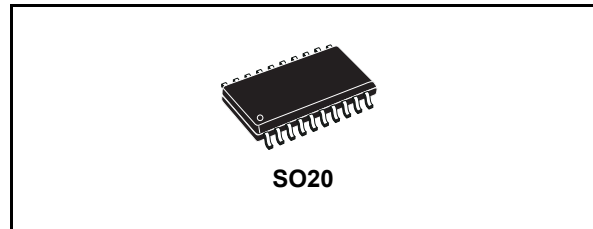


3 band car audio processor

Features

- Input multiplexer
 - PD/SE4: pseudo differential stereo input, programmable as single-ended input
 - SE1: stereo single-end input
 - SE2: stereo single-end input
 - SE3: stereo single-end input
 - Input gain adjust from 0 to 15dB with 1dB steps
 - Internal offset-cancellation (AutoZero)
- Loudness
 - Second order frequency response
 - Programmable center frequency (400 Hz / 800 Hz / 2400 Hz)
 - 15dB with 1dB steps
 - Selectable low and high frequency boost
 - Selectable flat-mode (constant attenuation)
- Volume
 - +15dB to -79dB with 1dB step resolution
 - Soft-step control with programmable blend times
- Bass
 - Second order frequency response
 - Center frequency programmable in 4 steps (60 Hz / 80 Hz / 100 Hz / 200 Hz)
 - Q programmable 1.0/1.25/1.5/2.0
 - DC gain programmable
 - -15 to 15dB range with 1dB resolution
- Middle
 - Second order frequency response
 - Center frequency programmable in 4 steps (500 Hz / 1 kHz / 1.5 kHz / 2.5 kHz)



- Q programmable 0.5/0.75/1.0/1.25
- -15 to 15dB range with 1dB resolution
- Treble
 - Second order frequency response
 - Center frequency programmable in 4 steps (10 kHz / 12.5 kHz / 15 kHz / 17.5 kHz)
 - -15 to 15dB range with 1dB resolution
- Speaker
 - 4 independent soft step speaker controls, +15dB to -79dB with 1dB steps direct mute
- Subwoofer
 - Single-ended mono output
 - Independent soft step level control, +15dB to -79dB with 1dB steps
- Mute functions
 - Direct mute
 - Digitally controlled SoftMute with 3 programmable mute-times (0.48 ms / 0.96 ms / 123 ms)

Description

The TDA7418 includes a high performance audio processor with fully integrated 3-Band filters to process signals at audible frequencies. The digital control allows a full programming of the audioprocessor and filters characteristics.

Table 1. Device summary

Order code	Temp range, °C	Package	Packing
TDA7418	-40 to +85	SO20	Tube
TDA7418TR	-40 to +85	SO20	Tape and reel

Contents

- 1 Block diagram 6**
- 2 Pin description 7**
 - 2.1 Connection diagram 7
 - 2.2 Pin list 7
- 3 Electrical specification 8**
 - 3.1 Absolute maximum ratings 8
 - 3.2 Electrical characteristics 8
- 4 Description of the audioprocessor 12**
 - 4.1 Input stages 12
 - 4.2 AutoZero 12
 - 4.3 Loudness 13
 - 4.3.1 Attenuation 13
 - 4.3.2 Peak frequency 13
 - 4.3.3 Low and high frequency boost 14
 - 4.3.4 Flat mode 14
 - 4.4 SoftMute 14
 - 4.5 SoftStep volume 15
 - 4.6 Bass 15
 - 4.6.1 Attenuation 15
 - 4.6.2 Center frequency 16
 - 4.6.3 Quality factors 16
 - 4.6.4 DC mode 16
 - 4.7 Middle 17
 - 4.7.1 Attenuation 17
 - 4.7.2 Center frequency 17
 - 4.7.3 Quality factors 17
 - 4.8 Treble 18
 - 4.8.1 Attenuation 18
 - 4.8.2 Center frequency 18
 - 4.9 Speaker attenuator 18

4.10	Subwoofer attenuator	18
4.11	MUX output	19
4.12	Audioprocessor testing	19
5	I²C bus specification	20
5.1	Interface protocol	20
5.1.1	Receive mode	20
5.1.2	Transmission mode	20
5.1.3	Reset condition	20
5.2	Subaddress (receive mode)	21
5.3	Data byte specification	22
6	Package information	27
7	Revision history	28

List of tables

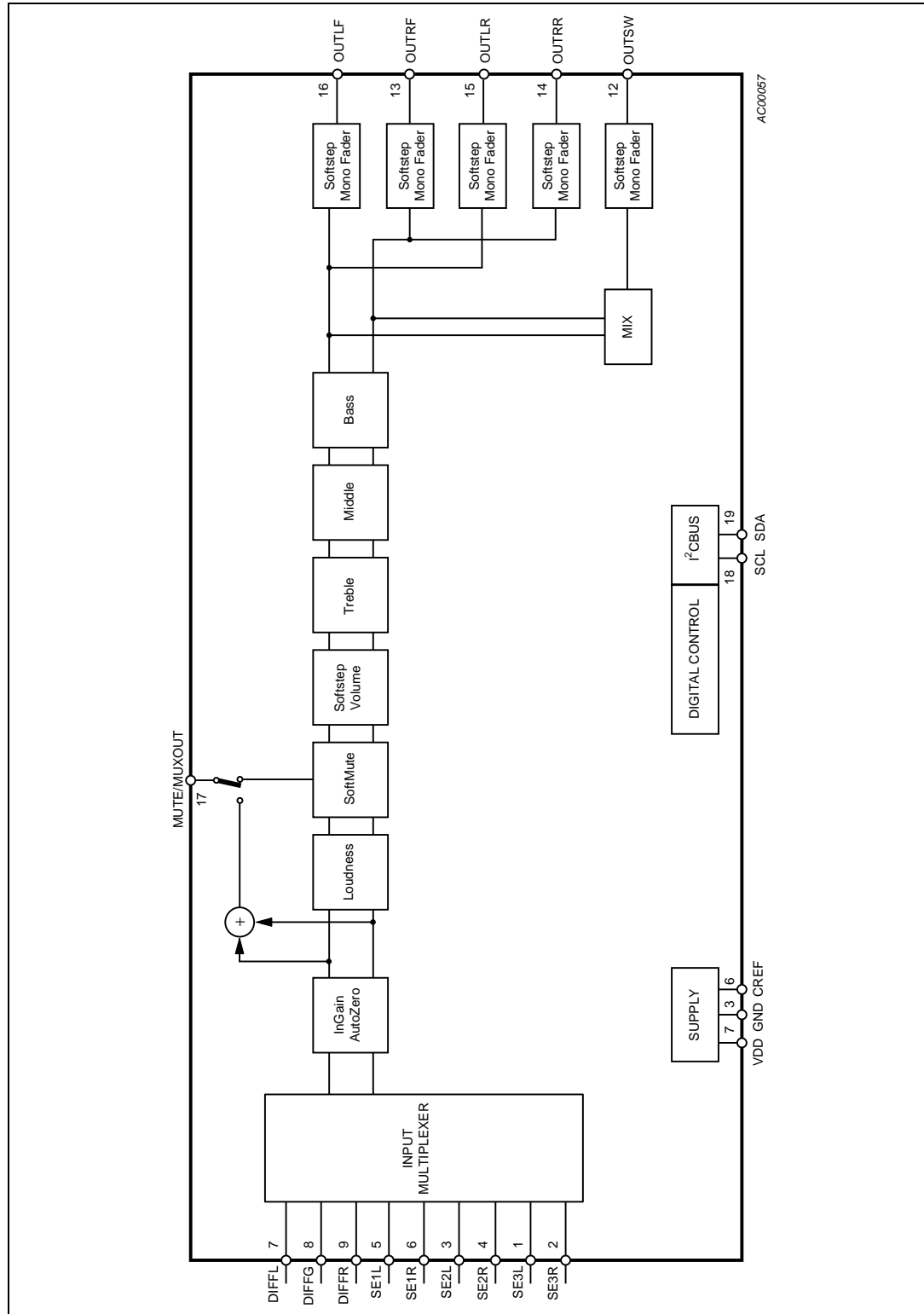
Table 1.	Device summary	1
Table 2.	Pin list	7
Table 3.	Absolute maximum ratings	8
Table 4.	Electrical characteristics	8
Table 5.	Registers of all subaddresses.	20
Table 6.	Subaddress (receive mode)	21
Table 7.	Input selector /gain (0)	22
Table 8.	Loudness (1).	22
Table 9.	Volume / speaker attenuation (2,7,8,9,10,11).	23
Table 10.	Treble filter (3)	23
Table 11.	Middle filter (4)	24
Table 12.	Bass filter (5).	25
Table 13.	Middle / bass Fc select (6)	25
Table 14.	Soft mute and soft step time (12)	26
Table 15.	Testing audio processor (13)	26
Table 16.	Document revision history	28

