as V<sub>AF1</sub>.

Normally stereo channel separation is adjusted in the stereo decoder for the B/G standard.

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### Second sound carrier mute

The output of the second FM demodulator is muted when the signal level (signal and/or noise) at pin 15 is less than typically 0.5 mV (RMS value). This avoids an incorrect stereo or dual sound identification when a mono signal is

transmitted. Therefore, with a mono transmission, there is no audio output at pin 7. When the signal level at pin 15 is greater than typically 1.0 mV (RMS value) mute is switched off.

### LIMITING VALUES

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

| SYMBOL    | PARAMETER   | CONDITIONS | MIN.  | MAX.  | UNIT |
|-----------|---|------------|-------|-------|------|
| $V_P$     | supply voltage (pin 14)   |            | -0.5  | +9.0  | V    |
| $V_i$     | input signal (pins 1 and 15)  |            | -0.5  | +5.0  | V    |
| $t_s$     | short-circuit time (each pin except pins 13 and 14 to be tested; one at the time) |            | -     | 10    | s    |
| $T_{stg}$ | storage temperature   |            |       |       |      |
|           | device  |            | -25   | +125  | °C   |
|           | device in packing   |            | -25   | +85   | °C   |
| $T_j$     | junction temperature  |            | -     | 150   | °C   |
| $T_{amb}$ | operating ambient temperature   |            | 0     | 70    | °C   |
| $V_{es}$  | electrostatic handling for all pins   | note 1     | -500  | +500  | V    |
|           |   | note 2     | -4000 | +4000 | V    |

### Notes

- Equivalent to discharging a 200 pF capacitor via a 0  $\Omega$  series resistor.
- Equivalent to discharging a 100 pF capacitor via a 1.5 k $\Omega$  series resistor.

### THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER   | VALUE | UNIT |
|---------------|---|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient in free air | 74    | K/W  |

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## CHARACTERISTICS

All voltages are measured to GND (pin 13);  $V_P = 5\text{ V}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ;  $\Delta f_i = \pm 50\text{ kHz}$ ;  $f_{\text{mod}} = 1\text{ kHz}$ ;  $V_{1,15} = 10\text{ mV}$  (RMS value); measurements taken in Fig.5; unless otherwise specified.

| SYMBOL                                   | PARAMETER  | CONDITIONS                                  | MIN. | TYP. | MAX. | UNIT                  |
|--|--|---|------|------|------|-----------------------|
| <b>Supply (pin 14)</b>                   |  |   |      |      |      |                       |
| $V_P$                                    | supply voltage   |   | 4.5  | 5.0  | 8.8  | V                     |
| $I_P$                                    | supply current   |   | 23   | 30   | 37   | mA                    |
| <b>Limiter-amplifier 1</b>               |  |   |      |      |      |                       |
| $V_1$                                    | DC input voltage   |   | 2.25 | 2.5  | 2.75 | V                     |
| $R_1$                                    | input resistance   |   | 480  | 600  | 720  | $\Omega$              |
| $V_{1(\text{rms})}$                      | input signal (RMS value)                                       | $\frac{S+N}{N} = 40\text{ dB}$              | –    | 150  | 250  | $\mu\text{V}$         |
|  | allowed input signal (RMS value)                               |   | 200  | –    | –    | mV                    |
| <b>Limiter-amplifier 2</b>               |  |   |      |      |      |                       |
| $V_{15}$                                 | DC input voltage   |   | 2.25 | 2.5  | 2.75 | V                     |
| $V_{15(\text{rms})}$                     | input signal (RMS value)                                       | $\frac{S+N}{N} = 40\text{ dB}$ ; note 1     | –    | 150  | 250  | $\mu\text{V}$         |
|  | input signal for mute off (RMS value)                          |   | 0.7  | 1.0  | 1.5  | mV                    |
|  | allowed input signal (RMS value)                               |   | 200  | –    | –    | mV                    |
| $\Delta V_{15}$                          | mute hysteresis  |   | 8    | 12   | 16   | dB                    |
| $R_{15}$                                 | input resistance   |   | 480  | 600  | 720  | $\Omega$              |
| <b>PLL FM demodulators VCO1 and VCO2</b> |  |   |      |      |      |                       |
| $f_{\text{VCO1}}$                        | free-running frequency   | $R_{11} = 27\text{ k}\Omega$                | –    | 5.5  | –    | MHz                   |
| $f_{\text{VCO2}}$                        | free-running frequency   | $R_{11} = 27\text{ k}\Omega$                | –    | 5.7  | –    | MHz                   |
| $\Delta f_{\text{fr}}$                   | negative/positive free-running frequency spread                |   | –    | –    | 10   | %                     |
| $D/\Delta f_{\text{fr}}$                 | drift of free-running frequencies                              | $T_{\text{amb}} = 0\text{ to }70\text{ °C}$ | –    | 500  | –    | kHz                   |
| $\Delta f_{\text{fr}(\text{shift})}$     | shift of free-running frequencies                              | $4.5\text{ V} < V_P < 8.8\text{ V}$         | –    | 200  | –    | kHz                   |
| $\Delta f_{\text{fr}(\text{ar})}$        | negative/positive adjustment range of free-running frequencies | $R_{11} = 22\text{ k}\Omega$                | 1    | –    | –    | MHz                   |
| $R_{11}$                                 | adjustment resistance for free-running frequencies (pin 11)    |   | 15   | –    | 29   | $\text{k}\Omega$      |
| S  | negative slope of free-running frequency adjustment            | $R_{11} = 22\text{ k}\Omega$                | –    | 200  | –    | kHz/ $\text{k}\Omega$ |
| $\Delta f_1$                             | negative/positive catching range of PLLs                       |   | 1.4  | 1.9  | –    | MHz                   |
| $\Delta f_2$                             | negative/positive holding range of PLLs                        |   | 2.0  | 3.0  | –    | MHz                   |

