Best USB Audio Single Chip for PC Entertainment

CM101S+
USB 2CH Audio Controller
(Dolby Digital Live Software Technology Bundle)

Datasheet
Version 1.01

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1. DESCRIPTIONS AND OVERVIEW

CM101S+ is the world first USB audio chip that with Dolby Digital Live sounds technology supporting. This new chip design can provided more efficiency features and high quality sound for portable USB audio products application. It is a highly integrated single chip for USB stereo audio and SPDIF output application. Minimum external components are needed for building an USB audio system, which makes CM101S+ a simple and very cost-effective solution.

CM101S+ is design for all kind of PC base USB personal multi-media device products. It is USB 2.0 full speed compatible and utilizes USB bus power for plug-and-play feature. Via C-Media Xear 3D Sound USB audio driver, users can avail themselves of a much better virtual 7.1 CH environment capable. For high-end multi-media application, this light and portable personal audio device can easy to processing any sound source to Dolby Digital AC-3 raw data by real-time encoding function. The world first innovation software function to grade up every PC system and output high quality digital sound effects for link up with high-end home theater equipments like amplifier, DVD player or decoder etc.

This special feature is Dolby Digital Live function modules. As we know, Dolby Digital is the world well-known sound technology brand and generality using on consumer electronics. Therefore, if PC products need to be home theater equipment or media center this would be key feature and selling point for product development. These functions not only provide easy bridge to connect PCs and consumer electronics but also adding value and upgrade sound quality to PC products. In the future, PCs can put on Dolby logo on it and provide advanced sound quality to end-user. All of modules were implemented by C-Media in software technology and anyone can request these features by license from Dolby Lab. through C-Media.

The world smallest devices for Dolby Digital Live content encoding application.

2. FEATURES

- USB 2.0 Full Speed Compatible and USB IF Certification
- USB audio device class specification v1.0 Compatible

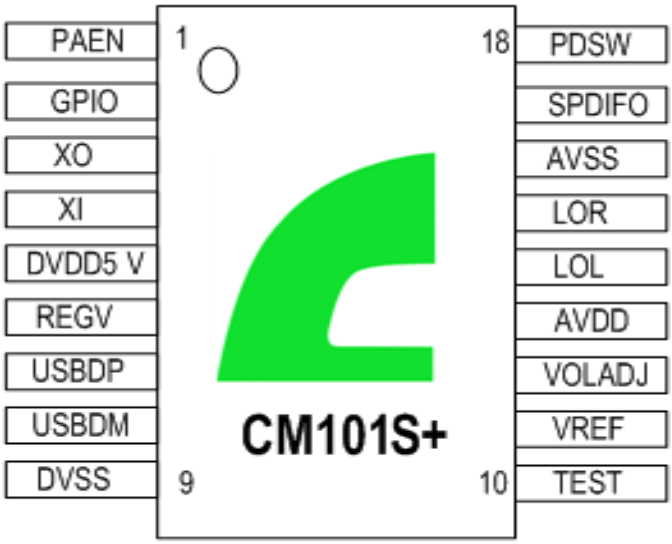
- USB bus powered 500mA operation with suspend mode support
- Single 12MHz crystal input with on-chip PLL and embedded USB transceiver
- USB audio function topology has 1 input terminal, 1 output terminal, and 1 feature unit
- Alternate zero bandwidth setting for releasing bandwidth on USB bus during inactive operation
- Isochroous transfer using adaptive synchronization with internal PLL
- High performance 16-Bit Stereo, 48 / 44.1 KHz Sampling Rate for Audio Playback
- Embedded high performance 16 bit stereo audio DAC
- Embedded Digital Control Power Amplifier for Speaker Driving
- SPDIF Output Interface
- Support Dynamic Range Control (DRC) Feature to Provide a Better Listen Experience
- Embedded X2 Modulation for Higher Audio Quality
- Embedded Anti-Pop Circuit with Internal Feedback Structure
- Volume control input with simple external VR circuit
- GPIO pin for application specific usage
- Support Power Amplifier Enable / Disable Control Pin
- Embedded Power-On-Reset Block
- LED Indicator Pin During Playback
- Embedded 5V to 3.3V Regulator with Voltage Level Detector for Single 5V External Power Supply
- 3.3V IO with 5V tolerance; 3.3V core logics design
- Compact 18 pin SOP package
- Dolby Digital Live Software Sound Technology Bundle
- Software Xear 3D Sound Technology With HRTF 3D, EAX^{TM}, Speaker Shifter and Virtual 7.1CH effects
- USB Software Driver Compatible with Win 98SE / Win ME / Win 2000 / Win XP

