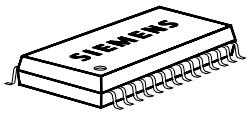
SIEMENS

Audioprocessor **TDA 4390-2X**

1 Overview

The TDA 4390-2X is a single-chip audio sound system. The circuit can be partitioned into two functional blocks.



P-DSO-28-3

1.1 Features

1. Stereo sound processing
   - Four stereo AF inputs
   - Input/Output interface for external equalizer
   - Max. gain switchable between 0 dB and 6 dB
   - Bass and treble control
   - Four independent attenuators for volume balance and fader control
2. Control part
   - I^2C Bus interface compatible for standard and fast mode
   - Control of sound processing

Type	Ordering Code	Package
TDA 4390-2X	Q67000-A5183	P-DSO-28-3

1.2 Pin Configuration

(top view)

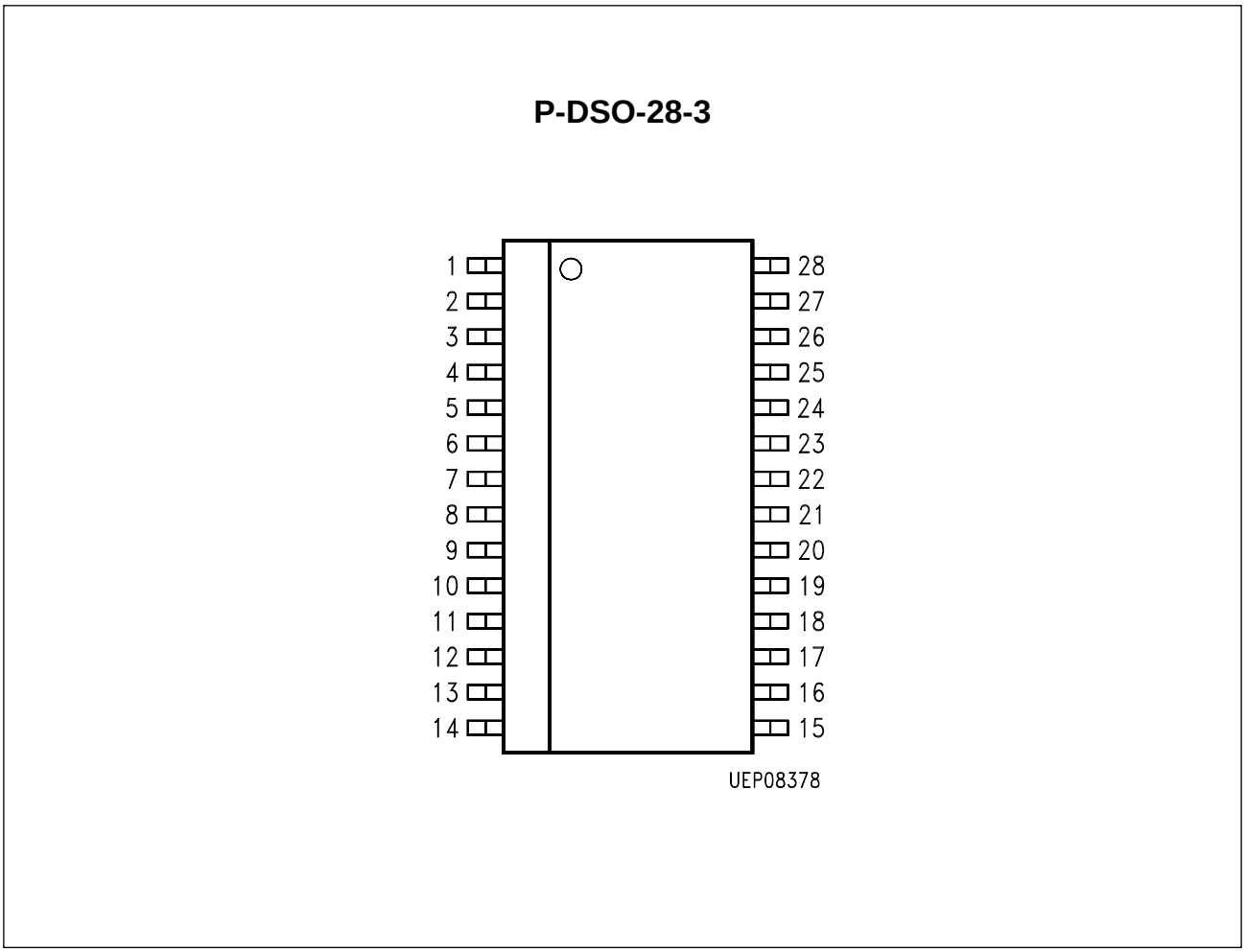


Figure 1

1.3 Pin Definitions and Functions

Pin No.	Symbol	Function
1		AF input 1 left
2		AF input 2 left
3		AF input 3 left
4		AF input 3 left
5		AF output switch left
6		AF input tone control volume left
7		Reset (all functions in power ON status)
8		I^2C Bus SCL
9		I^2C Bus SDA
10		Supply voltage
11		Corner frequency treble left
12		Corner frequency treble right
13		AF output right front
14		AF output right rear
15		AF output left rear
16		AF output left front
17		Corner frequency bass right output
18		Corner frequency bass right input
19		Corner frequency bass left output
20		Corner frequency bass left input
21		Ground
22		Blocking AF operating point
23		AF input tone control volume right
24		AF output switch right
25		AF input 4 right
26		AF input 3 right
27		AF input 2 right
28		AF input 1 right

