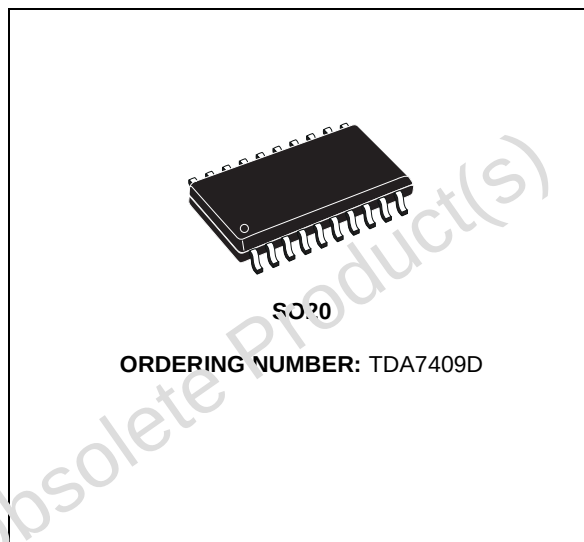


## CARRADIO-SIGNAL-PROCESSOR

- 4 STEREO INPUTS
- SOFT STEP-VOLUME
- BASS, TREBLE AND LOUDNESS CONTROL
- DIRECT MUTE AND SOFT MUTE
- INTERNAL BEEP
- FOUR INDEPENDENT SPEAKER-OUTPUTS
- SUBWOOFER STEREO OUTPUT
- DIGITAL CONTROL:
  - I<sup>2</sup>C-BUS INTERFACE
  - AUDIO-FILTER CHARACTERISTICS PROGRAMMABLE

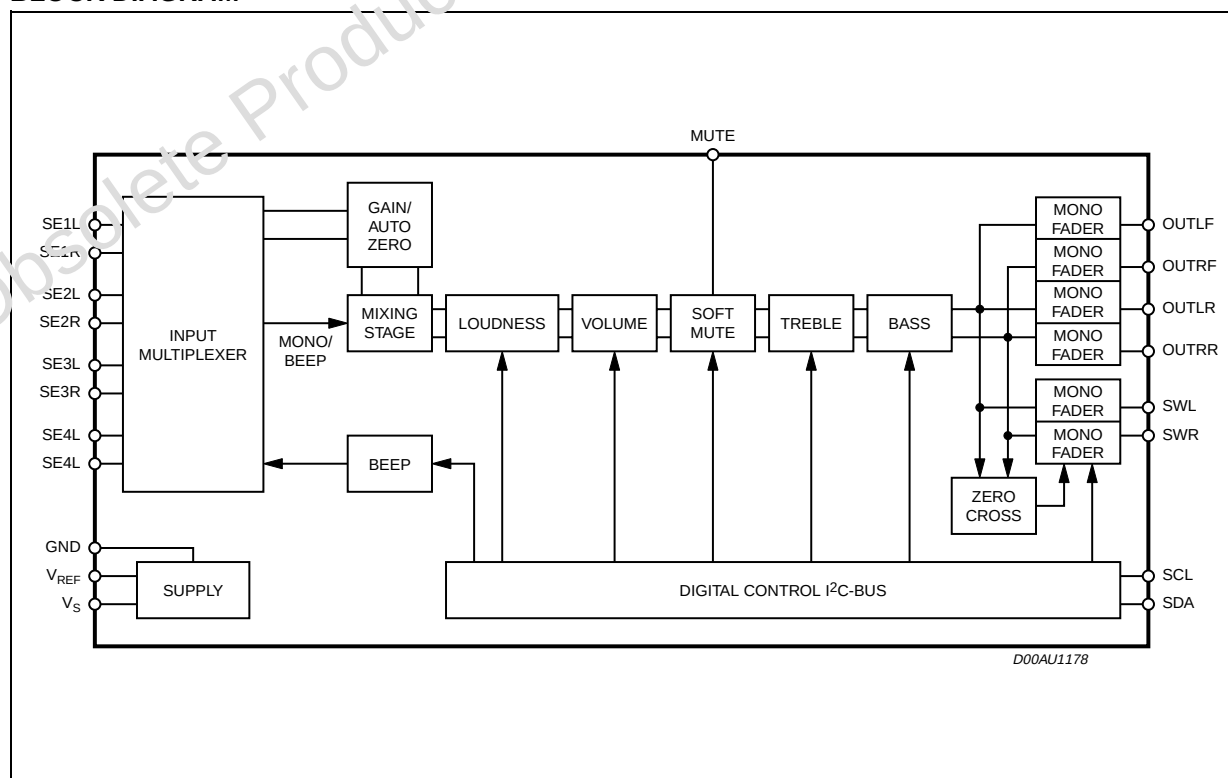
### DESCRIPTION

The TDA7409 is a high performance signal processor specifically designed for car radio applications. The device includes a high performance audioprocessor with fully integrated audio filters. The digital control allows a programming in a wide range of all the filter characteristics. By the use of a BICMOS-



process and a linear signal processing low distortion and low noise are obtained.

### BLOCK DIAGRAM



# TDA7409

## SUPPLY

| Symbol         | Parameter               | Test Condition                   | Min. | Typ. | Max. | Unit |
|----------------|-------------------------|----------------------------------|------|------|------|------|
| V <sub>s</sub> | Supply Voltage          |                                  | 7.5  | 9    | 10.5 | V    |
| I <sub>s</sub> | Supply Current          | V <sub>s</sub> = 9V              |      | 20   |      | mA   |
| SVRR           | Ripple Rejection @ 1KHz | Audioprocessor(all Filters flat) |      | 60   |      | dB   |

## THERMAL DATA

| Symbol                 | Parameter                            | Value | Unit |
|------------------------|--------------------------------------|-------|------|
| R <sub>Th j-pins</sub> | Thermal Resistance Junction-pins max | 85    | °C/W |

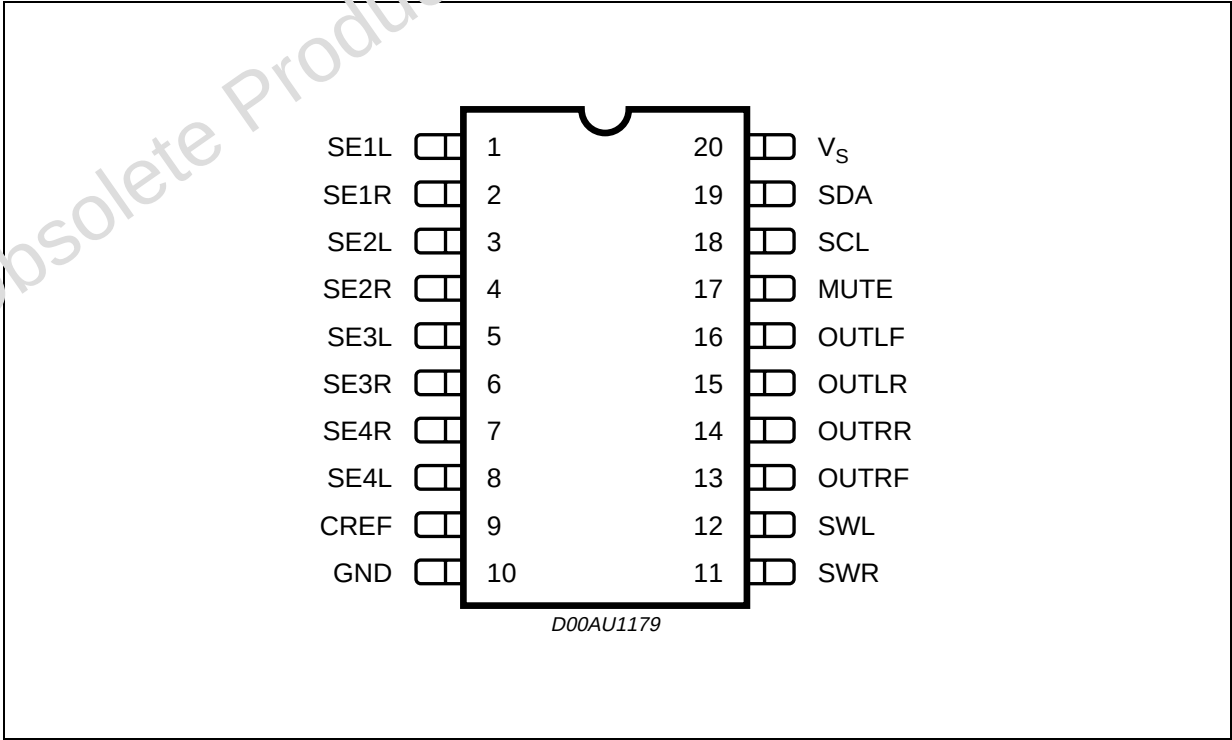
## ABSOLUTE MAXIMUM RATINGS

| Symbol           | Parameter                   | Value       | Unit |
|------------------|-----------------------------|-------------|------|
| V <sub>s</sub>   | Operating Supply Voltage    | 10.8        | V    |
| T <sub>amb</sub> | Operating Temperature Range | -40 to 85   | °C   |
| T <sub>stg</sub> | Storage Temperature Range   | -55 to +150 | °C   |

## ESD

All pins are protected against ESD according to the MIL883 standard.

## PIN CONNECTION



**FEATURES:**

|                   |                                                                                                                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Multiplexer | 4 single-end stereo inputs<br>In-Gain 0..14dB, 1dB steps, 14..20dB, 2dB steps<br>Auto Zero                                                                                              |
| Beep              | internal Beep with 3 frequencies<br>781Hz/1.56KHz/1.8KHz                                                                                                                                |
| Mixing stage      | 4 step-mixing-stage with mono or beep as mix-signals                                                                                                                                    |
| Loudness          | second order frequency response<br>programmable center frequency<br>15 x 1dB steps<br>selectable low & high frequency boost<br>selectable flat-mode (constant attenuation)              |
| Volume            | 1 dB attenuator<br>100dB range<br>soft-step control with programmable times                                                                                                             |
| Bass              | 2nd order frequency response<br>center frequency programmable in 4 steps<br>60Hz/80Hz/100Hz/200Hz<br>Q programmable 1.0/1.25/1.5/2.0<br>DC gain programmable<br>$\pm 15$ dB x 1dB steps |
| Treble            | 2nd order frequency response<br>center frequency programmable in 4 steps<br>10KHz/12.5KHz/15KHz/17.5KHz<br>$\pm 15$ dB x 1dB steps                                                      |
| Speaker           | 4 independent speaker controls in 1dB steps<br>control range 50dB with mute<br>Zero crossing attenuate                                                                                  |
| Subwoofer         | Stereo output<br>attenuator range 50dB                                                                                                                                                  |
| Mute Functions    | direct mute<br>digitally controlled Soft Mute with 4 programmable mute-times                                                                                                            |

**ELECTRICAL CHARACTERISTICS** ( $V_S=9V$ ;  $T_{AMB}=25$ ;  $R_L=10k\Omega$ ; all gains = 0dB;  $f = 1kHz$ ; unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