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

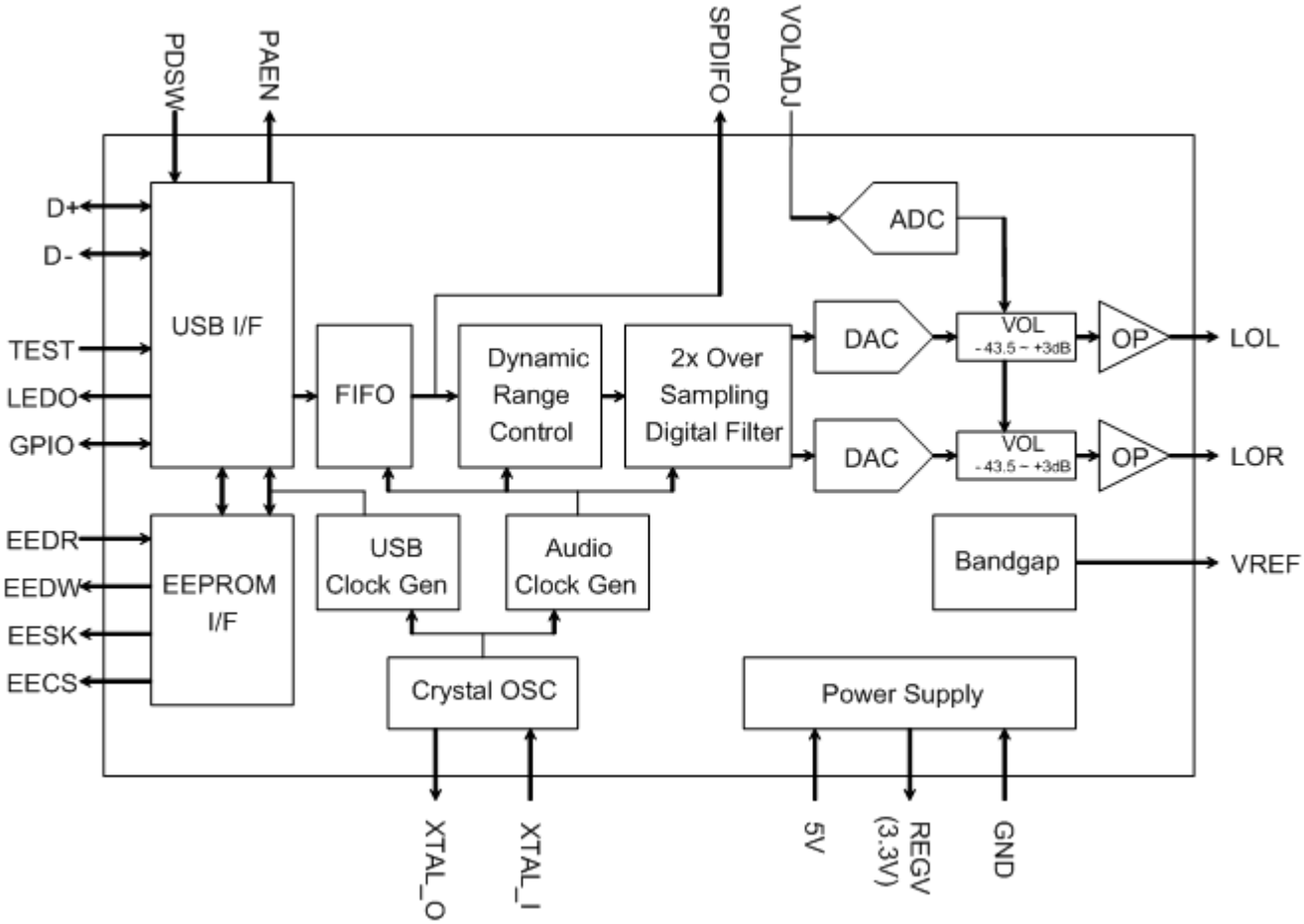


3.3 PIN SIGNAL DESCRIPTIONS

Pin #	Symbol	Type	Description
1	PAEN	DI, ST	Power Amplifier Control Input, Connect to a Switch or Pull-High in Normal Operation. H: Enable Power Amplifier (Normal Mode) 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 Band gap Circuit; 2.25V Output
12	VOLADJ	AI	Analog Volume Control Input from external VR circuit. 