List of figures

Figure 1.	Block diagram	6
Figure 2.	Pin out.	7
Figure 3.	Input stage	12
Figure 4.	Loudness attenuation @ $f_C = 400\text{Hz}$	13
Figure 5.	Loudness center frequencies @ Attn. = 15dB	13
Figure 6.	Loudness attenuation, $f_C = 2.4\text{kHz}$	14
Figure 7.	Softmute timing	14
Figure 8.	SoftStep timing	15
Figure 9.	Bass control @ $f_C = 80\text{Hz}$, $Q = 1$	15
Figure 10.	Bass center frequencies @ Gain = 15dB, $Q = 1$	16
Figure 11.	Bass quality factors @ Gain = 14dB, $f_C = 80\text{Hz}$	16
Figure 12.	Bass normal and DC mode @ Gain = 14dB, $f_C = 80\text{Hz}$	16
Figure 13.	Middle control @ $f_C = 1\text{kHz}$, $Q = 1$	17
Figure 14.	Middle center frequencies @ Gain = 14dB, $Q = 1$	17
Figure 15.	Bass quality factors @ Gain = 14dB, $f_C = 1\text{kHz}$	17
Figure 16.	Treble control @ $f_C = 17.5\text{kHz}$	18
Figure 17.	Treble center frequencies @ Gain = 14dB	18
Figure 18.	MUX output configuration	19
Figure 19.	SO20 mechanical data and package dimensions.	27

1 Block diagram

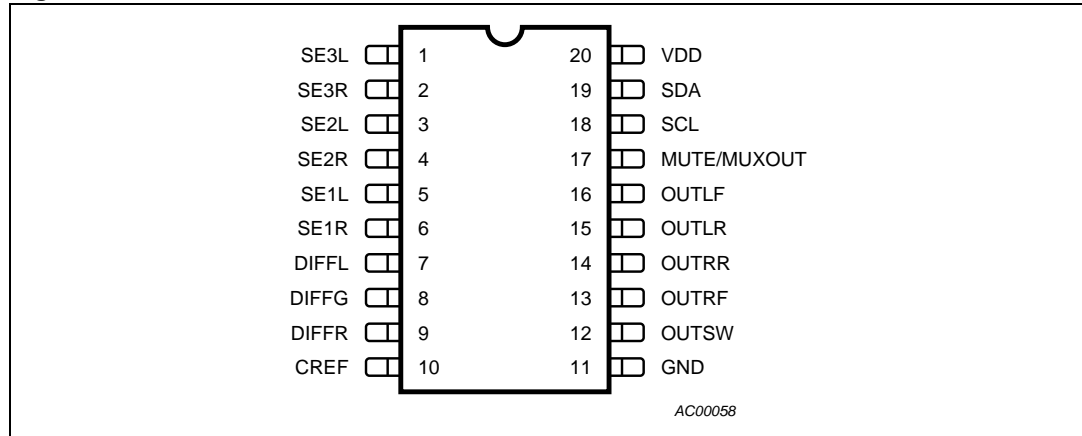
Figure 1. Block diagram



2 Pin description

2.1 Connection diagram

Figure 2. Pin out



2.2 Pin list

Table 2. Pin list

No.	Pin Name	Description	I/O
1	SE3L	Single-ended input 3 left channel	I
2	SE3R	Single-ended input 3 right channel	I
3	SE2L	Single-ended input 2 left channel	I
4	SE2R	Single-ended input 2 right channel	I
5	SE1L	Single-ended input 1 left channel	I
6	SE1R	Single-ended input 1 Right channel	I
7	DIFFL	Pseudo differential stereo input left	I
8	DIFFG	Pseudo differential stereo input common	I
9	DIFFR	Pseudo differential stereo input right	I
10	CREF	Reference capacitor	O
11	GND	Ground	S
12	OUTSW	Subwoofer output	O
13	OUTRF	Front right output	O
14	OUTRR	Rear right output	O
15	OUTLR	Rear left output	O
16	OUTLF	Front left output	O
17	MUTE / MUXOUT	External mute pin / MUX output	I
18	SCL	I ² C bus clock	I
19	SDA	I ² C bus data	I/O
20	VDD	Supply	S

3 Electrical specification

3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_S	Supply voltage for $V_{CC}^{(1)}$ for other pins	-0.4 to 10.2 -0.4 to $V_{CC} + 0.4$	V
T_{op}	Operating temperature range	-40 to +85	°C
T_{stg}	Storage temperature	-55 to +150	°C
V_{ESD}	ESD protection (Human Body Model)	±2000	V
V_{ESD}	ESD protection (Machine Model)	±200	V
V_{ESD}	ESD protection (Change Device Model)	±750	V

1. Reference level is GND.

3.2 Electrical characteristics

Table 4. Electrical characteristics

$V_S = 8.5\text{ V}$; $T_{amb} = 25\text{ °C}$; $R_L = 10\text{ k}\Omega$; all gains = 0 dB; $f = 1\text{ kHz}$; unless otherwise specified

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Supply						
V_S	Supply voltage		8	8.5	10	V
I_S	Supply current		18	25	32	mA
Input selector						
R_{in}	Input resistance	All single ended inputs	70	100	130	k Ω
V_{CL}	Clipping level		1.8	2		V_{RMS}
S_{IN}	Input separation		80	100		dB
$G_{IN\ MIN}$	Min. input gain		-0.5	0	0.5	dB
$G_{IN\ MAX}$	Max. input gain		14	15	16	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}	-30	4	30	mV
V_{offset}	Remaining offset with AutoZero			0.5		mV
Differential stereo inputs						
R_{in}	Input resistance	Differential	70	100	130	k Ω
CMRR	Common mode rejection ratio	$V_{CM}=1\ V_{RMS}@ 1\text{kHz}$	40	60		dB
		$V_{CM}=1\ V_{RMS}@ 10\text{kHz}$	40	60		dB

Table 4. Electrical characteristics (continued) $V_S = 8.5\text{ V}$; $T_{\text{amb}} = 25\text{ °C}$; $R_L = 10\text{ k}\Omega$; all gains = 0 dB; $f = 1\text{ kHz}$; unless otherwise specified