**INPUT SELECTOR**

|              |                                |                         |      |      |     |           |
|--------------|--------------------------------|-------------------------|------|------|-----|-----------|
| $R_{in}$     | Input Resistance               | all single ended Inputs | 70   | 100  | 130 | $k\Omega$ |
| $V_{CL}$     | Clipping Level                 |                         | 2.20 | 2.60 |     | $V_{RMS}$ |
| $S_{IN}$     | Input Separation               |                         | 80   | 100  |     | dB        |
| $G_{IN MIN}$ | Min. Input Gain                |                         | -1   | 0    | 1   | dB        |
| $G_{IN MAX}$ | Max. Input Gain                |                         | 18   | 20   | 22  | dB        |
| $G_{STEP}$   | Step Resolution                |                         | 0.5  | 1    | 1.5 | dB        |
| $V_{DC}$     | DC Steps                       | Adjacent Gain Steps     | -5   | 1    | 5   | mV        |
|              |                                | $G_{MIN}$ to $G_{MAX}$  | -10  | 5    | 10  | mV        |
| $V_{offset}$ | Remaining offset with AutoZero |                         |      | 0.5  |     | mV        |

**BEEP CONTROL**

|           |                |          |      |      |      |     |
|-----------|----------------|----------|------|------|------|-----|
| $V_{RMS}$ | Beep Level     |          | 250  | 350  | 500  | mV  |
| $f_B$     | Beep Frequency | $f_{B1}$ | 740  | 781  | 820  | Hz  |
|           |                | $f_{B2}$ | 1.48 | 1.56 | 1.64 | kHz |
|           |                | $f_{B3}$ | 1.7  | 1.8  | 1.9  | kHz |

**MIXING CONTROL**

|             |              |                   |            |           |           |    |
|-------------|--------------|-------------------|------------|-----------|-----------|----|
| $M_{LEVEL}$ | Mixing Level | Main / Mix-Source |            | 0/00      |           | dB |
|             |              | Main / Mix-Source | -0.5/-10.6 | -3.5/-9.6 | -2.5/-8.6 | dB |
|             |              | Main / Mix-Source | -5/-5      | -6/-6     | -7/-7     | dB |
|             |              | Main / Mix-Source | -11/-1.5   | -12/-2.5  | -13/-3.5  | dB |

**VOLUME CONTROL**

|            |                       |                      |     |     |     |    |
|------------|-----------------------|----------------------|-----|-----|-----|----|
| $G_{MAX}$  | Max. Gain             |                      | 28  | 30  | 32  | dB |
| $A_{MAX}$  | Max. Attenuation      |                      | -83 | -79 | -75 | dB |
| $A_{STEP}$ | Step Resolution       |                      | 0.5 | 1   | 1.5 | dB |
| $E_A$      | Attenuation Set Error | $G = -20$ to $+20dB$ | -1  | 0   | 1   | dB |
|            |                       | $G = -80$ to $-20dB$ | -4  | 0   | 3   | dB |
| $E_T$      | Tracking Error        |                      |     |     | 2   | dB |

**ELECTRICAL CHARACTERISTICS** (continued)

| Symbol          | Parameter | Test Conditions              | Min. | Typ. | Max. | Unit |
|-----------------|-----------|------------------------------|------|------|------|------|
| V <sub>DC</sub> | DC Steps  | Adjacent Steps               |      | 0.1  | 3    | mV   |
|                 |           | From 0dB to G <sub>MIN</sub> |      | 0.5  | 5    | mV   |

**LOUDNESS CONTROL**

|                   |                  |  |     |                  |     |     |
|-------------------|------------------|--|-----|------------------|-----|-----|
| A <sub>STEP</sub> | Step Resolution  |  | 0.5 | 1                | 1.5 | dB  |
| A <sub>MAX</sub>  | Max. Attenuation |  | 13  | 15               | 17  | dB  |
| f <sub>C</sub>    | Center Frequency |  | 360 | 400              | 440 | Hz  |
|                   |                  |  | 720 | 800              | 880 | Hz  |
|                   |                  |  | 2.3 | 2.4 <sup>1</sup> | 2.5 | kHz |

**SOFT MUTE**

|                      |                                       |    |      |      |     |    |
|----------------------|---------------------------------------|----|------|------|-----|----|
| A <sub>MUTE</sub>    | Mute Attenuation                      |    | 80   | 100  |     | dB |
| T <sub>D</sub>       | Delay Time                            | T1 |      | 0.48 | 1   | ms |
|                      |                                       | T2 |      | 0.96 | 2   | ms |
|                      |                                       | T3 | 20   | 30.7 | 50  | ms |
|                      |                                       | T4 | 70   | 123  | 170 | ms |
| V <sub>TH low</sub>  | Low Threshold for SM-Pin <sup>2</sup> |    |      |      | 1   | V  |
| V <sub>TH high</sub> | High Threshold for SM - Pin           |    | 2.50 |      |     | V  |
| R <sub>PU</sub>      | Internal pull-up resistor             |    | 70   | 100  | 130 | kΩ |
| V <sub>PU</sub>      | Pull-Up Voltage                       |    |      | 5    |     | V  |

**SOFT STEP**

|                 |             |                  |  |      |  |    |
|-----------------|-------------|------------------|--|------|--|----|
| T <sub>SW</sub> | Switch time | T <sub>SW1</sub> |  | 0.68 |  | ms |
|                 |             | T <sub>SW2</sub> |  | 1.26 |  | ms |
|                 |             | T <sub>SW3</sub> |  | 2.52 |  | ms |
|                 |             | T <sub>SW4</sub> |  | 5.04 |  | ms |

1) Center frequency 2.4kHz makes 1kHz bottom frequency at low & high frequency boost condition.

2) The SM-Pin is active low (Mute = 0)

**BASS CONTROL**

|                    |                  |                 |     |     |     |    |
|--------------------|------------------|-----------------|-----|-----|-----|----|
| C <sub>RANGE</sub> | Control Range    |                 | ±14 | ±15 | ±16 | dB |
| A <sub>STEP</sub>  | Step Resolution  |                 | 0.5 | 1   | 1.5 | dB |
| f <sub>C</sub>     | Center Frequency | f <sub>C1</sub> | 54  | 60  | 66  | Hz |
|                    |                  | f <sub>C2</sub> | 72  | 80  | 88  | Hz |
|                    |                  | f <sub>C3</sub> | 90  | 100 | 110 | Hz |
|                    |                  | f <sub>C4</sub> | 180 | 200 | 220 | Hz |

**ELECTRICAL CHARACTERISTICS** (continued)

| Symbol             | Parameter      | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------|----------------|-----------------|------|------|------|------|
| Q <sub>BASS</sub>  | Quality Factor | Q <sub>1</sub>  | 0.9  | 1    | 1.1  |      |
|                    |                | Q <sub>2</sub>  | 1.1  | 1.25 | 1.4  |      |
|                    |                | Q <sub>3</sub>  | 1.3  | 1.5  | 1.7  |      |
|                    |                | Q <sub>4</sub>  | 1.8  | 2    | 2.2  |      |
| DC <sub>GAIN</sub> | Bass-DC-Gain   | DC = off        | -1   | 0    | 1    | dB   |
|                    |                | DC = on         | 4    | 4.4  | 6    | dB   |

**TREBLE CONTROL**

|                    |                  |                 |     |      |     |     |
|--------------------|------------------|-----------------|-----|------|-----|-----|
| C <sub>RANGE</sub> | Control Range    |                 | ±14 | ±15  | ±16 | dB  |
| A <sub>STEP</sub>  | Step Resolution  |                 | 0.5 | 1    | 1.5 | dB  |
| f <sub>C</sub>     | Center Frequency | f <sub>C1</sub> | 8   | 10   | 12  | kHz |
|                    |                  | f <sub>C2</sub> | 10  | 12.5 | 15  | kHz |
|                    |                  | f <sub>C3</sub> | 12  | 15   | 18  | kHz |
|                    |                  | f <sub>C4</sub> | 14  | 17.5 | 21  | kHz |

**SPEAKER ATTENUATORS**

|                    |                         |                                 |     |      |     |    |
|--------------------|-------------------------|---------------------------------|-----|------|-----|----|
| C <sub>RANGE</sub> | Control Range           |                                 | -53 | 50   | -47 | dB |
| A <sub>STEP</sub>  | Step Resolution         | only for attenuation up to 24dB | 0.5 | 1    | 1.5 | dB |
| A <sub>MUTE</sub>  | Output Mute Attenuation |                                 | 80  | 90   |     | dB |
| E <sub>E</sub>     | Attenuation Set Error   |                                 | -2  |      | 2   | dB |
| V <sub>DC</sub>    | DC Steps                | Adjacent Attenuation Steps      |     | 0.10 | 5   | mV |
| T <sub>ZC</sub>    | Zero Cross Timer        | Data bit D1=1, D2=1             | 29  | 37   | 45  | ms |
| V <sub>th</sub>    | Zero Cross Threshold    |                                 |     | ±20  |     | mV |

**FASTER OUTPUTS**

|                   |                         |          |      |      |     |                  |
|-------------------|-------------------------|----------|------|------|-----|------------------|
| V <sub>CLIP</sub> | Clipping Level          | d = 0.3% | 2.20 | 2.60 |     | V <sub>RMS</sub> |
| R <sub>L</sub>    | Output Load Resistance  |          | 2    |      |     | kΩ               |
| C <sub>L</sub>    | Output Load Capacitance |          |      |      | 10  | nF               |
| R <sub>OUT</sub>  | Output Impedance        |          |      | 30   | 100 | Ω                |
| V <sub>DC</sub>   | DC Voltage Level        |          | 4.3  | 4.5  | 4.7 | V                |

**SUBWOOFER ATTENUATORS**

|                    |                         |  |     |    |     |    |
|--------------------|-------------------------|--|-----|----|-----|----|
| C <sub>RANGE</sub> | Control Range           |  | -53 | 50 | -47 | dB |
| A <sub>STEP</sub>  | Step Resolution         |  | 0.5 | 1  | 1.5 | dB |
| A <sub>MUTE</sub>  | Output Mute Attenuation |  | 80  | 90 |     | dB |

**ELECTRICAL CHARACTERISTICS** (continued)

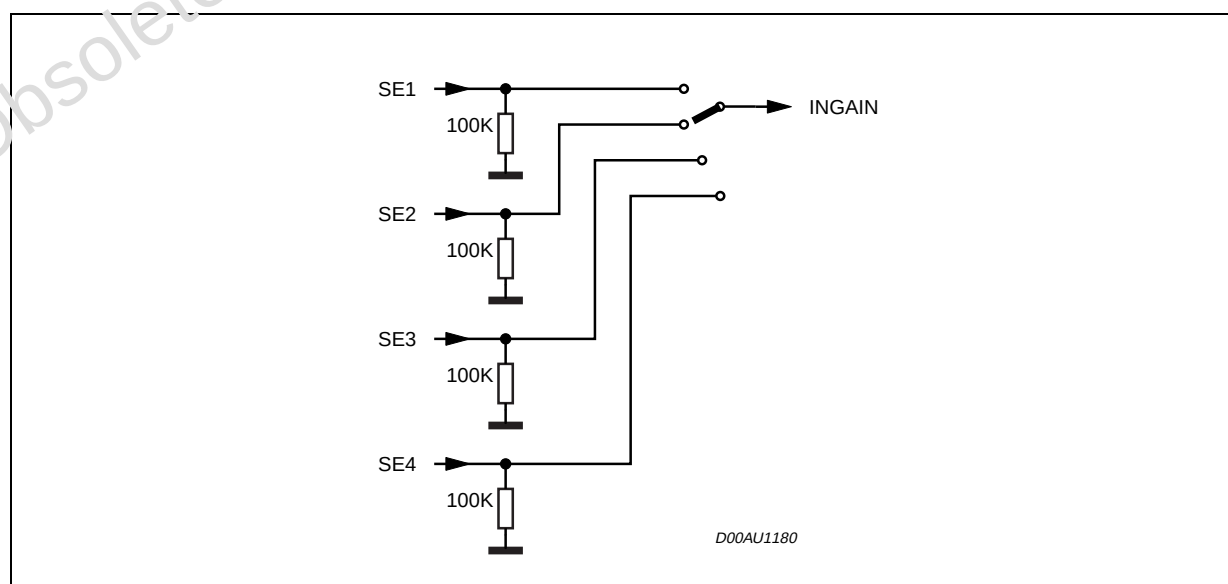
| Symbol   | Parameter             | Test Conditions            | Min. | Typ. | Max. | Unit |
|----------|-----------------------|----------------------------|------|------|------|------|
| $E_E$    | Attenuation Set Error |                            |      |      | 2    | dB   |
| $V_{DC}$ | DC Steps              | Adjacent Attenuation Steps |      | 0.10 | 5    | mV   |

