# CM102-A+/102S+
# USB 2CH Audio Controller for Speaker

# Datasheet

## Version 1.01

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**Date: 09/25/2005**
**Version: 1.01**

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# 1. DESCRIPTIONS AND OVERVIEW

CM102-A+/102S+ series is a highly integrated single chip for USB stereo speakers application. Minimum external components are needed for building an USB speaker system, which makes CM102-A+/102S+ a simple and very cost-effective solution. Since no driver is necessary for audio playback on all major OS. CM102-A+/102S+ 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+/102S+. With power amplifier enable pin and volume control VR input pin, a traditional speaker front panel design can be built. This new single chip not only support 44.1KHz and 48KHz sampling rate playback but also with X2 modulation for hi-frequency quality. Better yet, simplify anti-pop noise solution was embedded on chip for general pop noise issues. All of the functions have been approved by USB IF certification program. More flexible and customized design is possible with GPIO pin, which is accessible by USB vendor specific request.

This one chip solution not only embedded USB transceiver, ADC, DAC component but also integrated digital control power amplifier function for USB digital sound application. The Dynamic Range Control function can support high efficiency volume output to get loudness sound effect similar D class amplifier capability. Vender can just using single chip to saving external amplifier component and getting a better listen experience when listen to a music source with wide dynamic range.

Moreover, customers can use C-Media USB Audio Driver with Xear 3D functions to show up digital speaker features and upgrade PC multi-media stereo function to be a CE like devices. Xear 3D can support 10 band Equalizer, EnvironmentFX sound effects and virtual 7.1CH speaker shifter. This driver is optional for free bundle.

**Best USB Audio Chip for Digital Stereo Speakers Solution**

# 2. FEATURES

- USB 2.0 Full Speed Compatible and USB IF Certification

- USB audio device class specification v1.0 Compatible

- USB bus powered 500mA operation with suspend mode support

- USB audio function topology has 1 input terminal, 1 output terminal, and 1 feature unit

- Embedded high performance 16 bit stereo audio DAC

- Embedded Digital Control Power Amplifier for Speaker Driving

- Embedded power on reset block and Power amplifier enable / disable control pin

- Embedded X2 Modulation for Higher Audio Quality

- Embedded Anti-Pop Circuit with Internal Feedback Structure

- Embedded 5V to 3.3V Regulator with Voltage Level Detector for Single 5V External Power Supply

- Alternate zero bandwidth setting for releasing bandwidth on USB bus during inactive operation

- Single 12MHz crystal input with on-chip PLL and embedded USB transceiver

- Support Dynamic Range Control (DRC) Feature to Provide a Better Listen Experience

- Volume control input with simple external VR circuit

- Isochroous transfer using adaptive synchronization with internal PLL

- High performance 16-Bit Stereo, 48 / 44.1 KHz Sampling Rate for Audio Playback

- 3.3V IO with 5V tolerance; 3.3V core logics design

- GPIO pin for application specific usage

- Support S/PDIF output interface

- LED Indicator Pin During Playback

- Compatible with Win 98SE / Win ME / Win 2000 / Win XP, and Mac OS 9 / OS X without additional driver

- USB Software Drive Xear 3D Sound Technology With HRTF 3D, EAX$^{TM}$, Speaker Shifter and Virtual 7.1CH effects for free bundle

- Compact 18 pin PDIP and SOP package

# 3. PIN/SIGNAL DESCRIPTIONS

## 3.1 PIN ASSIGNMENT BY PIN NUMBER

| Pin # | Signal Name | Pin # | Signal Name |
|-------|-------------|-------|-------------|
| 1 | PAEN | 10 | TEST |
| 2 | GPIO | 11 | VREF |
| 3 | XO | 12 | VOLADJ |
| 4 | XI | 13 | AVDD |
| 5 | DVDD5V | 14 | LOL |
| 6 | REGV | 15 | LOR |
| 7 | USBDP | 16 | AVSS |
| 8 | USBDM | 17 | SPDIFO |
| 9 | DVSS | 18 | PDSW |

