



DIGITAL CONTROLLED AUDIO PROCESSOR

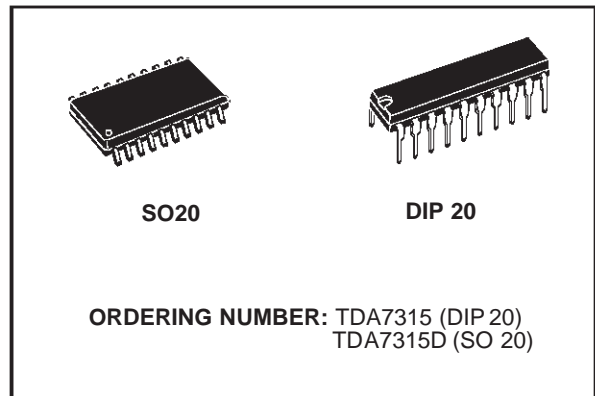
- 1 STEREO INPUT
- LOUDNESS FUNCTION
- VOLUME CONTROL IN 1.25dB STEPS
- TREBLE AND BASS CONTROL
- TWO SPEAKERS ATTENUATORS:
 - INDEPENDENT SPEAKERS CONTROL IN 1.25dB STEPS
 - INDEPENDENT MUTE FUNCTION
- ALL FUNCTIONS PROGRAMMABLE VIA SERIAL BUS

DESCRIPTION

The TDA7315 is a volume, tone (bass and treble) balance (Left/Right) processor for quality audio applications in car radio and Hi-Fi systems.

Control is accomplished by serial bus microprocessor interface.

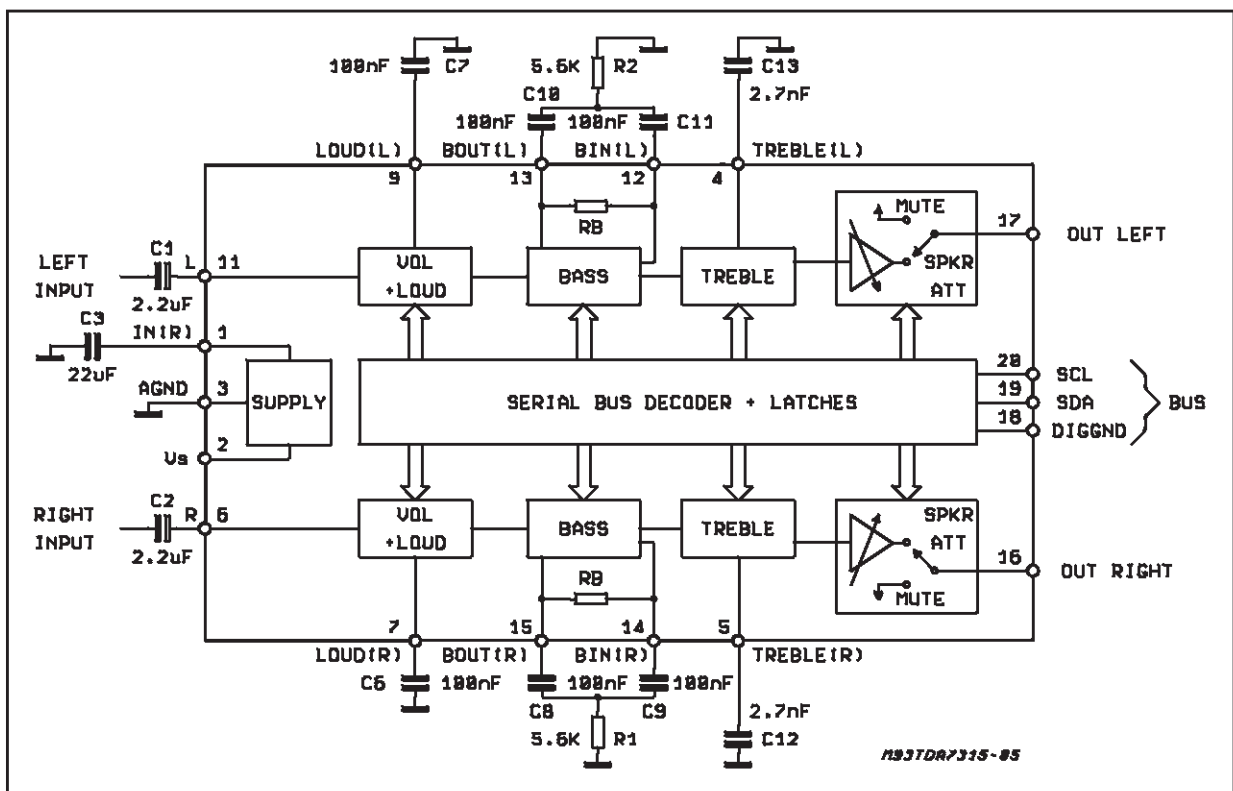
The AC signal setting is obtained by resistor networks



