

# DATA SHEET

## **TEA0678**

Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

Preliminary specification  
Supersedes data of August 1993  
File under Integrated Circuits, IC01

1996 Jun 06

# Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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## FEATURES

- Dual noise reduction (NR) channels
- Head pre-amplifiers
- Reverse head switching
- Automatic Music Search (AMS)
- Mute position
- Equalization with electronically switched time constants
- Dolby reference level = 387.5 mV
- 32 pins
- Switch inputs TTL compatible
- Differential output stage has:
  - Capability to drive 1.2 nF capacitive load
  - Capability to drive 1 k $\Omega$  load
  - Short-circuit proof
  - Short-circuit proof to 16 V via coupling capacitor.
- Improved EMC behaviour.

## GENERAL DESCRIPTION

The TEA0678 is a bipolar integrated circuit that provides two channels of Dolby B noise reduction for playback applications in car radios. It includes head and equalization amplifiers with electronically switchable time constants. Furthermore it includes electronically switchable inputs for tape drivers with reverse heads. This device also detects pauses of music in Automatic Music Search (AMS) mode, with a delay time fixed externally by a resistor. The short-circuit proof output stage of the TEA0678 is differential and provides muting. The device will operate with power supplies in the range of 7.6 to 12 V, output overload level increasing with increase in supply voltage. Current drain varies with supply voltage, noise reduction on/off and AMS on/off so it is advisable to use a regulated power supply or a supply with a long time constant.

Current drain varies with these variables:

Supply voltage

Noise reduction on/off

AMS on/off.

Because of this current drain variation it is advisable to use a regulated power supply or a supply with a long time constant.

## QUICK REFERENCE DATA

| SYMBOL          | PARAMETER                        | MIN. | TYP. | MAX. | UNIT |
|-----------------|----------------------------------|------|------|------|------|
| V <sub>CC</sub> | supply voltage                   | 7.6  | 10   | 12   | V    |
| I <sub>CC</sub> | supply current                   | –    | 25   | 28   | mA   |
| $\frac{S+N}{N}$ | signal plus noise-to-noise ratio | 78   | 84   | –    | dB   |

## ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |                                                            |          |
|-------------|---------|------------------------------------------------------------|----------|
|             | NAME    | DESCRIPTION                                                | VERSION  |
| TEA0678     | SDIP32  | plastic shrink dual in-line package; 32 leads (400 mil)    | SOT232-1 |
| TEA0678T    | SO32    | plastic small outline package; 32 leads; body width 7.5 mm | SOT287-1 |

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Dual Dolby® B-type noise reduction circuit, automatic music search, with differential outputs and mute

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BLOCK DIAGRAM

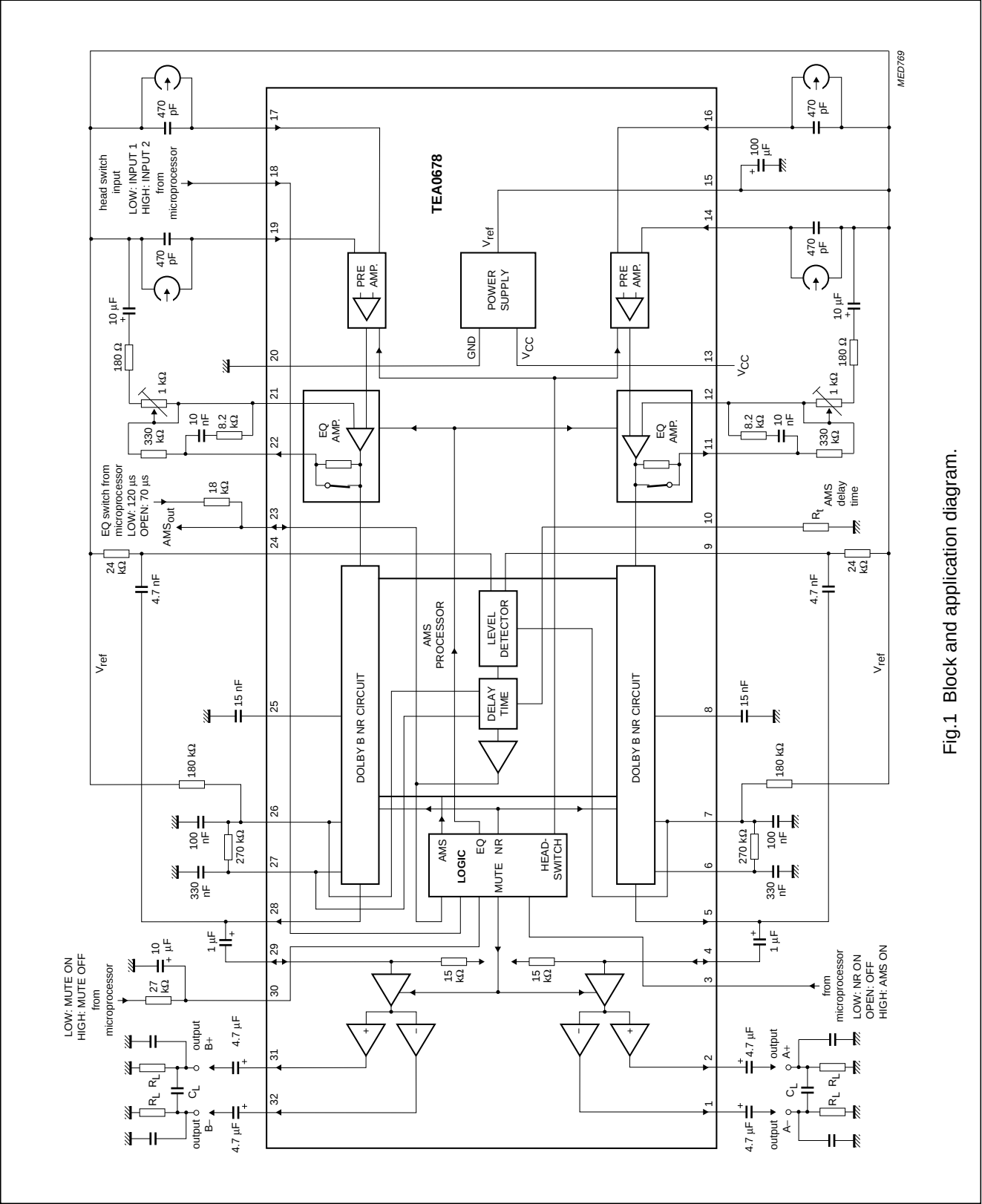


Fig.1 Block and application diagram.

# Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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## PINNING

| SYMBOL           | PIN | DESCRIPTION                           |
|------------------|-----|---------------------------------------|
| OUTA-            | 1   | negative output channel A             |
| OUTA+            | 2   | positive output channel A             |
| NR/AMS           | 3   | noise reduction/music search switch   |
| INCA             | 4   | input mute/output stage channel A     |
| OUTCA            | 5   | output Dolby B processor channel A    |
| INTA             | 6   | integrating filter channel A          |
| CONTRA           | 7   | control voltage channel A             |
| HPA              | 8   | high-pass filter channel A            |
| SCA              | 9   | side chain channel A                  |
| TD               | 10  | delay time constant                   |
| EQA              | 11  | equalizing output channel A           |
| EQFA             | 12  | equalizing feedback channel A         |
| V <sub>CC</sub>  | 13  | supply voltage                        |
| INA1             | 14  | input channel A1 (forward or reverse) |
| V <sub>ref</sub> | 15  | reference voltage                     |
| INA2             | 16  | input channel A2 (reverse or forward) |
| INB2             | 17  | input channel B2 (reverse or forward) |
| HS               | 18  | head switch input                     |
| INB1             | 19  | input channel B1 (forward or reverse) |
| GND              | 20  | ground                                |
| EQFB             | 21  | equalizing feedback channel B         |
| EQB              | 22  | equalizing output channel B           |
| AMSEQ            | 23  | AMS output and EQ switch input        |
| SCB              | 24  | side chain channel B                  |
| HPB              | 25  | high-pass filter channel B            |
| CONTRB           | 26  | control voltage channel B             |
| INTB             | 27  | integrating filter channel B          |
| OUTCB            | 28  | output Dolby B processor channel B    |
| INCB             | 29  | input mute/output stage channel B     |
| MUTE             | 30  | mute switch                           |
| OUTB+            | 31  | positive output channel B             |
| OUTB-            | 32  | negative output channel B             |

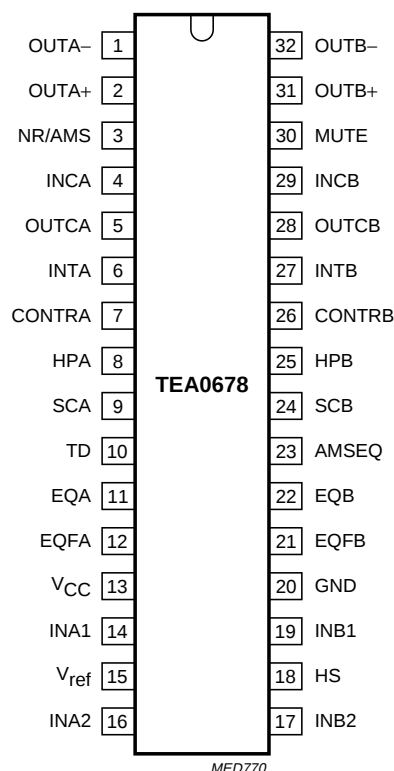


Fig.2 Pin configuration.

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### FUNCTIONAL DESCRIPTION

**Noise Reduction (NR)** is enabled when pin NR/AMS is connected to ground and disabled when open-circuit (left floating from a 3-state output).

Dolby noise reduction only operates correctly if 0 dB Dolby level is adjusted at 387.5 mV.

**Automatic Music Search (AMS)** is enabled when pin NR/AMS is connected to HIGH (5 V) and disabled when open-circuit (left floating from a 3-state output). In AMS mode the signal of both channels are rectified and then added. This means, even if one channel signal appears inverted to the other channel, with the TEA0678 the normal AMS function is ensured (see Figs 4, 5 and 6).

