

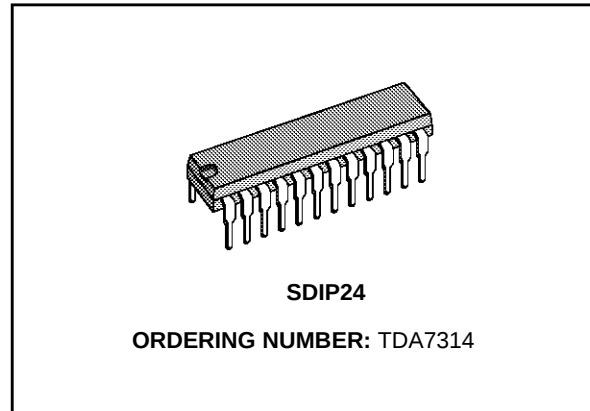
DIGITAL CONTROLLED AUDIO PROCESSOR WITH LOUDNESS

PRODUCT PREVIEW

- 1 STEREO INPUT
- SELECTABLE INPUT GAIN FOR OPTIMAL ADAPTION TO DIFFERENT SOURCES
- INPUT AND OUTPUT FOR EXTERNAL EQUALIZER OR NOISE REDUCTION SYSTEM
- LOUDNESS FUNCTION
- VOLUME CONTROL IN 1.25dB STEPS
- TREBLE AND BASS CONTROL
- FOUR SPEAKER ATTENUATORS:
 - 4 INDEPENDENT SPEAKERS CONTROL IN 1.25dB STEPS FOR BALANCE AND FADER FACILITIES
 - INDEPENDENT MUTE FUNCTION
- ALL FUNCTIONS PROGRAMMABLE VIA SERIAL BUS

DESCRIPTION

The TDA7314 is a volume, tone (bass and treble) balance (Left/Right) and fader (front/rear) processor for quality audio applications in car radio and Hi-Fi systems.

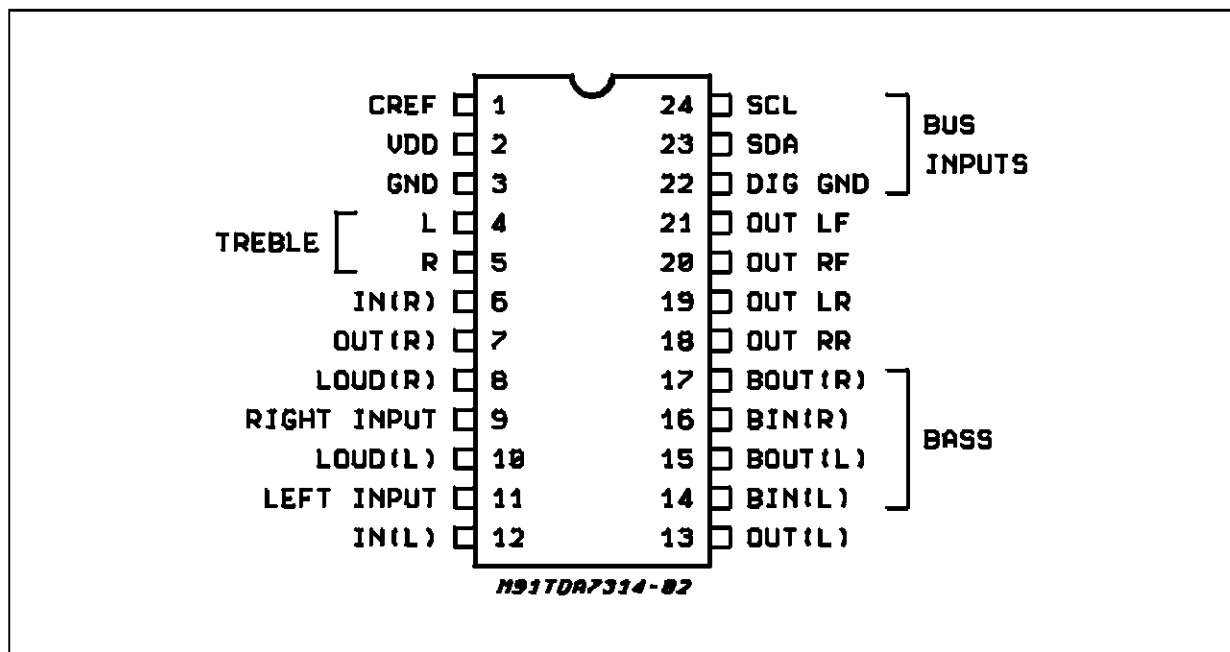


Selectable input gain and internal loudness function are provided. Control is accomplished by serial bus microprocessor interface.

