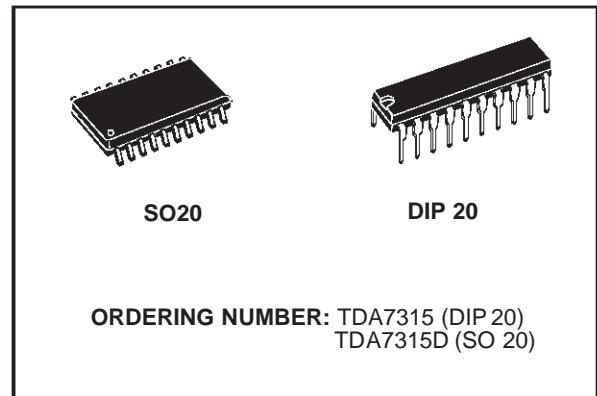# TDA7315

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.

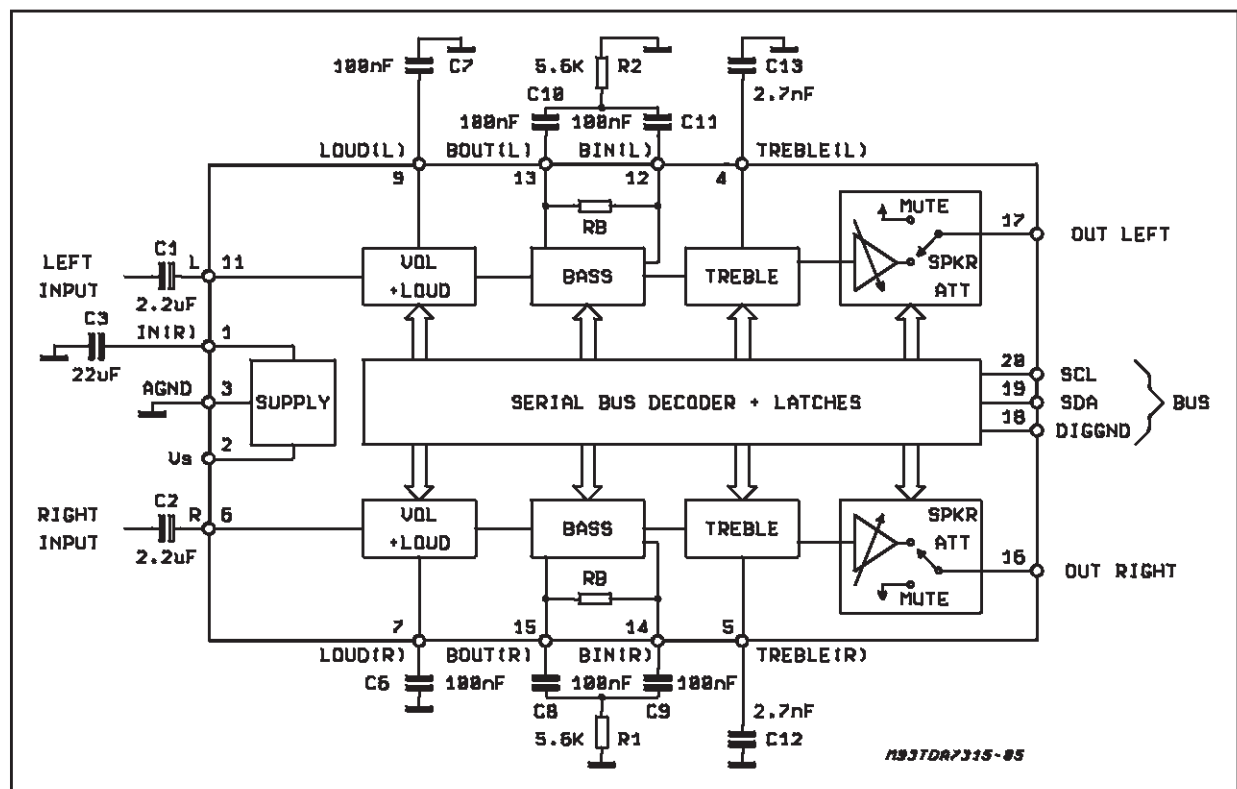Control is accomplished by serial bus microprocessor interface.

