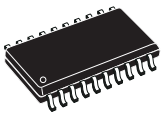
TDA7418

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)



SO20

  - 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

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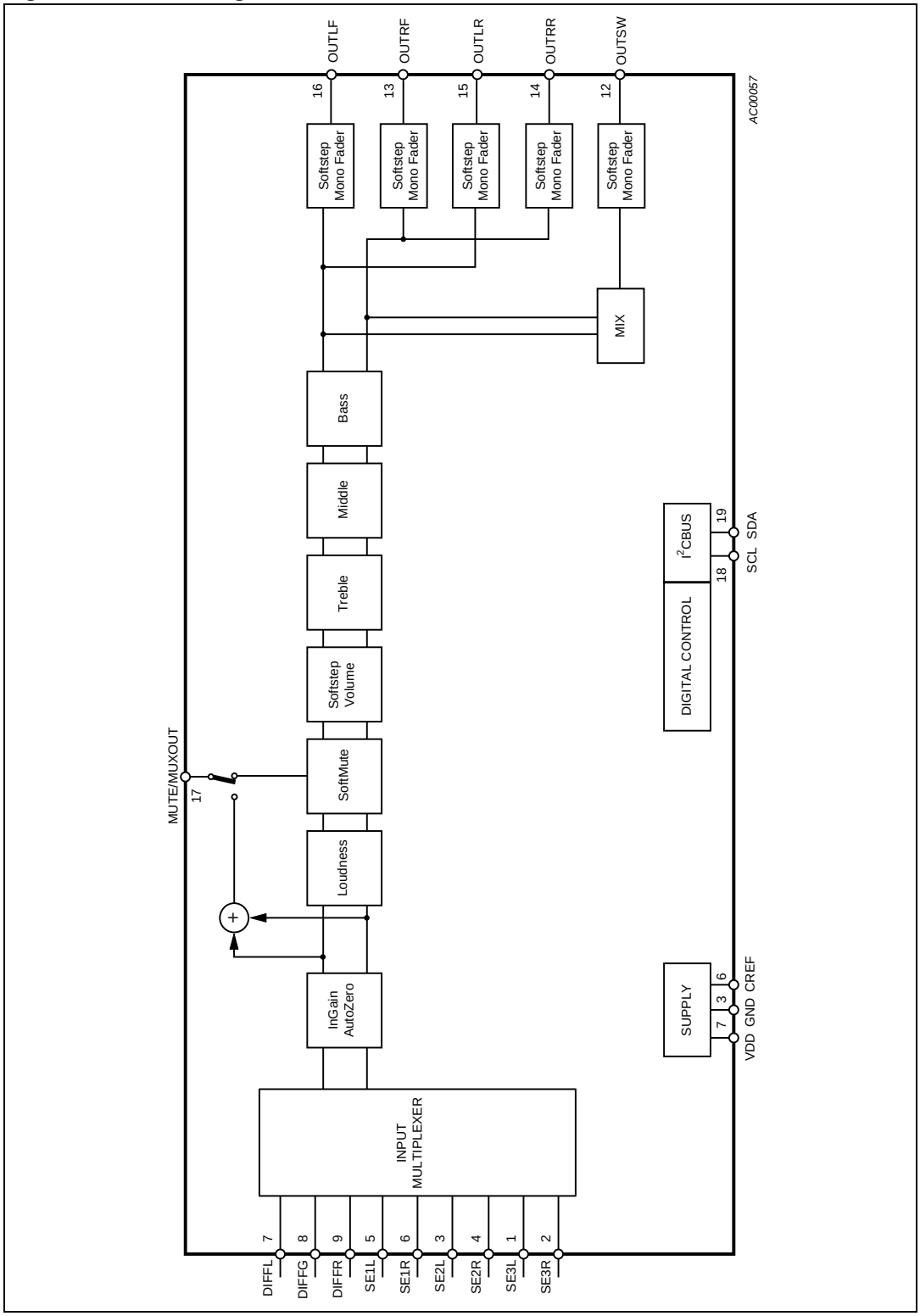
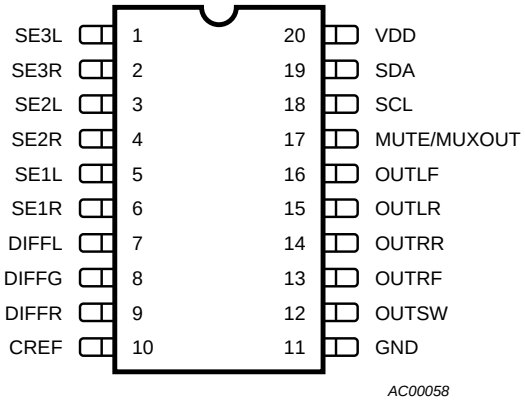
Figure 1. Block diagram