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

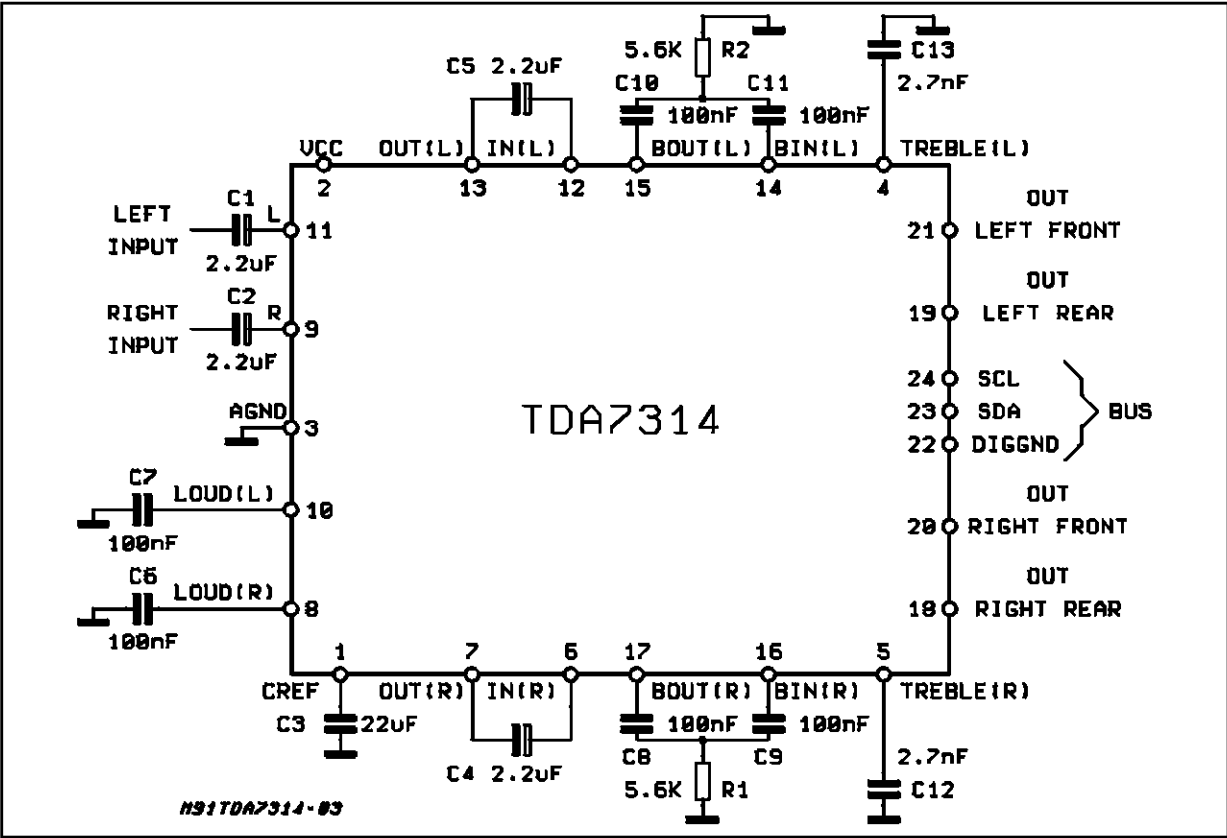
Thanks to the used BIPOLAR/CMOS Technology, Low Distortion, Low Noise and DC stepping are obtained.

PIN CONNECTION (Top view)



TDA7314

TEST CIRCUIT



THERMAL DATA

Symbol	Description	Value	Unit
R _{th j-pins}	Thermal Resistance Junction-pins	Max. 65	°C/W

