Linkplay Wireless Smart Audio Module (A98M-12)

User Manual

Revision 0.1

May 29, 2019

HISTORY

Version	Date	Description
0.1	05/29/2019	Initial version release

INDEX

1.Overview

Linkplay Wireless Smart Audio module–A98M-12, is our 3rd generation smart audio modules developed to be used in the connected speaker, sound bar and other connected audio devices. It integrates the low power Broadcom BCM43456 Wi-Fi/BT chip and amlogic A113X application processor. A113X is an advanced application processor designed for connected audio applications. It integrates a powerful CPU subsystem, advanced multi-format audio processing unit, a secured running environment and all major peripherals to form the low power audio AP.

The main system CPU is a quad-core ARM Cortex-A53 CPU with L1 instruction/data cache for each core and a large unified L2 cache to improve system performance. Each Cortex-A53 CPU can run up to 1.5GHz (DVFS + hot plug) and has a wide bus connecting to the memory sub-system. When the system is suspended, the main CPU can be powered off and the cortex-M3 in the always-on power domain can resume the system from multiple interrupt sources.

The audio processing engine (APE) is based on ARM® NEONTM general-purpose SIMD architecture which works seamlessly with main CPU to accelerate the multimedia processing algorithms, enhancing the user experience. It is able to decode all major high resolution audio formats including MP3, AAC, WMA, RM, FLAC, Ogg, etc and with the flexibility to support future audio standards.

A113X integrates all standard audio input/output interfaces including multiple TDM, PCM, I2S and SPDIF digital audio input/output interfaces, and 8 channel far-field PDM digital microphone (DMIC) inputs. Audio input has power detector to wake up from low activity states and hardware assisted synchronization blocks for multiple room audio applications. Audio input data can be restricted to trusted memory space to protect always-on audio privacy.

A98M-12 module supports IEEE 802.11 a/b/g/n/ac 2.4GHz and 5GHz. It also supports BT5.0 with EDR and BLE.

A98M-12 module also provides USB, I2S, I2C, PDM, SPI, UART etc. interfaces.

The firmware is fully compatible with Apple AirPlay and digital living network alliance (DLNA) streaming standards. It supports Hi-Fi audio up to 192KHz, 24-bit with most popular audio formats. It supports multi-room and multi-channel audio streaming with perfect synchronization.

With this module, you can play the music on your speaker wirelessly from iPhone, iPad , iPod touch, Android devices or PC. More important, it enables the traditional speaker system to become the Internet enabled device through the wired or wireless connection provided by the module. Thus, you could freely playback any Internet audio contents such as music, podcast, radio or either the accompany audio in the movie directly from the Internet.

Features

- amlogic A113X application processor
- 128MB DRAM
- 256MB NAND FLASH
- AMPAK AP6256
- Support IEEE 802.11 a/b/g/n/ac Wi-Fi dual band
- Support BT5.0 with EDR and BLE

