# **PRMBA00** Bluetooth Low Latency audio module

Data sheet version 0.2



# Disclaimer

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### Introduction

PRBMA00 is a Bluetooth audio module with low latency, complies with Bluetooth v5.1 dual mode (Classic and Low Energy) specification.

The core chip is a 32-bit processor with 16Mb flash and a AV DSP with two 32x32 MAC, with such powerful audio processor, PRBMA00 is possible to implement advance features, such as low latency, noise cancellation, echo cancellation...

Different standard firmwares are available for PRBMA00 for different applications, such as gaming headset, 2.1 soundboard, broadcasting speakers... provides the easiest way for user to implement such feature to their products.

PRMBA01 is FCC, CE, TELEC and BQB certified module, which reduces customer's resource for qualification and allows product to be time to market.



# Applications

- Phone accessories
- Home Theatre
- Gaming headset
- Party speaker
- TV system
- Projector
- Karaoke system
- Microphone
- PC audio system

# Hardware information

### **Features**

- Chip antenna, ext. antennal optional
- Tensilica HiFi 3 DSP with LX7 processor
  - Two 32x32 MAC, or Four 24 x 24 MAC
  - 352KB RAM, 16Mb NOR flash
- Bluetooth v5.1 dual mode (Classic and Low Energy) transceiver
- Support profiles\*:
  - SPP1.2,
  - RECOMM 1.2,
  - A2DP1.3,
  - AVRCP 1.6,
  - GAVDP 1.3,
  - AVDTP 1.3,
  - AVCTP 1.4,
  - HFP 1.7, - PBAP 1.2
- IDAI 1.2
- Support codec\*:
  - SBC,
  - FastStream,
  - mSBC,
  - MP3 with 384kbps support,
  - AAC and AAC+,
  - DAB and DAB+,
  - AAC Multi Channel
  - and third party codec
- Audio processing\*:
  - Multi-band EQ,
  - Multi-band DRC,
  - High quality SRC,
  - Pitch and speed control,
  - MIC array,
  - FFT,
  - Echo cancellation
  - And third party algorithms
- High SNR PWM output, able to direct drive speaker
- Audio sources:
  - Analog in (AUX)
  - SD/MMC/eMMC
  - I2S
  - S/PDIF
  - Mic
- Audio output
  - Analog (internal DAC, Headphone out)
- Audio PWM
- Interfaces
  - UART(s), SPI, IR
- FCC, CE, KCC and TELEC certifications (in progress)

# Pin assignment



pin	name	Description	Multiplex function
1	GND	Gound	
2	MIC2_DATA	Digital mic channel 2 data	i. 12S[2] data; ii. GPIO[0]5; iii.SD card[2]data; iv. 12S[2] data in
3	MIC_CLK	Digital mic PDM CLK	i. GPIO0[0]; ii. I2S[1] master CLK; iii. General PWM
4	MIC0_DATA	Digital mic channel 0 data	i. SD card data 0; ii. GPIO0[3]; iii. I2S[0] data
5	MIC1_DATA	Digital mic channel 1 data	i. SD card data 1; ii. GPIO0[4] ; iii. I2S[1] data
6	MIC3_DATA	Digital mic channel 2 data	i. GPIO0[6]; ii. SD card[3] DATA; iii. I2S[3] Data in; iv. SPI clock
7	UART[2]_Rx	UART port 2 Rx	<b>i.</b> GPIO0[26]; <b>ii</b> . IR input
8	UART[2]_Tx	UART port 2 Tx	GPIO0[9];
9	Rot A	Rotary A input, channel 2	Channel 2; GPIO2[28]
10	Rot B	Rotary B input, channel 2	Channel 2 GPIO2[29]
11	I2S BCLK	I2S master clk, BCLK channel B	GPIO1[8]
12	I2S LRCK	I2S master clock, LRCK channel B	GPIO1[9]
13	AGND	Analog ground	NIL
14	MIC_L+	Analog mic input, LEFT positive	NIL
15	MIC_R+	Analog mic input, RIGHT	NIL
16	AUX_L+	Left channel single-end line-in	NIL
17	AUX_R+	Right channel single-end line-in	NIL
18	GND	ground	NIL
19	BATT	battery charging	NIL
20	GND	ground	NIL
21	USB_D+	USB data +	NIL
22	USB_D-	USB data -	NIL