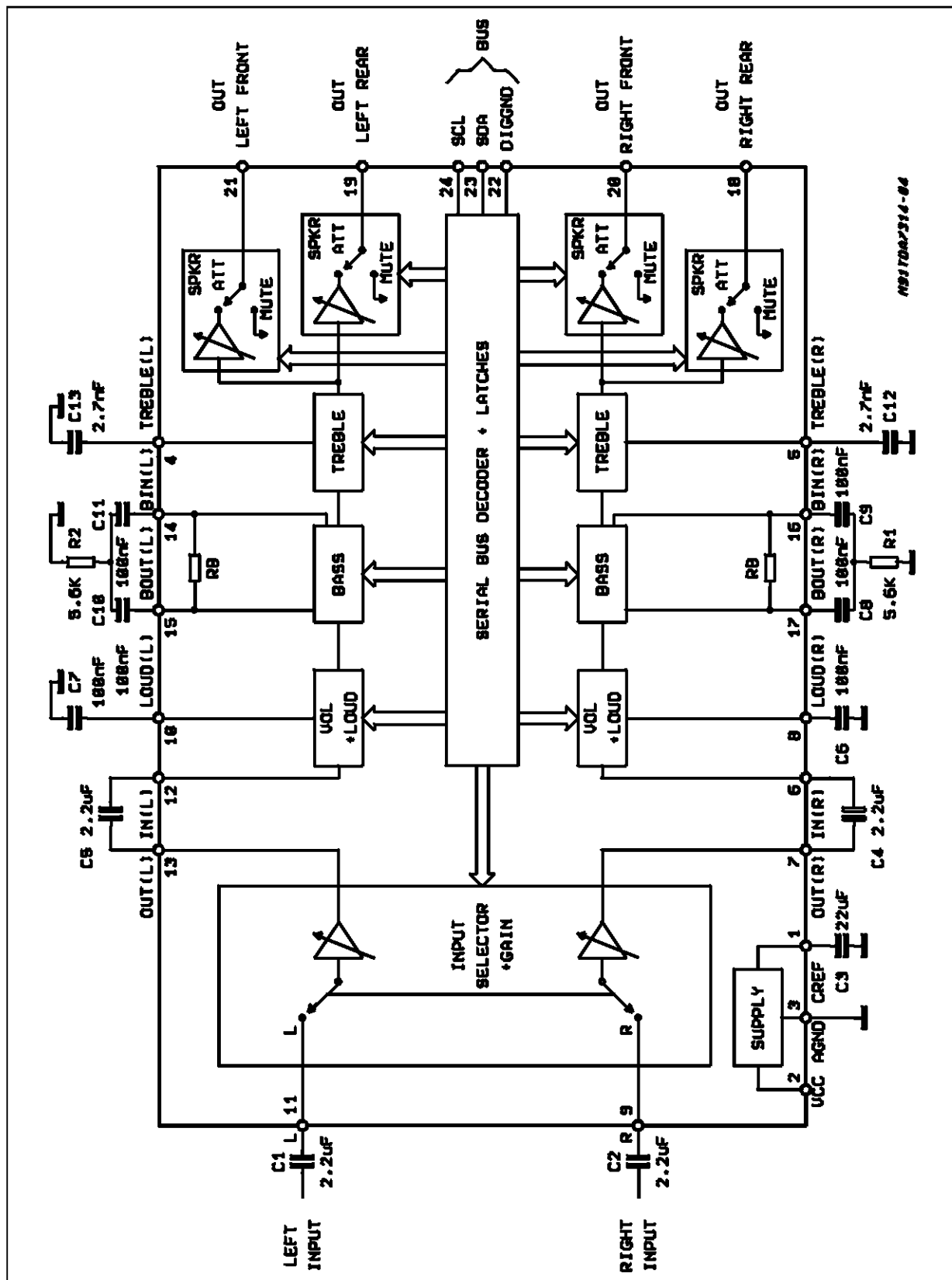
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _S	Operating Supply Voltage	10.2	V
T _{amb}	Operating Ambient Temperature	-40 to 85	°C
T _{stg}	Storage Temperature Range	-55 to +150	°C

QUICK REFERENCE DATA

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _S	Supply Voltage	6	9	10	V
V _{CL}	Max. input signal handling	2			V _{rms}
THD	Total Harmonic Distortion V = 1V _{rms} f = 1KHz		0.01	0.1	%
S/N	Signal to Noise Ratio		106		dB
Sc	Channel Separation f = 1KHz		103		dB
	Volume Control 1.25dB step	-78.75		0	dB
	Bass and Treble Control 2db step	-14		+14	dB
	Fader and Balance Control 1.25dB step	-38.75		0	dB
	Input Gain 6.25dB step	0		18.75	dB
	Mute Attenuation		100		dB

BLOCK DIAGRAM



TDA7314

ELECTRICAL CHARACTERISTICS (refer to the test circuit $T_{amb} = 25^{\circ}\text{C}$, $V_S = 9\text{V}$, $R_L = 10\text{K}\Omega$, $R_G = 600\Omega$, all controls flat ($G = 0$), $f = 1\text{KHz}$ unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
--------	-----------	----------------	------	------	------	------

SUPPLY

V_S	Supply Voltage		6	9	10	V
I_S	Supply Current			8	11	mA
SVR	Ripple Rejection		60	80		dB

INPUT STAGE

R_{II}	Input Resistance	Pin 9, 11	35	50	70	$\text{K}\Omega$
V_{CL}	Clipping Level		2	2.5		Vrms
R_L	Output Load resistance	pin 7, 17	2			$\text{K}\Omega$
G_{INmin}	Min. Input Gain		-1	0	1	dB
G_{INmax}	Max. Input Gain			18.75		dB
G_{STEP}	Step Resolution			6.25		dB
e_{IN}	Input Noise	$G = 18.75\text{dB}$		2		μV
V_{DC}	DC Steps	adjacent gain steps		4	20	mV
		$G = 18.75$ to Mute		4		mV

VOLUME CONTROL

R_{IV}	Input Resistance		20	33	50	$\text{k}\Omega$
C_{RANGE}	Control Range		70	75	80	dB
A_{VMIN}	Min. Attenuation		-1	0	1	dB
A_{VMAX}	Max. Attenuation		70	75	80	dB
A_{STEP}	Step Resolution		0.5	1.25	1.75	dB
E_A	Attenuation Set Error	$A_v = 0$ to -20dB	-1.25	0	1.25	dB
		$A_v = -20$ to -60dB	-3		2	dB
E_T	Tracking Error				2	dB
V_{DC}	DC Steps	adjacent attenuation steps		0	3	mV
		From 0dB to A_v max		0.5	7.5	mV