The AC signal setting is obtained by resistor networks

SO20   **DIP 20**

ORDERING NUMBER: TDA7315 (DIP 20)
TDA7315D (SO 20)
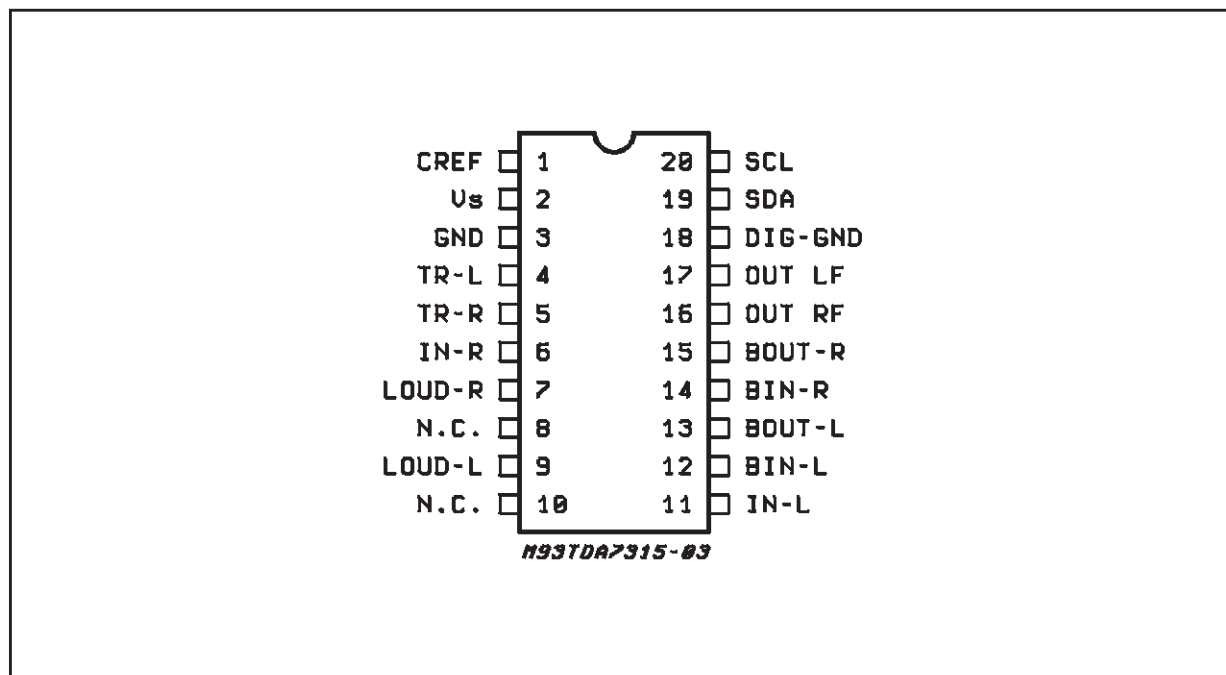
and switches combined with operational amplifiers.

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

BLOCK DIAGRAM

PIN CONNECTION (Top view)

```
          CREF □  1      20 □ SCL
            Vs □  2      19 □ SDA
           GND □  3      18 □ DIG-GND
          TR-L □  4      17 □ OUT LF
          TR-R □  5      16 □ OUT RF
          IN-R □  6      15 □ BOUT-R
        LOUD-R □  7      14 □ BIN-R
          N.C. □  8      13 □ BOUT-L
        LOUD-L □  9      12 □ BIN-L
          N.C. □ 10      11 □ IN-L
```

