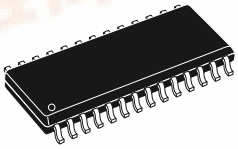
TDA7443D

TONE CONTROL AND SURROUND DIGITALLY CONTROLLED AUDIO PROCESSOR WITH AGC

PRODUCT PREVIEW

- INPUT MULTIPLEXER
  - 5 STEREO INPUTS
  - SELECTABLE INPUT GAIN FOR OPTIMAL ADAPTATION TO DIFFERENT SOURCES
- ONE STEREO OUTPUT
- AGC
- TREBLE AND BASS CONTROL IN 2.0dB STEPS
- VOLUME CONTROL IN 1.0dB STEPS
- TWO SPEAKER ATTENUATORS:
  - TWO INDEPENDENT SPEAKER CONTROL IN 1.0dB STEPS FOR BALANCE FACILITY
  - INDEPENDENT MUTE FUNCTION
- TWO SURROND MODES AVAILABLE
  - MUSIC
  PSEUDO STEREO
- ALL FUNCTION ARE PROGRAMMABLE VIA SERIAL BUS



SO28
ORDERING NUMBER: TDA7443D

DESCRIPTION

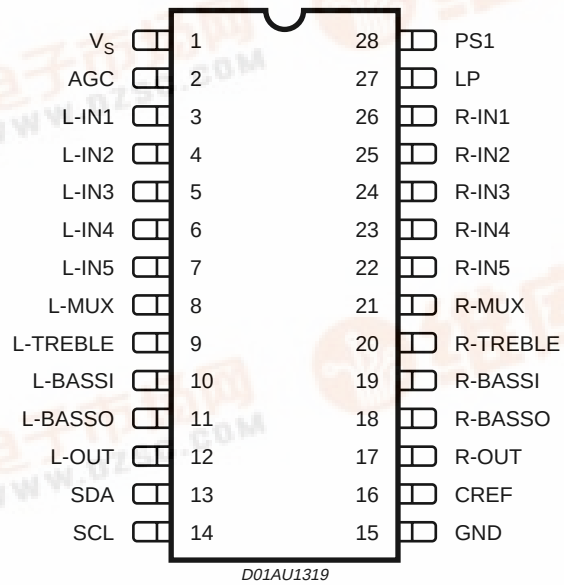
The TDA7443D is a volume tone (bass and treble) balance (Left/Right) processor for quality audio applications in Hi-Fi systems.

Selectable input gain is provided. Control of all the functions is accomplished by serial bus.

The AC signal setting is obtained by resistor networks and switches combined with operational amplifiers.

Thanks to the used BIPOLAR/CMOS Technology, Low Distortion, Low Noise and DC stepping are obtained.

PIN CONNECTION (Top view)