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^2C bus clock	I
19	SDA	I^2C 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 V; T_{amb}= 25 °C; R_L= 10 kΩ; all gains = 0 dB; f = 1 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	kΩ
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
		$G_{MIN\ to\ GMAX}$	-30	4	30	mV
V_{offset}	Remaining offset with AutoZero			0.5		mV
Differential stereo inputs						
Rin	Input resistance	Differential	70	100	130	kΩ
CMRR	Common mode rejection ratio	V_{CM}=1 V_{RMS}@ 1kHz	40	60		dB
		V_{CM}=1 V_{RMS}@ 10kHz	40	60		dB

Table 4. Electrical characteristics (continued)

V_S = 8.5 V; T_{amb}= 25 °C; R_L= 10 kΩ; all gains = 0 dB; f = 1 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 to +15dB	-1	0	1	dB
		G = -79 to -20dB	-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
$V_{TH\ Low}$	Low threshold for SM pin				0.7	V
$V_{TH\ High}$	High threshold for SM pin		2.7			V
R_{PU}	Internal pull-up resistor		32	45	58	kΩ
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 V; T_{amb}= 25 °C; R_L= 10 kΩ; all gains = 0 dB; f = 1 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
fc	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
fc	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 V; T_{amb}= 25 °C; R_L= 10 kΩ; all gains = 0 dB; f = 1 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			kΩ
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; Vo=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.

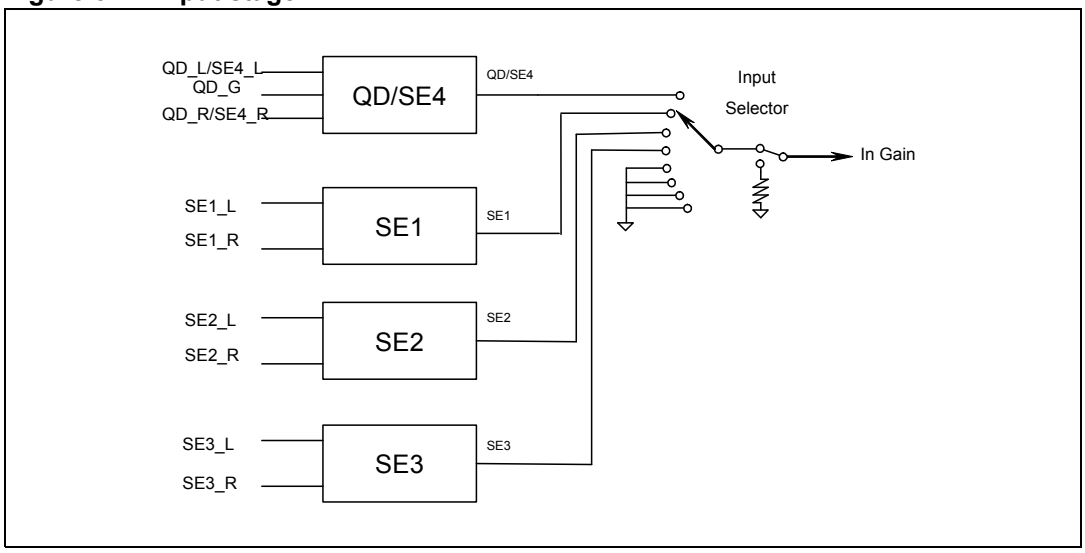
Pseudo differential stereo input (PD/SE4)

The PD input is implemented as a buffered pseudo differential stereo stage with 100kΩ 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 100kΩ 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.