**Equalization time constant switching** (70  $\mu$ s or 120  $\mu$ s) is achieved when pin AMSEQ is connected to GND via an 18 k $\Omega$  resistor (120  $\mu$ s), or left open-circuit (70  $\mu$ s).

This does not affect the AMS output signal during AMS mode (see Fig.1).

**Head switching** is achieved when pin HS is connected to GND (input IN1 active) or connected to HIGH (5 V) level (input IN2 active). If left open-circuit IN1 is active.

**Mute** is enabled when pin MUTE is connected to ground and off when connected to HIGH (5 V) level. For smooth switching a time constant is recommended. If left open-circuit MUTE is active.

The **differential output stage** of each channel is connected via a provision to the Dolby and pre-amplifier part. This provision may be used for any processing of the tape signal or to add another signal. Each output drives a resistive load of nominal 10 k $\Omega$  and is capable of driving 1 k $\Omega$ , also a capacitive load of 1.2 nF to ground and between differential outputs. Each output can be short-circuited to a battery (16 V) via a coupling capacitor (4.7  $\mu$ F).

### LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); note1.

| SYMBOL      | PARAMETER                                                                                                           | CONDITIONS | MIN. | MAX.       | UNIT |
|-------------|---------------------------------------------------------------------------------------------------------------------|------------|------|------------|------|
| $V_{CC}$    | supply voltage                                                                                                      |            | 0    | 16         | V    |
| $V_i$       | input voltage (pins 1 to 32) except pin 15 ( $V_{ref}$ ); pin 3 (NR/AMS), pin 18 (HS) and pin 30 (MUTE) to $V_{CC}$ |            | -0.3 | + $V_{CC}$ | V    |
|             | input voltage at pin 3 (NR/AMS), pin 18 (HS) and pin 30 (MUTE)                                                      | note 2     | -0.3 | +6.5       | V    |
| $t_{short}$ | pin 15 ( $V_{ref}$ ) to $V_{CC}$ short-circuiting duration                                                          |            | –    | 5          | s    |
| $T_{stg}$   | storage temperature                                                                                                 |            | -55  | +150       | °C   |
| $T_{amb}$   | operating ambient temperature                                                                                       |            | -40  | +85        | °C   |
| $V_{es}$    | electrostatic handling voltage for all pins                                                                         | note 3     | -2   | +2         | kV   |
|             |                                                                                                                     | note 4     | -500 | +500       | V    |

### Notes

- The device may not operate correctly when subjected to these ratings when the ratings exceed the electrical characteristics of the device as specified in Chapter "Characteristics". The device will recover automatically when the environment is reduced to the requirements of the characteristics.
- The TEA0678 allows a HIGH-level at switching pins without supply voltage ( $V_{CC} = 0$ ; stand-by mode). This means a maximum input voltage of 6.5 V for the switching input pins.
- Human body model (1.5 k $\Omega$ , 100 pF).
- Machine model (0  $\Omega$ , 200 pF).

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## CHARACTERISTICS

$V_{CC} = 10\text{ V}$ ;  $f = 20\text{ Hz}$  to  $20\text{ kHz}$ ;  $T_{amb} = 25\text{ °C}$ ; nominal load  $10\text{ k}\Omega$ ; all levels are referenced to  $775\text{ mV (RMS)}$  ( $0\text{ dB}$ ) at differential outputs ( $V_o = V_{o+} - V_{o-}$ ), this corresponds to Dolby level  $387.5\text{ mV (RMS)}$  ( $0\text{ dB}$ ) at test point (OUTC); see Fig.1; NR on/AMS off; EQ switch in the  $70\text{ }\mu\text{s}$  position; unless otherwise specified.

| SYMBOL          | PARAMETER                                                                                                               | CONDITIONS                                                                                     | MIN.  | TYP.  | MAX.  | UNIT             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------|-------|-------|------------------|
| $V_{CC}$        | supply voltage                                                                                                          |                                                                                                | 7.6   | 10    | 12    | V                |
| $I_{CC}$        | supply current                                                                                                          | pins 14, 16, 17 and 19 connected to $V_{ref}$                                                  | –     | 25    | 28    | mA               |
|                 |                                                                                                                         | $f = 1\text{ kHz}$ ; $V_o = 0\text{ dB}$ at each output                                        | –     | 26    | 37    | mA               |
| $\alpha_m$      | channel matching                                                                                                        | $f = 1\text{ kHz}$ ; $V_o = 0\text{ dB}$ ; NR off; OUTA/OUTB                                   | –0.5  | –     | +0.5  | dB               |
| $G_v$           | voltage gain (output stage)                                                                                             | between OUT and OUTC; $f = 1\text{ kHz}$ ; NR off                                              | 5.5   | 6     | 6.5   | dB               |
| $G_{mm}$        | voltage gain mismatch (output stage)                                                                                    | mismatch between OUT+ and OUT–; $f = 1\text{ kHz}$ ; NR off                                    | –0.5  | –     | +0.5  | dB               |
| THD             | total harmonic distortion (2nd and 3rd harmonic)                                                                        | $f = 1\text{ kHz}$ ; $V_o = 0\text{ dB}$                                                       | –     | 0.08  | 0.15  | %                |
|                 |                                                                                                                         | $f = 10\text{ kHz}$ ; $V_o = 6\text{ dB}$                                                      | –     | 0.15  | 0.3   | %                |
| $H_R$           | headroom at output                                                                                                      | $V_{CC} = 9\text{ V}$ ; THD = 1%; $f = 1\text{ kHz}$                                           | 13    | –     | –     | dB               |
| $\frac{S+N}{N}$ | signal plus noise-to-noise ratio                                                                                        | internal gain 40 dB; linear; CCIR/ARM weighted; decode mode; see Fig.10                        | 78    | 84    | –     | dB               |
| $V_{no(rms)}$   | equivalent input noise voltage in decode mode (RMS value)                                                               | NR off; unweighted; $f = 20\text{ Hz}$ to $20\text{ kHz}$ ; $R_{source} = 0\text{ }\Omega$     | –     | –     | 1.4   | $\mu\text{V}$    |
| PSRR            | power supply ripple rejection                                                                                           | $V_{i(rms)} = 0.25\text{ V}$ ; $f = 1\text{ kHz}$ ; see Fig.7 for unsymmetrical signal at OUTC | 52    | 57    | –     | dB               |
|                 |                                                                                                                         | at differential OUT; note 1                                                                    | 49    | 52    | –     | dB               |
| $f_o$           | frequency response measured in encode mode; referenced to TP                                                            | see Fig.10                                                                                     |       |       |       |                  |
|                 |                                                                                                                         | $V_o = -25\text{ dB}$ ; $f = 0.2\text{ kHz}$                                                   | –22.9 | –24.4 | –25.9 | dB               |
|                 |                                                                                                                         | $V_o = 0\text{ dB}$ ; $f = 1\text{ kHz}$                                                       | –1.5  | 0     | +1.5  | dB               |
|                 |                                                                                                                         | $V_o = -25\text{ dB}$ ; $f = 1\text{ kHz}$                                                     | –17.8 | –19.3 | –20.8 | dB               |
|                 |                                                                                                                         | $V_o = -25\text{ dB}$ ; $f = 5\text{ kHz}$                                                     | –18.1 | –19.6 | –21.1 | dB               |
|                 |                                                                                                                         | $V_o = -35\text{ dB}$ ; $f = 10\text{ kHz}$                                                    | –24.4 | –25.9 | –27.4 | dB               |
| $\alpha_{CS}$   | channel separation                                                                                                      | $V_o = +10\text{ dB}$ ; $f = 1\text{ kHz}$ ; see Fig.8                                         | 61    | 67    | –     | dB               |
| $\alpha_{CC}$   | crosstalk between active and inactive input                                                                             | NR off; $f = 1\text{ kHz}$ ; $V_o = +10\text{ dB}$ ; see Fig.8                                 | 70    | 77    | –     | dB               |
| $R_L$           | load resistance at each output OUTA+, OUTA–, OUTB+ and OUTB– (corresponds to $2\text{ k}\Omega$ at differential output) | AC-coupled $f = 1\text{ kHz}$ ; $V_o = 12\text{ dB}$ ; THD = 1%                                | 10    | –     | –     | $\text{k}\Omega$ |
|                 |                                                                                                                         | THD = 1%; note 2                                                                               | 1     | –     | –     | $\text{k}\Omega$ |
| $C_L$           | capacitive load at each output (between OUT+ and OUT–) and ground                                                       | $C_{Lmin}$ at each output to ground (pins 1, 2, 31 and 32)                                     | 0.3   | –     | 1.3   | nF               |
| $G_v$           | voltage gain of pre-amplifier                                                                                           | from pin INA1 or INA2 to pin EQFA and from pin INB1 or INB2 to pin EQFB; $f = 1\text{ kHz}$    | 29    | 30    | 31    | dB               |