## 3.2 PIN-OUT DIAGRAM
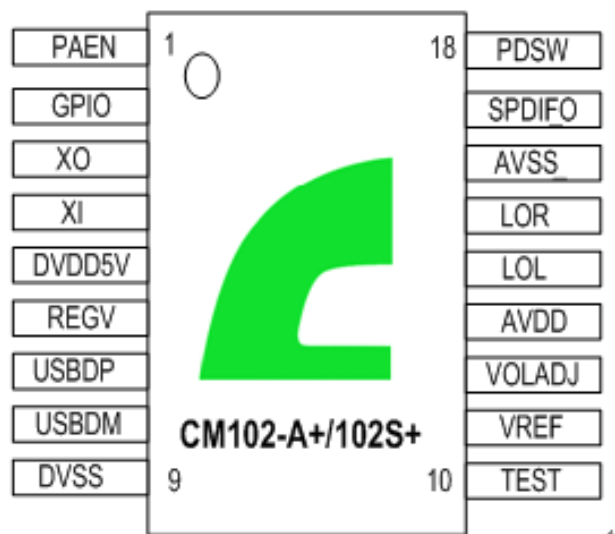
## 3.3 PIN SIGNAL DESCRIPTIONS

| Pin # | Symbol | Type | Description |
|-------|--------|------|-------------|
| 1 | PAEN | DI, ST | Power Amplifier Control Input, Connect to a Switch or Pull-High in Normal Operation.<br>H: Enable Power Amplifier (Normal Mode)<br>L: Disable Power Amplifier |
| 2 | GPIO | DIO, 8mA, ST, SR, PD | GPIO Pin, Controlled via Vender Specific Command |
| 3 | XO | AO | Output Pin for 12MHz Oscillator |
| 4 | XI | AI | Input Pin for 12MHz Oscillator |
| 5 | DVDD5V | P | 5V Power Supply |
| 6 | REGV | AO | Regulator output 3.3v |
| 7 | USBDP | AIO | USB Data D+ |
| 8 | USBDM | AIO | USB Data D- |
| 9 | DVSS | P | Digital Ground |
| 10 | TEST | DI, ST, PD | Test Mode Select Pin, Pull-Down in normal Operation |
| 11 | VREF | AO | Connecting to External Decoupling Capacitor for Embedded Bandgap Circuit; 2.25V Output |
| 12 | VOLADJ | AI | Analog Volume Control Input from external VR circuit.<br>0 ~ 2.25V:    +12 dB ~ 3 dB / mute<br>3.5 ~ 5V:    0 dB |
| 13 | AVDD | P | 5V Power Supply for Analog Circuit |
| 14 | LOL | AO | Line Out Left Channel |
| 15 | LOR | AO | Line Out Right Channel |

| 16 | AVSS | P | Analog Ground |
|----|------|---|---------------|
| 17 | SPDIFO | DO, 8mA, SR | S/PDIF Data Output |
| 18 | PDSW | DO, 8mA, SR | Power Down Switch Control Signal Output<br><br>1: Normal Mode<br><br>0: Power Down Mode (Suspend Mode) |

