



*Best Single Chip USB Audio Controller for PC Entertainment*

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# **CM102-A/102S USB 2CH Audio Controller Data Sheet**

**Version 1.5**

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## 1. DESCRIPTION AND OVERVIEW

CM102 series is a highly integrated single chip for USB speaker application. Minimum external components are needed for building an USB speaker system, which makes CM102-A/S a simple and very cost-effective solution. Since no driver is necessary for audio playback on all major OS; CM102-A/S provides a truly plug-and-play feature for external digital audio playback. For energy saving, USB suspend mode and resume is supported by CM102-A/S. With power amplifier enable pin and volume control VR input pin, a traditional speaker front panel design can be built. More flexible and customized design is possible with GPIO pin, which is accessible by USB vendor specific request.

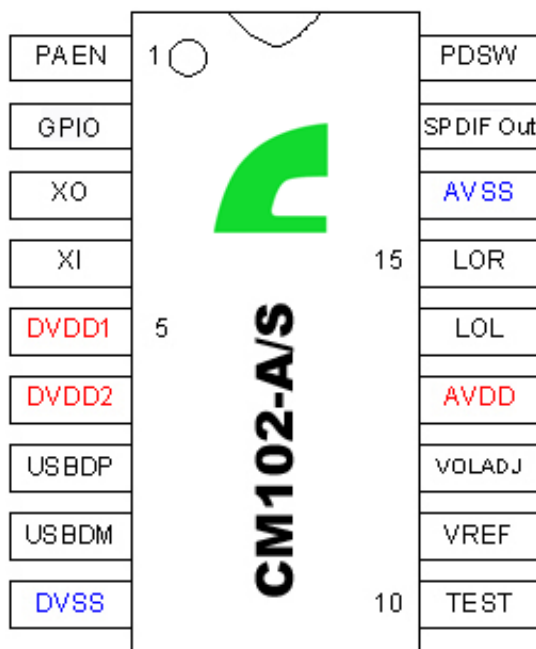
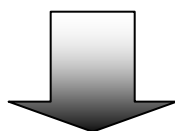
### Features

- USB 2.0 Full Speed Compatible
- USB audio device class specification v1.0 Compatible
- USB bus powered 500mA operation with suspend mode support
- Single 12MHz crystal input with on-chip PLL and embedded USB transceiver
- USB audio function topology has 1 input terminal, 1 output terminal, and 1 feature unit
- Alternate zero bandwidth setting for releasing bandwidth on USB bus during inactive operation
- Isochronous transfer using adaptive synchronization with internal PLL
- High performance 48KHz sampling rate for audio playback
- Embedded high performance 16 bit audio DAC
- Embedded class AB power amplifier for speaker driving
- Embedded power on reset block and Power amplifier enable / disable control pin
- Volume control input with simple external VR circuit
- GPIO pin for application specific usage
- **S/PDIF output interface**
- Single 5V external power supply with internal power regulation
- 3.3V IO with 5V tolerance; 3.3V core logics design
- Compatible with Win 98SE / Win ME / Win 2000 / Win XP, and Mac OS 9 / OS X without additional driver
- Compact 18 pin SOP package
- Target application: multimedia USB audio box, decoder integrated, pen driver
- **Software Xear 3D Sound Technology With HRTF 3D, EAX™, Speaker Shifter and Virtual 5.1CH effects**