SPEAKER ATTENUATORS

C_{range}	Control Range		35	37.5	40	dB
S_{STEP}	Step Resolution		0.5	1.25	1.75	dB
E_A	Attenuation set error				1.5	dB
A_{MUTE}	Output Mute Attenuation		80	100		dB
V_{DC}	DC Steps	adjacent att. steps		0	3	mV
		from 0 to mute		1	10	mV

BASS CONTROL (1)

G_b	Control Range	Max. Boost/cut	± 12	± 14	± 16	dB
B_{STEP}	Step Resolution		1	2	3	dB
R_B	Internal Feedback Resistance		34	44	58	$\text{K}\Omega$

TREBLE CONTROL (1)

G_t	Control Range	Max. Boost/cut	± 13	± 14	± 15	dB
T_{STEP}	Step Resolution		1	2	3	dB

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
--------	-----------	----------------	------	------	------	------

AUDIO OUTPUTS

V_{OCL}	Clipping Level	$d = 0.3\%$	2	2.5		Vrms
R_L	Output Load Resistance		2			K Ω
C_L	Output Load Capacitance				10	nF
R_{OUT}	Output resistance		30	75	120	Ω
V_{OUT}	DC Voltage Level		4.2	4.5	4.8	V

GENERAL

e_{NO}	Output Noise	BW = 20-20KHz, flat output muted all gains = 0dB		2.5 5	15	μV μV
		A curve all gains = 0dB		3		μV
S/N	Signal to Noise Ratio	all gains = 0dB; $V_O = 1V_{rms}$		106		dB
d	Distortion	$A_V = 0, V_{IN} = 1V_{rms}$		0.01	0.1	%
		$A_V = -20dB, V_{IN} = 1V_{rms}$		0.09	0.3	%
		$V_{IN} = 0.3V_{rms}$		0.04		%
Sc	Channel Separation left/right		80	103		dB
	Total Tracking error	$A_V = 0$ to -20dB		0	1	dB
		-20 to -60 dB		0	2	dB

BUS INPUTS

V_{IL}	Input Low Voltage				1	V
V_{IH}	Input High Voltage		3			V
I_{IN}	Input Current		-5		+5	μA
V_O	Output Voltage SDA Acknowledge	$I_O = 1.6mA$			0.4	V

Note:

- (1) Bass and Treble response see attached diagram (fig.19). The center frequency and quality of the resonance behaviour can be chosen by the external circuitry. A standard first order bass response can be realized by a standard feedback network.

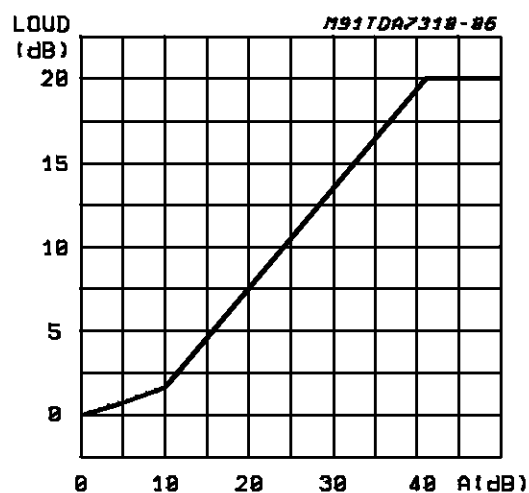
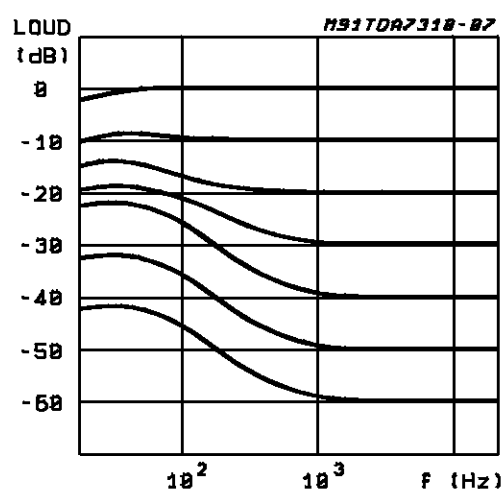
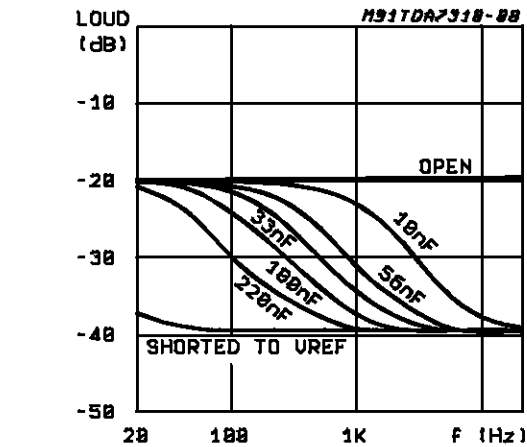
Figure 1: Loudness versus Volume Attenuation**Figure 2:** Loudness versus Frequency
($C_{LOUD} = 100nF$)