*Note: **DI / DO / DIO** – Digital Input / Output / Bi-Directional Pad

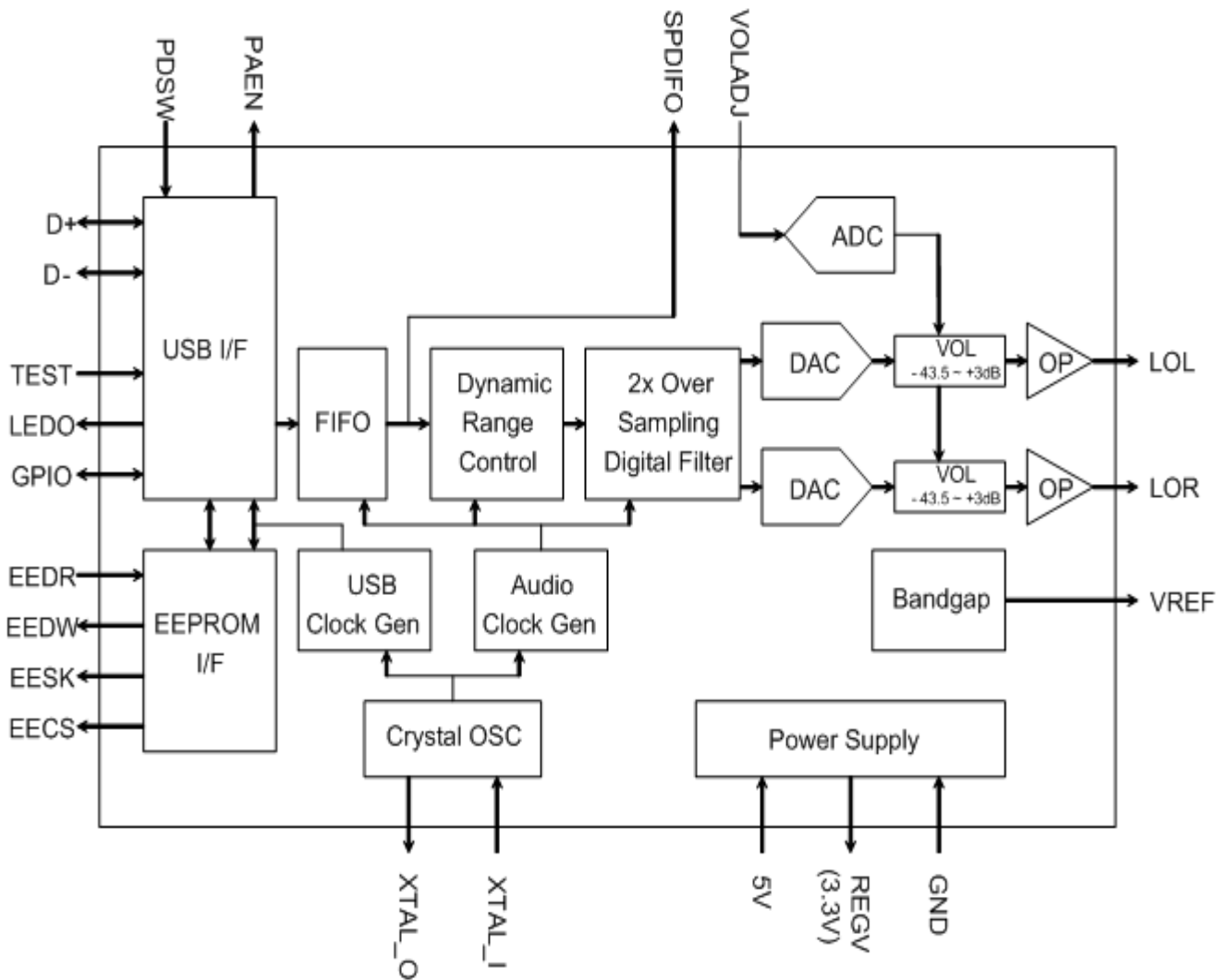**AI / AO / AIO** – Analog Input / Output / Bi-Directional Pad

**P** – Power Pin

**SR** – Slew Rate Control

**ST** – Schmitt Trigger

**PD / PU** – Pull Down / Pull Up
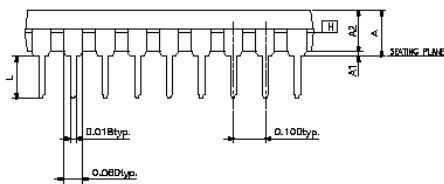
**5VT** – 5 Volt Tolerant (3.3V Pad)

## 4. BLOCK DIAGRAM



**Block Diagram Of CM102-A+/102S+**

# 5. ORDERING INFORMATION

| Model Number | Package | Operating Ambient Temperature | Supply Range |
|---|---|---|---|
| CM102-A+/102S+ | 18-Pin PDIP | 0 o C to +70 o C | DVdd = 5V, AVdd = 5V |
| | 18-Pin SOP | 0 o C to +70 o C | DVdd = 5V, AVdd = 5V |

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

◆**18- Plastic dual-in-line packaging (PDIP)**
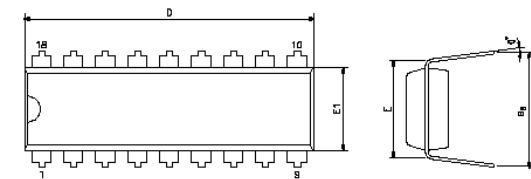
| SYMBOLS | MIN. | NOR. | MAX. |
|---|---|---|---|
| A | – | – | 0.210 |
| A1 | 0.015 | – | – |
| A2 | 0.125 | 0.130 | 0.135 |
| D | 0.880 | 0.900 | 0.920 |
| E | | 0.300  BSC. | |
| E1 | 0.245 | 0.250 | 0.255 |
| L | 0.115 | 0.130 | 0.150 |
| $e_B$ | 0.335 | 0.355 | 0.375 |
| $\theta^o$ | 0 | 7 | 15 |