**PIN DESCRIPTIONS**

**CM102-A/102S**

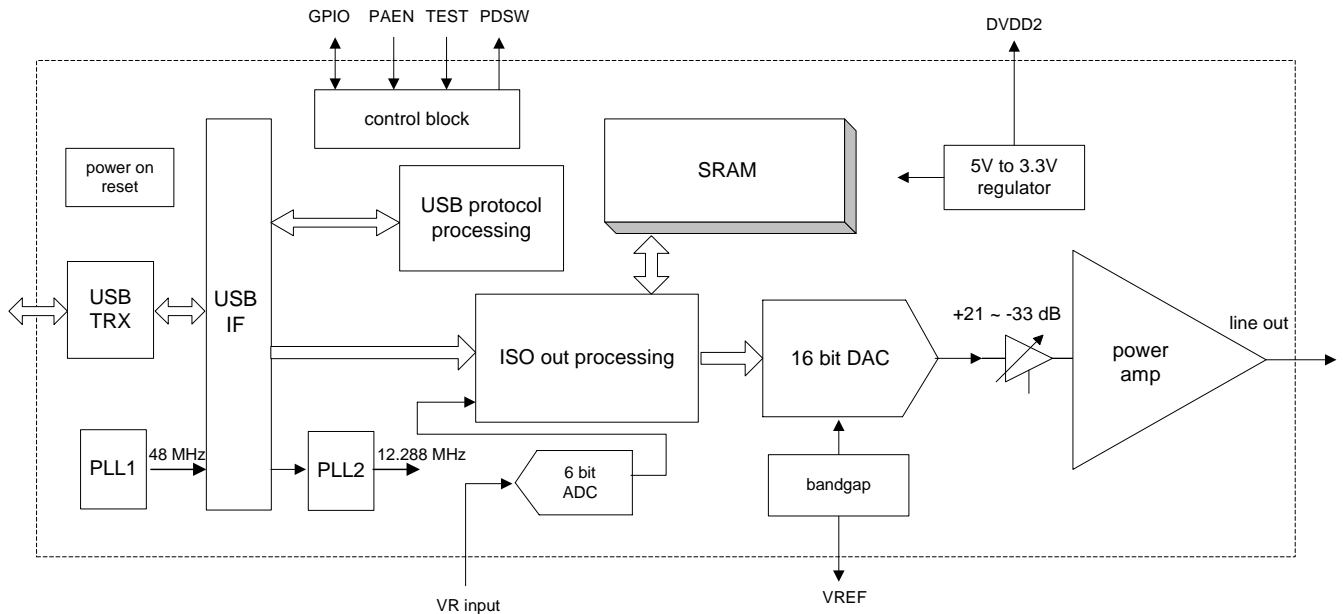
PIN #	Signal Name	PIN #	Signal Name
1	PAEN	10	TEST
2	GPIO	11	VREF
3	XO	12	VOLADJ
4	XI	13	AVDD
5	DVDD1	14	LOL
6	DVDD2	15	LOR
7	USBDP	16	AVSS
8	USBDM	17	SPDIF Out
9	DVSS	18	PDSW



**Figure 1. Pin Assignments (Top View)**

Pin #	Symbol	Type	Description
1	PAEN	DI, PD	Power amplifier enable; H – normal mode, L – power down power amplifier
2	GPIO	DIO, PD	GPIO pin, default is input mode after reset; accessible by USB vendor specific request
3	XO	AO	Clock output pin for 12MHz oscillator
4	XI	AI	Clock input pin for 12MHz oscillator
5	DVDD1	P	5V digital power
6	DVDD2	P	3.3V voltage from internal regulator for decouple capacitor connection It is not affected by power down mode and can be used to connect USB pull up resistor.
7	USBDP	AIO	USB data D+
8	USBDM	AIO	USB data D-
9	DVSS	P	5V digital ground
10	TEST	DI, PD	Test mode select pin; pull low in normal mode operation
11	VREF	AO	Connect to external decouple capacitor for embedded bandgap
12	VOLADJ	AI	0 ~ 2.25V input for volume adjustment by external VR; pull high to disable VR volume adjustment function
13	AVDD	P	5V analog power
14	LOL	AO	Line out left channel
15	LOR	AO	Line out right channel
16	AVSS	P	5V analog ground
17	SPDIF Out	DO	SPDIF Out
18	PDSW	DO, 4mA	Power down switch control 1: normal mode, 0: power down mode

- Note: DI – digital input pin, DO – digital output pin, DIO – digital bi-directional pin, P – power pin, PD – pull down with 100K Ohm resistor, AI – analog input, AO – analog output

**Block Diagram of CM102-A/102S**

**Figure 2 : Block Diagram Of CM102-A/102S**
**Vendor Specific Request for GPIO Access**
**GPIO write**

Offset	Field	Size	Value	Description
0	bmRequestType	1	43	
1	bRequest	1	01	
2	wValue	2	Value	Bit 0: GPIO value Bit 1: 1: output; 0: input
4	wIndex	2	0000	
6	wLength	2	0000	

