

# DATA SHEET

**TEA6360**

**5-band stereo equalizer circuit**

Preliminary specification  
File under Integrated Circuits, IC01

May 1991

## 5-band stereo equalizer circuit

TEA6360

## FEATURES

- Monolithic integrated 5-band stereo equalizer circuit
- Five filters for each channel
- Centre frequency, bandwidth and maximum boost/cut defined by external components
- Choice for variable or constant Q-factor via I<sup>2</sup>C software
- Defeat mode
- All stages are DC-coupled
- I<sup>2</sup>C-bus control for all functions
- Two different modul addresses programmable.



## GENERAL DESCRIPTION

The 5-band stereo equalizer is an I<sup>2</sup>C-bus controlled tone processor for application in car radio sets, TV sets and music centres. It offers the possibility of sound control as well as equalization of sound pressure behaviour of different rooms or loudspeakers, especially in cars.

## QUICK REFERENCE DATA

| SYMBOL            | PARAMETER                                               | MIN.     | TYP.                    | MAX. | UNIT |
|-------------------|---------------------------------------------------------|----------|-------------------------|------|------|
| V <sub>p</sub>    | supply voltage (pin 14)                                 | 7        | 8.5                     | 13.2 | V    |
| I <sub>p</sub>    | supply current                                          | –        | 24.5                    | –    | mA   |
| V <sub>1,32</sub> | input voltage range                                     | –        | 2.1 to V <sub>P-1</sub> | –    | V    |
| V <sub>o</sub>    | maximum output signal level (RMS value, pins 13 and 20) | –<br>1.1 |                         | –    | V    |
| G <sub>v</sub>    | total signal gain, all filters linear                   | –0.5     | –                       | 0    | dB   |
| B                 | –1 dB frequency response (linear)                       | 0 to 20  | –                       | –    | kHz  |
| T <sub>amb</sub>  | operating ambient temperature                           | –40      | –                       | 85   | °C   |

## ORDERING INFORMATION

| EXTENDED<br>TYPE NUMBER  | PACKAGE |              |          |        |
|--------------------------|---------|--------------|----------|--------|
|                          | PINS    | PIN POSITION | MATERIAL | CODE   |
| TEA6360 <sup>(1)</sup>   | 32      | shrink DIL   | plastic  | SOT232 |
| TEA6360/T <sup>(2)</sup> | 32      | mini-pack    | plastic  | SOT287 |

## Notes

1. SOT232; SOT232-1; 1996 August 08.
2. SOT287; SOT287-1; 1996 August 08.

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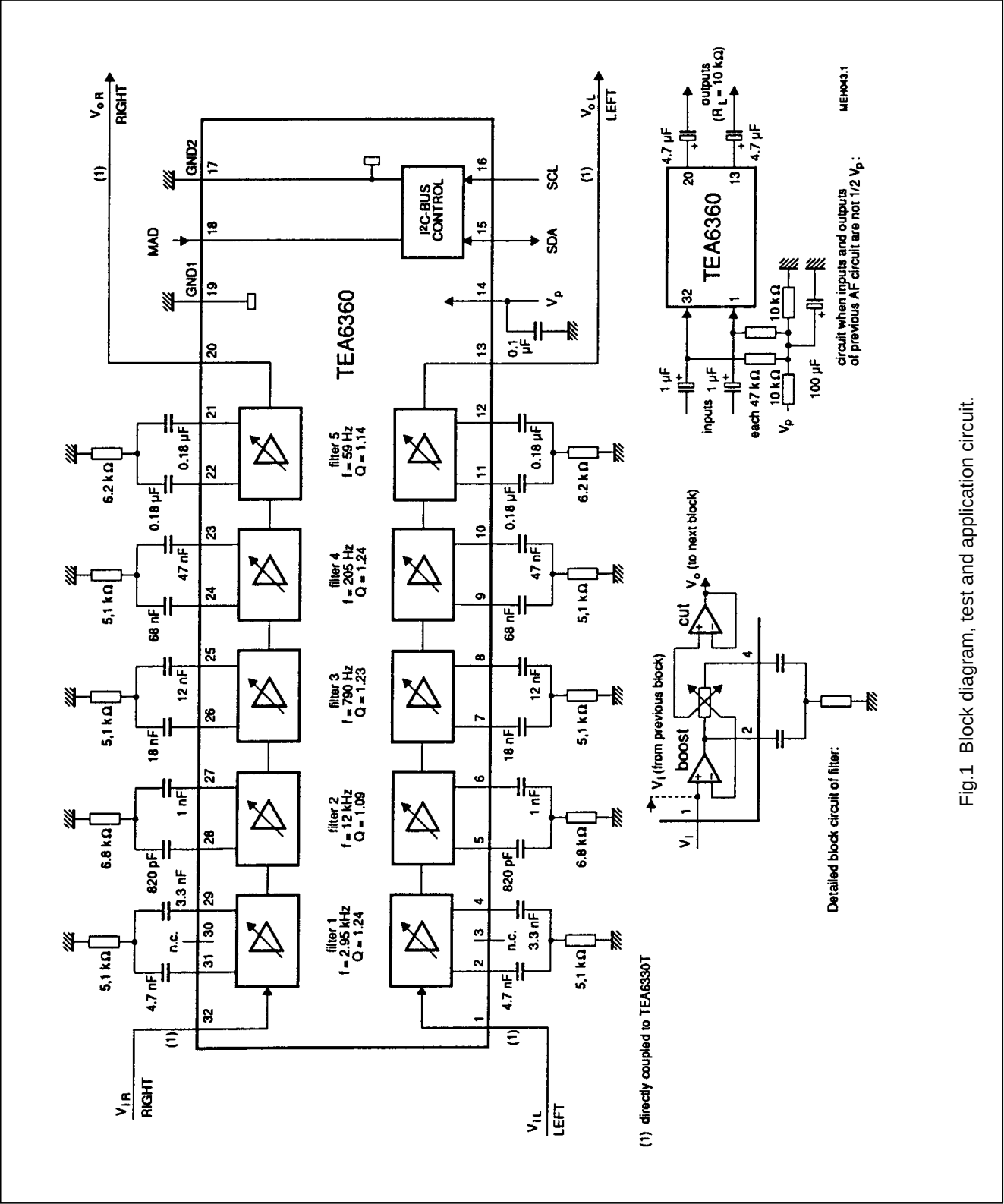