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
e_{No}	Output noise @ speaker outputs	20Hz-20kHz, flat; all stages 0dB		12	20	μV
Loudness control						
A_{MAX}	Max. attenuation		-16	-15	-14	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
f_{Peak}	Peak frequency ⁽¹⁾	f_{P1}	360	400	440	Hz
		f_{P2}	720	800	880	Hz
		f_{P4}	2.1	2.4	2.7	kHz
Volume control						
G_{MAX}	Max. gain		14	15	16	dB
A_{MAX}	Max. attenuation		-84	-79	-74	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
E_A	Attenuation set error	$G = -20\text{ to }+15\text{dB}$	-1	0	1	dB
		$G = -79\text{ to }-20\text{dB}$	-4	0	3	dB
E_T	Tracking error				2	dB
V_{DC}	DC steps	Adjacent Attenuation Steps	-3	0.1	3	mV
		From 0dB to G_{MIN}	-10	0.5	10	mV
Soft mute						
A_{MUTE}	Mute attenuation		80	100		dB
T_D	Delay time	T1		0.48		ms
		T2		0.96		ms
		T3		123		ms
$V_{\text{TH Low}}$	Low threshold for SM pin				0.7	V
$V_{\text{TH High}}$	High threshold for SM pin		2.7			V
R_{PU}	Internal pull-up resistor		32	45	58	$\text{k}\Omega$
V_{PU}	Internal pull-up voltage			3.3		V
Bass control						
fc	Center frequency ⁽¹⁾	f_{C1}	54	60	66	Hz
		f_{C2}	72	80	88	Hz
		f_{C3}	90	100	110	Hz
		f_{C4}	180	200	220	Hz

Table 4. Electrical characteristics (continued) $V_S = 8.5\text{ V}$; $T_{\text{amb}} = 25\text{ °C}$; $R_L = 10\text{ k}\Omega$; all gains = 0 dB; $f = 1\text{ kHz}$; unless otherwise specified

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Q_{BASS}	Quality factor ⁽¹⁾	Q_1	0.9	1	1.1	
		Q_2	1.1	1.25	1.4	
		Q_3	1.3	1.5	1.7	
		Q_4	1.8	2	2.2	
C_{RANGE}	Control range		± 14	± 15	± 16	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
DC_{GAIN}	Bass-DC-gain	DC = off		0		dB
		DC = on	3.5	4.4	6	dB
Middle control						
C_{RANGE}	Control range		± 14	± 15	± 16	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
f_c	Center frequency ⁽¹⁾	f_{c1}	400	500	600	Hz
		f_{c2}	0.8	1	1.2	kHz
		f_{c3}	1.2	1.5	1.8	kHz
		f_{c4}	2	2.5	3	kHz
Q_{BASS}	Quality factor ⁽¹⁾	Q_1	0.45	0.5	0.55	
		Q_2	0.65	0.75	0.85	
		Q_3	0.9	1	1.1	
		Q_4	1.1	1.25	1.4	
Treble control						
C_{RANGE}	Clipping level		± 14	± 15	± 16	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
f_c	Center frequency ⁽¹⁾	f_{c1}	8	10	12	kHz
		f_{c2}	10	12.5	15	kHz
		f_{c3}	12	15	18	kHz
		f_{c4}	14	17.5	21	kHz
Speaker attenuator						
G_{MAX}	Max. gain		14	15	16	dB
A_{MAX}	Max. attenuation		-84	-79	-74	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
A_{MUTE}	Mute attenuation		80	90		dB
E_E	Attenuation set error				2	dB
V_{DC}	DC steps	Adjacent attenuation steps	-5	0.1	5	mV

Table 4. Electrical characteristics (continued) $V_S = 8.5\text{ V}$; $T_{\text{amb}} = 25\text{ }^\circ\text{C}$; $R_L = 10\text{ k}\Omega$; all gains = 0 dB; $f = 1\text{ kHz}$; unless otherwise specified

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Audio outputs						
V_{CL}	Clipping level	$d = 0.3\%$	1.8	2		V_{RMS}
R_{OUT}	Output impedance			30	100	Ω
R_L	Output load resistance		2			$k\Omega$
C_L	Output load capacitor				10	nF
V_{DC}	DC voltage level		3.8	4.0	4.2	V
Subwoofer attenuator						
G_{MAX}	Max. gain		14	15	16	dB
A_{MAX}	Max. attenuation		-84	-79	-74	dB
A_{STEP}	Step resolution		0.5	1	1.5	dB
A_{MUTE}	Mute attenuation		80	90		dB
E_E	Attenuation set error				2	dB
V_{DC}	DC steps	Adjacent attenuation steps	-5	0.1	5	mV
General						
e_{NO}	Output noise	BW=20Hz to 20 kHz all gain = 0dB		12	20	μV
S/N	Signal to noise ratio	all gain = 0dB flat; $V_o=2V_{RMS}$		100		dB
D	Distortion	$V_{IN}=1V_{RMS}$; all stages 0dB		0.005	0.100	%
S_C	Channel separation left/right		80	90		dB

1. Min. and max. values are calculated according to simulation results; functionality is guaranteed by measuring a directly correlated parameter.

4 Description of the audioprocessor

4.1 Input stages

In the basic configuration, one stereo pseudo differential (programmable as single-ended input) and three single-ended stereo inputs are available.

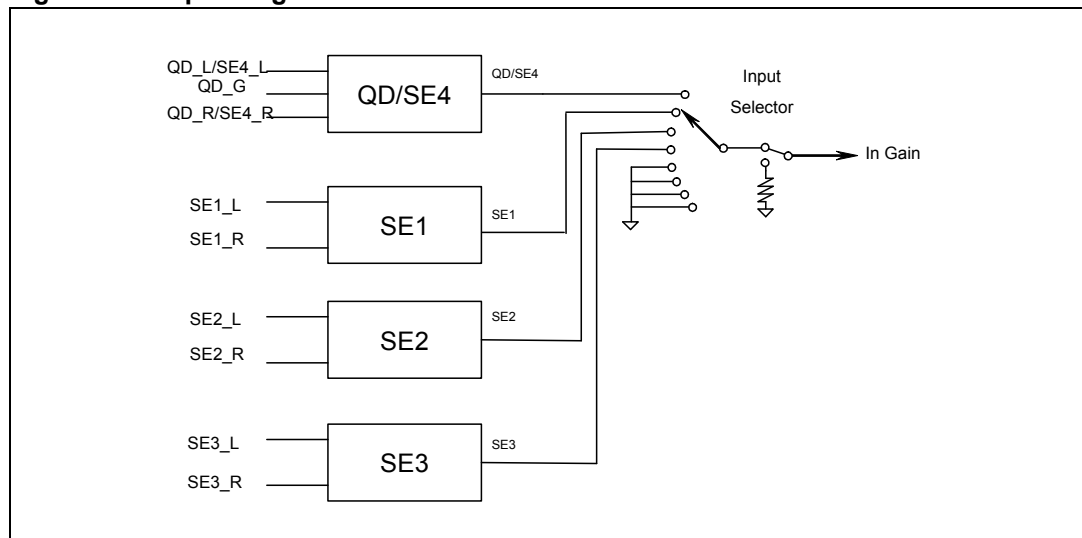
Pseudo differential stereo input (PD/SE4)

The PD input is implemented as a buffered pseudo differential stereo stage with $100\text{k}\Omega$ input-impedance at each input. The attenuation is fixed to -3dB in order to adapt the incoming signal level. It is also configurable as single-ended input.

