

## A Highly Integrated USB Audio Single Chip

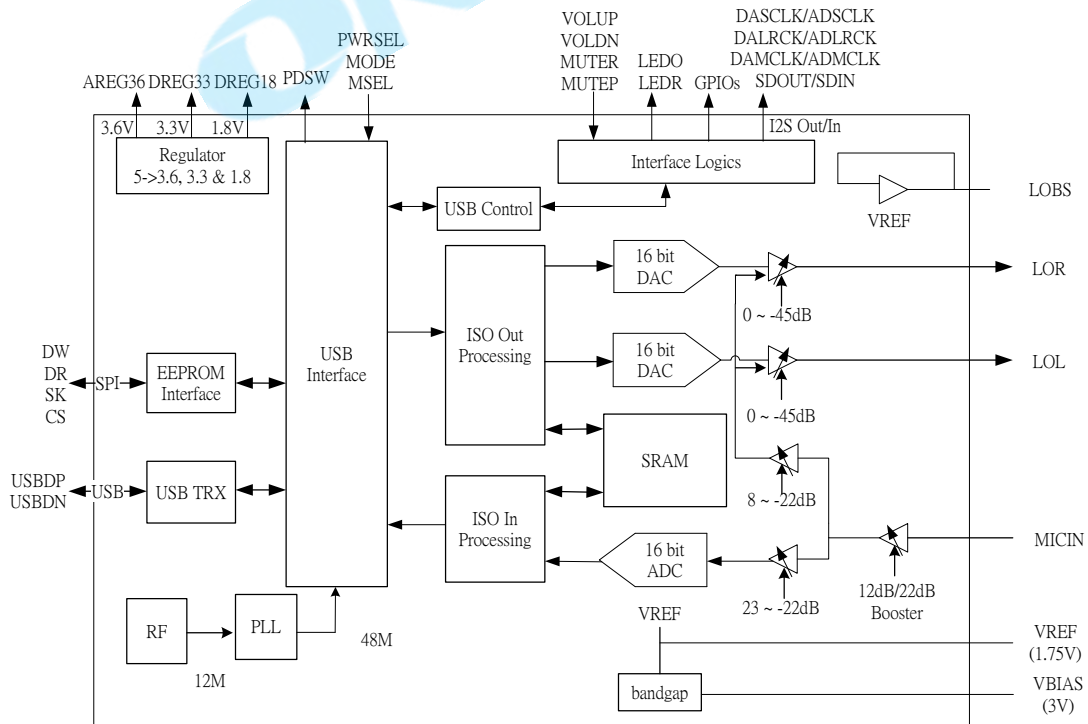
### DESCRIPTION

The CM108B is a highly integrated crystal-free USB audio single chip solution optimized for USB headset, headphone, and dongle applications. The CM108B comes with software driver interface which supports Xear™ sound effects for multimedia entertainments. All essential analog modules are embedded in the CM108B, including dual DAC and earphone driver, ADC, microphone booster, PLL, regulator and USB transceiver modules. Many features are programmable with jumper pins or by external EEPROM. Audio adjustments are easily controlled via specific HID-compliant volume control pins. An external codec or audio DSP can be connected to the CM108B via I2S pin for further processing. Vendors can customize unique USB VID/PID/Product String/Manufacture String and min/max/initial volumes to EEPROM. The CM108B also comes with an anti-pop noise circuits design and internal oscillator which can operate without an external crystal oscillator.

### FEATURES

- Compliant with USB 2.0 Full Speed Operation
- Compliant with USB Audio Device Class specification v1.0
- Supports USB Suspend/Resume Mode and Remote Wakeup with Volume Control pins
- On-chip oscillator that provides reference sources for PLL and embedded USB transceiver
- Jumper pin for Headset Mode (Playback + Recording) and Speaker/Headphone Mode (Playback Only)
- Jumper pin for Mixer Unit enable/disable under Headset Mode and Power Mode setting
- I2S interfaces for external CODEC
- Anti-pop noise design for plugged and vice-versa
- Support Xear™ Audio Centre Software Driver for Windows OS

### BLOCK DIAGRAM



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## Release notes

Revision	Date	Description
1.00	31 Oct 2013	First release
1.11	18 Nov 2014	Correction on page 6 diagram
1.2	22 Dec 2015	Modify SPI definition and operation temperature
1.3	16 Sep 2020	Modify I2S Interface description
1.31	15 Jul 2021	Adjust format
1.41	5 Jan 2024	<ul style="list-style-type: none"><li>- Update Block Diagram</li><li>- Update Package Information</li></ul>

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## 1 Description and overview

The CM108B is a highly integrated single-chip USB audio solution. All essential analog modules are embedded in the CM108B, including dual DAC and earphone driver, ADC, microphone booster, PLL, regulator and USB transceiver modules. It is perfectly suited to USB headset, USB earphone or USB audio-interface box applications. As well, many features are programmable with jumper pins or by external EEPROM.

The CM108B can connect to an external codec or audio DSP via I2S pins for further processing. Plus, 3 GPIO pins can be accessed with customer application software for additional value-adding applications. In addition, audio adjustments can be easily controlled via specific HID compliant volume control pins. Many features are programmable with jumper pins or external EEPROM. Vendors can customize unique USB VID/PID/Product String/Manufacture String and max/min/initial volumes to EEPROM. The CM108B also comes with an anti-pop noise circuits design and internal oscillator which can operate without an external crystal oscillator.