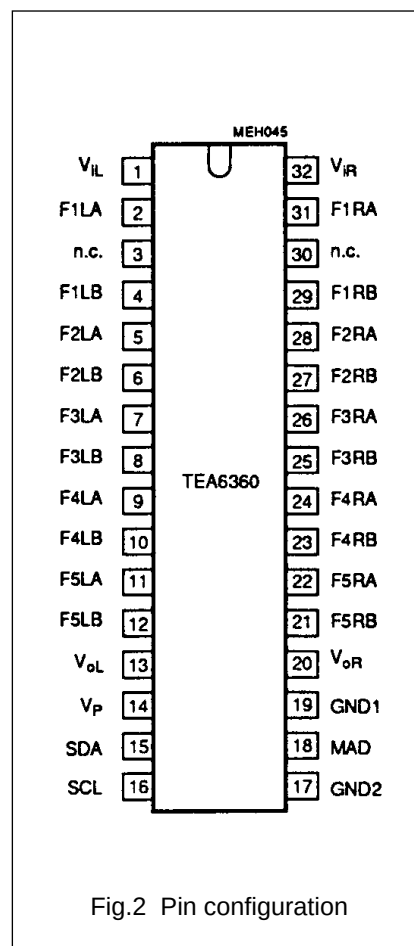
Fig.1 Block diagram, test and application circuit.

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## PINNING

| SYMBOL          | PIN | DESCRIPTION                                    |
|-----------------|-----|------------------------------------------------|
| V <sub>iL</sub> | 1   | audio frequency input LEFT                     |
| F1LA            | 2   | connection A for filter 1 LEFT (f = 2.95 kHz)  |
| n.c.            | 3   | not connected                                  |
| F1LB            | 4   | connection B for filter 1 LEFT (f = 2.95 kHz)  |
| F2LA            | 5   | connection A for filter 2 LEFT (f = 12 kHz)    |
| F2LB            | 6   | connection B for filter 2 LEFT (f = 12 kHz)    |
| F3LA            | 7   | connection A for filter 3 LEFT (f = 790 Hz)    |
| F3LB            | 8   | connection B for filter 3 LEFT (f = 790 Hz)    |
| F4LA            | 9   | connection A for filter 4 LEFT (f = 205 Hz)    |
| F4LB            | 10  | connection B for filter 4 LEFT (f = 205 Hz)    |
| F5LA            | 11  | connection A for filter 5 LEFT (f = 59 Hz)     |
| F5LB            | 12  | connection B for filter 5 LEFT (f = 59 Hz)     |
| V <sub>oL</sub> | 13  | audio frequency output LEFT                    |
| V <sub>P</sub>  | 14  | supply voltage (+8.5 V)                        |
| SDA             | 15  | I <sup>2</sup> C-bus data line                 |
| SCL             | 16  | I <sup>2</sup> C-bus clock line                |
| GND2            | 17  | ground 2 (I <sup>2</sup> C-bus ground)         |
| MAD             | 18  | modul address                                  |
| GND1            | 19  | ground 1 (analog ground)                       |
| V <sub>oR</sub> | 20  | audio frequency output RIGHT                   |
| F5RB            | 21  | connection B for filter 5 RIGHT (f = 59 Hz)    |
| F5RA            | 22  | connection A for filter 5 RIGHT (f = 59 Hz)    |
| F4RB            | 23  | connection B for filter 4 RIGHT (f = 205 Hz)   |
| F4RA            | 24  | connection A for filter 4 RIGHT (f = 205 Hz)   |
| F3RB            | 25  | connection B for filter 3 RIGHT (f = 790 Hz)   |
| F3RA            | 26  | connection A for filter 3 RIGHT (f = 790 Hz)   |
| F2RB            | 27  | connection B for filter 2 RIGHT (f = 12 kHz)   |
| F2RA            | 28  | connection A for filter 2 RIGHT (f = 12 kHz)   |
| F1RB            | 29  | connection B for filter 1 RIGHT (f = 2.95 kHz) |
| n.c.            | 30  | not connected                                  |
| F1RA            | 31  | connection A for filter 1 RIGHT (f = 2.95 kHz) |
| V <sub>iR</sub> | 32  | audio frequency input RIGHT                    |



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**FUNCTIONAL DESCRIPTION**

The TEA6360 is performed with two stereo channels (RIGHT and LEFT), each one consists of five equal filter amplifiers (Fig.1).

The centre frequencies for the different filters as well as the bandwidth and the control ranges for boost and cut depend on the external components. Each filter can have different external components but for one definite pair of filters the centre frequency as well as the control range for boost and cut are the same. That means, they have symmetrical curves for boost and cut.

The control range (maximum value in dB) is divided into five steps and one extra step for the linear position.

At maximum gain of 12 dB the typical step resolution is 2.4 dB. The internal resistor chain of each filter amplifier is optimized for 12 dB maximum gain. Therefore the typical gain factors for 15 dB application are as follows:

|        |   |      |    |
|--------|---|------|----|
| step 1 | = | 2.7  | dB |
| step 2 | = | 5.5  | dB |
| step 3 | = | 8.4  | dB |
| step 4 | = | 11.6 | dB |
| step 5 | = | 15.0 | dB |

The control of the different filters is obtained by selecting the appropriate subaddress byte (Table 1).