Single-ended stereo input (SE1, SE2, SE3)

The input-impedance at each input is $100\text{k}\Omega$ and the attenuation is fixed to -3dB for incoming signals.

Figure 3. Input stage



4.2 AutoZero

The AutoZero allows a reduction of the number of pins as well as external components by canceling any offset generated by or before the In-Gain-stage (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 input source is changed and needs max. 0.6ms for the alignment. To avoid audible clicks the Audio processor is muted before the loudness stage during this time.

AutoZero-remain

In some cases, for example if the μP 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, it can be switched in the AutoZero-Remain-Mode (Bit 6 of the subaddress-byte). If this bit is set to high, the AutoZero will not be invoked and the old adjustment-value remains.

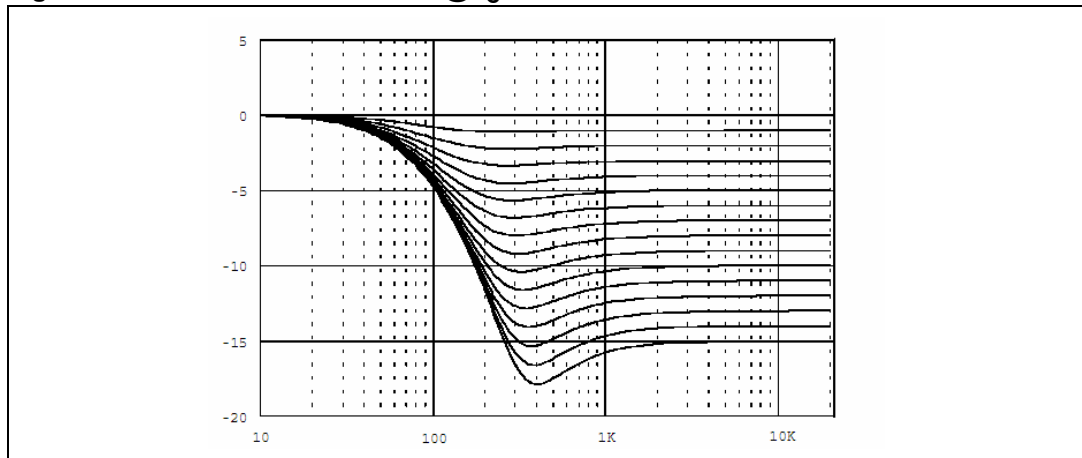
4.3 Loudness

There are four parameters programmable in the loudness stage:

4.3.1 Attenuation

Figure 4 shows the attenuation as a function of frequency at $f_C = 400\text{Hz}$

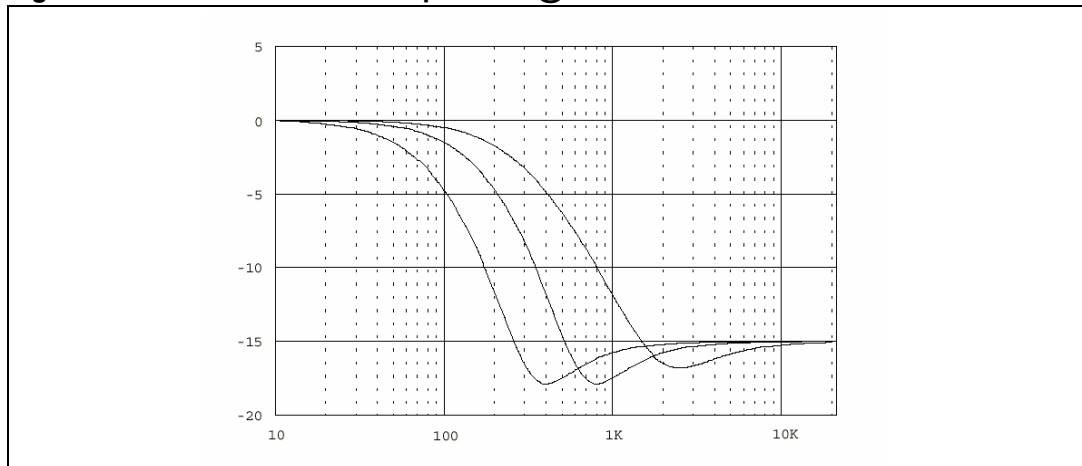
Figure 4. Loudness attenuation @ $f_C = 400\text{Hz}$.



4.3.2 Peak frequency

Figure 5 shows the four possible peak-frequencies at 400, 800 and 2400Hz

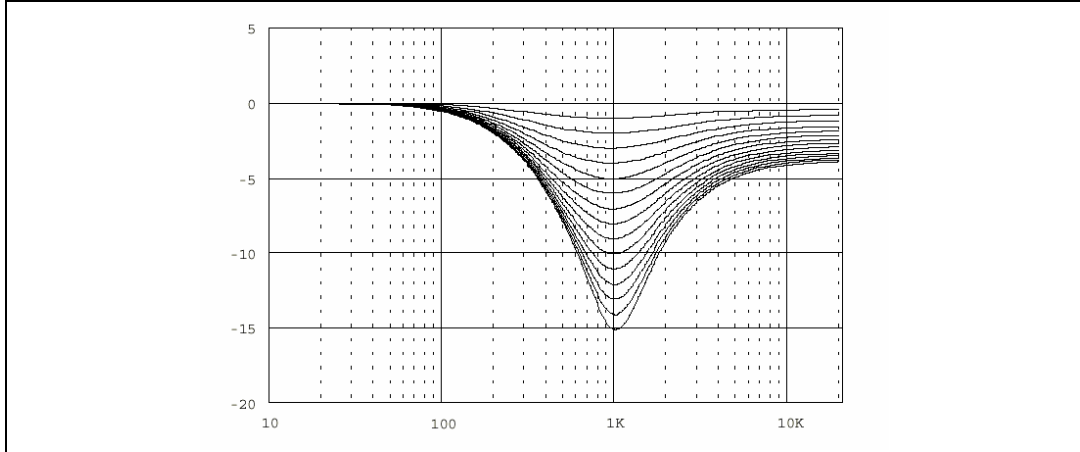
Figure 5. Loudness center frequencies @ Attn. = 15dB



4.3.3 Low and high frequency boost

Figure 6 shows the different Loudness shapes in low & high frequency boost.

Figure 6. Loudness attenuation, $f_c = 2.4\text{kHz}$



4.3.4 Flat mode

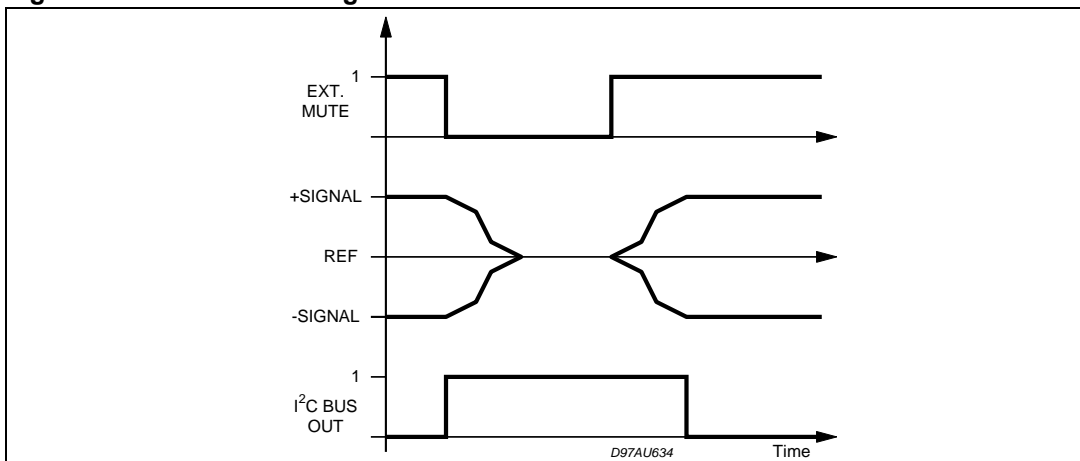
In flat mode the loudness stage works as a 0dB to -15dB attenuator.