## 2 Ordering information

Model No.	Package	Storage Ambient Temperature	Supply Range
CM108B	48-pin LQFP, 7mm × 7mm × 1.4mm (plastic)	-40 °C to +125 °C	DVdd = 5V, AVdd = 5V

## 3 Features

- Supports USB 2.0 full speed operation
- Compliant with USB audio device class specification 1.0
- Supports USB suspend/resume modes and remote wakeup with volume control pins
- On-chip oscillator that provides reference sources for PLL and embedded USB transceiver
- Support Xear™ audio driver for multimedia sound effects in Windows OS, for further information please refer to CM108B Xear™ Audio Center Driver User's Manual
- Jumper pin for speaker mode (playback only) or headset mode (playback plus recording)
- For headset mode, USB audio function topology has 2 input terminals, 2 output terminals, 1 mixer unit, 1 selector unit and 3 feature units
- Jumper pin allows for mixer unit enable/disable when in headset mode
- For speaker mode, the USB audio topology has 1 input terminal, 1 output terminal and 1 feature unit
- Supports one control endpoint, one isochroous OUT endpoint, one isochroous IN endpoint, and one interrupt IN endpoint
- Alternate zero bandwidth setting for releasing playback bandwidth on USB Bus when device is inactive
- Anti-pop noise design for device plugged and vice-versa, while A-A path is off
- Supports AES/EBU, IEC60958, S/PDIF consumer formats for stereo PCM data at S/PDIF output
- Volume up, volume down, and playback mute pins support USB HID for host control synchronization
- Record mute pin with LED indicator for record mute status
- Includes external EEPROM Interface for Vendor Specific USB VID, PID, Product String, Manufacture String, and max/min/initial volumes
- 3 GPIO pins with read/write via HID interface
- Jumper pin to set the power mode (100mA or 500mA, Bus-powered or self-powered)
- Isochronous transfer uses adaptive mode with internal PLL for synchronization
- 48K/44.1KHz sampling rate for both playback and recording
- Soft mute function

- 
- Embedded 16-bit ADC input with microphone boost
  - Embedded power-on reset block
  - Embedded 5V to 3.6V/3.3V/1.8V regulators for single external 5V power
  - 48-pin LQFP package

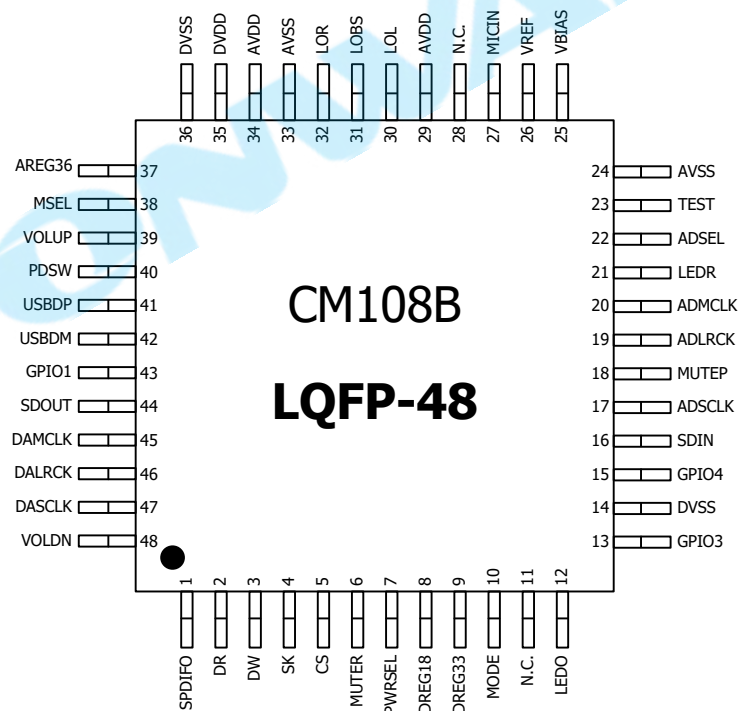
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## 4 Pin descriptions

### 4.1 Pin assignment by pin number

Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name
1	SPDIFO	13	GPIO3	25	VBIAS	37	AREG36
2	DR	14	DVSS	26	VREF	38	MSEL
3	DW	15	GPIO4	27	MICIN	39	VOLUP
4	SK	16	SDIN	28	N.C.	40	PDSW
5	CS	17	ADSCLS	29	AVDD	41	USBDP
6	MUTER	18	MUTEP	30	LOL	42	USBDM
7	PWRSEL	19	ADLRCK	31	LOBS	43	GPIO1
8	DREG18	20	ADMCLK	32	LOR	44	SDOUT
9	DREG33	21	LEDR	33	AVSS	45	DAMCLK
10	MODE	22	ADSEL	34	AVDD	46	DALRCK
11	N.C.	23	TEST	35	DVDD	47	DASCLK
12	LEDO	24	AVSS	36	DVSS	48	VOLDN

### 4.2 Pin-out diagram



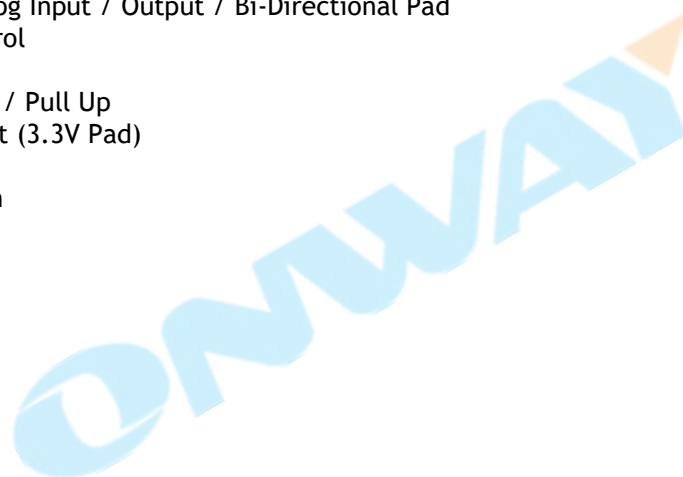
Pin Assignments (top view)