pin	name	Description	Multiplex function	
23	USB_5V	5V input from USB port	NIL	
24	RST_55P	For battery charging	NIL	
25	SCL_55P	For battery charging	NIL	
26	SDA_55P	For battery charging	NIL	
27	HP_N_LCH	Headphone analog output, left -	Ground for signle-end output	
28	HP_P_LCH	Headphone analog output, left +	internal DAC output	
29	HP_P_RCH	Headphone analog output, right +	internal DAC output	
30	HP_N_RCH	Headphone analog output, right -	Ground for signle-end output	
31	GND	Ground		
32	PWM_CH3 +	Audio PWM CH3 +	i. GPIO2[4]; ii. General PWM output	
33	PWM_CH3 -	Audio PWM CH3 -	i. SPI 1 Chip Select, active low; ii. GPIO2[5]	
34	PWM_CH4 +	Audio PWM CH4 +	i. I2S[0] data in; ii. I2S[2]master CLK, iii. channel2; GPIO2[6]	
35	PWM_CH4 -	Audio PWM CH4 -	i. I2S[1] data in; ii. S/PDIF output; iii. GPIO2[7]	
36	PWM_CH5 +	Audio PWM CH5 +	i. SPI master input slave output; ii. GPIO2 [8]	
37	PWM_CH5 -	Audio PWM CH5 -	i. SPI master output slave input; ii GPIO2[9]	
38	PWM_CH6 +	Audio PWM_CH6 +	i. SPI selection, active low; ii. GPIO2[10]	
39	PWM_CH6 -	Audio PWM_CH6 -	i. SPI CLK; ii. GPIO2[11]	
40	GPIO[0]7	GPIO channel0 pin 7	i. I2S CLK; ii. SD card CLK	
41	GPIO0[8]	GPIO channel0 pin 8	i. I2S LR CLK; ii. SD card command pin	
42	Key_in	Push button input	ADC channel 0	
43	ADC_IN 1	General channel 1 ADC	NIL	
44	UART[0]_Rx	UART port 0 Rx	GPI00[2]	
45	UART[0]_Tx	UART port 0 Tx	GPIO0[1]	
46	OFF_CTRL	Power control, for testing only	NIL	
47	OFF_KEY	Power on/off pin	NIL	
48	GND	Ground	NIL	

\* actual pin feature depends on configuration in firmware.

### Suggested external circuit

#### Audio PWM output

With high PWM frequency, PRBMA00 is able to output high SNR audio to PWM output, and drive speaker through a simple push-pull MosFET circuit instead of class-D amplifier. Below is the testing result:



PWM output performance



#### Key\_in

The Key\_in pin is to connect to control buttons, such as volume control, source selection...etc. The circuit is as following:



#### **USB** interface

PRBMA00 is able to be powered by USB interface, as well as USB audio source, the related circuit is illustrated as below:



#### Power\_ON/OFF

Here is the simple circuit of turn PRBMA00 to ON or OFF status.



#### **Optical interface**

PRBMA00 is able receive audio signal from optical, and below is the circuit.



#### IR receiver

It is also possible PRBMA00 to accept command from IR control, and the circuit will be as following.