and switches combined with operational amplifiers.

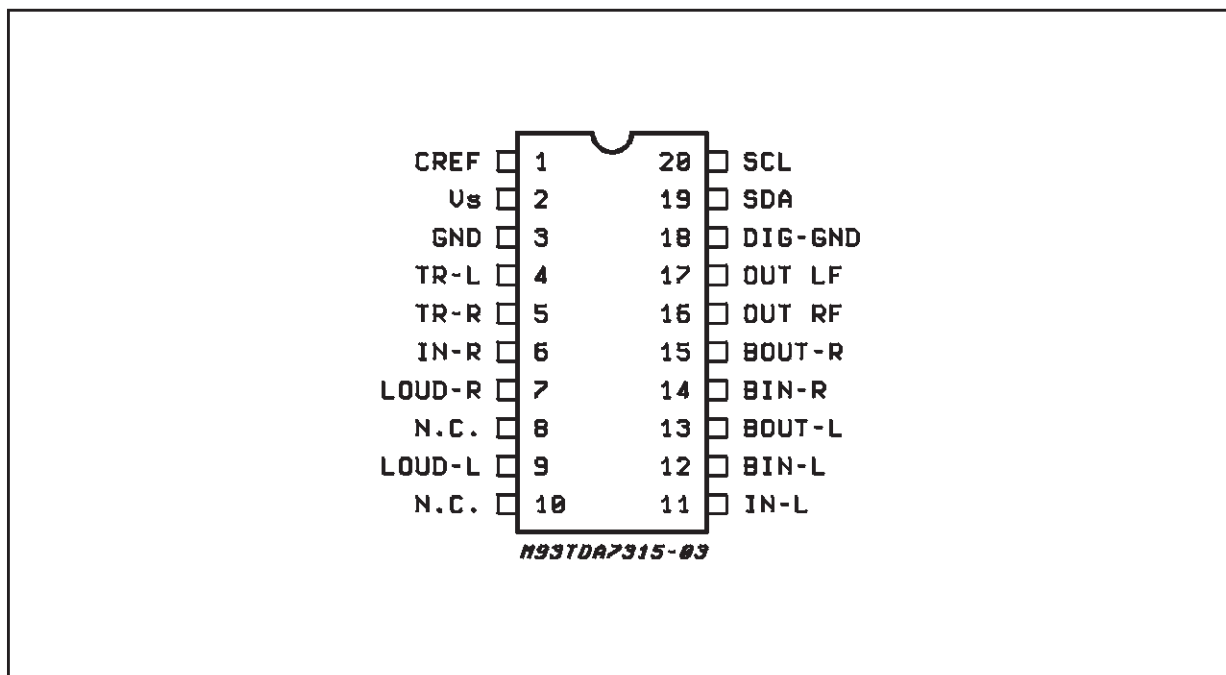
Thanks to the used BIPOLAR/CMOS Technology, Low Distortion, Low Noise and DC stepping are obtained.

BLOCK DIAGRAM



TDA7315

PIN CONNECTION (Top view)



THERMAL DATA

Symbol	Parameter	SO 20	DIP 20	Unit
$R_{thj-pins}$	Thermal Resistance Junction-pins Max.	150	150	°C/W