### 4.3 Pin signal descriptions

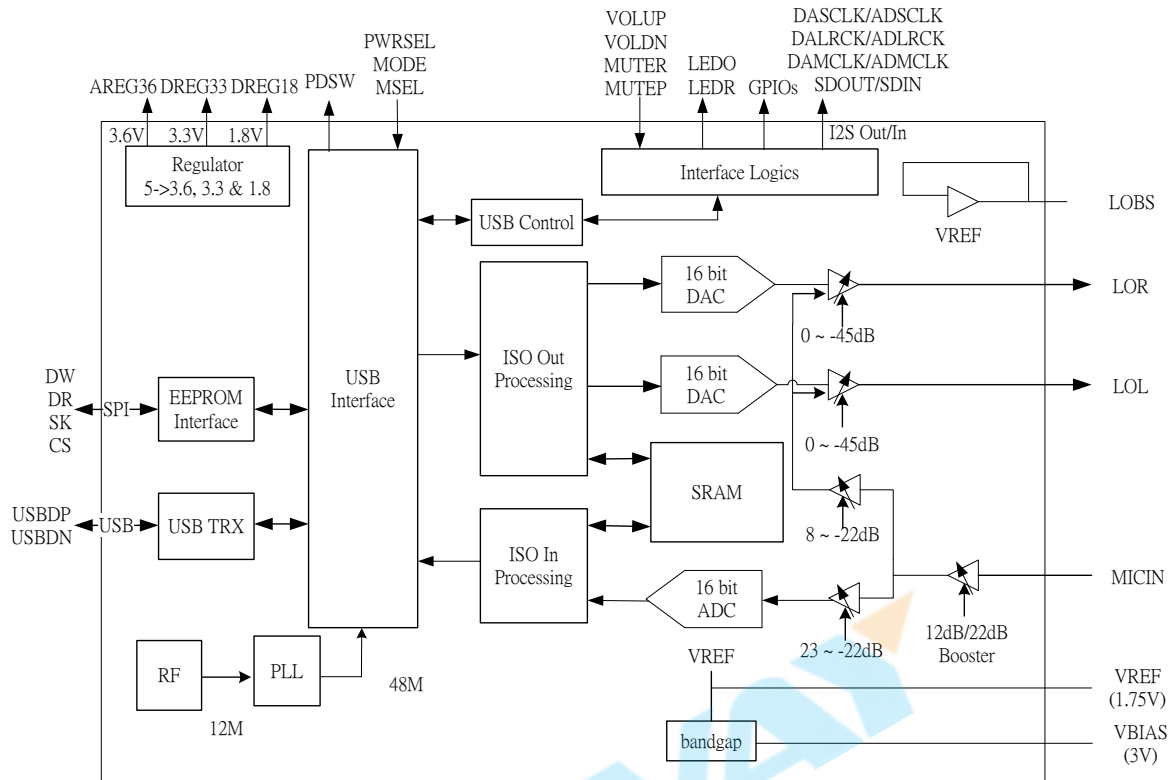
Pin #	Symbol	Type	Description
1	SPDIFO	DO, 4mA, SR	SPDIF output
2	DR	DI, 8mA, PD, 5VT	EEPROM interface data read from EEPROM
3	DW	DO, 4mA, SR	EEPROM interface data write to EEPROM
4	SK	DO, 4mA, SR	EEPROM interface clock
5	CS	DO, 4mA, SR	EEPROM interface chip select
6	MUTER	DI, ST, PU	Mute recording (edge trigger with de-bouncing)
7	PWRSEL	DI, ST, PU	Chip power select pin: H: push up to 3.3V, L: push down to ground Speaker mode - H: 100mA self-powered, L: 500mA Bus-powered Headset mode - H: 100mA Bus-powered, L: 500mA Bus-powered
8	DREG18	P	1.8V Regulator Output for Digital Core
9	DREG33	P	3.3V Regulator Output for Digital I/O (driving current 40mA)
10	MODE	DI, ST, PD	Operating mode selection: H: push up to 3.3V, L: pull down to ground H: speaker mode - playback only L: headset mode - playback & recording
11	N.C.	-	
12	LEDO	DO, SR, 4mA	LED operation light: output H for power on, toggling for data transmit
13	GPIO3	DIO, 8mA, PD, 5VT	GPIO pin
14	DVSS	P	Digital ground
15	GPIO4	DIO, 8mA, PD, 5VT	GPIO pin
16	SDIN	DIO, 8mA, PD, 5VT	ADC I2S data input
17	ADSCCLK	DO, 2mA, SR	ADC I2S serial clock
18	MUTEPL	DI, ST, PU	Mute playback (edge trigger with de-bouncing)
19	ADLRCK	DO, 2mA, SR	ADC I2S left/right clock
20	ADMCLK	DO, 2mA, SR	11.2896MHz output for 44.1KHz sampled data and 12.288MHz output for 48KHz sampled data
21	LEDR	DO, SR, 4mA	LED for mute recording indicator, output H when recording is muted
22	ADSEL	DI, ST, PD	ADC input source select pin H: use external (via I2S) ADC L: use internal ADC (H: push up to 3.3V, L: push down to ground)
23	TEST	DI, ST, PD	Test mode select pin, H: test mode L: normal operation (H: push up to 3.3V, L: push down to ground)
24	AVSS	P	Analog ground
25	VBIAS	AO	Microphone bias voltage supply (3V), with a small driving capability
26	VREF	AO	Connecting to external decoupling capacitor for embedded bandgap circuit, 1.75V output
27	MICIN	AI	Microphone input, input impedance is 10k Ohm
28	N.C.		
29	AVDD	P	5V analog power for analog circuit
30	LOL	AO	Line out: left channel
31	LOBS	AO	DC 1.75V output for line out bias
32	LOR	AO	Line out: right channel
33	AVSS	P	Analog ground
34	AVDD	P	5V power supply for analog circuit
35	DVDD	P	5V power supply for internal regulator
36	DVSS	P	Digital ground
37	AREG36	P	3.6V analog power for analog circuit

38	MSEL	DI, ST, PU	Mixer enable select: H: push up to 3.3V, L: push down to ground H: with mixer/AA-path enabled (with default mute) L: without mixer/AA-path disabled USB descriptors will also be changed accordingly
39	VOLUP	DI, ST, PU	Volume up (edge trigger with de-bouncing)
40	PDSW	DO, 4mA, OD	Power down switch control signal (for PMOS polarity) 0: normal operation 1: power down mode (suspend mode)
41	USBDP	AIO	USB Data D+
42	USBDM	AIO	USB Data D-
43	GPIO1	DIO, 8mA, PD, 5VT	GPIO pin
44	SDOUT	DO, 2mA, SR	DAC I2S data output
45	DAMCLK	DO, 2mA, SR	11.2896 MHz output for 44.1KHz sampled data and 12.288 MHz output for 48KHz sampled data
46	DALRCK	DO, 2mA, SR	DAC I2S left/right clock
47	DASCLK	DO, 2mA, SR	DAC I2S serial clock
48	VOLDN	DI, ST, PU	Volume down (edge trigger with de-bouncing)