**GENERAL**

|          |                               |                                                            |    |       |     |         |
|----------|-------------------------------|------------------------------------------------------------|----|-------|-----|---------|
| $e_{NO}$ | Output Noise                  | BW = 20Hz - 20kHz<br>all gains = 0dB single ended inputs   |    | 10    | 15  | $\mu$ V |
| S/N      | Signal to Noise Ratio         | all gains = 0dB<br>flat; $V_O = 2V_{RMS}$                  |    | 106   |     | dB      |
|          |                               | bass, treble at +12dB;<br>a-weighted; $V_O = 2.6V_{RMS}$   |    | 100   |     | dB      |
| d        | Distortion                    | $V_{IN} = 1V_{RMS}$ ; all stages 0dB<br>internal pass only |    | 0.005 | 0.1 | %       |
|          |                               | $V_{OUT} = 1V_{RMS}$ ; Bass & Treble =<br>12dB             |    | 0.05  | 0.1 | %       |
| $S_C$    | Channel Separation left/right |                                                            | 80 | 100   |     | dB      |
| $E_T$    | Total Tracking Error          | $A_V = 0$ to -20dB                                         | -1 | 0     | 1   | dB      |
|          |                               | $A_V = -20$ to -60dB                                       | -2 | 0     | 2   | dB      |

**1.0 DESCRIPTION OF FUNCTIONALITY****1.1 Input stages**

The input stages have remained the same as in preceding ST-Audioprocessors.

**Figure 1. Input stages**

## 1.2 AutoZero

In order to reduce the number of pins there is no AC coupling between the In-Gain and the following stage, so that any offset generated by or before the In-Gain-stage would be transferred or even amplified to the output. To avoid that effect a special Offset-cancellation-stage called AutoZero is implemented. This stage is located before the Mixing-block to eliminate all offsets generated by the Input-Stages and the In-Gain (Please notice that externally generated offsets, e.g. generated through the leakage current of the coupling capacitors, are not canceled).

The auto-zeroing is started every time the DATA-BYTE 0 (Input Selector/Gain) is selected and takes a time of max. **0.3ms**. To avoid audible clicks the Audioprocessor is muted before the loudness stage during this time.

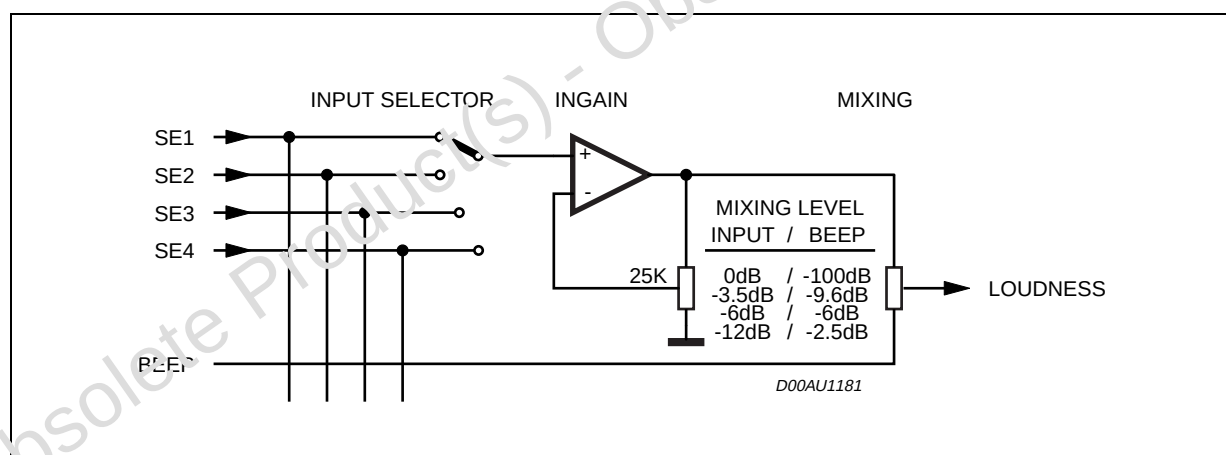
### 1.2.1 AutoZero-Remain

In some cases, for example if the uP is executing a refresh cycle of the IIC-Bus-programming, it is not useful to start a new AutoZero-action because no new source is selected and an undesired mute would appear at the outputs. For such applications the TDA7409 could be switched in the **AutoZero-Remain-Mode** (2 bit of the subaddress-byte). If this bit is set to high, the DATA-BYTE 0 could be loaded without invoking the AutoZero and the old adjustment-value remains.

## 1.3 Mixing Stage

The 4 step Mixing stage offers the possibility to mix the rear selector signal or the phone signal to any other source. Due to the fact that the mixing-stage is located behind the In-Gain-stage fine adjustments of the main source level could be done in this way.

**Figure 2. Signal-Flow of Mixing-Stage**



## 1.4 Loudness

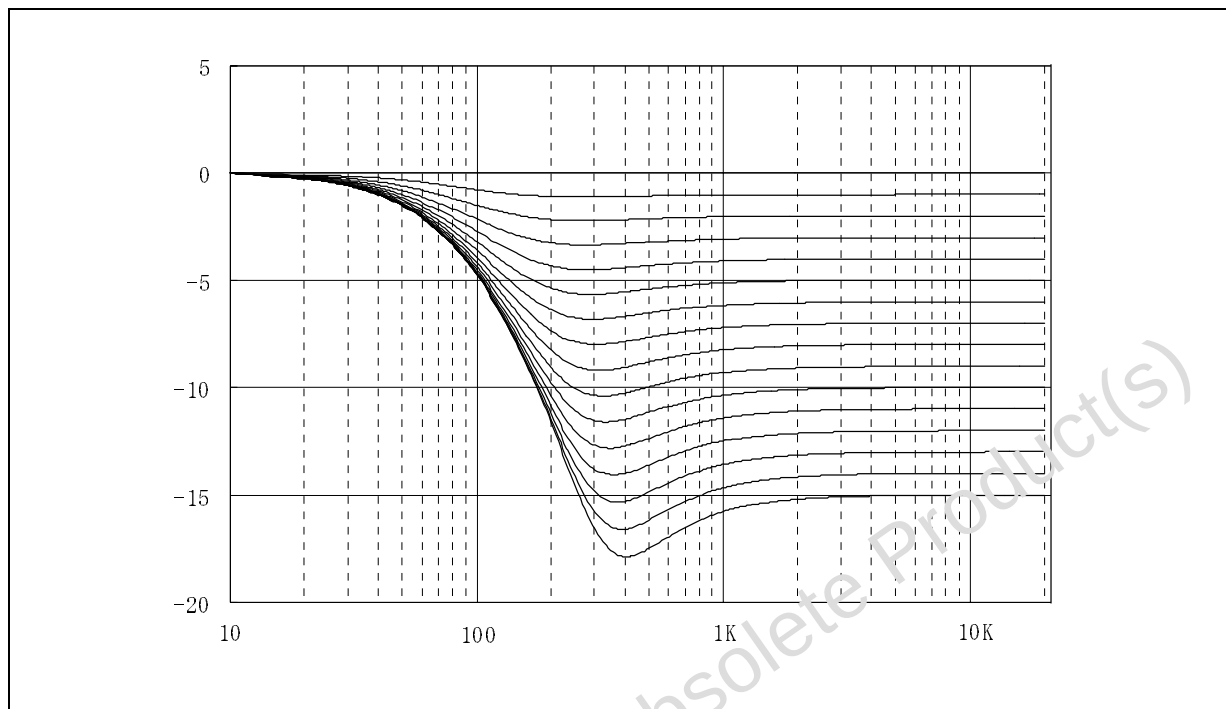
There are four parameters programmable in the loudness stage:

### 1.4.1 Attenuation

Figure 3 shows the attenuation as a function of frequency at  $f_c = 400\text{Hz}$ .



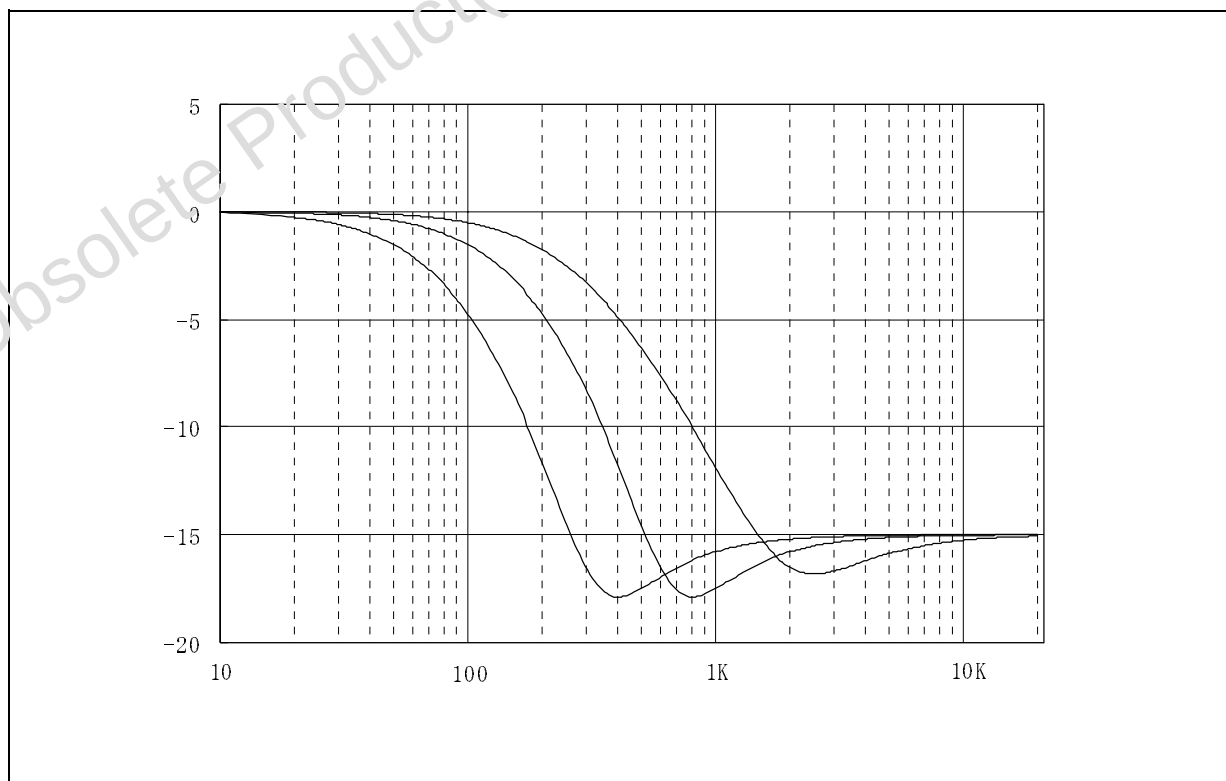
**Figure 3. Loudness Attenuation @  $f_c = 400\text{Hz}$**



#### 1.4.2 Center Frequency

Figure 4 shows the three possible peak-frequencies 400Hz , 800Hz and 2.4kHz.