◆**18- Pin SOP**
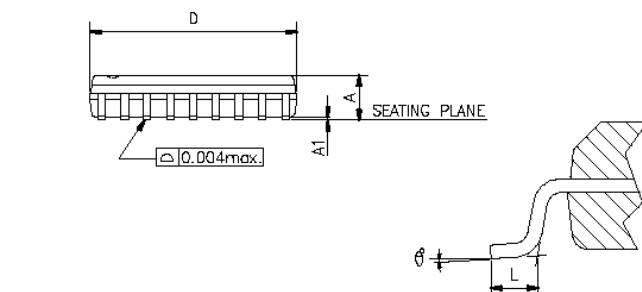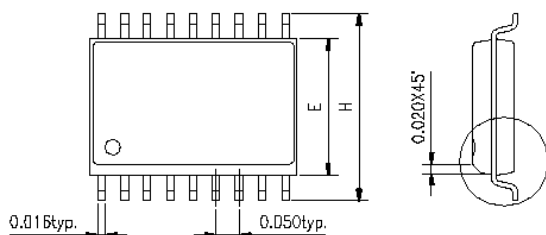
**Mechanical Dimension of CM102-A+**

| 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 |
| $\theta^o$ | 0 | 8 |

**Mechanical Dimension of CM102S+**

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# 6. FUNCTION DESCRIPTIONS

## 6.1 USB INTERFACE

### 6.1.1 DEVICE DESCRIPTOR

| Offset | Field | Size | Value (Hex) | Description |
|--------|-------|------|-------------|-------------|
| 0 | bLength | 1 | 12 | Total 18 Bytes |
| 1 | bDescriptorType | 1 | 01 | Device Descriptor |
| 2 | bcdUSB | 2 | 0110 | USB 1.1 compliant. |
| 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 | 0103 | Product ID |
| 12 | bcdDevice | 2 | 0010 | Device Release Number |
| 14 | iManufacturer | 1 | 01 | Index of string descriptor describing manufacturer -> "*C-Media INC.*" |
| 15 | iProduct | 1 | 02 | Index of string descriptor describing product -> "*C-Media USB Audio*       " |
| 16 | iSerialNumber | 1 | 00 | Index of string descriptor describing the device's serial number |
| 17 | bNumConfigurations | 1 | 01 | Configurations number = 1 |

### 6.1.2 CONFIGURATION DESCRIPTOR

| Offset | Field | Size | Value (Hex) | Description |
|--------|-------|------|-------------|-------------|
| 0 | bLength | 1 | 09 | Total 9 Bytes |
| 1 | bDescriptorType | 1 | 02 | Configuration Descriptor |
| 2 | wTotalLength | 2 | 008D | Total length of data returned for this configuration. |
| 4 | bNumInterfaces | 1 | 03 | Number of interfaces supported by this Configuration. |
| 5 | bConfigurationValue | 1 | 01 | |
| 6 | iConfiguration | 1 | 00 | |
| 7 | bmAttributes | 1 | 80 | Self-powered without Remote Wakeup |
| 8 | bMaxPower | 2 | FA | Maximum power consumption of the USB. 0xFA=500 mA |

### 6.1.3 USB AUDIO TOPOLOGY DIAGRAM



USB streaming      Feature Unit       Speaker
ID = 01            (Volume) (Mute)    ID = 03
                   ID = 0D
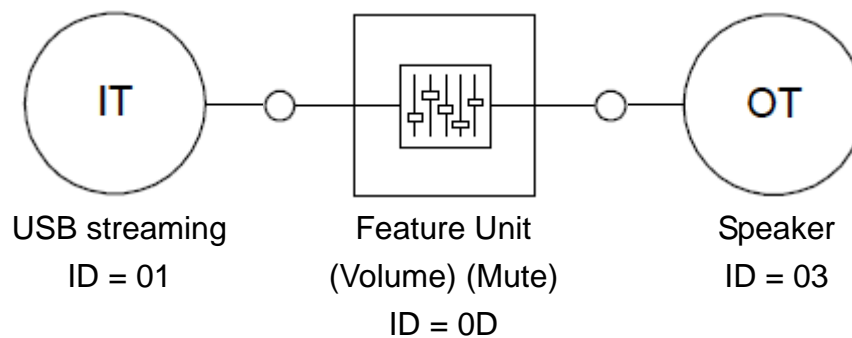
## 6.2 DYNAMIC RANGE CONTROL (DRC)

CM102-A+/102S+ include a new feature called Dynamic Range Control (DRC), and with a default ON setting (Users can still turn it off within the Windows audio advance control panel)