0 ~ 2.25V: +12 dB ~ 3 dB / mute 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 1: Normal Mode 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



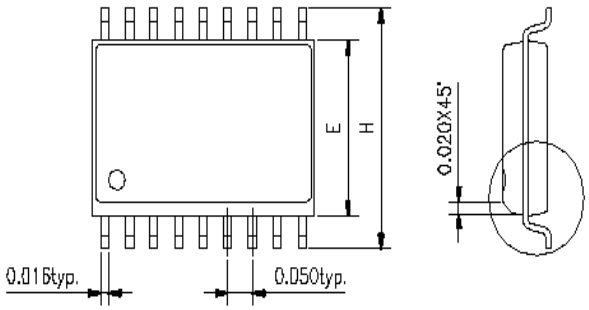
Block Diagram Of CM101S+

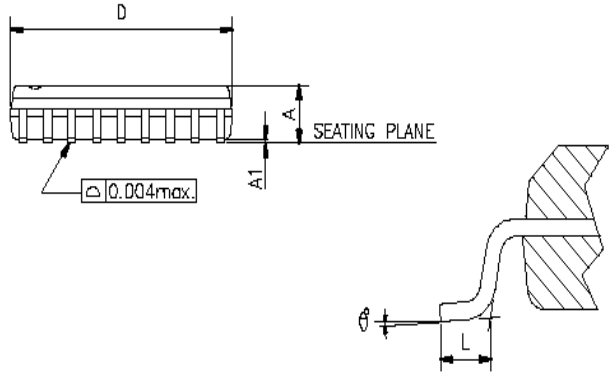
5. ORDERING INFORMATION

Model Number	Package	Operating Ambient Temperature	Supply Range
CM101S+	18-Pin PDIP	0 o C to +70 o C	DVdd = 5V, AVdd = 5V

Outline of Dimensions Dimensions shown in inches and (mm)