Note: DI / DO / DIO - Digital Input / Output / Bi-Directional Pad  
 AI / AO / AIO - Analog Input / Output / Bi-Directional Pad  
 SR - Slew Rate Control  
 ST - Schmitt Trigger  
 PD / PU - Pull Down / Pull Up  
 5VT - 5 Volt Tolerant (3.3V Pad)  
 OD - Open Drain  
 P - Power Supply Pin



## 5 Block diagram

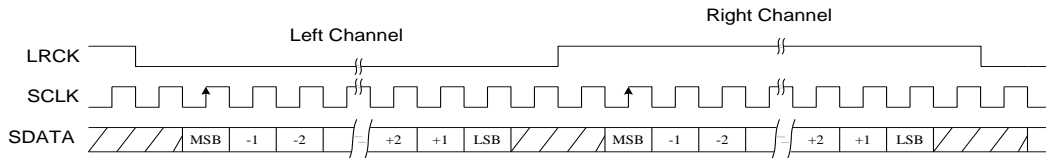


CM108B Block Diagram

## 6 I2S Interface

The CM108B provides an I2S interface for both playback and recording. External ADC, DAC, or DSP can be added to provide additional functions within the USB audio system. The CM108B sends out master clock (fixed at  $\times 256$ ), BCLK (fixed at  $\times 64$ ), and data clock data. Therefore, external ADCs, DACs, or DSPs should be set to slave mode.

The left channel of the CM108B's I2S bus is used for mono recording. Both IP<sup>2P</sup>S buses use a 5V tolerant pad in order to easily interface with 5V or 3.3V devices. Playback data is simultaneously sent to both the DAC and I2S bus. The recording source (ADC or I2S bus) can be selected by ADSEL jumper pin.



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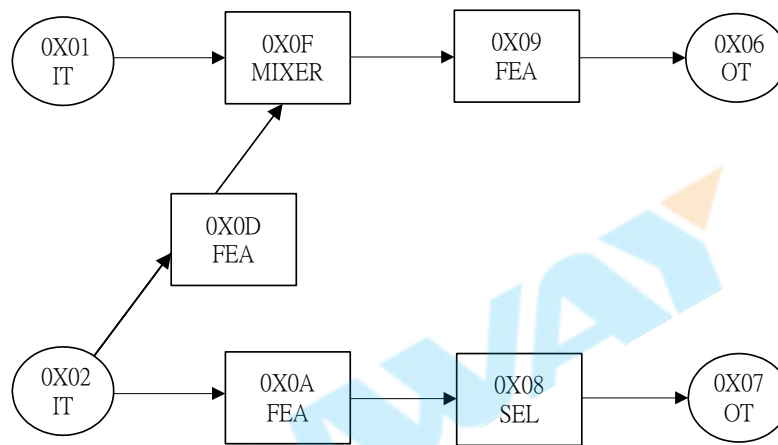
## 7 Function description

### 7.1 USB interface

The CM108B integrates USB transceiver, PLL and regulator modules, meaning only a few passive components are necessary for USB interface connection. Default USB descriptors are embedded in the CM108B, so no additional design effort is needed for generic USB operation. For custom orders, customers can attach a 93C46 EEPROM to override the embedded VID, PID, product and manufacturer strings, and initial/max/min volume settings. The CM108B automatically detects the 93C46, and the overwrite function is performed at start up.

#### 7.1.1 USB audio topology diagram for headset

The CM108B supports headset and speaker topology that can be selected by MODE pin. The topology setting as following: MODE=0, Headset Topology; MODE=1, Speaker Topology



#### 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	Device class specified by interface
5	bDeviceSubClass	1	00	Device subclass specified by interface
6	bDeviceProtocol	1	00	Device protocol specified by interface
7	bMaxPacketSize0	1	8	Endpoint zero Size = 8 bytes
8	idVendor	2	0d8c	Vendor ID
10	idProduct	2	0012	Product ID
12	bcdDevice	2	0100	Device compliant to the Audio Device Class specification version 1.00
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

#### Configuration Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	09	Total 9 Bytes
1	bDescriptorType	1	02	Configuration Descriptor
2	wTotalLength	2	XXXX	Total length of data returned for this configuration: Programmable by MSEL and MODE pin
4	bNumInterfaces	1	04	Number of interfaces supported by this Configuration: 0: control interface      1: ISO-OUT interface 2: ISO-IN interface      3: INT-IN(HID) interface
5	bConfigurationValue	1	01	Configuration value
6	iConfiguration	1	00	Index of string descriptor describing this configuration
7	bmAttributes	1	80	Bus Power and support Remote Wakeup
8	bMaxPower	2	32	Maximum power consumption of the USB Device: 100mA

### 7.1.2 USB audio topology diagram for speaker



#### Device Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	12	Descriptor length
1	bDescriptorType	1	01	Device Descriptor
2	bcdUSB	2	0110	USB 1.1 compliant
4	bDeviceClass	1	00	Device class specified by interface
5	bDeviceSubClass	1	00	Device subclass specified by interface
6	bDeviceProtocol	1	00	Device protocol specified by interface
7	bMaxPacketSize0	1	08	Endpoint zero packet size
8	idVendor	2	0d8c	Vendor ID
10	idProduct	2	0012	Product ID
12	bcdDevice	2	0100	Device release number
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 serial number
17	bNumConfigurations	1	01	Number of configuration

#### Configuration Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	09	Descriptor length
1	bDescriptorType	1	02	Configuration Descriptor
2	wTotalLength	2	XXXX	Total length of data returned for this configuration: Programmable by MSEL and MODE pin
4	bNumInterfaces	1	03	Number of interfaces supported by this Configuration: 00: Control 01: ISO-Out 02: INT-IN (HID)
5	bConfigurationValue	1	01	Configuration value
6	iConfiguration	1	00	Index of string descriptor describing this configuration
7	bmAttributes	1	80	Attributes(PWRSEL=0:Bus Powered, 1:SELF Powered)
8	bMaxPower	1	32	Maximum power consumption from bus = 100mA