**LIMITING VALUES**

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

Ground pins 19, 28 and 43 connected together.

| SYMBOL    | PARAMETER                                          | MIN. | MAX.  | UNIT |
|-----------|----------------------------------------------------|------|-------|------|
| $V_P$     | supply voltage (pin 14)                            | 0    | 13.2  | V    |
| $V_n$     | voltage on all pins, grounds excluded              | 0    | $V_P$ | V    |
| $P_{tot}$ | total power dissipation                            | 0    | 500   | mW   |
| $T_{stg}$ | storage temperature range                          | -40  | 150   | °C   |
|           | storage temperature range                          | -40  | 150   | °C   |
| $T_{amb}$ | operating ambient temperature range                | -40  | 85    | °C   |
| $V_{ESD}$ | electrostatic handling <sup>(1)</sup> for all pins |      | ±500  | V    |

**Note**

1. Equivalent to discharging a 200 pF capacitor through a 0  $\Omega$  series resistor.

The position of the filter in the left channel and that in the right channel is always the same (stereo).

The position of the boost part and the cut part is independently controllable (Tables 2 and 3).

The quality factor of the filter has its maximum in the maximum position (steps 5), if boost (cut on step 0) or cut (boost on step 0) is used. The quality factor decreases also with the step number (variable quality factor).

In this mode the control pattern are according to Table 4.

A different control is necessary to achieve a constant quality factor over the whole control range. For boost with a constant quality factor over the boost range position +5 is selected and boost control is then performed using cut. This control technique is applied to the cut range with position -5 selected and the boost is varied (Table 5).

The cut part has to follow the boost part in each filter for economic reasons. So the signal is first amplified and then attenuated. This has to be taken into account for the internal level diagram in case of constant quality factor.

This may result in a mode between constant Q and non-constant Q mode; for example for the position +2 it is not necessary to amplify by step +5 and then attenuate by -3 step. The combination of step +4 and step -2 to reach position +2 is a good result (quasi constant quality factor, Table 6).

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## CHARACTERISTICS

$V_P = 8.5\text{ V}$ ;  $f_i = 1\text{ kHz}$  ( $R_S = 600\ \Omega$ ),  $R_L = 10\text{ k}\Omega$ ,  $T_{amb} = 25\text{ }^\circ\text{C}$  and measurements taken in Fig.1, unless otherwise specified.

| SYMBOL             | PARAMETER                                                  | CONDITIONS                                                                | MIN.                        | TYP.         | MAX.   | UNIT     |
|--------------------|------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------|--------------|--------|----------|
| V <sub>P</sub>     | supply voltage. range (pin 14)                             |                                                                           | 7                           | 8.5          | 13.2   | V        |
| I <sub>P</sub>     | supply current (pin 14)                                    | V <sub>P</sub> = 8.5 V<br>V <sub>P</sub> = 12 V                           | –<br>–                      | 25.5<br>26.0 | –<br>– | mA<br>mA |
| Analog part        |                                                            |                                                                           |                             |              |        |          |
| R <sub>i</sub>     | input resistor (pins 1 and 32)                             |                                                                           | 1                           | –            | –      | MΩ       |
| V <sub>1,32</sub>  | input voltage range at any stage                           |                                                                           | 2.1 to<br>V <sub>P</sub> –1 | –            | –      | V        |
| V <sub>13,20</sub> | output voltage range at any stage                          |                                                                           | 1.0 to<br>V <sub>P</sub> –1 | –            | –      | V        |
| V <sub>o</sub>     | output signal level (RMS value, pins 13 and 20)            | control range 0 to +5,<br>variable Q-factor or<br>quasi constant Q-factor | 1.1                         | –            | –      | V        |
| R <sub>o</sub>     | output resistor (pins 13 and 20)                           |                                                                           | –                           | 100          | –      | Ω        |
| R <sub>L</sub>     | admissible load resistance at outputs<br>(pins 13 and 20)  |                                                                           | 2                           | –            | –      | kΩ       |
| C <sub>L</sub>     | admissible load capacitance at outputs<br>(pins 13 and 20) |                                                                           | –                           | –            | 2.5    | nF       |
| G <sub>v</sub>     | total signal gain (G = V <sub>o</sub> / V <sub>i</sub> )   | all filters linear                                                        | –0.5                        | –            | 0      | dB       |
| B                  | frequency response                                         | all filters linear, roll off<br>frequency for –1 dB<br>(DC-coupled)       |                             |              |        |          |
|                    | minimum value                                              |                                                                           | 0                           | –            | –      | Hz       |
|                    | maximum value                                              |                                                                           | 20                          | –            | –      | kHz      |
| α <sub>Cr</sub>    | crosstalk attenuation between channels                     | f = 250 to 10000 Hz                                                       |                             |              |        |          |
|                    | all filters linear                                         |                                                                           | 60                          | 75           | –      | dB       |
|                    | all filters maximum boost                                  |                                                                           | 55                          | –            | –      | dB       |
|                    | all filters maximum cut                                    |                                                                           | 55                          | –            | –      | dB       |
| THD                | distortion (pins 13 and 20)                                | f = 20 to 12500 Hz<br>V <sub>P</sub> = 8.5 to 12 V                        |                             |              |        |          |
|                    | V <sub>o (rms)</sub> = 1.1 V                               | all filters linear                                                        | –                           | 0.2          | 0.5    | %        |
|                    | V <sub>o (rms)</sub> = 0.1 V                               | all filters linear                                                        | –                           | 0.05         | 0.2    | %        |
|                    | V <sub>o (rms)</sub> = 1.1 V                               | all filters max. boost                                                    | –                           | 0.5          | 1.0    | %        |
|                    | V <sub>o (rms)</sub> = 0.1 V                               | all filters max. boost                                                    | –                           | 0.1          | 0.3    | %        |
|                    | V <sub>o (rms)</sub> = 0.1 V                               | all filters maximum cut                                                   | –                           | 0.2          | 0.5    | %        |
|                    | V <sub>o (rms)</sub> = 1 V                                 | all filters max. boost                                                    | –                           | –            | 0.35   | %        |
|                    |                                                            | f = 1 kHz                                                                 | –                           | –            | 0.35   | %        |