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| SYMBOL                             | PARAMETER                                                           | CONDITIONS                                                                                                                                                                              | MIN.                     | TYP.             | MAX.             | UNIT                 |
|------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------|------------------|----------------------|
| $V_{I(\text{offset})(\text{DC})}$  | DC input offset voltage                                             |                                                                                                                                                                                         | –                        | 2                | –                | mV                   |
| $I_{i(\text{bias})}$               | input bias current                                                  |                                                                                                                                                                                         | –                        | –                | 0.4              | $\mu\text{A}$        |
| $R_{\text{EQ}}$                    | equalization resistor                                               |                                                                                                                                                                                         | 4.7                      | 5.8              | 6.9              | $\text{k}\Omega$     |
| $R_{\text{I}}$                     | input resistance head inputs                                        |                                                                                                                                                                                         | 60                       | 100              | –                | $\text{k}\Omega$     |
| $A_{\text{v}}$                     | open-loop amplification                                             | pin INA1 or INA2 to pin EQA and<br>pin INB1 or INB2 to pin EQB<br><br>$f = 10 \text{ kHz}$<br>$f = 400 \text{ Hz}$                                                                      | 80<br>104                | 86<br>110        | –<br>–           | dB<br>dB             |
| $V_{O(\text{offset})(\text{DC})}$  | DC offset voltage at pins<br>OUT+ to OUT–                           | pins INA1, INA2, INB1 and INB2<br>connected to $V_{\text{ref}}$                                                                                                                         | –10                      | –                | +10              | mV                   |
| $V_{\text{mute}(\text{offset})}$   | MUTE offset voltage at pins<br>OUT+ to OUT–                         | pins INA1, INA2, INB1 and INB2<br>connected to $V_{\text{ref}}$                                                                                                                         | –10                      | –                | +10              | mV                   |
| $V_{\text{ref}} - V_{\text{OUTC}}$ | DC output offset voltage at<br>pins OUTCA and OUTCB                 | NR off; pins INA1, INA2, INB1 and<br>INB2 connected to $V_{\text{ref}}$                                                                                                                 | –0.15                    | –                | +0.15            | V                    |
| $I_{\text{O}}$                     | DC output current                                                   | pins INA1, INA2, INB1 and INB2<br>connected to $V_{\text{ref}}$<br><br>pin OUTC to ground<br>pin OUTC to $V_{\text{CC}}$<br>pin OUT $\pm$ to ground<br>pin OUT $\pm$ to $V_{\text{CC}}$ | –2<br>0.3<br>–2.5<br>2.5 | –<br>–<br>–<br>– | –<br>–<br>–<br>– | mA<br>mA<br>mA<br>mA |
| $R_{\text{i}}$                     | input resistance output stage<br>at pins INCA and INCB              |                                                                                                                                                                                         | 10                       | 16               | –                | $\text{k}\Omega$     |
| $Z_{\text{O}}$                     | output impedance at each<br>output OUTA+, OUTA–,<br>OUTB+ and OUTB– |                                                                                                                                                                                         | –                        | 90               | 110              | $\Omega$             |
| $d_{\text{mute}}$                  | mute depth at differential<br>output                                | NR off<br><br>$f = 1 \text{ kHz}$<br><br>$f = 10 \text{ kHz}$                                                                                                                           | –80<br>–80               | –<br>–           | –<br>–           | dB<br>dB             |
| AMSL                               | AMS threshold level at<br>music to pause                            | NR off; $f = 10 \text{ kHz}$ ; see Fig.9                                                                                                                                                | –25                      | –22              | –19              | dB                   |
| AMSH                               | AMS threshold level at<br>pause to music                            | note 3                                                                                                                                                                                  | –24                      | –21              | –18              | dB                   |
| $t_{\text{d}}$                     | AMS delay time range                                                | $f = 10 \text{ kHz}$ ; 0 dB burst; see Table 1                                                                                                                                          | –                        | 23 to 160        | –                | ms                   |
| $t_{\text{r}}$                     | AMS rise/delay time                                                 | $f = 10 \text{ kHz}$ ; 0 dB burst                                                                                                                                                       | 2                        | –                | 10               | ms                   |
| EMC                                | DC offset voltage at<br>pins OUTA–, OUTA+,<br>OUTB+ and OUTB–       | $f = 900 \text{ MHz}$ ; $V_{\text{i}} = 3 V_{(\text{RMS})}$ ;<br>see Figs 11, 12 and 13                                                                                                 | –                        | 100              | –                | mV                   |

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| SYMBOL                      | PARAMETER                      | CONDITIONS                                                     | MIN.   | TYP. | MAX.  | UNIT |
|-----------------------------|--------------------------------|----------------------------------------------------------------|--------|------|-------|------|
| <b>Switching thresholds</b> |                                |                                                                |        |      |       |      |
| NR/AMS SWITCH (PIN 3)       |                                |                                                                |        |      |       |      |
| V <sub>IL</sub>             | LOW level input voltage        | NR on                                                          | −0.3   | –    | +0.8  | V    |
| I <sub>IL</sub>             | LOW level input current        | NR on                                                          | −10    | −20  | −40   | μA   |
| I <sub>i(float)</sub>       | allowed floating input current | pin left open-circuit; NR/AMS off                              | −10    | 0    | +10   | μA   |
| V <sub>float</sub>          | floating voltage               | pin left open-circuit; NR/AMS off                              | –      | 2.4  | 5     | V    |
| V <sub>IH</sub>             | HIGH level input voltage       | AMS on                                                         | 4      | –    | 5.5   | V    |
| I <sub>IH</sub>             | HIGH level input current       | AMS on                                                         | 10     | 20   | 40    | μA   |
| EQUALIZATION (PIN 23)       |                                |                                                                |        |      |       |      |
| I <sub>EQ70</sub>           | floating leakage current       | time constant 70 μs active                                     | +0.002 | –    | −0.15 | mA   |
| V <sub>EQ70</sub>           | floating voltage               | time constant 70 μs active                                     | –      | 4.6  | 5     | V    |
| I <sub>EQ120</sub>          | input current                  | time constant 120 μs active                                    | −0.25  | –    | −1    | mA   |
| AMS OUTPUT (PIN 23)         |                                |                                                                |        |      |       |      |
| V <sub>OH</sub>             | HIGH level output voltage      | music present                                                  | 4      | 4.6  | 5     | V    |
| I <sub>OH</sub>             | HIGH level output current      | current capability                                             | +0.01  | –    | −1    | mA   |
| I <sub>OH</sub>             | HIGH level output current      | current capability; note 4                                     | +0.01  | –    | −0.15 | mA   |
| V <sub>OL</sub>             | LOW level output voltage       | music not present                                              | –      | –    | 0.8   | V    |
| I <sub>OL</sub>             | LOW level output current       | current capability                                             | −0.01  | –    | +1    | mA   |
| MUTE SWITCH (PIN 30)        |                                |                                                                |        |      |       |      |
| V <sub>IL</sub>             | LOW level input voltage        | MUTE on                                                        | −0.3   | –    | +0.8  | V    |
| I <sub>IL</sub>             | LOW level input current        | MUTE on                                                        | –      | −4   | −100  | μA   |
| V <sub>IH</sub>             | HIGH level input voltage       | MUTE off                                                       | 4      | –    | 5.5   | V    |
| I <sub>IH</sub>             | HIGH level input current       | MUTE off; smooth switching with a time constant is recommended | –      | 10   | 100   | μA   |
| HEAD SWITCH (PIN 18)        |                                |                                                                |        |      |       |      |
| V <sub>IL</sub>             | LOW level input voltage        | INPUT 1 on                                                     | −0.3   | –    | +0.8  | V    |
| I <sub>IL</sub>             | LOW level input current        | INPUT 1 on                                                     | –      | –    | −100  | μA   |
| V <sub>IH</sub>             | HIGH level input voltage       | INPUT 2 on                                                     | 4      | –    | 5.5   | V    |
| I <sub>IH</sub>             | HIGH level input current       | INPUT 2 on                                                     | –      | 30   | 100   | μA   |

## Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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### Notes to the characteristics

1. For the signal to be doubled (+6 dB) at differential output as a function of OUTC, the signal-to-ripple ratio is improved at differential output for approximately 3 dB.
2. By using the small load, the output voltage may be divided by  $-0.8$  dB.
3. The high speed of the tape (FF, REW) at the tape head during AMS mode causes a transformation of level and frequency of the originally recorded signal. It means a boost of signal level of approximately 10 dB and more for recorded frequencies from 500 Hz up to 4 kHz. So the threshold level of  $-22$  dB corresponds to signal levels in PB mode of approximately  $-32$  dB. The AMS inputs for each channel are pin SCA and pin SCB. As the frequency spectrum is transformed by a factor of approximately 10 to 30 due to the higher tape speed in FF, REW, the high-pass filter (4.7 nF/24 k $\Omega$ ) removes the effect of offset voltages but does not affect the music search function. In the application circuit (Fig.1) the frequency response of the system between tape heads input, e.g. pins INA2/INB2, to the AMS input pins SCA and SCB is constant over the whole frequency range (see Fig.3). The frequency dependence of threshold level is shown in Fig.3.
4. In AMS OFF mode, pin AMSEQ is HIGH level, the equalization time constant will be switched by pulling approximately 200  $\mu$ A out of pin AMSEQ. This means for the device connected to pin AMSEQ, a restriction of input current at HIGH level less than 200  $\mu$ A during AMS off; otherwise the switching of the time constants is disabled but fixed at 120  $\mu$ s. If the following devices, input consumes more than 200  $\mu$ A, this input has to be disconnected in AMS off mode. (To ensure switching the currents for the different switched modes are specified with a tolerance of  $\pm 50$   $\mu$ A in Chapter "Characteristics".) For an application with a fixed EQ time constant of 120  $\mu$ s the equalizing network may be applied completely external. Change 8.2 k $\Omega$  resistor to 14 k $\Omega$  the internal resistor  $R_{EQ} = 5.8$  k $\Omega$  is short-circuited by fixing the EQ switch input at the 70  $\mu$ s position ( $I_{EQ70}$ ).