M93TDA7315-03

THERMAL DATA

Symbol	Parameter		SO 20	DIP 20	Unit
$R_{th\,j\text{-pins}}$	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			Vrms
THD	Total Harmonic Distortion V = 1Vrms 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
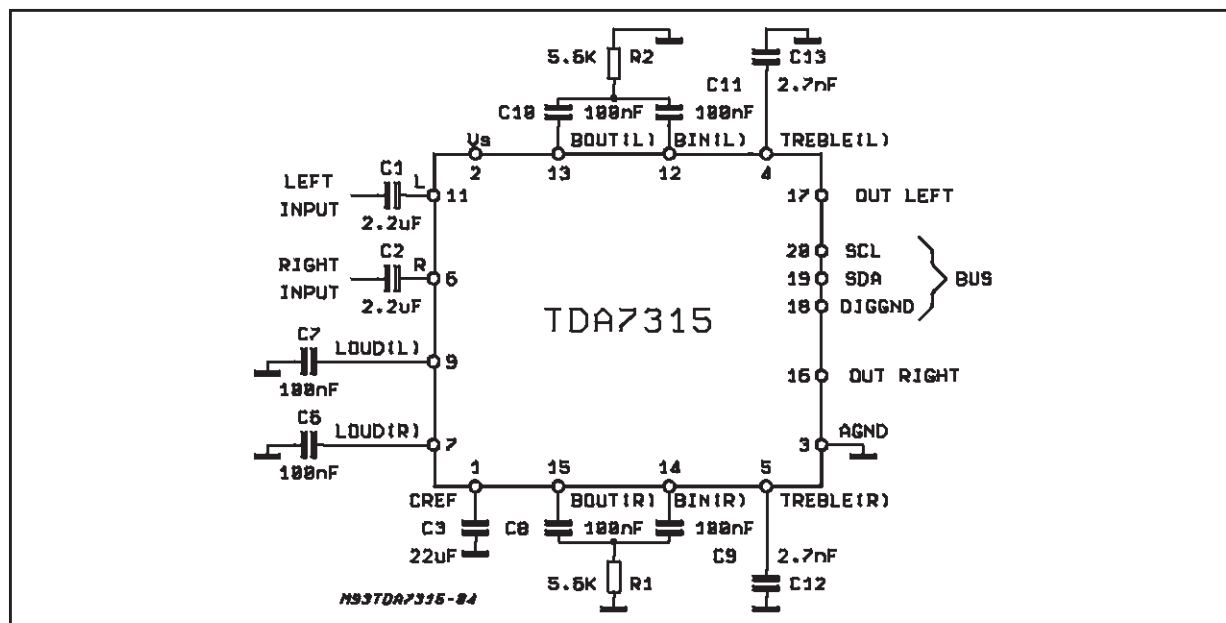
ELECTRICAL CHARACTERISTICS (refer to the test circuit $T_{amb} = 25°C$, $V_S = 9V$, $R_L = 10K\Omega$, $R_G = 600\Omega$, all controls flat (G = 0), f = 1KHz unless otherwise specified)

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	kΩ
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	Av = 0 to -20dB Av = -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 Av 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)						
Gb	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	KΩ

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit

TREBLE CONTROL (1)

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

AUDIO OUTPUTS

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{OCL}	Clipping Level	d = 0.3%	2	2.5		Vrms
R_L	Output Load Resistance		2			KΩ
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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
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 = 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 0.04	0.1 0.3	% % %
Sc	Channel Separation left/right		80	103		dB
	Total Tracking error	A_V = 0 to -20dB -20 to -60 dB		0 0	1 2	dB dB