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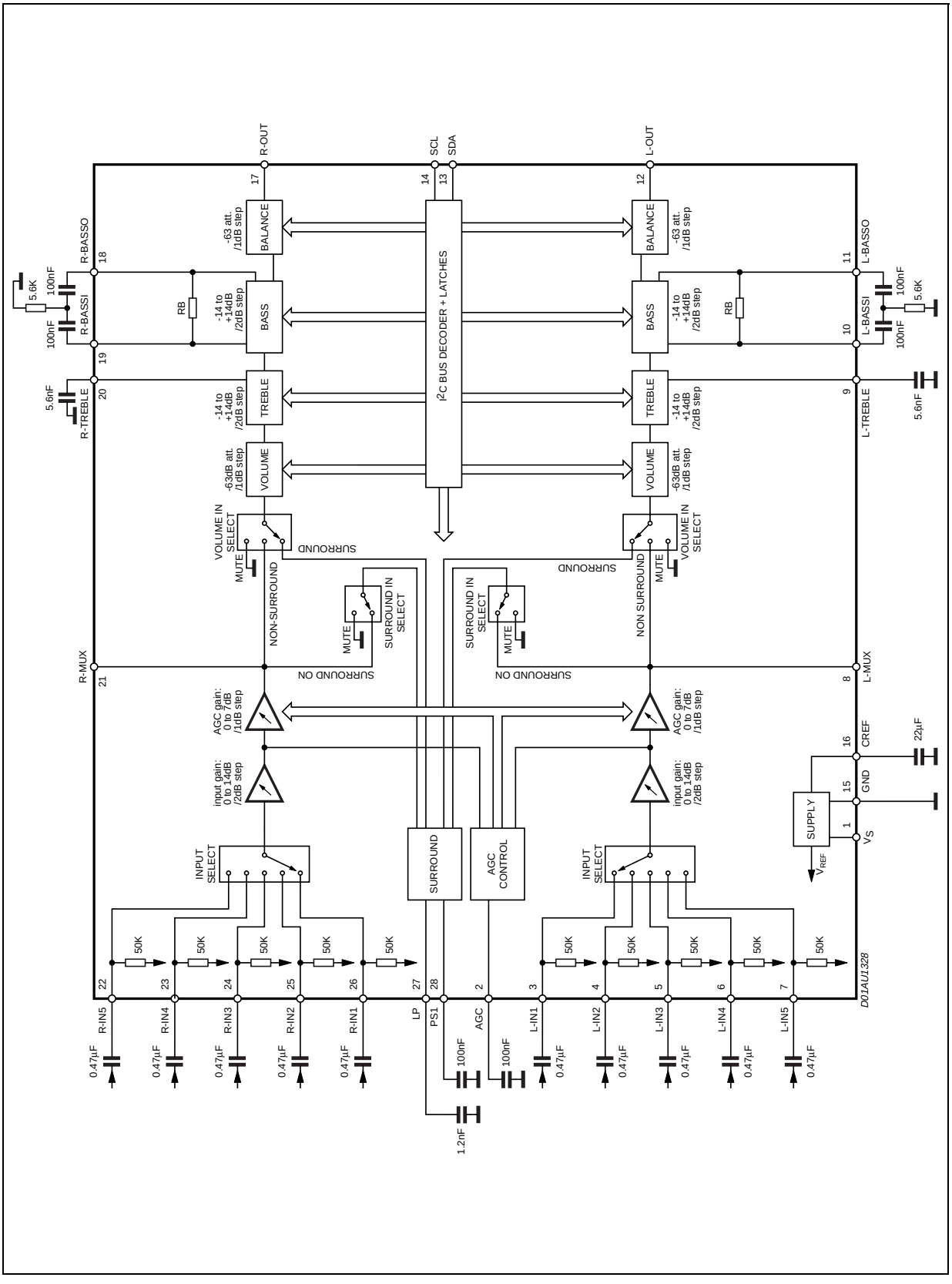
BLOCK DIAGRAM & TEST CIRCUIT



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_s	Operating Supply Voltage	10.5	V
T_{amb}	Operating Ambient Temperature	-10 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 150	°C

THERMAL DATA

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}pin}$	Thermal Resistance Junction-pins	85	°C/W

QUICK REFERENCE DATA

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_S	Supply Voltage	5	9	10	V
V_{CL}	Max. input signal handling	2			Vrms
THD	Total Harmonic Distortion V=1Vrms f=1kHz		0.01	0.1	%
S/N	Signal to Noise Ratio V_{OUT}=1Vrms(mode=OFF)		100		dB
S_C	Channel Separation f=1kHz		90		dB
	Input Gain (2dB step)	0		14	dB
	AGC Gain (1dB step)	0		7	dB
	Volume Control (1dB step)	-63		0	dB
	Treble Control (2dB step)	-14		+14	dB
	Bass Control (2dB step)	-14		+14	dB
	Balance Control (1dB step)	-63		0	dB
	Mute Attenuation		90		dB