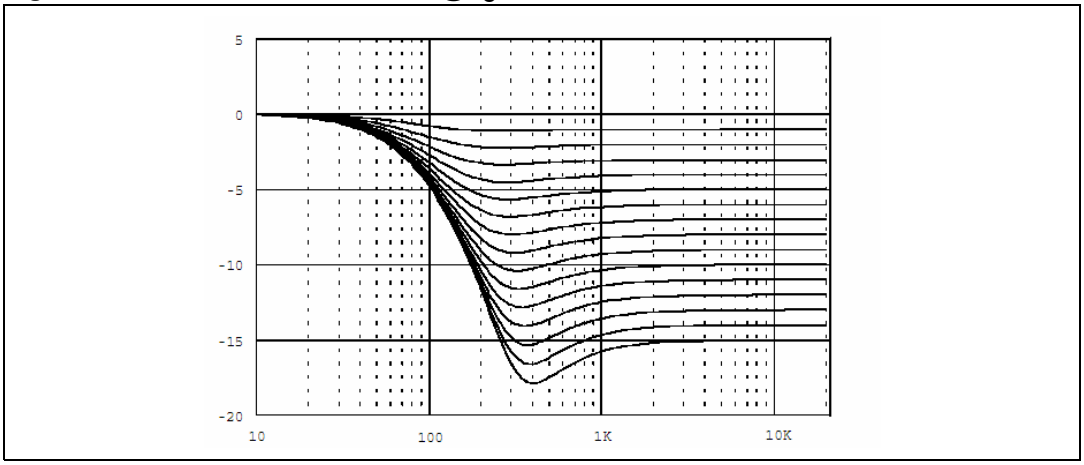
4.3 Loudness

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 = 400Hz

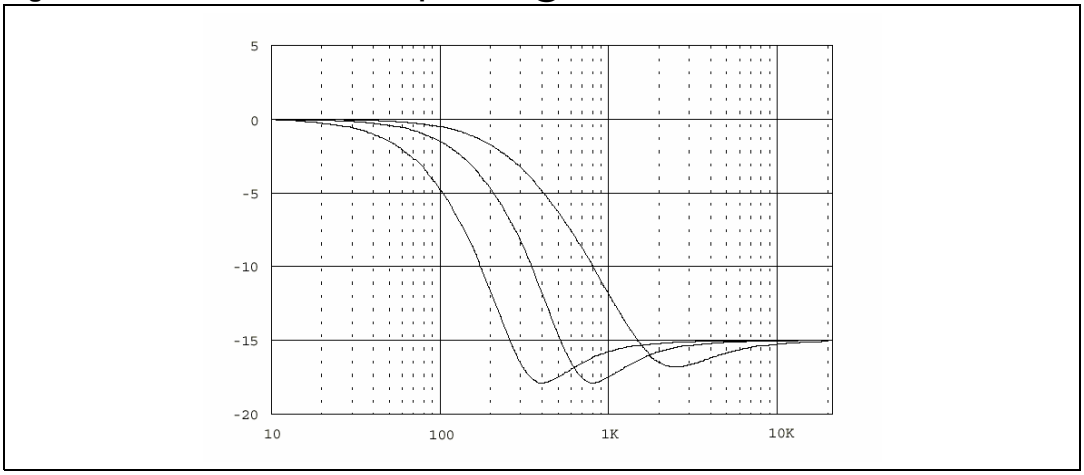
Figure 4. Loudness attenuation @ f_C = 400Hz.