Dynamic range is defined as the difference, in decibels (dB), between the loudest and quietest sounds in any particular piece of audio content. Classical music is a good example, with ranges from piano (soft) to forte to FFF (for extremely loud). Movies also typically have a wide dynamic range, which may cause you to have to turn the volume up and down as scenes change. For example, when watching a movie at home, you may be forced to turn up volume to hear the dialog in a quiet scene, and then quickly turn it down again during a car chase scene that follows. In this way, there may be times in a home theater environment when it would be useful to be able to control the dynamic range.
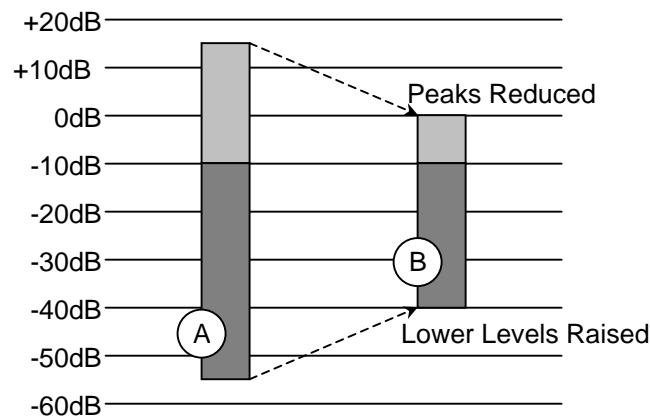


With Dynamic Range Control enabled, the full dynamic range (A) of the program is reduced (B).
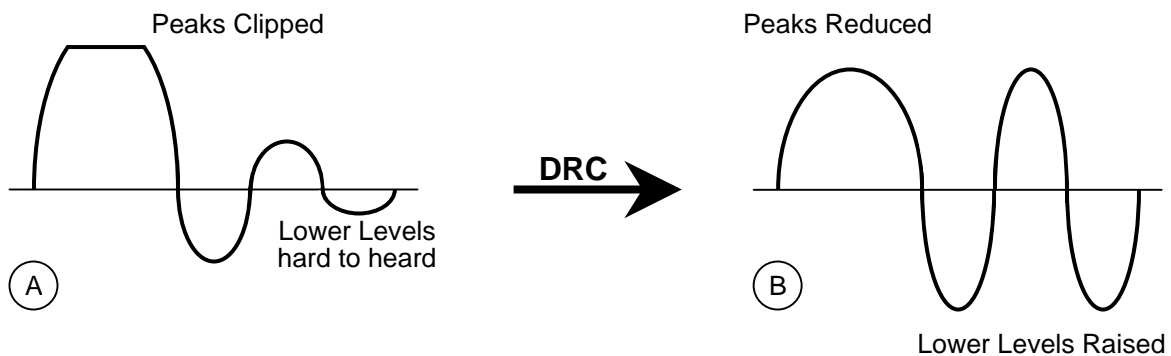
# 7. ELECTRICAL CHARACTERISTICS

## 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 |
| $T_{stg}$ | Storage Temperature Range | -40 to +125 | $^0C$ |
| ESD (HBM) | ESD Human Body Mode | 2000 | V |
| ESD (MM) | ESD Machine Mode | 200 | V |
| Latchup | Latch Up Test | 200 | mA |

## 7.2 OPERATION CONDITIONS

| | 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 | - | - | 500 | mA |
| Suspend Mode Power Consumption | - | - | 320 | uA |
| Operating ambient temperature | 0 | - | 70 | $^oC$ |

## 7.3 SPERKER IMPEDANCE VS. OUTPUT POWER (PER CHANNEL)

| Loading (Ohm) Items | 4 Ohm | 8 Ohm | 32 Ohm | 10K Ohm |
|---|---|---|---|---|
| Vpp | 3.14 | 3.4 | 3.635 | 3.722 |
| Vrms | 1.11 | 1.202 | 1.285 | 1.316 |
| W(rms/sin wave) | 308 mW | 181 mW | 52 mW | 0.17 mW |
| W(rms/square wave) | 616 mW | 361 mW | 103 mW | 0.35 mW |
| W(PMPO) | 2460 mW | 1450 mW | 410 mW | 1 mW |