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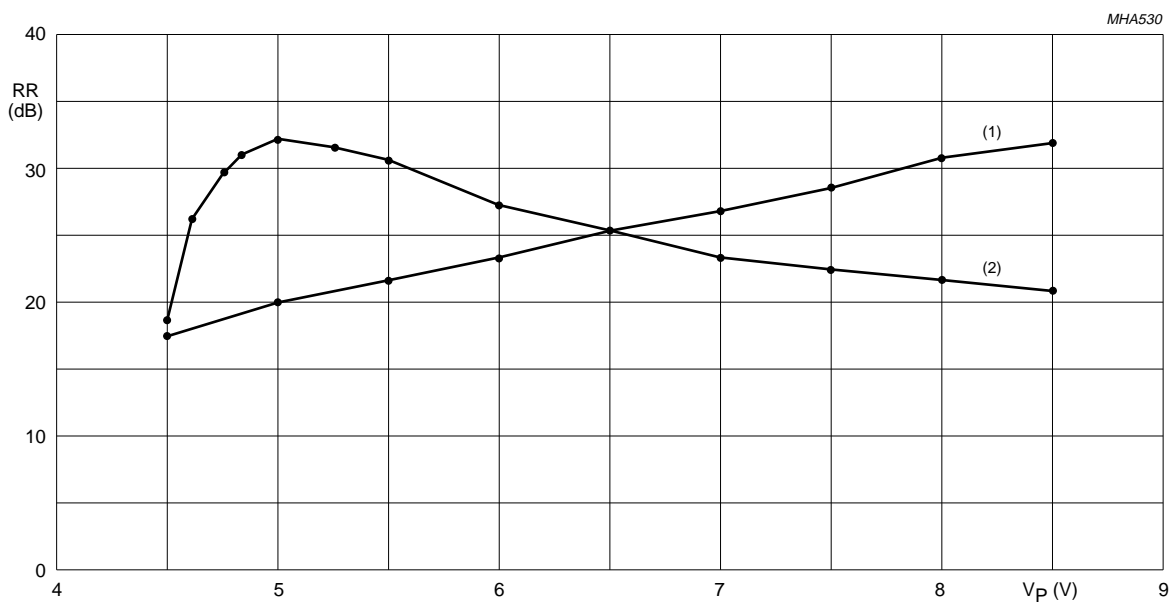
| SYMBOL   | PARAMETER   | CONDITIONS   | MIN. | TYP. | MAX. | UNIT     |
|--|---|--|------|------|------|----------|
| <b>Output amplifiers AF1 (pin 8) and AF2 (pin 7) and overall performance</b> |   |  |      |      |      |          |
| $V_O$  | DC output voltage   |  | 1.8  | 2.1  | 2.5  | V        |
| $V_{O(rms)}$   | output signal (RMS value)   |  | 0.4  | 0.5  | 0.6  | V        |
|  |   | clipping level   | 1.2  | –    | –    | V        |
| $I_M$  | AC peak current   |  | –    | –    | 1.5  | mA       |
| $I_O$  | DC source current   |  | –    | –    | 2.0  | mA       |
| $\Delta V_O/V_O$   | absolute drift of AF output signals   | $T_{amb} = 0 \text{ to } 70 \text{ }^\circ\text{C}$                      | –    | 0.7  | –    | dB       |
| $\Delta V_{O1}/\Delta V_{O2}$  | relative drift of AF output signals   | $T_{amb} = 0 \text{ to } 70 \text{ }^\circ\text{C}$                      | –    | 0.2  | –    | dB       |
| $\Delta V_{AF(1-2)}$   | negative/positive difference between output signals                               | 50 $\mu\text{s}$ de-emphasis   | –    | 0.3  | 1.0  | dB       |
| $R_O$  | output resistance   |  | –    | 100  | –    | $\Omega$ |
| $\alpha_{cs(ar)}$  | adjustment range of channel separation  | $R_s = 1.1 \text{ k}\Omega$ ;<br>$R_{pot} = 2.2 \text{ k}\Omega$         | 1.5  | –    | –    | dB       |
| THD  | total harmonic distortion   | 50 $\mu\text{s}$ de-emphasis   |      |      |      |          |
|  |   | pin 8  | –    | 0.1  | 0.3  | %        |
|  |   | pin 7  | –    | 0.25 | 0.5  | %        |