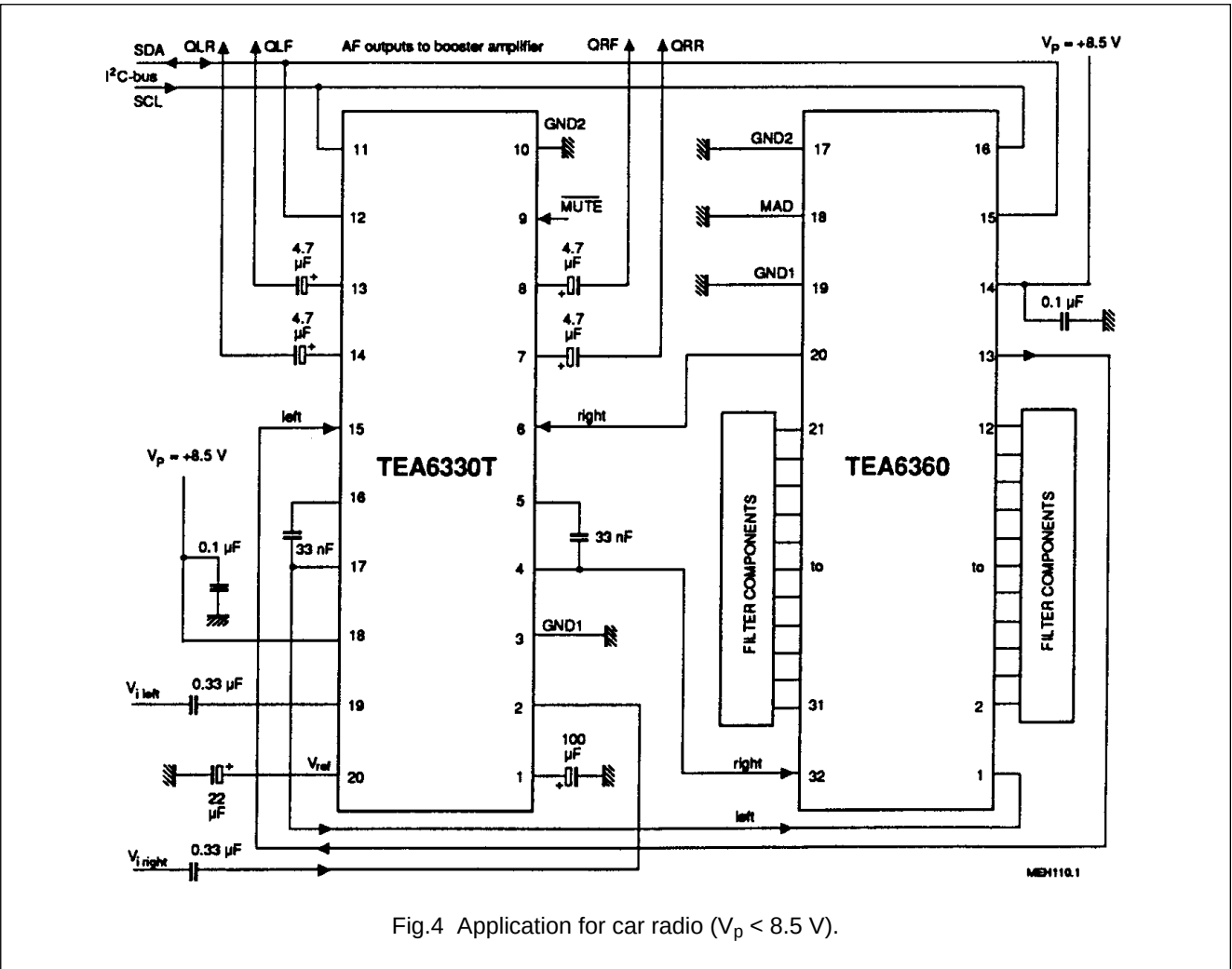
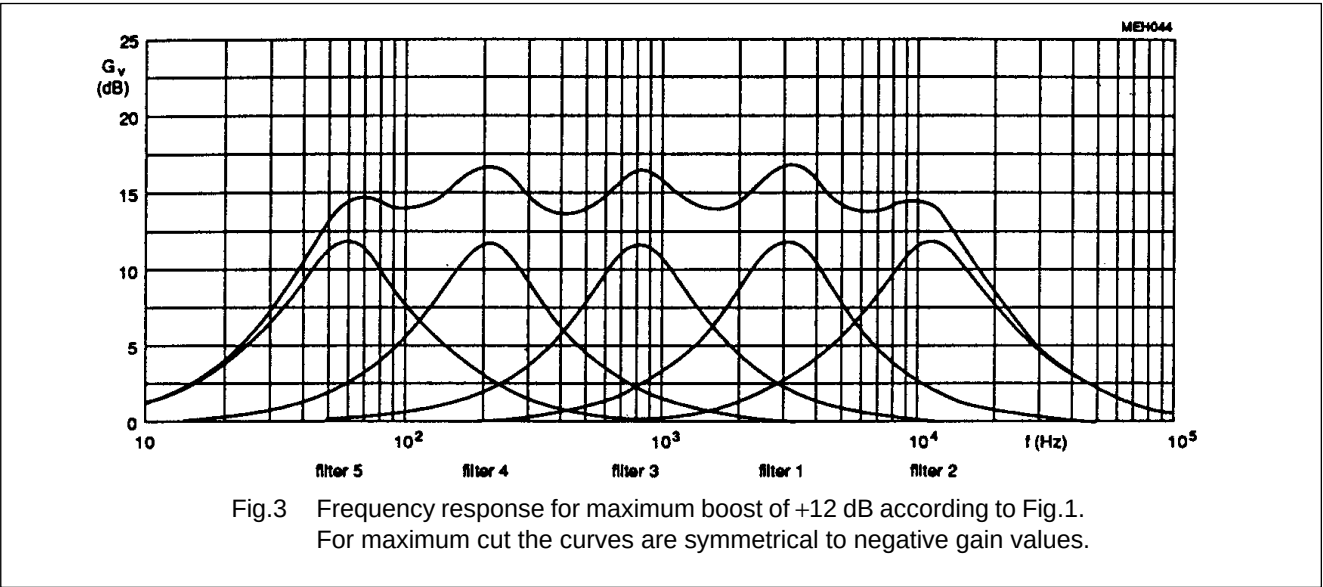
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| SYMBOL                                                                                                                       | PARAMETER                                                                                              | CONDITIONS                                  | MIN. | TYP. | MAX.           | UNIT |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------|------|------|----------------|------|
| V <sub>N</sub>                                                                                                               | weighted output noise voltage<br>(RMS value)                                                           | CCIR 468-3, maximum<br>gain/filter of 12 dB |      |      |                |      |
|                                                                                                                              | defeat mode                                                                                            |                                             | –    | 8    | 16             | μV   |
|                                                                                                                              | all filters linear                                                                                     |                                             | –    | 23   | 46             | μV   |
|                                                                                                                              | all filters maximum boost                                                                              |                                             | –    | 70   | 140            | μV   |
|                                                                                                                              | all filters maximum cut                                                                                |                                             | –    | 23   | 46             | μV   |
| α <sub>Cr</sub>                                                                                                              | crosstalk between bus inputs and signal<br>outputs, 20 log (V <sub>bus</sub> (p-p)/V <sub>o</sub> rms) | all filters linear                          | –    | 120  | –              | dB   |
| RR                                                                                                                           | ripple rejection at V <sub>ripple</sub> rms < 200 mV<br>for f = 100 Hz                                 | all filters linear                          | –    | 70   | –              | dB   |
|                                                                                                                              | for f = 40 to 12500 Hz                                                                                 |                                             | –    | 60   | –              | dB   |
|                                                                                                                              |                                                                                                        |                                             |      |      |                |      |
| Internal filters of analog part                                                                                              |                                                                                                        |                                             |      |      |                |      |
| Q                                                                                                                            | Q-factor dependent on maximum gain                                                                     |                                             |      |      |                |      |
|                                                                                                                              | maximum gain 10 dB                                                                                     |                                             | 0.1  | –    | 1.2            |      |
|                                                                                                                              | maximum gain 12 dB                                                                                     |                                             | 0.1  | –    | 1.4            |      |
|                                                                                                                              | maximum gain 15 dB                                                                                     |                                             | 0.1  | –    | 1.8            |      |
| R <sub>tot</sub>                                                                                                             | total resistor of different filter sections                                                            |                                             | 29.6 | 37.0 | 44.4           | kΩ   |
| ΔR <sub>tot</sub>                                                                                                            | tolerance between any filter section                                                                   |                                             | –    | –    | ± 4            | %    |
| Internal controls of analog part via I <sup>2</sup> C-bus                                                                    |                                                                                                        |                                             |      |      |                |      |