1.3.1 Pin Description

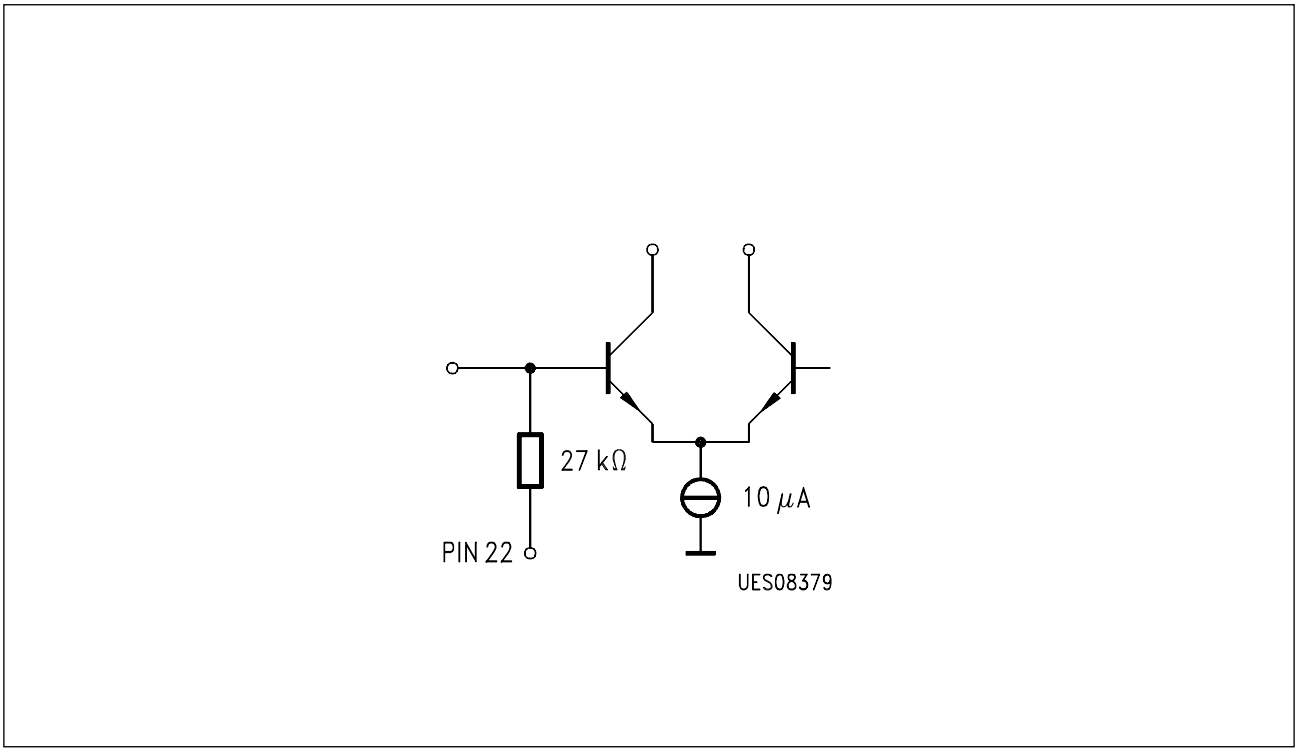


Figure 2
AF Inputs PIN 1/2/3/4/6/23/25/26/27/28

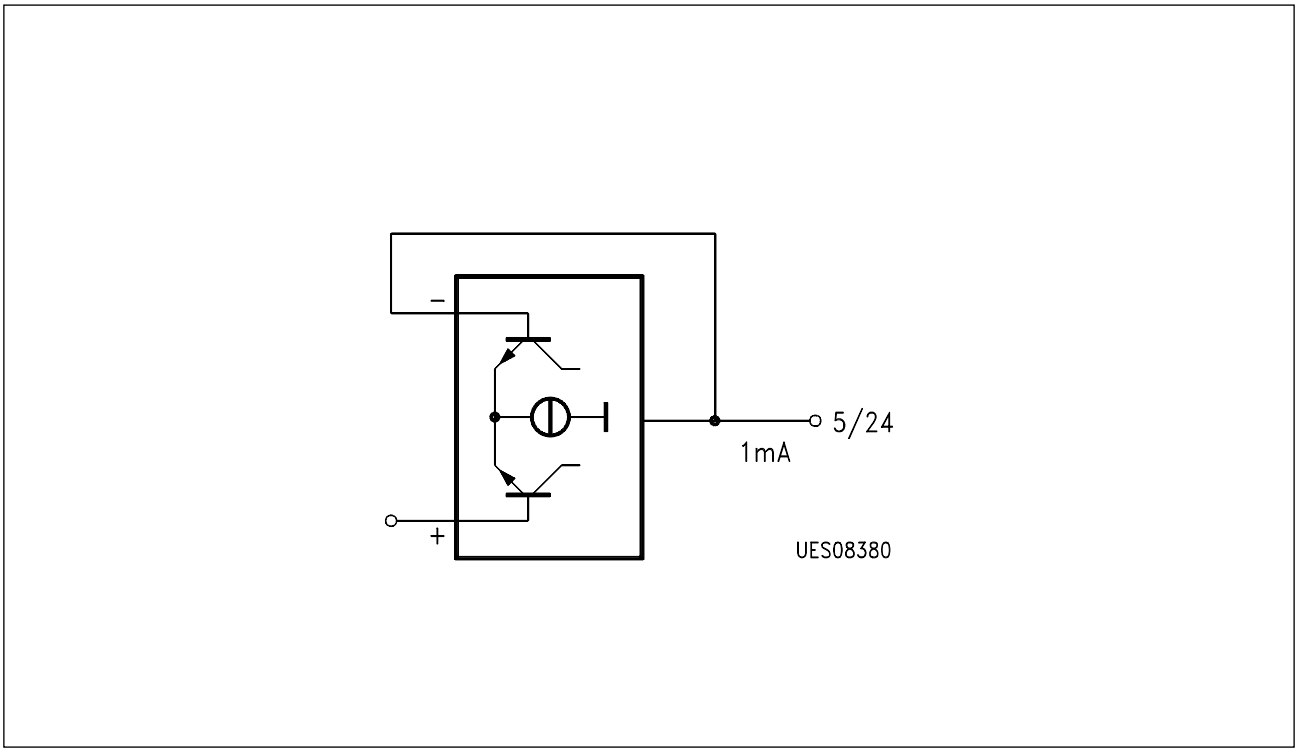


Figure 3
AF Outputs PIN 5/24

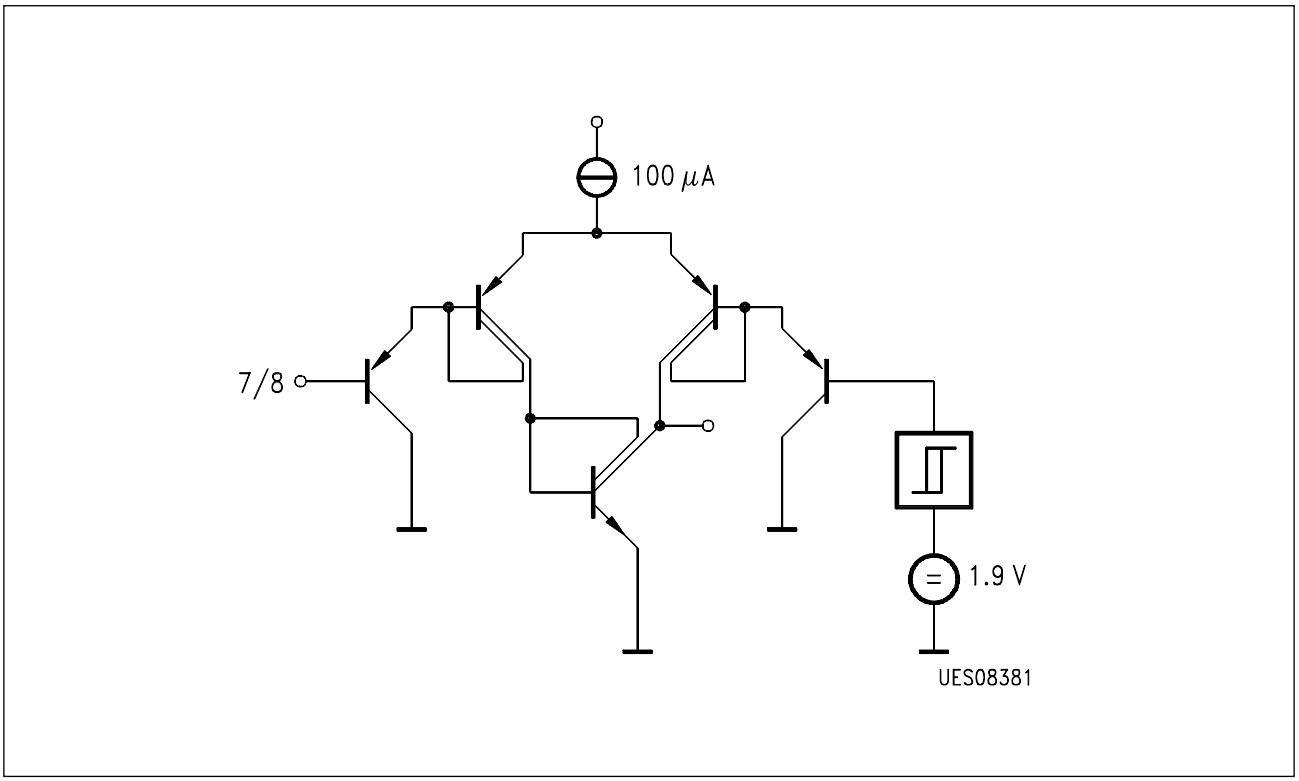


Figure 4
Reset PIN 7, I²C Bus SCL PIN 8

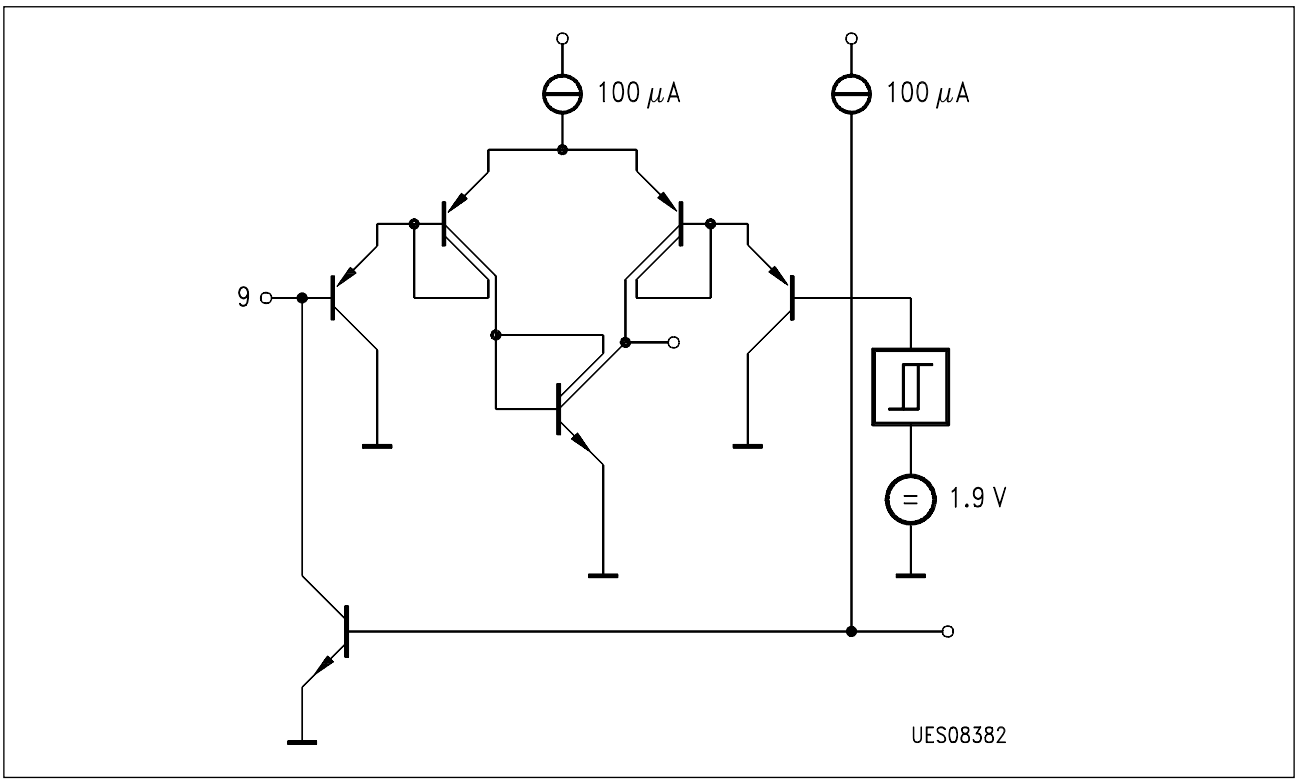


Figure 5
I²C Bus SDA PIN 9

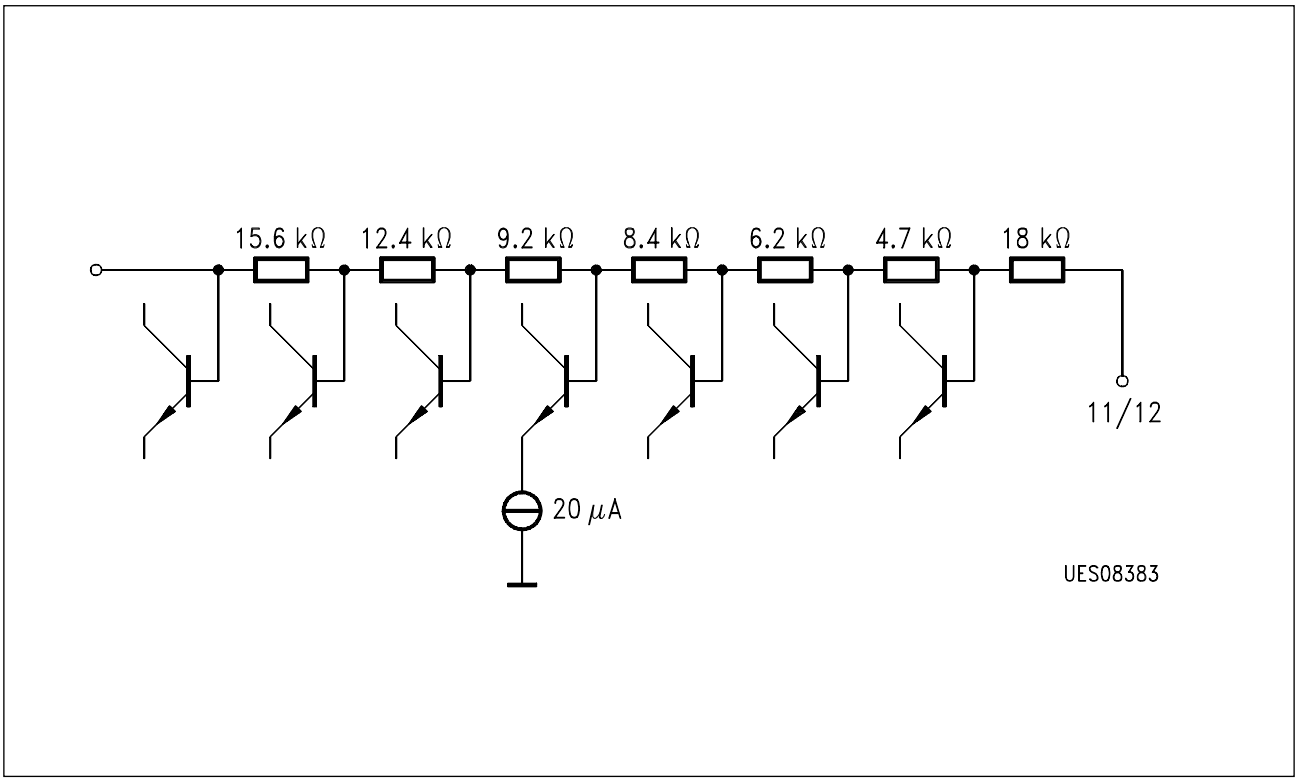


Figure 6
Corner Frequency Treble PIN 11/12

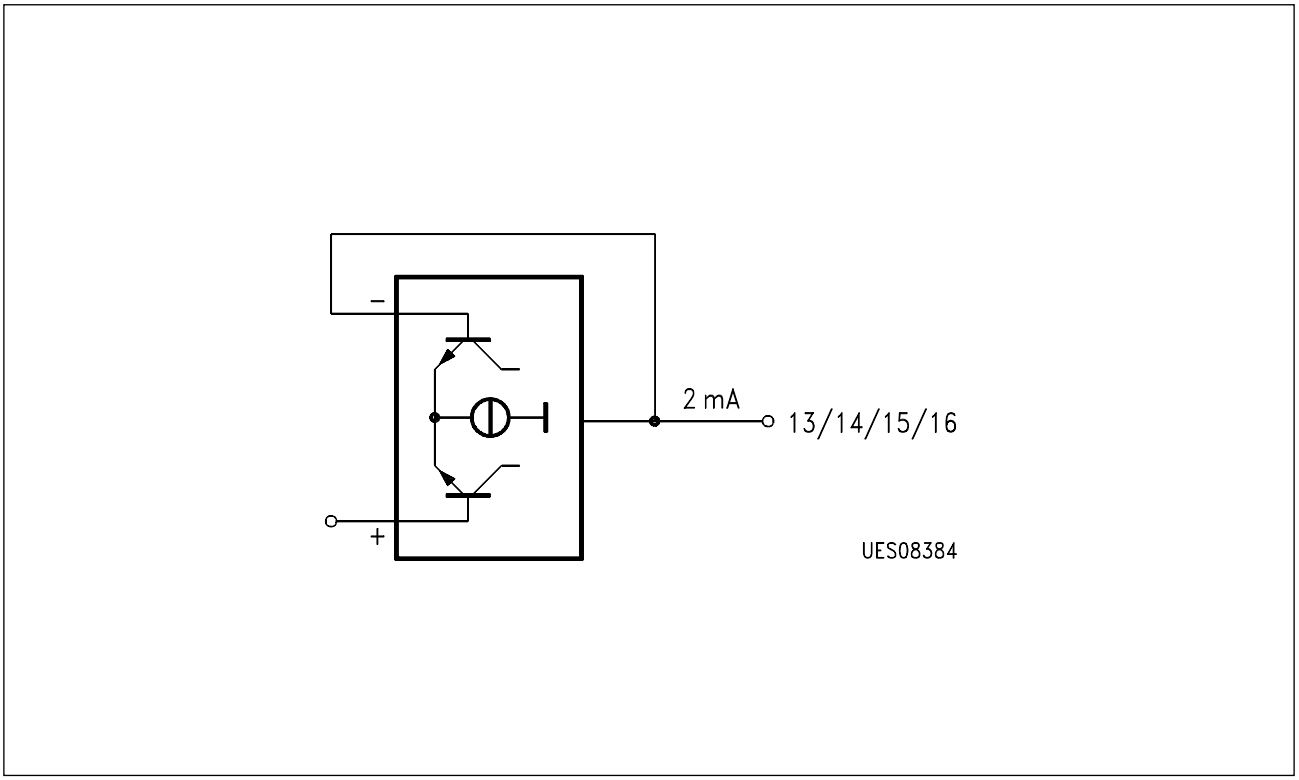


Figure 7
AF Outputs PIN 13/14/15/16

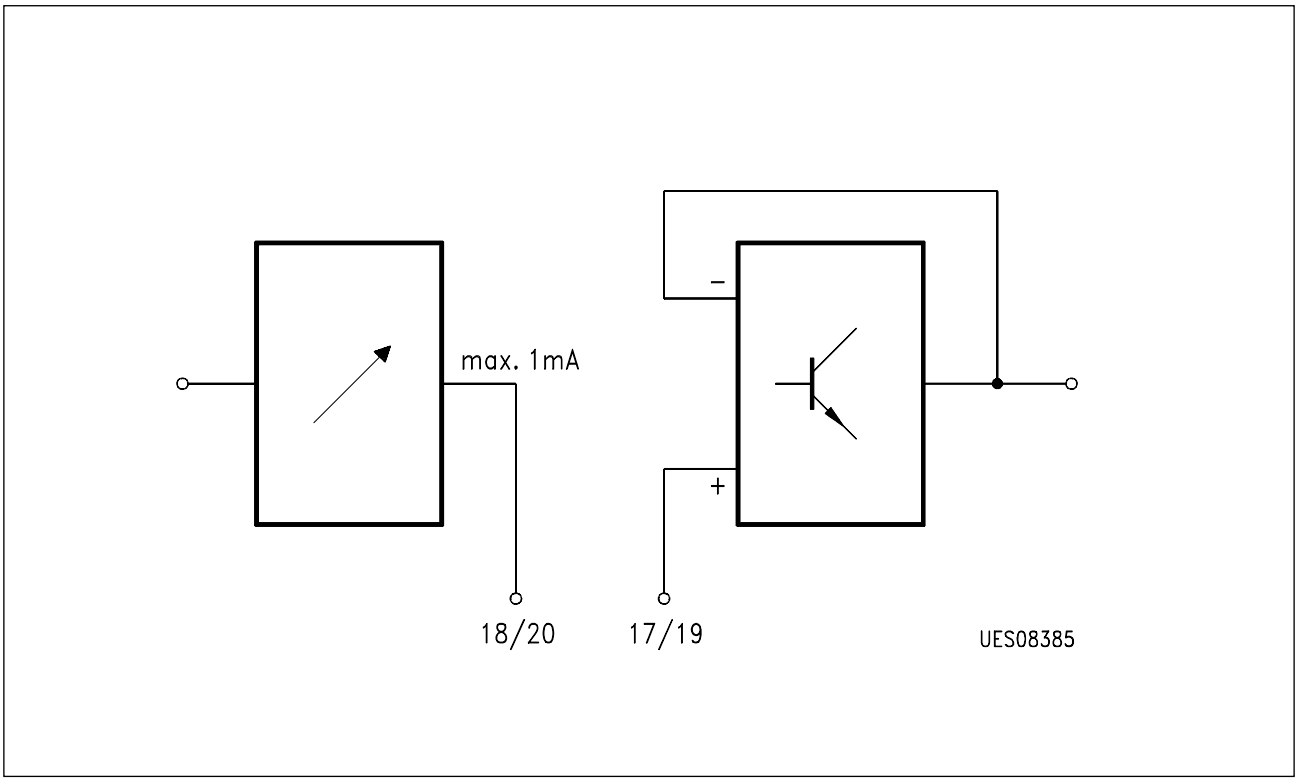


Figure 8
Corner Frequency Bass PIN 17/18/19/20

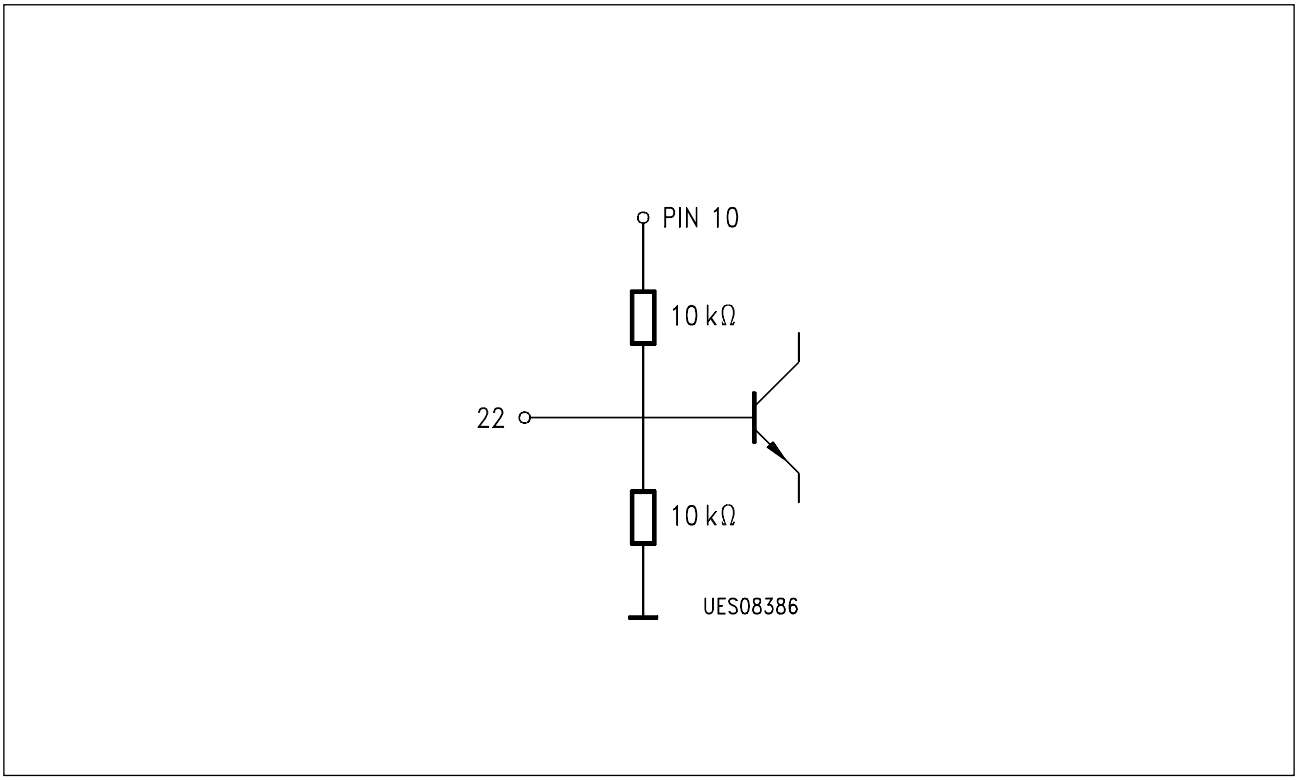


Figure 9
AF Operating Point PIN 22

1.4 Functional Block Diagram

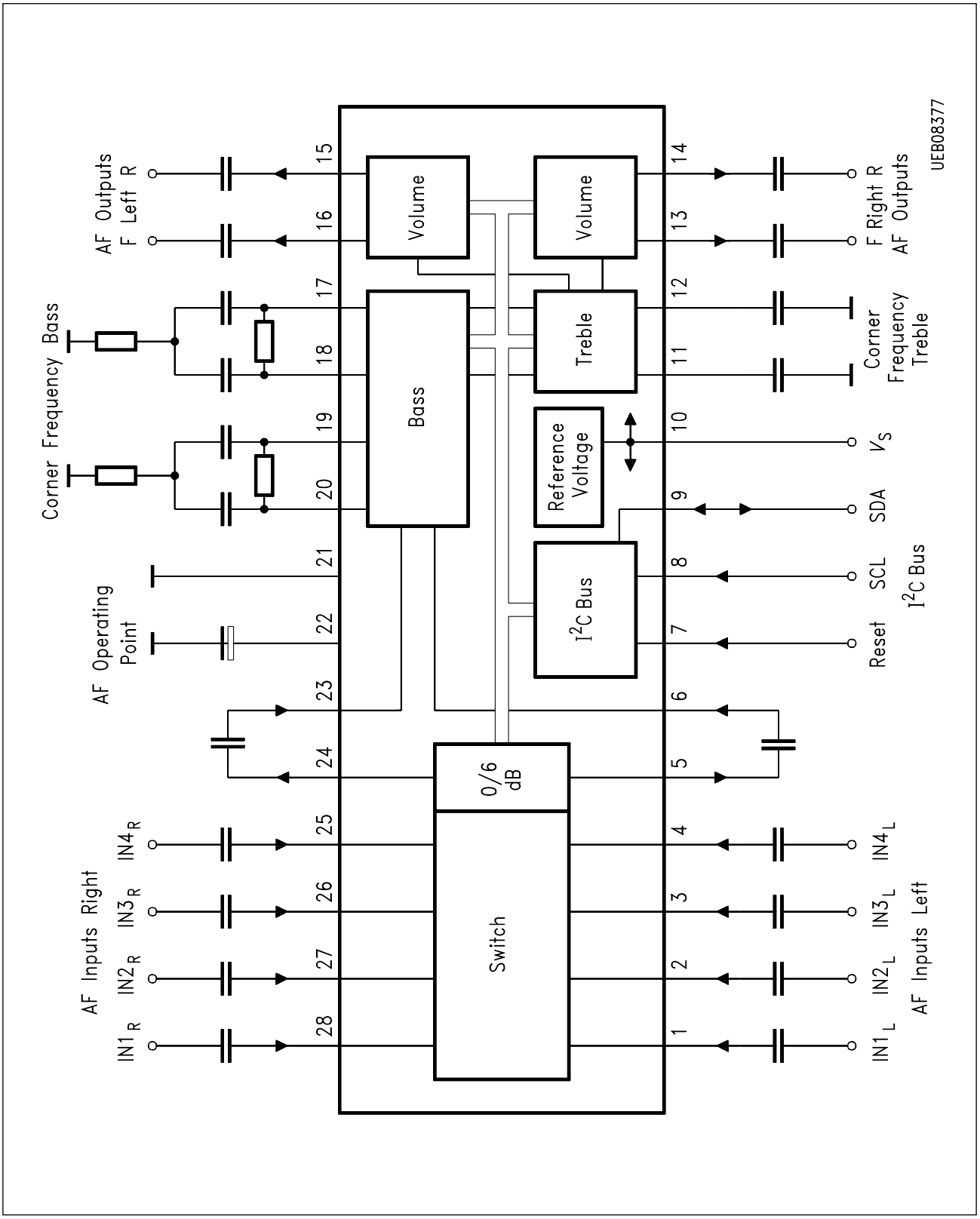


Figure 10
Block Diagram

2 Circuit Description

2.1 Signal Processing

1. The selection of the AF inputs happens in the input switch. There are four stereo inputs available. An input level switch circuitry behind the input switch realizes the adaption of different signal source levels. A gain of 0 dB or 6 dB is possible. After this section a stereo output/input is placed for connecting external circuits like an equalizer.
2. In the following signalpath there is tone control, consisting of bass and treble control. Bass control offers a control range of + 18 dB to – 12 dB with a stepwidth of 2 dB. Frequency characteristic, 1st order or 2nd order (resonance type) is fixed by external components. Treble control offers a control range of ± 12 dB with a stepwidth of 2 dB. The treble control corner frequency is fixed by an external capacitor. Last stage in signalpath is volume control which can be adjusted independent for left, right, rear and front. 57 steps with an increment of 1.25 dB give a setting range of 70 dB, the 57th step activates muting.