| $\alpha_{AM}$  | AM suppression of AF(1-2)   | 50 $\mu\text{s}$ de-emphasis;<br>$m = 0.3$ ; $f_{AM} = 1 \text{ kHz}$    | 46   | 66   | –    | dB       |
| $\frac{S+N}{N}$  | signal plus noise-to-noise ratio  | 50 $\mu\text{s}$ de-emphasis;<br>in accordance with<br>"CCIR 468-3"      | 64   | 68   | –    | dB       |
| $AF_{resp}$  | LOW-level AF frequency response   | $\Delta V_{AF(1-2)} = -3 \text{ dB}$                                     | –    | –    | 20   | Hz       |
|  | HIGH-level AF frequency response  |  | 200  | –    | –    | kHz      |
| $AM_{res(rms)}$  | residual sound carrier signal and harmonics (RMS value)                           |  | –    | 50   | 80   | mV       |
| $\alpha_{8/7}$   | crosstalk attenuation between AF outputs  | $f = 50 \text{ to } 12500 \text{ Hz}$                                    | 60   | 70   | –    | dB       |
| RR   | supply voltage ripple rejection   | $V_{RR} < 200 \text{ mV}$ ;<br>$f_r = 20 \text{ Hz to } 200 \text{ kHz}$ |      |      |      |          |
|  |   | $V_P = 5 \text{ V}$  | 16   | 20   | –    | dB       |
|  |   | $V_P = 8 \text{ V}$  | 24   | 28   | –    | dB       |
| RR   | supply voltage ripple rejection with improved application for $V_P = 5 \text{ V}$ | $f_r = 20 \text{ Hz to } 3 \text{ kHz}$ ;<br>see Fig.3 and note 2        |      |      |      |          |
|  |   | $V_P = 4.5 \text{ V}$  | 18   | 24   | –    | dB       |
|  |   | $V_P = 4.75 \text{ V}$   | 21   | 27   | –    | dB       |
|  |   | $V_P = 5.0 \text{ V}$  | 24   | 30   | –    | dB       |
|  |   | $V_P = 5.5 \text{ V}$  | 21   | 27   | –    | dB       |

