



## CARRADIO-SIGNAL-PROCESSOR

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

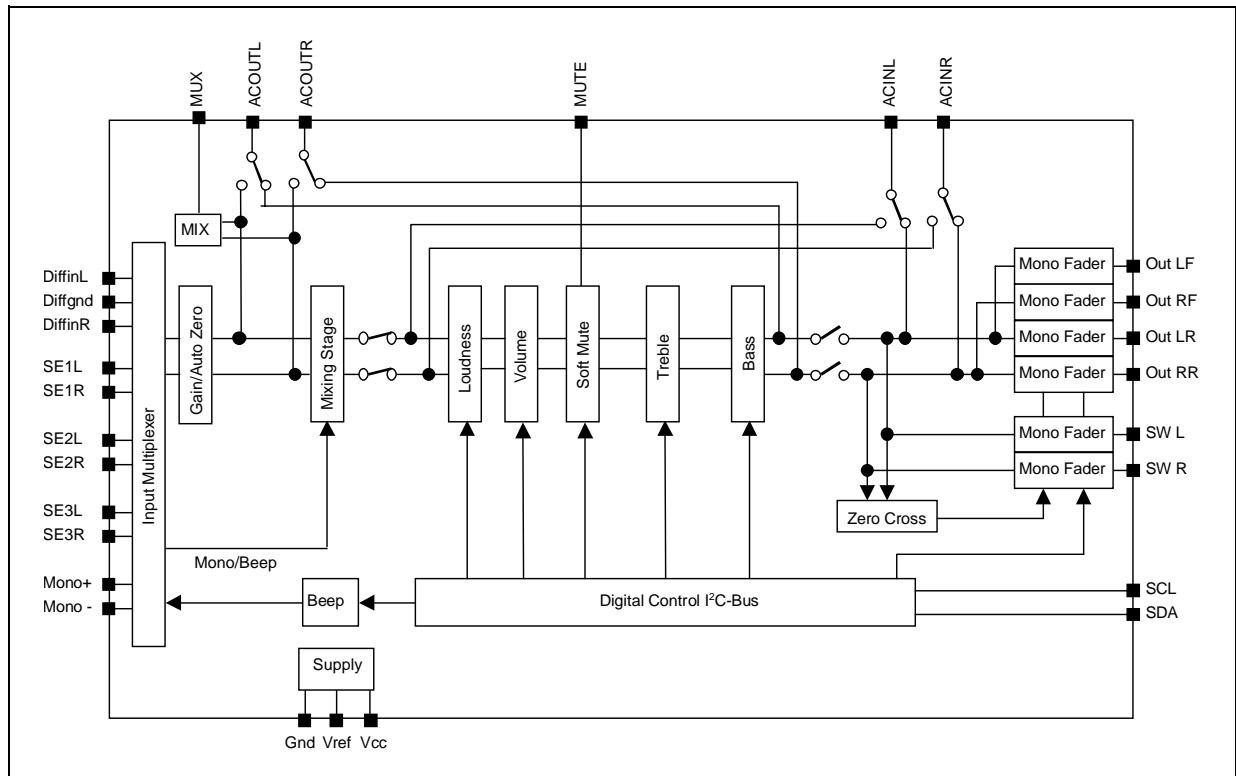


### DESCRIPTION

The TDA7404D is a high performance signal processor specifically designed for car radio applications. The device includes a high performance audiopro-

cessor 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



## TDA7404D

### 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

SE1L	1	28	ACOUTL
SE1R	2	27	ACOUTR
SE2L	3	26	VDD
SE2R	4	25	SDA
SE3L	5	24	SCL
SE3R	6	23	MUTE
Mono+	7	22	MUX
Mono-	8	21	OUTLF
DiffinR	9	20	OUTLR
Diffgnd	10	19	OUTRR
DiffinL	11	18	OUTRF
ACINR	12	17	SWL
ACINL	13	16	SWR
CREF	14	15	GND

**FEATURES:**

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

## TDA7404D

**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
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### 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

### P DIFFERENTIAL STEREO INPUTS

$R_{in}$	Input Resistance (see Figure 1)	Differential	70	100	130	$k\Omega$
$G_{CD}$	Gain	only at true differential input	-0.75	0	0.75	dB
			-5	-6	-7	dB
			-11	-12	-13	dB
CMRR	Common Mode Rejection Ratio	$V_{CM} = 1V_{RMS}$ @ 1kHz	40	70		dB
		$V_{CM} = 1V_{RMS}$ @ 10kHz	40	60		dB
$e_{NO}$	Output-Noise @ Speaker-Outputs	20Hz - 20kHz, flat; all stages 0 dB		9		V

### DIFFERENTIAL MONO INPUT

$R_{in}$	Input Resistance	Differential	39	56	73	$k\Omega$
CMRR	Common Mode Rejection Ratio	$V_{CM} = 1V_{RMS}$ @ 1kHz	40	70		dB
		$V_{CM} = 1V_{RMS}$ @ 10kHz	40	60		dB

### 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

## ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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## MIXING CONTROL

M <sub>LEVEL</sub>	Mixing Level	Main / Mix-Source		0/00		dB
		Main / Mix-Source	-8.5/-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 <sub>MAX</sub>	Max. Gain		28	30	32	dB
A <sub>MAX</sub>	Max. Attenuation		-83	-79	-75	dB
A <sub>STEP</sub>	Step Resolution		0.5	1	1.5	dB
E <sub>A</sub>	Attenuation Set Error	G = -20 to +20dB	-1	0	1	dB
		G = -80 to -20dB	-4	0	3	dB
E <sub>T</sub>	Tracking Error				2	dB
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

# TDA7404D

## ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>SOFT STEP</b>						
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
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

## ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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

## FADER 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
E <sub>E</sub>	Attenuation Set Error				2	dB
V <sub>DC</sub>	DC Steps	Adjacent Attenuation Steps		0.10	5	mV