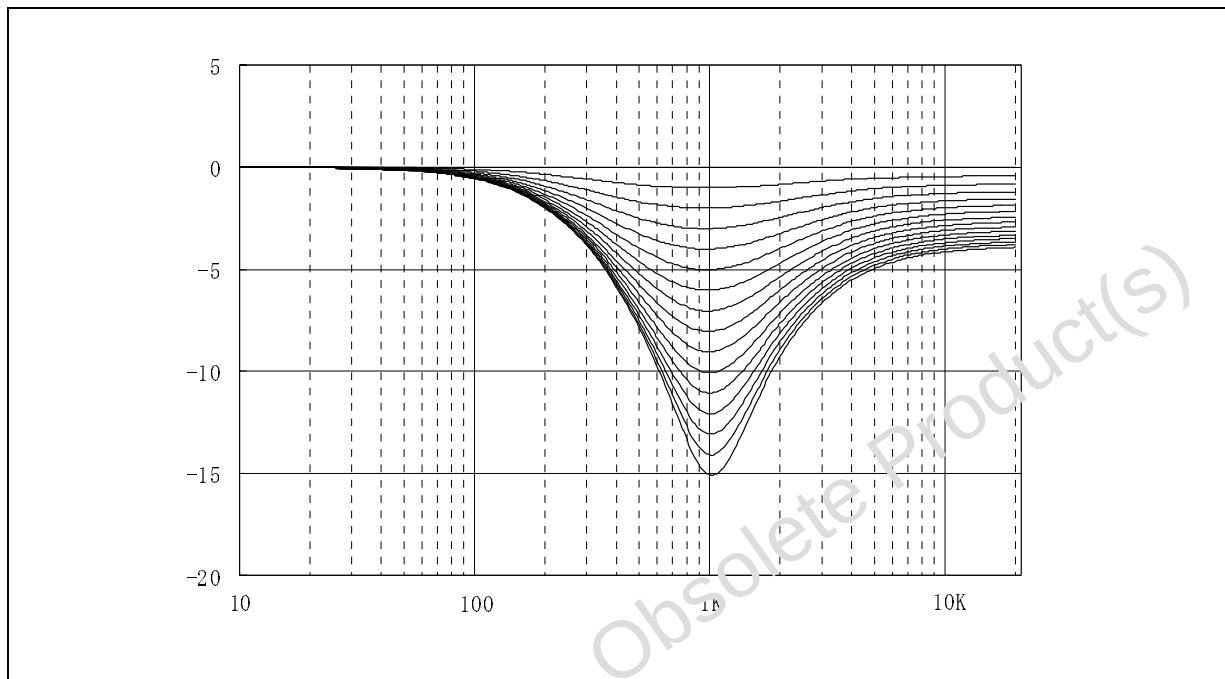
**Figure 4. Loudness Center frequencies @ Attn. = 15dB**



### 1.4.3 Low & High Frequency Boost

Figure 5 shows the different Loudness-shapes in low & high frequency boost.

**Figure 5. Loudness Attenuation ,  $f_c = 2.4\text{KHz}$**

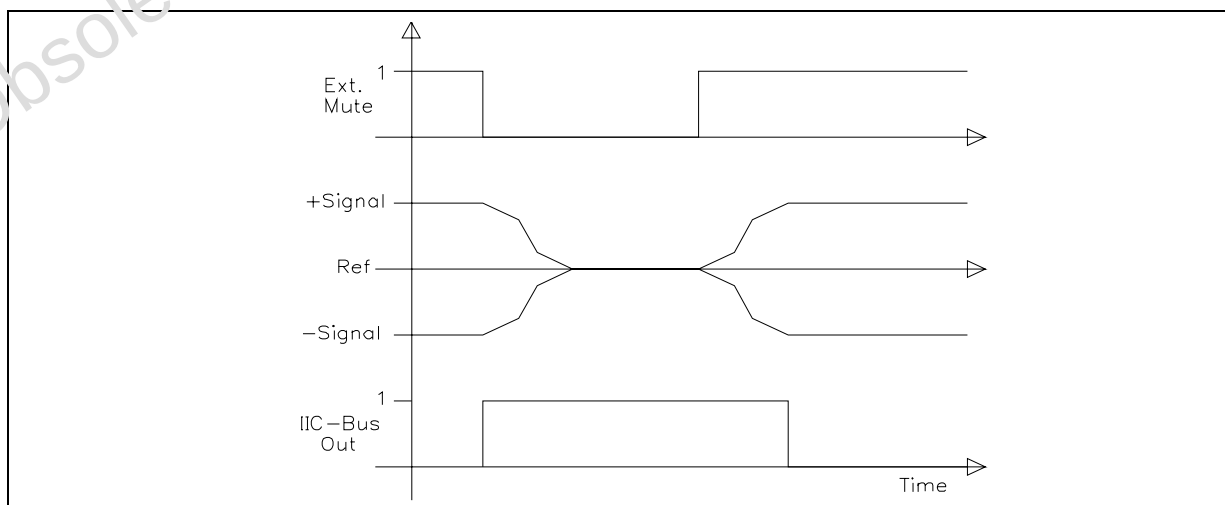


### 1.5 SoftMute

The digitally controlled SoftMute stage allows muting/demuting the signal with a I2C-bus programmable slope. The mute process can either be activated by the Mute pin or by the I2C-bus. This slope is realized in a special S-shaped curve to mute slowly in the critical regions (see Figure 6).

For timing purposes the Bit 0 of the I2C-bus output register is set to 1 from the start of muting until the end of de-muting.

**Figure 6. Softmute-Timing**

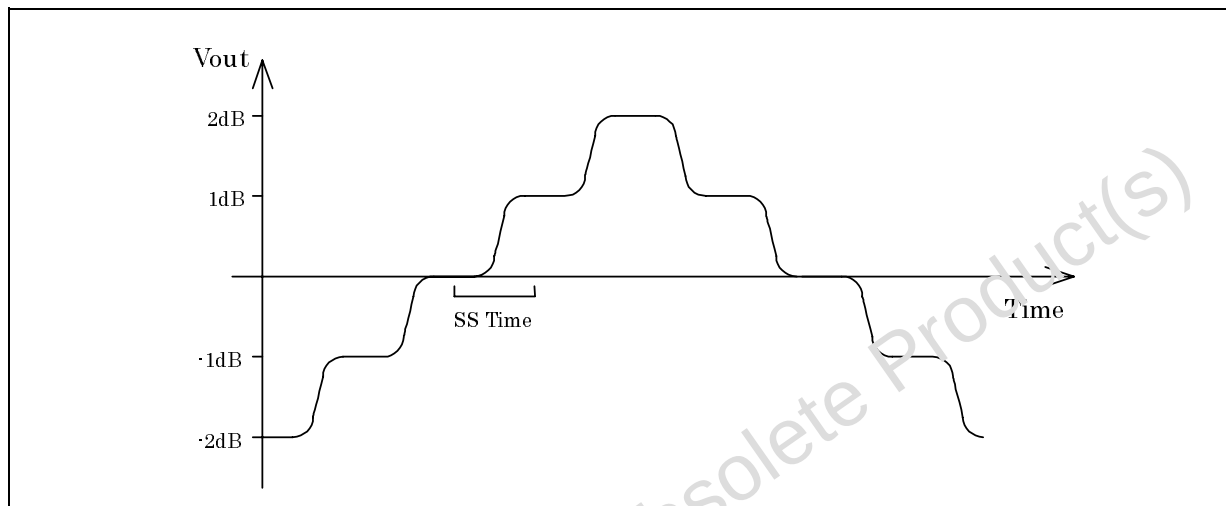


Note: Please notice that a started Mute-action is always terminated and could not be interrupted by a change of the mute -signal.

### 1.6 SoftStep-Volume

When the volume-level is changed audible clicks could appear at the output. The root cause of those clicks could either be a DC-Offset before the volume-stage or the sudden change of the envelope of the audiosignal. With the SoftStep-feature both kinds of clicks could be reduced to a minimum and are no more audible. Four programmable soft step time from one step to the next, are user selectable.

**Figure 7. SoftStep-Timing**



Note: For steps more than 1dB the SoftStep mode should be deactivated because it could generate a 1dB error during the blend-time.

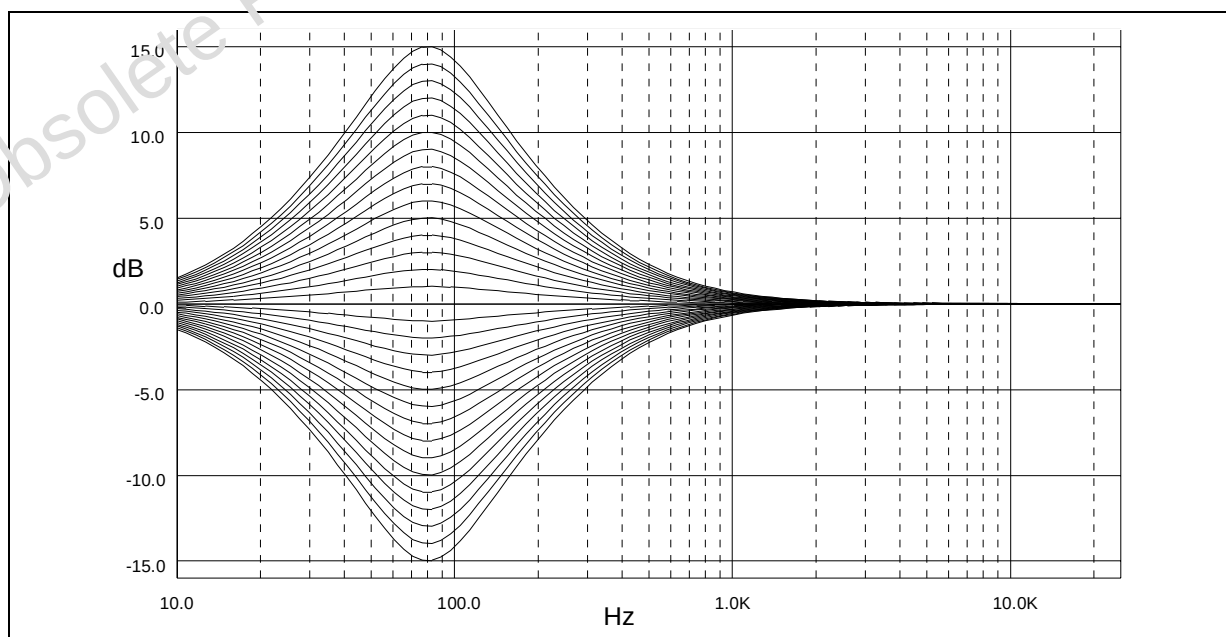
### 1.7 Bass

There are three parameters programmable in the bass stage:

#### 1.7.1 Attenuation

Figure 8 shows the attenuation as a function of frequency at a center frequency of 80Hz.