| Step                                                                                                                         | number of steps for boost or for cut                                                                   | maximum gain 12 dB                          | –    | 5    | –              |      |
|                                                                                                                              | position for linear                                                                                    |                                             | –    | 1    | –              |      |
|                                                                                                                              | step resolution                                                                                        |                                             | –    | 2.4  | –              | dB   |
|                                                                                                                              | step set error                                                                                         |                                             | –    | 0.5  | –              | dB   |
| ΔV <sub>o</sub>                                                                                                              | DC offset between any step or<br>neighbouring step or defeat                                           |                                             | –    | –    | ±10            | mV   |
| I <sup>2</sup> C-bus control SDA and SCL (pins 15 and 16)                                                                    |                                                                                                        |                                             |      |      |                |      |
| V <sub>IH</sub>                                                                                                              | input level HIGH                                                                                       |                                             | 3    | –    | V <sub>P</sub> | V    |
| V <sub>IL</sub>                                                                                                              | input level LOW                                                                                        |                                             | 0    | –    | 1.5            | V    |
| I <sub>I</sub>                                                                                                               | input current                                                                                          |                                             | –    | –    | ±10            | μA   |
| V <sub>ACK</sub>                                                                                                             | acknowledge voltage on SDA                                                                             | I <sub>15</sub> = 3 mA at LOW               | –    | –    | 0.4            | V    |
| Module address bit (pin 18)                                                                                                  |                                                                                                        |                                             |      |      |                |      |
| V <sub>IH</sub>                                                                                                              | input level HIGH for address 1000 0110                                                                 |                                             | 3    | –    | V <sub>P</sub> | V    |
| V <sub>IL</sub>                                                                                                              | input level LOW for address 1000 0100                                                                  |                                             | 0    | –    | 1.5            | V    |
| I <sub>I</sub>                                                                                                               | input current                                                                                          |                                             | –    | –    | ±10            | μA   |
| Power on reset: When reset is active the DEF-bit (defeat) is set and the I <sup>2</sup> C-bus receiver is in reset position. |                                                                                                        |                                             |      |      |                |      |
| RESET                                                                                                                        | start of reset                                                                                         | increasing V <sub>P</sub>                   | –    | –    | 2.5            | V    |
|                                                                                                                              |                                                                                                        | decreasing V <sub>P</sub>                   | 4.2  | 5.0  | 5.8            | V    |
|                                                                                                                              | end of reset                                                                                           | increasing V <sub>P</sub>                   | 5.2  | 6.0  | 6.8            | V    |