## GENERAL

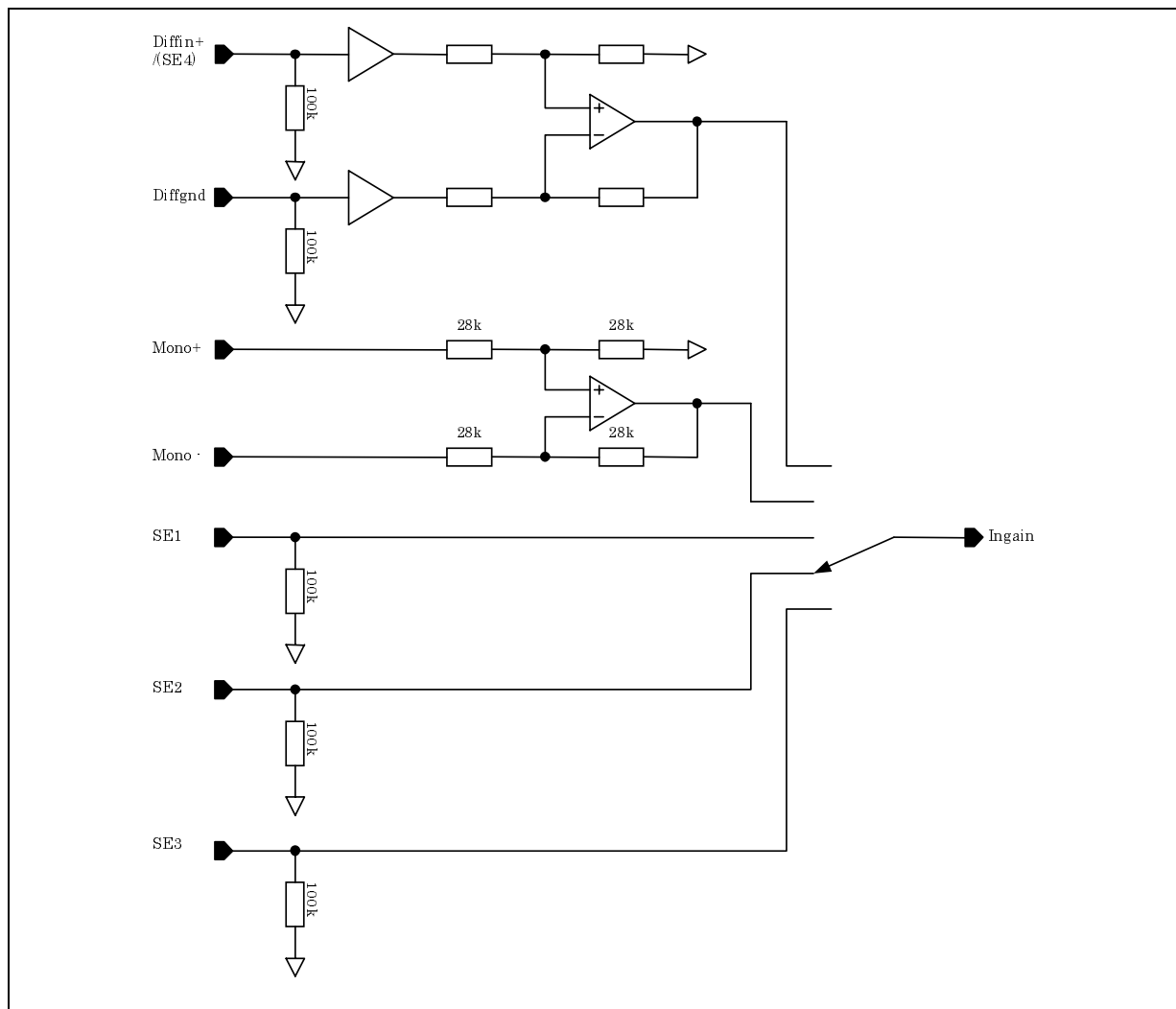
e <sub>NO</sub>	Output Noise	BW = 20Hz - 20kHz all gains = 0dB single ended inputs		10	15	μV
S/N	Signal to Noise Ratio	all gains = 0dB flat; V <sub>O</sub> = 2V <sub>RMS</sub>		106		dB
		bass, treble at +12dB; a-weighted; V <sub>O</sub> = 2.6V <sub>RMS</sub>		100		dB
d	Distortion	V <sub>IN</sub> = 1V <sub>RMS</sub> ; all stages 0dB internal pass only		0.005	0.1	%
		V <sub>OUT</sub> = 1V <sub>RMS</sub> ; Bass & Treble = 12dB		0.05	0.1	%
S <sub>C</sub>	Channel Separation left/right		80	100		dB
E <sub>T</sub>	Total Tracking Error	A <sub>V</sub> = 0 to -20dB	-1	0	1	dB
		A <sub>V</sub> = -20 to -60dB	-2	0	2	dB

1.0 DESCRIPTION OF FUNCTIONALITY

1.1 Input stages

Most of the input stages have remained the same as in preceding ST-Audioprocessors with exception of the CD-inputs (see Figure 1). In the meantime there are some CD-players in the market which have a significant high source-impedance which effects strongly the common-mode-rejection of the normal differential input stage. The additional buffer of the TDA7404D Diff -input avoids this drawback and offers the full common-mode-rejection even with those CD-players.

Figure 1. Input-stages



Note. It is possible that the Differential input is switched a single ended input (SE4) like SE1.. 3.

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.

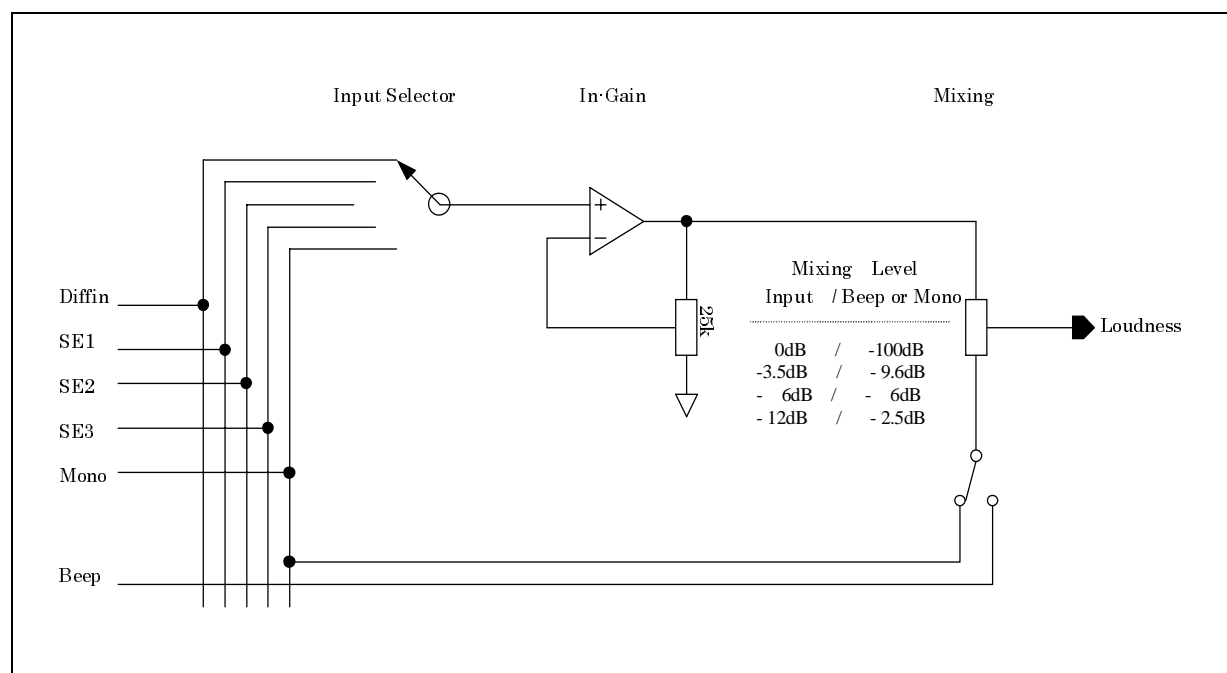
### 1.2.1 AutoZero-Remain

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 TDA7404D could be switched in the **AutoZero-Remain-Mode** (12 bit of the subaddress-byte). If this bit is set to high, the DATABYTE 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**