ELECTRICAL CHARACTERISTICS

(Refer to the test circuit Tamb=25C, Vs=9V, f=1kHz ,all controls flat, unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
SUPPLY						
V_S	Supply Voltage		5	9	10	V
I_S	Supply Current			tbd		mA
SVR	Ripple Rejection		60	80		dB
INPUT STAGE						
R_{IN}	Input Resistance		35	50	65	kΩ
V_{CL}	Clipping Level	THD = 0.3%	2	2.5		Vrms
S_{IN}	Input Separation		80	100		dB
$G_{in\ min}$	Minimum Input Gain		-1	0	1	dB
$G_{in\ max}$	Maximum Input Gain		13	14	15	dB
$G_{in\ step}$	Step Resolution		1.5	2	2.5	dB
AGC						
G_{AGCmin}	Minimum AGC Gain		-1	0	1	dB
G_{AGCmax}	Maximum AGC Gain		6	7	8	dB
$G_{AGCstep}$	Step Resolution		0.5	1	1.5	dB
SURROUND						
R_{IN}	Input Resistance		35	50	65	kΩ
R_{PS0}	Phase Shifter:D1=0,D0=0		8.3	11.8	15.2	kΩ
R_{PS1}	Phase Shifter:D1=0,D0=1		10	14.1	18.3	kΩ
R_{PS2}	Phase Shifter:D1=1,D0=0		12.6	17.9	23.3	kΩ
R_{PS3}	Phase Shifter:D1=1,D0=1		26.4	37.3	48.85	kΩ
C_{RANGE}	Effect Control Range		-21		-6	dB
S_{step}	Effect Control Step Resolution		0.5	1	1.5	dB
VOLUME CONTROL						
A_{VOLmin}	Minimum Attenuation		-1	0	1	dB
A_{VOLmax}	Maximum Attenuation		61	63	65	dB
$A_{VOLstep}$	Step Resolution		0.5	1	1.5	dB
E_A	Attenuation set error	A_V = 0 to –24 dB	-1	0	1	dB
		A_V = –24 to –63 dB	-2	0	2	dB
V_{DC}	DC Steps	Adjacent att. steps	-3	0	3	mV
BASS CONTROL						
G_B	Control Range	Max. Boost/Cut	±12	±14	±16	dB

ELECTRICAL CHARACTERISTICS (continued)
(Refer to the test circuit Tamb=25C, Vs=9V, f=1kHz ,all controls flat, unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
B_{step}	Step Resolution		1	2	3	dB
R_B	Internal Feedback Resistance		33	44	55	kΩ
TREBLE CONTROL						
G_T	Control Range	Max. Boost/Cut	±13	±14	±15	dB
T_{step}	Step Resolution		1	2	3	dB
R_T	Internal Feedback Resistance			25		kΩ
BALANCE CONTROL						
A_{BALmin}	Minimum Attenuation		-1	0	1	dB
A_{BALmax}	Maximum Attenuation		61	63	65	dB
$A_{BALstep}$	Step Resolution			1		dB
E_A	Attenuation set error	A_V = 0 to –24 dB	-1	0	1	dB
		A_V = –24 to –63 dB	-2	0	2	dB
V_{DC}	DC Steps	Adjacent att. steps	-3	0	3	mV
AUDIO OUTPUTS						
V_{OCL}	Clipping Level	THD = 0.3%	2	2.5		Vrms
R_L	Output Load Resistance		2			kΩ
V_{OUT}	DC Voltage Level			4.5		V
$N_{O(OFF)}$	Output Noise (OFF)	BW=20Hz to 20kHz; All gains 0dB; Output muted flat		 5 10	 15	 µV µV
$N_{O(MUS)}$	Output Noise (Music)	BW=20Hz to 20kHz; Mode=Music		30		µV
$N_{O(PS)}$	Output Noise(Pseudo Stereo)	BW=20Hz to 20kHz; Mode=Pseudo Stereo		30		µV
A_{MUTE}	Output Mute Condition			90		dB
S/N	Signal to Noise Ratio	All gains 0dB;V_O = 1Vrms		100		dB
S_C	Channel Separation Left/Right			90		dB
d	Distortion	A_V = 0; V_I = 1Vrms		0.01	0.1	%
BUS INPUT						
V_{IL}	Input Low Voltage				1	V
V_{IH}	Input High Voltage		2.5			V
I_{IN}	Input Current	V_{IN} = 0.4V	-5		5	µA
V_O	Output Voltage (ACK)	I_O = 1.6mA		0.4	0.8	V

I²C BUS INTERFACE

Data transmission from microprocessor to the TDA7443D and vice versa takes place through the 2 wires I²C BUS interface, consisting of the two lines SDA and SCL (pull-up resistors to positive supply voltage must be connected).