Application

- Connected speaker, sound bar

- Connected audio devices

1.1. Parameter

Type	Items	Performance
Wi-Fi	Certification	TBD
	WLAN Standard	IEEE 802.11 a/b/g/n/ac Wi-Fi compliant
Wi-Fi (2.4G)	Frequency Range	2.400 GHz ~ 2.4835 GHz (2.4 GHz ISM Band)
	Number of Channels	Ch1 ~ Ch13
	Modulation	802.11b : DQPSK, DBPSK, CCK
		802.11g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK
	Output Power (Tolerance ± 1.5 dB The transmit EVM quality & spectrum mask are compliant with IEEE 802.11 standard)	802.11b 1/2/5.5/11Mbps : 17 dB
		802.11g 6/9/12/18/24/36Mbps : 16 dB
		802.11g 48/54Mbps : 15 dB
		802.11n 20MHz MCS0-3 : 17 dB
		802.11n 20MHz MCS4 : 16 dB
		802.11n 20MHz MCS5 : 15 dB
		802.11n 20MHz MCS6/MCS7 : 14 dB
	Receive Sensitivity (Tolerance ± 2 dB CCK modulation PER ≦ 8%、OFDM modulation PER ≦ 10%) @8% PER	802.11b 1Mbps -96 dBm
		802.11b 2Mbps -90 dBm
		802.11b 5.5Mbps -88 dBm
		802.11b 11Mbps -87 dBm
		802.11g 6Mbps -91 dBm
		802.11g 9Mbps -88 dBm
		802.11g 12Mbps -87 dBm
		802.11g 18Mbps -85 dBm
		802.11g 24Mbps -83 dBm
		802.11g 36Mbps -80 dBm
		802.11g 48Mbps -76 dBm
		802.11g 54Mbps -73 dBm
		802.11n 20MHz MCS0 -90 dBm
		802.11n 20MHz MCS1 -85 dBm
		802.11n 20MHz MCS2 -84 dBm
		802.11n 20MHz MCS3 -80 dBm
		802.11n 20MHz MCS4 -77 dBm
		802.11n 20MHz MCS5 -75 dBm
		802.11n 20MHz MCS6 -72 dBm
		802.11n 20MHz MCS7 -71 dBm
	Maximum Input Level	802.11b : -10 dBm
		802.11g/n : -20 dBm

	Antenna Interface	External: I-PEX I with 0 ~ 2 dBi peak gain
	WLAN Standard	IEEE 802.11a/n/ac 1x1 & Wi-Fi compliant
	Frequency Range	5.15 ~ 5.35GHz、5.47 ~ 5.725GHz、5.725 ~ 5.85GHz (5GHz UNII Band)
	Number of Channels	5.18~5.35GHz：Ch36 ~ Ch64 5.5~5.7GHz：Ch100 ~ Ch140 5.745~5.825GHz：Ch149 ~ Ch165
	Modulation	802.11a : OFDM /64-QAM、16-QAM、QPSK、BPS
		802.11n : OFDM /64-QAM、16-QAM、QPSK、BPSK
		802.11ac : OFDM /256-QAM、OFDM /64-QAM、16-QAM、QPSK、BPSK
	Output Power (Tolerance ± 2 dB The transmit EVM quality & spectrum mask are compliant with IEEE 802.11 standard)	802.11a 5180~5350GHz 6-9Mbps、12-18Mbps、24Mbps : 17 dBm
		802.11a 5180~5350GHz 36/48Mbps : 16 dB
		802.11a 5180~5350GHz 54Mbps : 15 dB
		802.11a 5500~5700GHz 6-9Mbps、12-18Mbps、24Mbps : 17 dB
		802.11a 5500~5700GHz 36/48Mbps : 16 dB
		802.11a 5500~5700GHz 54Mbps : 15 dB
		802.11a 5745~5825GHz 6-9Mbps、12-18Mbps、24Mbps : 17 dB
		802.11a 5745~5825GHz 36/48Mbps : 16 dB
		802.11a 5745~5825GHz 54Mbps : 15 dB
		802.11n 20MHz 5180~5350GHz MCS0-3 : 17 dB
		802.11n 20MHz 5180~5350GHz MCS4/5 : 16 dB
		802.11n 20MHz 5180~5350GHz MCS6 : 15 dB
		802.11n 20MHz 5180~5350GHz MCS7 : 14 dB
		802.11n 20MHz 5500~5700GHz MCS0-3 : 17 dB
		802.11n 20MHz 5500~5700GHz MCS4/5 : 16 dB
		802.11n 20MHz 5500~5700GHz MCS6 : 15 dB
		802.11n 20MHz 5500~5700GHz MCS7 : 14 dB
		802.11n 20MHz 5745~5825GHz MCS0-3 : 17 dB
		802.11n 20MHz 5745~5825GHz MCS4/5 : 16 dB
		802.11n 20MHz 5745~5825GHz MCS6 : 15 dB
		802.11n 20MHz 5745~5825GHz MCS7 : 14 dB
		802.11n 40MHz 5180~5350GHz MCS0-3 : 17 dB
		802.11n 40MHz 5180~5350GHz MCS4/5 : 16 dB
		802.11n 40MHz 5180~5350GHz MCS6 : 15 dB
		802.11n 40MHz 5180~5350GHz MCS7 : 14 dB
		802.11n 40MHz 5500~5700GHz MCS0-3 : 17 dB
		802.11n 40MHz 5500~5700GHz MCS4/5 : 16 dB