**\*Note1:** Test Condition @ 25$^o$C, 5 Volt +- 10%

**\*Note2:** Typical Output with THD+N < 1%; Maximal Output with THD+N < 10%

## 7.4 AUDIO PERFORMANCE

| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Resolution | -- | 16 | -- | Bits |
| Frequency response @ 48KHz | 20 | -- | 20K | Hz |
| Frequency Response @ 44.1KHz | 20 | -- | 20K | Hz |
| Passband Ripple @ 48 KHz | 40 | -- | 9.6K | Hz |
| Passband Ripple @ 44.1 KHz | 40 | -- | 8.8K | Hz |
| DAC (10K Ohm Loading) | | | | |
| SNR | -- | 97.75 | -- | dB |
| Dynamic Range | -- | 96.27 | -- | dB |
| THD + N | -- | -67.97 | -- | dB |
| Output Voltage (rms) | - | 1.316 | - | Vrms |

| DAC (32 Ohm Loading) | | | | |
|---|---|---|---|---|
| SNR | -- | 97.68 | -- | dB |
| Dynamic Range | -- | 95.99 | -- | dB |
| THD + N | -- | -57.82 | -- | dB |
| Output Voltage (rms) | - | 1.285 | - | Vrms |
| DAC (8 Ohm Loading) | | | | |
| SNR | -- | 97.67 | -- | dB |
| Dynamic Range | -- | 96.03 | -- | dB |
| THD + N | -- | -53.28 | -- | dB |
| Output Voltage (rms) | - | 1.202 | - | Vrms |
| DAC (4 Ohm Loading) | | | | |
| SNR | -- | 97.45 | -- | dB |
| Dynamic Range | -- | 95.89 | -- | dB |
| THD + N | -- | -52.76 | -- | dB |
| Output Voltage (rms) | - | 1.11 | - | Vrms |

# 8. AUDIO PERFORMANCE CURVES

## 8.1 FREQUENCY RESPONSE (10K OHM LOADING)

### 8.1.1 FREQUENCY RESPONSE @ 44.1 KS/SEC

C-MEDIA    Digital Playback (PC-D-A) for Line Output Frequency    05/31/05 14:10:33
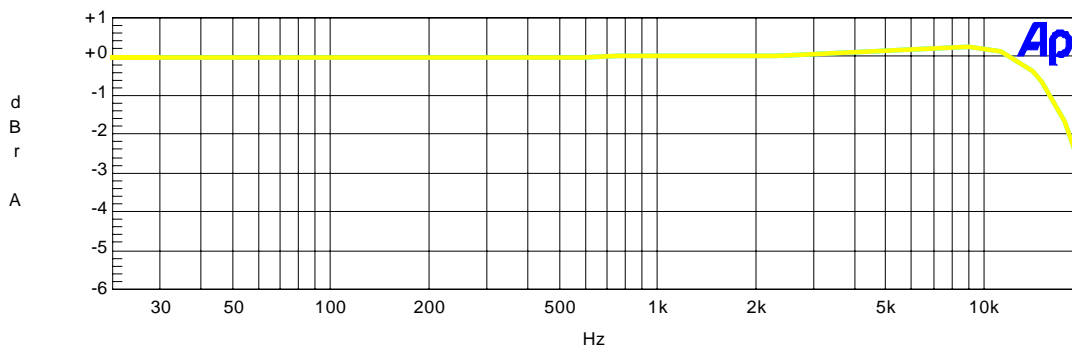Response
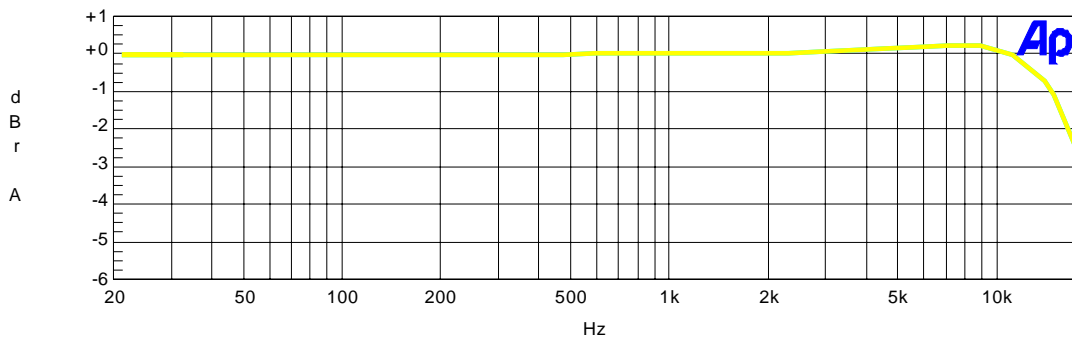


| Sweep | Trace | Color | Line Style | Thick | Data | Axis | Comment |
|---|---|---|---|---|---|---|---|
| 1 | 1 | Cyan | Solid | 3 | Fasttest.Ch.1 Ampl!Normalize | Left | |
| 1 | 2 | Yellow | Solid | 3 | Fasttest.Ch.2 Ampl!Normalize | Left | |