**GPIO read**

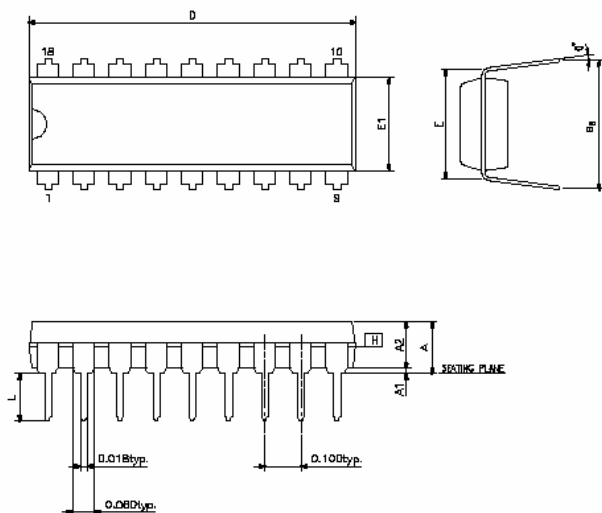
Offset	Field	Size	Value	Description
0	bmRequestType	1	C3	
1	bRequest	1	81	
2	wValue	2	Value	Bit 0: GPIO value Bit 1: 1: output; 0: input
4	wIndex	2	0000	
6	wLength	2	0001	

## 2. ORDERING INFORMATION

Model Number	Package	Operating Ambient Temperature	Supply Range
CM102-A/102S	18-Pin PDIP	0 o C to +70 o C	DVdd = 4.5V, AVdd = 5.5V
	18-Pin SOP	0 o C to +70 o C	DVdd = 4.5V, AVdd = 5.5V

**Outline of Dimensions** Dimensions shown in inches and (mm)

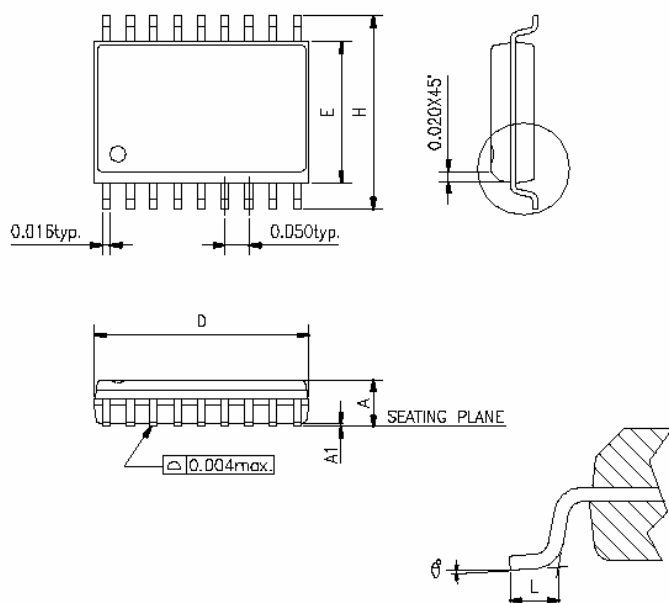
### ◆18- Plastic dual-in-line packaging (PDIP)



SYMBOLS	MIN.	NOR.	MAX.
A	—	—	0.210
A1	0.015	—	—
A2	0.125	0.130	0.135
D	0.880	0.900	0.920
E	0.300 BSC.		
E1	0.245	0.250	0.255
L	0.115	0.130	0.150
e <sub>B</sub>	0.335	0.355	0.375
θ°	0	7	15

**Figure 3 : Mechanical Dimension of CM102-A**

### ◆18- Pin SOP



SYMBOLS	MIN.	MAX.
A	0.093	0.104
A1	0.004	0.012
D	0.447	0.463
E	0.291	0.299
H	0.394	0.419
L	0.016	0.050
θ°	0	8

**Figure 4 : Mechanical Dimension of CM102S**

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### 3. PIN/SIGNAL DESCRIPTIONS

#### 3.1 Clock Pin

These signals connect CM102-A/CM102S to external clock source signal.

Signal Name	Type	Pin No	Description
XO	O	3	Clock output pin for 12MHz oscillator.
XI	I	4	Clock input pin for 12MHz oscillator.

#### 3.2 Analog I/O

These signals connect CM102-A/CM102S to analog signals, external VR, and decouple capacitor.

