MD-7EM Application Note

1. Module Features
-Bluetooth V1.2 Compliant

-Dual UART Port

-16-bit Audio CODEC

2. Specification
-Operating Conditions

  Supply Voltage: 2.4 – 3.6V

  Temperature Range: -20 ~ 70℃

-Radio Characteristics

  Receiver Sensitivity: -87dBm(Typical)

  Transmitter Power: +16dBm(Typical)

3. Applications
-Stereo Headphones

-Echo Cancellation

-Automotive hands free kits

-High Performance Telephony personal

-Enhanced Audio Applications

## 4. Features
-Size (30 x 16.2 x 1.72 mm)

-Surface Mountable

-Support PCM interface for SCO

-Support Kalimba DSP

5. Descriptions
MD-7EM is Class 1 Bluetooth Stereo Audio Module for High Performance Telephony Headsets, Enhanced Audio Applications, other A/V Applications. It is designed to be used as a universal Bluetooth Module of Bluetooth specification version 1.2 which can be deployed to implement versatile wireless applications such as voice communications. The Band-pass filter and balun are integrated into the substrate.

6. Block Diagram
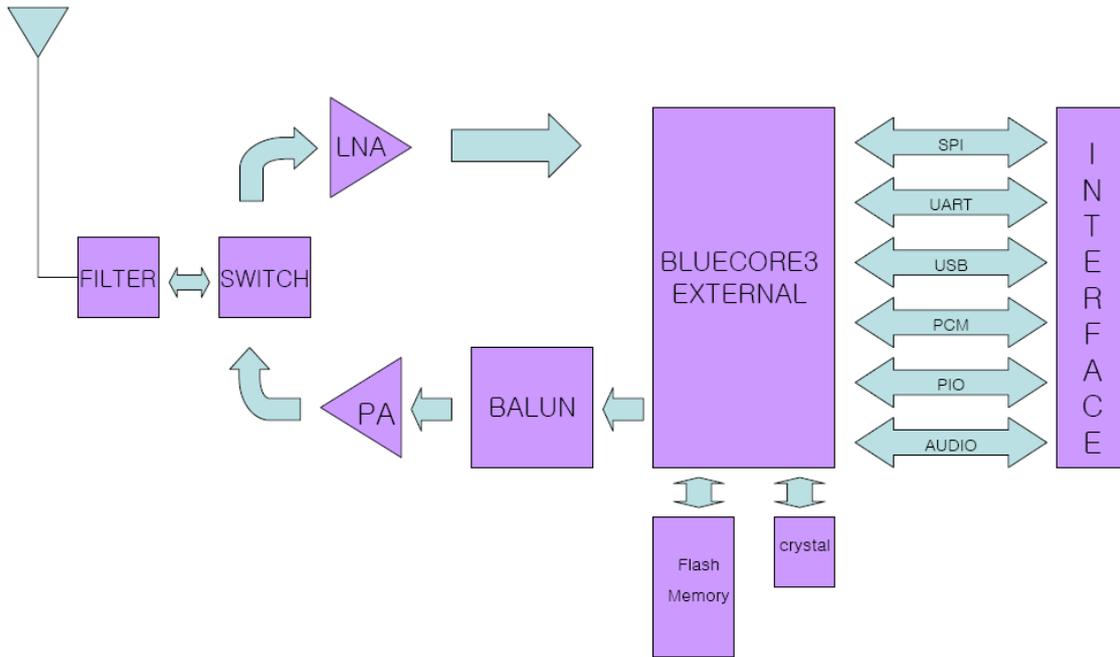
7. Electrical Characteristics

Absolute Maximum Ratings			
Parameter	Min	Max	Unit
Temperature	-20	70	℃
Supply Voltage(V_PA)	3.2	3.4	V
Supply Voltage(VDD)	2.4	3.6	V
Recommended Operating Conditions			
Parameter	Min	Max	Unit
Supply Voltage(V_PA	3.3		V
Supply Voltage(VDD)	2.6	3.3	V