2.2 Controlpart

All functions are controlled via an I^2C Bus interface. All data is stored into a latch circuit. The telegram structure is built as follows:

Startcondition – chipaddress – any number of databytes – stopcondition.

For the databytes the following conditions must be fulfilled:

Before transmitting a databyte a subaddress byte must *first* be placed in the data telegram.

2.2.1 Chipaddress

MSB							LSB
1	0	0	0	0	0	1	0

2.2.2 Subaddress bytes

	MSB							LSB
Volume front left	×	×	×	×	×	0	0	0
Volume front right	×	×	×	×	×	0	0	1
Volume rear left	×	×	×	×	×	0	1	0
Volume rear right	×	×	×	×	×	0	1	1
Bass/treble	×	×	×	×	×	1	0	1
Switchbyte	×	×	×	×	×	1	1	1

2.2.3 Controlbytes

a) Volume left, right, front, rear

	MSB							LSB
Max. volume	×	×	1	1	1	1	1	1
Max-1	×	×	1	1	1	1	1	0
Max-16	×	×	1	1	0	0	0	0
Max-55	×	×	0	0	1	0	0	0
MUTE	×	×	0	0	0	1	1	1
MUTE	×	×	0	0	0	0	0	0
MUTE	×	×	0	0	0	×	×	×
Power ON	0	0	0	0	0	0	0	1

b) Treble/Bass

	MSB							LSB
Linear	1	0	0	0	1	0	0	1
Max. treble, lin. bass	0	0	1	0	1	0	0	1
Max. treble, lin. bass	0	0	0	×	1	0	0	1
Min. treble, lin. bass	1	1	1	0	1	0	0	1
Min. treble, lin. bass	1	1	1	×	1	0	0	1
Lin. treble, max. bass	1	0	0	0	0	0	0	0
Lin. treble, min. bass	1	0	0	0	1	1	1	1
Max. treble, max. bass	0	0	0	×	0	0	0	0
Min. treble, min. bass	1	1	1	×	1	1	1	1
Power ON	0	0	0	0	0	0	0	1
	MSB treble			LSB treble	MSB bass			LSB bass

c) Switchbyte

MSB LSB

MUTE	IN1	IN2	IN3	IN4	Gain	×	×

MUTE = 0 MUTE OFF; power ON
MUTE = 1 MUTE ON

IN1 = 0 Input1 OFF; power ON
IN1 = 1 Input1 ON

IN2 = 0 Input1 OFF; power ON
IN2 = 1 Input1 ON

IN3 = 0 Input1 OFF; power ON