4.4 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 SoftMute 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 7).

For timing purposes the Bit0 of the I²C-bus output register is set to 1 from the start of muting until the end of demuting.

Figure 7. Softmute timing



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

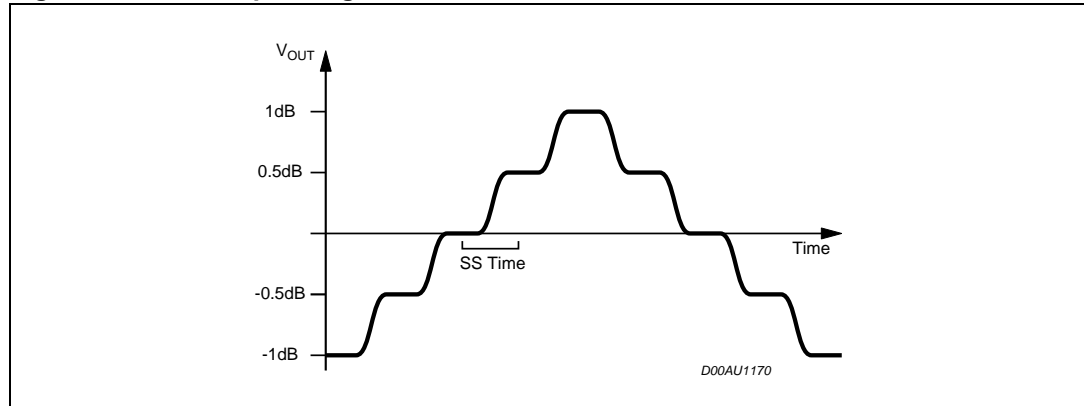
4.5 SoftStep volume

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 audio signal. With the SoftStep-feature both kinds of clicks could be reduced to a minimum and are no more audible.

Eight programmable softstep time from one step to the next are user selectable.

Figure 8. SoftStep timing



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

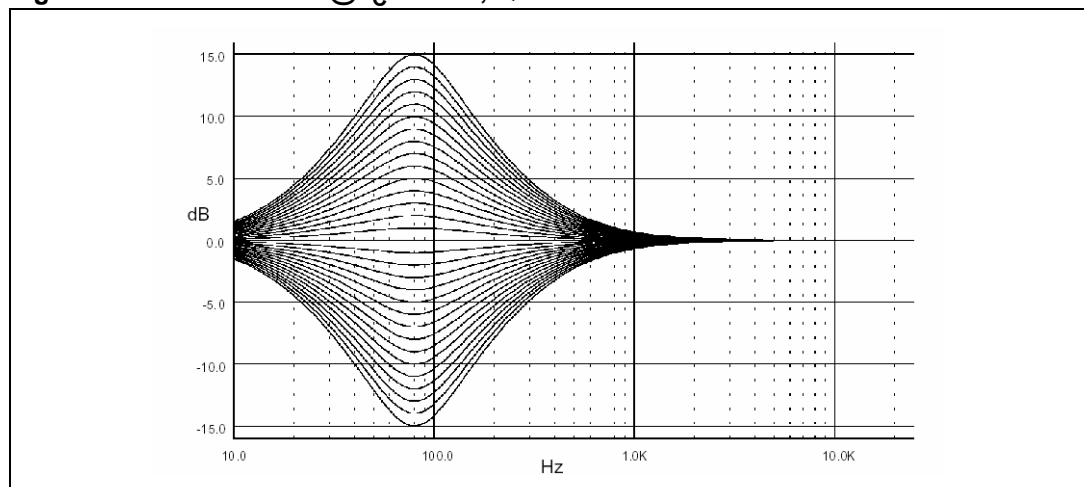
4.6 Bass

There are four parameters programmable in the bass stage:

4.6.1 Attenuation

Figure 9 shows the attenuation as a function of frequency at a center frequency of 80Hz.

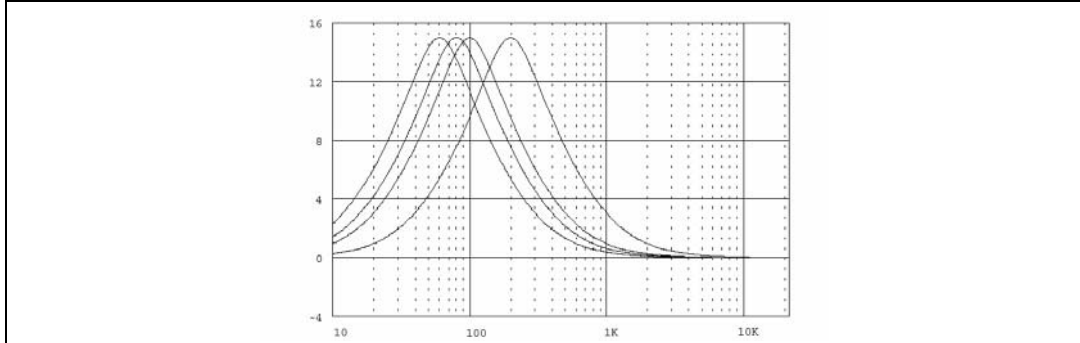
Figure 9. Bass control @ $f_c = 80\text{Hz}$, $Q = 1$



4.6.2 Center frequency

Figure 10 shows the four possible center frequencies 60, 80, 100 and 200Hz.

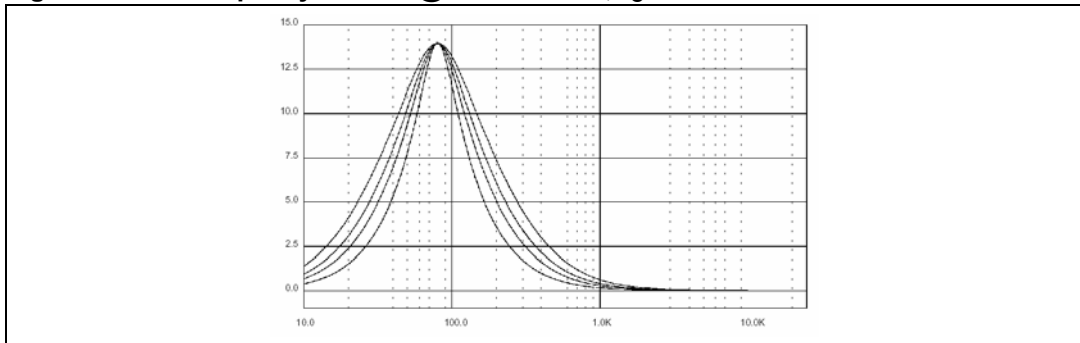
Figure 10. Bass center frequencies @ Gain = 15dB, Q = 1



4.6.3 Quality factors

Figure 11 shows the four possible quality factors 1, 1.25, 1.5 and 2.