8. RF Specification

Transmitter Performance					
Parameter	Condition	Min	Typ.	Max	Unit
Output Power	Normal/extreme test	-	16	-	dBm
Power Density	Normal/extreme test	-	-	20	dBm
Power Control	Normal/extreme test	2dB ≤ Step size ≥ 8dB			
Frequency Range	Normal/extreme test	2400	-	2483.5	MHz
20dB Bandwidth	Normal/extreme test	-	850	1000	KHz
Adjacent Characteristics	±2MHz	-	-	-20	dBm
	±3MHz	-	-	-40	dBm
	±4MHz	-	-	-40	dBm
Modulation Characteristics	ΔF1avg	140		175	KHz
	ΔF2 max	115			KHz
	ΔF2 avg / ΔF1max			80	%
Initial Carrier Frequency Tolerance		-75		75	KHz
Carrier Frequency Drift	One slot packet(DH1)	-25		25	KHz
	Three slot packet(DH3)	-40		40	KHz
	Five slot packet(DH5)	-40		40	KHz
Transceiver Performance					
Parameter	Condition	Min	Typ.	Max	Unit
Out-of-Band Spurious Emissions	30MHz ~ 1MHz	-	-	-36	dBm
	1GHz ~ 12.75GHz	-	-	-30	dBm
	1.8GHz ~ 5.3GHz	-	-	-47	dBm
	5.1GHz ~ 5.3GHz	-	-	-47	dBm
Receiver Performance					
Parameter	Condition	Min	Typ.	Max	Unit
Sensitivity level	Single slot packets	-	-87	-	dBm
	Multi slot packets	-	-86	-	dBm
C/I performance	C/I co-channel	-	-	11	dB
	C/I 1MHz(Adjacent channel selectivity)	-	-	0	dB
	C/I 2MHz(Adjacent channel selectivity)	-	-	-30	dB
	C/I ≥3MHz(Adjacent channel selectivity)	-	-	-40	dB
Blocking performance	30MHz ~ 2000MHz	-10			dBm
	2000MHz ~ 2400MHz	-27			dBm
	2500MHz ~ 3000MHz	-27			dBm
	3000MHz ~ 12.75MHz	-10			dBm
Inter-modulation Performance	N=5	-39	-		dBm
Maximum Input Level		-20	-10		dBm

9. Pin Description

| Pin NO	Pin Name	Description	Pad Type
1	GND	Common Ground	VSS
2	V_PA	Power Amp power supply	V_PA
3	PIO_2	Programmable input/output line	Bi-directional
4	PIO_3	Programmable input/output line	Bi-directional
5	PIO_8	Programmable input/output line	Bi-directional
6	PIO_9	Programmable input/output line	Bi-directional
7	PIO_10	Programmable input/output line	Bi-directional
8	PIO_11	Programmable input/output line	Bi-directional
9	AIO_1	Programmable input/output line	Bi-directional
10	AIO_0	Programmable input/output line	Bi-directional
11	AUD_OUT_LP	Speaker output positive (Left channel)	Analogue
12	AUD_OUT_LN	Speaker output negative(Left channel)	Analogue
13	AUD_OUT_RN	Speaker output negative(Right channel)	Analogue
14	AUD_OUT_RP	Speaker output positive(Right channel)	Analogue
15	AUD_IN_LP	Audio Signal input positive(Left channel)	Analogue
16	AUD_IN_LN	Audio Signal input negative(Left channel)	Analogue
17	AUD_IN_RP	Audio Signal input positive(Right channel)	Analogue
18	AUD_IN_RN	Audio Signal input negative(Right channel)	Analogue
19	VDD	Module power supply	VDD
20	RESET	Module reset input. Reset if high>5ms to cause	CMOS input
21	USB_DN	USB data minus	Bi-directional
22	USB_DP	USB data plus	Bi-directional
23	UART_RTS	UART request to send active low	CMOS output
24	UART_CTS	UART clear to send active low	CMOS input
25	UART_RX	UART data input	CMOS input
26	UART_TX	UART data output	CMOS output
27	PCM_IN	Pulse Code Modulation Synchronous data input	CMOS input
28	PCM_SYNC	Pulse Code Modulation Synchronous data sync	Bi-directional
29	PCM_CLK	Pulse Code Modulation Synchronous data clk	Bi-directional
30	PCM_OUT	Pulse Code Modulation Synchronous data output	PCM output
31	SPI_MOSI	Serial Peripheral Interface data input	CMOS input
32	SPI_MISO	Serial Peripheral Interface data output	CMOS output
33	SPI_CSB	Chip select for Synchronous Serial Interface	CMOS input