IN3 = 1 Input1 ON

IN4 = 0 Input1 OFF; power ON
IN4 = 1 Input1 ON

Gain = 0 Gain 0 dB; power ON
Gain = 1 Gain 6 dB

If no signal is activated, this is interpreted as muting.
There is no mutual lockout of the inputs for multiple selections.

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Supply voltage	V_{10}	0	14	V	
Max. DC voltage	V_1	0	V_{10}	V	
Max. DC voltage	V_2	0	V_{10}	V	
Max. DC voltage	V_3	0	V_{10}	V	
Max. DC voltage	V_4	0	V_{10}	V	
Max. DC voltage	V_6	0	V_{10}	V	
Max. DC voltage	V_7	0	V_{10}	V	
Max. DC voltage	V_8	0	6	V	
Max. DC voltage	V_{11}	0	V_{10}	V	
Max. DC voltage	V_{12}	0	V_{10}	V	
Max. DC voltage	V_{18}	0	V_{10}	V	
Max. DC voltage	V_{20}	0	V_{10}	V	
Max. DC voltage	V_{22}	0	V_{10}	V	
Max. DC voltage	V_{23}	0	V_{10}	V	
Max. DC voltage	V_{25}	0	V_{10}	V	
Max. DC voltage	V_{26}	0	V_{10}	V	
Max. DC voltage	V_{27}	0	V_{10}	V	
Max. DC voltage	V_{28}	0	V_{10}	V	
Max. DC current	I_5	0	2	mA	
Max. DC current	I_9	0	2	mA	
Max. DC current	I_{13}	0	2	mA	
Max. DC current	I_{14}	0	2	mA	

3.1 Absolute Maximum Ratings (cont'd)

T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Max. DC current	I_{15}	0	2	mA	
Max. DC current	I_{16}	0	2	mA	
Max. DC current	I_{17}	0	2	mA	
Max. DC current	I_{19}	0	2	mA	
Max. DC current	I_{24}	0	2	mA	
Junction temperature	T_j		150	°C	
Storage temperature	T_S	– 40	125	°C	
Thermal resistance	R_{thSA}		76	K/W	

Note: Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

3.2 Operating Range

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Supply voltage	V_S	7.5	13.2	V
Ambient temperature range	T_A	– 40	85	°C
Input frequency range	f_I	0.01	20	kHz

Note: In the operating range the functions given in the circuit description are fulfilled.