◆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

6. FUNCTION DESCRIPTIONS

6.1 USB INTERFACE

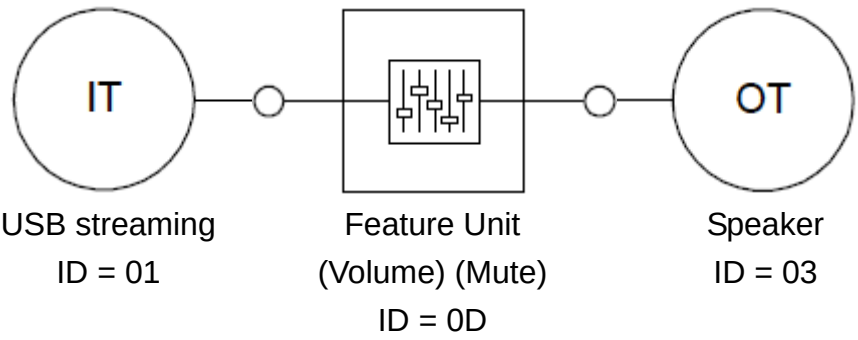
6.1.1 DEVICE DESCRIPTOR

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

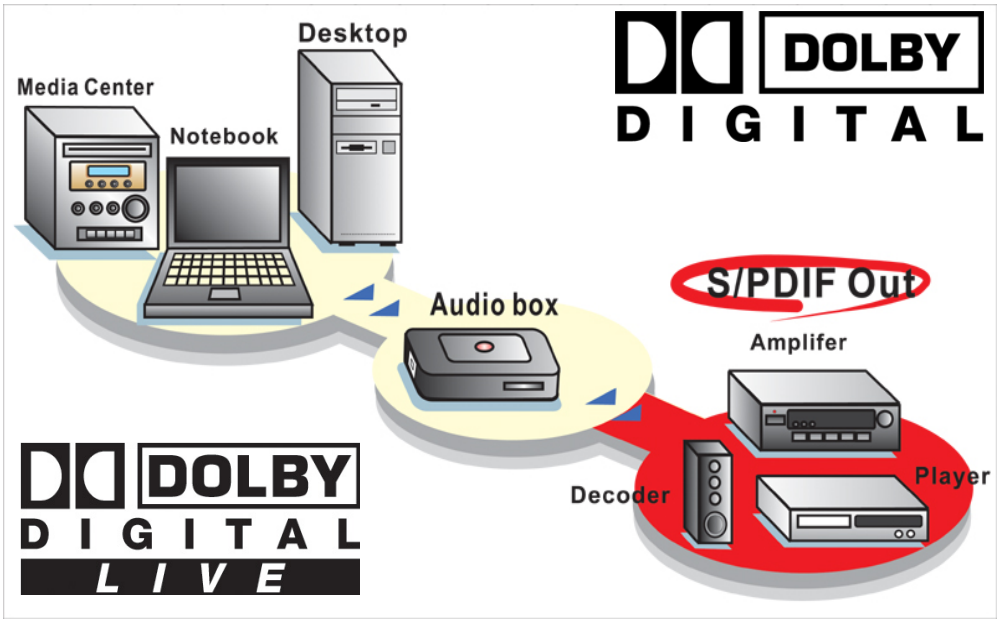
6.1.3 USB AUDIO TOPOLOGY DIAGRAM



6.2 DOLBY DIGITAL LIVE TECHNOLOGY

C-Media Xear 3D™ Sound Solution provides another state-of-the-art high quality audio function--Dolby Digital Live module. With this real-time software AC-3 encoder, the existing and future customers who are using C-Media USB audio solution and devices can obtain this digital quality audio output by S/PDIF format much easier than before. This function can output various 3D and environmental sound effects by high quality AC-3 encoding; in the meantime, it exhibits supreme efficiency—it takes only 7% of CPU consumption from a Pentium 4 Processor.

Better yet, the pure digital signal not only prevents the audio signal from distortion, but also reduces the number of wires connected between PC and a HI-FI audio system. That is to say, this breakthrough real-time AC-3 encoder can digitally transmit data from PC to HI-FI system via a single RCA cable, instead of three pairs in an analog signal case in the past.