Figure 3: Loudness versus External Capacitors



LOUDNESS
 $V_s = 9V$
 Volume = -40dB
 All other control flat
 $C_{in} = 2.2\mu F$
 $C_{load} = 220nF, 100nF, 33nF, 10nF, \text{Open}, \text{Shorter to Vref}$

Figure 5: Signal to Noise Ratio vs. Volume Setting

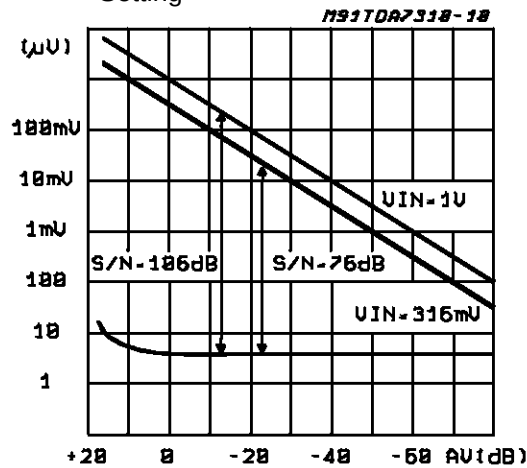


Figure 7: Distortion & Noise vs. Frequency

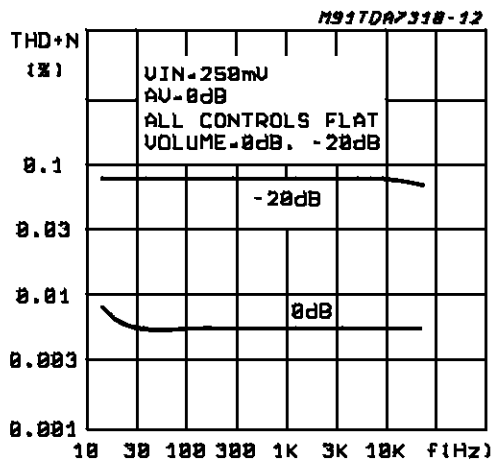


Figure 4: Noise vs. Volume/Gain Settings

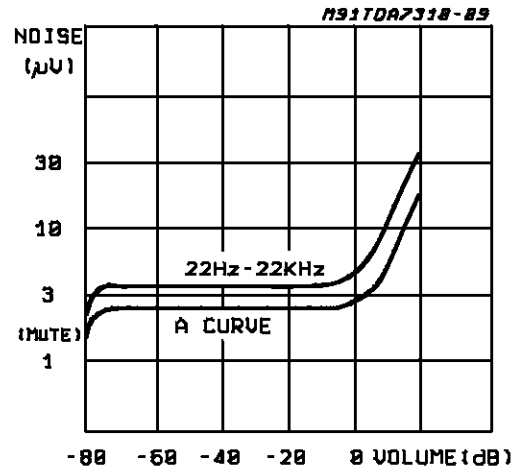