BUS INPUTS

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
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 choosen by the external circuitry. A standard first order bass response can be realized by a standard feedback network.
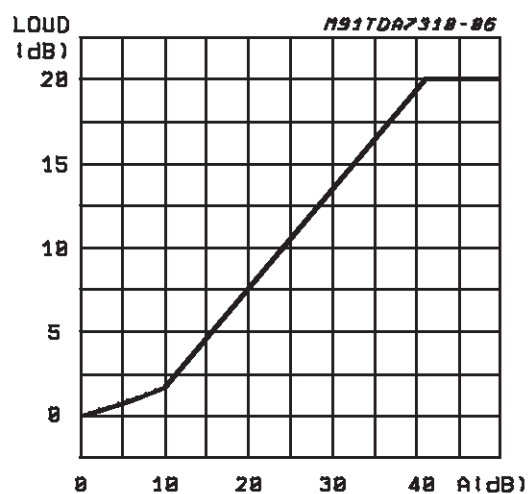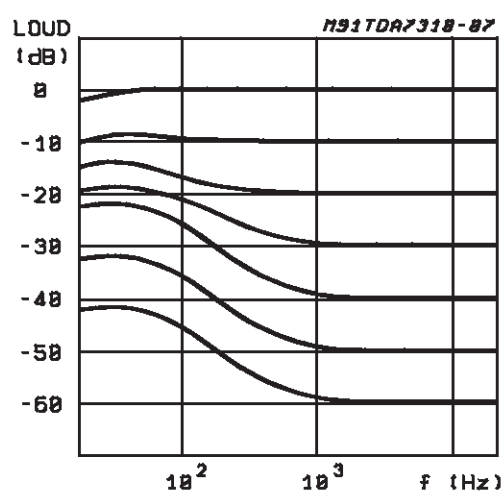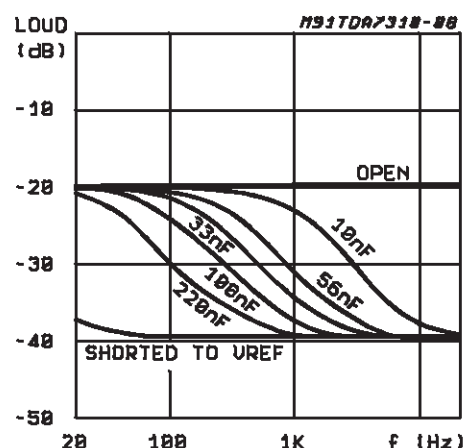
Figure 1: Loudness versus Volume Attenuation

Figure 2: Loudness versus Frequency

Figure 3: Loudness versus External Capacitors

M91TDA7318-08

LOUDNESS
V_S = 9V
Volume = -40dB
All other control flat
C_{in} = 2.2μF
C_{loud} = 220nF, 100nF, 33nF, 10nF, Open, Shorter to Vref

Figure 4: Noise vs. Volume/Gain Settings

M91TDA7318-09
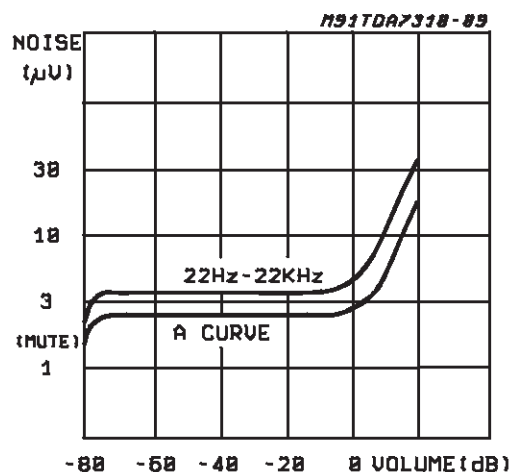
Figure 5: Signal to Noise Ratio vs. Volume Setting

M91TDA7318-10

Figure 6: Distortion & Noise vs. Frequency

M91TDA7318-07
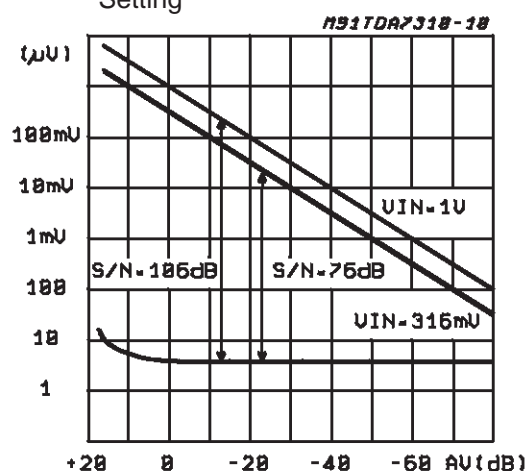
Figure 7: Distortion & Noise vs. Frequency