34	SPI_CLK	Serial Peripheral Interface data clock	CMOS input
35	PIO_7	Programmable input/output line	Bi-directional
36	PIO_6	Programmable input/output line	Bi-directional
37	PIO_5	Programmable input/output line	Bi-directional
38	PIO_4	Programmable input/output line	Bi-directional
39	RF_IN	Connect to Antenna(for RF Signal)	Analogue
40	GND	Common Ground	VSS
41	GND	Common Ground	VSS
42	GND	Common Ground	VSS
43	AIO_3	Programmable input/output line	Bi-directional
44	GND	Common Ground	VSS
45	GND	Common Ground	VSS
46	GND	Common Ground	VSS
47	GND	Common Ground	VSS

10. UART Interface

MD-7EM is Universal Asynchronous Receiver Transmitter (UART) interface provides a simple mechanism for communicating with other serial device using the RS232 standard.

When MD-7EM is connected to another digital device, UART_RX and UART_TX transfer data between the two devices. The remaining two signals, UART_CTS, UART_RTS, can be used to implement RS232 hardware flow control control where both are active low indicators.

All UART connections are implemented using CMOS technology and have signaling levels of 0V and VDD

RS-232C
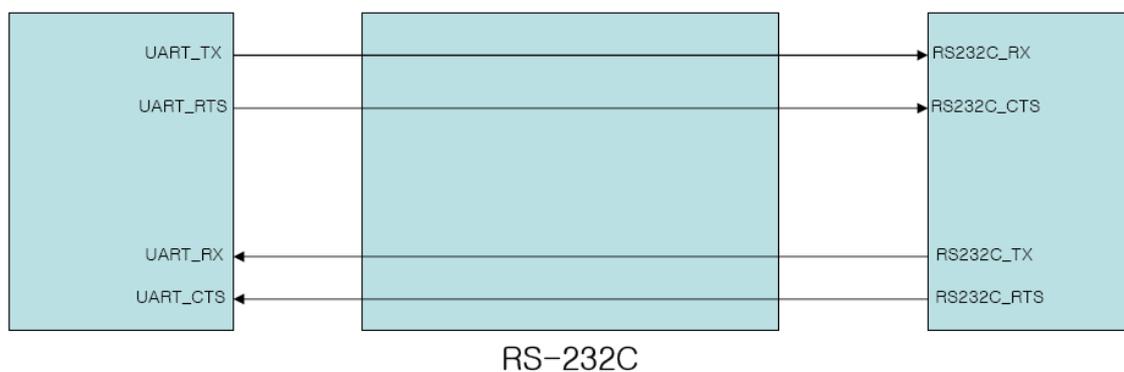
UART connected to Host PC
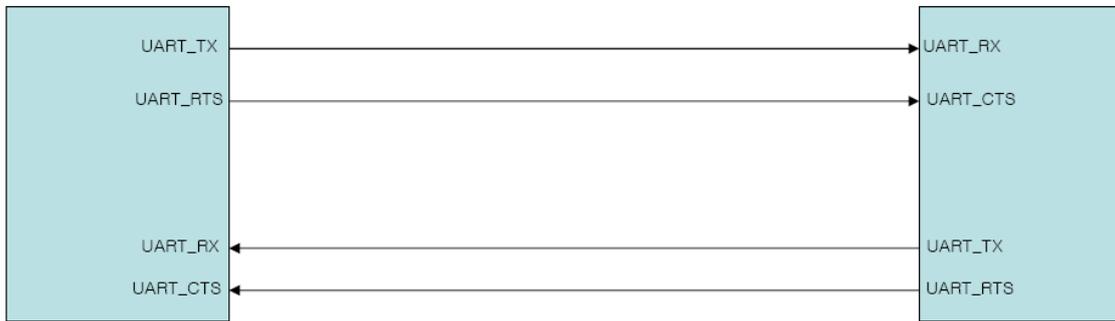
UART connected to MCU

11. PCM Interface

Pulse Code Modulation (PCM) is a standard method used to digitize human voice patterns for transmission over digital communication channel. Through its PCM interface, MD-7EM has hardware support for continual transmission reception of PCM data, thus reducing processor overhead for wireless application. MD-7EM offers a Bi-directional digital audio interface that route directly into the baseband layer of the Module firmware. It does not pass through the HCI protocol layer.