Data Validity

As shown in fig. 1, the data on the SDA line must be stable during the high period of the clock. The HIGH and LOW state of the data line can only change when the clock signal on the SCL line is LOW.

Start and Stop Conditions

As shown in fig. 2 a start condition is a HIGH to LOW transition of the SDA line while SCL is HIGH. The stop condition is a LOW to HIGH transition of the SDA line while SCL is HIGH.

Byte Format

Every byte transferred on the SDA line must contain 8 bits. Each byte must be followed by an acknowledge bit. The MSB is transferred first.

Acknowledge

The master (µP) puts a resistive HIGH level on the SDA line during the acknowledge clock pulse (see fig. 3). The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during this clock pulse.

The audio processor which has been addressed has to generate an acknowledge after the reception of each byte, otherwise the SDA line remains at the HIGH level during the ninth clock pulse time. In this case the master transmitter can generate the STOP information in order to abort the transfer.

Transmission without Acknowledge

Avoiding to detect the acknowledge of the audio processor, the µP can use a simpler transmission: simply it waits one clock without checking the slave acknowledging, and sends the new data.

This approach of course is less protected from misworking.

Figure 1. Data Validity on the I²CBUS

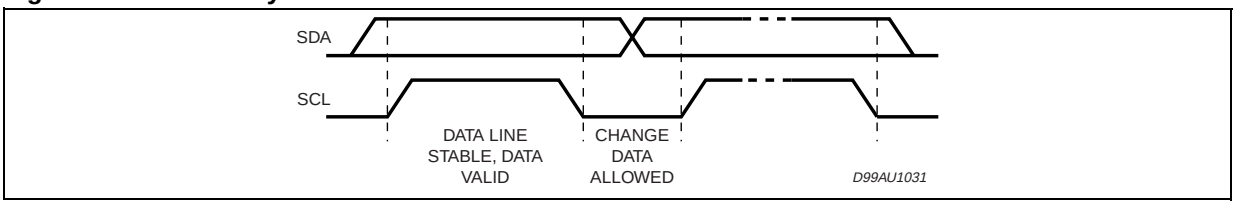


Figure 2. Timing Diagram of I²CBUS

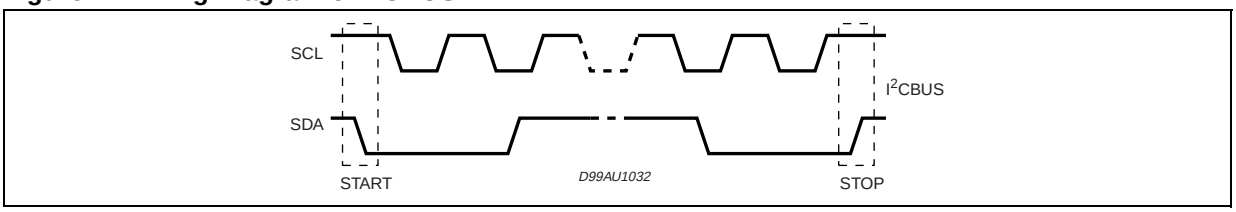
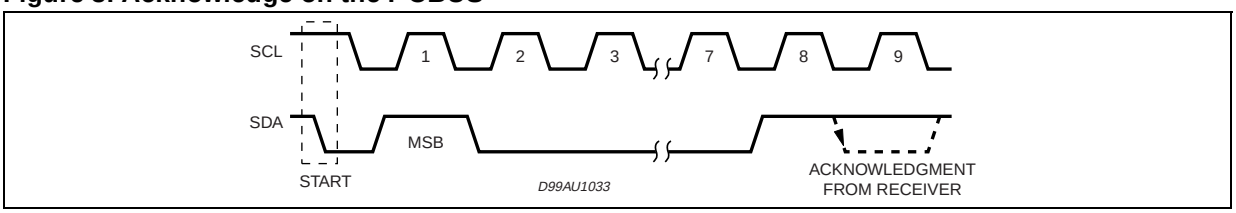