M91TDA7318-12
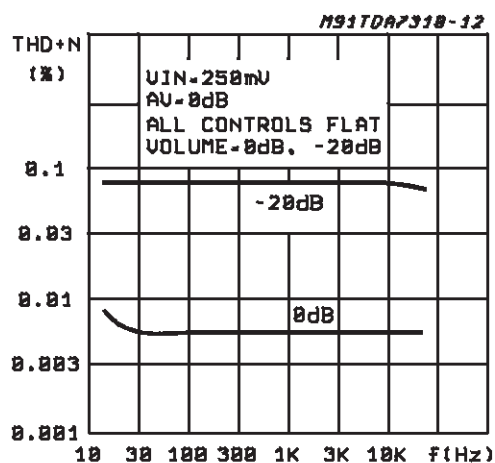
Figure 8: Distortion vs. Load Resistance
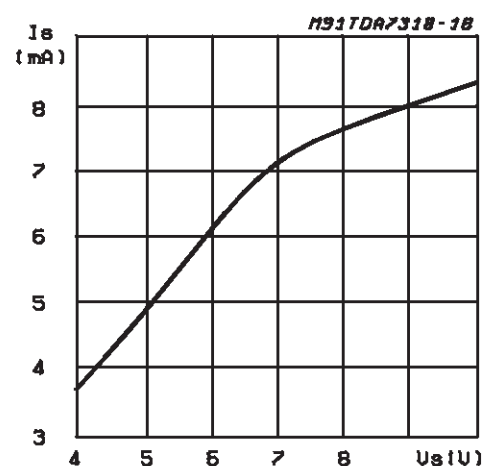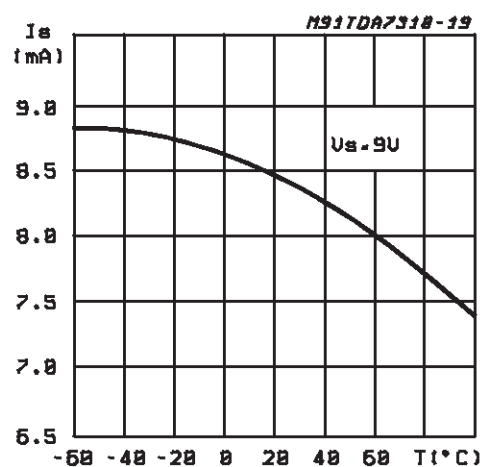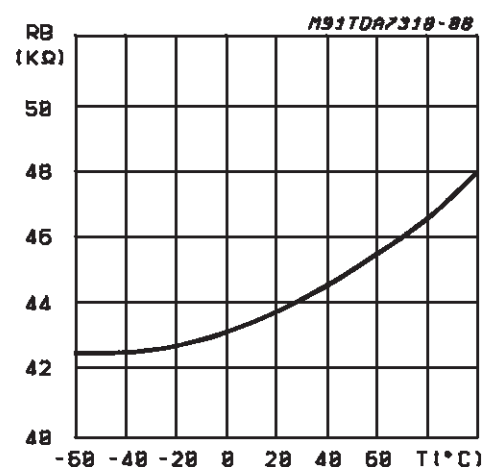