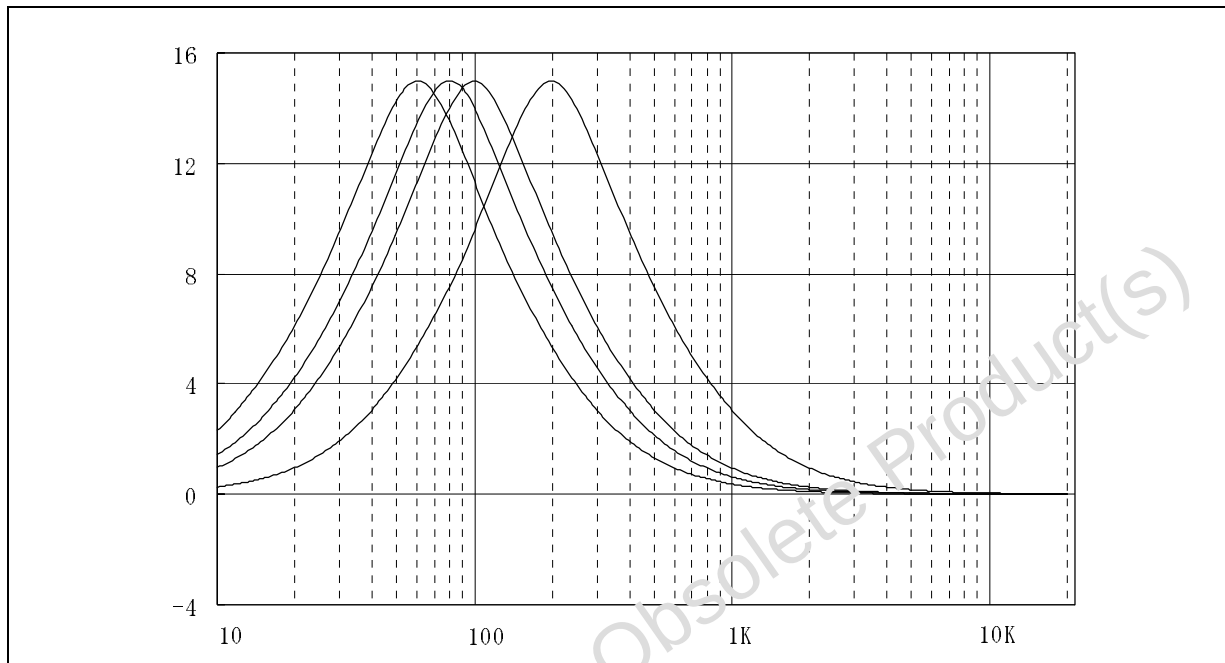
**Figure 8. Bass Control @  $f_C = 80\text{Hz}$ ,  $Q = 1$**



### 1.7.2 Center Frequency

Figure 9 shows the four possible center frequencies 60, 80, 100 and 200Hz.

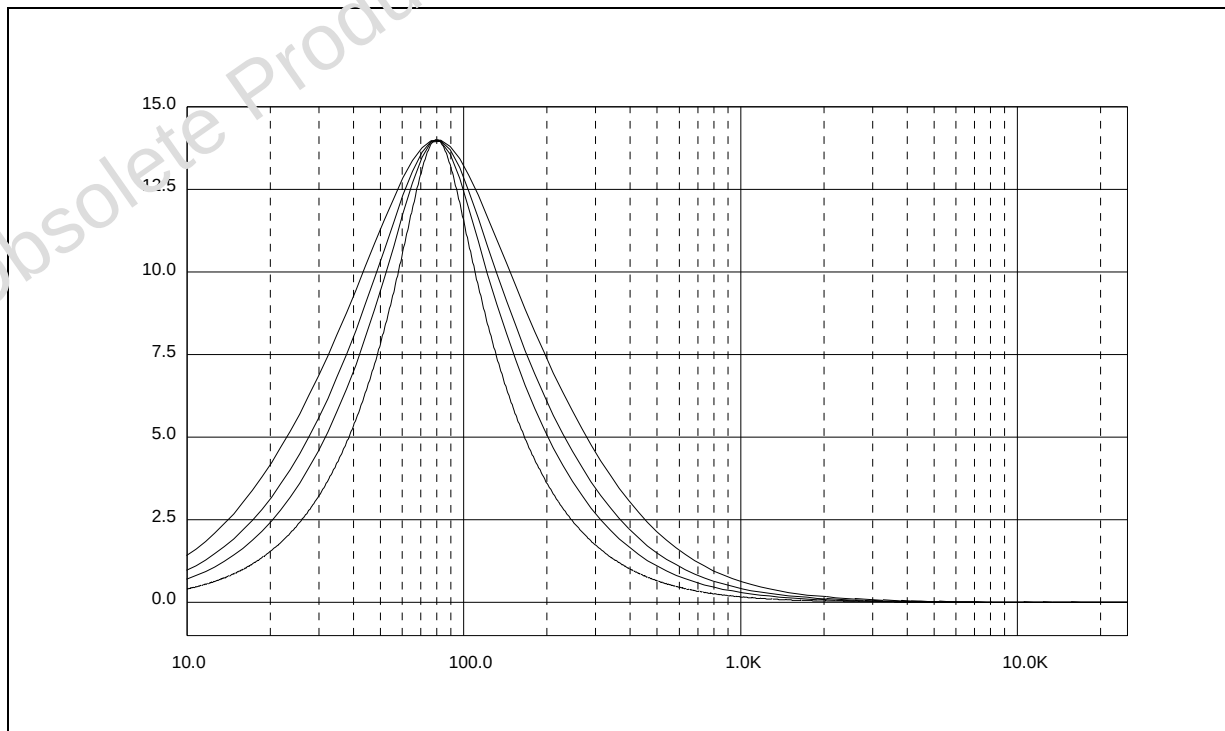
**Figure 9. Bass center Frequencies @ Gain = 15dB, Q = 1**



### 1.7.3 Quality Factors

Figure 10 shows the four possible quality factors 1, 1.25, 1.5 and 2.

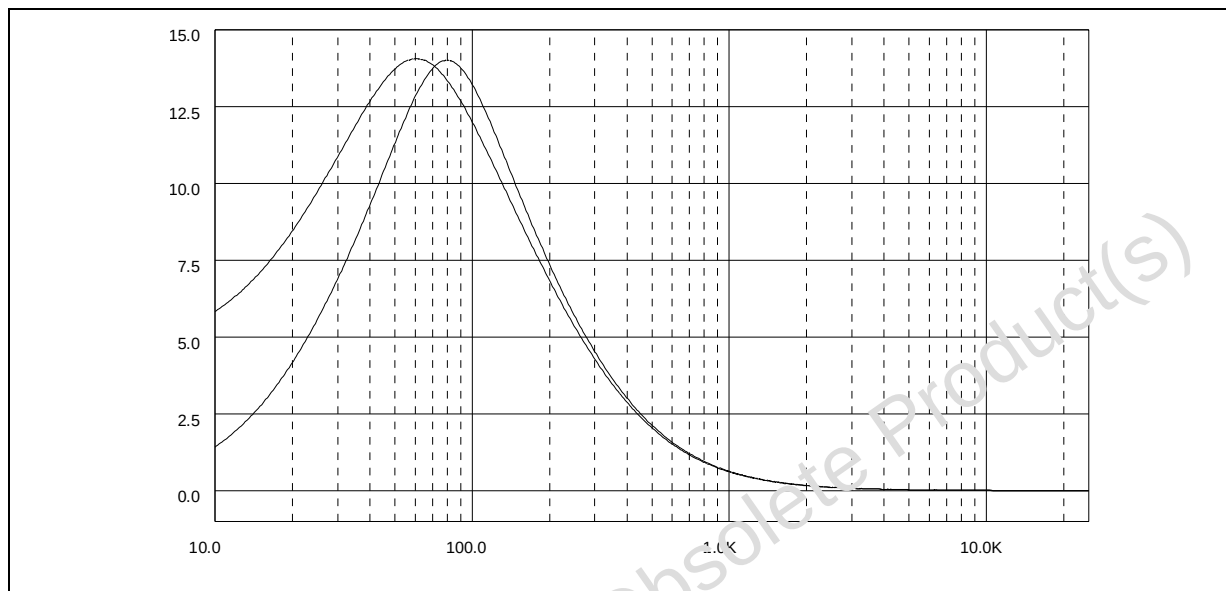
**Figure 10. Bass Quality factors @ Gain = 14dB, fC = 80Hz**



### 1.7.4 DC Mode

In this mode the DC-gain is increased by 4.4dB. In addition the programmed center frequency and quality factor is decreased by 25% which can be used to reach alternative center frequencies or quality factors.

**Figure 11. Bass normal and DC Mode @ Gain = 14dB,  $f_c = 80\text{Hz}$**



Note: The center frequency, Q and DC-mode can be set fully independently.

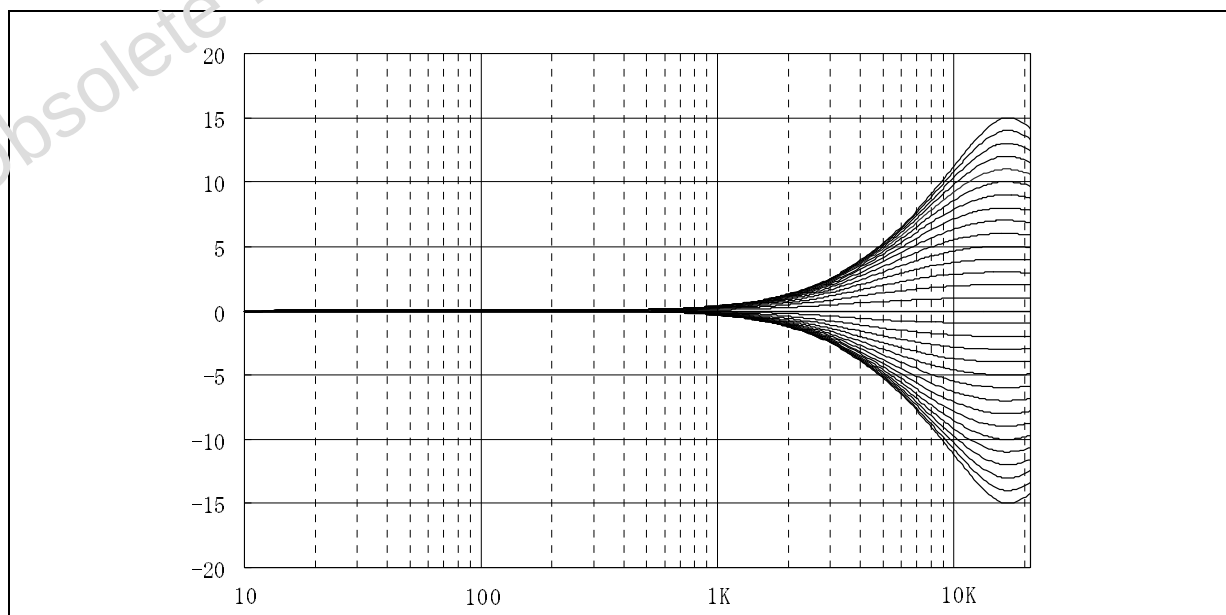
### 1.8 Treble

There are two parameters programmable in the treble stage:

#### 1.8.1 Attenuation

Figure 12 shows the attenuation as a function of frequency at a center frequency of 17.5kHz.