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### Notes

1. The output signal at pin 7 can only be measured when mute is disabled. This is achieved by inserting a resistor of  $2.7\text{ k}\Omega$  between pin 15 and ground. In this event the input impedance is  $490\ \Omega$ .
2. Improvement of ripple rejection is possible by connecting series RC between pin 11 and pin 14 ( $15\text{ k}\Omega + 2.2\ \mu\text{F}$ ; see Fig.5) for a supply voltage of 4.5 to 5.5 V. The rejection of ripple frequencies up to 3 kHz is improved, but up to 200 kHz is worse; see Fig.3.



MHA530

The curves are typical and valid for ripple frequencies between 50 Hz and 3 kHz.

Conditions: input signal:  $f = 5.5\text{ MHz}$ , 10 mV (RMS value); ripple on  $V_P = 100\text{ mV}$  (RMS value),  $f_r = 1\text{ kHz}$ ; ripple rejection measurement: unweighted RMS.

(1) Without RC.

(2) With  $R = 15\text{ k}\Omega$  and  $C = 2.2\ \mu\text{F}$ .

Fig.3 Typical improvement.



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### INTERNAL CIRCUITRY

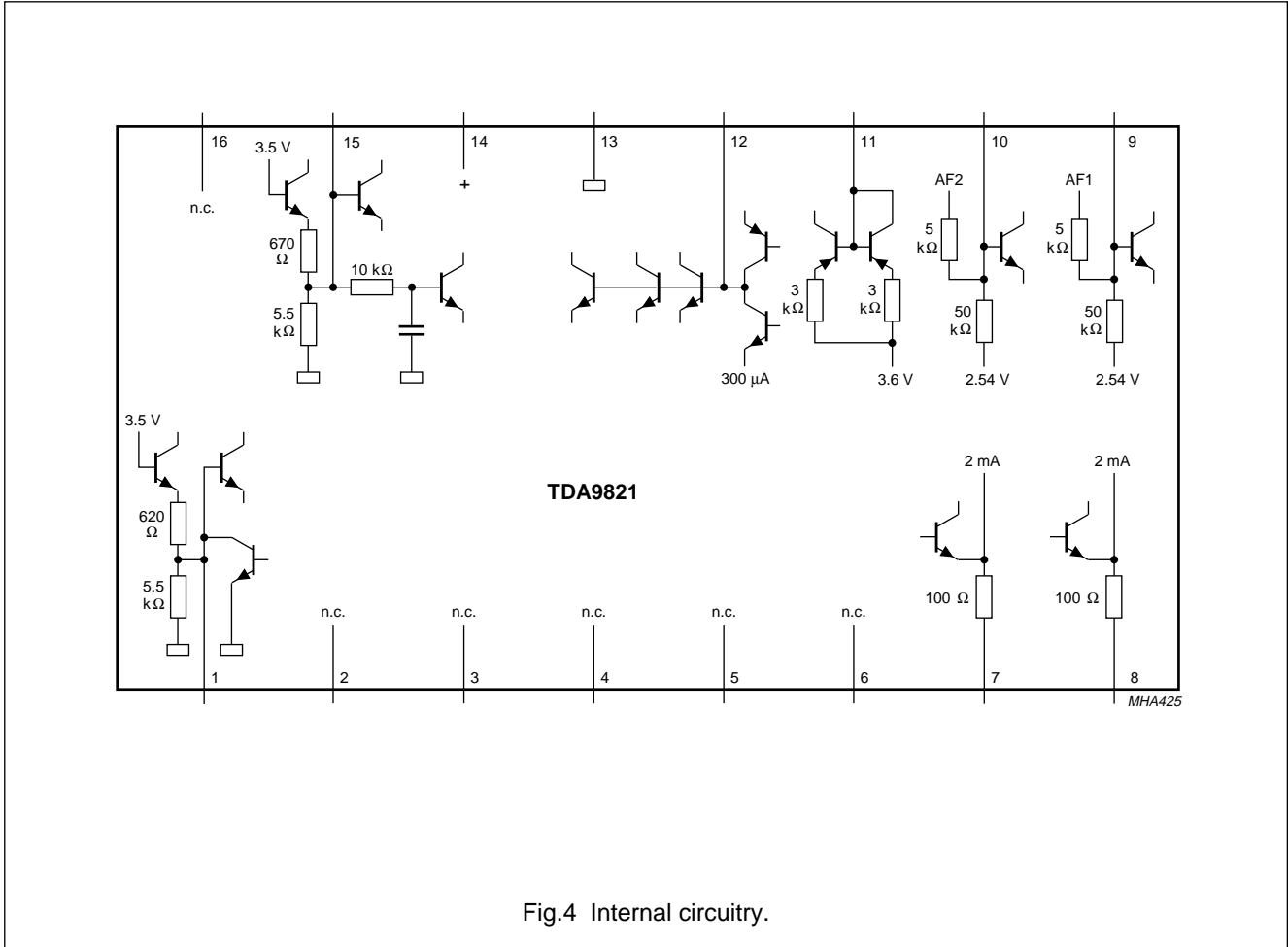
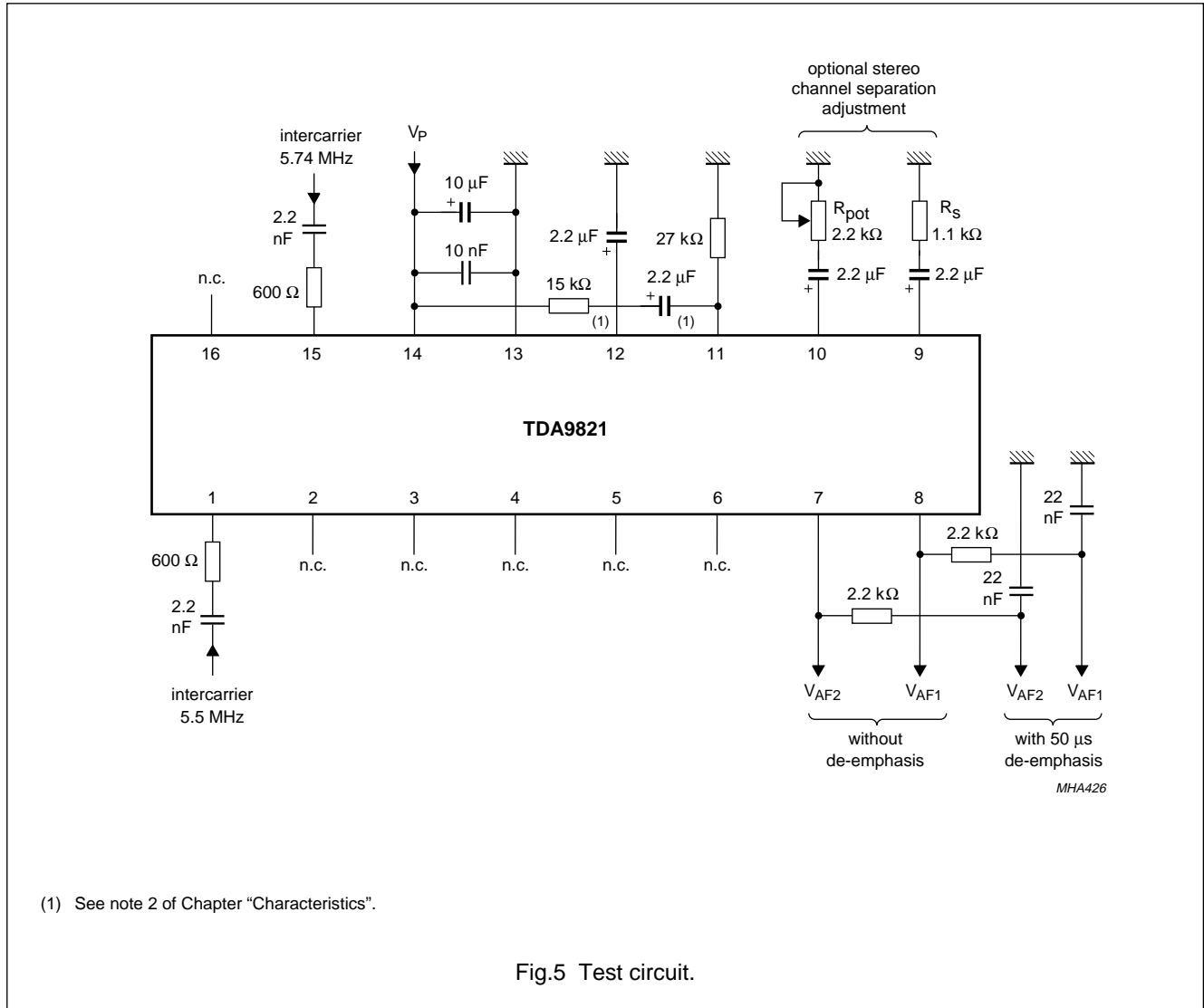


Fig.4 Internal circuitry.