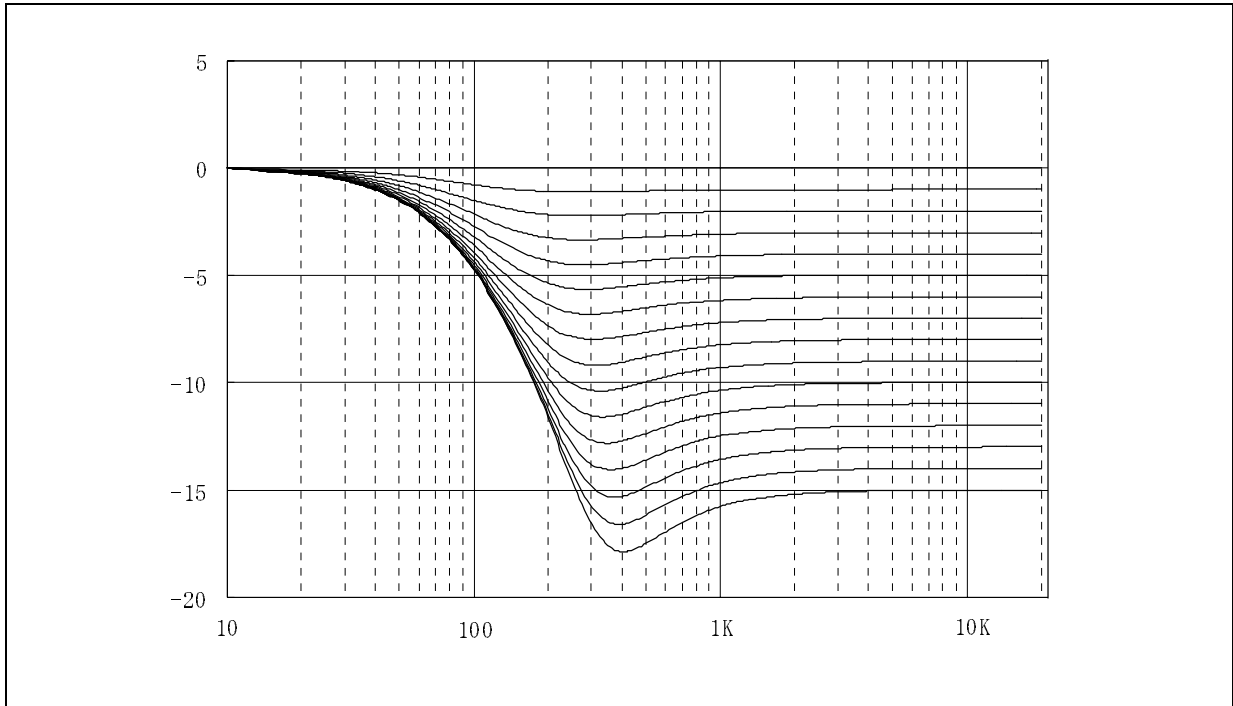
### 1.4 Loudness

There are four parameters programmable in the loudness stage:

#### 1.4.1 Attenuation

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

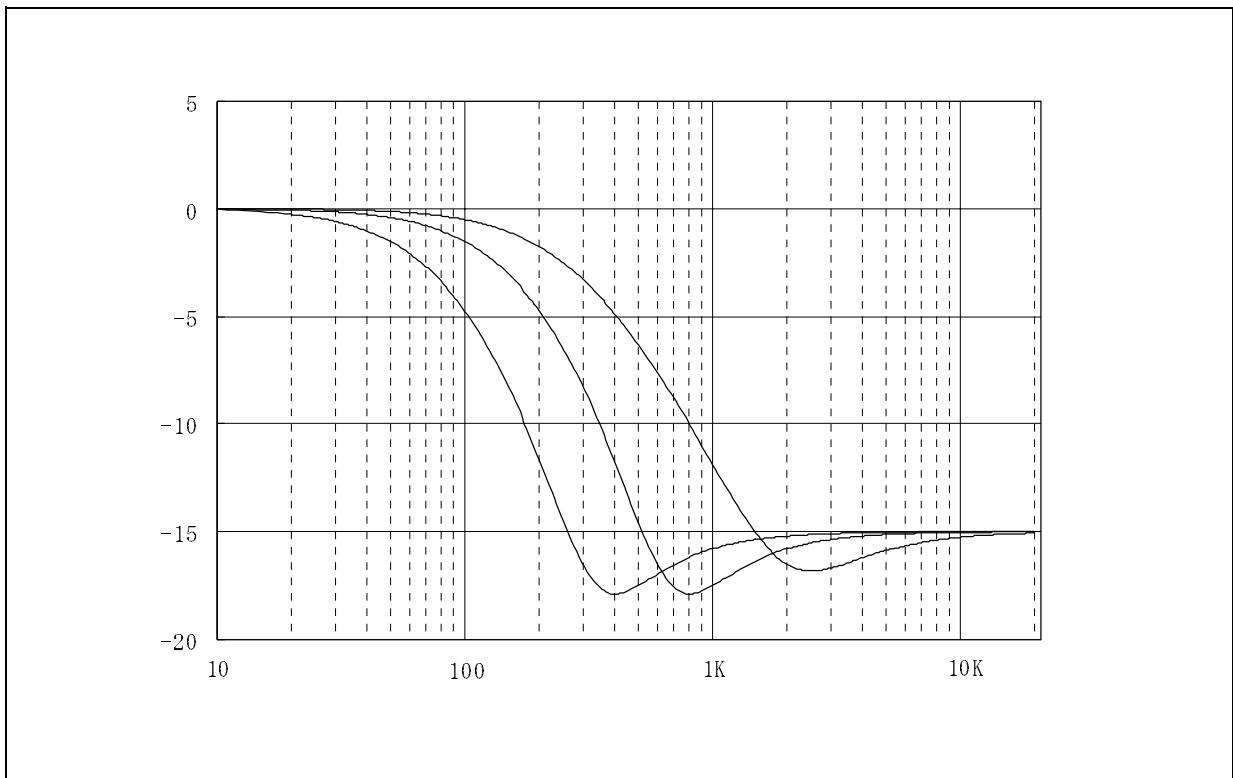
Figure 3. Loudness Attenuation @  $f_c = 400\text{Hz}$



1.4.2 Center Frequency

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

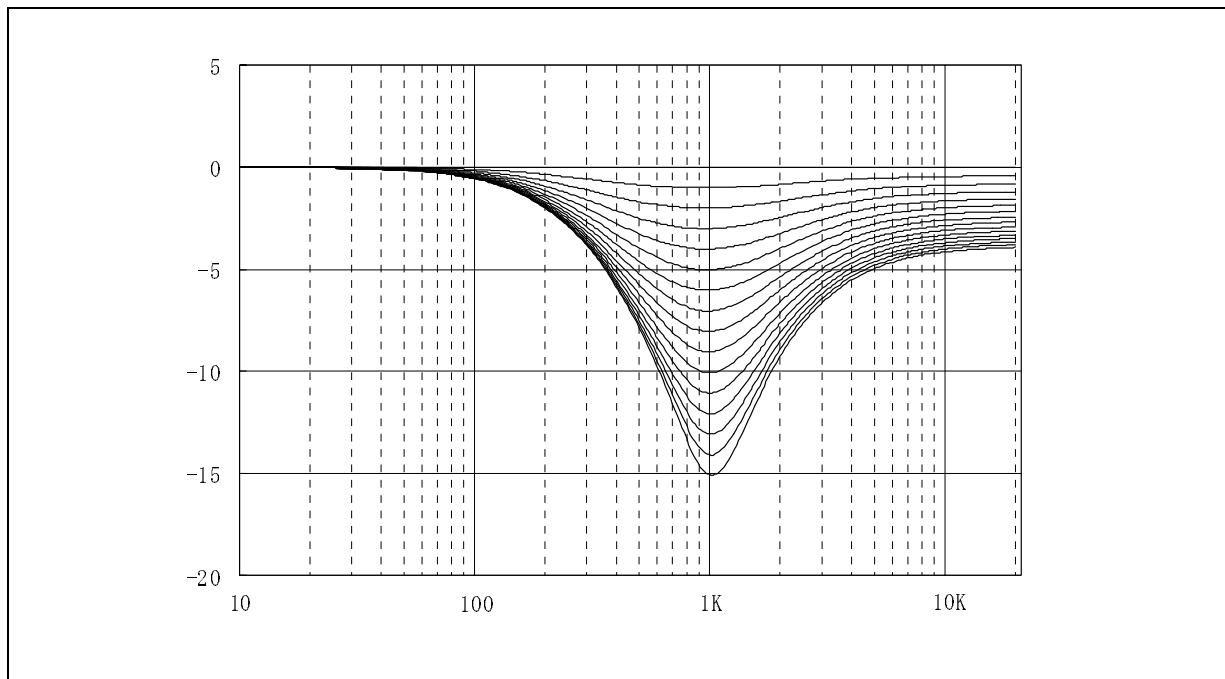
Figure 4. Loudness Center frequencies @ Attn. = 15dB