3.3 AC/DC Characteristics

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
AF reference level 0 dB = 150 mV, f_i = 1 kHz, if not stated otherwise. I^2C Bus preset: Start – 82 – 00, 3F – 01, 3F – 02, 3F – 03, 3F – 05, 89 – 07, 40 – Stop Chipaddr. – Vol 63 – Vol 63 – Vol 63 – Vol 63 – tone lin – IN1 The basic setting for each point in the specification is always preset; only settings which are deviate from this, are given in the test conditions. Details in *italics* only provide explanation of the hexadecimal code and which switch bits on the setbytes are stated.							
Current consumption	I_{10}		39	55	mA		1
A. Signal Section							
Gain[1)]	$V_{5\text{-}1}$	– 1	0	1	dB		1
Gain[1)]	$V_{24\text{-}28}$	– 1	0	1	dB		1
Gain[1)]	$V_{5\text{-}1}$	5	6	7	dB	07, 44; *gain = 6 dB*	1
Gain[1)]	$V_{24\text{-}28}$	5	6	7	dB	07, 44; *gain = 6 dB*	1
Max. gain	$V_{15\text{-}6}$	– 2	0	2	dB		1
Max. gain	$V_{16\text{-}6}$	– 2	0	2	dB		1
Max. gain	$V_{13\text{-}23}$	– 2	0	2	dB		1
Max. gain	$V_{14\text{-}23}$	– 2	0	2	dB		1
Min. gain	$V_{15\text{-}6}$		– 70	– 60	dB	00, 08-02, 08; *Vol 8*	1
Min. gain	$V_{16\text{-}6}$		– 70	– 60	dB	00, 08-02, 08; *Vol 8*	1
Min. gain	$V_{13\text{-}23}$		– 70	– 60	dB	01, 08-03, 08; *Vol 8*	1
Min. gain	$V_{14\text{-}23}$		– 70	– 60	dB	01, 08-03, 08; *Vol 8*	1
Tracking error	$\Delta V_{13\text{-}14}$			± 3	dB	01, 3F to 01, 24 03, 3F to 03, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{15\text{-}16}$			± 3	dB	00, 3F to 00, 24 02, 3F to 02, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{13\text{-}16}$			± 3	dB	00, 3F to 00, 24 01, 3F to 01, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{14\text{-}15}$			± 3	dB	02, 3F to 02, 24 03, 3F to 03, 24; *Vol 63-36*	1

[1)] Same values apply for feeding in on pins 2 … 4, and 25 … 27.

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Step width Vol_{13}	ΔV_{13}	0	1.25	2.5	dB	01, X-01, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{14}	ΔV_{14}	0	1.25	2.5	dB	03, X-03, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{15}	ΔV_{15}	0	1.25	2.5	dB	02, X-02, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{16}	ΔV_{16}	0	1.25	2.5	dB	02, X-02, (X ± 1) *Vol X-Vol (X ± 1)*	1
Bass boost	$V_{15\text{-}6}$	15	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{16\text{-}6}$	15	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{13\text{-}23}$	15	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{14\text{-}23}$	15	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{15\text{-}6}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{16\text{-}6}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{13\text{-}23}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{14\text{-}23}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Step width bass	ΔV_{13}	1	2	3	dB	05, 8X-05,8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{14}	1	2	3	dB	05, 8X-05,8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{15}	1	2	3	dB	05, 8X-05,8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{16}	1	2	3	dB	05, 8X-05,8 (X ± 1) *bass X-bass (X ± 1)*	1

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Treble boost	$V_{15\text{-}6}$	9	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{16\text{-}6}$	9	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{13\text{-}23}$	9	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{14\text{-}23}$	9	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{15\text{-}6}$	9	12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{15\text{-}6}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{16\text{-}6}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{13\text{-}23}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{14\text{-}23}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Step width treble	ΔV_{13}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{14}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{15}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{16}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Tone linearity	ΔV_{13}			± 3	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{14}			± 3	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{15}			± 3	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{16}			± 3	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Channel separation	$\Delta V_{14\text{-}15}$	60			dB	V_6 or V_{23} = 300 mVrms	1
Channel separation	$\Delta V_{13\text{-}16}$	60			dB	V_6 or V_{23} = 300 mVrms	1
Crosstalk of the switch[1]	$a_{\text{input unwanted/ output wanted}}$	80			dB	$V_{\text{i wanted}}$ = 0 $V_{\text{i unwanted}}$ = 300 mVrms	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	01, 00-03, 00; V_1 = 300 mVrms*; Vol 0*	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	07, C0; V_1 = 300 mVrms *MUTE active*	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	07, 00; V_1 = 300 mVrms *not select*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	00, 00 to 03, 00; V_{28} = 300 mVrms; *Vol 0*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	07, 00; V_{28} = 300 mVrms *MUTE active*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	07, 00; V_{28} = 300 mVrms *not select*	1

[1] Same values apply for feeding in on pins 1 … 4 or 25 … 28, and measurement on pins 5 or 24.
[2] Analogous values apply for feeding in on pins 2, 3, 4.
[3] Same values apply for feeding in on pins 25, 26, 27.

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Max. input voltage[1]	V_1	1.5			Vrms	$k_{15,\,16} \leq 1$ %; $R_{L15,\,16}$ = 2.2 kΩ	1
Max. input voltage[1]	V_1	0.75			Vrms	$k_{15,\,16} \leq 1$ %; 07, 44 $R_{L15,\,16}$ = 2.2 kΩ	1
Max. input voltage[2]	V_{28}	1.5			Vrms	$k_{13,\,14} \leq 1$ %; $R_{L13,\,14}$ = 2.2 kΩ	1
Max. input voltage[2]	V_{28}	0.75			Vrms	$k_{13,\,14} \leq 1$ %; 07, 44 $R_{L13,\,14}$ = 2.2 kΩ	1
Max. input voltage	V_6	250			Vrms	$k_{15,\,16}$ < 1 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	250			Vrms	$k_{13,\,14}$ < 1 %; 05, XX *any sound*	1
Max. output voltage	V_{13}	2.0			Vrms	k_{13} < 1 %	1
Max. output voltage	V_{14}	2.0			Vrms	k_{14} < 1 %	1
Max. output voltage	V_{15}	2.0			Vrms	k_{15} < 1 %	1
Max. output voltage	V_{16}	2.0			Vrms	k_V < 1 %	1
Distortion[3]	k_5		0.01	0.1	%	V_1 = 150 mVrms	1
Distortion[3]	k_{24}		0.01	0.1	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{13}		0.01	0.1	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{14}		0.01	0.1	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{15}		0.01	0.1	%	V_1 = 150 mVrms	1
Distortion[3]	k_{16}		0.01	0.1	%	V_1 = 150 mVrms	1
Distortion[3]	k_{13}		0.01	0.1	%	V_{28} = 150 mVrms 01, 2F; *Vol 47*	1
Distortion[3]	k_{14}		0.01	0.1	%	V_{28} = 150 mVrms 03, 2F; *Vol 47*	1
Distortion[3]	k_{15}		0.01	0.1	%	V_1 = 150 mVrms 02, 2F; *Vol 47*	1
Distortion[3]	k_{16}		0.01	0.1	%	V_1 = 150 mVrms 00, 2F; *Vol 47*	1

[1] Same values apply for feeding in on pins 2, 3, 4.
[2] Same values apply for feeding in on pins 25, 26, 27.
[3] Same values apply for feeding in on pins 2 … 4 or 25 … 27.

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Distortion[1)]	k_{13}		0.05	0.5	%	V_{28} = 150 mVrms 05, XX; *any sound*	1
Distortion[1)]	k_{14}		0.05	0.5	%	V_{28} = 150 mVrms 05, XX; *any sound*	1
Distortion[1)]	k_{15}		0.05	0.5	%	V_1 = 150 mVrms 05, XX; *any sound*	1
Distortion[1)]	k_{16}		0.05	0.5	%	V_1 = 150 mVrms 05, XX; *any sound*	1
Signal/noise ratio[1)]	$a_{S/N13}$	80	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms	1
Signal/noise ratio[1)]	$a_{S/N14}$	80	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms	1
Signal/noise ratio[1)]	$a_{S/N15}$	80	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms	1
Signal/noise ratio[1)]	$a_{S/N16}$	80	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms	1
Signal/noise ratio[1)]	$a_{S/N13}$	60	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms 01, 27; *Vol 39*	1
Signal/noise ratio[1)]	$a_{S/N14}$	60	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms 03, 27; *Vol 39*	1
Signal/noise ratio[1)]	$a_{S/N15}$	60	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms; 02, 27	1
Signal/noise ratio[1)]	$a_{S/N16}$	60	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms 00, 27; *Vol 39*	1

[1)] Same values apply for feeding in on pins 2 … 4 or 25 … 27.

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Noise voltage	V_{N13}		2	10	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 01, 00-03, 00; *Vol 0*	1
Noise voltage	V_{N14}		2	10	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 00, 00-03, 00; *Vol 0*	1
Noise voltage	V_{N15}		2	10	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 00, 00-02, 00; *Vol 0*	1
Noise voltage	V_{N16}		2	10	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 01, 00-02, 00; *Vol 0*	1
DC jump Δ 1 bit	ΔV_{13}			± 10	mV	01, X-01, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{14}			± 10	mV	03, X-03, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{15}			± 10	mV	02, X-02, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{16}			± 10	mV	00, X-00, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{13}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{14}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{15}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{16}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
PSRR	A_{PSRR13}		70		dB	$V_{undesired}$ = 1 Vrms $f_{undesired}$ = 100 Hz … 20 kHz	1
PSRR	A_{PSRR14}		70		dB	input termination with 220 Ω	1
PSRR	A_{PSRR15}		70		dB	measurement rms according CCIR 651	1
PSRR	A_{PSRR16}		70		dB		1

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Design Hints							
Input resistance	R_1	22	27		kΩ		
Input resistance	R_2	22	27		kΩ		
Input resistance	R_3	22	27		kΩ		
Input resistance	R_4	22	27		kΩ		
Input resistance	R_6	24	30		kΩ		
Input resistance	R_{23}	24	30		kΩ		
Input resistance	R_{25}	22	27		kΩ		
Input resistance	R_{26}	22	27		kΩ		
Input resistance	R_{27}	22	27		kΩ		
Input resistance	R_{28}	22	27		kΩ		
Output resistance	R_5			200	Ω		
Output resistance	R_{13}			200	Ω		
Output resistance	R_{14}			200	Ω		
Output resistance	R_{15}			200	Ω		
Output resistance	R_V			200	Ω		
Output resistance	R_{24}			200	Ω		
V_S = 8.5 V							
Max. input voltage	V_6	180			mVrms	$k_{15, 16}$ < 5 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	180			mVrms	$k_{13, 14}$ < 5 %; 05, XX *any sound*	1
Bass boost	$V_{15\text{-}6}$	10	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{16\text{-}6}$	10	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{13\text{-}23}$	10	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{14\text{-}23}$	10	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
V_S = 12 V							
Max. input voltage	V_6	300			mVrms	$k_{15,\ 16}$ < 1 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	300			mVrms	$k_{13,\ 14}$ < 1 %; 05, XX *any sound*	1
B. I²C Bus (SCL, SDA edges)							
Rise time	t_R			300	ns		
Fall time	t_F			300	ns		
Shift Register Clock Pulse SCL							
Frequency	f_{SCL}	0		400	kHz		
H-pulse width	t_{HIGH}	0.6			µs		
L-pulse width	t_{LOW}	1.3			µs		
Start							
Set-up time	t_{SUSTA}	0.6			µs		
Hold time	t_{HDSTA}	0.6			µs		
Stop							
Set-up time	t_{SUSTO}	0.6			µs		
Bus free time	t_{BUF}	1.3			µs		
Data Transfer							
Set-up time	t_{SUDAT}	100			µs		
Hold time	t_{HDDAT}	0		0.9	µs		

3.3 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Inputs SCL, SDA							
Input voltage	V_{QH}	3		5.5	V		
	V_{QL}			1.5	V		
Hysteresis	V_{HYS}	0.2			V		
Spike suppression	t_{SP}	50			ns		
Input current	I_{QH}			50	µA		
	V_{QL}			100	µA		
Output SDA (open collector)							
Output voltage	V_{QH}	5.4			V	R_L = 2.5 kΩ	
	V_{QL}			0.4	V	I_{QL} = 3 mA	
Reset inactive	V_L			1.5	V		
Reset active	V_H	3		5.5	V		

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_A = 25 °C and the given supply voltage.