Signal Name	Type	Pin No	Description
VREF	O	11	Connect to external decouple capacitor for embedded bandgap.
VOLADJ	I	12	0 ~ 2.25V input for volume adjustment by external VR; pull high to disable VR volume adjustment function.
LOL	O	14	Line out left channel.
LOR	O	15	Line out right channel.
USBDP	I/O	7	USB data D+.
USBDM	I/O	8	USB data D-.

#### 3.3 Power / Ground

Analog VDD is 5V, Digital VDD is 3.3V and 5V. Analog ground plane and digital ground plane should be separated well.

Signal Name	Type	Pin No	Description
DVDD1	I	5	5V digital power.
DVDD2	O	6	3.3V voltage from internal regulator for decouple capacitor connection. It is not affected by power down mode and can be used to connect USB pull up resistor.
DVSS	I	9	Digital ground.
AVDD	I	13	5V analog power.
AVSS	I	16	5V analog ground.

### 3.4 Configuration / GPIO

These signals are for various configuration and GPIO.

Signal Name	Type	Pin No	Description
PAEN	I	1	Power amplifier enable; H – Normal mode, L – Power down power amplifier.
GPIO	I/O	2	GPIO pin, default is input mode after reset; accessible by USB vendor specific request.
TEST	I	10	Test mode select pin; pull low in normal mode operation.
SPDIF Out	O	17	This pin is used for SPDIF Out.
PDSW	O	18	Power down switch control. H - Normal mode, L - Power down mode.

**PAEN / GPIO / TEST:**

**Internal pull down via 100KΩ resistor.**

#### 4. VR MAPPING TABLE

VOLADJ (pin 12) can be pulled high to disable external VR volume adjustment function. Voltage level set by external VR can change the CM102-A/CM102S volume control value according to the following table.

Input DC voltage relative to 2.25V	Adjust value added to volume control (unit : DAC step)	Input DC voltage relative to 2.25V	Adjust value added to volume control (unit : DAC step)
$\geq 96.5\%$	<b>-37 (MUTE)</b>	48.5 ~ 50 %	0
95 ~ 96.5 %	-30	47 ~ 48.5 %	+1
93.5 ~ 95 %	-29	45.5 ~ 47 %	+2
92 ~ 93.5 %	-28	44 ~ 45.5 %	+3
90.5 ~ 92 %	-27	42.5 ~ 44 %	+4
89 ~ 90.5 %	-26	41 ~ 42.5 %	+5
87.5 ~ 89 %	-25	39.5 ~ 41 %	+6
86 ~ 87.5 %	-24	38 ~ 39.5 %	+7
84.5 ~ 86 %	-23	36.5 ~ 38 %	+8
83 ~ 84.5 %	-22	35 ~ 36.5 %	+9
81.5 ~ 83 %	-21	33.5 ~ 35 %	+10
80 ~ 81.5 %	-20	32 ~ 33.5 %	+11
78.5 ~ 80 %	-19	30.5 ~ 32 %	+12
77 ~ 78.5 %	-18	29 ~ 30.5 %	+13
75.5 ~ 77 %	-17	27.5 ~ 29 %	+14
74 ~ 75.5 %	-16	26 ~ 27.5 %	+15
72.5 ~ 74 %	-15	24.5 ~ 26 %	+16
71 ~ 72.5 %	-14	23 ~ 24.5 %	+17
69.5 ~ 71 %	-13	21.5 ~ 23 %	+18
68 ~ 69.5 %	-12	20 ~ 21.5 %	+19
66.5 ~ 68 %	-11	18.5 ~ 20 %	+20
65 ~ 66.5 %	-10	17 ~ 18.5 %	+21
63.5 ~ 65 %	-9	15.5 ~ 17 %	+22
62 ~ 63.5 %	-8	14 ~ 15.5 %	+23
60.5 ~ 62 %	-7	12.5 ~ 14 %	+24
59 ~ 60.5 %	-6	11 ~ 12.5 %	+25
57.5 ~ 59 %	-5	9.5 ~ 11 %	+26
56 ~ 57.5 %	-4	8 ~ 9.5 %	+27
54.5 ~ 56 %	-3	6.5 ~ 8 %	+28
53 ~ 54.5 %	-2	5 ~ 6.5 %	+29
51.5 ~ 53 %	-1	3.5 ~ 5 %	+30
50 ~ 51.5 %	0	$\leq 3.5\%$	<b>+37</b>