### 1.4.3 Low & High Frequency Boost

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

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

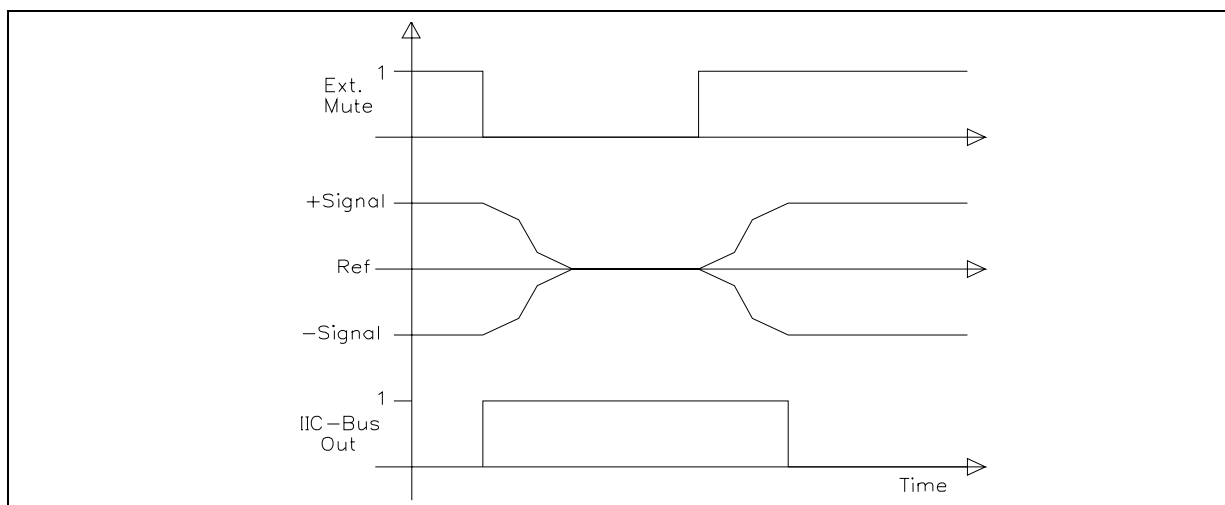


### 1.5 SoftMute

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 slow 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**

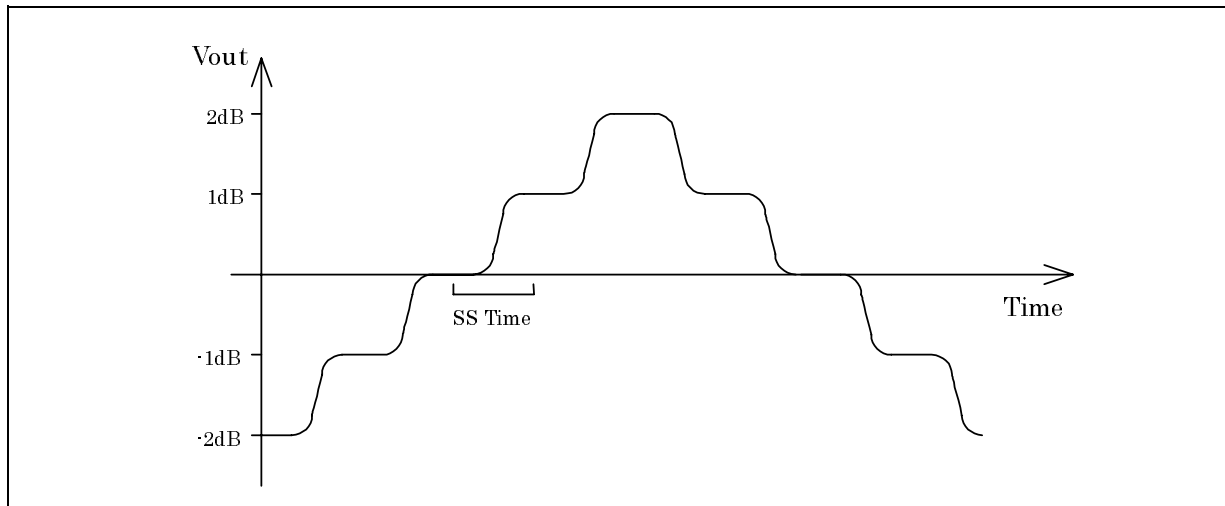


Note: Please notice that a started Mute-action is always terminated and could not be interrupted by a change of the mute -signal.

**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.

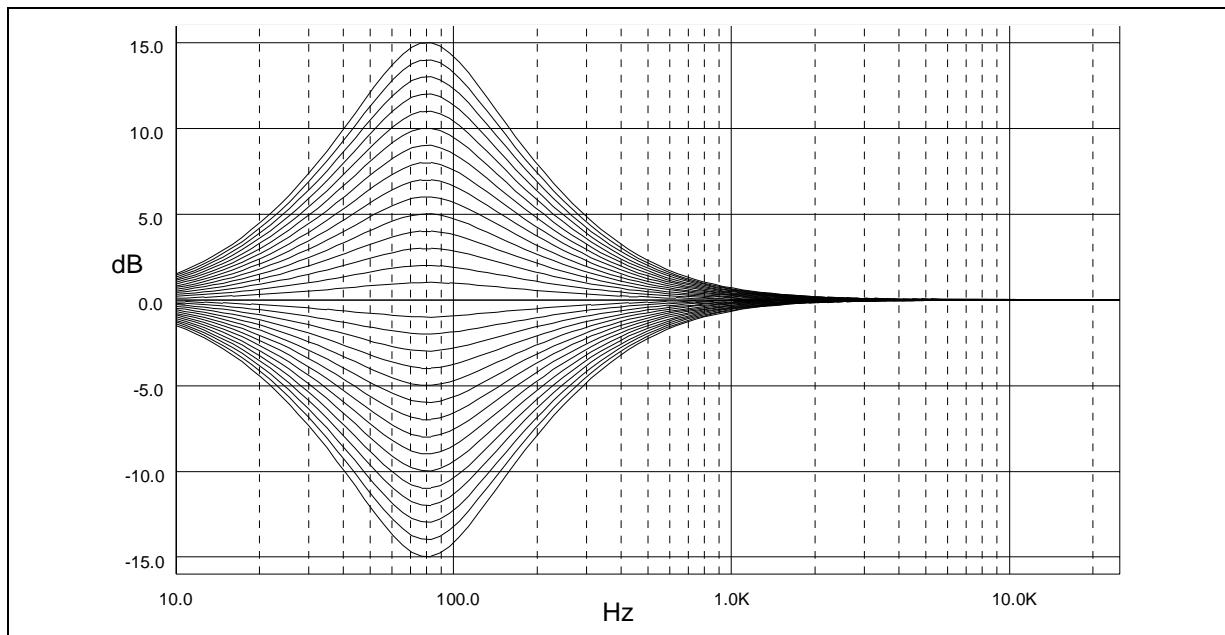
**1.7 Bass**

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.

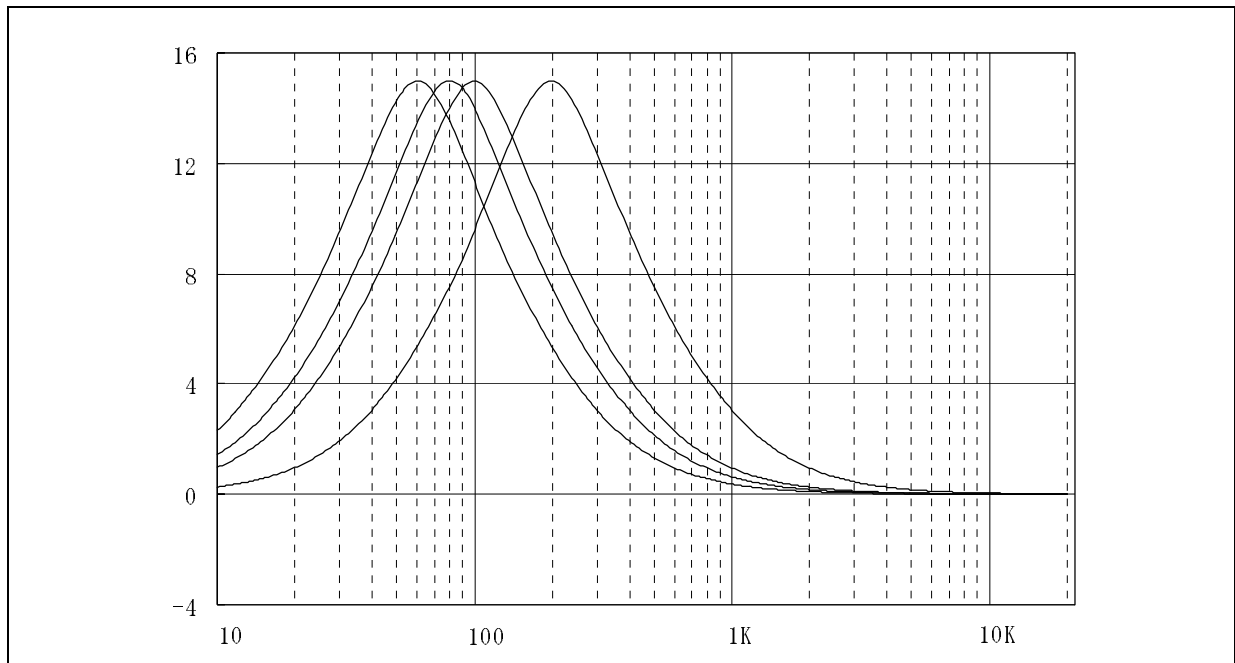
**Figure 8. Bass Control @ fC = 80Hz, Q = 1**