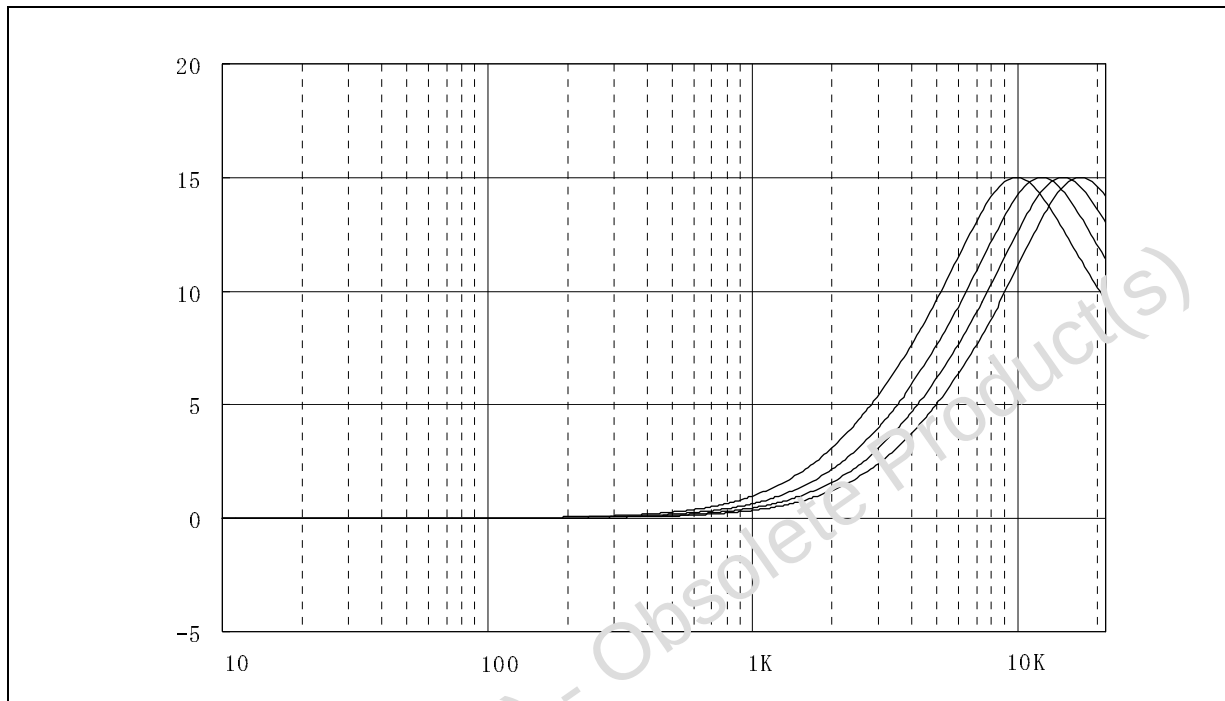
**Figure 12. Treble Control @  $f_c = 17.5\text{kHz}$**



### 1.8.2 Center Frequency

Figure 13 shows the four possible center frequencies 10k, 12.5k, 15k and 17.5kHz.

**Figure 13. Treble Center Frequencies @ Gain = 15dB**



### 1.9 Speaker Attenuator

Due to practical aspects the steps in the speaker-attenuators are not linear over the full range. At attenuations more than 24dB the steps increase from 1.5dB to 10dB (please see data byte specification).

### 1.10 Subwoofer Attenuator

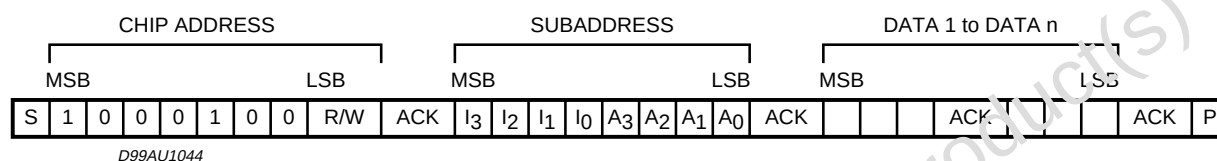
The Subwoofer output is a single ended stereo output. The attenuator is exactly the same like the other speakers.

## 2.0 I<sup>2</sup>C BUS INTERFACE

### 2.1 Interface Protocol

The interface protocol comprises:

- a start condition (S)
- a chip address byte (the LSB bit determines read / write transmission)
- a subaddress byte
- a sequence of data (N-bytes + acknowledge)
- a stop condition (P)
- the max. CLOCK SPEED is 500kbits/s



S = Start

R/W = "0" -> Receive-Mode (Chip could be programmed by P)

"1" -> Transmission-Mode (Data could be received by P)

ACK = Acknowledge

P = Stop

### 2.2 TRANSMITTED DATA (send mode)

| MSB |   |   |   |   |   |   | LSB |
|-----|---|---|---|---|---|---|-----|
| X   | X | X | X | X | X | X | SM  |

SM = Soft mute activated

X = Not Used

The transmitted data is automatic updated after each ACK. Transmission can be repeated without new chipaddress.

### 2.3 Reset Condition

A Power-On-Reset is invoked if the Supply-Voltage is below than 3.5V. After that the following data is written automatically into the registers of all subaddresses :

| MSB |   |   |   |   |   |   | LSB |
|-----|---|---|---|---|---|---|-----|
| 1   | 1 | 1 | 1 | 1 | 1 | 1 | 0   |

The programming after POR is marked bold-face / underlined in the programming tables.

With this programming all the outputs are muted to  $V_{REF}$  ( $V_{OUT} = V_{DD}/2$ ).

Note : All the blank bits in the following tables are "don't care"-bits.

## 2.4 SUBADDRESS (receive mode)

| MSB            |                |                |                |                                                                         |                                                                         |                                                                         | LSB                                                                     | FUNCTION                                                                                                                                                                                                                                                                                       |
|----------------|----------------|----------------|----------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I <sub>3</sub> | I <sub>2</sub> | I <sub>1</sub> | I <sub>0</sub> | A <sub>3</sub>                                                          | A <sub>2</sub>                                                          | A <sub>1</sub>                                                          | A <sub>0</sub>                                                          |                                                                                                                                                                                                                                                                                                |
| 0<br>1         |                |                |                |                                                                         |                                                                         |                                                                         |                                                                         | <b>Zero cross / Soft Mute</b> <sup>1</sup><br>Zero Cross available<br>Soft Mute available                                                                                                                                                                                                      |
|                | 0<br>1         |                |                |                                                                         |                                                                         |                                                                         |                                                                         | <b>AutoZero Remain</b> <sup>2</sup><br>off<br>on                                                                                                                                                                                                                                               |
|                |                | 0<br>1         |                |                                                                         |                                                                         |                                                                         |                                                                         | <b>Testmode</b> <sup>3</sup><br>off<br>on                                                                                                                                                                                                                                                      |
|                |                |                | 0<br>1         |                                                                         |                                                                         |                                                                         |                                                                         | <b>Auto-Increment Mode</b> <sup>4</sup><br>off<br>on                                                                                                                                                                                                                                           |
|                |                |                |                | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>1<br>1<br>1<br>1<br>1<br>1 | 0<br>0<br>0<br>0<br>1<br>1<br>1<br>0<br>0<br>0<br>0<br>1<br>1<br>1<br>1 | 0<br>0<br>1<br>1<br>0<br>1<br>1<br>0<br>0<br>0<br>1<br>0<br>0<br>0<br>1 | 0<br>1<br>0<br>1<br>0<br>1<br>1<br>0<br>0<br>1<br>0<br>1<br>1<br>0<br>1 | Input Selector / Gain<br>Loudness<br>Volume<br>Treble<br>Bass<br>Speaker attenuator LF / Bass Fc select<br>Speaker attenuator RF<br>Speaker attenuator LR<br>Speaker attenuator RR<br>Subwoofer attenuator LSW<br>Subwoofer attenuator RSW<br>SoftMute / Mixing<br>Others selection<br>Testing |

<sup>1</sup> For more information see Soft Mute section<sup>2</sup> For more information see AutoZero-section<sup>3</sup> For more information see Test Programming block<sup>4</sup> If this bit is set to "on" the subaddress is automatically incremented after the transmission of a data-byte.  
Therefore a transmission of more than one byte without sending the new subaddress is possible.



## 2.5 DATA BYTE SPECIFICATION

### 2.5.1 Input Selector / Gain

| MSB            |                |                |                |                |                |                | LSB            | FUNCTION               |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                        |
|                |                |                |                |                | 0              | 0              | 0              | <b>Source Selector</b> |
|                |                |                |                |                | 0              | 0              | 1              | Not used               |
|                |                |                |                |                | 0              | 1              | 0              | Single Ended 1         |
|                |                |                |                |                | 0              | 1              | 1              | Mute                   |
|                |                |                |                |                | 1              | 0              | 0              | Single Ended 2         |
|                |                |                |                |                | 1              | 0              | 1              | Single Ended 4         |
|                |                |                |                |                | 1              | 1              | 0              | Single Ended 3         |
|                |                |                |                |                | 1              | 1              | 0              | <b>Mute</b>            |
|                |                |                |                |                | 1              | 1              | 1              | Beep                   |
| 0              | 0              | 0              | 0              | 0              |                |                |                | <b>Input Gain</b>      |
| 0              | 0              | 0              | 0              | 1              |                |                |                | 0dB                    |
| 0              | 0              | 0              | 1              | 0              |                |                |                | 1dB                    |
| 0              | 0              | 0              | 1              | 1              |                |                |                | 2dB                    |
| 0              | 0              | 1              | 0              | 0              |                |                |                | 3dB                    |
| 0              | 0              | 1              | 0              | 1              |                |                |                | 4dB                    |
| 0              | 0              | 1              | 1              | 0              |                |                |                | 5dB                    |
| 0              | 0              | 1              | 1              | 1              |                |                |                | 6dB                    |
| 0              | 1              | 0              | 0              | 0              |                |                |                | 7dB                    |
| 0              | 1              | 0              | 0              | 1              |                |                |                | 8dB                    |
| 0              | 1              | 0              | 1              | 0              |                |                |                | 9dB                    |
| 0              | 1              | 0              | 1              | 1              |                |                |                | 10dB                   |
| 0              | 1              | 1              | 0              | 0              |                |                |                | 11dB                   |
| 0              | 1              | 1              | 0              | 1              |                |                |                | 12dB                   |
| 0              | 1              | 1              | 1              | 0              |                |                |                | 13dB                   |
| 0              | 1              | 1              | 1              | 1              |                |                |                | 14dB                   |
| 0              | 1              | 1              | 1              | 1              |                |                |                | 16dB                   |
| 1              | X              | X              | X              | X              |                |                |                | 18dB                   |
| 1              | X              | X              | X              | X              |                |                |                | 20dB                   |

### 2.5.2 Loudness

| MSB            |                |                |                |                |                |                | LSB            | LOUDNESS                         |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                                  |
|                |                |                |                | 0              | 0              | 0              | 0              | <b>Attenuation</b>               |
|                |                |                |                | 0              | 0              | 0              | 1              | 0 dB                             |
|                |                |                |                | 1              | 1              | 1              | 0              | -1 dB                            |
|                |                |                |                | 1              | 1              | 1              | 1              | -14 dB                           |
|                |                |                |                | 1              | 1              | 1              | 1              | -15 dB                           |
|                | 0              | 0              | 0              |                |                |                |                | <b>Filter / Center Frequency</b> |
|                |                | 0              | 1              |                |                |                |                | off(flat) 'D6 must be = 0'       |
|                |                | 1              | 0              |                |                |                |                | 400Hz                            |
|                |                | 1              | 1              |                |                |                |                | 800Hz                            |
|                |                | 1              | 1              |                |                |                |                | 2.4KHz                           |
|                | 0              |                |                |                |                |                |                | <b>Shape</b>                     |
|                | 1              |                |                |                |                |                |                | Low Boost                        |
|                | 1              |                |                |                |                |                |                | Low & High Boost                 |
| 0              |                |                |                |                |                |                |                | <b>SoftStep-Volume</b>           |
| 1              |                |                |                |                |                |                |                | off                              |
| 1              |                |                |                |                |                |                |                | on                               |

Note 1: The attenuation is specified at high frequencies. Around the center frequency the value is different depending on the programmed attenuation (see Loudness-frequency-response).