		802.11n 40MHz 5500~5700GHz MCS6 : 15 dB
		802.11n 40MHz 5500~5700GHz MCS7 : 14 dB
		802.11n 40MHz 5745~5825GHz MCS0-3 : 17 dB
		802.11n 40MHz 5745~5825GHz MCS4/5 : 16 dB
		802.11n 40MHz 5745~5825GHz MCS6 : 15 dB
		802.11n 40MHz 5745~5825GHz MCS7 : 14 dB
		802.11ac 20MHz 5180~5350GHz MCS0-3 : 17 dB
		802.11ac 20MHz 5180~5350GHz MCS4/5 : 16 dB
		802.11ac 20MHz 5180~5350GHz MCS6 : 15 dB
		802.11ac 20MHz 5180~5350GHz MCS7 : 14 dB
		802.11ac 20MHz 5180~5350GHz MCS8 : 12 dB
		802.11ac 20MHz 5500~5700GHz MCS0-3 : 17 dB
		802.11ac 20MHz 5500~5700GHz MCS4/5 : 16 dB
		802.11ac 20MHz 5500~5700GHz MCS6 : 15 dB
		802.11ac 20MHz 5500~5700GHz MCS7 : 14 dB
		802.11ac 20MHz 5500~5700GHz MCS8 : 12 dB
		802.11ac 20MHz 5745~5825GHz MCS0-3 : 17 dB
		802.11ac 20MHz 5745~5825GHz MCS4/5 : 16 dB
		802.11ac 20MHz 5745~5825GHz MCS6 : 15 dB
		802.11ac 20MHz 5745~5825GHz MCS7 : 14 dB
		802.11ac 20MHz 5745~5825GHz MCS8 : 12 dB
		802.11ac 40MHz 5180~5350GHz MCS0-3 : 17 dB
		802.11ac 40MHz 5180~5350GHz MCS4/5 : 16 dB
		802.11ac 40MHz 5180~5350GHz MCS6 : 15 dB
		802.11ac 40MHz 5180~5350GHz MCS7 : 14 dB
		802.11ac 40MHz 5180~5350GHz MCS8 : 12 dB
		802.11ac 40MHz 5180~5350GHz MCS9 : 10.5 dB
		802.11ac 40MHz 5500~5700GHz MCS0-3 : 17 dB
		802.11ac 40MHz 5500~5700GHz MCS4/5 : 16 dB
		802.11ac 40MHz 5500~5700GHz MCS6 : 15 dB
		802.11ac 40MHz 5500~5700GHz MCS7 : 14 dB
		802.11ac 40MHz 5500~5700GHz MCS8 : 12 dB
		802.11ac 40MHz 5500~5700GHz MCS9 : 10.5 dB
		802.11ac 40MHz 5745~5825GHz MCS0-3 : 17 dB
		802.11ac 40MHz 5745~5825GHz MCS4/5 : 16 dB
		802.11ac 40MHz 5745~5825GHz MCS6 : 15 dB
		802.11ac 40MHz 5745~5825GHz MCS7 : 14 dB
		802.11ac 40MHz 5745~5825GHz MCS8 : 12 dB
		802.11ac 40MHz 5745~5825GHz MCS9 : 10.5 dB
		802.11ac 80MHz 5180~5350GHz MCS0-3 : 17 dB
		802.11ac 80MHz 5180~5350GHz MCS4/5 : 16 dB
		802.11ac 80MHz 5180~5350GHz MCS6 : 15 dB