**Table 1** Blank delay time set by resistor  $R_t$  at pin TD

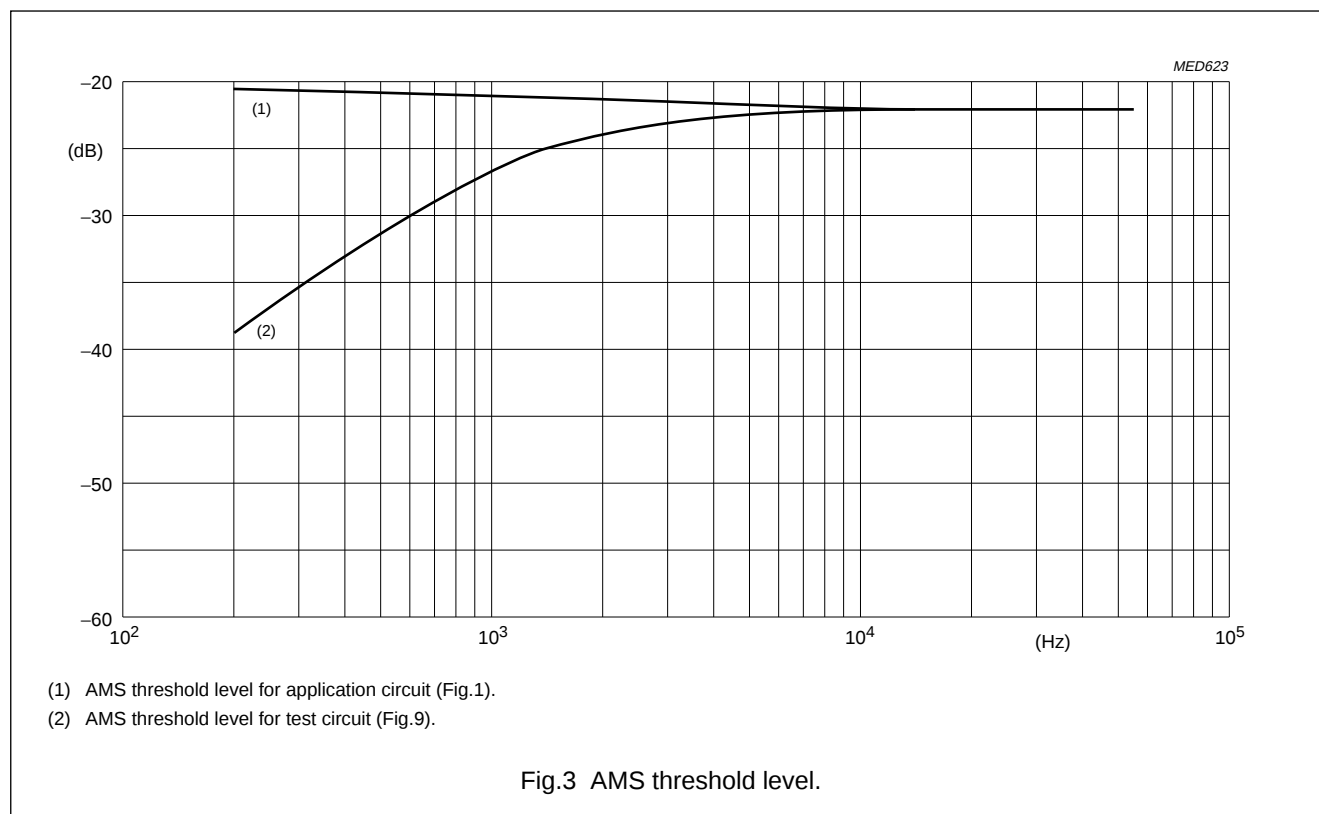
| RESISTOR VALUE $R_t$<br>(k $\Omega$ ) | DELAY TIME $t_d$<br>TYP. (ms) | TOLERANCE<br>(%) |
|---------------------------------------|-------------------------------|------------------|
| 68                                    | 23                            | 20               |
| 150                                   | 42                            | 15               |
| 180                                   | 48                            | 15               |
| 220                                   | 56                            | 15               |
| 270                                   | 65                            | 10               |
| 330                                   | 76                            | 10               |
| 470                                   | 98                            | 10               |
| 560                                   | 112                           | 10               |
| 680                                   | 126                           | 10               |
| 820                                   | 142                           | 10               |
| 1000                                  | 160                           | 10               |

# Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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## General note

It is recommended to switch off  $V_{CC}$  with a gradient of 400 V/s at maximum to avoid plops on tape in the event of contact between tape and tape head while switching off.



## General note on AMS

The speed of tape at the tape head during FF, REW depends on the diameter of the tape on the spindle. Depending on this speed, the recorded signal occurs transformed in frequency and magnitude as a function of the original signal in playback mode speed. For example: A recorded pause of 3 s passes the tape head at its highest speed in 111 ms, e.g. during FF mode near tape end. This time constant of 111 ms corresponds to a pause of 1.3 s at the beginning of the tape in playback mode.

Thus a pause  $T$  is uniquely defined outside the interval  $1.3 \text{ s} < T < 3 \text{ s}$ . Inside this interval  $T$  will be recognized as a pause or not dependent on the local point of tape, respectively the speed of tape. Times of pauses described investigated for this document are valid for tape devices

with a speed of its spindle (FF, REW):  $\omega_r = 51 \frac{1}{s}$   
 respectively 12 to 27 times of the playback speed.

## Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

TEA0678

### Short description 'music search'

A system for 'music search' mainly consists of a level and a time detection (see Fig.4). For adapting and decoupling the input signal will be amplified (A), then rectified (B) and smoothed with a time constant (C). So the voltage at (C) corresponds to the signal level and will be compared to the predefined pause level at the first comparator (D), the level detector. If the signal level becomes smaller than the pause level, the level detector (D) changes its output signal. Due to the output level of the level detector the

capacitor of the second time constant (E) will be charged, respectively discharged. If the pause level of the input signal remains for a certain time, the voltage at the capacitor reaches a certain value, which corresponds to an equivalent time value due to the charging. The voltage at the capacitor will be compared to a predefined time-equivalent voltage by the second comparator (F), the time detector. If the pause level of the input signal remains for this predefined time, the time detector (F) changes its output level for 'pause found' status.

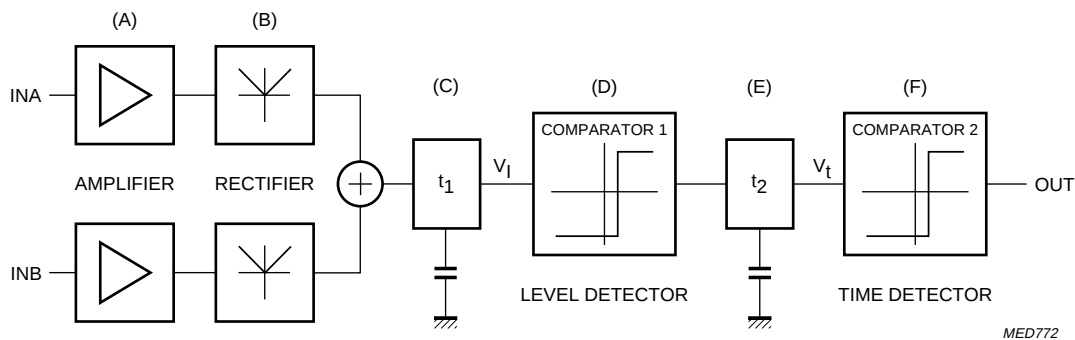


Fig.4 Integrated 'music search' function.

In this IC the signals of both channels are first rectified and then added. The signal behind the adder is described by  $V_{add} = |V_{chanA}| + |V_{chanB}|$ , where:

$|V_{chanA}|$ : absolute value channel A

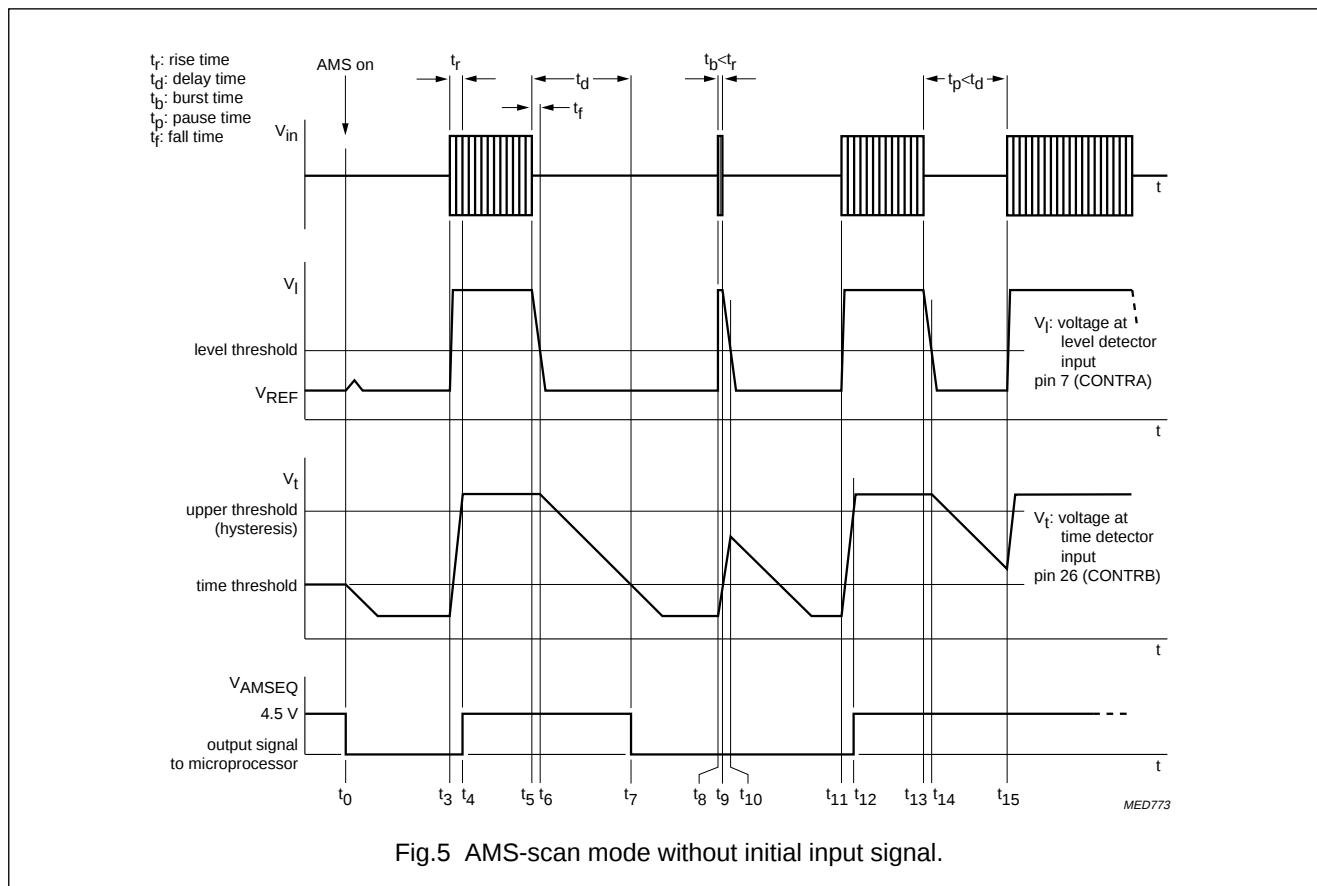
$|V_{chanB}|$ : absolute value channel B

This means, even if one channel signal appears phase shifted to the other channel (at worst cases inverted), the TEA0678 will ensure the normal AMS function.

# Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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Description of the principle timing diagram for AMS-scan mode without initial input signal (see Fig.5)



By activating AMS-scan mode, the AMS output level directly indicates whether the input level corresponds to a pause level ( $V_{AMSEQ} = \text{LOW}$ ) or not ( $V_{AMSEQ} = \text{HIGH}$ ). At  $t_0$  the AMS-scan mode is activated. Without a signal at  $V_{in}$ , the following initial procedure runs until the AMS output changes to LOW level: due to no signal at  $V_{in}$  the voltage at the level detector input  $V_l$  (pin 7, CONTRA) remains below the level threshold and the second time constant will be discharged (time detector input  $V_t$ ). When  $V_t$  passes the time threshold level, the time detector output changes to LOW level. Now the initial procedure is completed.

If a signal burst appears at  $t_3$ , the level detector input voltage rises immediately and causes its output to charge the second time constant, which supplies the input voltage  $V_t$  for the time detector. When  $V_t$  passes the upper

threshold level after the rise time  $t_r$  (at  $t_4$ ), the AMS output changes to HIGH. If the signal burst ends at  $t_5$  the level detector input  $V_l$  falls to its LOW level. When passing the level threshold at  $t_6$ , the discharging of the second time constant begins. Now the circuit measures the delay time  $t_d$ , which is externally fixed by a resistor and defines the length of a pause to be detected. If no signal appears at  $V_{in}$  within the time interval  $t_d$ , the time detector output switches the AMS output to LOW level at  $t_7$ .

If a pop noise pulse appears at  $V_{in}$  ( $t_8$ ) with a pulse width less than the rise time  $t_r > t_b$ , the pop noise will not be detected as music. The AMS output remains LOW.

Similarly the system handles 'no music pulses'  $t_p$ : when music appears at  $t_{11}$  with a small interruption at  $t_{13}$ , this interruption will not affect the AMS output for  $t_p < t_d$ .

# Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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Description of the principle timing diagram for AMS-scan mode with initial input signal (see Fig.6)

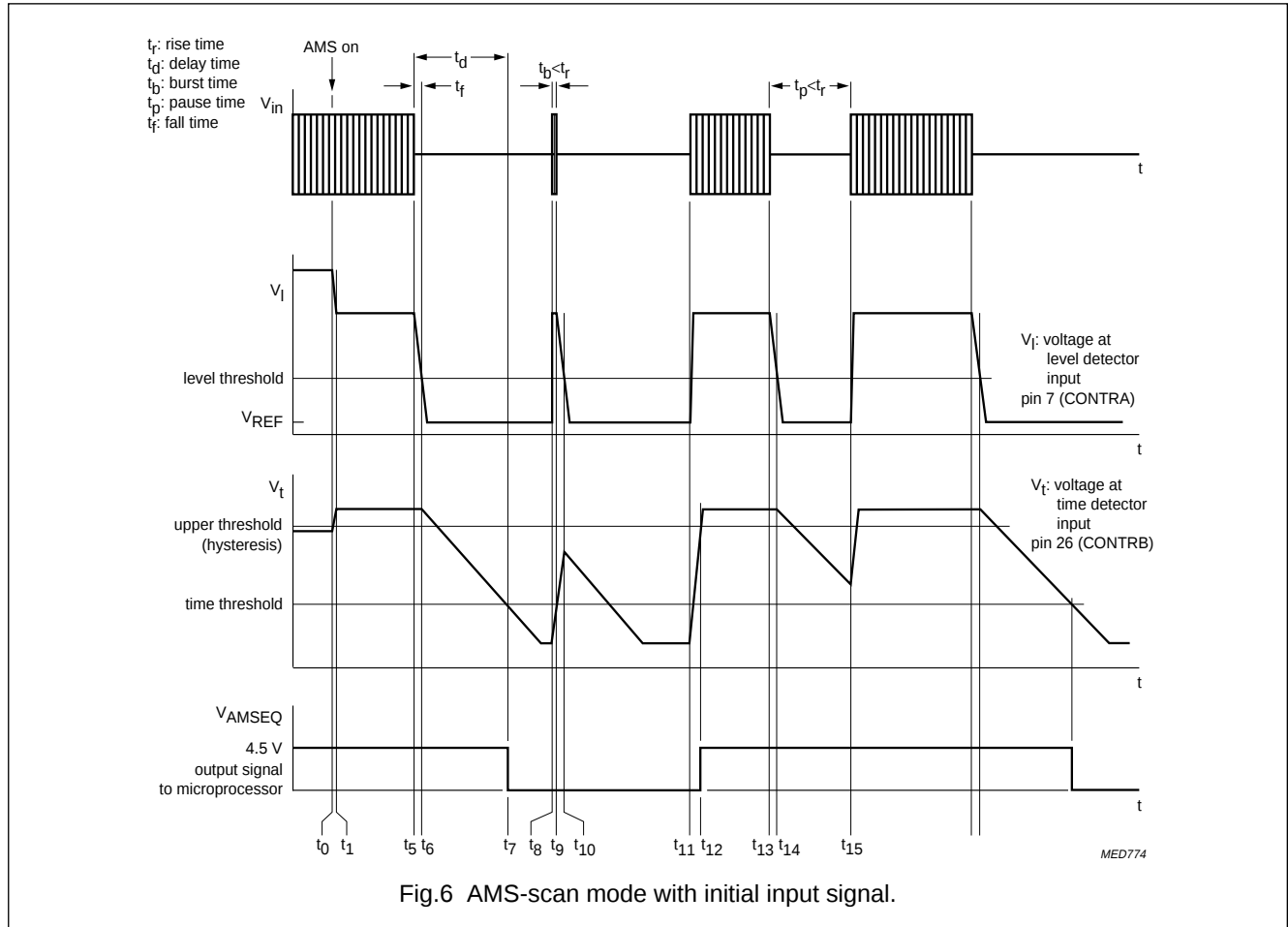


Fig.6 AMS-scan mode with initial input signal.

At  $t_0$  the AMS-scan mode is activated. With an input signal at  $V_{in}$ , the following initial procedure runs until the circuit gets a steady state status.

Due to the signal at  $V_{in}$  the voltage at the level detector input  $V_l$  (pin 7, CONTRA) slides to a value which is defined by a limiter. This voltage causes the level detector output charging the second time constant (time detector input  $V_t$ ) to its maximum voltage level at  $t_1$ . Now the initial procedure is completed.

The following behaviour does not differ from the description in Section "Description of the principle timing diagram for AMS-scan mode without initial input signal (see Fig.5)".

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## TEST AND APPLICATION INFORMATION

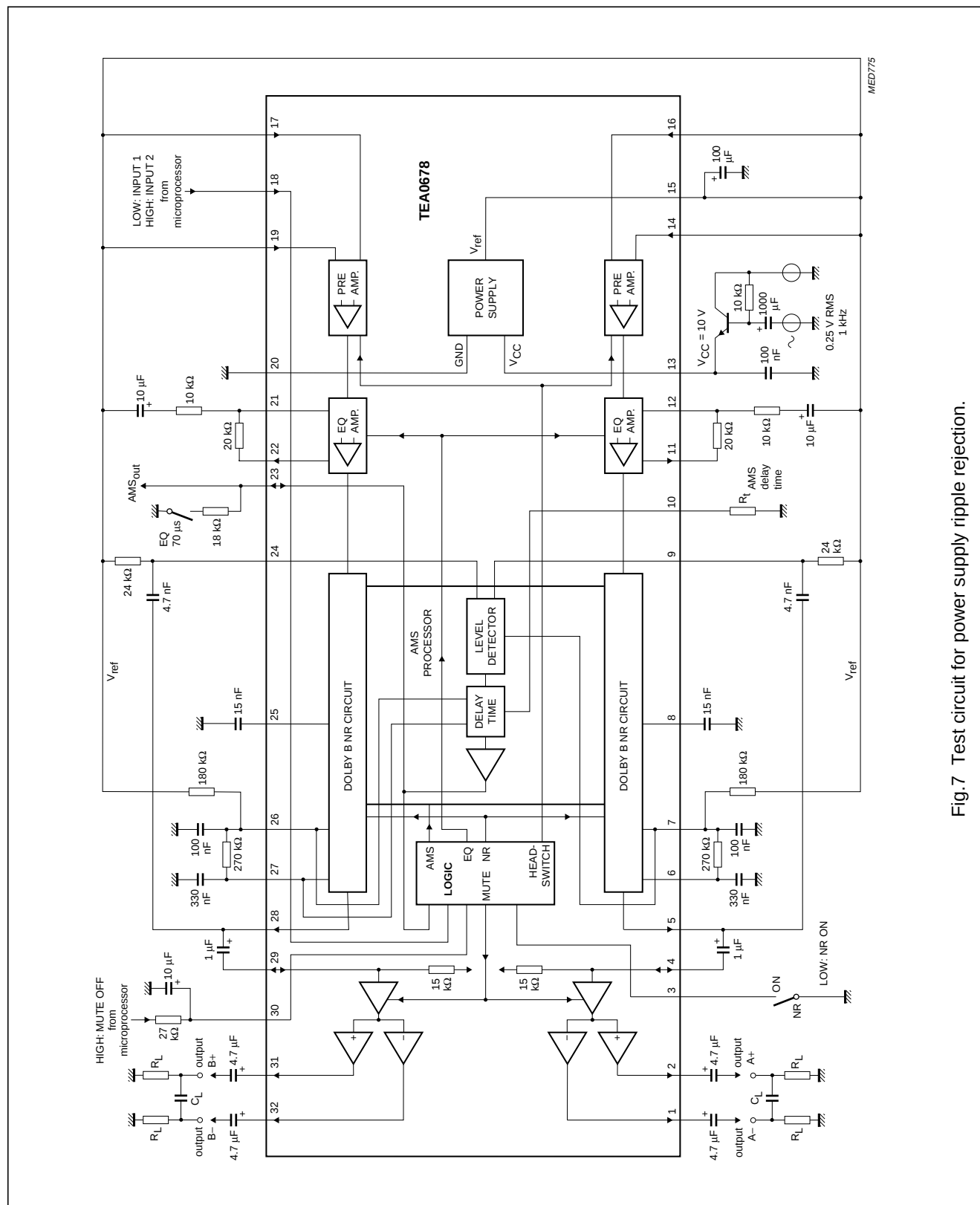


Fig. 7 Test circuit for power supply ripple rejection.