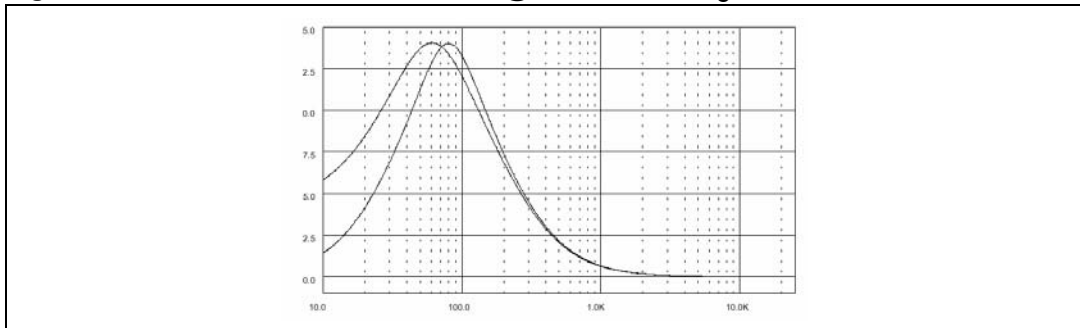
Figure 11. Bass quality factors @ Gain = 14dB, $f_c = 80\text{Hz}$



4.6.4 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 12. Bass normal and DC mode @ Gain = 14dB, $f_c = 80\text{Hz}$



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

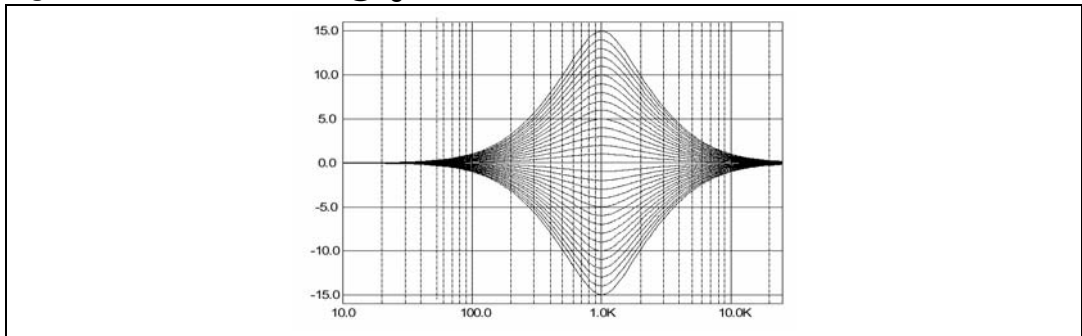
4.7 Middle

There are three parameters programmable in the middle stage:

4.7.1 Attenuation

Figure 13 shows the attenuation as a function of frequency at a center frequency of 1kHz.

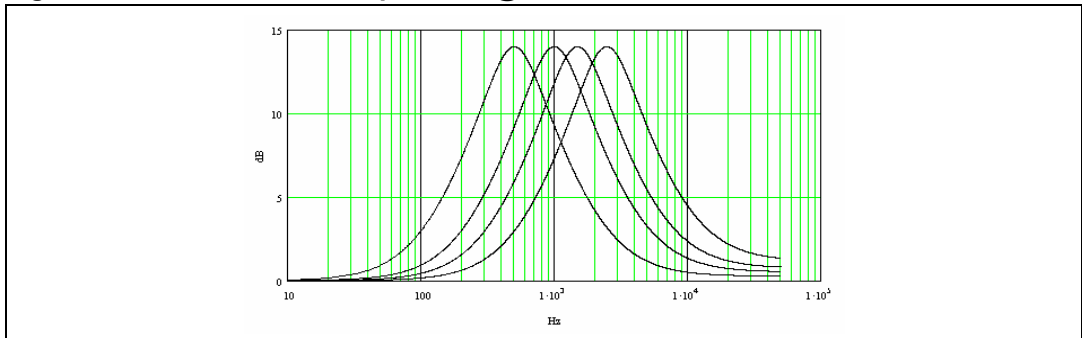
Figure 13. Middle control @ $f_C = 1$ kHz, $Q = 1$



4.7.2 Center frequency

Figure 14 shows the four possible center frequencies 500Hz, 1kHz, 1.5kHz and 2.5kHz.

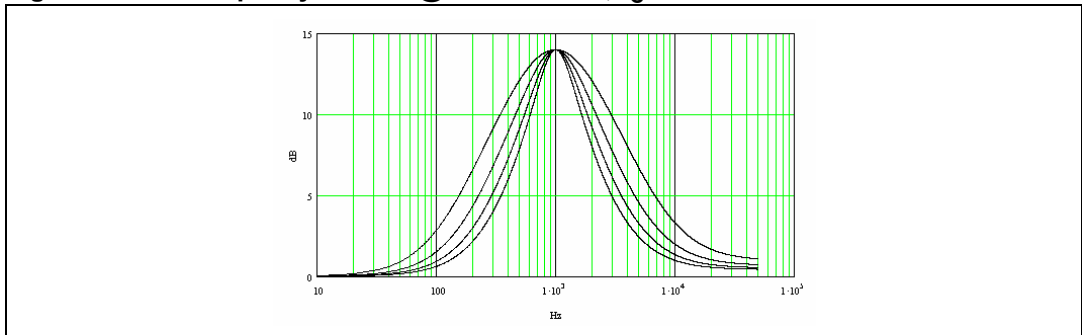
Figure 14. Middle center frequencies @ Gain = 14dB, $Q = 1$



4.7.3 Quality factors

Figure 15 shows the four possible quality factors 0.5, 0.75, 1 and 1.5.

Figure 15. Bass quality factors @ Gain = 14dB, $f_C = 1$ kHz



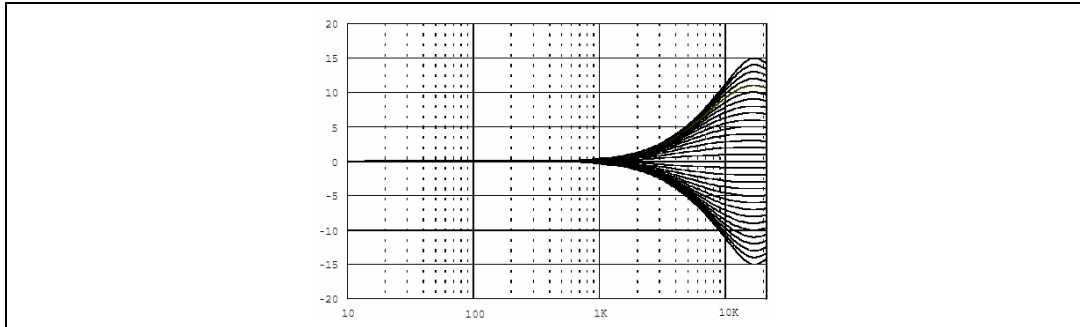
4.8 Treble

There are two parameters programmable in the treble stage:

4.8.1 Attenuation

Figure 16 shows the attenuation as a function of frequency at a center frequency of 17.5kHz.