4.3.2 Peak frequency

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

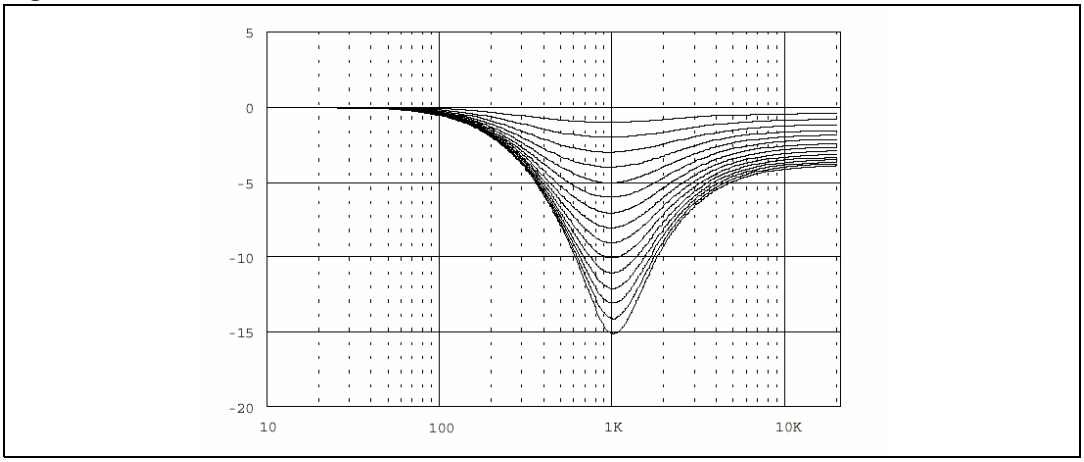
Figure 5. Loudness center frequencies @ Attn. = 15dB



4.3.3 Low and high frequency boost

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

Figure 6. Loudness attenuation, fc = 2.4kHz



4.3.4 Flat mode

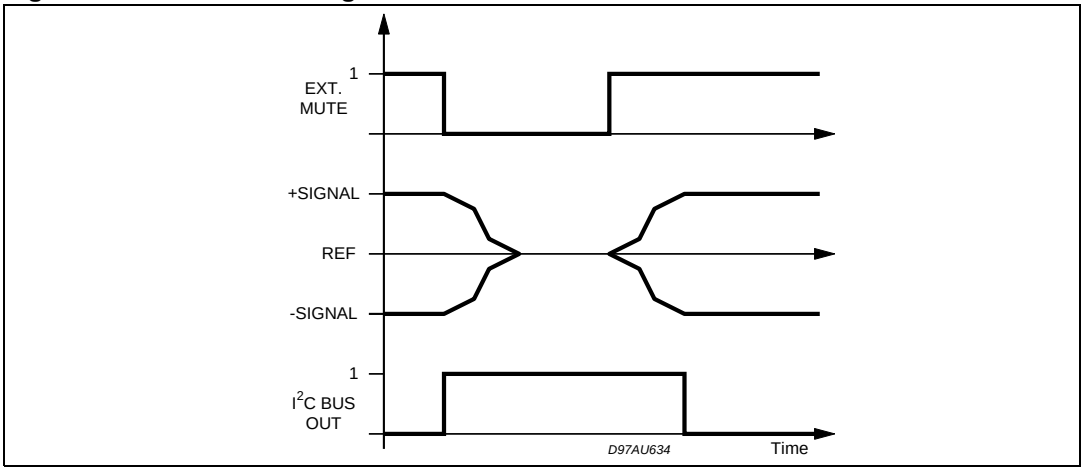
In flat mode the loudness stage works as a 0dB to -15dB attenuator.

4.4 SoftMute

The digitally controlled SoftMute stage allows muting/demuting the signal with a I^2C-bus programmable slope. The mute process can either be activated by the SoftMute pin or by the I^2C-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 I^2C-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