WL-Multitone-44k.at2c

### 8.1.2 FREQUENCY RESPONSE @ 48 ks/sec

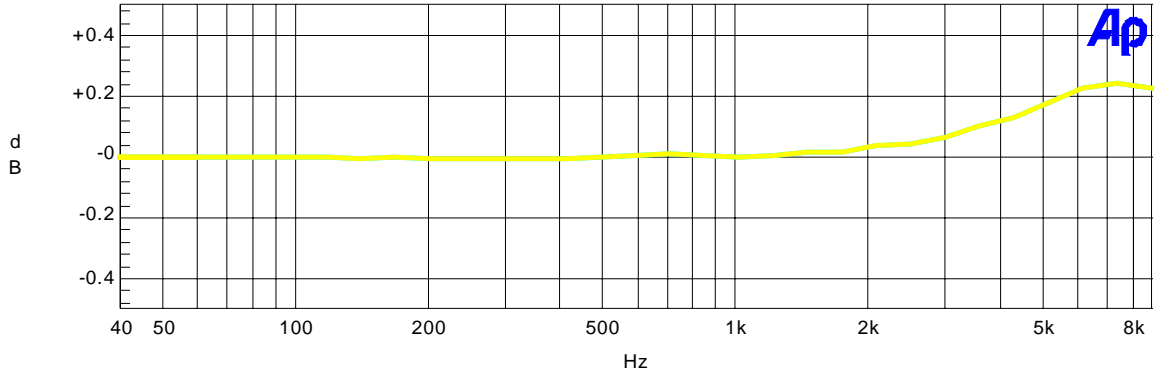C-MEDIA    Digital Playback (PC-D-A) for Line Output Frequency    05/31/05 14:07:22
Response



| Sweep | Trace | Color | Line Style | Thick | Data | Axis | Comment |
|---|---|---|---|---|---|---|---|
| 1 | 1 | Cyan | Solid | 3 | Fasttest.Ch.1 Ampl!Normalize | Left | |
| 1 | 2 | Yellow | Solid | 3 | Fasttest.Ch.2 Ampl!Normalize | Left | |

WL-Multitone-48k.at2c

## 8.2 PASSBAND RIPPLE (10K OHM LOADING)

### 8.2.1 PASSBAND RIPPLE @ 44.1 ks/sec

C-MEDIA    Digital Playback (PC-D-A) for Line Output Passband    05/31/05 14:11:07
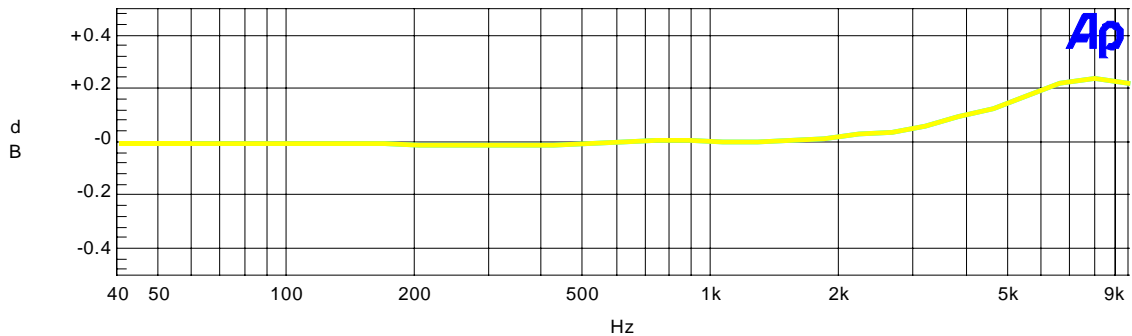Ripple @44.1ks/sec

| Sweep | Trace | Color | Line Style | Thick | Data | Axis | Comment |
|-------|-------|-------|-----------|-------|------|------|---------|
| 1 | 1 | Cyan | Solid | 3 | Fasttest.Ch.1 Ampl!Normalize | Left | |
| 1 | 2 | Yellow | Solid | 3 | Fasttest.Ch.2 Ampl!Normalize | Left | |