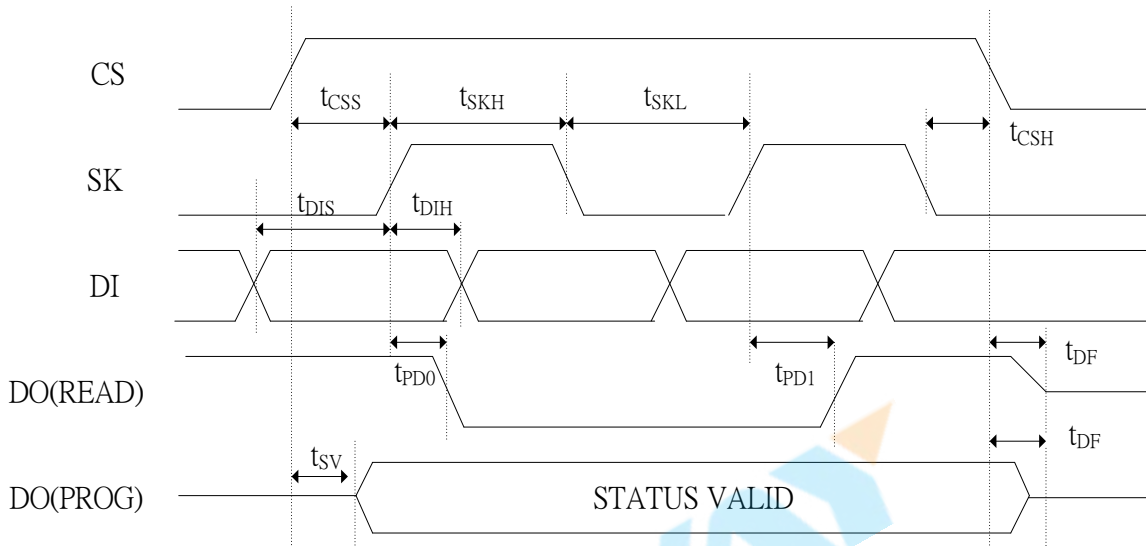
### 7.1.3 Content format for EEPROM (93C46)

Each address has 2-byte data, prefix `0x` means hex number

Address(Hex)	Description	
0x00	bit[15:4] Magic Word 0x670X where X = bit 4, 3, 2, 1 bit[3] The value within address 0x2A, 0x2B, 0x32 is valid 1: valid 0: invalid bit[2] reserved, should be 1 bit[1] serial number enable control 1: enable, 0: disable(default) bit[0] reserved, should be 1	
0x01	VID 2-byte	
0x02	PID 2-byte	
0x03	Serial number 1st byte (bit15-bit8, first character)	Serial number length (bit7-bit0)
0x04 ~ 0x09	Serial number 12-byte	
0x0A	Product string 1st byte (bit15-bit8, first character)	Product string length (bit7-bit0) [0x3E->30,0x40->31Char]
0x0B ~ 0x19	Product string 30-byte (default: USB Audio Device)	
0x1A	Manufacturer string 1st byte (bit15-bit8, first character)	Manufacturer string length (bit7-bit0) [0x3E->30,0x40->31Char]
0x1B ~ 0x29	Manufacturer string 30-byte (default: C-Media Electronics Inc.)	
0x2A	bit[15: 9] DAC initial volume (7-bit, default = -10dB) bit[8: 3] ADC initial volume (6-bit, default = 8dB) bit[2] DAC EEPROM MAX/MIN volume valid bit[1] ADC EEPROM MAX/MIN volume valid bit[0] AA EEPROM MAX/MIN volume valid	
0x2B	bit[15:11] AA initial volume (5-bit, default = -7dB) bit[10] Reserved, should be 0 bit[9] Boost mode 0: 22dB 1:12dB (default) bit[8] Shout down DAC analog circuits 1: shoutdown, 0: active(default) bit[7] Total Power Control 1:enable, 0:disable(default) bit[6] Reserved, should be 0 bit[5] MIC High Pass Filter 1:enable(default), 0:disable bit[4] MIC PLL Adjust 1:enable, 0:disable(default) bit[3] MIC BOOST 1:enable (default), 0:disable bit[2] DAC Output Terminal property set to SPK or HP 1: Headset, 0: Speaker(default) bit[1] HID, 1: enable (default), 0: disable bit[0] Remote wakeup, 1:enable, 0:disable(default)	
0x2C	bit[15:0] DAC Minimum Volume (0xD300, DAC-Min.=-37dB, default=-37dB)	
0x2D	bit[15:0] DAC Maximum Volume (0x0000, DAC-Max.=0dB, default=0dB)	
0x2E	bit[15:0] ADC Minimum Volume(0xEA00, ADC-Min.=-22dB, default=-12dB)	
0x2F	bit[15:0] ADC Maximum Volume(0x1700, ADC-Max.=+23dB, default=+23dB)	
0x30	bit[15:0] AA Minimum Volume (0xE900, AA-Min.=-23dB, default=-23dB)	
0x31	bit[15:0] AA Maximum Volume (0x0800,AA-Max.+8dB, default=+8dB)	
0x32	EE_OPTION2 Register bit[3] Reserved, should be 0 bit[2] Reserved, should be 0	