### 1.7.2 Center Frequency

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

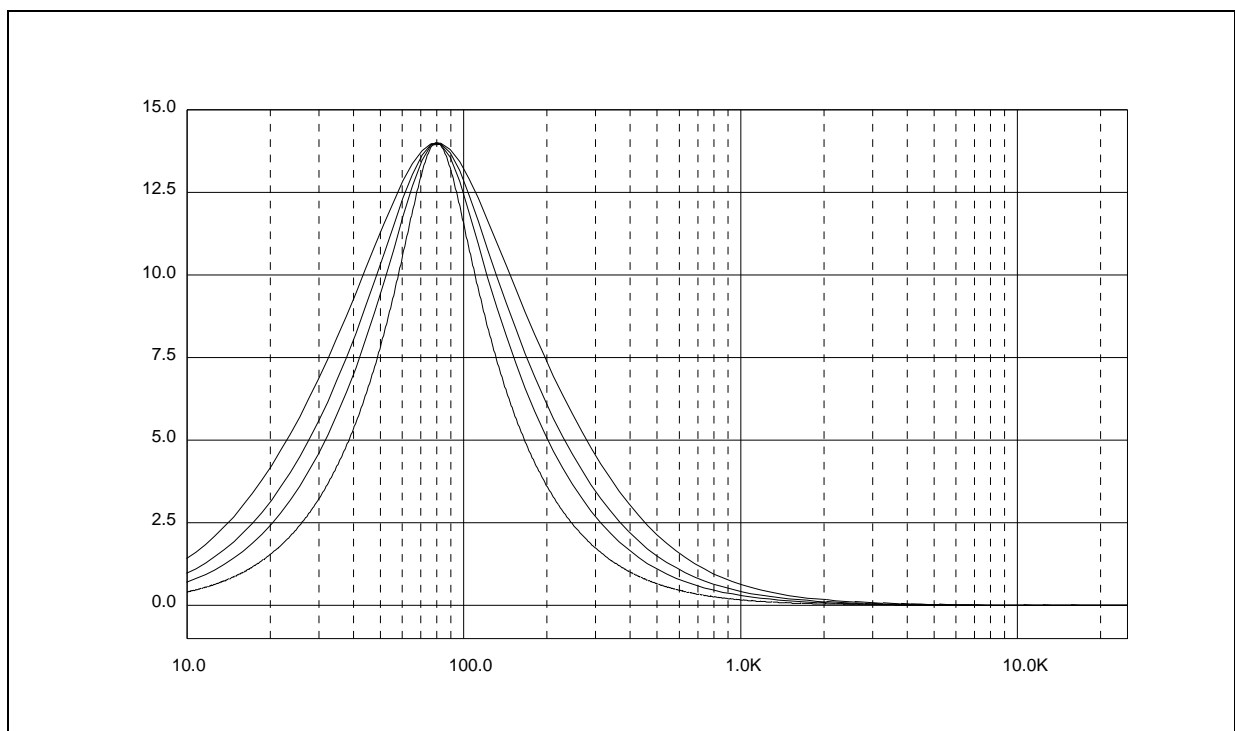
**Figure 9. Bass center Frequencies @ Gain = 15dB, Q = 1**



### 1.7.3 Quality Factors

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

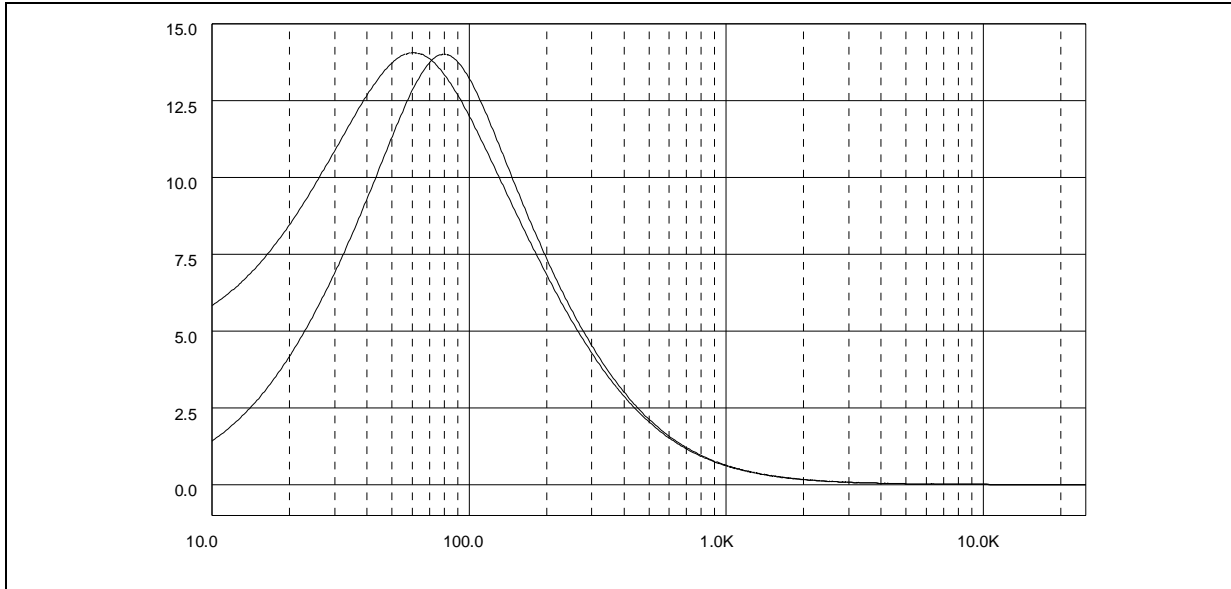
**Figure 10. Bass Quality factors @ Gain = 14dB, fC = 80Hz**