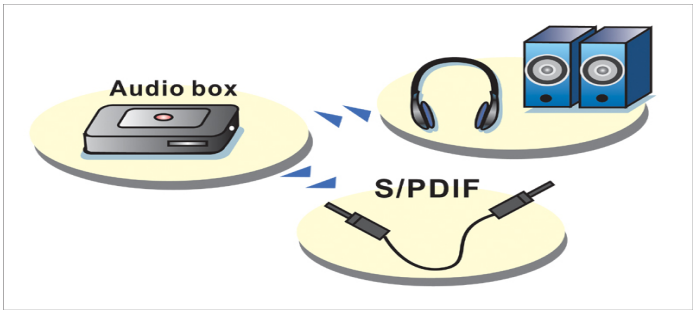
Advantages of this feature：

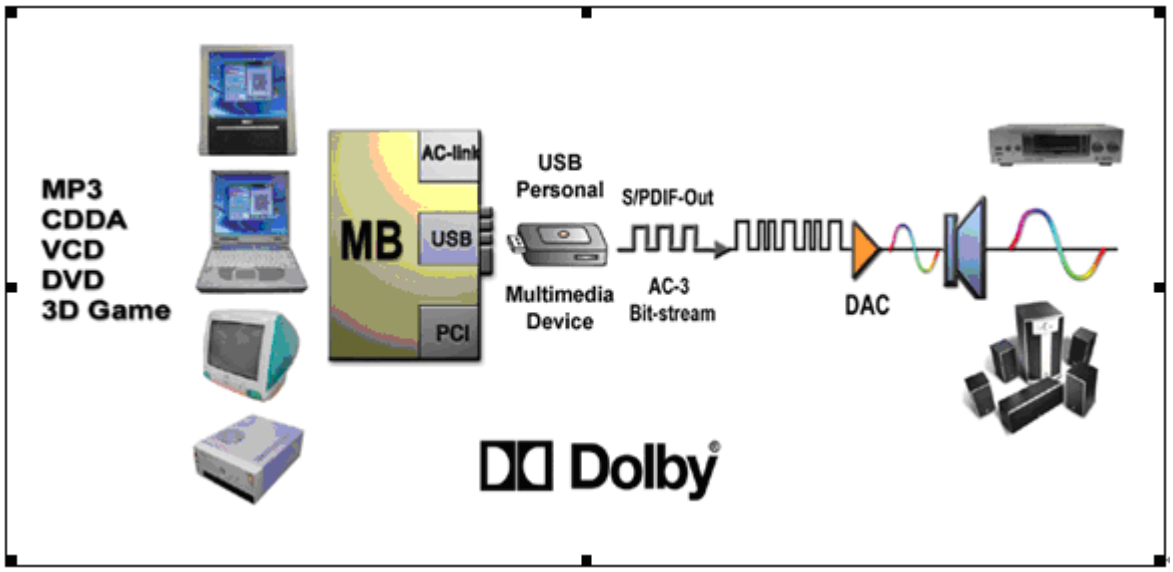
1.Getting higher quality audio signal output compared with any other SPDIF-Out solutions. C-Media Xear 3D™ Plus Dolby Digltal Live encoder sound solution can directly process and transmit any PC sound source to digital AC-3 signal. Digital-transmitted data processed by software driver can absolutely rule out the characteristics influence of DAC quality. Therefore, users are able to get the best sound quality.

2.General PC audio SPDIF-Out solution can only provide 2CH PCM data to external amplifier. If users want to output high quality digital AC-3 bit-stream, they have to rely on software DVD

player, from which only DVD playback is achievable. In that case, it will limit and impair the high quality multi-channel sound enjoyment. C-Media DDL solution not only retains the above functions, but also provides other possible applications on PC audio. Xear 3D™ plus DDL sound solution can process any type of sound sources, and people are able to obtain 7.1CH output by using virtual SPEAKER SHIFTER™ to create optimized personal listening environment.

3. In terms of 3D gaming, C-Media Xear 3D™ sound engine for real-time AC-3 encoder are far better than Window DirectX 3D sound emulator, in that it is powered by sophisticated HRTF (Head Related Transfer Function) library, supporting environmental effects (EAX 1.0 & 2.0 compatible) to create highly immersive 3D gaming experience. All interactive sound effects of 3D game can real-time encoding to AC-3 bit-stream and getting high quality digital signal to external decoder and speakers for enjoyment.