## 5. VENDOR SPECIFIC REQUEST FOR GPIO ACCESS

### GPIO Write

Offset	Field	Size	Value (Hex)	Description
0	bmRequestType	1	43	
1	bRequest	1	01	
2	wValue	2	Value	Bit 0: GPIO value Bit 1: 1: output; 0: input
4	wIndex	2	0000	
6	wLength	2	0000	

### GPIO Read

Offset	Field	Size	Value (Hex)	Description
0	bmRequestType	1	C3	
1	bRequest	1	81	
2	wValue	2	Value	Bit 0: GPIO value Bit 1: 1: output; 0: input
4	wIndex	2	0000	
6	wLength	2	0001	

## 6. USB DESCRIPTORS

The audio and control data are transferred to CM102-A/CM102S via USBDP (Pin 7) and USBDM (Pin8) in full-speed, which correspond to D+ and D- in the USB specification. The descriptors are listed for design reference.

### 6.1 Device Descriptors

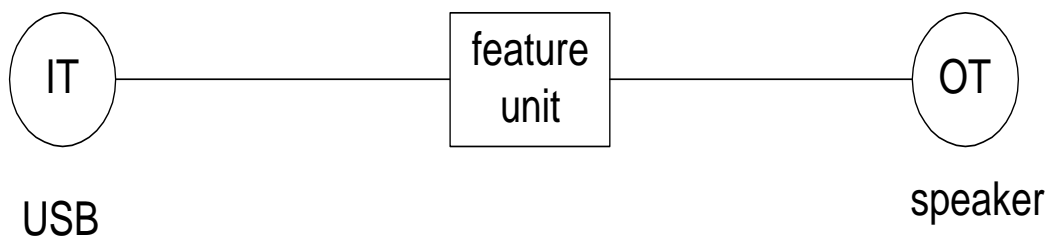
Offset	Field	Size	Value (Hex)	Description
0	bLength	1	12	Total 18 Bytes.
1	bDescriptorType	1	01	Device Descriptor.
2	bcdUSB	2	0110	USB Specification compatible.
4	bDeviceClass	1	00	
5	bDeviceSubClass	1	00	
6	bDeviceProtocol	1	00	
7	bMaxPacketSize0	1	08	Endpoint zero Size = 8 bytes.
8	idVendor	2	0D8C	Vendor ID.
10	idProduct	2	0001	Product ID.
12	bcdDevice	2	0010	
14	iManufacturer	1	01	Index of string descriptor describing manufacturer.
15	iProduct	1	02	Index of string descriptor describing product.
16	iSerialNumber	1	00	Index of string descriptor describing the device's serial number.
17	bNumConfigurations	1	01	Configurations number = 1.

### 6.2 Configuration Descriptor

The following information is described in the configuration descriptor.

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	09	Total 9 Bytes.
1	bDescriptorType	1	02	Configuration Descriptor.
2	wTotalLength	2	006e	Total length of data returned for this configuration: 110 Bytes.
4	bNumInterfaces	1	02	Number of interfaces supported by this Configuration: 0: control interface. 1: ISO-OUT interface.
5	bConfigurationValue	1	01	
6	iConfiguration	1	00	
7	bmAttributes	1	80	bus Power and non support Remote Wakeup.
8	bMaxPower	2	FA	Maximum power consumption of the USB Device: 500mA.

### 6.3 USB audio topology diagram



**Figure 5 : Topology Diagram**

## 7. ELECTRICAL CHARACTERISTICS

### 7.1 Absolute maximum rating

Symbol	Parameter	Value	Unit
Dvmin	Min digital supply voltage	- 0.3	V
Dvmax	Max digital supply voltage	+ 6	V
Avmin	Min analog supply voltage	- 0.3	V
Avmax	Max analog supply voltage	+ 6	V
Dvinout	Voltage on any digital input or output pin	-0.3 to +5.5	V
Avinout	Voltage on any analog input or output pin	-0.3 to +5.5	V
Tstg	Storage temperature range	-40 to +125	
ESD (HBM)	ESD human body mode	3500	V
ESD (MM)	ESD machine mode	200	V