**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.

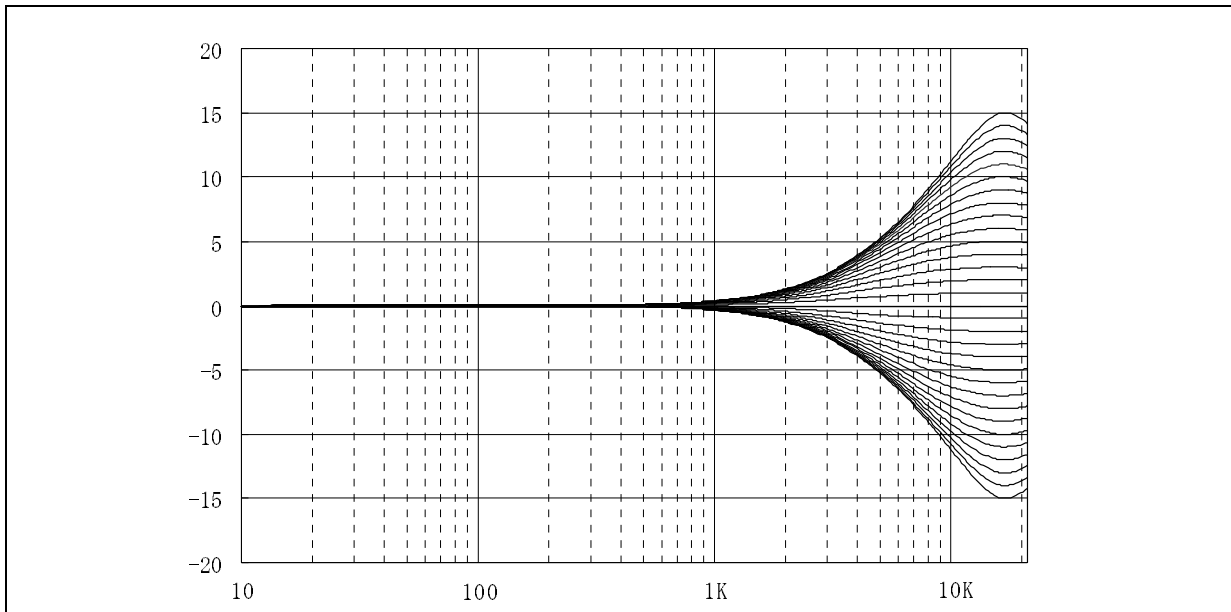
**1.8 Treble**

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.

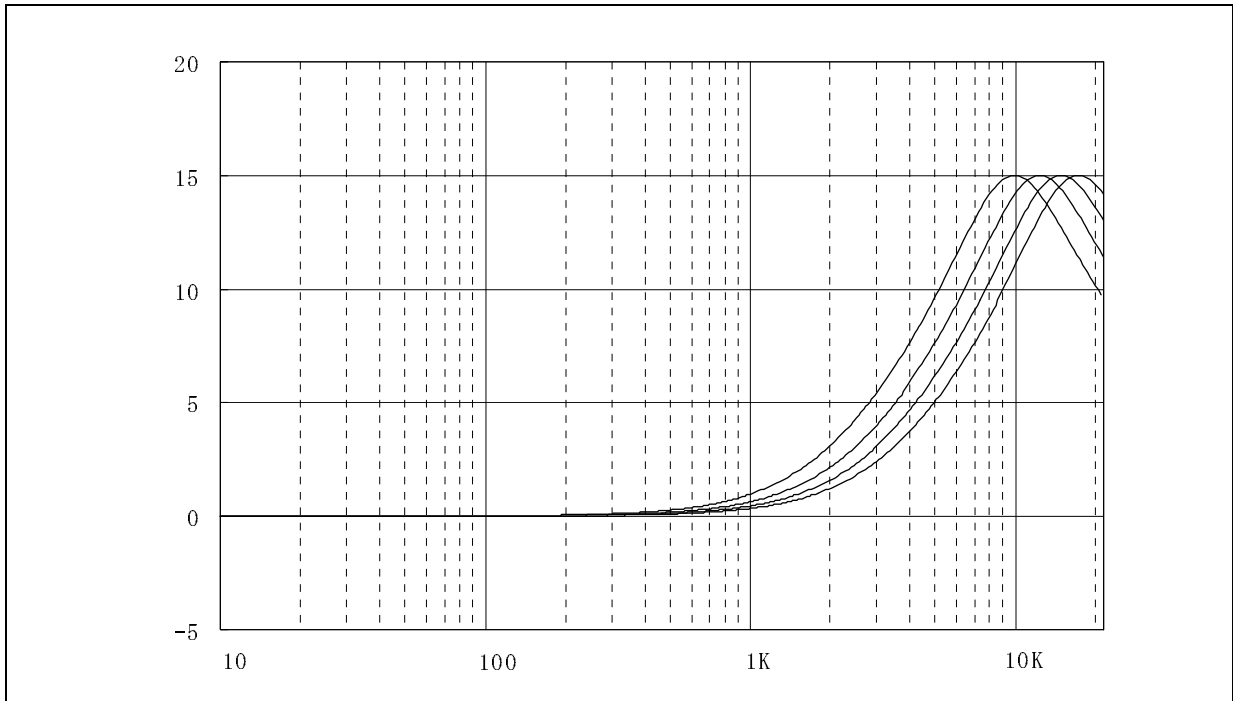
**Figure 12. Treble Control @  $f_c = 17.5\text{kHz}$**



### 1.8.2 Center Frequency

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

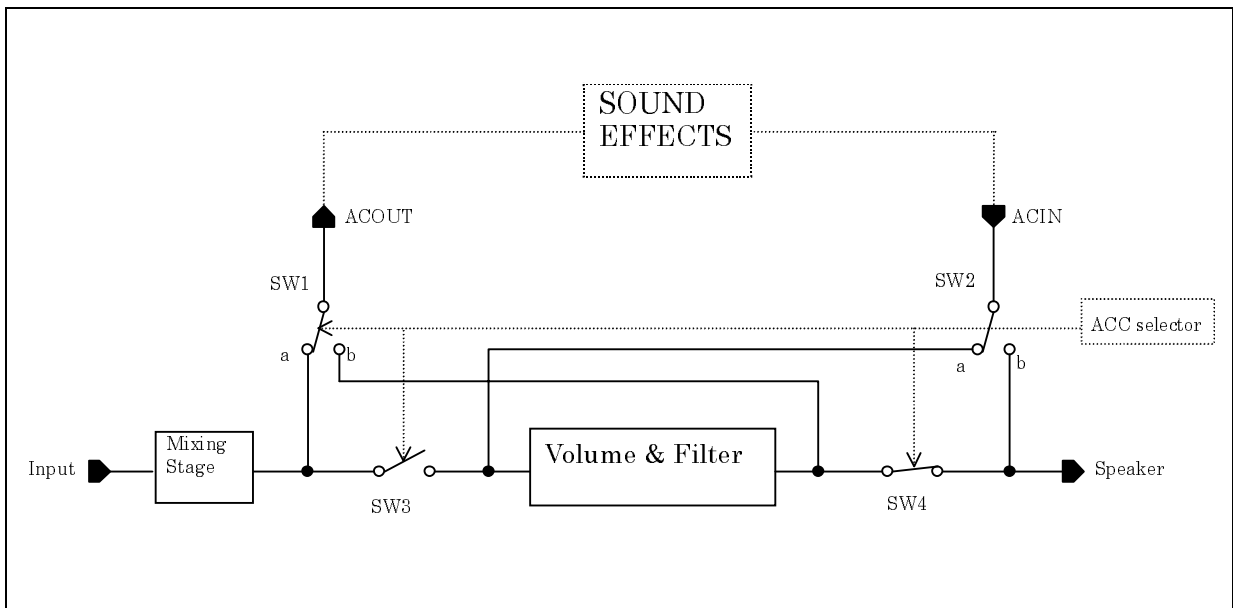
**Figure 13. Treble Center Frequencies @ Gain = 15dB**



### 1.9 External AC - Coupling

TDA7404D has external AC - coupling terminals which can be selected one of two positions behind the Mixing stage or Bass filter.

**Figure 14. External AC - Coupling**



## TDA7404D

The External AC - Coupling is selected in position of four switches controlled by the lower 2bit in the Others selection. (See table)

### Others selection

D1	D0	Switch position
X	0	SW3 = ON , SW4 = ON (selected internal pass), SW1 = b , SW2 = open
0	1	SW3 = OFF , SW4 = ON, SW1 = a , SW2 = a
1	1	SW3 = ON , SW4 = OFF, SW1 = b , SW2 = b

### 1.10 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).

### 1.11 Subwoofer Attenuator

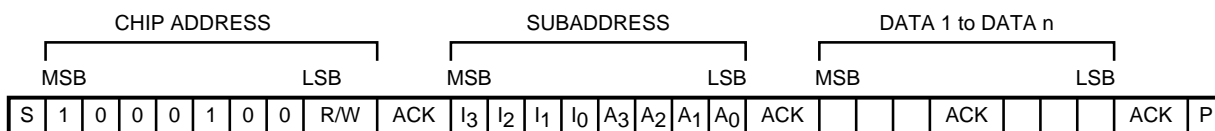
The Subwoofer output is a single ended stereo output. The attenuator is exactly the same like the other speakers.