## 2.5.3 Volume

| MSB            |                |                |                |                |                |                | LSB            | ATTENUATION      |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                  |
|                | 0              | 0              | 0              | 0              | 0              | 0              | 0              | Gain/Attenuation |
|                | 0              | 0              | 0              | 0              | 0              | 0              | 1              | not allow        |
|                | 0              | 0              | 0              | 0              | 0              | 1              | 0              | not allow        |
|                | 0              | 0              | 0              | 0              | 0              | 1              | 1              | +30.0dB          |
|                |                |                |                |                |                |                |                | +29.0dB          |
|                |                |                |                |                |                |                |                | :                |
|                | 0              | 0              | 1              | 1              | 1              | 1              | 1              | +1.0dB           |
|                | 0              | 1              | 0              | 0              | 0              | 0              | 0              | 0.0dB            |
|                | 0              | 1              | 0              | 0              | 0              | 0              | 1              | -1.0dB           |
|                | 0              | 1              | 0              | 0              | 0              | 1              | 0              | -2.0dB           |
|                |                |                |                |                |                |                |                | :                |
|                | 1              | 1              | 0              | 1              | 1              | 1              | 0              | -78.0dB          |
|                | 1              | 1              | 0              | 1              | 1              | 1              | 1              | -79.0dB          |
|                | 1              | 1              | 1              | X              | X              | X              | X              | Mute             |
| 0              |                |                |                |                |                |                |                | Must BE "0"      |

**Note 2:** It is not recommended to use a gain more than 20dB for system performance reason. In general, the max. gain should be limited by software to the maximum value, which is needed for the system.

## 2.5.4 Treble Programming

| MSB            |                |                |                |                |                |                | LSB            | BASS & TREBLE PROGRAMMING |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                           |
|                |                |                |                | 0              | 0              | 0              | 0              | Treble Steps              |
|                |                |                |                | 0              | 0              | 0              | 1              | 15dB                      |
|                |                |                |                | 0              | 0              | 1              | 0              | 14dB                      |
|                |                |                |                | 0              | 0              | 1              | 1              | 13dB                      |
|                |                |                |                | 0              | 1              | 0              | 0              | 12dB                      |
|                |                |                |                | 0              | 1              | 0              | 1              | 11dB                      |
|                |                |                |                | 0              | 1              | 1              | 0              | 10dB                      |
|                |                |                |                | 0              | 1              | 1              | 1              | 9dB                       |
|                |                |                |                | 0              | 1              | 1              | 1              | 8dB                       |
|                |                |                |                | 1              | 0              | 0              | 0              | 7dB                       |
|                |                |                |                | 1              | 0              | 0              | 1              | 6dB                       |
|                |                |                |                | 1              | 0              | 1              | 0              | 5dB                       |
|                |                |                |                | 1              | 0              | 1              | 1              | 4dB                       |
|                |                |                |                | 1              | 1              | 0              | 0              | 3dB                       |
|                |                |                |                | 1              | 1              | 0              | 1              | 2dB                       |
|                |                |                |                | 1              | 1              | 1              | 0              | 1dB                       |
|                |                |                |                | 1              | 1              | 1              | 1              | 0dB                       |
|                |                |                | 0              |                |                |                |                | Mode                      |
|                |                |                | 1              |                |                |                |                | Cut                       |
|                |                |                |                |                |                |                |                | Boost                     |
| X              | 0              | 0              |                |                |                |                |                | Treble Center Frequency   |
| X              | 0              | 1              |                |                |                |                |                | 10KHz                     |
| X              | 1              | 0              |                |                |                |                |                | 12.5KHz                   |
| X              | 1              | 1              |                |                |                |                |                | 15KHz                     |
|                |                |                |                |                |                |                |                | 17.5KHz                   |

## 2.5.5 Bass Programming

| MSB            |                  |                  |                |                                                                                   |                                                                                   |                                                                                        | LSB                                                                               | BASS & TREBLE PROGRAMMING                                                                                                                      |
|----------------|------------------|------------------|----------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| D <sub>7</sub> | D <sub>6</sub>   | D <sub>5</sub>   | D <sub>4</sub> | D <sub>3</sub>                                                                    | D <sub>2</sub>                                                                    | D <sub>1</sub>                                                                         | D <sub>0</sub>                                                                    |                                                                                                                                                |
|                |                  |                  |                | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | 0<br>0<br>0<br>0<br>1<br>1<br>1<br>0<br>0<br>0<br>0<br>1<br>1<br>1<br>1<br>1<br>1 | 0<br>0<br>1<br>1<br>0<br>0<br>1<br>1<br>0<br>0<br>1<br>1<br>0<br>0<br>0<br>0<br>0<br>0 | 0<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>0<br>1<br>1<br>0<br>1<br>0<br>1 | <b>Bass Steps</b><br>15dB<br>14dB<br>13dB<br>12dB<br>11dB<br>10dB<br>9dB<br>8dB<br>7dB<br>6dB<br>5dB<br>4dB<br>3dB<br>2dB<br><b>1dB</b><br>0dB |
|                |                  |                  | 0<br>1         |                                                                                   |                                                                                   |                                                                                        |                                                                                   | <b>Mode</b><br>Cut<br><b>Boost</b>                                                                                                             |
|                | 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                |                                                                                   |                                                                                   |                                                                                        |                                                                                   | <b>Quality Factor</b><br>1<br>1.25<br>1.5<br>2                                                                                                 |
| 0<br>1         |                  |                  |                |                                                                                   |                                                                                   |                                                                                        |                                                                                   | <b>DC - Mode</b><br>Off<br><b>On</b>                                                                                                           |

Note 3: For more information please refer to section Bass description

## 2.5.6 Speaker Attenuator Left Front

| MSB              |                  |                                                               |                                                                    |                                                                    |                                                                    |                                                                    | LSB                                                                | ATTENUATION / BASS CF                                                                                                                                      |
|------------------|------------------|---------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D <sub>7</sub>   | D <sub>6</sub>   | D <sub>5</sub>                                                | D <sub>4</sub>                                                     | D <sub>3</sub>                                                     | D <sub>2</sub>                                                     | D <sub>1</sub>                                                     | D <sub>0</sub>                                                     |                                                                                                                                                            |
|                  |                  | 0<br>0<br>:<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>1 | 0<br>0<br>:<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>X | 0<br>0<br>:<br>0<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>X | 0<br>0<br>:<br>1<br>0<br>0<br>0<br>1<br>1<br>1<br>1<br>1<br>1<br>X | 0<br>0<br>:<br>1<br>0<br>0<br>1<br>1<br>0<br>0<br>1<br>1<br>1<br>X | 0<br>1<br>:<br>1<br>0<br>1<br>0<br>1<br>1<br>0<br>1<br>1<br>1<br>X | <b>Attenuation</b><br>0 dB<br>-1 dB<br>:<br>-23 dB<br>-24.5dB<br>-26 dB<br>-28 dB<br>-30 dB<br>-32 dB<br>-35 dB<br>-40 dB<br>-50 dB<br><b>Speaker Mute</b> |
| 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                                                               |                                                                    |                                                                    |                                                                    |                                                                    |                                                                    | <b>Bass Center-Frequency</b><br>60Hz<br>80Hz<br>100Hz<br><b>200Hz</b>                                                                                      |

## 2.5.7 Speaker Attenuator Right Front

| MSB            |                |                |                |                |                |                | LSB            | ATTENUATION  |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |              |
|                |                | 0              | 0              | 0              | 0              | 0              | 0              | Attenuation  |
|                |                | 0              | 0              | 0              | 0              | 0              | 1              | 0 dB         |
|                |                | :              | :              | :              | :              | :              | :              | -1 dB        |
|                |                | 0              | 1              | 0              | 1              | 1              | 1              | :            |
|                |                | 0              | 1              | 1              | 0              | 0              | 0              | -23 dB       |
|                |                | 0              | 1              | 1              | 0              | 0              | 1              | -24.5dB      |
|                |                | 0              | 1              | 1              | 0              | 1              | 0              | -26 dB       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -28 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 0              | -30 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 1              | -32 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 0              | -35 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -40 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -50 dB       |
| X              | X              | 1              | X              | X              | X              | X              | X              | Speaker Mute |

## 2.5.8 Speaker Attenuator Left Rear

| MSB            |                |                |                |                |                |                | LSB            | ATTENUATION / Soft Step Time |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                              |
|                |                | 0              | 0              | 0              | 0              | 0              | 0              | Attenuation                  |
|                |                | 0              | 0              | 0              | 0              | 0              | 1              | 0 dB                         |
|                |                | :              | :              | :              | :              | :              | :              | -1 dB                        |
|                |                | 0              | 1              | 0              | 1              | 1              | 1              | :                            |
|                |                | 0              | 1              | 1              | 0              | 0              | 0              | -23 dB                       |
|                |                | 0              | 1              | 1              | 0              | 0              | 1              | -24.5dB                      |
|                |                | 0              | 1              | 1              | 0              | 1              | 0              | -26 dB                       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -28 dB                       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -30 dB                       |
|                |                | 0              | 1              | 1              | 1              | 0              | 0              | -32 dB                       |
|                |                | 0              | 1              | 1              | 1              | 0              | 1              | -35 dB                       |
|                |                | 0              | 1              | 1              | 1              | 1              | 0              | -40 dB                       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -50 dB                       |
| X              | X              | 1              | X              | X              | X              | X              | X              | Speaker Mute                 |

## 2.5.9 Speaker Attenuator Right Rear

| MSB            |                |                |                |                |                |                | LSB            | ATTENUATION  |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |              |
|                |                | 0              | 0              | 0              | 0              | 0              | 0              | Attenuation  |
|                |                | 0              | 0              | 0              | 0              | 0              | 1              | 0 dB         |
|                |                | :              | :              | :              | :              | :              | :              | -1 dB        |
|                |                | 0              | 1              | 0              | 1              | 1              | 1              | :            |
|                |                | 0              | 1              | 1              | 0              | 0              | 0              | -23 dB       |
|                |                | 0              | 1              | 1              | 0              | 0              | 1              | -24.5dB      |
|                |                | 0              | 1              | 1              | 0              | 1              | 0              | -26 dB       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -28 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 0              | -30 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 1              | -32 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 0              | -35 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -40 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -50 dB       |
| X              | X              | 1              | X              | X              | X              | X              | X              | Speaker Mute |