	bit[1] Reserved, should be 0 bit[0] Reserved, should be 0
~ END	

### 7.1.4 EEPROM SPI interface timing information



Symbol	Parameter	Test Condition*	Min	Typ	Max	Units
$f_{SK}$	SK Clock Frequency	$2.7V \leq V_{CC} \leq 5.5V$	0	-	200	KHz
$t_{SKH}$	SK High Time	$2.7V \leq V_{CC} \leq 5.5V$	250	-	-	ns
$t_{SKL}$	SK Low Time	$2.7V \leq V_{CC} \leq 5.5V$	250	-	-	ns
$t_{CS}$	Minimum CS Low Time	$2.7V \leq V_{CC} \leq 5.5V$	250	-	-	ns
$t_{CSS}$	CS Setup Time	$2.7V \leq V_{CC} \leq 5.5V$	50	-	-	ns
$t_{DIS}$	DI Setup Time	$2.7V \leq V_{CC} \leq 5.5V$	100	-	-	ns
$t_{CSH}$	CS Hold Time	$2.7V \leq V_{CC} \leq 5.5V$	0	-	-	ns
$t_{DIH}$	DI Hold Time	$2.7V \leq V_{CC} \leq 5.5V$	100	-	-	ns
$t_{PD1}$	Output Delay to "1"	$2.7V \leq V_{CC} \leq 5.5V$	-	-	250	ns
$t_{PD0}$	Output Delay to "0"	$2.7V \leq V_{CC} \leq 5.5V$	-	-	250	ns
$t_{SV}$	CS to Status Valid	$2.7V \leq V_{CC} \leq 5.5V$	-	-	250	ns
$t_{DF}$	CS to DO in High Impedance	$2.7V \leq V_{CC} \leq 5.5V$	-	-	100	ns
$t_{WP}$	Write Cycle Time	$4.5V \leq V_{CC} \leq 5.5V$	0.1	3	10	ms

\* based on ATMEL 93C46 EEPROM data

## 7.2 Jumper pins and mode setting:

The CM108B can be configured via several jumper pins. These jumper pin settings affect both USB descriptors and USB audio topology.

### 7.2.1 Mode pin and msel pin

If the MODE pin is pushed up to 3.3V (speaker mode), a playback-only function is activated and no recording function is declared to the host. At this setting, the MSEL pin is ignored and only one input terminal, one output terminal and one feature unit is declared in the USB audio topology.

If the MODE pin is pulled low (headset mode), a full-duplex playback and recording function is reported to the host. The MSEL pin setting activates one mixer unit and one feature unit.

- When MSEL = 1, the mixer is enabled (AA-path enabled), but with default mute setting
- When MSEL = 0, the mixer is disabled (AA-path disabled)

The above USB audio topology (7.1.4) is an example of headset mode with enabled mixer.

### 7.2.2 Mode pin and pwrssel pin

The PWRSEL pin affects the power configuration of the CM108B. Together with the MODE pin, there are a total of 4 programmable combinations.

Combinations		MODE	
		3.3V	GND
PWRSEL	3.3V	Speaker mode: Playback only (100mA self-powered)	Headset mode: Playback and recording (100mA Bus-powered)
	GND	Speaker mode: Playback only (500mA Bus-powered)	Headset mode: Playback and recording (500mA Bus-powered)

USB Audio Topology Diagram

## 7.3 HID feature

USB protocols can configure devices at startup or when they are plugged in at run time. These devices are categorized into various device classes. Each device class defines the common behavior and protocols for devices that serve similar functions. The HID (Human Interface Device) class is one of the device classes.

The HID class consists primarily of devices that are used to control the operation of computer systems. Typical examples of HID class devices include:

The CM108B's HID feature allows users to set volume up, volume down, playback mute and recording mute button pins, and reports the changes to the host to synchronize host side settings. In addition, all CM108B internal registers can be accessed via HID function call.

### 7.3.1 HID descriptors

#### HID Interface Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	09	Size of this descriptor: 9 bytes
1	bDescriptorType	1	04	Interface descriptor type
2	bInterfaceNumber	1	03	Interface number: 3
3	bAlternateSetting	1	00	Alternate: 0
4	bNumEndpoints	1	01	Number of endpoints used by this interface: 1
5	bInterfaceClass	1	03	Interface class: HID
6	bInterfaceSubClass	1	00	Subclass: no
7	bInterfaceProtocol	1	00	Must be set to 0
8	iInterface	1	00	String descriptor index that characterizes this interface

#### HID Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	09	Total: 9 bytes
1	bDescriptorType	1	21	HID descriptor type
2	bcdHID	2	0100	HID class version 1.0
4	bCountryCode	1	00	
5	bNumDescriptors	1	01	
6	bDescriptorType	1	22	Report descriptor
7	wDescriptorLength	2	003C	Total size of the optional descriptor: 60 bytes

#### Interrupt IN Endpoint Descriptor

Offset	Field	Size	Value (Hex)	Description
0	bLength	1	07	Total: 7 bytes
1	bDescriptorType	1	05	Endpoint descriptor type
2	bEndpointAddress	1	87	In Endpoint Number = 3
3	bmAttributes	1	03	Interrupt endpoint type
4	wMaxPacketSize	2	0004	Maximum packet size: 4 bytes
6	bInterval	1	2	2ms

## 7.4 Internal Registers

All of CM108B's internal registers can be accessed via generic HID functional calls without the need to develop a kernel mode driver. In total, 4 bytes of data can be read or written from the HID. The input report is for read and the output report is for write. These internal registers of CM108B are used to control GPIO pins, S/PDIF output and EEPROM data access.

### Access via HID Class Command

HID interrupt will occur when HID\_IR0-3 are updated by button status, or GPI in case HID\_IR0[7:6] == 2'b00).

### HID Get\_Input\_Report Format

Command Format:

bmRequestType	bRequest	wValue	wIndex	wLength	Data
8'h A1	8'h 01 (Get_Report)	16'h 01 00 (Rpt Type + Rpt ID)	16'h 00 02 16'h 00 03 (Interface)	16'h 00 04 (4 bytes)	Report

### Input Data Format:

byte 0	HID IR0[7:0]
byte1	HID IR1[7:0]
byte2	HID IR2[7:0]
byte3	HID IR3[7:0]

### HID Set\_Output\_Report Format

Command Format:

bmRequestType	bRequest	wValue	wIndex	wLength	Data
8'h 21	8'h 09 (Set_Report)	16'h 02 00 (Rpt Type + Rpt ID)	16'h 00 02 16'h 00 03 (Interface)	16'h 00 04 (4 bytes)	Report

### Output Data Format:

byte 0	HID OR0[7:0]
byte1	HID OR1[7:0]
byte2	HID OR2[7:0]
byte3	HID OR3[7:0]