## 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 1								<b>Zero cross / Soft Mute</b> <sup>1</sup> Zero Cross available Soft Mute available	
	0 1							<b>AutoZero Remain</b> <sup>2</sup> off on	
		0 1						<b>Testmode</b> <sup>3</sup> off on	
			0 1					<b>Auto-Increment Mode</b> <sup>4</sup> off on	
				0 0 0 0 0 0 0 0 1 1 1 1 1 1	0 0 0 0 1 1 1 0 0 1 0 1 1	0 0 1 1 0 1 1 0 0 1 1 0 0	0 1 0 1 0 1 0 1 0 1 0 0 0 1	Input Selector / Gain Loudness Volume Treble Bass Speaker attenuator LF / Bass Fc select Speaker attenuator RF Speaker attenuator LR Speaker attenuator RR Subwoofer attenuator LSW Subwoofer attenuator RSW SoftMute / Mixing Others selection 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 "1", 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
D7	D6	D5	D4	D3	D2	D1	D0	
					0	0	0	<b>Source Selector</b> Mono Differential
					0	0	1	Single Ended 1
					0	1	0	Mute
					0	1	1	Single Ended 2
					1	0	0	Pseudo Differential / Single Ended 4
					1	0	1	Single Ended 3
					<b>1</b>	<b>1</b>	<b>0</b>	<b>Mute</b>
					1	1	1	Beep
0	0	0	0	0				<b>Input Gain</b> 0dB
0	0	0	0	1				1dB
0	0	0	1	0				2dB
0	0	0	1	1				3dB
0	0	1	0	0				4dB
0	0	1	0	1				5dB
0	0	1	1	0				6dB
0	0	1	1	1				7dB
0	1	0	0	0				8dB
0	1	0	0	1				9dB
0	1	0	1	0				10dB
0	1	0	1	1				11dB
0	1	1	0	0				12dB
0	1	1	0	1				13dB
0	1	1	1	0				14dB
0	1	1	1	1				16dB
1	X	X	X	0				18dB
1	X	X	X	1				<b>20dB</b>

2.5.2 Loudness

MSB							LSB	LOUDNESS
D7	D6	D5	D4	D3	D2	D1	D0	
				0	0	0	0	<b>Attenuation</b> 0 dB
				0	0	0	1	-1 dB
				:	:	:	:	:
				<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>-14 dB</b>
				1	1	1	1	-15 dB
	0	0	0					<b>Filter / Center Frequency</b> off(flat) 'D6 must be = 0'
		0	1					400Hz
		1	0					800Hz
		<b>1</b>	<b>1</b>					<b>2.4KHz</b>
	0							<b>Shape</b> Low Boost
	<b>1</b>							<b>Low &amp; High Boost</b>
0								<b>SoftStep-Volume</b> off
<b>1</b>								<b>on</b>

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
D7	D6	D5	D4	D3	D2	D1	D0	
	0	0	0	0	0	0	0	<b>Gain/Attenuation</b>
	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	<b>Mute</b>
0								<b>Diffin - mode</b>
1								Single ended stereo
								Differential Stereo

**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
D7	D6	D5	D4	D3	D2	D1	D0	
				0	0	0	0	<b>Treble Steps</b>
				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
				1	0	0	0	8dB
				1	0	0	1	7dB
				1	0	1	0	6dB
				1	0	1	1	5dB
				1	1	0	0	4dB
				1	1	0	1	3dB
				1	1	0	1	2dB
				1	1	1	0	<b>1dB</b>
				1	1	1	1	0dB
			0					<b>Mode</b>
			1					Cut
								<b>Boost</b>
								<b>Treble Center Frequency</b>
X	0	0						10KHz
X	0	1						12.5KHz
X	1	0						15KHz
X	1	1						17.5KHz

2.5.5 Bass Programming

MSB							LSB	BASS & TREBLE PROGRAMMING
D7	D6	D5	D4	D3	D2	D1	D0	
				0	0	0	0	<b>Bass Steps</b>
				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
				1	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	<b>1dB</b>
				1	1	1	1	0dB
			0					<b>Mode</b>
			1					Cut
								<b>Boost</b>
	0	0						<b>Quality Factor</b>
	0	1						1
	1	0						1.25
	1	1						1.5
								<b>2</b>
0								<b>DC - Mode</b>
1								Off
								<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
D7	D6	D5	D4	D3	D2	D1	D0	
		0	0	0	0	0	0	<b>Attenuation</b>
		0	0	0	0	0	1	0 dB
		:	:	:	:	:	:	-1 dB
		0	1	0	1	1	1	-23 dB
		0	1	1	0	0	0	-24.5dB
		0	1	1	0	0	1	-26 dB
		0	1	1	0	1	0	-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
		1	X	X	X	X	X	<b>Speaker Mute</b>
0	0							<b>Bass Center-Frequency</b>
0	1							60Hz
1	0							80Hz
1	1							100Hz
								<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 dB
		0	0	0	0	0	1	-1 dB
		:	:	:	:	:	:	:
		0	1	0	1	1	1	-23 dB
		0	1	1	0	0	0	-24.5dB
		0	1	1	0	0	1	-26 dB
		0	1	1	0	1	0	-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

## 2.5.8 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 dB
		0	0	0	0	0	1	-1 dB
		:	:	:	:	:	:	:
		0	1	0	1	1	1	-23 dB
		0	1	1	0	0	0	-24.5dB
		0	1	1	0	0	1	-26 dB
		0	1	1	0	1	0	-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
D7	D6	D5	D4	D3	D2	D1	D0	
		0	0	0	0	0	0	0 dB
		0	0	0	0	0	1	-1 dB
		:	:	:	:	:	:	:
		0	1	0	1	1	1	-23 dB
		0	1	1	0	0	0	-24.5dB
		0	1	1	0	0	1	-26 dB
		0	1	1	0	1	0	-28 dB
		0	1	1	0	1	1	-30 dB
		0	1	1	1	0	0	-32 dB
		0	1	1	1	1	0	-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

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

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
		0	0	0	0	0	0	0 dB
		0	0	0	0	0	1	-1 dB
		:	:	:	:	:	:	:
		0	1	0	1	1	1	-23 dB
		0	1	1	0	0	0	-24.5dB
		0	1	1	0	0	1	-26 dB
		0	1	1	0	1	0	-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
D7	D6	D5	D4	D3	D2	D1	D0	
							0 1	<b>Mute</b> enable SoftMute disable SoftMute
					0 0 1 1	0 1 0 1		<b>Mute/Zero Cross-Times</b> 0.48ms 0.96ms 30.7ms / 9ms <b>122.8ms / 37ms</b>
				0 1				Mixing-Source Beep <b>Phone</b>
		0 0 1 1	0 1 0 1					<b>Mixing-Level (Main / Mix-Source)</b> -12 / -2.5dB -6 / -6dB -3.5 / -9.6dB <b>0 / ∞</b>
0 0 1 1	0 1 0 1							<b>Beep Frequency</b> 781Hz 1.56KHz Not allow <b>1.8KHz</b>