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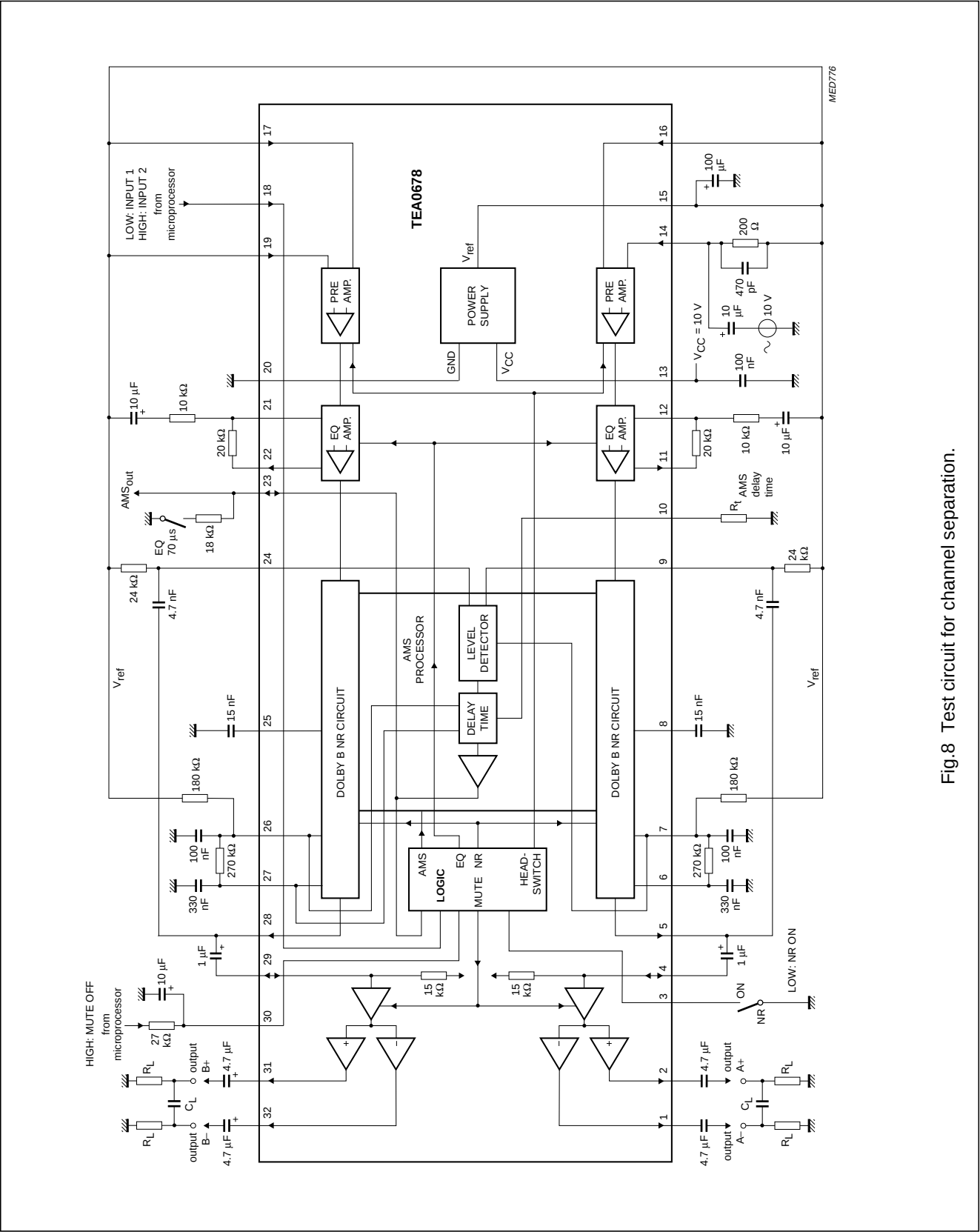


Fig.8 Test circuit for channel separation.

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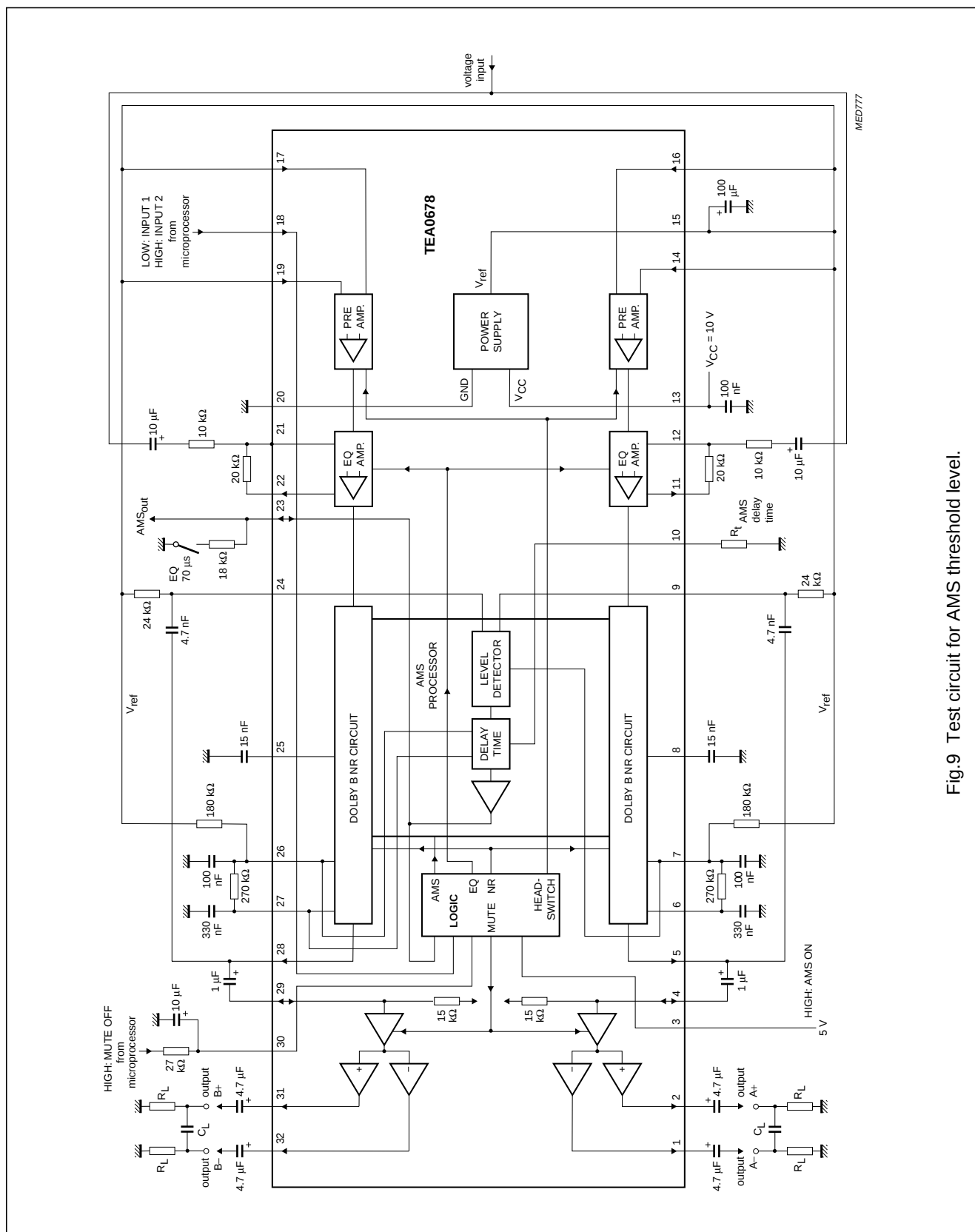


Fig.9 Test circuit for AMS threshold level.