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I<sup>2</sup>C-BUS PROTOCOLI<sup>2</sup>C-bus format

| S | SLAVE ADDRESS | A | SUBADDRESS | A | DATA | P |
|---|---------------|---|------------|---|------|---|
|---|---------------|---|------------|---|------|---|

|               |   |                                                                                                        |
|---------------|---|--------------------------------------------------------------------------------------------------------|
| S             | = | start condition                                                                                        |
| SLAVE ADDRESS | = | <b>1000 0100</b> when pin 18 is set LOW<br>or <b>1000 0110</b> when pin 18 is set HIGH or open-circuit |
| A             | = | acknowledge, generated by the slave                                                                    |
| SUBADDRESS    | = | subaddress byte, see Table 1                                                                           |
| DATA          | = | data byte, see Table 1                                                                                 |
| P             | = | stop condition                                                                                         |

If more than 1 byte DATA are transmitted, then auto-increment of the subaddress is performed.

## Byte organisation

Table 1 I<sup>2</sup>C-bus transmission

| FUNCTION        | SUBADDRESS BYTE | DATA BYTE |     |     |     |    |     |     |     |
|-----------------|-----------------|-----------|-----|-----|-----|----|-----|-----|-----|
|                 |                 | D7        | D6  | D5  | D4  | D3 | D2  | D1  | D0  |
| filter 1/defeat | 0 0 0 0 0 0 0 0 | DEF       | 1B2 | 1B1 | 1B0 | 0  | 1C2 | 1C1 | 1C0 |
| filter 2        | 0 0 0 0 0 0 0 1 | 0         | 2B2 | 2B1 | 2B0 | 0  | 2C2 | 2C1 | 2C0 |
| filter 3        | 0 0 0 0 0 0 1 0 | 0         | 3B2 | 3B1 | 3B0 | 0  | 3C2 | 3C1 | 3C0 |
| filter 4        | 0 0 0 0 0 0 1 1 | 0         | 4B2 | 4B1 | 4B0 | 0  | 4C2 | 4C1 | 4C0 |
| filter 5        | 0 0 0 0 0 1 0 0 | 0         | 5B2 | 5B1 | 5B0 | 0  | 5C2 | 5C1 | 5C0 |

## Function of the bits of Table 1:

1B0 to 1B2 boost control for filter 1

1B0 to 1B2 cut control for filter 1

2B0 to 2B2 boost control for filter 2

2B0 to 2B2 cut control for filter 2

3B0 to 3B2 boost control for filter 3

3B0 to 3B2 cut control for filter 3

4B0 to 4B2 boost control for filter 4

4B0 to 4B2 cut control for filter 4

5B0 to 5B2 boost control for filter 5

5B0 to 5B2 cut control for filter 5

DEF DEF = 0 (defeat bit): All filters operating.

DEF = 1: Linear frequency response, input is directly connected to the output of the output amplifier. The filter settings are stored but the internal amplification is controlled to 0 dB, independent on bits nB2 to nB0.

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**Table 2** Boost control for filter n

| DATA     |                 |     |     |     |
|----------|-----------------|-----|-----|-----|
| POSITION |                 | nB2 | nB1 | nB0 |
| step 0   | (no boost)      | 0   | 0   | 0   |
| step 1   |                 | 0   | 0   | 1   |
| step 2   |                 | 0   | 1   | 0   |
| step 3   |                 | 0   | 1   | 1   |
| step 4   |                 | 1   | 0   | 0   |
| step 5   | (maximum boost) | 1   | 0   | 1   |
| step 5   | (maximum boost) | 1   | 1   | 0   |
| step 5   | (maximum boost) | 1   | 1   | 1   |

**Table 3** Cut control for filter n

| DATA     |               |     |     |     |
|----------|---------------|-----|-----|-----|
| POSITION |               | nB2 | nB1 | nB0 |
| step 0   | (no cut)      | 0   | 0   | 0   |
| step 1   |               | 0   | 0   | 1   |
| step 2   |               | 0   | 1   | 0   |
| step 3   |               | 0   | 1   | 1   |
| step 4   |               | 1   | 0   | 0   |
| step 5   | (maximum cut) | 1   | 0   | 1   |
| step 5   | (maximum cut) | 1   | 1   | 0   |
| step 5   | (maximum cut) | 1   | 1   | 1   |

**Table 4** Filter control with variable quality factor

| POSITION |                 | D7<br>X | D6<br>nB2 | D5<br>nB1 | D4<br>nB0 | D3<br>X | D2<br>nC2 | D1<br>nC1 | D0<br>nC0 | COMMENT |   |      |      |
|----------|-----------------|---------|-----------|-----------|-----------|---------|-----------|-----------|-----------|---------|---|------|------|
| +5       | (maximum boost) | 0       | 1         | 0         | 1         | 0       | 0         | 0         | 0         | (+5)    | + | (-0) | = +5 |
| +4       |                 | 0       | 1         | 0         | 0         | 0       | 0         | 0         | 0         | (+4)    | + | (-0) | = +4 |
| +3       |                 | 0       | 0         | 1         | 1         | 0       | 0         | 0         | 0         | (+3)    | + | (-0) | = +3 |
| +2       |                 | 0       | 0         | 1         | 0         | 0       | 0         | 0         | 0         | (+2)    | + | (-0) | = +2 |
| +1       |                 | 0       | 0         | 0         | 1         | 0       | 0         | 0         | 0         | (+1)    | + | (-0) | = +1 |
| 0        | (linear)        | 0       | 0         | 0         | 0         | 0       | 0         | 0         | 0         | (+0)    | + | (-0) | = 0  |
| -1       |                 | 0       | 0         | 0         | 0         | 0       | 0         | 0         | 1         | (+0)    | + | (-1) | = -1 |
| -2       |                 | 0       | 0         | 0         | 0         | 0       | 0         | 1         | 0         | (+0)    | + | (-2) | = -2 |
| -3       |                 | 0       | 0         | 0         | 0         | 0       | 0         | 1         | 1         | (+0)    | + | (-3) | = -3 |
| -4       |                 | 0       | 0         | 0         | 0         | 0       | 1         | 0         | 0         | (+0)    | + | (-4) | = -4 |
| -5       | (maximum cut)   | 0       | 0         | 0         | 0         | 0       | 1         | 0         | 1         | (+0)    | + | (-5) | = -5 |