Figure 6: Distortion & Noise vs. Frequency

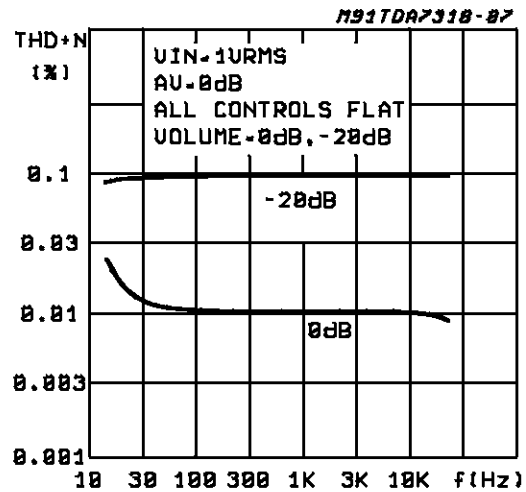


Figure 8: Distortion vs. Load Resistance

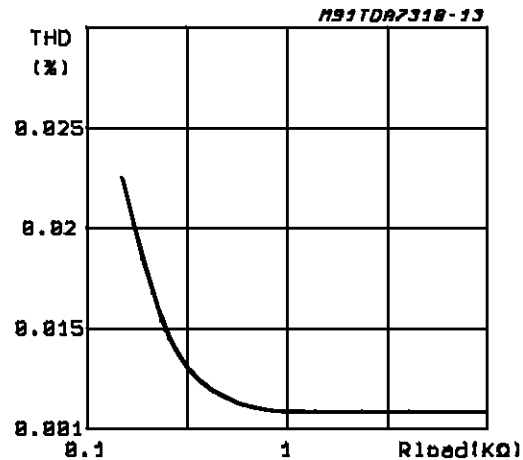
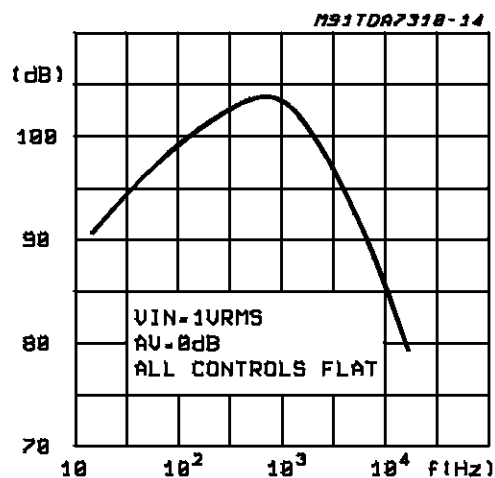
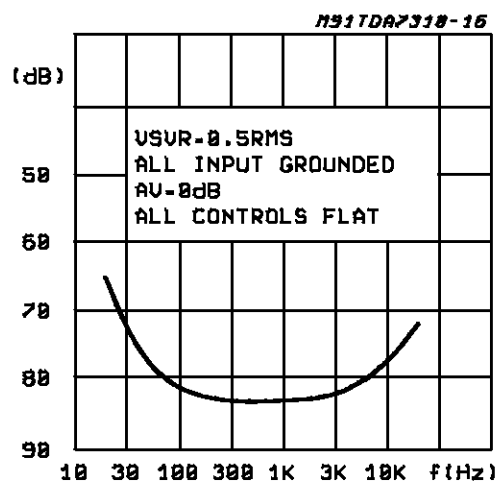
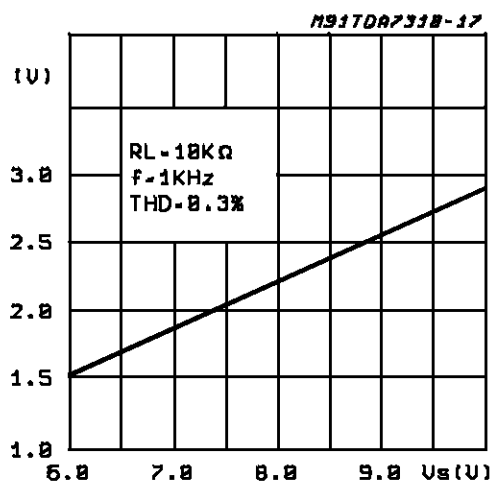
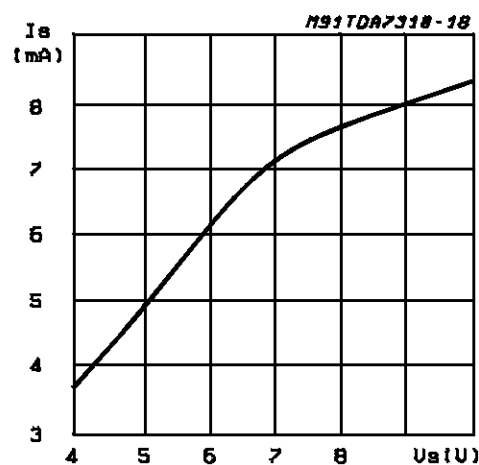
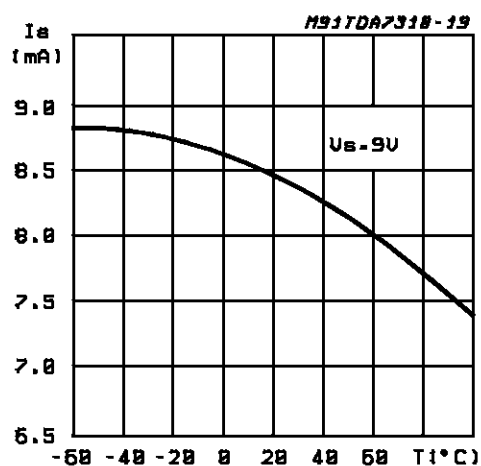
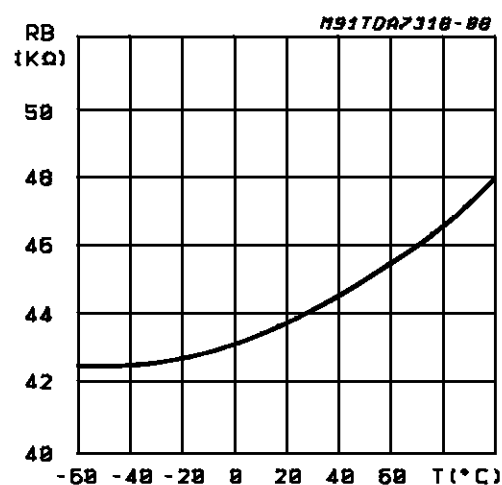
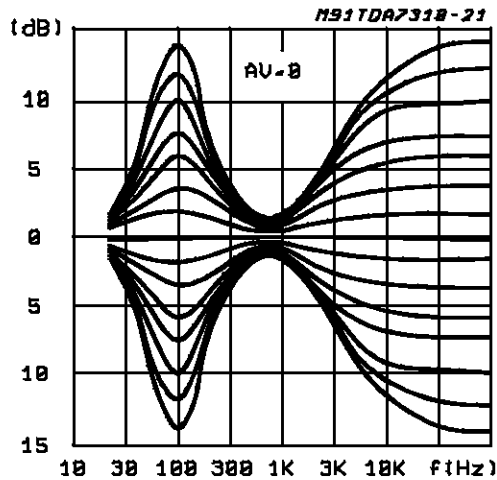