Figure 3. Acknowledge on the I²CBUS

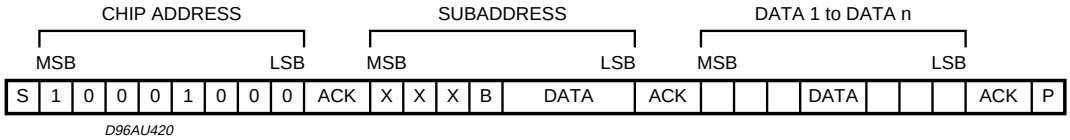


SOFTWARE SPECIFICATION

Interface Protocol

The interface protocol comprises:

- A start condition (S)
- A chip address byte, containing the TDA7440D address
- A subaddress bytes
- A sequence of data (N byte + acknowledge)
- A stop condition (P)

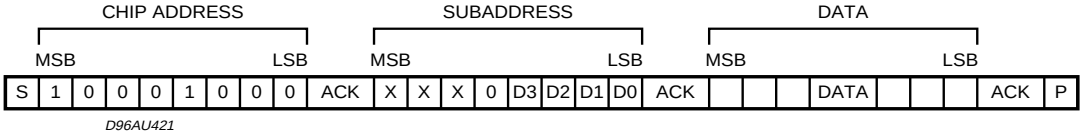


ACK = Acknowledge; S = Start; P = Stop; A = Address; B = Auto Increment

EXAMPLES

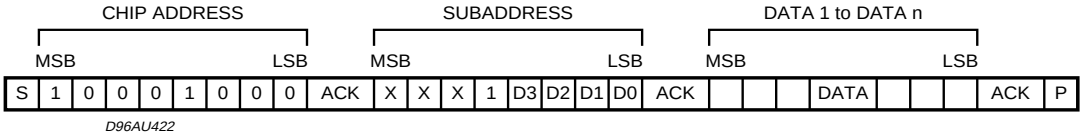
No Incremental Bus

The TDA7443D receives a start condition, the correct chip address, a subaddress with the B = 0 (no incremental bus), N-data (all these data concern the subaddress selected), a stop condition.



Incremental Bus

The TDA7443D receivea start conditions, the correct chip address, a subaddress with the B = 1 (incremental bus): now it is in a loop condition with an autoincrease of the subaddress whereas SUBADDRESS from "XXX1000" to "XXX1111" of DATA are ignored.The DATA 1 concern the subaddress sent, and the DATA 2 concern the subaddress sent plus one in the loop etc, and at the end it receivers the stop condition.



POWER ON RESET CONDITION

MSB							LSB
D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	1	1	1	1	0

DATA BYTES

Address=(HEX) 10001000

FUNCTION SELECTION: First byte (subaddress)

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
X	X	X	B	0	0	0	0	INPUT
X	X	X	B	0	0	0	1	AGC
X	X	X	B	0	0	1	0	SURROUND
X	X	X	B	0	0	1	1	VOLUME
X	X	X	B	0	1	0	0	TONE
X	X	X	B	0	1	0	1	BALANCE “L”
X	X	X	B	0	1	1	0	BALANCE “R”

B=1: INCREMENTAL BUS; ACTIVE

B=0: NO INCREMENTAL BUS

X= INDIFFERENT 0/1

INPUT

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								INPUT SELECT
					0	0	0	IN1
					0	0	1	IN2
					0	1	0	IN3
					0	1	1	IN4
					1	X	X	IN5
								MUTE
				0				Output Mute OFF
				1				Output Mute ON
								SURROUND IN SELECT
			0					Surround ONI
			1					Mute
								INPUT GAIN
0	0	0						0dB
0	0	1						2dB
0	1	0						4dB
0	1	1						6dB
1	0	0						8dB
1	0	1						10dB
1	1	0						12dB
1	1	1						14dB