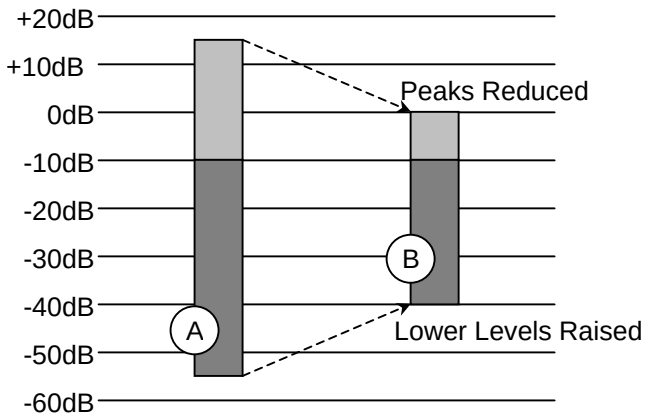




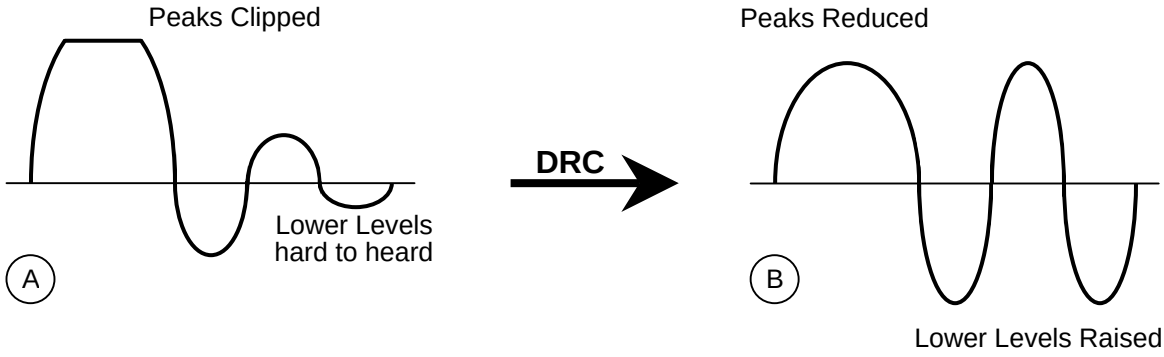
6.3 DYNAMIC RANGE CONTROL (DRC)

CM101S+ 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	^{0}C
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	^{o}C

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°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

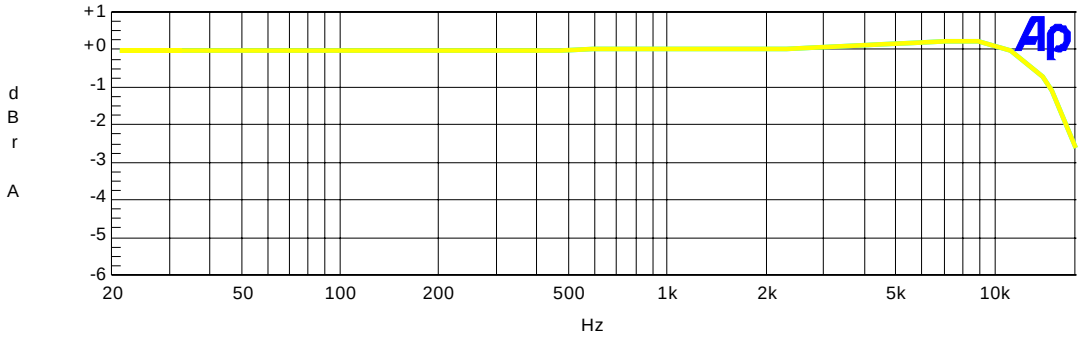
	Min	Typ	Max	Unit
DAC (32 Ohm Loading)				
SNR	--	97.68	--	dB
Dynamic Range	--	95.99	--	dB
THD + N	--	-57.82	--	dB
Output Voltage (rms)	-	1.285	-	Vrms
DAC (8 Ohm Loading)				
SNR	--	97.67	--	dB
Dynamic Range	--	96.03	--	dB
THD + N	--	-53.28	--	dB
Output Voltage (rms)	-	1.202	-	Vrms
DAC (4 Ohm Loading)				
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)

8.1.1FREQUENCY RESPONSE @ 44.1 KS/SEC

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

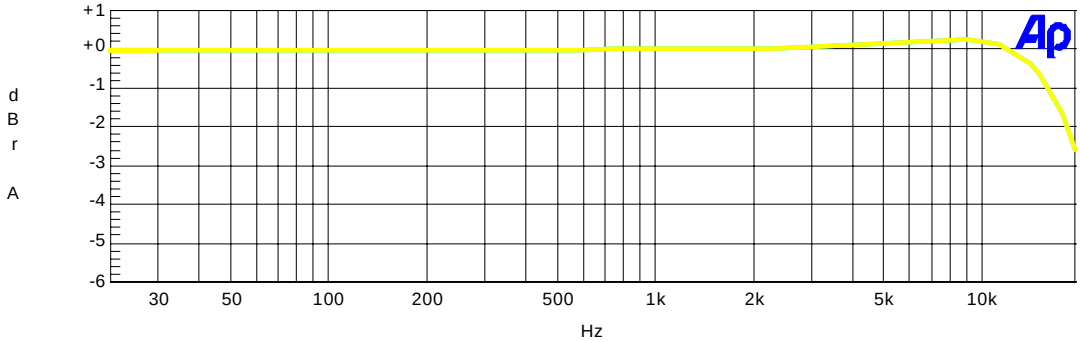


Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Cyan	Solid	3	Fasttest.Ch.1 Ampl!Normalize	Left	
1	2	Yellow	Solid	3	Fasttest.Ch.2 Ampl!Normalize	Left	