Hardware on MD-7EM allows the data to be sent to the received from a SCO connection.

MD-7EM can be configured as PCM interface Master generating an output clock of 128, 256 or 512KHz. When configured as PCM interface slave it can operated with input clock up to 2048KHz. MD-7EM is compatible with a variety of clock formats, including Long Frame Sync, Short Frame Sync and GCI timing environments.

It supports 13-bit or 16-bit liner, 8-bit u-law or A-law companied sample formats at 8K samples/s and can receive and transmit on any selection of the first four slots following PCM_SYNC.
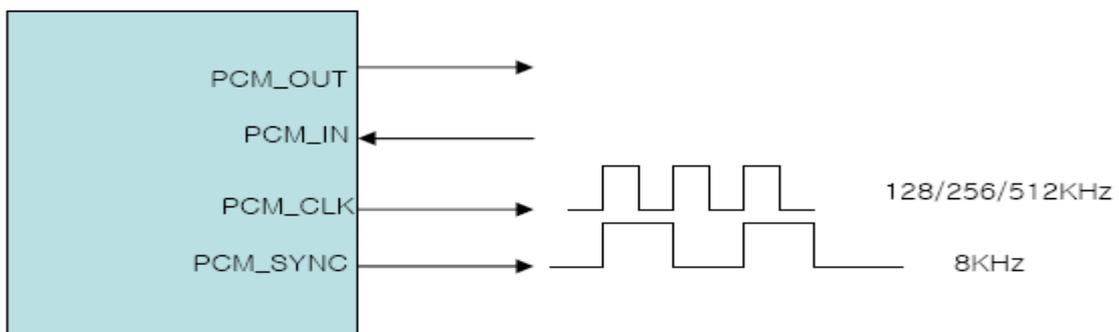
MD-7EM as PCM Interface Master
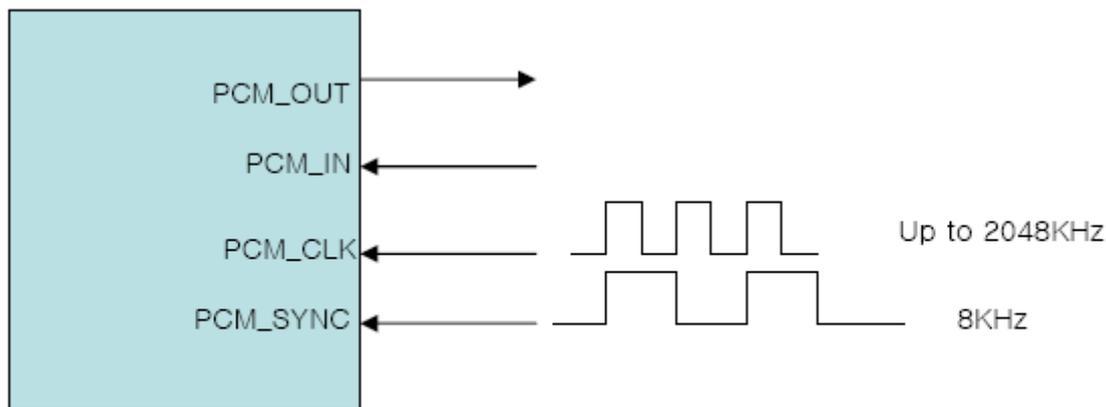
MD-7EM as PCM Interface Slave

12. USB Interface

　　MD-7EM USB devices contain a full speed (12Mbit/s) USB interface that is capable of driving of a USB cable directly. No external USB transceiver is required. The device operates as s USB peripheral, responding to requests from a master host controller such as a PC. Both the OHCI and UHCI standards supported. The set of the USB endpoints implemented behave as specification V1.2.

As USB is Master/Slave oriented system (in common with other USB peripheral), MD-7EM only supports USB slave operation.