AGC

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								AGC MODE
							0	OFF
							1	ON
								DETECTOR
						0		OFF
						1		ON
								RELEASE CURRENT
					0			OFF
					1			ON
								ATTACK TIME
			0	0				ATTACK1
			0	1				ATTACK2
			1	0				ATTACK3
			1	1				ATTACK4
								TARGET LEVEL
	0	0						TARGET1
	0	1						TARGET2
	1	0						TARGET3
	1	1						TARGET4
								ZEROCROSS
0								OFF
1								ON

SURROUND

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								SURROUND MODE
						0		PSEUDO STEREO
						1		MUSIC
								EFFECT CONTROL
		0	0	0	0			-6 dB
		0	0	0	1			-7 dB
		0	0	1	0			-8 dB
		0	0	1	1			-9 dB
		0	1	0	0			-10 dB
		0	1	0	1			-11 dB
		0	1	1	0			-12 dB
		0	1	1	1			-13 dB
		1	0	0	0			-14 dB
		1	0	0	1			-15 dB
		1	0	1	0			-16 dB
		1	0	1	1			-17 dB
		1	1	0	0			-18 dB
		1	1	0	1			-19 dB
		1	1	1	0			-20 dB
		1	1	1	1			-21 dB
								PHASE SHIFT RESISTOR
0	0							12 kohm
0	1							14 kohm
1	0							18 kohm
1	1							37 kohm

VOLUME

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								VOLUME IN SELECT
						0	0	Surround
						0	1	Non Surround
						1	X	Mute
								1dB STEPS
			0	0	0			0dB
			0	0	1			-1dB
			0	1	0			-2dB
			0	1	1			-3dB
			1	0	0			-4dB
			1	0	1			-5dB
			1	1	0			-6dB
			1	1	1			-7dB
								8dB STEPS
0	0	0						0dB
0	0	1						-8dB
0	1	0						-16dB
0	1	1						-24dB
1	0	0						-32dB
1	0	1						-40dB
1	1	0						-48dB
1	1	1						-56dB

VOLUME=0 to –63dB

TREBLE & BASS

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								TREBLE
				0	0	0	0	-14 dB
				0	0	0	1	-12 dB
				0	0	1	0	-10 dB
				0	0	1	1	-8 dB
				0	1	0	0	-6 dB
				0	1	0	1	-4 dB
				0	1	1	0	-2 dB
				0	1	1	1	0 dB
				1	0	0	0	14 dB
				1	0	0	1	12 dB
				1	0	1	0	10 dB
				1	0	1	1	8 dB
				1	1	0	0	6 dB
				1	1	0	1	4 dB
				1	1	1	0	2 dB
				1	1	1	1	0 dB
								BASS
0	0	0	0					-14 dB
0	0	0	1					-12 dB
0	0	1	0					-10 dB
0	0	1	1					-8 dB
0	1	0	0					-6 dB
0	1	0	1					-4 dB
0	1	1	0					-2 dB
0	1	1	1					0 dB
1	0	0	0					14 dB
1	0	0	1					12 dB
1	0	1	0					10 dB
1	0	1	1					8 dB
1	1	0	0					6 dB
1	1	0	1					4 dB
1	1	1	0					2 dB
1	1	1	1					0 dB

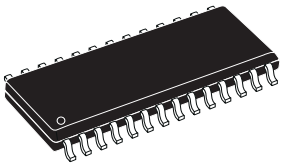
BALANCE

MSB							LSB	SUBADDRESS
D7	D6	D5	D4	D3	D2	D1	D0	
								1dB STEPS
			0	0	0			0dB
			0	0	1			-1dB
			0	1	0			-2dB
			0	1	1			-3dB
			1	0	0			-4dB
			1	0	1			-5dB
			1	1	0			-6dB
			1	1	1			-7dB
								8dB STEPS
0	0	0						0dB
0	0	1						-8dB
0	1	0						-16dB
0	1	1						-24dB
1	0	0						-32dB
1	0	1						-40dB
1	1	0						-48dB
1	1	1						-56dB

VOLUME=0 to –63dB

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

OUTLINE AND MECHANICAL DATA



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