### 7.2 Operation conditions

Parameter	Min	Typ	Max	Unit
Analog supply voltage	4.5	5.0	5.5	V
Digital supply voltage	4.5	5.0	5.5	V
Total power consumption	-	-	50	mA
Operating ambient temperature	0	-	70	

### 7.3 Electrical Parameters

Parameter	Min	Typ	Max	Unit
<b>VR Input</b>				
Resolution	-	5	-	bit
Input range	0	-	2.25	V
<b>Clock</b>				
Clock input frequency	11.994	12	12.006	MHz
PLL1 output frequency	-	48	-	MHz
PLL2 output frequency	-	12.288	-	MHz
<b>Amplification</b>				
Volume control level	-33	-	+6	dB
Volume control step <sub>(1)</sub>	-	37	-	Steps

Note: 1) with an additional mute step



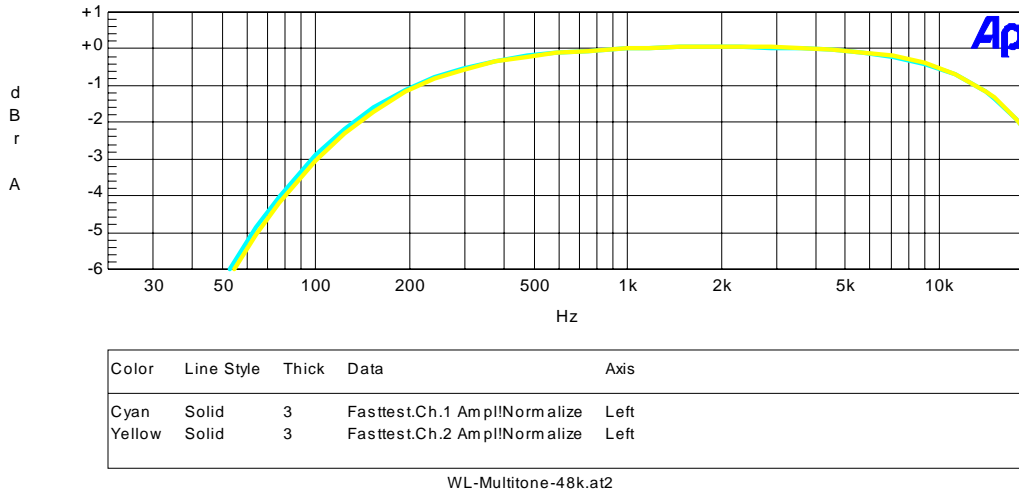
**7.4 Audio Performance**

Parameter	Min	Typ	Max	Unit
<b>DAC</b>				
Resolution	-	16	-	bits
THD + N (-3dBr)	-66	-	-	dB
SNR	82.1	-	-	dB
Silent SNR	90.5	-	-	dB
Dynamic range	82.7	-	-	dB
Frequency response	20	-	20K	Hz
Output voltage (rms)	-	1.1	-	Vrms
Output voltage swing	0.7	-	3.8	V
<b>Power amplifier</b>				
Power supply	4.5	5.0	5.5	V
THD + N (-3dBr)	-53.5	-	-	dB
SNR	82	-	-	dB
Silent SNR	103	-	-	dB
Dynamic range	83.4	-	-	dB
Output voltage (rms)	-	1.34	-	Vrms
Output voltage swing	-	-	4.50 Vpp	V
Maximum output power per channel (RMS value, 4 ohm load)	0.308	-	0.427	W
Maximum output power per channel (RMS value, 6 ohm load)	0.291	-	0.368	W
Maximum output power per channel (RMS value, 8 ohm load)	0.248	-	0.316	W