MD-7EM features an internal USB pull-up resistor. This pulls the USB+ pin weakly high when MD-7EM is ready to enumerate. It signals to the PC that it is a full Speed (12Mbit/s) USB device.

13. Audio Interface

　The audio interface circuit consists of audio CODEC, dual audio inputs and outputs, and a PCM, I2S or SPDIF configurable interface V1.2.

The CODEC supports stereo playback and recording of audio signals at multiple sample rates with a resolution of 16-bit. The ADC and the DAC of the CODEC each contain two independent channels. Any ADC or DAC channel can be run at its won independent sample rate.

PCM Interface	SPDIF Interface	I2S Interface
PCM_OUT	SPDIF_OUT	SD_OUT
PCM_IN	SPDIF_IN	SD_IN
PCM_SYNC		WS
PCM_CLK		SCK

< Alternative Functions of the Digital Audio Bus Interface On the PCM Interface>

The audio input circuitry consists of a dual audio input that can be configured to be either single ended or fully differential and programmed for either microphone or line input. It has a programmable gain stage for optimization of different microphones.

The digital audio bus supports various digital bus standard, which include I2S, and the interfaces contained within the IEC 60958 specification such as SPDIF and AES3.
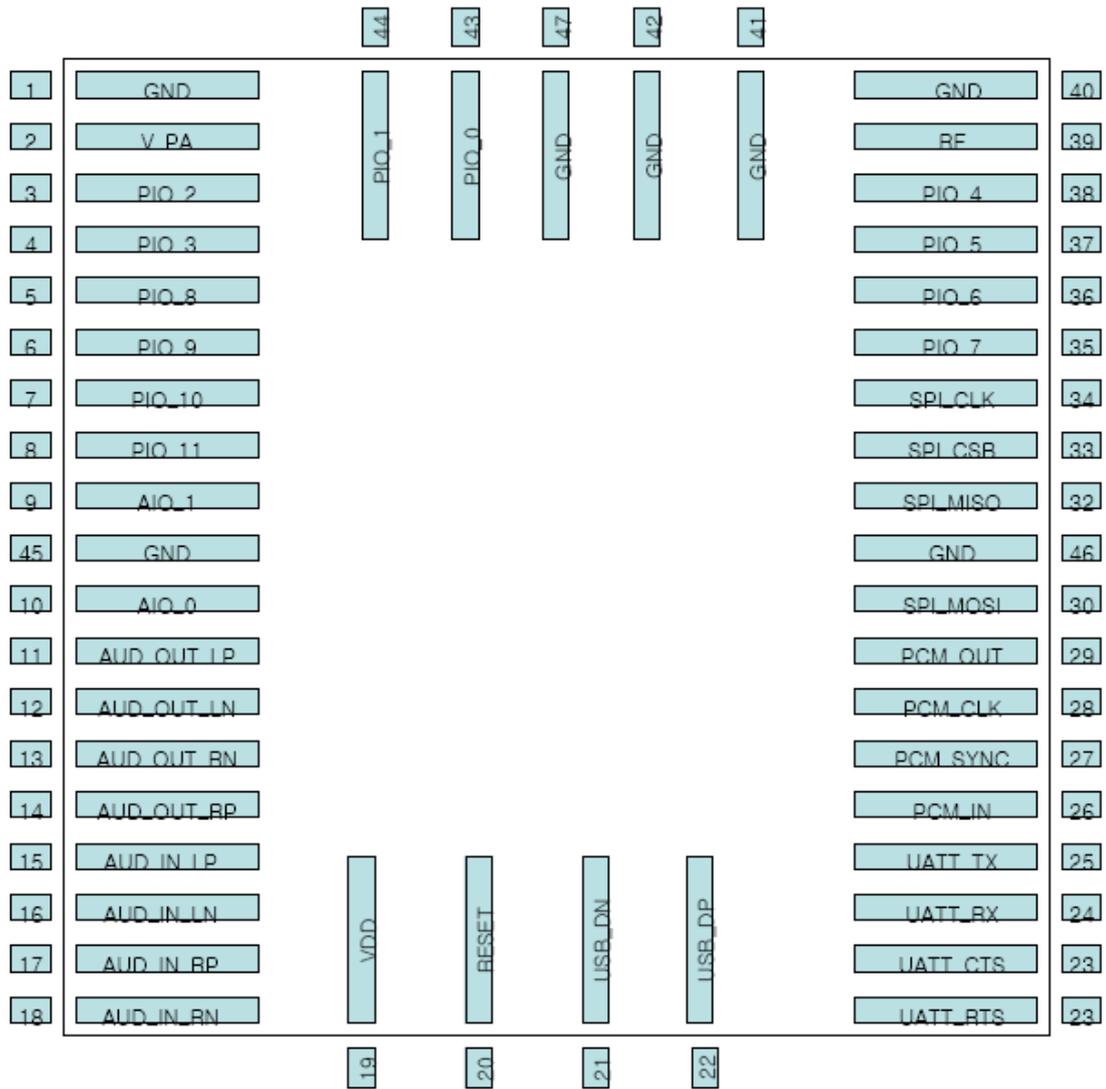
14. Stereo Audio Interface.