## TEA0678

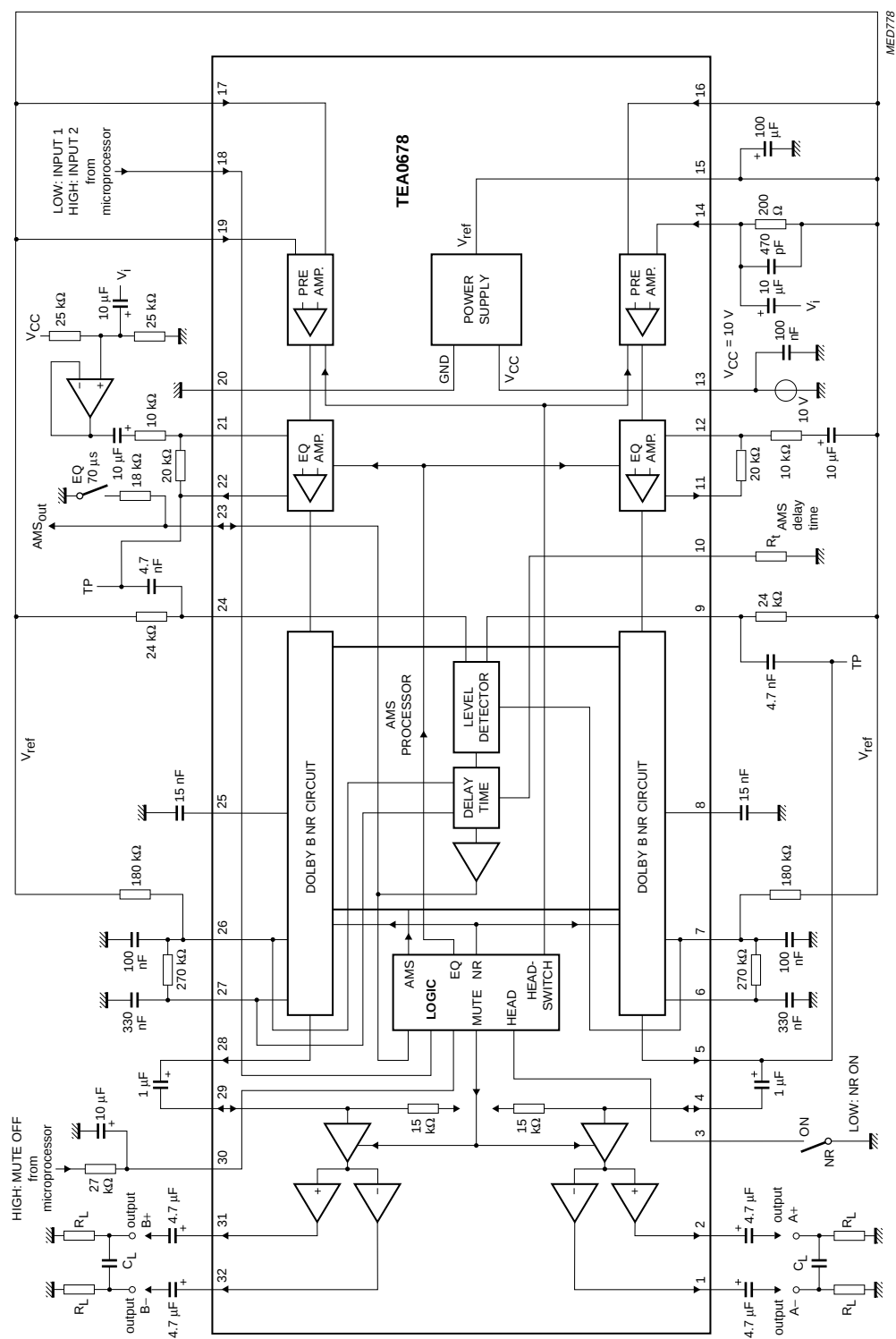


Fig.10 Test circuit for frequency response (channel B, encode mode).

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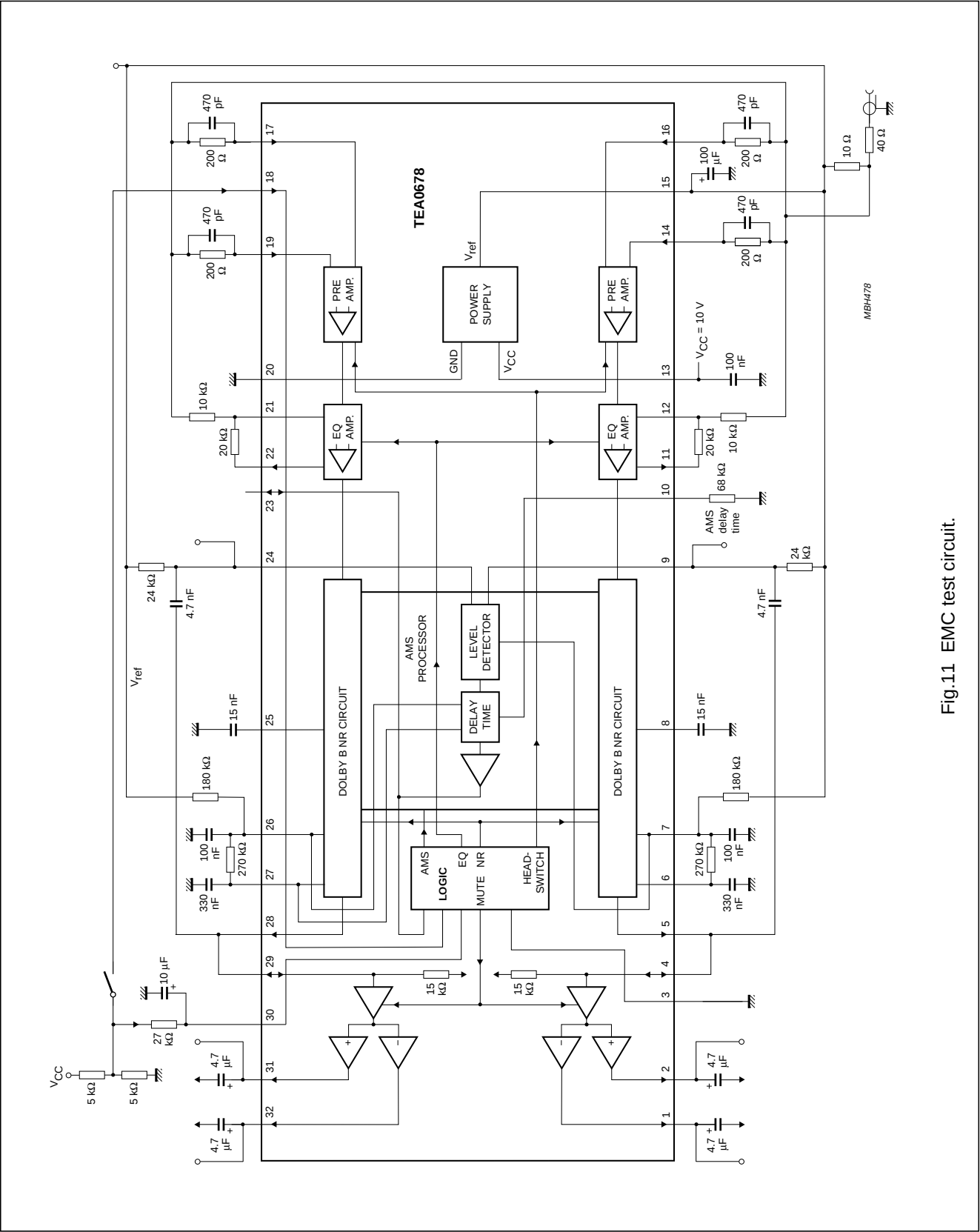


Fig.11 EMC test circuit.

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## LAYOUT OF PRINTED-CIRCUIT BOARD FOR EMC TEST CIRCUIT (FOR TEA0678T)

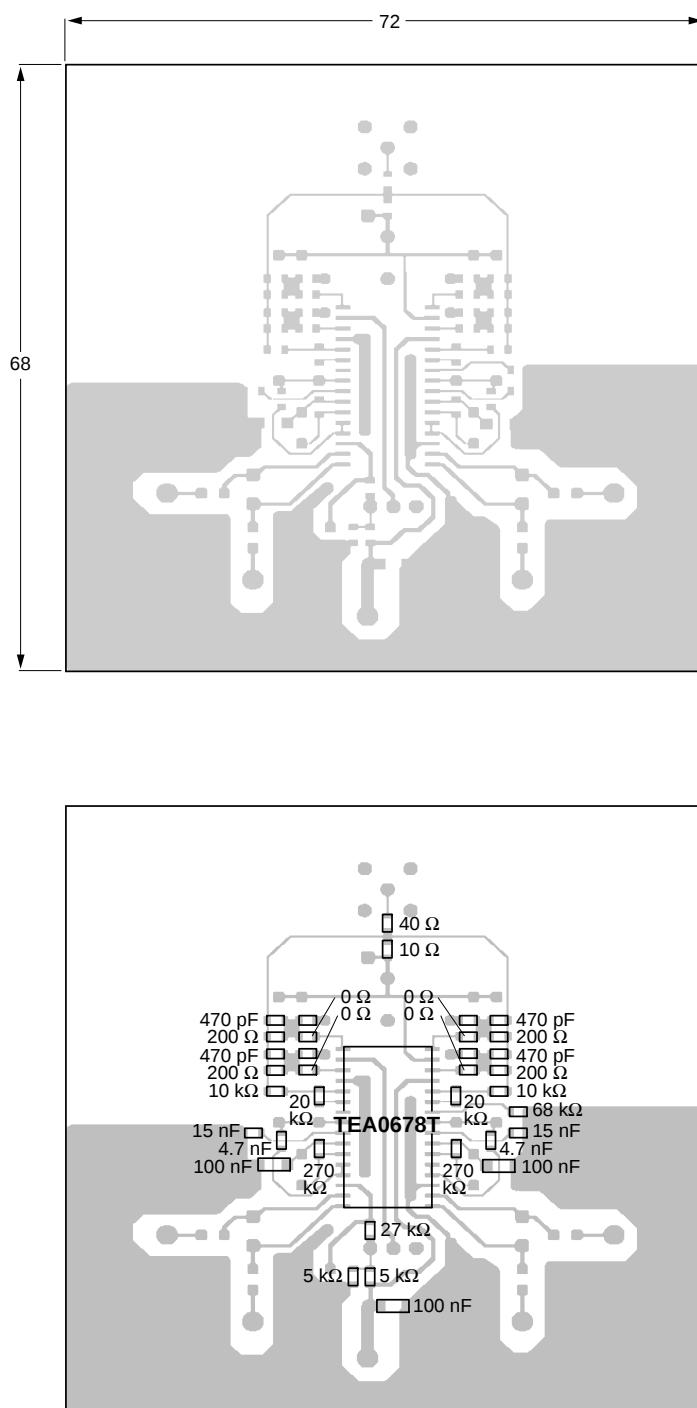
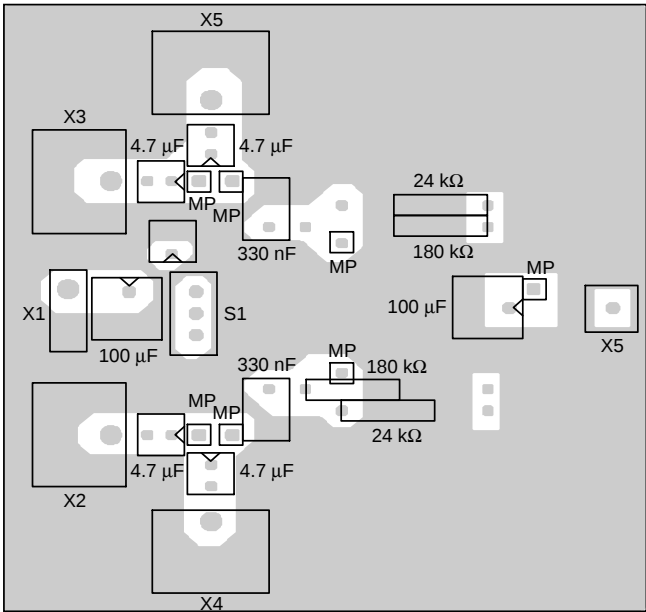
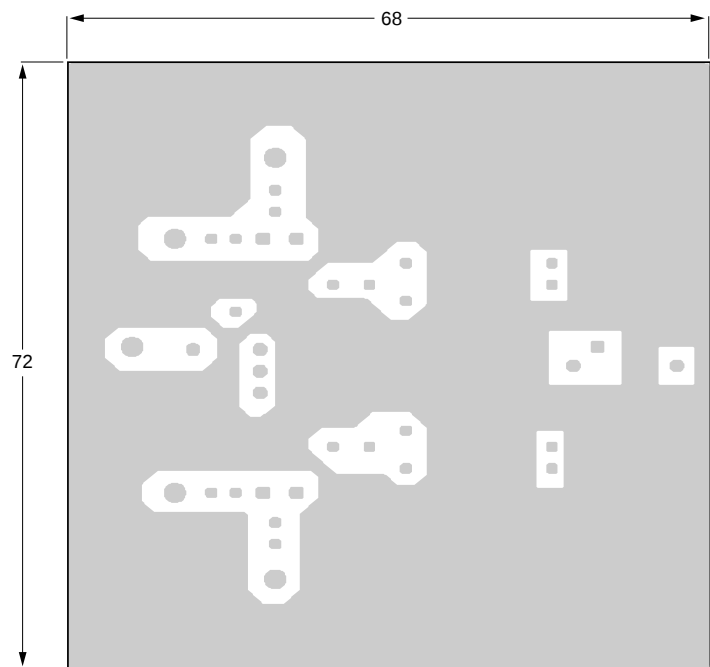