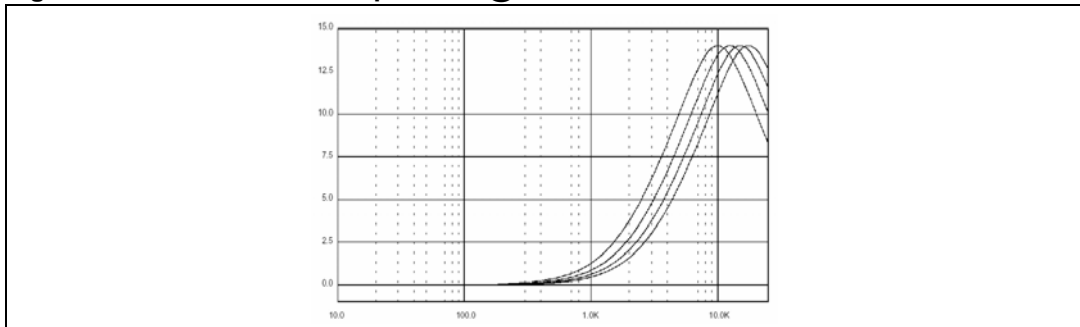
Figure 16. Treble control @ $f_C = 17.5$ kHz



4.8.2 Center frequency

Figure 17 shows the four possible center frequencies 10k, 12.5k, 15k and 17.5kHz.

Figure 17. Treble center frequencies @ Gain = 14dB



4.9 Speaker attenuator

The four speakers have independent soft step speaker controls. And their attenuators can be adjusted from +15dB to -79dB with 1dB steps.

4.10 Subwoofer attenuator

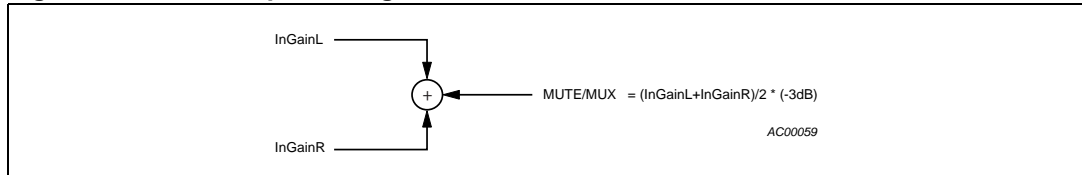
The Subwoofer output is a single ended mono output. The attenuator is exactly the same like the other speakers.

4.11 MUX output

It provides a mono signal output (before tone filters) at Mute/MUX pin, used for external level meter / spectrum analyzer.

The mute pin can be configured as MUX output (I²C Byte13_D7D1). When it is configured as MUX output, the output voltage is $(\text{InGainL} + \text{InGainR})/2$ with -3dB attenuation.

Figure 18. MUX output configuration



4.12 Audioprocessor testing

In the test mode, which can be activated by setting bit D7 of the IIC subaddress byte and bit D0 of the testing audioprocessor byte, several internal signals are available at the SE2R pin. In this mode, the input resistance of 100kOhm is disconnected from the pin. Internal signals available for testing are listed in the data-byte specification.

5 I²C bus specification

5.1 Interface protocol

The interface protocol comprises:

- a start condition (S)
- a chip address byte (the LSB 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

5.1.1 Receive mode

S	1	0	0	0	1	0	0	R/W	ACK	TS	AZ	AI	A4	A3	A2	A1	A0	ACK	DATA	ACK	P
---	---	---	---	---	---	---	---	-----	-----	----	----	----	----	----	----	----	----	-----	------	-----	---

S = Start

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

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

ACK = Acknowledge

P = Stop

TS = Testing mode

AZ = Auto zero remain

AI = Auto increment

5.1.2 Transmission mode

S	1	0	0	0	1	0	0	R/W	ACK	X	X	X	X	X	X	X	X	SM	ACK	P
---	---	---	---	---	---	---	---	-----	-----	---	---	---	---	---	---	---	---	----	-----	---

SM = Soft mute activated for main channel

X = Not Used

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

5.1.3 Reset condition

A Power-On-Reset is invoked if the Supply-Voltage is below than 2.5V. After that the following data is written automatically into the registers of all subaddresses:

Table 5. Registers of all subaddresses

MSB							LSB
1	1	1	1	1	1	1	0

5.2 Subaddress (receive mode)

Table 6. Subaddress (receive mode)

MSB							LSB	Function
I2	I1	I0	A4	A3	A2	A1	A0	
0								Testing Mode Off On
1								Auto Zero Remain Off On
	0							Auto Increment Mode Off On
	1							Auto Increment Mode Off On
		0						Auto Increment Mode Off On
		1						Auto Increment Mode Off On
			0	0	0	0	0	Main Source Selector
			0	0	0	0	1	Loudness
			0	0	0	1	0	Volume
			0	0	0	1	1	Treble
			0	0	1	0	0	Middle
			0	0	1	0	1	Bass
			0	0	1	1	0	Middle/ Bass Fc Select
			0	0	1	1	1	Speaker Attenuator Left Front
			0	1	0	0	0	Speaker Attenuator Left Rear
			0	1	0	0	1	Speaker Attenuator Right Rear
			0	1	0	1	0	Speaker Attenuator Right Front
			0	1	0	1	1	Subwoofer Attenuator
			0	1	1	0	0	Soft Mute / Soft Step
			0	1	1	0	1	Testing Audio Processor

5.3 Data byte specification

Table 7. Input selector /gain (0)

MSB				LSB				Function
D7	D6	D5	D4	D3	D2	D1	D0	
					0 0 0 0 1	0 0 1 1 X	0 1 0 1 X	Source Selector PD/SE4 SE1 SE2 SE3 mute
	0 0 : 1 1	0 0 : 1 1	0 0 : 1 1	0 1 : 0 1				Input Gain 0dB 1dB : 14dB 15dB
0 1								Diffin Mode Single Ended Stereo Differential Stereo

Table 8. Loudness (1)

MSB				LSB				Function
D7	D6	D5	D4	D3	D2	D1	D0	
				0 0 : 1 1	0 0 : 1 1	0 0 : 1 1	0 1 : 0 1	Attenuation 0dB -1dB : -14dB -15dB
	0 0 1 1	0 0 1 1	0 1 0 1					Filter/Center Frequency Off (Flat) D6 must be = 0 400Hz 800Hz 2400Hz
	0 1							Shape Low Boost Low & HighBoost
0 1								Loudness Soft Step on off

Table 9. Volume / speaker attenuation (2,7,8,9,10,11)

MSB							LSB		Function
D7	D6	D5	D4	D3	D2	D1	D0		
	0	0	0	1	1	1	1	Gain/Attenuation +15dB	
	0	0	0	1	1	1	0	+14dB	
	:	:	:	:	:	:	:	:	
	0	0	0	0	0	0	1	+1dB	
	0	0	0	0	0	0	0	0dB	
	0	0	1	0	0	0	0	0dB	
	0	0	1	0	0	0	1	-1dB	
	:	:	:	:	:	:	:	:	
	0	0	1	1	1	1	1	-15dB	
	0	1	0	0	0	0	0	-16dB	
	:	:	:	:	:	:	:	:	
	1	0	1	1	1	1	0	-78dB	
	1	0	1	1	1	1	1	-79dB	
	1	1	x	x	x	x	x	Mute	
0								Volume Soft Step on	
1								off	

Table 10. Treble filter (3)

MSB							LSB		Function
D7	D6	D5	D4	D3	D2	D1	D0		
			0	0	0	0	0	Gain/Attenuation -15dB	
			0	0	0	0	1	-14dB	
			:	:	:	:	:	:	
			0	1	1	1	0	-1dB	
			0	1	1	1	1	0dB	
			1	1	1	1	1	0dB	
			1	1	1	1	0	+1dB	
			:	:	:	:	:	:	
			1	0	0	0	1	+14dB	
			1	0	0	0	0	+15dB	
	0	0						Treble Center Frequency 10.0kHz	
	0	1						12.5kHz	
	1	0						15.0kHz	
	1	1						17.5kHz	
1								Must be "1"	