M91TDA7318-13
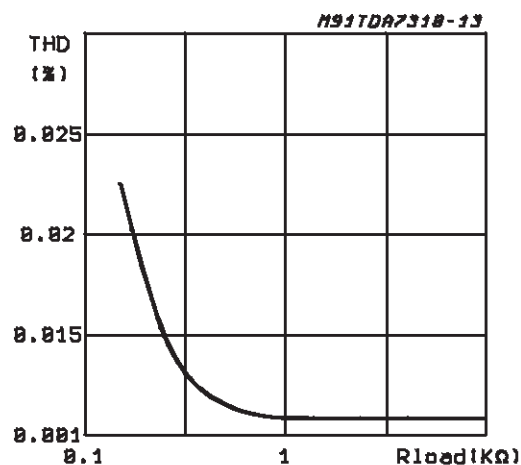
Figure 9: Channel Separation (L → R) vs. Frequency
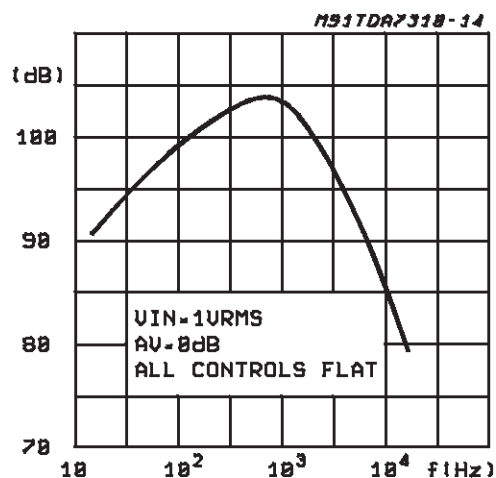
Figure 10: Supply Voltage Rejection vs. Frequency
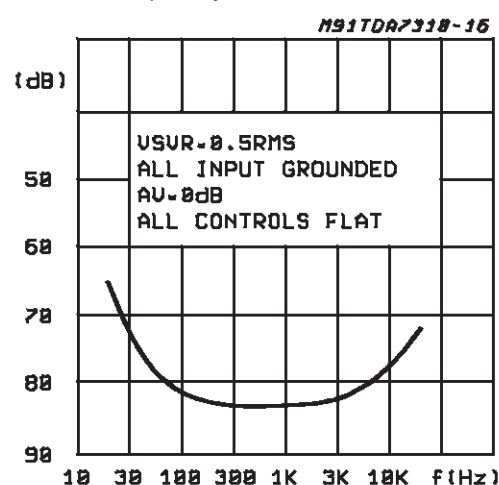
Figure 11: Output Clipping Level vs. Supply Voltage
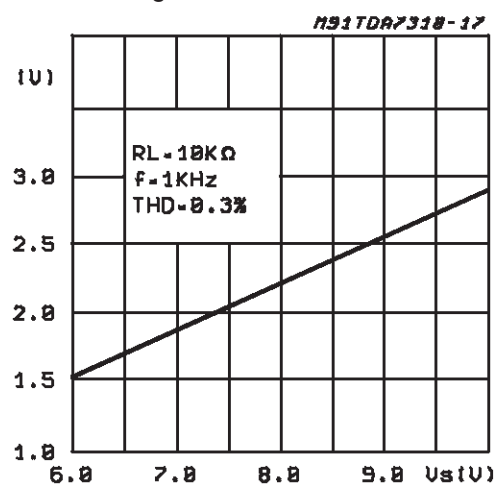
Figure 12: Quiescent Current vs. Supply Voltage

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)
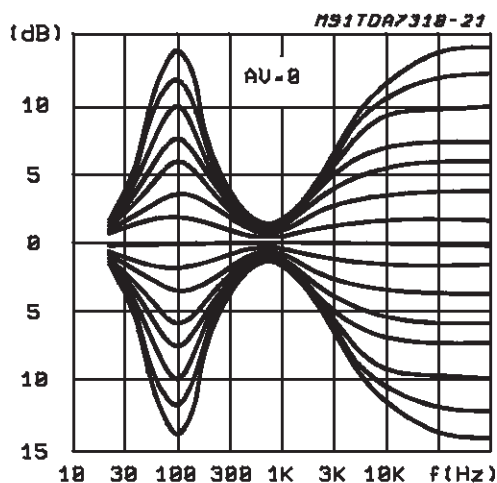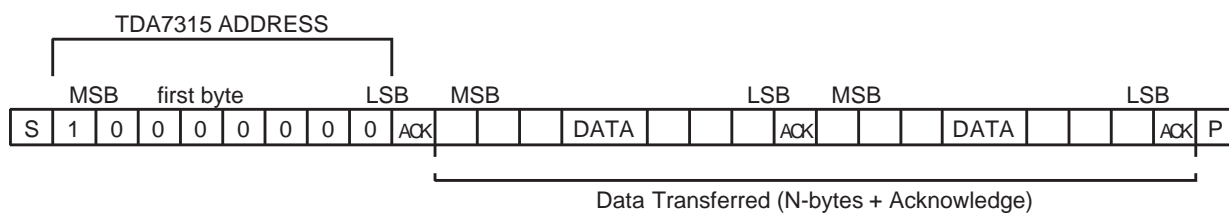