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**Table 5** Filter control with constant quality factor

| POSITION |                 | D7<br>X | D6<br>nB2 | D5<br>nB1 | D4<br>nB0 | D3<br>X | D2<br>nC2 | D1<br>nC1 | D0<br>nC0 | COMMENT |   |      |      |
|----------|-----------------|---------|-----------|-----------|-----------|---------|-----------|-----------|-----------|---------|---|------|------|
| +5       | (maximum boost) | 0       | 1         | 0         | 1         | 0       | 0         | 0         | 0         | (+5)    | + | (-0) | = +5 |
| +4       |                 | 0       | 1         | 0         | 1         | 0       | 0         | 0         | 1         | (+5)    | + | (-1) | = +4 |
| +3       |                 | 0       | 1         | 0         | 1         | 0       | 0         | 1         | 0         | (+5)    | + | (-2) | = +3 |
| +2       |                 | 0       | 1         | 0         | 1         | 0       | 0         | 1         | 1         | (+5)    | + | (-3) | = +2 |
| +1       |                 | 0       | 1         | 0         | 1         | 0       | 1         | 0         | 0         | (+5)    | + | (-4) | = +1 |
| 0        | (linear)        | 0       | 0         | 0         | 0         | 0       | 0         | 0         | 0         | (+0)    | + | (-0) | = 0  |
| -1       |                 | 0       | 1         | 0         | 0         | 0       | 1         | 0         | 1         | (+4)    | + | (-5) | = -1 |
| -2       |                 | 0       | 0         | 1         | 1         | 0       | 1         | 0         | 1         | (+3)    | + | (-5) | = -2 |
| -3       |                 | 0       | 0         | 1         | 0         | 0       | 1         | 0         | 1         | (+2)    | + | (-5) | = -3 |
| -4       |                 | 0       | 0         | 0         | 1         | 0       | 1         | 0         | 1         | (+1)    | + | (-5) | = -4 |
| -5       | (maximum cut)   | 0       | 0         | 0         | 0         | 0       | 1         | 0         | 1         | (+0)    | + | (-5) | = -5 |

**Table 6** Filter control with quasi-constant quality factor

| POSITION |                 | D7<br>X | D6<br>nB2 | D5<br>nB1 | D4<br>nB0 | D3<br>X | D2<br>nC2 | D1<br>nC1 | D0<br>nC0 | COMMENT |   |      |      |
|----------|-----------------|---------|-----------|-----------|-----------|---------|-----------|-----------|-----------|---------|---|------|------|
| +5       | (maximum boost) | 0       | 1         | 0         | 1         | 0       | 0         | 0         | 0         | (+5)    | + | (-0) | = +5 |
| +4       |                 | 0       | 1         | 0         | 1         | 0       | 0         | 0         | 1         | (+5)    | + | (-1) | = +4 |
| +3       |                 | 0       | 1         | 0         | 1         | 0       | 0         | 1         | 0         | (+5)    | + | (-2) | = +3 |
| +2       |                 | 0       | 1         | 0         | 0         | 0       | 0         | 1         | 0         | (+4)    | + | (-2) | = +2 |
| +1       |                 | 0       | 0         | 1         | 1         | 0       | 0         | 1         | 0         | (+3)    | + | (-2) | = +1 |
| 0        | (linear)        | 0       | 0         | 0         | 0         | 0       | 0         | 0         | 0         | (+0)    | + | (-0) | = 0  |
| -1       |                 | 0       | 0         | 1         | 0         | 0       | 0         | 1         | 1         | (+2)    | + | (-3) | = -1 |
| -2       |                 | 0       | 0         | 1         | 0         | 0       | 1         | 0         | 0         | (+2)    | + | (-4) | = -2 |
| -3       |                 | 0       | 0         | 1         | 0         | 0       | 1         | 0         | 1         | (+2)    | + | (-5) | = -3 |
| -4       |                 | 0       | 0         | 0         | 1         | 0       | 1         | 0         | 1         | (+1)    | + | (-5) | = -4 |
| -5       | (maximum cut)   | 0       | 0         | 0         | 0         | 0       | 1         | 0         | 1         | (+0)    | + | (-5) | = -5 |