## 2.5.12 Others

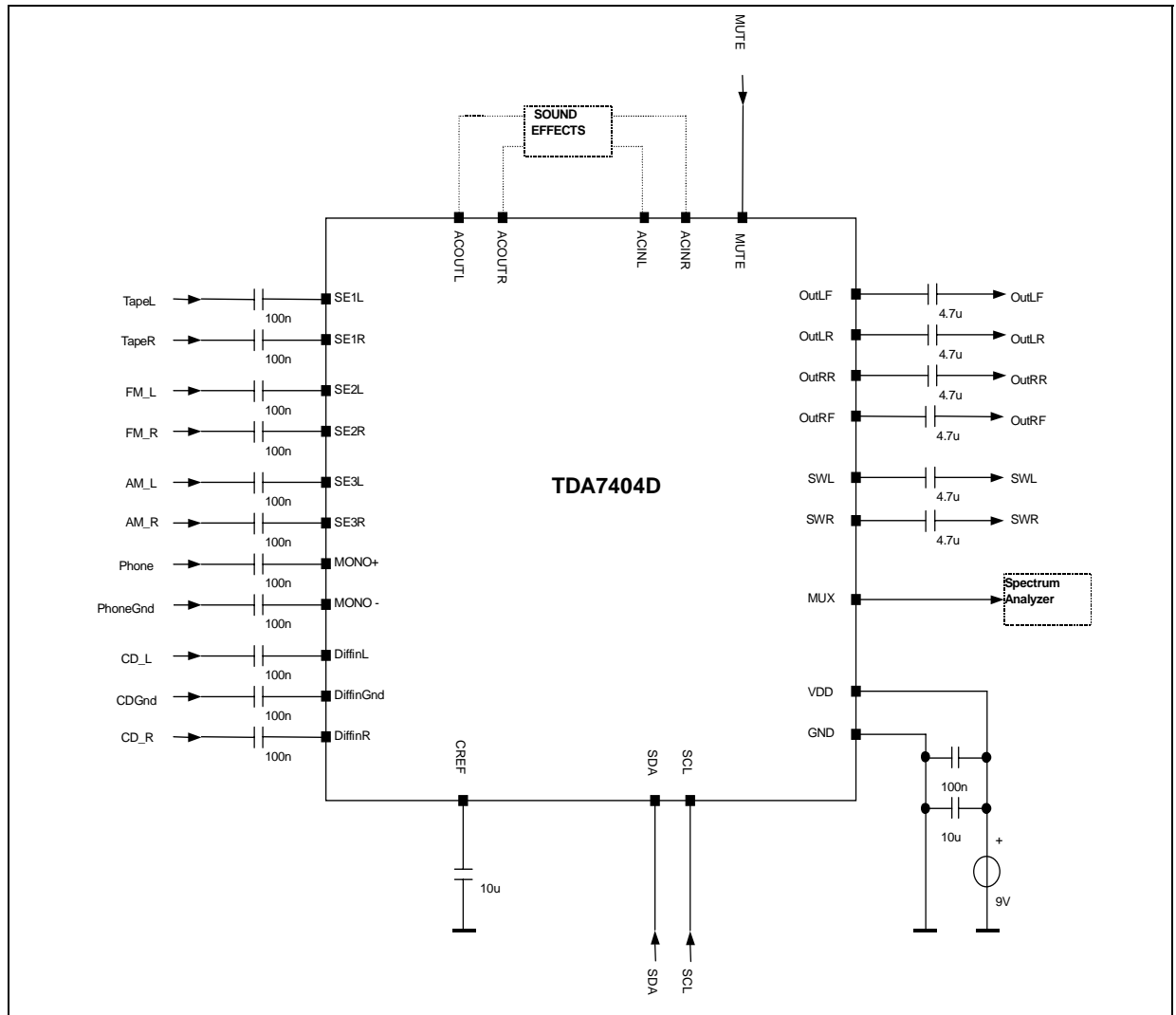
MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
						X 0 1	0 1 1	<b>AC-Coupling</b> <b>Internal pass</b> Coupling between Mixing Stage and Volume Coupling between Bass filter and Speaker attenuator
				1	1			Must be "1" for make up Must be "1" for make up
		0 0 1 1	0 1 0 1					<b>Soft Step Time</b> 0.68ms 1.26ms 2.52ms <b>5.04ms</b>
	1							Must be "1" for Auto zero
0 1								<b>Internal Beep</b> Off <b>ON</b>

# TDA7404D

## 2.5.13 Testing

MSB							LSB	Testing
D7	D6	D5	D4	D3	D2	D1	D0	
		X X	X X	X X			0 1	<b>Main-Testmode</b> off on
		X X	X X	X X		0 1		<b>Test-Multiplexer</b> internal 200kHz Clock <b>internal Bandgap Voltage</b>
		X X	X X	X X	0 1			<b>Clock</b> external <b>internal</b>
1	1							must be "1"

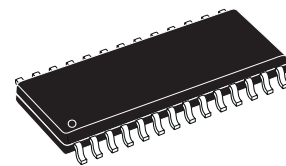
Figure 15. TDA7404D Application Circuit



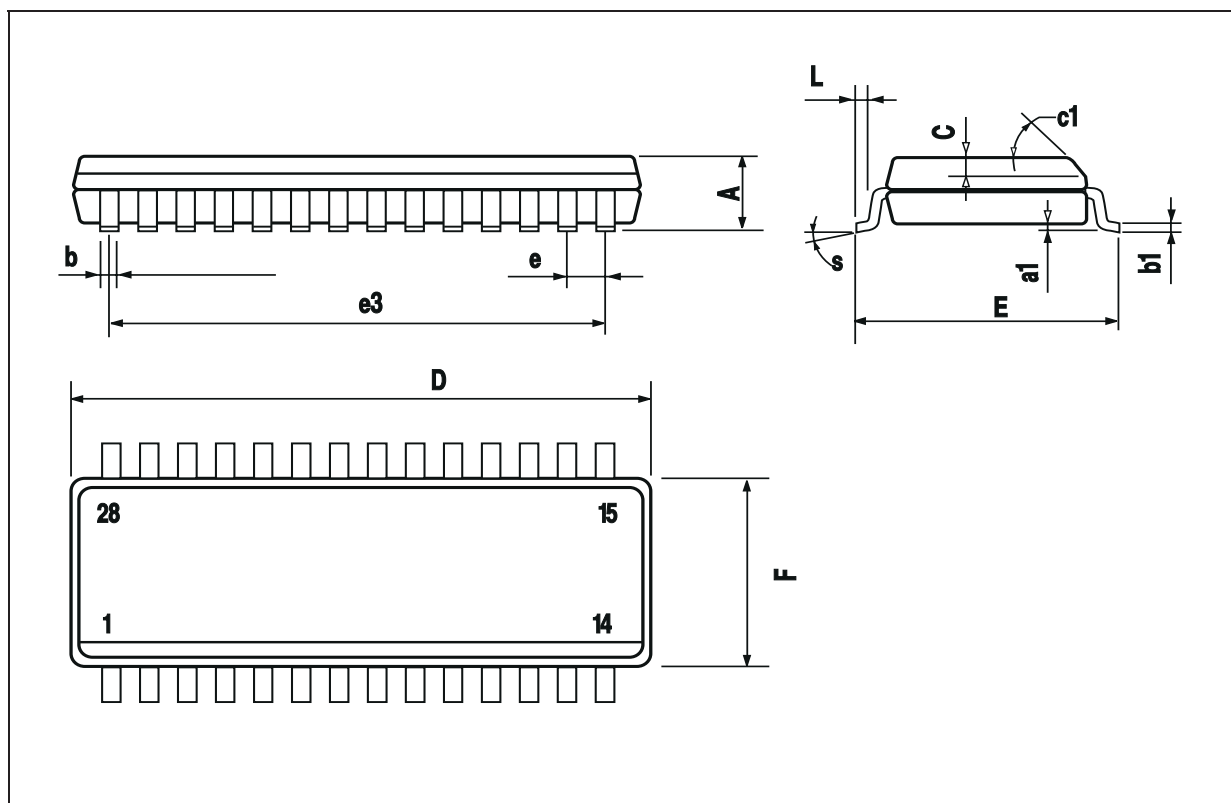


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.3	0.004		0.012
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1	45° (typ.)					
D	17.7		18.1	0.697		0.713
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		16.51			0.65	
F	7.4		7.6	0.291		0.299
L	0.4		1.27	0.016		0.050
S	8° (max.)					

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