Table 11. Middle filter (4)

MSB				LSB				Function
D7	D6	D5	D4	D3	D2	D1	D0	
			0	0	0	0	0	Gain/Attenuation -15dB
			0	0	0	0	1	-14dB
			:	:	:	:	:	:
			0	1	1	1	0	-1dB
			0	1	1	1	1	0dB
			1	1	1	1	1	0dB
			1	1	1	1	0	+1dB
			:	:	:	:	:	:
			1	0	0	0	1	+14dB
			1	0	0	0	0	+15dB
	0	0						Middle Q Factor 0.5
	0	1						0.75
	1	0						1
	1	1						1.25
0								Middle Soft Step on
1								off

Table 12. Bass filter (5)

MSB							LSB		Function
D7	D6	D5	D4	D3	D2	D1	D0		
			0	0	0	0	0	Gain/Attenuation -15dB	
			0	0	0	0	1	-14dB	
			:	:	:	:	:	:	
			0	1	1	1	0	-1dB	
			0	1	1	1	1	0dB	
			1	1	1	1	1	0dB	
			1	1	1	1	0	+1dB	
			:	:	:	:	:	:	
			1	0	0	0	1	+14dB	
			1	0	0	0	0	+15dB	
	0	0						Bass Q Factor 1.0	
	0	1						1.25	
	1	0						1.5	
	1	1						2.0	
0								Bass Soft Step on	
1								off	

Table 13. Middle / bass Fc select (6)

MSB							LSB		Function
D7	D6	D5	D4	D3	D2	D1	D0		
						0	0	Middle Center Frequency 500Hz	
						0	1	1kHz	
						1	0	1.5kHz	
						1	1	2.5kHz	
				0	0			Bass Center Frequency 60Hz	
				0	1			80Hz	
				1	0			100Hz	
				1	1			200Hz	
			0					Bass DC Mode off	
			1					on	
		0						Smoothing Filter off	
		1						on	
X	X							Not used	

Table 14. Soft mute and soft step time (12)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
							0 1	Soft Mute on off
					0 0 1	0 1 X		Soft Mute Time 0.48ms 0.96ms 123ms
		0 0 0 0 1 1 1 1	0 0 1 1 0 0 1 1	0 1 0 1 0 1 0 1				Soft Step Time 0.16ms 0.32ms 0.64ms 1.28ms 2.56ms 5.12ms 10.24ms 20.48ms
	0 1							AZ function off on
X								Not used

Table 15. Testing audio processor (13)

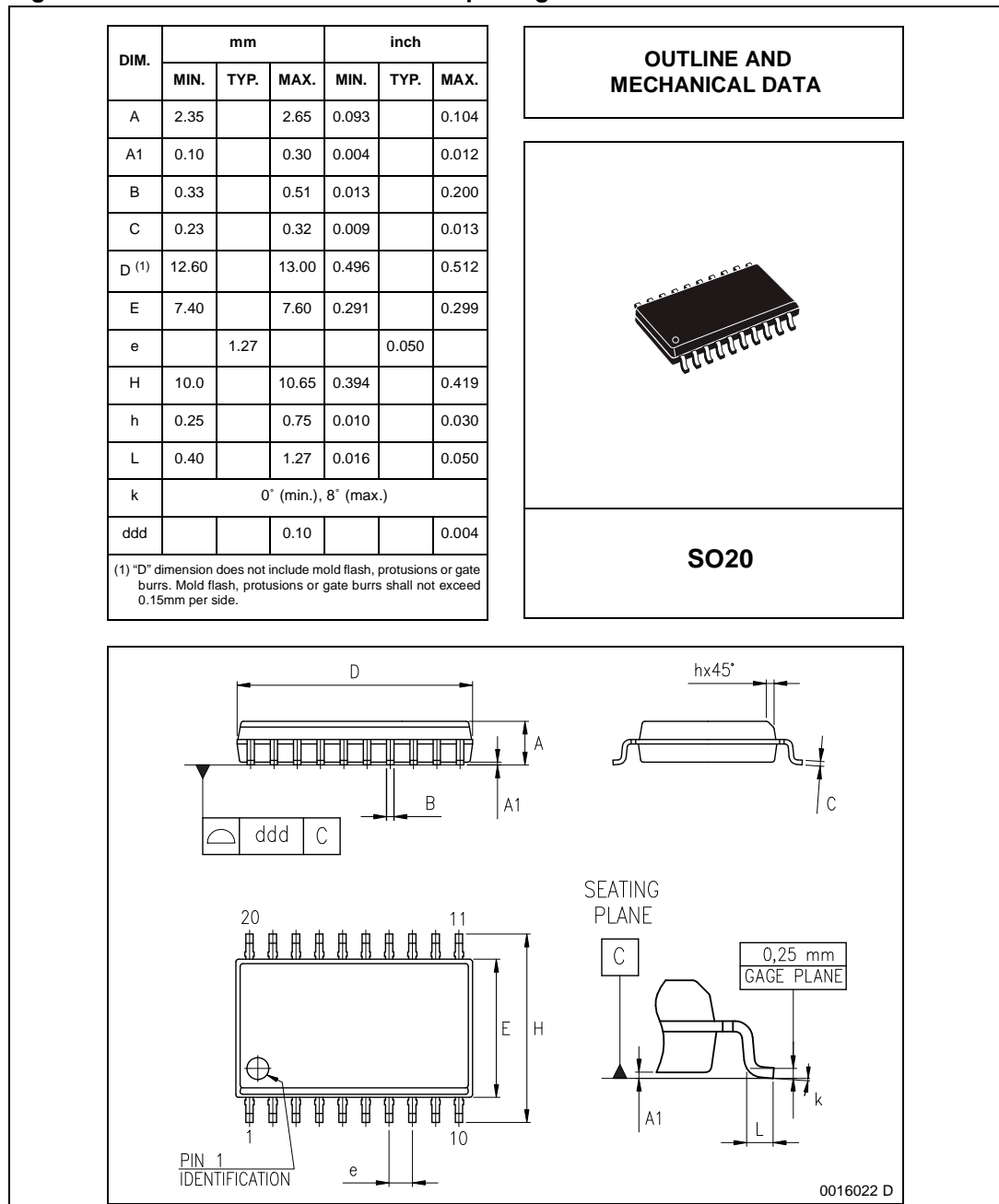
MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
							0 1	Audio Processor Testing Mode off on
			0 0 0 0 1 1 1 1	0 0 1 1 0 0 1 1	0 1 1 1 0 0 1 1			Test Multiplexer InMuxOutR LoudOutR VolumeOutR VBG1.26 REF5V5 SSCLK SMCLK Clk200kHz
		x						Not Used
	0 1							Schlock Normal Fast Mode
0 1 1						x 0 1		MUTE Pin Config. MUX output External clock Mute (normal)

6 Package information

In order to meet environmental requirements, ST (also) offers these devices in ECOPACK® packages. ECOPACK® packages are lead-free. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label.

ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 19. SO20 mechanical data and package dimensions



7 Revision history

Table 16. Document revision history

Date	Revision	Changes
15-Feb-2007	1	Initial release.
23-Oct-2008	2	Updated Table 6: Subaddress (receive mode) on page 21 .
03-Nov-2008	3	Corrected Table 6: Subaddress (receive mode) on page 21 .
23-Sep-2013	4	Updated Disclaimer.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com