The main features of the interface are:

-16-bit resolution, standard, sample rates of 8KHz, 11.025KHz, 16KHz, 22.050KHz, 32KHz, 44.1KHz and 48KHz(DAC only)

-Dual ADC and DAC for stereo audio.

-Integrated amplifiers for driving microphone and speakers with minimum external components

-Stereo and mono analogue input for voice band and audio band

-Stereo and mono analogue output for voice band and audio band

-Support for stereo digital audio bus standards such as I2S

-Support for IEC-60958 standard stereo digital bus standards i.e. S/PDIF and AES3EBU

-Support for PCM interfaces including PCM master CODEC that require an external system clock.
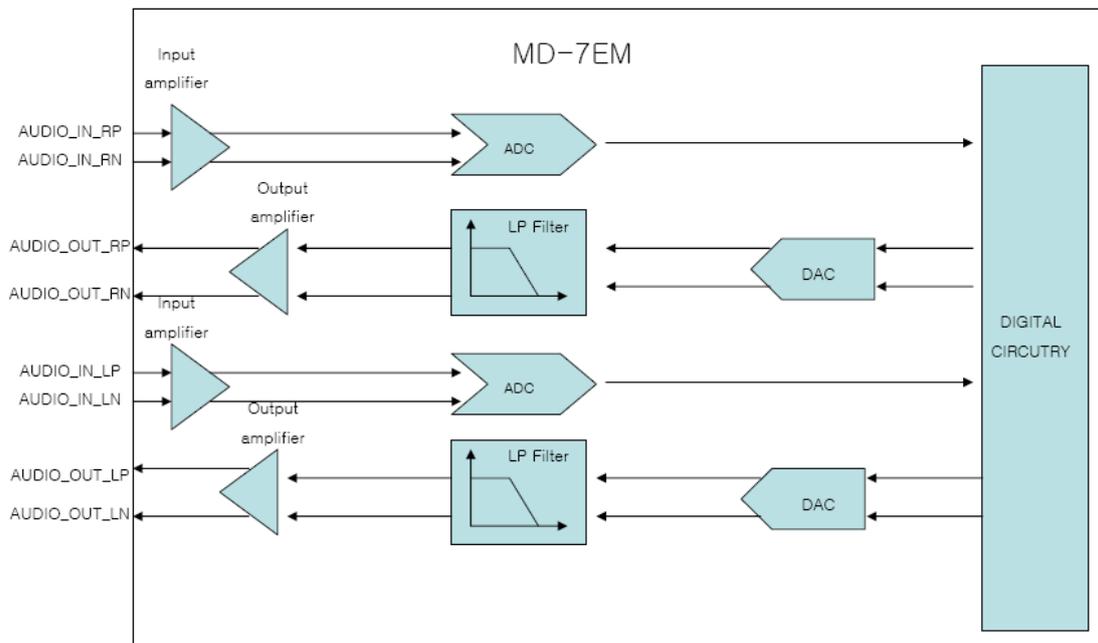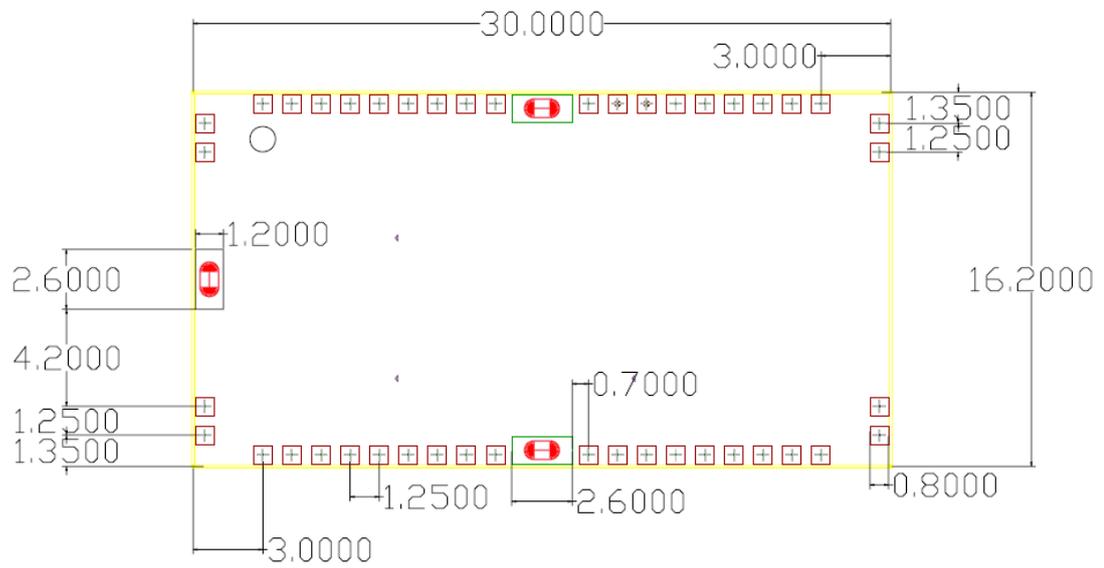
The stereo audio CODEC uses a fully differential architecture in the analogue signal path, which results in low noise sensitivity and good power supply rejection while effectively doubling the signal amplitude. It operates from a single power-supply of 1.8V and uses a minimum of external components.
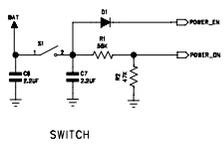
14. Pin Map