Fig.12 Top side with components.

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MBH461

Dimensions in mm.

Fig.13 Bottom side with components.

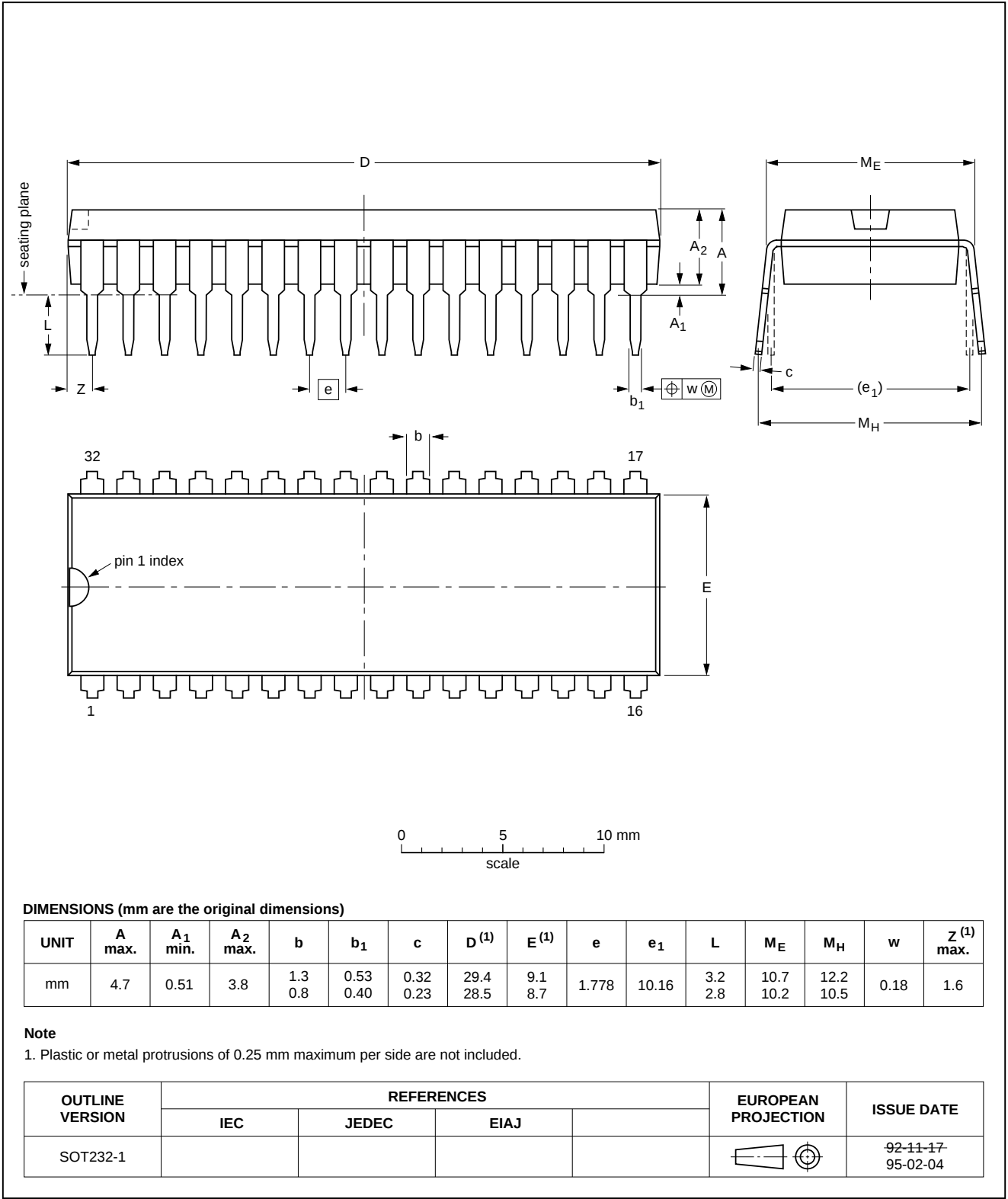
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PACKAGE OUTLINES

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

SOT232-1

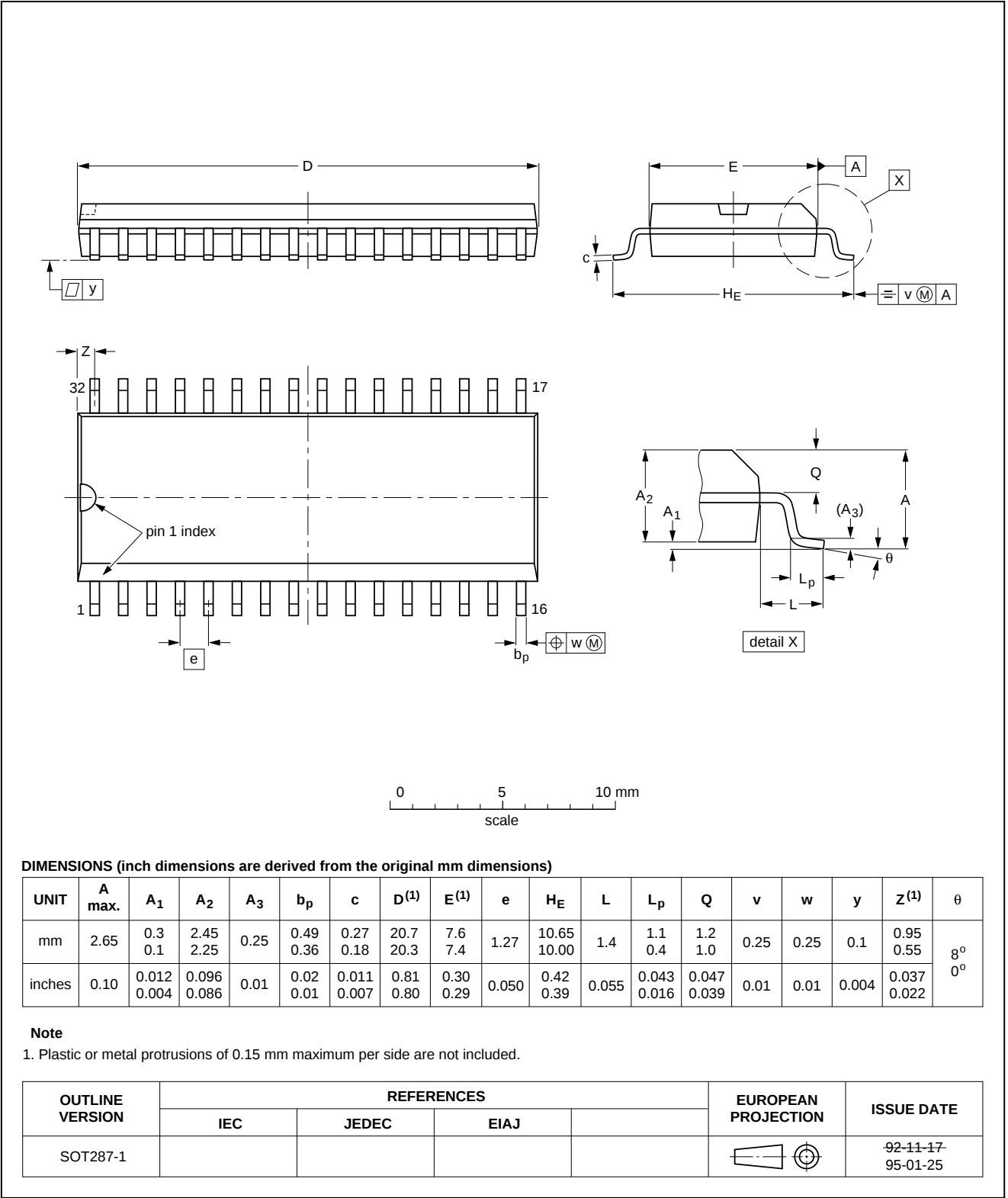


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SO32: plastic small outline package; 32 leads; body width 7.5 mm

SOT287-1



## Dual Dolby\* B-type noise reduction circuit, automatic music search, with differential outputs and mute

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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).

#### SDIP

##### 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.

#### SO

##### REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

##### WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

##### REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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**Dual Dolby\* B-type noise reduction circuit, automatic  
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**TEA0678****DEFINITIONS**

| <b>Data sheet status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 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.                                |
| <b>Limiting values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| 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. |                                                                                       |
| <b>Application information</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |

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**NOTES**

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