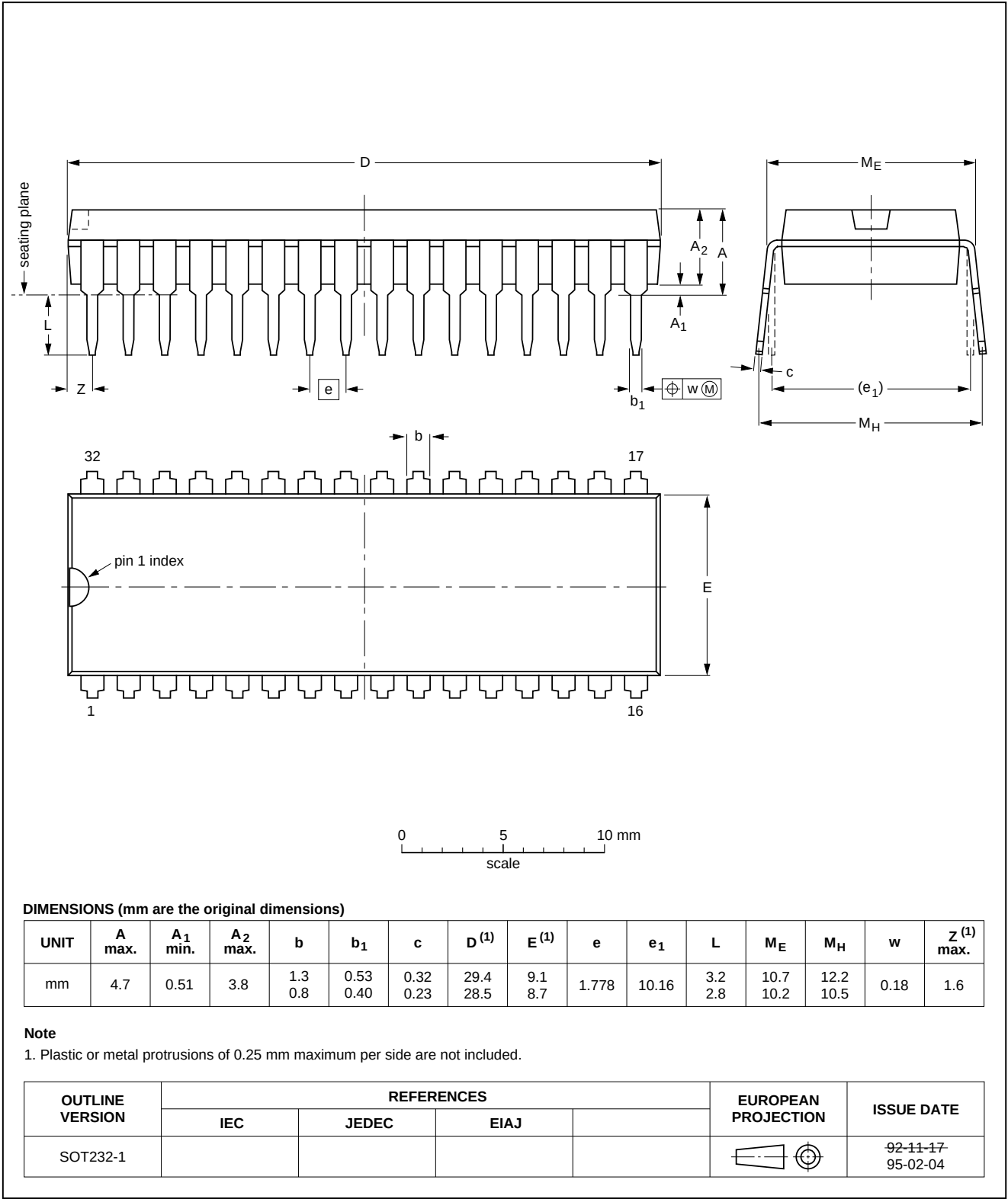
5-band stereo equalizer circuit

TEA6360

PACKAGE OUTLINES

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

SOT232-1

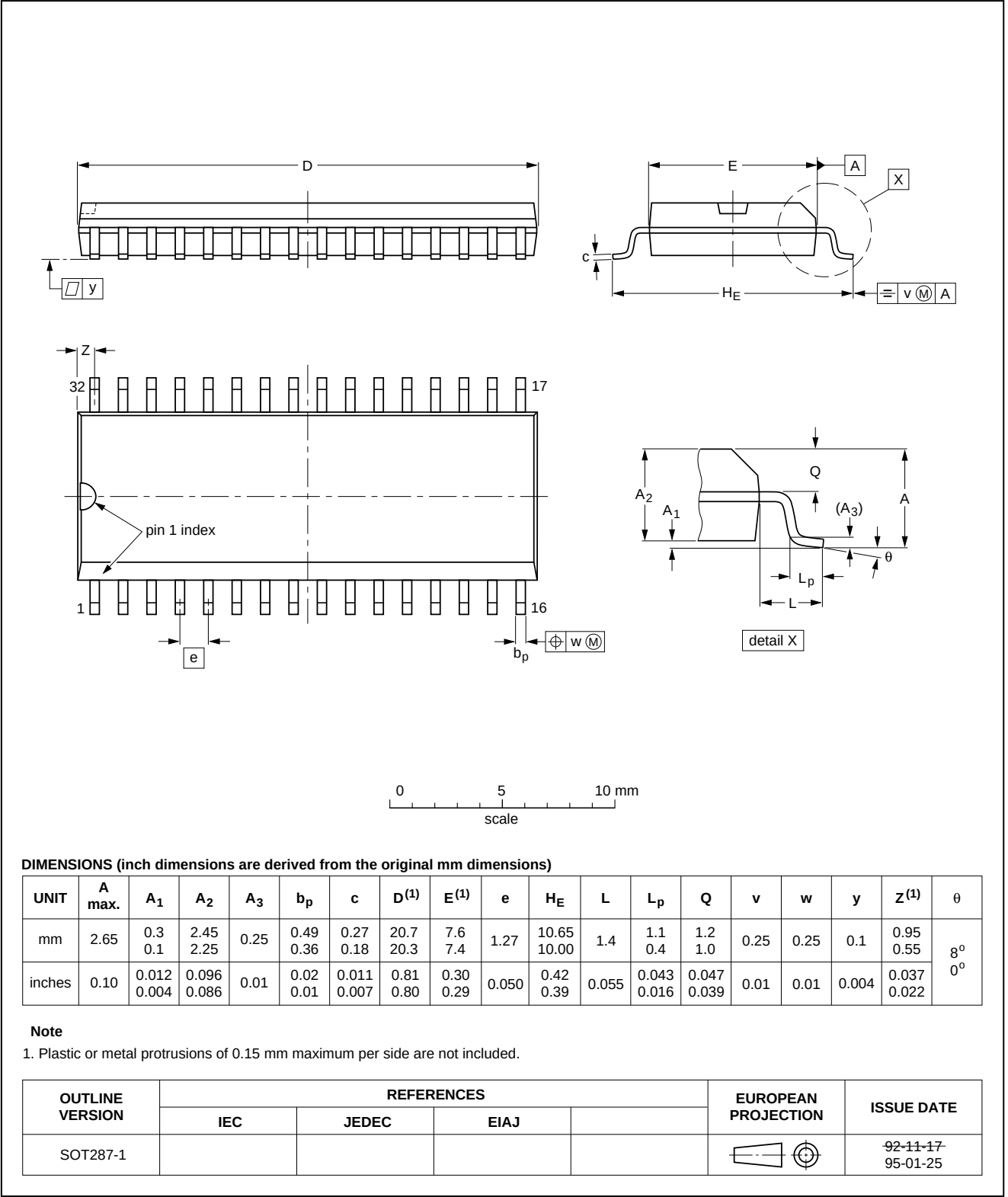


5-band stereo equalizer circuit

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

SOT287-1



## 5-band stereo equalizer circuit

TEA6360

### 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.

## 5-band stereo equalizer circuit

TEA6360

## 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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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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