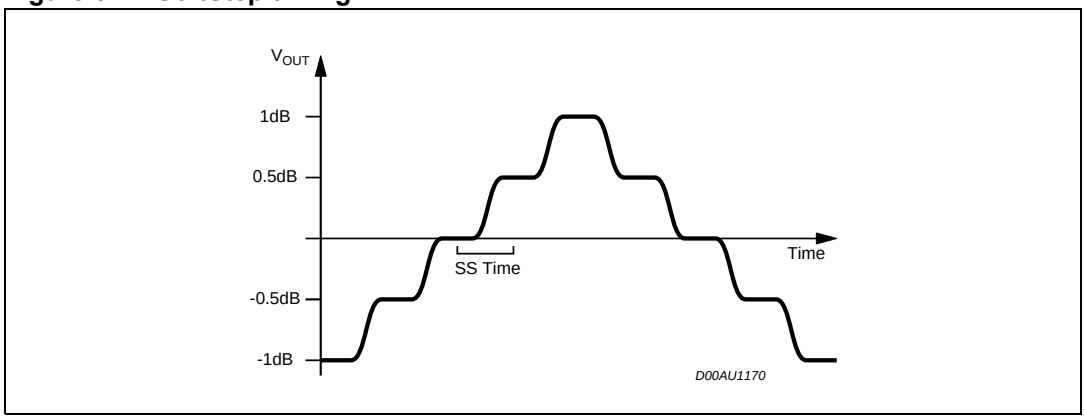
4.5 SoftStep volume

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.

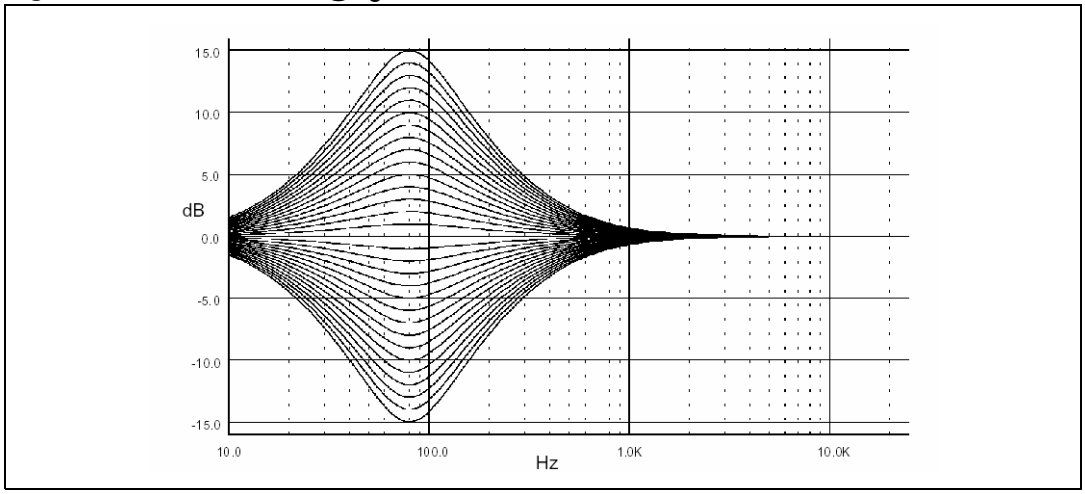
4.6 Bass

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.

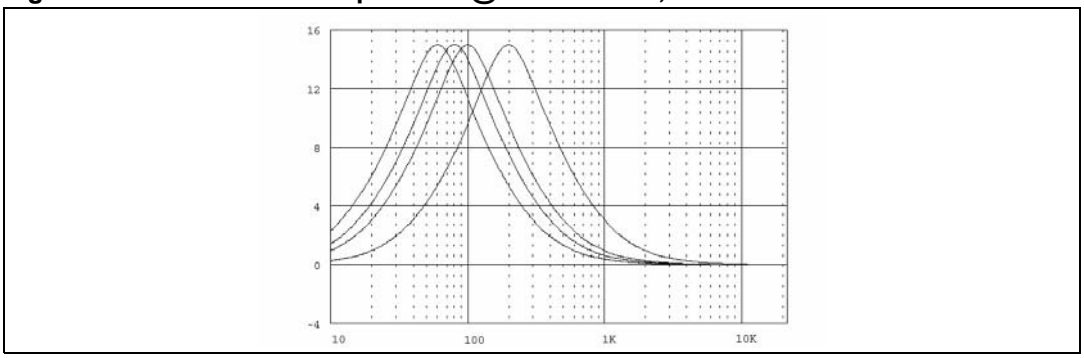
Figure 9. Bass control @ f_C = 80Hz, Q = 1