Figure 9: Channel Separation (L → R) vs. Frequency**Figure 10:** Supply Voltage Rejection vs. Frequency**Figure 11:** Output Clipping Level vs. Supply Voltage**Figure 12:** Quiescent Current vs. Supply Voltage**Figure 13:** Supply Current vs. Temperature**Figure 14:** Bass Resistance vs. Temperature

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Figure 15: Typical Tone Response (with the ext. components indicated in the test circuit)

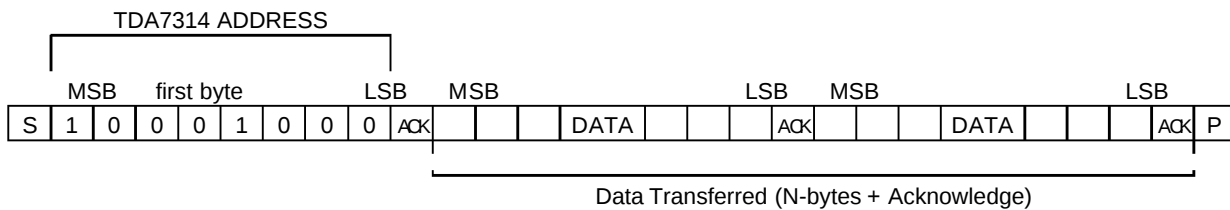


SOFTWARE SPECIFICATION

Interface Protocol

The interface protocol comprises:

- A start condition (S)
- A chip address byte, containing the TDA7314 address (the 8th bit of the byte must be 0). The TDA7314 must always acknowledge at the end of each transmitted byte.
- A sequence of data (N-bytes + acknowledge)
- A stop condition (P)



ACK = Acknowledge

S = Start

P = Stop

MAX CLOCK SPEED 100kb/s

SOFTWARE SPECIFICATION

Chip address

1	0	0	0	1	0	0	0
MSB							LSB

DATA BYTES

MSB							LSB	FUNCTION
0	0	B2	B1	B0	A2	A1	A0	Volume control
1	1	0	B1	B0	A2	A1	A0	Speaker ATT LR
1	1	1	B1	B0	A2	A1	A0	Speaker ATT RR
1	0	0	B1	B0	A2	A1	A0	Speaker ATT LF
1	0	1	B1	B0	A2	A1	A0	Speaker ATT RF
0	1	0	G1	G0	S2	S1	S0	Audio switch
0	1	1	0	C3	C2	C1	C0	Bass control
0	1	1	1	C3	C2	C1	C0	Treble control

Ax = 1.25dB steps; Bx = 10dB steps; Cx = 2dB steps; Gx = 6.25dB steps

SOFTWARE SPECIFICATION (continued)

DATA BYTES (detailed description)

Volume

MSB					LSB			FUNCTION
0	0	B2	B1	B0	A2	A1	A0	Volume 1.25dB steps
					0	0	0	0
					0	0	1	-1.25
					0	1	0	-2.5
					0	1	1	-3.75
					1	0	0	-5
					1	0	1	-6.25
					1	1	0	-7.5
					1	1	1	-8.75
0	0	B2	B1	B0	A2	A1	A0	Volume 10dB steps
		0	0	0				0
		0	0	1				-10
		0	1	0				-20
		0	1	1				-30
		1	0	0				-40
		1	0	1				-50
		1	1	0				-60
		1	1	1				-70

For example a volume of -45dB is given by:

0 0 1 0 0 1 0 0

Speaker Attenuators

MSB							LSB		FUNCTION
1	0	0	B1	B0	A2	A1	A0	Speaker LF	
1	0	1	B1	B0	A2	A1	A0	Speaker RF	
1	1	0	B1	B0	A2	A1	A0	Speaker LR	
1	1	1	B1	B0	A2	A1	A0	Speaker RR	
					0	0	0	0	
					0	0	1	-1.25	
					0	1	0	-2.5	
					0	1	1	-3.75	
					1	0	0	-5	
					1	0	1	-6.25	
					1	1	0	-7.5	
					1	1	1	-8.75	
			0 0					0	
								-10	
								-20	
								-30	
			1 1		1 1 1			Mute	

For example attenuation of 25dB on speaker RF is given by:

1 0 1 1 0 1 0 0

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Audio Switch

MSB						LSB		FUNCTION		
0	1	0	G1	G0	S2	S1	S0	Audio Switch		
								0	0	Stereo 1
								0	1	Stereo 2 (MUTE) (*)
								1	0	Stereo 3 (MUTE) (*)
								1	1	Stereo 4 (MUTE) (*)
			0							LOUDNESS ON
								1		
			0	0				+18.75dB		
			0	1				+12.5dB		
			1	0				+6.25dB		
			1	1				0dB		

For example to select the stereo 1 input with a gain of +12.5dB, loudness on, the 8 bit string is:

0 1 0 0 1 0 0 0

(*) Stereo 2, 3, 4 are connected internally but not available on pins.