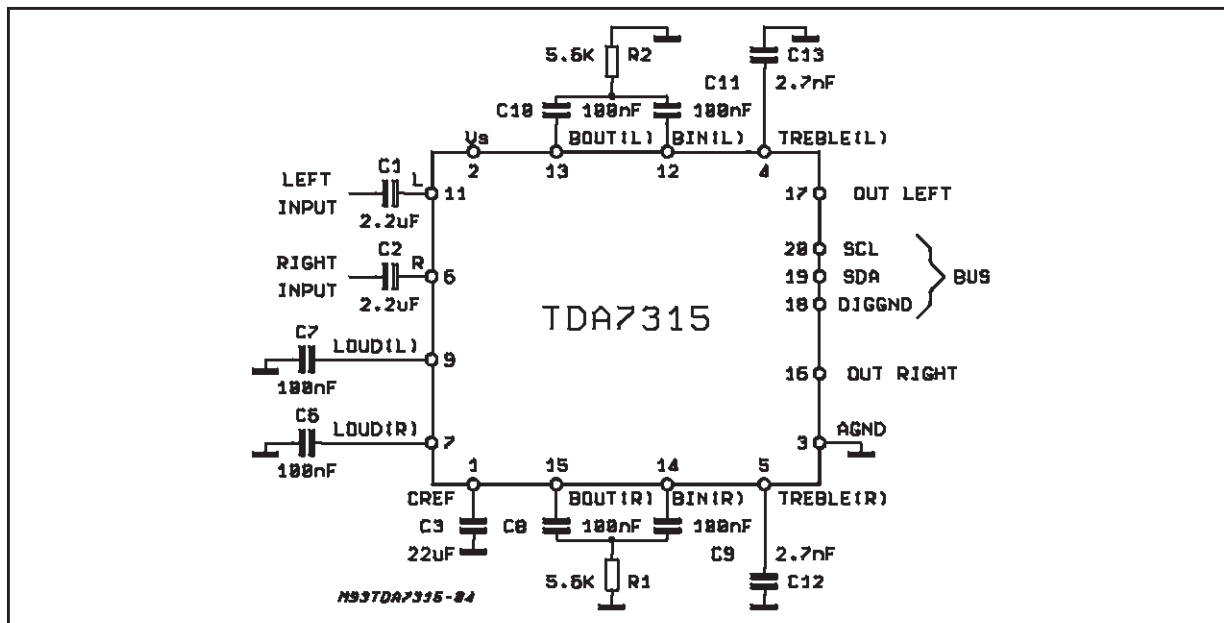
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Operating Supply Voltage	10.2	V
T_{amb}	Operating Ambient Temperature	-10 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
S_C	Channel Separation $f = 1KHz$		103		dB
	Volume Control 1.25dB step	-78.75		0	dB
	Bass and Treble Control 2db step	-14		+14	dB
	Balance Control 1.25dB step	-38.75		0	dB
	Mute Attenuation		100		dB

TEST CIRCUIT



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

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 $A_v = -20$ to -60dB	-1.25 -3	0	1.25 2	dB dB
E_T	Tracking Error				2	dB
V_{DC}	DC Steps	adjacent attenuation steps From 0dB to A_v max		0 0.5	3 7.5	mV 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 from 0 to mute		0 1	3 10	mV 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	$\text{K}\Omega$

TDA7315

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
TREBLE CONTROL (1)						
Gt	Control Range	Max. Boost/cut	± 13	± 14	± 15	dB
T _{STEP}	Step Resolution		1	2	3	dB

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	μ V
		A curve all gains = 0dB		3			μ V
S/N	Signal to Noise Ratio	all gains = 0dB; V _O = 1Vrms		106			dB
d	Distortion	A _V = 0, V _{IN} = 1Vrms A _V = -20dB V _{IN} = 1Vrms V _{IN} = 0.3Vrms		0.01	0.09	0.1	%
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	μ A
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