3.4 AC/DC Characteristics

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
AF reference level 0 dB = 150 mV, f_i = 1 kHz, if not stated otherwise. I^2C Bus preset: Start – 82 – 00, 3F – 01, 3F – 02, 3F – 03, 3F – 05, 89 – 07, 40 – Stop Chipaddr. – Vol 63 – Vol 63 – Vol 63 – Vol 63 – tone lin – IN1 The basic setting for each point in the specification is always preset; only settings which are deviate from this, are given in the test conditions. Details in *italics* only provide explanation of the hexadecimal code and which switch bits on the setbytes are stated.							
Current consumption	I_{10}		39	50	mA		1
A. Signal Section							
Gain[1)]	$V_{5\text{-}1}$	–1	0	1	dB		1
Gain[1)]	$V_{24\text{-}28}$	– 1	0	1	dB		1
Gain[1)]	$V_{5\text{-}1}$	5	6	7	dB	07, 44; *gain = 6 dB*	1
Gain[1)]	$V_{24\text{-}28}$	5	6	7	dB	07, 44; *gain = 6 dB*	1
Max. gain	$V_{15\text{-}6}$	– 2	0	2	dB		1
Max. gain	$V_{16\text{-}6}$	– 2	0	2	dB		1
Max. gain	$V_{13\text{-}23}$	– 2	0	2	dB		1
Max. gain	$V_{14\text{-}23}$	– 2	0	2	dB		1
Min. gain	$V_{15\text{-}6}$		– 70	– 65	dB	00, 08-02, 0; 8 *Vol 8*	1
Min. gain	$V_{16\text{-}6}$		– 70	– 65	dB	00, 08-02, 0; 8 *Vol 8*	1
Min. gain	$V_{13\text{-}23}$		– 70	– 65	dB	01, 08-03, 0; 8 *Vol 8*	1
Min. gain	$V_{14\text{-}23}$		– 70	– 65	dB	01, 08-03, 08; *Vol 8*	1
Tracking error	$\Delta V_{13\text{-}14}$			± 2	dB	01, 3F to 01, 24 03, 3F to 03, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{15\text{-}16}$			± 2	dB	00, 3F to 00, 24 02, 3F to 02, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{13\text{-}16}$			± 2	dB	00, 3F to 00, 24 01, 3F to 01, 24; *Vol 63-36*	1
Tracking error	$\Delta V_{14\text{-}15}$			± 2	dB	02, 3F to 02, 24 03, 3F to 03, 24; *Vol 63-36*	1

[1)] Same values apply for feeding in on pins 2 … 4, and 25 … 27.

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Step width Vol_{13}	ΔV_{13}	0	1.25	2.5	dB	01, X-01, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{14}	ΔV_{14}	0	1.25	2.5	dB	03, X-03, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{15}	ΔV_{15}	0	1.25	2.5	dB	02, X-02, (X ± 1) *Vol X-Vol (X ± 1)*	1
Step width Vol_{16}	ΔV_{16}	0	1.25	2.5	dB	00, X-00, (X ± 1) *Vol X-Vol (X ± 1)*	1
Bass boost	$V_{15\text{-}6}$	16	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{16\text{-}6}$	16	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{13\text{-}23}$	16	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{14\text{-}23}$	16	18		dB	05, 80; f_i = 40 Hz *bass max, treble lin*	1
Bass boost	$V_{15\text{-}6}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{16\text{-}6}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{13\text{-}23}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Bass boost	$V_{14\text{-}23}$		– 12		dB	05, 8F; f_i = 40 Hz *bass min, treble lin*	1
Step width bass	ΔV_{13}	1	2	3	dB	05, 8X-05, 8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{14}	1	2	3	dB	05, 8X-05, 8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{15}	1	2	3	dB	05, 8X-05, 8 (X ± 1) *bass X-bass (X ± 1)*	1
Step width bass	ΔV_{16}	1	2	3	dB	05, 8X-05, 8 (X ± 1) *bass X-bass (X ± 1)*	1

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Treble boost	$V_{15\text{-}6}$	10	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{16\text{-}6}$	10	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{13\text{-}23}$	10	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{14\text{-}23}$	10	12		dB	05, 09; f_i = 15 kHz *treble max, bass lin*	1
Treble boost	$V_{15\text{-}6}$	10	12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{15\text{-}6}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{16\text{-}6}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{13\text{-}23}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Treble boost	$V_{14\text{-}23}$		– 12		dB	05, F9; f_i = 15 kHz *treble min, bass lin*	1
Step width treble	ΔV_{13}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{14}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{15}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1
Step width treble	ΔV_{16}	1	2	3	dB	05, X9-05, (X ± 1) 9 *treble X-treble (X ± 1)*	1

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Tone linearity	ΔV_{13}			± 2	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{14}			± 2	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{15}			± 2	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Tone linearity	ΔV_{16}			± 2	dB	05, 89; f_i = 40 Hz … 15 kHz *treble, bass lin*	1
Channel separation	$\Delta V_{14\text{-}15}$	60			dB	V_6 or V_{23} = 300 mVrms	1
Channel separation	$\Delta V_{13\text{-}16}$	60			dB	V_6 or V_{23} = 300 mVrms	1
Crosstalk of the switch[1]	$a_{\text{input unwanted/ output wanted}}$	80			dB	$V_{\text{i wanted}}$ = 0 $V_{\text{i unwanted}}$ = 300 mVrms	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	01, 00-03, 00; V_1 = 300 mVrms; *Vol 0*	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	07, C0; V_1 = 300 mVrms *MUTE active*	1
Attenuation MUTE[2]	$a_{1\text{-}5}$	80			dB	07, 00; V_1 = 300 mVrms *not select*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	00, 00 to 03, 00; V_{28} = 300 mVrms; *Vol 0*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	07, C0; V_{28} = 300 mVrms *MUTE active*	1
Attenuation MUTE[3]	$a_{28\text{-}24}$	80			dB	07, 00; V_{28} = 300 mVrms *not select*	1

[1] Same values apply for feeding in on pins 1 … 4 or 25 … 28, and measurement on pins 5 or 24.
[2] Analogous values apply for feeding in on pins 2, 3, 4.
[3] Same values apply for feeding in on pins 25, 26, 27.

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Max. input voltage[1]	V_1	2			Vrms	$k_{15,16} \leq 1$ %; $R_{L15,16}$ = 2.2 kΩ	1
Max. input voltage[1]	V_1	1			Vrms	$k_{15,16} \leq 1$ %; 07, 44 $R_{L15,16}$ = 2.2 kΩ	1
Max. input voltage[2]	V_{28}	2			Vrms	$k_{13,14} \leq 1$ %; $R_{L13,14}$ = 2.2 kΩ	1
Max. input voltage[2]	V_{28}	1			Vrms	$k_{13,14} \leq 1$ %; 07, 44 $R_{L13,14}$ = 2.2 kΩ	1
Max. input voltage	V_6	280			Vrms	$k_{15,16}$ < 1 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	280			Vrms	$k_{13,14}$ < 1 %; 05, XX *any sound*	1
Max. output voltage	V_{13}	2.2			Vrms	k_{13} < 1 %	1
Max. output voltage	V_{14}	2.2			Vrms	k_{14} < 1 %	1
Max. output voltage	V_{15}	2.2			Vrms	k_{15} < 1 %	1
Max. output voltage	V_{16}	2.2			Vrms	k_{16} < 1 %	1
Distortion[3]	k_5		0.01	0.05	%	V_1 = 150 mVrms	1
Distortion[3]	k_{24}		0.01	0.05	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{13}		0.01	0.05	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{14}		0.01	0.05	%	V_{28} = 150 mVrms	1
Distortion[3]	k_{15}		0.01	0.05	%	V_1 = 150 mVrms	1
Distortion[3]	k_{16}		0.01	0.05	%	V_1 = 150 mVrms	1
Distortion[3]	k_{13}		0.01	0.1	%	V_{28} = 150 mVrms 01, 2F; *Vol 47*	1
Distortion[3]	k_{14}		0.01	0.1	%	V_{28} = 150 mVrms 03, 2F; *Vol 47*	1
Distortion[3]	k_{15}		0.01	0.1	%	V_1 = 150 mVrms 02, 2F; *Vol 47*	1
Distortion[3]	k_{16}		0.01	0.1	%	V_1 = 150 mVrms 00, 2F; *Vol 47*	1

[1] Same values apply for feeding in on pins 2, 3, 4.
[2] Same values apply for feeding in on pins 25, 26, 27.
[3] Same values apply for feeding in on pins 2 … 4 or 25 … 27.

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Distortion[1]	k_{13}		0.05	0.2	%	V_{28} = 150 mVrms 05, XX; *any sound*	1
Distortion[1]	k_{14}		0.05	0.2	%	V_{28} = 150 mVrms 05, XX; *any sound*	1
Distortion[1]	k_{15}		0.05	0.2	%	V_1 = 150 mVrms 05, XX; *any sound*	1
Distortion[1]	k_{16}		0.05	0.2	%	V_1 = 150 mVrms 05, XX; *any sound*	1
Signal/noise ratio[1]	$a_{S/N13}$	90	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms	1
Signal/noise ratio[1]	$a_{S/N14}$	90	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms	1
Signal/noise ratio[1]	$a_{S/N15}$	90	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms	1
Signal/noise ratio[1]	$a_{S/N16}$	90	95		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms	1
Signal/noise ratio[1]	$a_{S/N13}$	70	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms 01, 27; *Vol 39*	1
Signal/noise ratio[1]	$a_{S/N14}$	70	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_{28} = 0.3 Vrms 03, 27; *Vol 39*	1
Signal/noise ratio[1]	$a_{S/N15}$	70	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms; 02, 27	1
Signal/noise ratio[1]	$a_{S/N16}$	70	80		dB	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ V_1 = 0.3 Vrms 00, 27; *Vol 39*	1

[1] Same values apply for feeding in on pins 2 … 4 or 25 … 27.