# Dual channel TV FM intercarrier sound demodulator

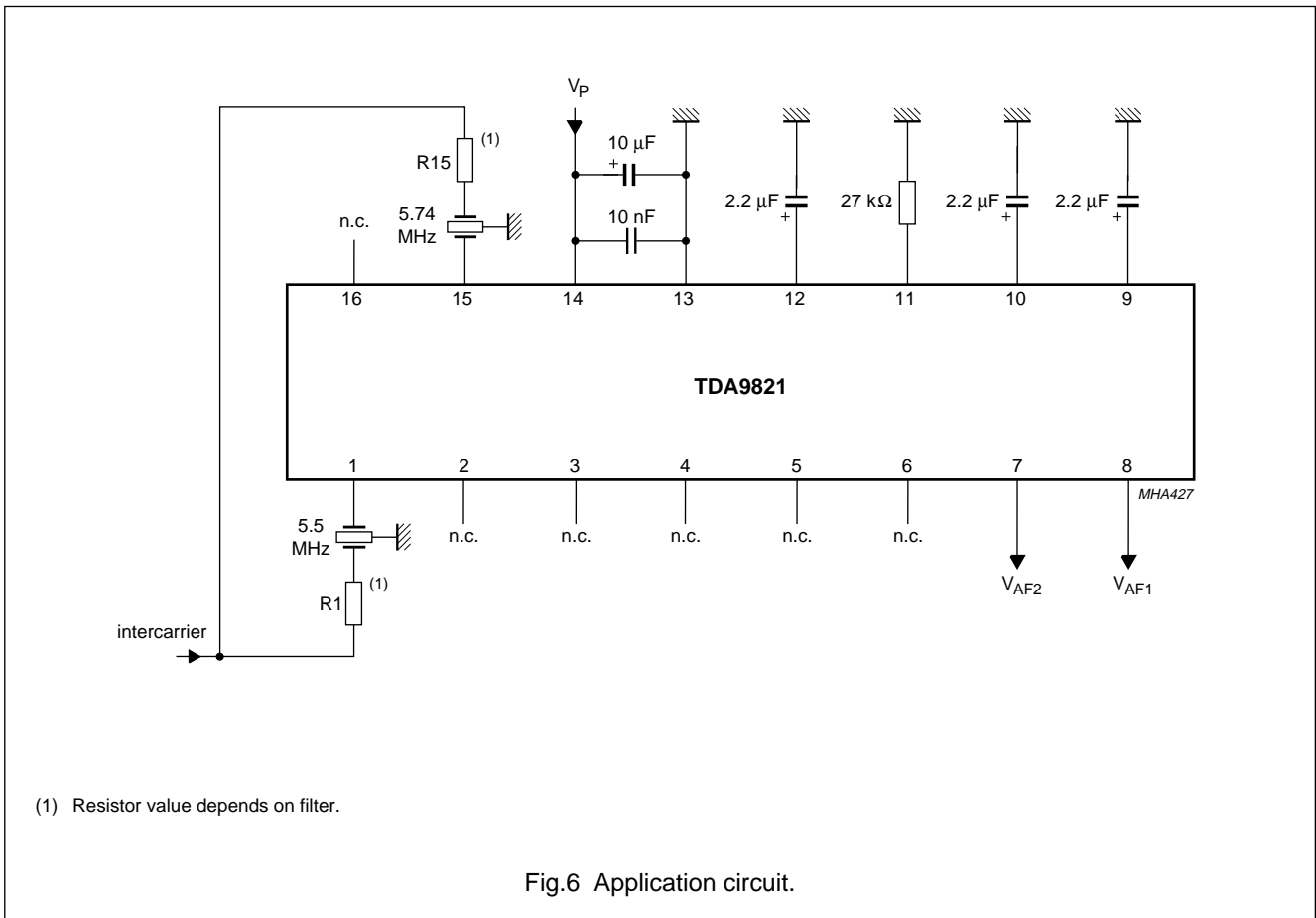
## TDA9821

### TEST AND APPLICATION INFORMATION



Dual channel TV FM intercarrier  
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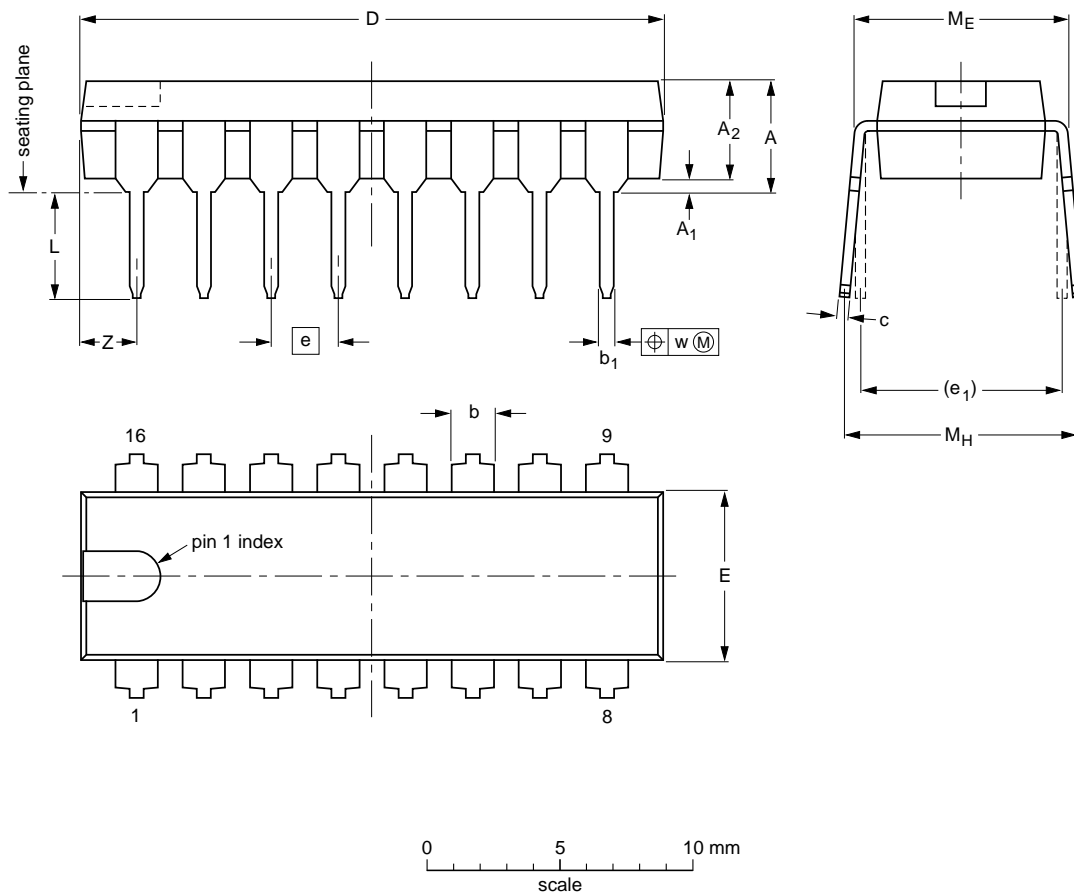
Dual channel TV FM intercarrier  
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PACKAGE OUTLINE

DIP16: plastic dual in-line package; 16 leads (300 mil); long body

SOT38-1



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

| UNIT   | A max. | A <sub>1</sub> min. | A <sub>2</sub> max. | b              | b <sub>1</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | L            | M <sub>E</sub> | M <sub>H</sub> | w     | Z <sup>(1)</sup> max. |
|--------|--------|---------------------|---------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|-----------------------|
| mm     | 4.7    | 0.51                | 3.7                 | 1.40<br>1.14   | 0.53<br>0.38   | 0.32<br>0.23   | 21.8<br>21.4     | 6.48<br>6.20     | 2.54 | 7.62           | 3.9<br>3.4   | 8.25<br>7.80   | 9.5<br>8.3     | 0.254 | 2.2                   |
| inches | 0.19   | 0.020               | 0.15                | 0.055<br>0.045 | 0.021<br>0.015 | 0.013<br>0.009 | 0.86<br>0.84     | 0.26<br>0.24     | 0.10 | 0.30           | 0.15<br>0.13 | 0.32<br>0.31   | 0.37<br>0.33   | 0.01  | 0.087                 |

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 |                     |                       |
| SOT38-1         | 050G09     | MO-001AE |      |                     | 92-10-02-<br>95-01-19 |

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### 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.

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**NOTES**

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**NOTES**

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