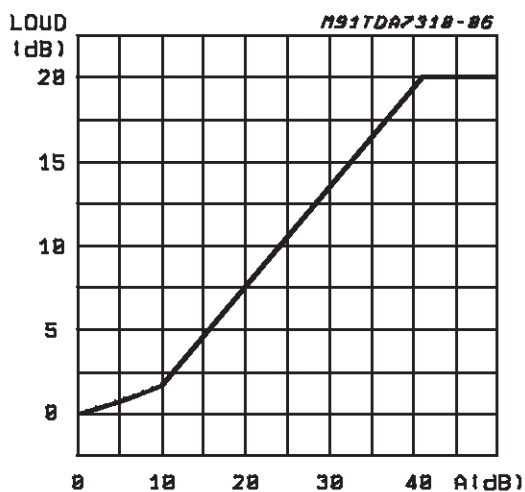


Figure 2: Loudness versus Frequency

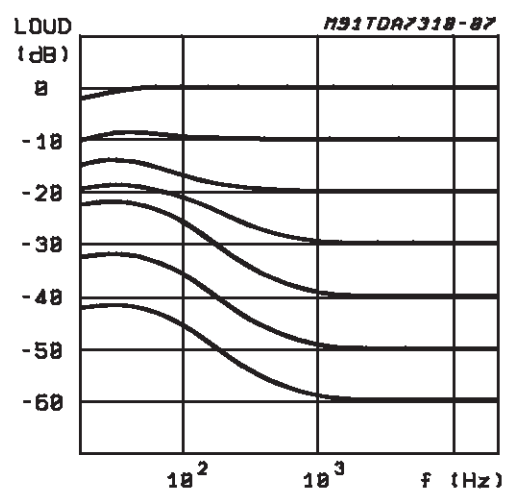
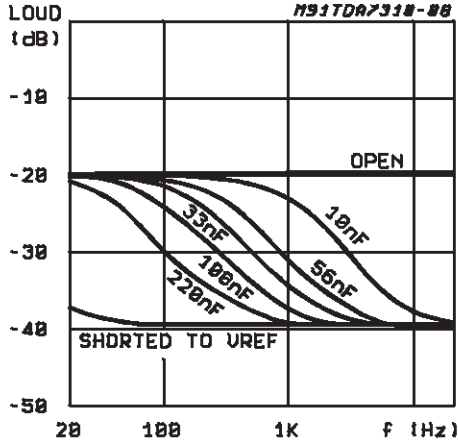