WL-PassbandRipple-M44k.at2c

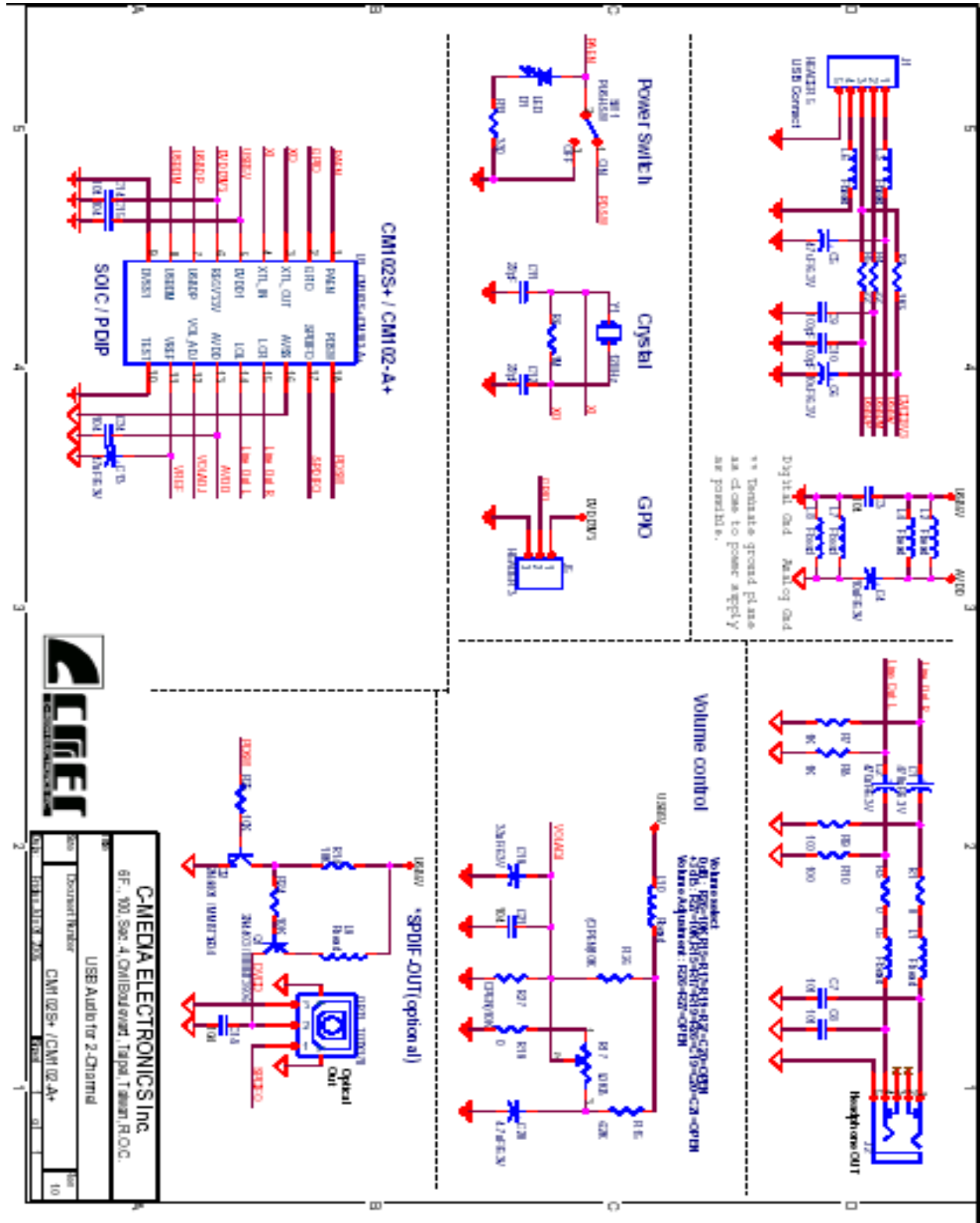### 8.2.2 PASSBAND RIPPLE @ 48 ks/sec

C-MEDIA    Digital Playback (PC-D-A) for Line Output Passband    05/31/05 14:09:08
Ripple @48ks/sec

| Sweep | Trace | Color | Line Style | Thick | Data | Axis | Comment |
|-------|-------|-------|-----------|-------|------|------|---------|
| 1 | 1 | Cyan | Solid | 3 | Fasttest.Ch.1 Ampl!Normalize | Left | |
| 1 | 2 | Yellow | Solid | 3 | Fasttest.Ch.2 Ampl!Normalize | Left | |

WL-PassbandRipple-M48k.at2c

# 9. REFERENCE APPLICATION CIRCUIT

## 10. REFERENCE

- Universal Serial Bus Specification, Version 2.0

- Universal Serial Bus Device Class Definition for Audio Devices, Version 1.0.

- Universal Serial Bus Device Class Definition for Human Interface Devices (HID), Version 1.11

－**End of Specifications**－

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