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Noise voltage	V_{N13}		2	5	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 01, 00-03, 00; *Vol 0*	1
Noise voltage	V_{N14}		2	5	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 01, 00-03, 00; *Vol 0*	1
Noise voltage	V_{N15}		2	5	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 00, 00-02, 00; *Vol 0*	1
Noise voltage	V_{N16}		2	5	µVrms	$V_{Nrms\ 20\ Hz\text{-}20\ kHz}$ 00, 00-02, 00; *Vol 0*	1
DC jump Δ 1 bit	ΔV_{13}			± 10	mV	01, X-01, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{14}			± 10	mV	03, X-03, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{15}			± 10	mV	02, X-02, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{16}			± 10	mV	00, X-00, (X ± 1) *Vol X-Vol (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{13}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{14}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{15}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
DC jump Δ 1 bit	ΔV_{16}			± 10	mV	05, X-05, (X ± 1) *tone X-tone (X ± 1)*	1
PSRR	A_{PSRR13}		70		dB	$V_{undesired}$ = 1 Vrms $f_{undesired}$ = 100 Hz … 20 kHz	1
PSRR	A_{PSRR14}		70		dB	input termination with 220 Ω	1
PSRR	A_{PSRR15}		70		dB	measurement rms according CCIR 651	1
PSRR	A_{PSRR16}		70		dB		1

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Design Hints							
Input resistance	R_1	23	27		kΩ		
Input resistance	R_2	23	27		kΩ		
Input resistance	R_3	23	27		kΩ		
Input resistance	R_4	23	27		kΩ		
Input resistance	R_6	25.5	30		kΩ		
Input resistance	R_{23}	25.5	30		kΩ		
Input resistance	R_{25}	23	27		kΩ		
Input resistance	R_{26}	23	27		kΩ		
Input resistance	R_{27}	23	27		kΩ		
Input resistance	R_{28}	23	27		kΩ		
Output resistance	R_5			200	Ω		
Output resistance	R_{13}			200	Ω		
Output resistance	R_{14}			200	Ω		
Output resistance	R_{15}			200	Ω		
Output resistance	R_{16}			200	Ω		
Output resistance	R_{24}			200	Ω		
V_S = 8.5 V							
Max. input voltage	V_6	220			mVrms	$k_{15,\,16}$ < 5 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	220			mVrms	$k_{13,\,14}$ < 5 %; 05, XX *any sound*	1
Bass boost	$V_{15\text{-}6}$	11	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{16\text{-}6}$	11	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{13\text{-}23}$	11	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1
Bass boost	$V_{14\text{-}23}$	11	12		dB	05,83; f_i = 40 Hz bass step 6, treble lin	1

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
V_S = 12 V							
Max. input voltage	V_6	370			mVrms	$k_{15,16}$ < 1 %; 05, XX *any sound*	1
Max. input voltage	V_{23}	370			mVrms	$k_{13,14}$ < 1 %; 05, XX *any sound*	1
B. I²C Bus (SCL, SDA edges)							
Rise time	t_R			300	ns		
Fall time	t_F			300	ns		
Shift Register Clock Pulse SCL							
Frequency	f_{SCL}	0		400	kHz		
H-pulse width	t_{HIGH}	0.6			µs		
L-pulse width	t_{LOW}	1.3			µs		
Start							
Set-up time	t_{SUSTA}	0.6			µs		
Hold time	t_{HDSTA}	0.6			µs		
Stop							
Set-up time	t_{SUSTO}	0.6			µs		
Bus free time	t_{BUF}	1.3			µs		
Data Transfer							
Set-up time	t_{SUDAT}	100			µs		
Hold time	t_{HDDAT}	0		0.9	µs		

3.4 AC/DC Characteristics (cont'd)

V_S = 10 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Inputs SCL, SDA							
Input voltage	V_{QH}	3		5.5	V		
	V_{QL}			1.5	V		
Hysteresis	V_{HYS}	0.2			V		
Spike suppression	t_{SP}	50			ns		
Input current	I_{QH}			50	µA		
	V_{QL}			100	µA		
Output SDA (open collector)							
Output voltage	V_{QH}	5.4			V	R_L = 2.5 kΩ	
	V_{QL}			0.4	V	I_{QL} = 3 mA	
Reset inactive	V_L			1.5	V		
Reset active	V_H	3		5.5	V		

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_A = 25 °C and the given supply voltage.