## 2.5.10 Subwoofer Attenuator (Left &amp; Right)

| MSB            |                |                |                |                |                |                | LSB            | FUNCTION     |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |              |
|                |                | 0              | 0              | 0              | 0              | 0              | 0              | Attenuation  |
|                |                | 0              | 0              | 0              | 0              | 0              | 1              | 0 dB         |
|                |                | :              | :              | :              | :              | :              | :              | -1 dB        |
|                |                | 0              | 1              | 0              | 1              | 1              | 1              | :            |
|                |                | 0              | 1              | 1              | 0              | 0              | 0              | -23 dB       |
|                |                | 0              | 1              | 1              | 0              | 0              | 1              | -24.5dB      |
|                |                | 0              | 1              | 1              | 0              | 1              | 0              | -26 dB       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -28 dB       |
|                |                | 0              | 1              | 1              | 0              | 1              | 1              | -30 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 0              | -32 dB       |
|                |                | 0              | 1              | 1              | 1              | 0              | 1              | -35 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 0              | -40 dB       |
|                |                | 0              | 1              | 1              | 1              | 1              | 1              | -50 dB       |
| X              | X              | 1              | X              | X              | X              | X              | X              | Speaker Mute |

## 2.5.11 SoftMute and Mixing

| MSB              |                  |                  |                  |                |                  |                  | LSB            | FUNCTION                                                                                |
|------------------|------------------|------------------|------------------|----------------|------------------|------------------|----------------|-----------------------------------------------------------------------------------------|
| D <sub>7</sub>   | D <sub>6</sub>   | D <sub>5</sub>   | D <sub>4</sub>   | D <sub>3</sub> | D <sub>2</sub>   | D <sub>1</sub>   | D <sub>0</sub> |                                                                                         |
|                  |                  |                  |                  |                |                  |                  | 0<br>1         | Mute<br>enable SoftMute<br>disable SoftMute                                             |
|                  |                  |                  |                  |                | 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                | Mute/Zero Cross-Times<br>0.48ms<br>0.96ms<br>30.7ms / 9ms<br>122.8ms / 37ms             |
|                  |                  |                  |                  | 0              |                  |                  |                | Must BE "0"                                                                             |
|                  |                  | 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                |                  |                  |                | Mixing-Level (Main / Mix-Source)<br>-12 / -2.5dB<br>-6 / -6dB<br>-3.5 / -0.6dB<br>0 / - |
| 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                  |                  |                |                  |                  |                | Beep Frequency<br>781Hz<br>1.56KHz<br>Not allow<br>1.8KHz                               |

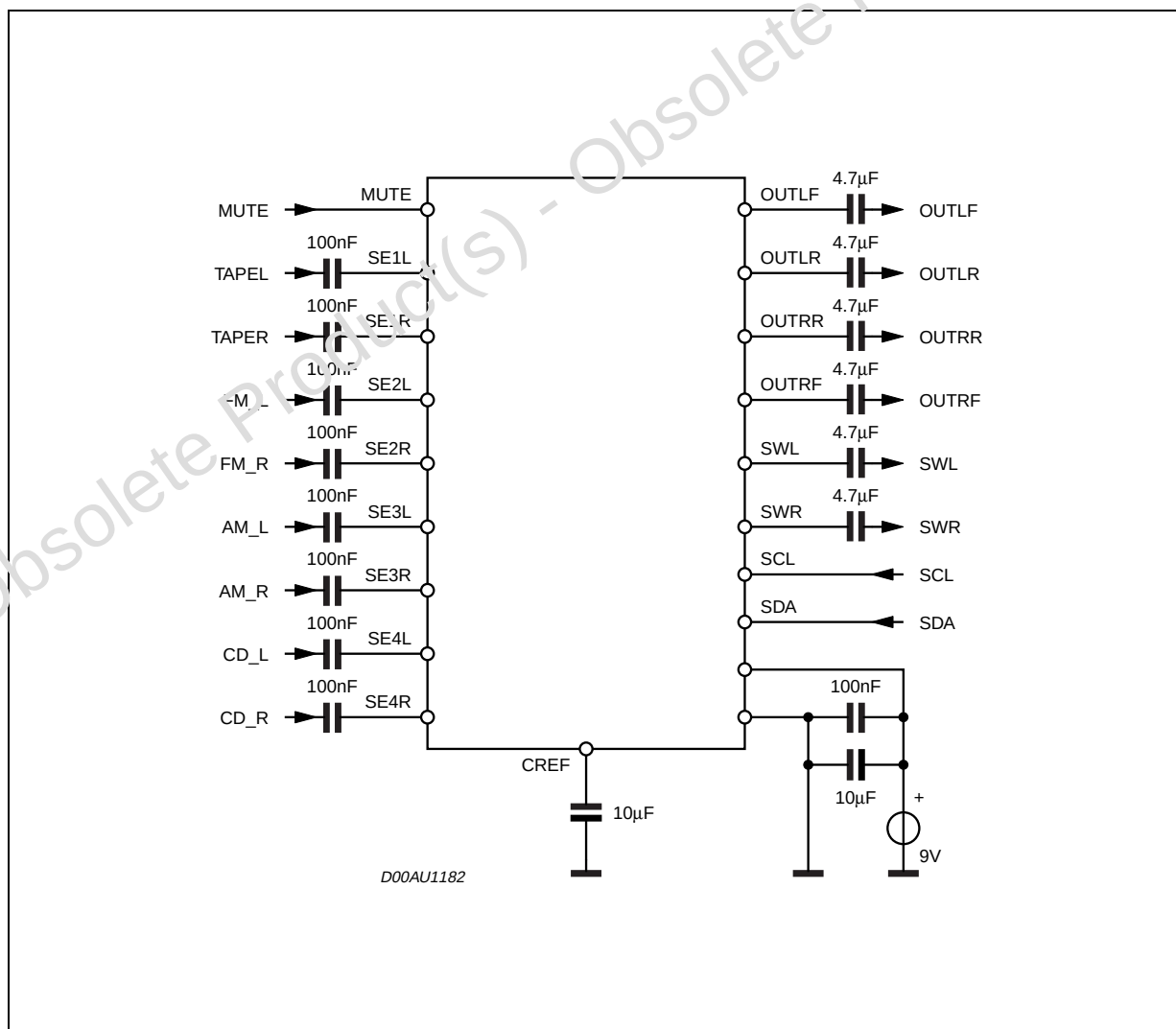
## 2.5.12 Others

| MSB            |                |                  |                  |                |                |                | LSB            | FUNCTION                                               |
|----------------|----------------|------------------|------------------|----------------|----------------|----------------|----------------|--------------------------------------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub>   | D <sub>4</sub>   | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                                                        |
|                |                |                  |                  |                |                | X              | 0              | AC-Coupling<br>Internal pass                           |
|                |                |                  |                  | 1              | 1              |                |                | Must be "1"<br>Must be "1"                             |
|                |                | 0<br>0<br>1<br>1 | 0<br>1<br>0<br>1 |                |                |                |                | Soft Step Time<br>0.68ms<br>1.26ms<br>2.52ms<br>5.04ms |
|                | 1              |                  |                  |                |                |                |                | Must be "1" for Auto zero                              |
| 0<br>1         |                |                  |                  |                |                |                |                | Internal Beep<br>Off<br>ON                             |

## 2.5.13 Testing

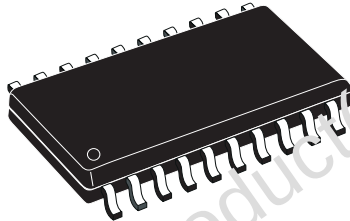
| MSB            |                |                |                |                |                |                | LSB            | Testing                                                               |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------------------------------------------------------------|
| D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |                                                                       |
|                |                | X<br>X         | X<br>X         | X<br>X         |                |                | 0<br>1         | Main-Testmode<br>off<br>on                                            |
|                |                | X<br>X         | X<br>X         | X<br>X         |                | 0<br>1         |                | Test-Multiplexer<br>internal 200kHz Clock<br>internal Bandgap Voltage |
|                |                | X<br>X         | X<br>X         | X<br>X         | 0<br>1         |                |                | Clock<br>external<br>internal                                         |
| 1              | 1              |                |                |                |                |                |                | must be "1"                                                           |

Figure 14. TDA7409 Application Circuit

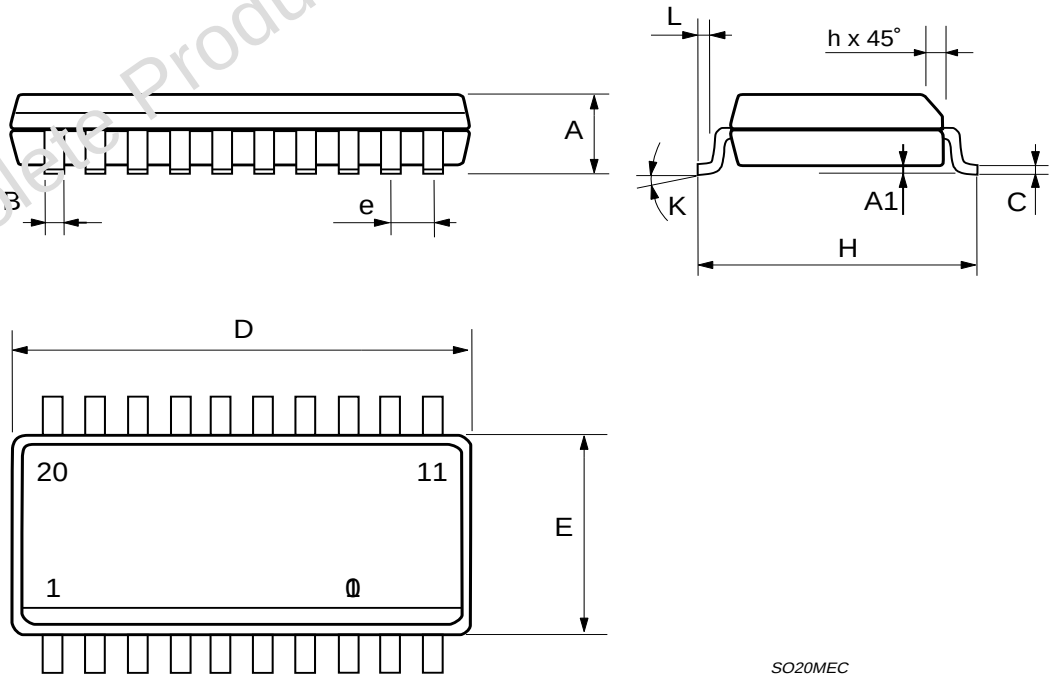


| DIM. | mm                 |      |       | inch  |       |       |
|------|--------------------|------|-------|-------|-------|-------|
|      | MIN.               | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.35               |      | 2.65  | 0.093 |       | 0.104 |
| A1   | 0.1                |      | 0.3   | 0.004 |       | 0.012 |
| B    | 0.33               |      | 0.51  | 0.013 |       | 0.020 |
| C    | 0.23               |      | 0.32  | 0.009 |       | 0.013 |
| D    | 12.6               |      | 13    | 0.496 |       | 0.512 |
| E    | 7.4                |      | 7.6   | 0.291 |       | 0.299 |
| e    |                    | 1.27 |       |       | 0.050 |       |
| H    | 10                 |      | 10.65 | 0.394 |       | 0.419 |
| h    | 0.25               |      | 0.75  | 0.010 |       | 0.030 |
| L    | 0.4                |      | 1.27  | 0.016 |       | 0.050 |
| K    | 0° (min.)8° (max.) |      |       |       |       |       |

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