4.6.2 Center frequency

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

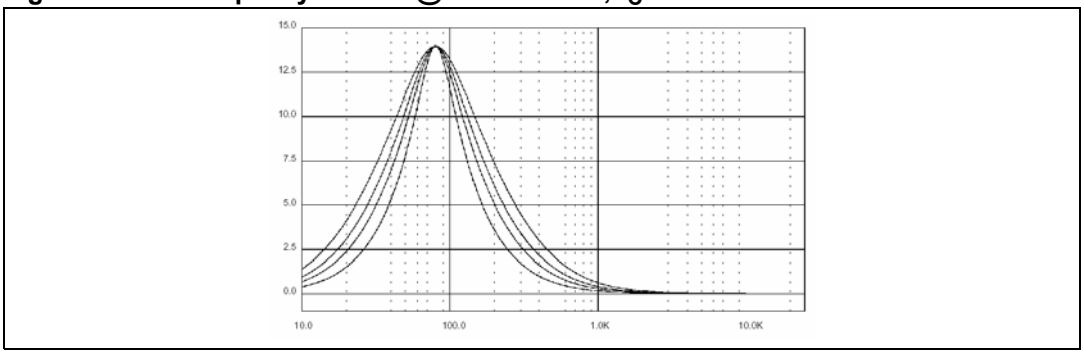
Figure 10. Bass center frequencies @ Gain = 15dB, Q = 1



4.6.3 Quality factors

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

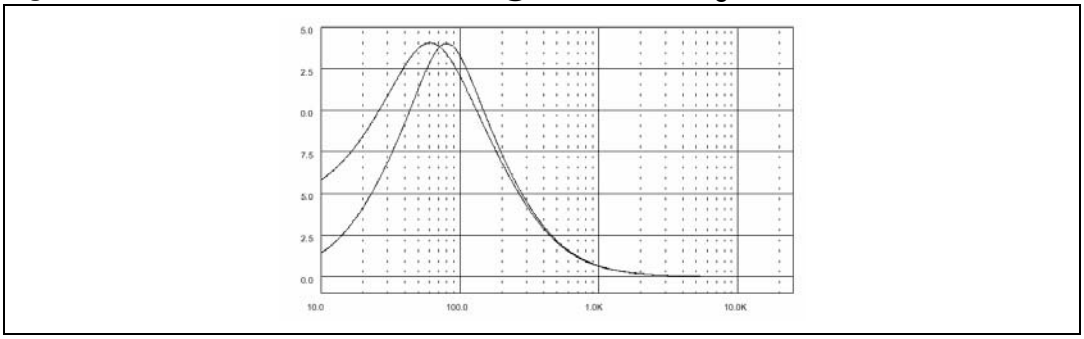
Figure 11. Bass quality factors @ Gain = 14dB, f_C = 80Hz



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 = 80Hz



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

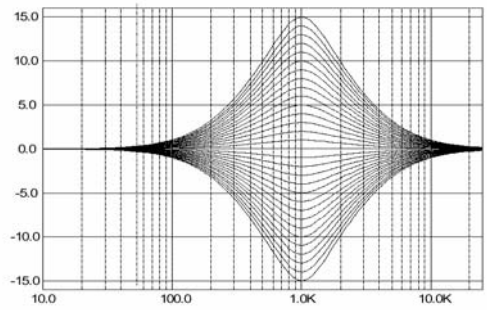
4.7 Middle

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.

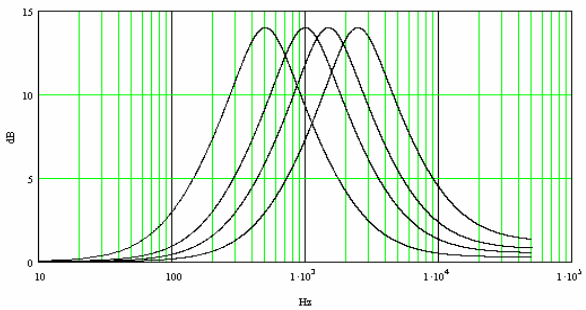
Figure 13. Middle control @ f_C = 1 kHz, Q = 1



4.7.2 Center frequency

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

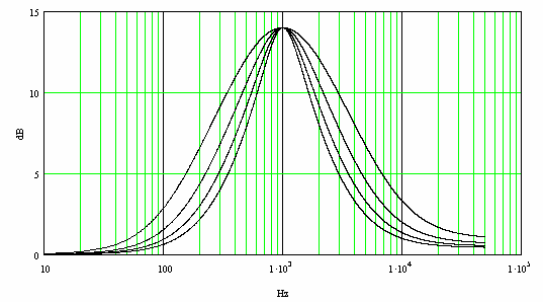
Figure 14. Middle center frequencies @ Gain = 14dB, Q = 1