Figure 3: Loudness versus External Capacitors



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

Figure 4: Noise vs. Volume/Gain Settings

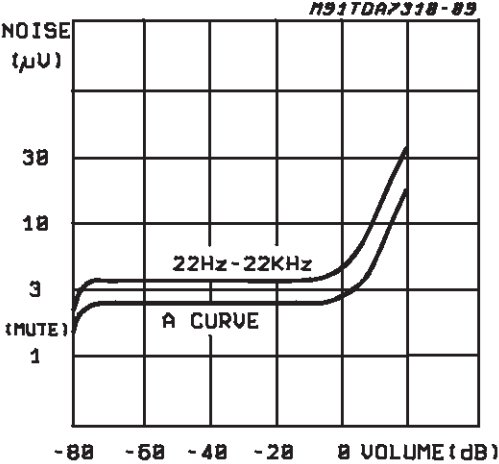


Figure 6: Distortion & Noise vs. Frequency

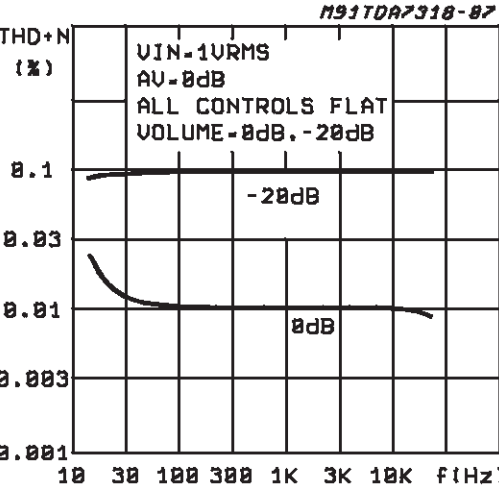


Figure 5: Signal to Noise Ratio vs. Volume Setting

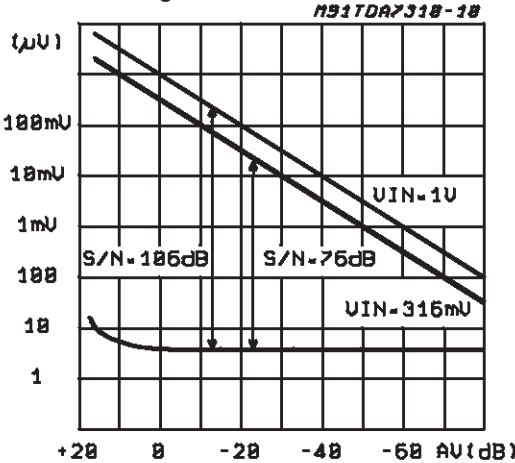


Figure 7: Distortion & Noise vs. Frequency

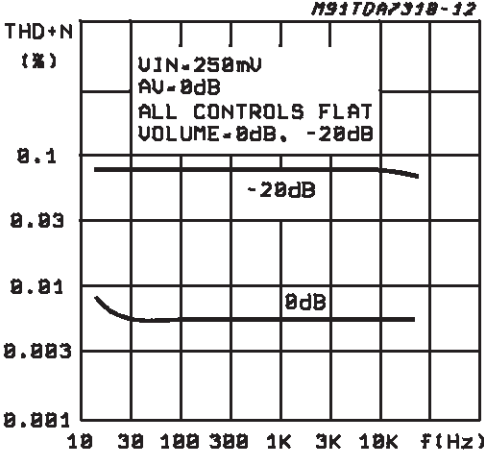


Figure 8: Distortion vs. Load Resistance

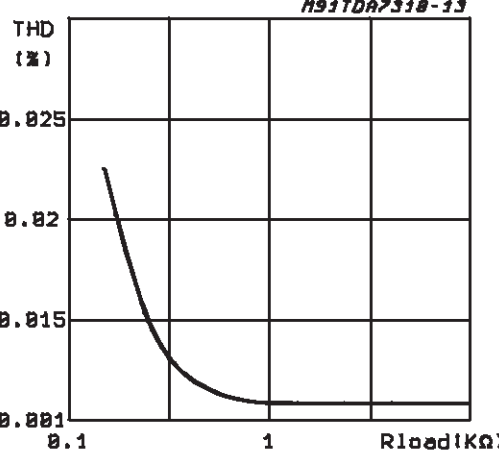


Figure 9: Channel Separation (L → R) vs. Frequency

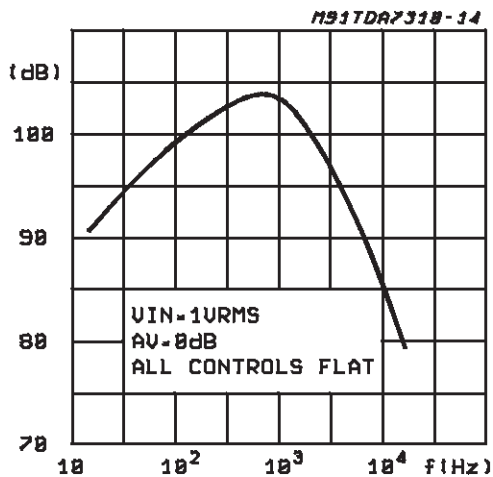


Figure 10: Supply Voltage Rejection vs. Frequency