# Dimension



unit: mm

# **Electrical Specification**

General	Operation voltage	5-7VDC
	Supply current	TBC
	Microcontroller	Tensicilica LX7
	GPIO	19 configurable (PRMD01) 35 configurable (PRMD00)
	Oscillators	24MHz crystal oscillator 32.768kHz oscillator
	Audio IO	DAC input/output, PWM, I2S,
	Digital I/O	X2 Hardware SPI master UART
RF	Frequency band	2.4GHz ISM ( 2.40000 – 2.4835GHz)
	Modulation	GFSK
	Data rate	250kbps, 1 Mbps, 2 Mbps
	TX Power	-20 to +4dBm in 4dB steps
	Sensitivity	-91dBm Bluetooth low energy -94dBm at 250kb -88dBm at 1Mbs -83dBm at 2Mbs
	RF Range (indoor)	to be determined
Environmental	Operation temperature	-20 ~ +70°C (target)
	Storage temperature	$-40 \sim +80^{\circ}C$ (target)
	Operation humidity	to be determined
	Storage humidity	to be determined

Table 1 Specification

### Antenna

PRBMA00 comes with on-board chip antenna as default, PRBMA00 also provides an optional I-PEX connector, allowing user to connect PRBMA00 with external antenna.



User must aware that when I-PEX connector is used, RF performance may be vary from the specification listed in this document. It is suggest user with RF knowledge if selecting I-PEX option.

Characteristic of on-board chip antenna is illustrated as following:



# The firmware

Two type of firmware will be pre-programmed into PRBMA0x: Two-way streaming firmware and Multi-connection firmware, ordering part number is listed on the Ordering information section. The feature and operation of these firmware is described as below.

#### i. Two-way streaming firmware

#### **Basic description**

This firmware allows audio source , from USB, AUX or Bluetooth to be sent from Txmodule to Rx-module with low latency (~16ms), and where audio signal pickup from mic from Rx-module to Tx-module with about 30ms<sup>\*</sup>. Diagram below illustrates the operation:



#### Pairing

This firmware supports pairing method:

Pairing Tx and Rx module

Press and hold STOP button Tx-module and SOURCE button of Rx-module for 5 sec., the two modules into paring mode and they will then automatically paired and connected [ADD LED here]. When a Tx and Rx module are connected, low-latency feature will be automatically enabled.

Pairing Rx module with other device

Rx module can also connected with other Bluetooth device, such as smart phone, when the Rx module is in pairing mode and noTx module exist, Rx-module will then advise itself and allows third party Bluetooth device to connect. When Rx-module is connect with third party Bluetooth device, the connection will become a classic Bluetooth connection and no low-latency will be enabled.

#### Audio source

Pressing SOURCE button of Tx-module switches audio source to Tx-module, and the order is: USB  $\rightarrow$  AUX  $\rightarrow$  Bluetooth  $\rightarrow$  USB  $\rightarrow$  AUX ...

\* the figure are the latency between Tx and Rx module

#### Audio stream

When Tx and Rx module are paired and connected, the audio stream is as following: Audio source from USB, AUX or Bluetooth will be transmitted to to Rx-module, and will then output to MPS port (speaker output), as illustrated as the blue path on the above diagram; On the other hand, audio signal picked up from capacitor mic that connected to Rx-module will be then transmitted to Tx-module and output the the MPS ports of Tx-module (as the red path).

#### ii. Multi-connection firmware

This firmware allows an audio source to be transmitted from one Tx-module to multiple Rx-modules. The audio streaming from Tx-module to Rx-modules are with low latency and synchronised It is illustrated as the following diagram:



#### Multi-connection illustration

#### Pairing

After power up, there is a 10 sec that Tx-module is "ready for connection", Rxmodule is able to pair and connect with Tx-module within this window. Once they are paired, Rx-module(s) and Tx-module will re-connect after power up.

When in "ready for connection" window, press SOUCE button of Rx-module(s) will force Rx-module(s) to connect to Tx-module, and once the Tx-module and Rx-module(s) are connected, low latency and synchronise feature will be automatically enable.

Pressing Rx-module(s) SOURCE key again will disconnect the connection with Txmodule and makes the Rx-module available for connection of other devices, i.e. smart phone.