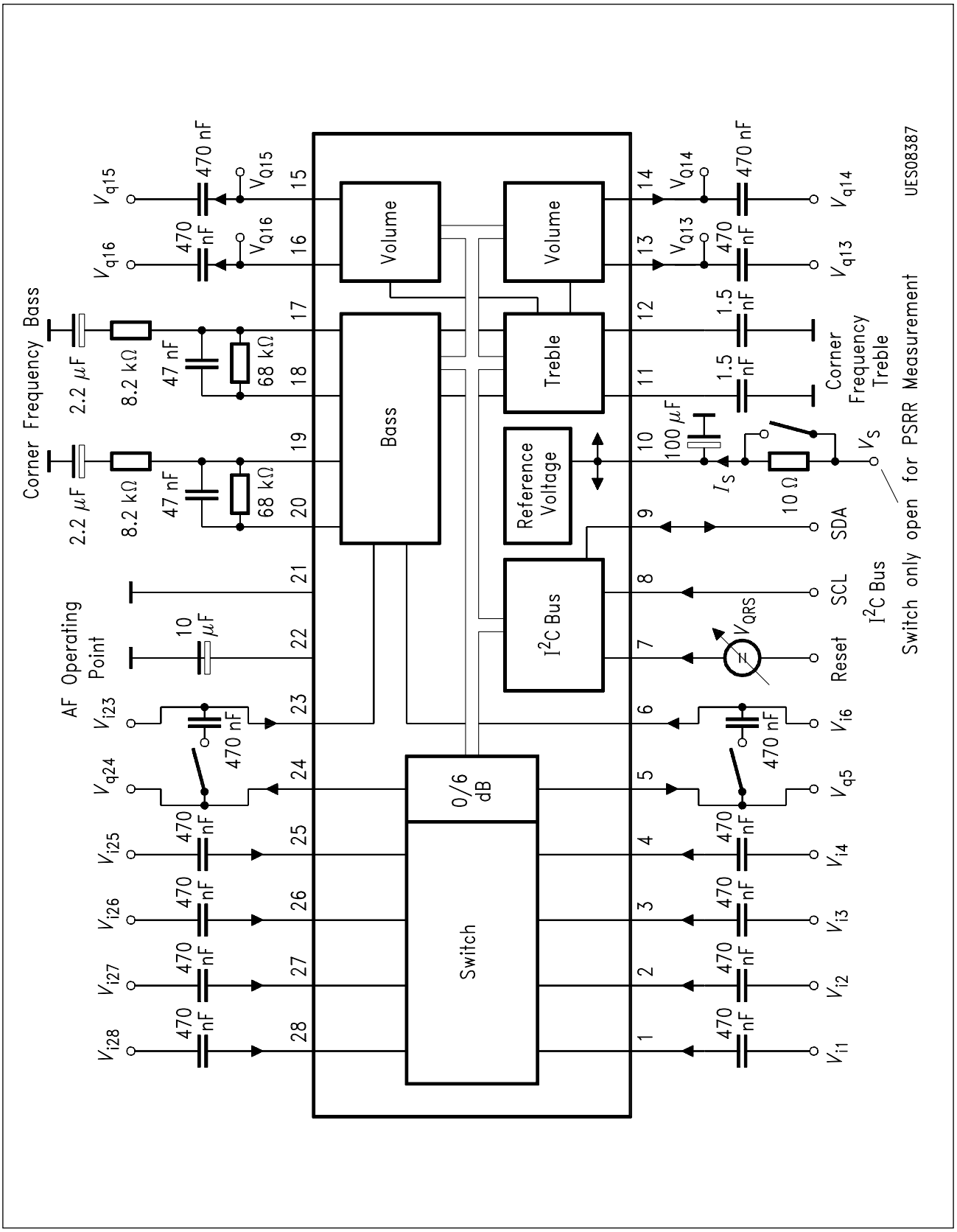


Figure 11
Test Circuit

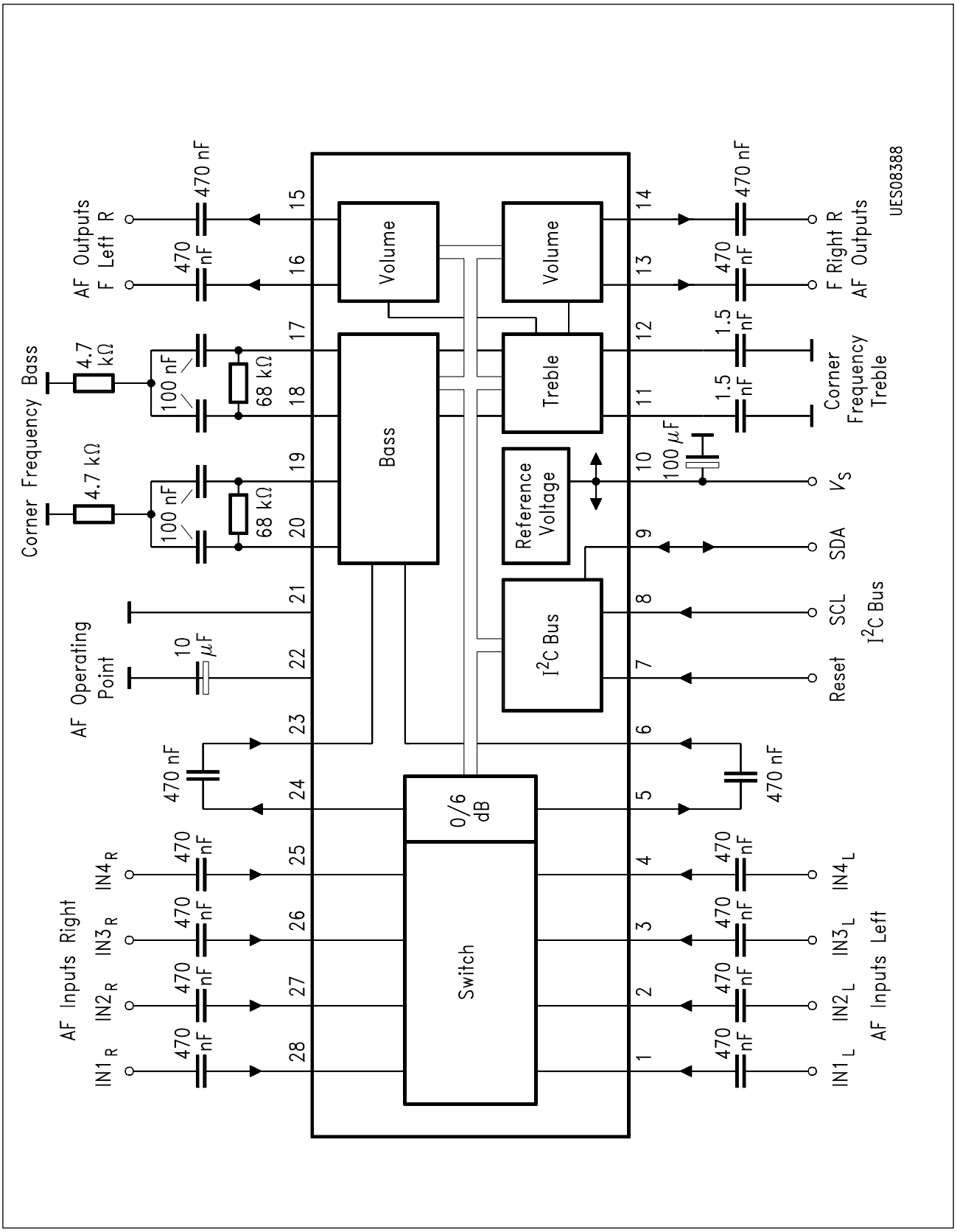


Figure 12
Application Circuit

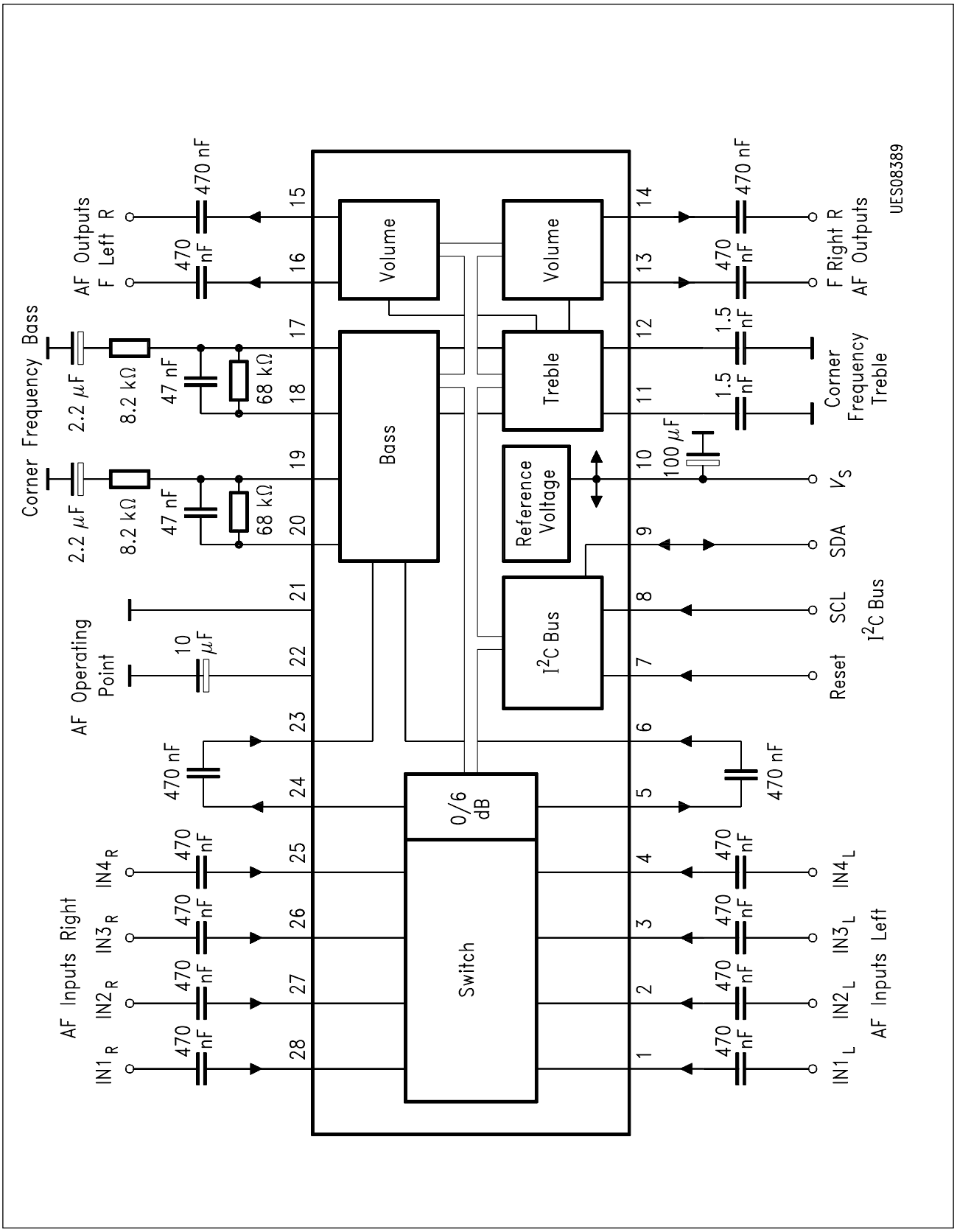
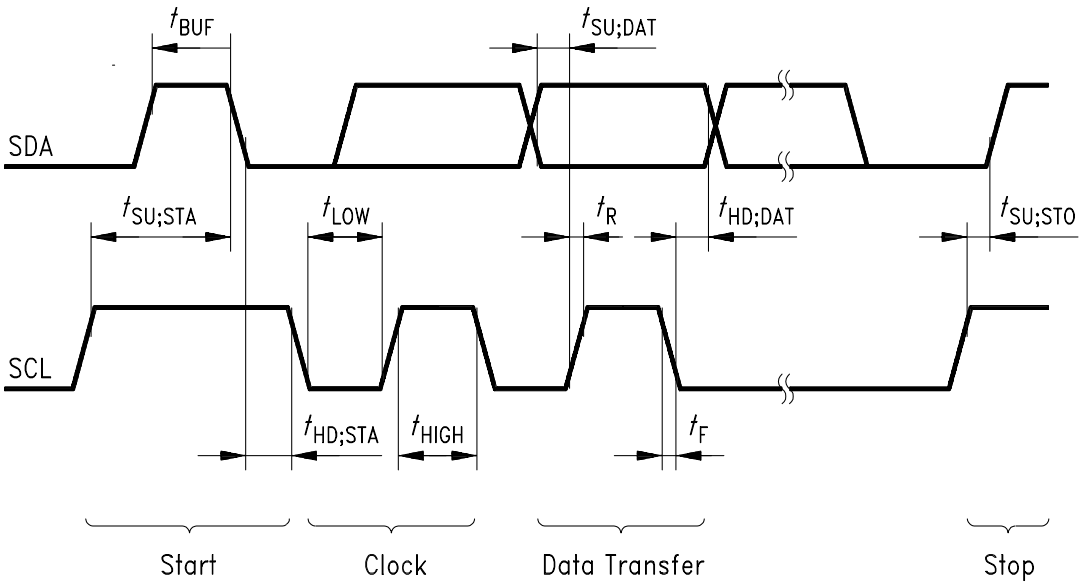


Figure 13
Application Circuit



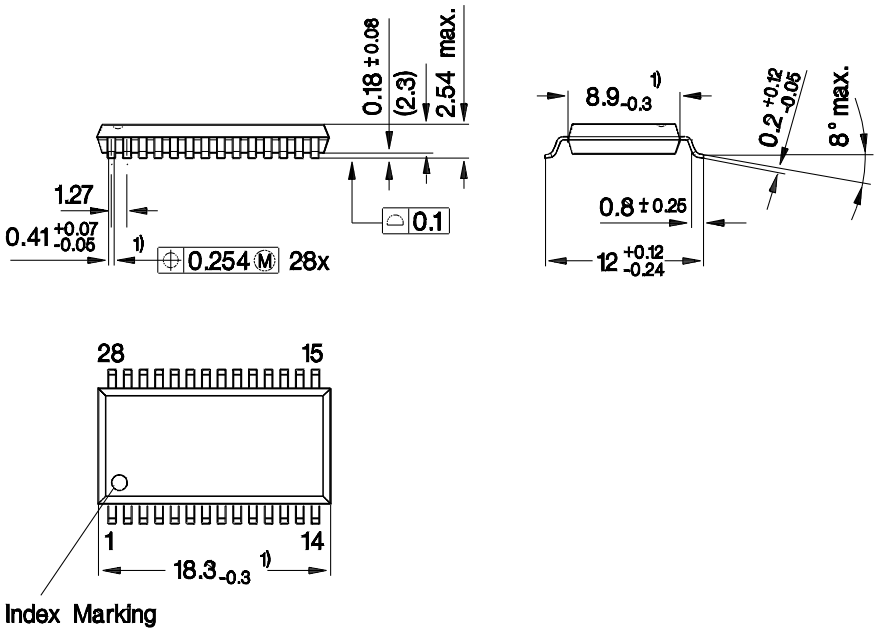
$t_{SU;STA}$	Set–up Time (Start)
$t_{HD;STA}$	Hold Time (Start)
t_{HIGH}	HIGH Pulse Width (Clock)
t_{LOW}	LOW Pulse Width (Clock)
$t_{SU;DAT}$	Set–up Time (Data Transfer)
$t_{HD;DAT}$	Hold Time (Data Transfer)
$t_{SU;STO}$	Set–up Time (Stop)
t_{BUF}	Bus Free Time
t_F	Fall Time
t_R	Rise Time

UET08390

Figure 14
I²C Bus Timing

4 Package Outlines

P-DSO-28-3
(Plastic Dual Small Outline Package)



1) Does not include plastic or metal protrusion of 0.25 max. per side
2) Does not include dambar protrusion

GPS05182

Sorts of Packing
Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.

SMD = Surface Mounted Device

Dimensions in mm