## 8. FREQUENCY RESPONSE GRAPHS

### 8.1 Line Output Series Capacitors : 220 $\mu$ F

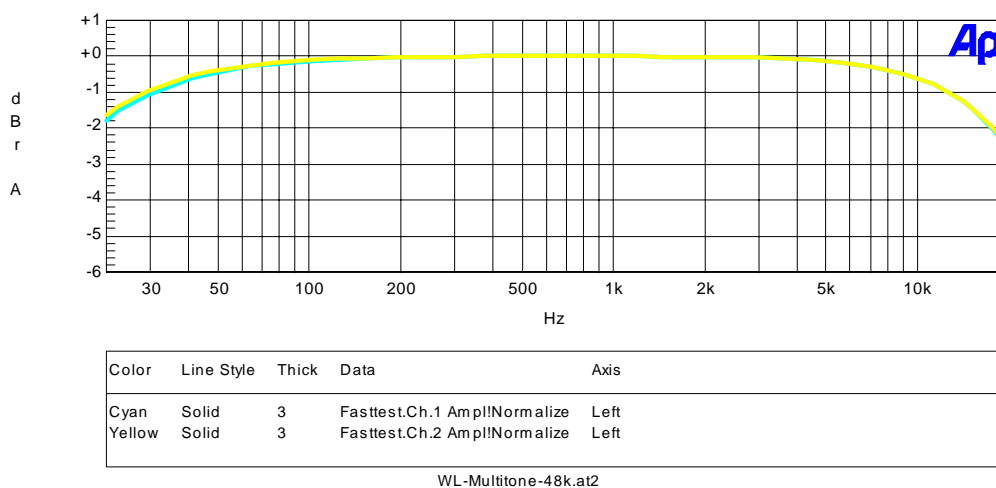
C-media Digital Playback (PC-D-A) for Line Output Frequency Response 01/29/01 18:06:34



**Figure 6 : Frequency Response of CM102-A/S with 220 $\mu$ F Series Capacitor**

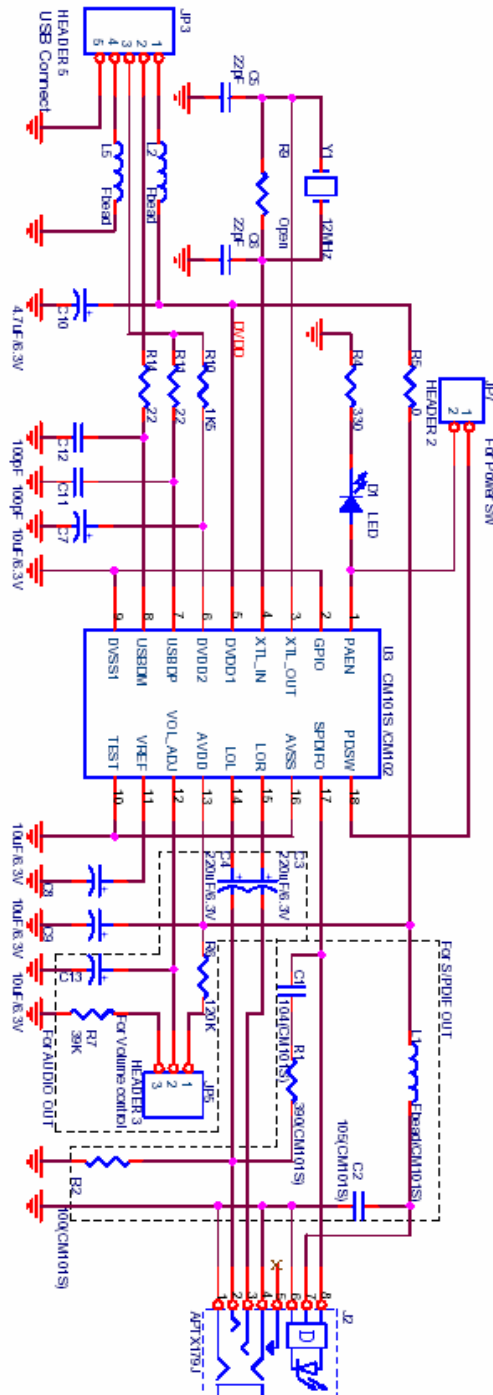
### 8.2 Line Output Series Capacitors : 1000 $\mu$ F

C-Media Digital Playback (PC-D-A) for Line Output Frequency Response 01/29/01 18:16:17



**Figure 7 : Frequency Response of CM102-A/S with 1000 $\mu$ F Series Capacitor**

**9. APPLICATION CIRCUIT REFERENCE**



**Figure 8 : Application Circuit of CM102-A/S Rev 1.6**

## **10. REFERENCE**

USB-IF, USB Specification, Revision 1.1 and 2.0, and USB Audio Device Class Specification, Revision 1.0,.

**- End of Specifications -**

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