#### Audio source

Pressing SOURCE button of Tx-module switches audio source to Tx-module, and the order is: USB  $\rightarrow$  AUX  $\rightarrow$  Bluetooth  $\rightarrow$  USB  $\rightarrow$  AUX ... , details to be added

#### iii. Customised firmware

It is possible to customise firmway base on customer's application, possible change are changing user interface, adding audio processing algorithm, and even adding Dolby Digital and DTS \*. Non-refundable Engineering charge (NRE) is needed for customising firmware, please simply contact us for the details.

#### iv. Simple UART port Command

Each firmware provides a UART port command feature, which allows user to control PRBMA00 from UART port. Configuration of UART port is: BAUD: 115200, 8, n, 1, and the command is listed as below:

Action	command	return value
Change Bluetooth name		
Volume up		Later /
Volume down	Jetai	
Select source	Adda	
Sleep mode	$\sim$	
Disconnect exist connection		

\*Dolby and DTS are trade mark of Dolby lab. and DTS respectively

# Mounting guide

PRBMA0x is RF sensitive; in order to obtain the best performance, it is recommended to mount the module at corner of mother board, and with some marginal space.

Also, keep it away from metal components, such like speakers, transformers, batteries, big aluminum capacitors, heat sinks and Metal Panels.

The figure below illustrates how to mount the PRBMA0x module. Improper mounting will decrease the RF performance dramatically.



Note: This guide applies to PRBMA00 with on-board chip antenna, and not for PRBMA00 using external antenna

# **Physical Dimension**



Dimension (mm)

# Soldering flow

Add details here, mainly tray

# Package

Add details here, mainly tray

# **Evaluation Kit**

The evaluation kit (EVK) consists of 3 different boards and order separately, they are: main board, IO board and speaker board, they can be stacked for operation.

Main board - It is the core board of the EVK containing PRBMA0x module on bard, where user can connect it with external circuit directly.

IO board - This board contains external interface circuits that connects to the Main board, including HDMI interface, USB, AUX in, headphone out, IR receiver and mic input. This is a optional board

Speaker board - This board contains suggest speaker circuit so that user can simply connect speaker on it. This is an optional board



# Application

PRBMA00 can be used in different applications, here are some of the suggested application block diagrams for reference.

#### Sound bar system

A sound bar system is an audio system which is relatively simpler than traditional AV system, a wireless sound bar system is illustrated as following:



A sound bar system mainly consist a sound bar and a sub-woofer. Usually the sound bar is wired with audio source (i.e. TV), where sub-woofer is either wired or wireless, if wireless, low latency of this streaming becomes very important. Therefore, PRBMA00 's low latency is suitable for this application. Below is the block diagram for the sound bar and sub-woofer:





Wireless gaming head set

Video gaming become more popular nowadays, and wireless headset for video game must provide a very low latency feature so that audio and video are in-sync, and player can take proper action in time. System diagram of wireless gaming headset is illustrated as following:



The block diagram for both the Tx dongle and headset is suggested as following :



#### Tx dongle

#### Headset block diagram



#### Reference circuit





### Certifications



### Ordering part number

Naming of PRBMA00 is design as following:



Available part number: Module:

**PRBMA00-000**: PRBMA00 module, on board chip antenna, two-way streaming firmware **PRBMA00-001**: PRBMA00 module, on board chip antenna, multi-connection firmware **PRBMA00-100**: PRBMA00 module, I-PEX connector, two-way streaming firmware **PRBMA00-101**: PRBMA00 module, I-PEX connector, multi-connection firmware

Evaluation board:

**PRBMAEVK-CORE**: PRBMA00 evaluation board, main board, with PRBMA00 embedded **PRBMAEVK-IO**: I/O board for PRBMAEVK **PRBMAEVK-SPK**: Speaker board for PRBMAEVK

# **Revision History**

2020-Juneversion 0.1 — — first draft2020-Juneversion 0.2 — — adding application block diagram

# **Contact information**

#### Head quarter:

K-Solution Consulting Co. Ltd.

web: www.k-sol.com.hk

Tel: +852-91983405

Fax: +852 3013 8763

E-mail: sales@k-sol.com.hk