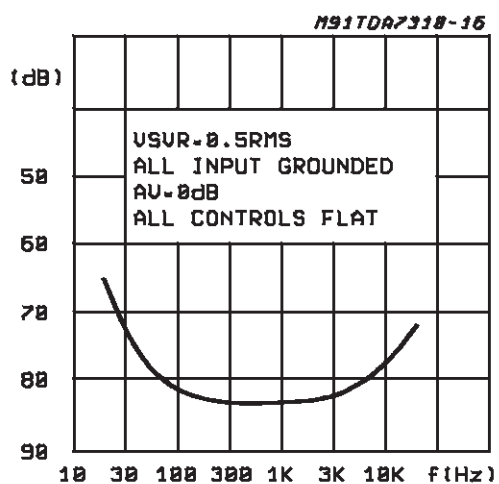


Figure 11: Output Clipping Level vs. Supply Voltage

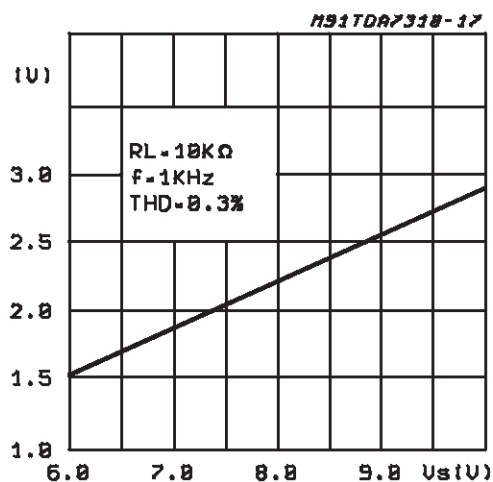


Figure 12: Quiescent Current vs. Supply Voltage

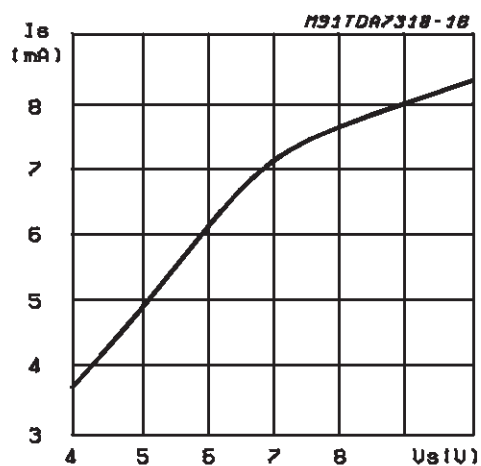


Figure 13: Supply Current vs. Temperature

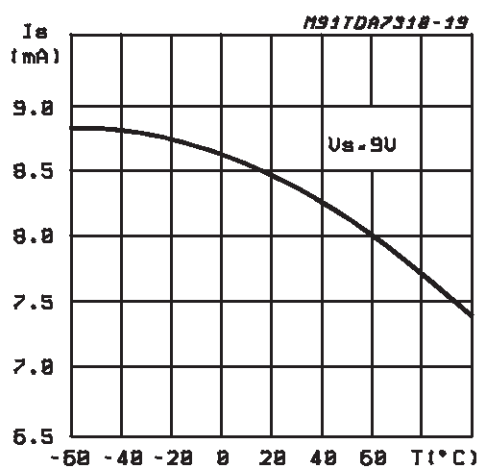


Figure 14: Bass Resistance vs. Temperature

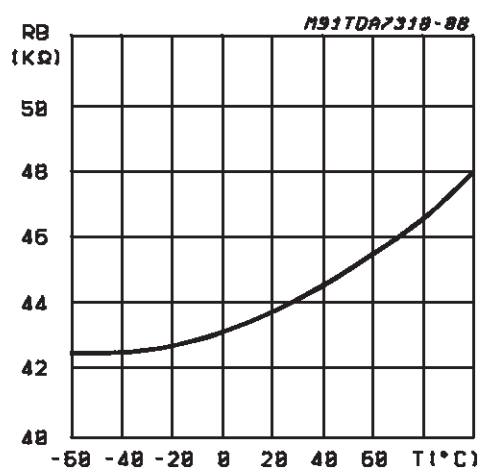
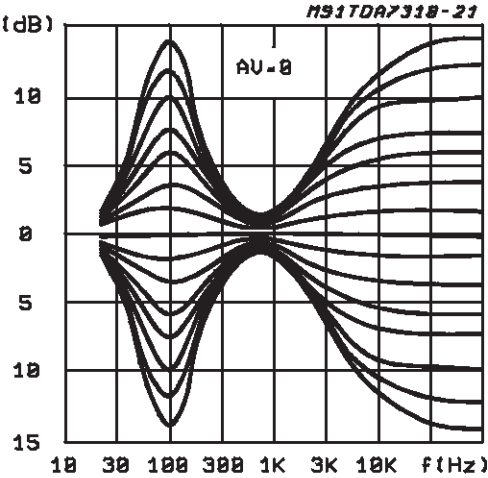


Figure 15: Typical Tone Response (with the ext. components indicated in the test circuit)

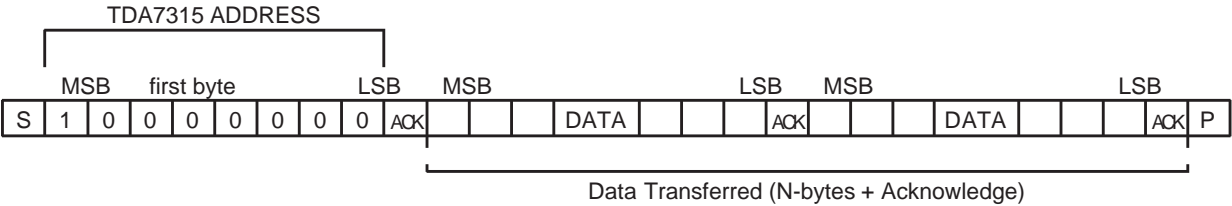


SOFTWARE SPECIFICATION

Interface Protocol

The interface protocol comprises:

- A start condition (S)
- A chip address byte, containing the TDA7315 address (the 8th bit of the byte must be 0). The TDA7315 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 100kbts/s

SOFTWARE SPECIFICATION

Chip address = 80 Hex

1	0	0	0	0	0	0	0
MSB							LSB

DATA BYTES

MSB								LSB	FUNCTION
0	0	B2	B1	B0	A2	A1	A0	Volume control	
1	0	0	B1	B0	A2	A1	A0	Speaker ATT L	
1	0	1	B1	B0	A2	A1	A0	Speaker ATT R	
0	1	0	X	X	L	X	X	Loudness	
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; X = don't care.

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 L
1	0	1	B1	B0	A2	A1	A0	Speaker R
					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
		0	1					-10
		1	0					-20
		1	1					-30
		1	1	1	1	1	1	Mute

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

1 0 1 1 0 1 0 0

Loudness

MSB						LSB		FUNCTION
0	1	0	X	X	L	X	X	
					0			LOUDNESS ON
					1			LOUDNESS OFF

x = don't care

For examples Loudness Off can be programmed by the following 8 bit string:

0 1 0 0 0 1 0 0

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

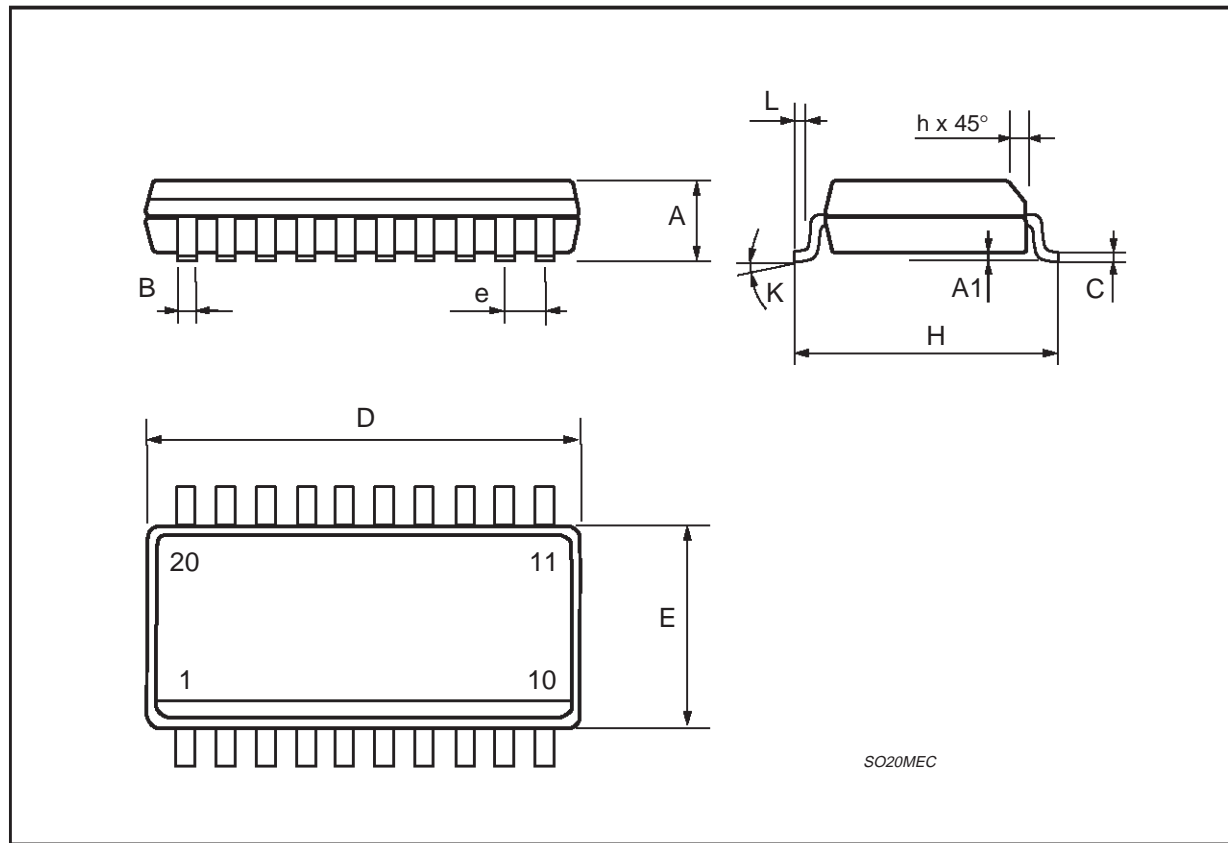
C3 = Sign

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

0 1 1 0 0 0 1 0

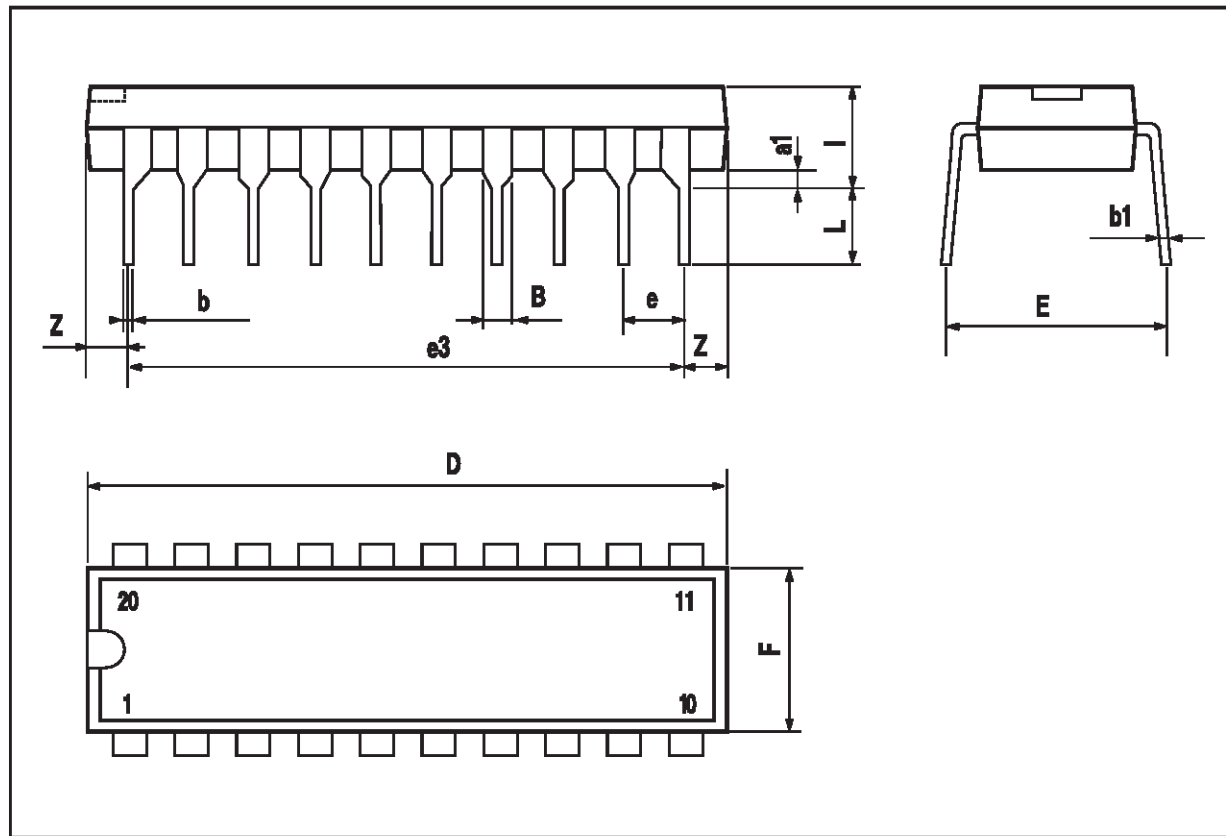
SO20 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13	0.496		0.512
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0 (min.)8 (max.)					



DIP20 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.254			0.010		
B	1.39		1.65	0.055		0.065
b		0.45			0.018	
b1		0.25			0.010	
D			25.4			1.000
E		8.5			0.335	
e		2.54			0.100	
e3		22.86			0.900	
F			7.1			0.280
I			3.93			0.155
L		3.3			0.130	
Z			1.34			0.053



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