### HID\_IR0 (HID input report byte 0)

Offset: 0x00

Bits	Read/Write	Description	Default
7-6	R	00: HID_IR1 is used as GPI, 10: values written to HID_IR0-3 are also mapped to EEPROM_DATA0-1 and EEPROM_CTRL Others: reserved	0x0
5-4	R	Reserved	0x0
3	R	0: no activity on record/mute button 1: record/mute button pressed then released	0x0
2	R	0: no activity on playback/mute button 1: playback/mute button pressed then released	0x0
1	R	0: volume-down button released	0x0

		1: volume-down button pressed	
0	R	0: volume-up button released 1: volume-up button pressed	0x0

HID\_IR1 (HID input report byte 1)

Offset: 0x01

Bits	Read/Write	Description	Default
7-0	R	When HID_IR0[7:6] == 2'b00: HID_IR1[3:0] is the input from GPIO4 - GPIO1 in input mode When HID_OR0[7] == 1'b1: mapped from EEPROM_DATA0	0x00

HID\_IR2 (HID input report byte 2)

Offset: 0x02

Bits	Read/Write	Description	Default
7-0	R	When HID_OR0[7] == 1'b1: mapped from EEPROM_DATA1	0x00

HID\_IR3 (HID input report byte 3)

Offset: 0x03

Bits	Read/Write	Description	Default
7-0	R	When HID_OR0[7] == 1'b1: mapped from EEPROM_CTRL	0x00

HID\_OR0 (HID output report byte 0)

Offset: 0x04

Bits	Read/Write	Description	Default
7-6	R / W	0: HID_OR1-2 are used for GPO; HID_OR0, 3 are used for SPDIF 1: reserved 2: values written to HID_OR0-3 are also mapped to EEPROM_DATA0-1, EEPROM_CTRL (See Note) 3: reserved	0x0
5	R / W	Reserved	0x0
4	R / W	When HID_OR0[7] == 1'b0: valid bit in SPDIF frame When HID_OR0[7] == 1'b1: reserved	0x0
3-0	R / W	When HID_OR0[7] == 1'b0: first nibble of SPDIF status channel When HID_OR0[7] == 1'b1: reserved	0x0

**Note 1:** When EEPROM access is done, HID interrupt will occur. USB host can get the result from interrupt pipe (endpoint 3).

**Note 2:** HID\_OR0 is used for SPDIF when SPDIF\_CONFIG[5] == 1'b0

HID\_OR1 (HID output report byte 1)

Offset: 0x05

Bits	Read/Write	Description	Default
7-0	R / W	When HID_OR0[7:6] == 2'b00: HID_OR1[3:0] is the output to GPIO4 - GPIO1 in output mode 0: GPO drives L 1: GPO drives H When HID_OR0[7:6] == 2'b01: reserved When HID_OR0[7:6] == 2'b1x: mapped to EEPROM_DATA0	0x00

HID\_OR2 (HID output report byte 2)

Offset: 0x06

Bits	Read/Write	Description	Default
7-0	R / W	When HID_OR0[7:6] == 2'b00: HID_OR2[3:0] is the mode setting for GPIO4 ~ GPIO1 0: set GPIO to input mode 1: set GPIO to output mode When HID_OR0[7:6] == 2'b01: reserved When HID_OR0[7:6] == 2'b1x: mapped to EEPROM_DATA1	0x00

HID\_OR3 (HID output report byte 3)

Offset: 0x07

Bits	Read/Write	Description	Default
7-0	R / W	When HID_OR0[7] == 1'b0: category byte of SPDIF status channel When HID_OR0[7] == 1'b1: mapped to EEPROM_CTRL	0x00

Note: HID\_OR3 is used for SPDIF when SPDIF\_CONFIG[5] == 1'b0



## 8 Electrical characteristics

### 8.1 Absolute maximum rating

Symbol	Parameters	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 +3.96	V
Tstg	Storage temperature range	-40 to +125	°C
ESD (HBM)	ESD human body mode	+ -4000	V
ESD (MM)	ESD machine mode	+ -200	V
Latch Up	JEDEC standard no.78, Mar. 1997	200	mA

### 8.2 Operation conditions

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	-	37.25		mA
Suspend-mode power consumption	-	1.58		uA
Operating ambient temperature	0	25	70	°C

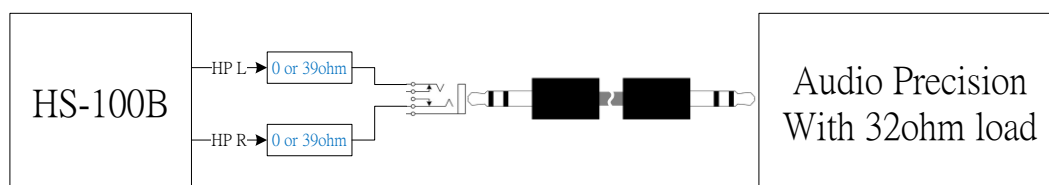
### 8.3 Electrical parameters

Platform HP ProDesk 600 G4 MT, 8G RAM, Windows 10 CHT.

TA=25°C, DVDD5V\_AVDD5V = 5V, AGND =0V, input test signal is 997Hz sine wave, measure bandwidth is 20Hz to 20kHz, Master Volume= 0dB.

	Min	Typ	Max	Unit
<b>DAC (10K Ohm Loading)</b>				
Resolution	-	16	-	bits
THD + N (-3dBr)@1KHz	-	-72	-	dB
SNR	-	93	-	dB
Silent SNR	-	98	-	dB
Dynamic range	-	92	-	dB
Frequency response 48KHz	20	-	20K	Hz
Frequency Response 44.1KHz	20	-	20K	Hz
Output Voltage (rms)	-	0.941	-	Vrms
<b>DAC (32 Ohm Loading)</b>				
<u>Note</u>				
Resolution	-	16	-	bits
THD + N (-3dBr)@1KHz	-	-69	-	dB
THD + N (-3dBr)@1KHz cascade with 39 ohm resistor	-	-69	-	
SNR cascade with 0 or 39 ohm resistor	-	93	-	dB
Silent SNR cascade with 39 ohm resistor	-	98	-	dB
Dynamic Range cascade with 0 or 39 ohm resistor	-	92	-	dB
Frequency Response 48KHz cascade with 0 or 39 ohm resistor	20	-	20K	Hz
Frequency Response 44.1KHz cascade with 0 or 39 ohm resistor	20	-	20K	Hz
Output Voltage (rms)	-	0.907	-	
Output Voltage (rms) cascade with 39 ohm resistor	-	0.486	-	Vrms
<b>Output Volume Control</b>				
Volume Control Initial Value		-10		dB
Volume Control Level	-37	-	0	dB
Volume Control Step	-	38	-	steps

**Note: Headphone 32 ohm loading audio quality measure by cascading 39 or 0 ohm resistors, the schematic diagram as below.**



Platform HP ProDesk 600 G4 MT, 8G RAM, Windows 10 CHT.