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 = 1kHz



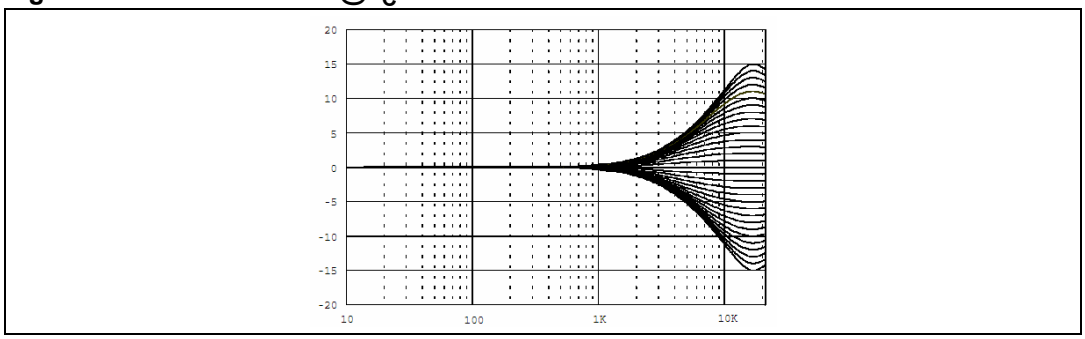
4.8 Treble

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.

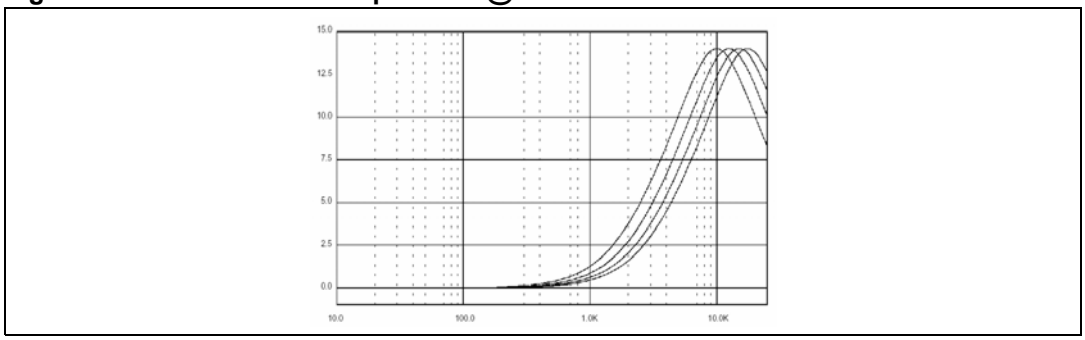
Figure 16. Treble control @ f_C = 17.5 kHz



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

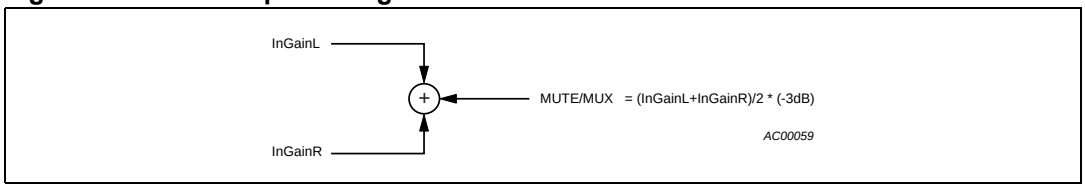
The Subwoofer output is a single ended mono output. The attenuator is exactly the same like the other speakers.