WL-Multitone-44k.at2c

8.1.2 FREQUENCY RESPONSE @ 48 ks/sec

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



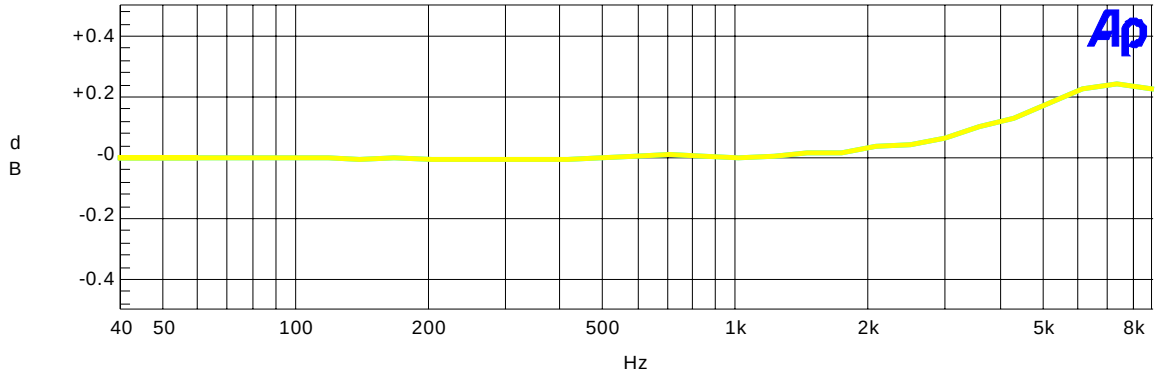
Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Cyan	Solid	3	Fasttest.Ch.1 Ampl!Normalize	Left	
1	2	Yellow	Solid	3	Fasttest.Ch.2 Ampl!Normalize	Left	

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 Ripple @44.1ks/sec 05/31/05 14:11:07

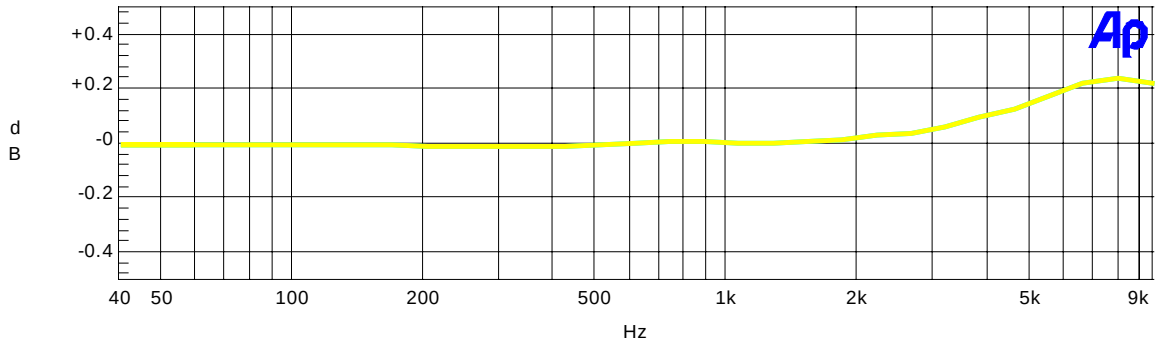


Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Cyan	Solid	3	Fasttest.Ch.1 Ampl!Normalize	Left	
1	2	Yellow	Solid	3	Fasttest.Ch.2 Ampl!Normalize	Left	