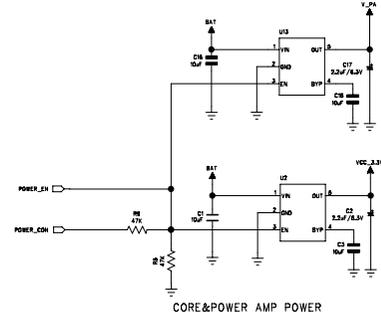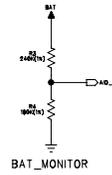|	
1	GND
2	V_PA
3	PIO_2
4	PIO_3
5	PIO_8
6	PIO_9
7	PIO_10
8	PIO_11
9	AIO_1
45	GND
10	AIO_0
11	AUD_OUT_LP
12	AUD_OUT_LN
13	AUD_OUT_RN
14	AUD_OUT_RP
15	AUD_IN_LP
16	AUD_IN_LN
17	AUD_IN_RP
18	AUD_IN_RN

Top pins: 44 PIO_1, 43 PIO_0, 47 GND, 42 GND, 41 GND

GND	40
RF	39
PIO_4	38
PIO_5	37
PIO_6	36
PIO_7	35
SPI_CLK	34
SPI_CSB	33
SPI_MISO	32
GND	46
SPI_MOSI	30
PCM_OUT	29
PCM_CLK	28
PCM_SYNC	27
PCM_IN	26
UATT_TX	25
UATT_RX	24
UATT_CTS	23
UATT_RTS	23

Bottom pins: 19 VDD, 20 RESET, 21 USB_DN, 22 USB_DP

TOP VIEW

15. Dimension

SWITCH

CORE&POWER AMP POWER

BAT_MONITOR

SPEAKER

MIC

COMPANY:

TITLE:

DRAWN:	DATED:				
CHECKED:	DATED:	CODE:	SIZE:	DRAWING NO:	REV:
QUALITY CONTROL:	DATED:				
RELEASED:	DATED:	SCALE:		SHEET: OF	