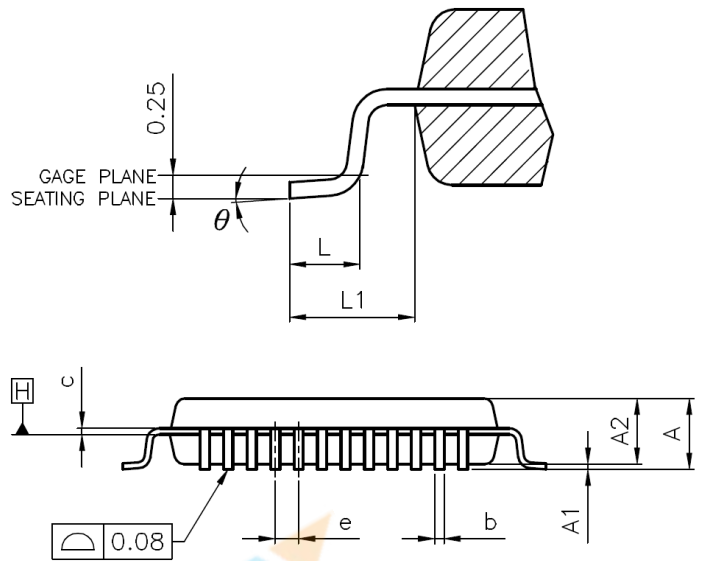
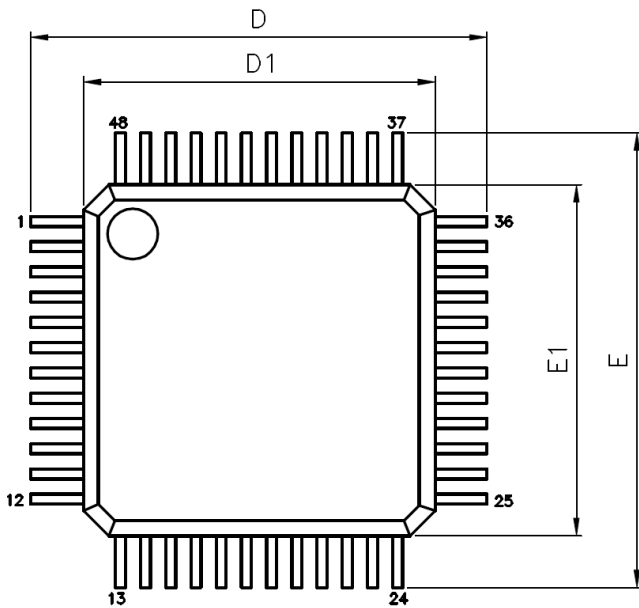
TA-25 °C, DVDD5V\_AVDD5V = 5V, AGND =0V, input test signal is 997Hz sine wave, measure bandwidth is 20Hz to 20kHz, Master Volume= 0dB.

	Min	Typ	Max	Unit
<b>ADC</b>				
Resolution	-	16	-	bit
THD + N (-3dBr)@1KHz	-	-87	-	dB
SNR	-	90	-	dB
Dynamic Range	-	89	-	dB
Frequency Response 48KHz	100	-	20K	Hz
Frequency Response 44.1KHz	100	-	20K	Hz
Input Range	0	-	2.88	Vpp
<b>Microphone Input</b>				
Boost Gain	-	12/22 (EEPROM)	-	dB
Gain Adjustment Initial Value		8		
Gain Adjustment Range	-12	-	23	dB
Gain Adjustment Steps	-	36	-	steps
Mixer Gain Initial Value		-7		
Mixer Gain Adjustment	-23.0	-	8.0	dB
Mixer Gain Adjustment Steps	-	32	-	steps

ONWAVE

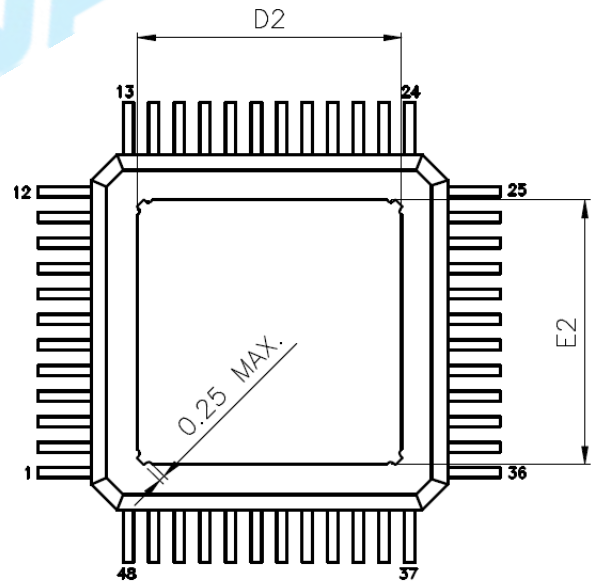
## 9 Package information

### 48-Lead Thin Plastic Quad Flatpack (LQFP)



#### VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.17	0.22	0.27
c	0.09	--	0.20
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
e	0.50 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
$\theta$	0°	3.5°	7°



#### THERMALLY ENHANCED DIMENSIONS(SHOWN IN MM)

PAD SIZE	E2		D2	
	MIN.	MAX.	MIN.	MAX.
20*X20*	4.31	5.36	4.31	5.36

Note: Outline Dimensions are shown in millimeters

## Reference

- USB specification 1.1 and 2.0-compliant
- USB audio device class specification 1.0-compliant
- USB human interface device class specification 1.11-compliant

ONWAY

— End of Datasheet —

ONWAY

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