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 (I^2C Byte13_D7D1). When it is configured as MUX output, the output voltage is (InGainL+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	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 1								**Testing Mode** Off On
	0 1							**Auto Zero Remain** Off On
		0 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	
								Source Selector
					0	0	0	PD/SE4
					0	0	1	SE1
					0	1	0	SE2
					0	1	1	SE3
					1	X	X	mute
								Input Gain
	0	0	0	0				0dB
	0	0	0	1				1dB
	:	:	:	:				:
	1	1	1	0				14dB
	1	1	1	1				15dB
								Diffin Mode
0								Single Ended Stereo
1								Differential Stereo

Table 8. Loudness (1)

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

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

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
								Gain/Attenuation
	0	0	0	1	1	1	1	+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
								Volume Soft Step
0								on
1								off

Table 10. Treble filter (3)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
								Gain/Attenuation
			0	0	0	0	0	-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
								Treble Center Frequency
	0	0						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	
								Gain/Attenuation
			0	0	0	0	0	-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
								Middle Q Factor
	0	0						0.5
	0	1						0.75
	1	0						1
	1	1						1.25
								Middle Soft Step
0								on
1								off

Table 12. Bass filter (5)

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

Table 13. Middle / bass Fc select (6)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
								Middle Center Frequency
						0	0	500Hz
						0	1	1kHz
						1	0	1.5kHz
						1	1	2.5kHz
								Bass Center Frequency
				0	0			60Hz
				0	1			80Hz
				1	0			100Hz
				1	1			200Hz
								Bass DC Mode
			0					off
			1					on
								Smoothing Filter
		0						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	
								Soft Mute
							0	on
							1	off
								Soft Mute Time
					0	0		0.48ms
					0	1		0.96ms
					1	X		123ms
								Soft Step Time
		0	0	0				0.16ms
		0	0	1				0.32ms
		0	1	0				0. 64ms
		0	1	1				1.28ms
		1	0	0				2.56ms
		1	0	1				5.12ms
		1	1	0				10.24ms
		1	1	1				20.48ms
								AZ function
	0							off
	1							on
X								Not used

Table 15. Testing audio processor (13)

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

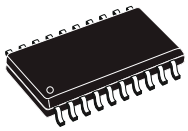
ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 19. SO20 mechanical data and package dimensions

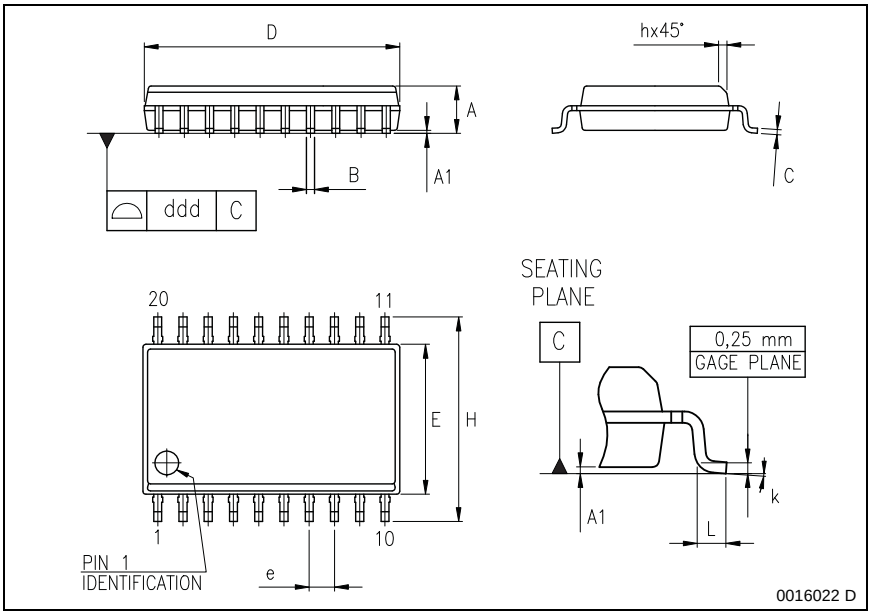
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
B	0.33		0.51	0.013		0.200
C	0.23		0.32	0.009		0.013
D (1)	12.60		13.00	0.496		0.512
E	7.40		7.60	0.291		0.299
e		1.27			0.050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

(1) "D" dimension does not include mold flash, protusions or gate burrs. Mold flash, protusions or gate burrs shall not exceed 0.15mm per side.

OUTLINE AND MECHANICAL DATA



SO20



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.

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