Bass and Treble

0	1	1	0	C3	C2	C1	C0	Bass
0	1	1	1	C3	C2	C1	C0	Treble
				0	0	0	0	-14
				0	0	0	1	-12
				0	0	1	0	-10
				0	0	1	1	-8
				0	1	0	0	-6
				0	1	0	1	-4
				0	1	1	0	-2
				0	1	1	1	0
				1	1	1	1	0
				1	1	1	0	2
				1	1	0	1	4
				1	1	0	0	6
				1	0	1	1	8
				1	0	1	0	10
				1	0	0	1	12
				1	0	0	0	14

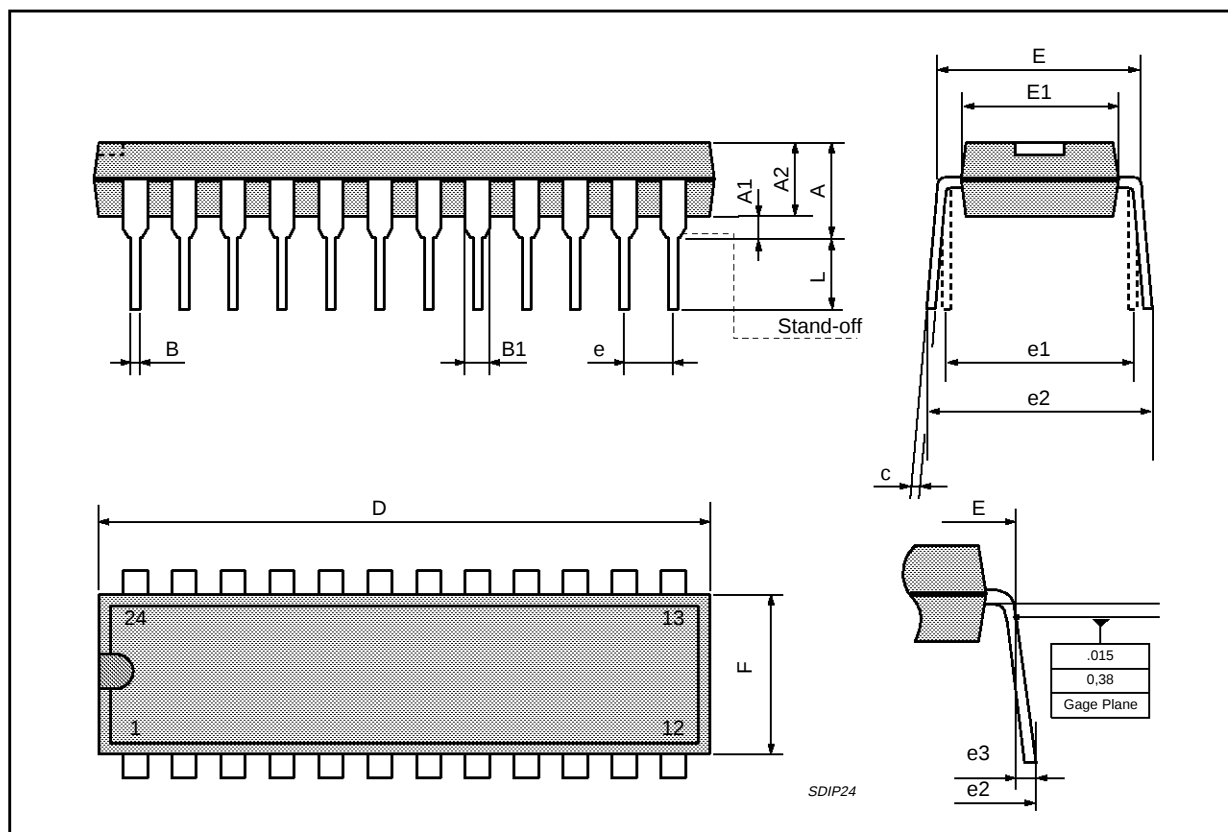
C3 = Sign

For example Bass at -10dB is obtained by the following 8 bit string:

0 1 1 0 0 0 1 0

SDIP24 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5.08			0.20
A1	0.51			0.020		
A2	3.05	3.30	4.57	0.120	0.130	0.180
B	0.36	0.46	0.56	0.0142	0.0181	0.0220
B1	0.76	1.02	1.14	0.030	0.040	0.045
c	0.23	0.25	0.38	0.0090	0.0098	0.0150
D	22.61	22.86	23.11	0.890	0.90	0.910
E	7.62		8.64	0.30		0.340
E1	6.10	6.40	6.86	0.240	0.252	0.270
e		1.778			0.070	
e1		7.62			0.30	
e2			10.92			0.430
e3			1.52			0.060



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