SOFTWARE SPECIFICATION
Interface Protocol

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)

| TDA7315 ADDRESS | | | | | | | | | | | |

	MSB	first byte					LSB				
S	1	0	0	0	0	0	0	0	ACK	...

ACK = Acknowledge
S = Start
P = Stop

MAX CLOCK SPEED 100kbits/s

SOFTWARE SPECIFICATION

Chip address = 80 Hex

1 MSB	0	0	0	0	0	0	0 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	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
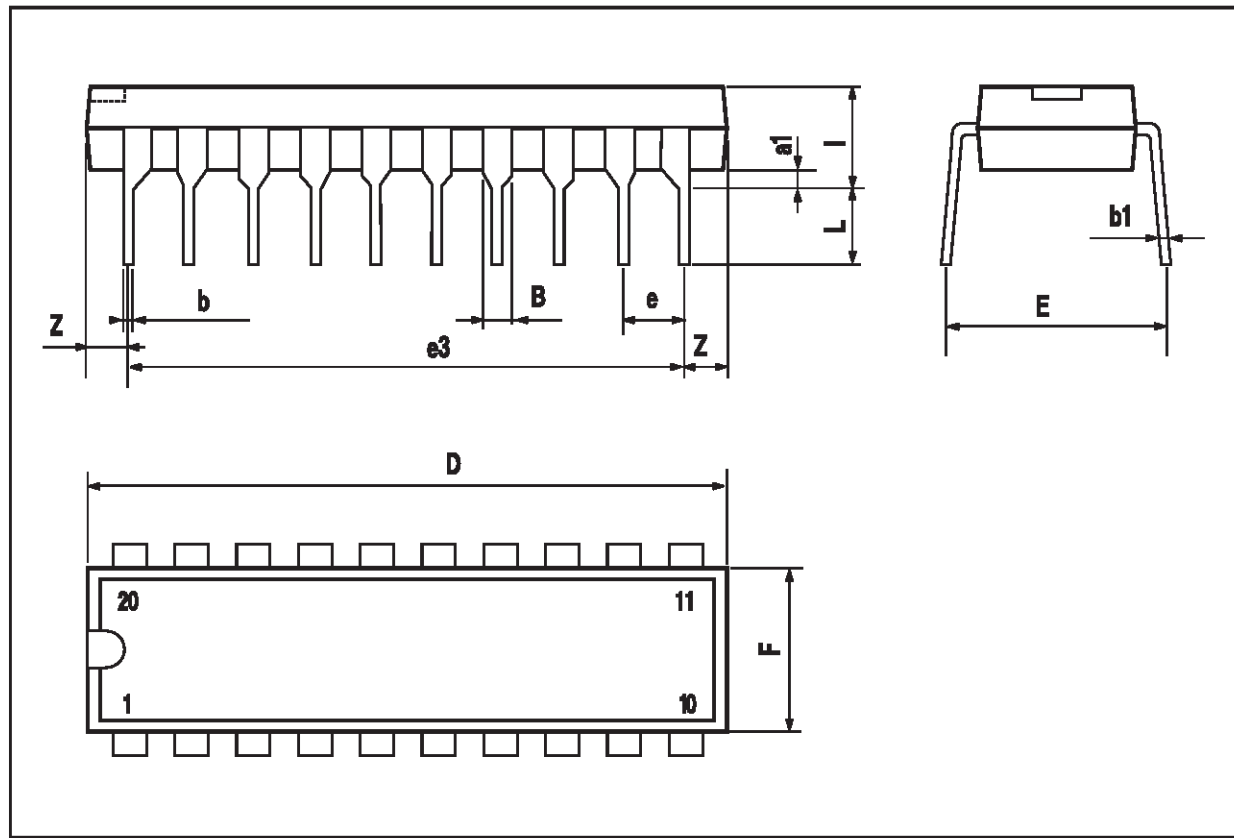For example Bass at -10dB is obtained by the following 8 bit string:
0 1 1 0 0 0 1 0

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.)					