WL-PassbandRipple-M44k.at2c

8.2.2 PASSBAND RIPPLE @ 48 ks/sec

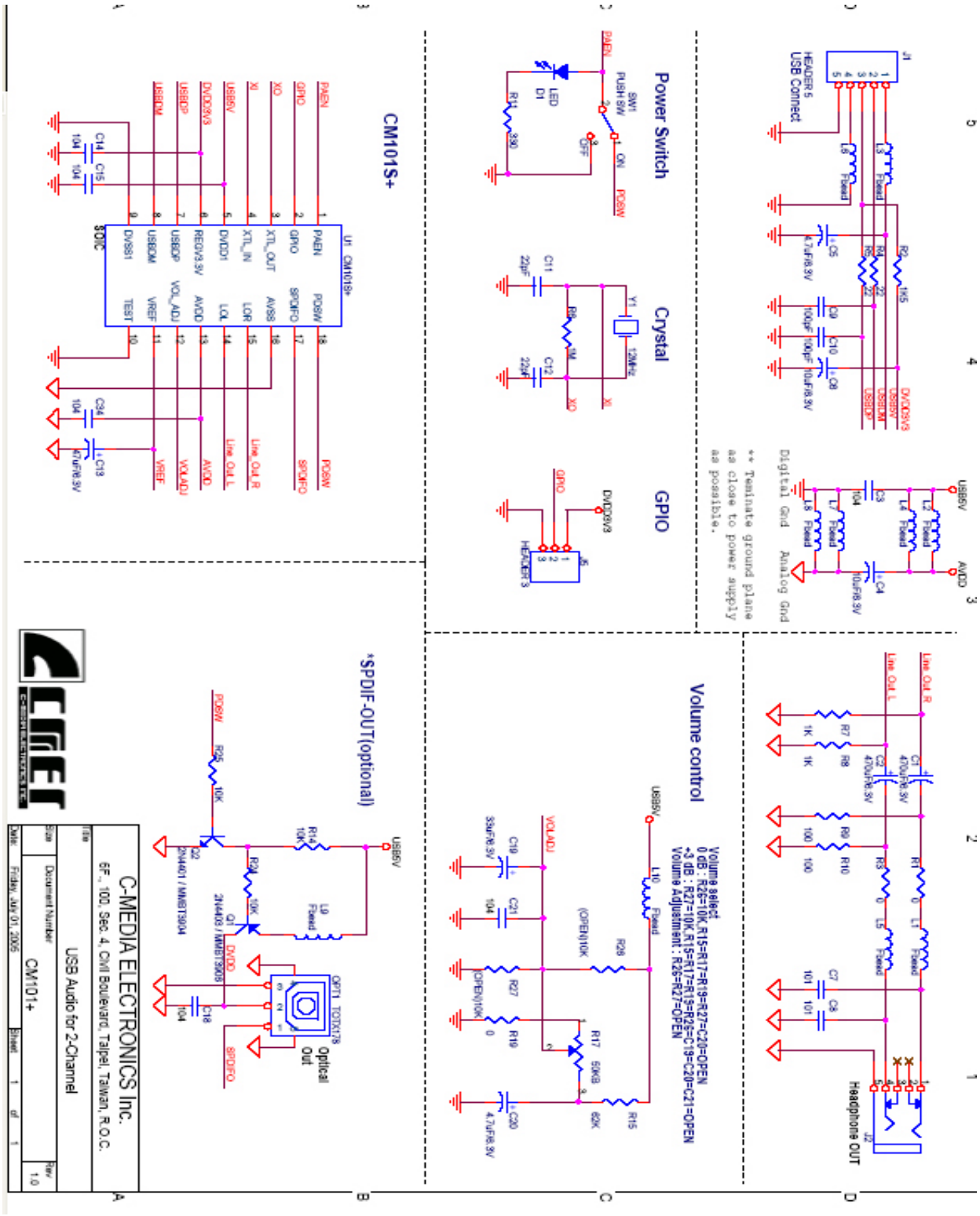
C-MEDIA Digital Playback (PC-D-A) for Line Output Passband Ripple @48ks/sec 05/31/05 14:09:08



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
- Dolby Digital Live function specification.

－End of Specifications－

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