SO20MEC
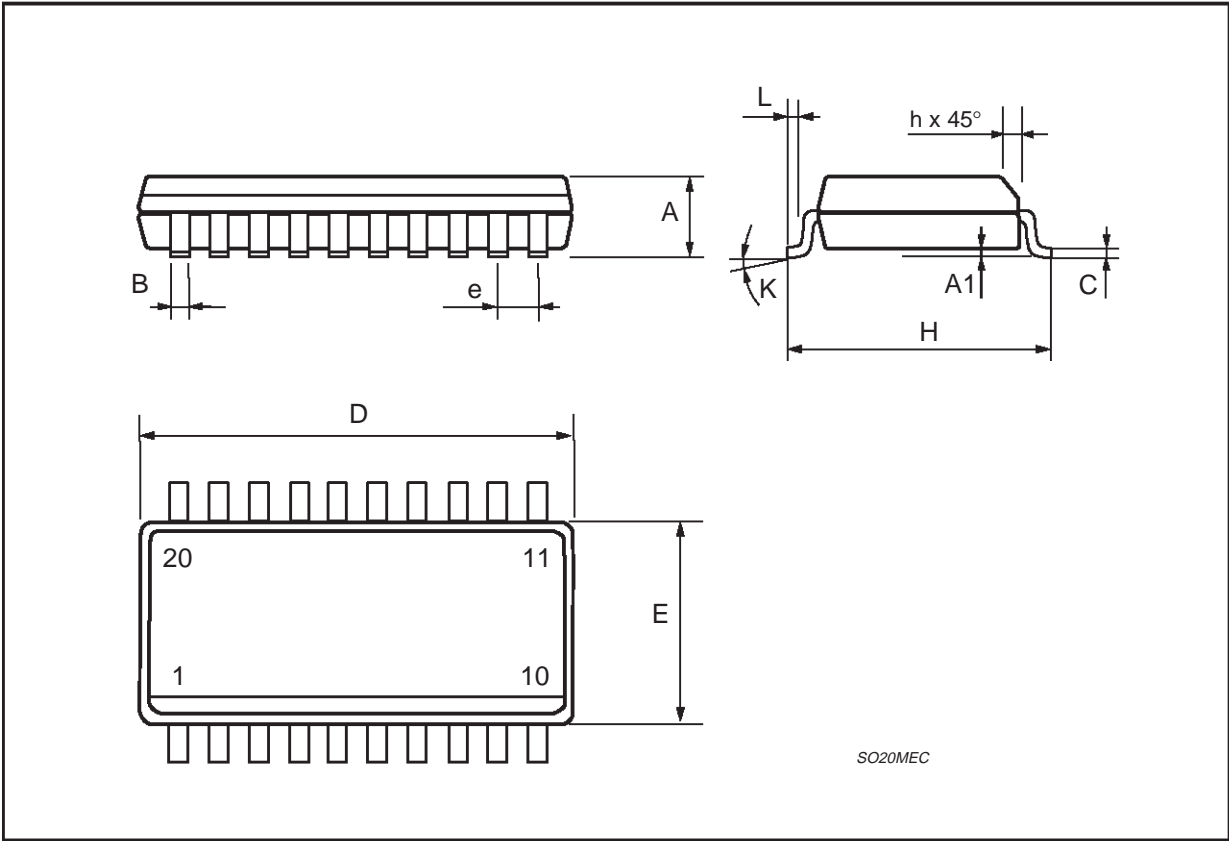
DIP20 PACKAGE MECHANICAL DATA

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