		802.11ac 80MHz 5180~5350GHz MCS7 : 14 dB
		802.11ac 80MHz 5180~5350GHz MCS8 : 12 dB
		802.11ac 80MHz 5180~5350GHz MCS9 : 10.5 dB
		802.11ac 80MHz 5500~5700GHz MCS0-3 : 17 dB
		802.11ac 80MHz 5500~5700GHz MCS4/5 : 16 dB
		802.11ac 80MHz 5500~5700GHz MCS6 : 15 dB
		802.11ac 80MHz 5500~5700GHz MCS7 : 14 dB
		802.11ac 80MHz 5500~5700GHz MCS8 : 12 dB
		802.11ac 80MHz 5500~5700GHz MCS9 : 10.5 dB
		802.11ac 80MHz 5745~5825GHz MCS0-3 : 17 dB
		802.11ac 80MHz 5745~5825GHz MCS4/5 : 16 dB
		802.11ac 80MHz 5745~5825GHz MCS6 : 15 dB
		802.11ac 80MHz 5745~5825GHz MCS7 : 14 dB
		802.11ac 80MHz 5745~5825GHz MCS8 : 12 dB
		802.11ac 80MHz 5745~5825GHz MCS9 : 10.5 dB
	Receive Sensitivity (Tolerance ± 2 dB OFDM modulation PER ≦ 10%)	802.11a 6Mbps -92 dBm
		802.11a 9Mbps -89 dBm
		802.11a 12Mbps -88 dBm
		802.11a 18Mbps -86 dBm
		802.11a 24Mbps -82 dBm
		802.11a 36Mbps -79 dBm
		802.11a 48Mbps -75 dBm
		802.11a 54Mbps -74 dBm
		802.11n 20MHz MCS0 -91 dBm
		802.11n 20MHz MCS1 -88 dBm
		802.11n 20MHz MCS2 -85 dBm
		802.11n 20MHz MCS3 -82 dBm
		802.11n 20MHz MCS4 -78 dBm
		802.11n 20MHz MCS5 -74 dBm
		802.11n 20MHz MCS6 -73 dBm
		802.11n 20MHz MCS7 -72 dBm
		802.11n 40MHz MCS0 -89 dBm
		802.11n 40MHz MCS1 -85 dBm
		802.11n 40MHz MCS2 -83 dBm
		802.11n 40MHz MCS3 -79 dBm
		802.11n 40MHz MCS4 -76 dBm
		802.11n 40MHz MCS5 -71 dBm
		802.11n 40MHz MCS6 -70 dBm
		802.11n 40MHz MCS7 -68 dBm
		802.11ac 20MHz MCS0 -90 dBm
		802.11ac 20MHz MCS1 -87 dBm

		802.11ac 20MHz MCS2 -84 dBm
		802.11ac 20MHz MCS3 -81 dBm
		802.11ac 20MHz MCS4 -77 dBm
		802.11ac 20MHz MCS5 -73 dBm
		802.11ac 20MHz MCS6 -71 dBm
		802.11ac 20MHz MCS7 -70 dBm
		802.11ac 20MHz MCS8 -67 dBm
		802.11ac 40MHz MCS0 -88 dBm
		802.11ac 40MHz MCS1 -83 dBm
		802.11ac 40MHz MCS2 -81 dBm
		802.11ac 40MHz MCS3 -78 dBm
		802.11ac 40MHz MCS4 -75 dBm
		802.11ac 40MHz MCS5 -70 dBm
		802.11ac 40MHz MCS6 -68 dBm
		802.11ac 40MHz MCS7 -66 dBm
		802.11ac 40MHz MCS8 -65 dBm
		802.11ac 40MHz MCS9 -63 dBm
		802.11ac 80MHz MCS0 -85 dBm
		802.11ac 80MHz MCS1 -82 dBm
		802.11ac 80MHz MCS2 -78 dBm
		802.11ac 80MHz MCS3 -74 dBm
		802.11ac 80MHz MCS4 -71 dBm
		802.11ac 80MHz MCS5 -69 dBm
		802.11ac 80MHz MCS6 -65 dBm
		802.11ac 80MHz MCS7 -63 dBm
		802.11ac 80MHz MCS8 -61 dBm
		802.11ac 80MHz MCS9 -60 dBm
	Maximum Input Level	802.11a/n : -20 dBm
		802.11ac : -30 dBm
	Antenna Reference	External: I-PE I with 0~2 dBi peak gain
Bluetooth	Certification	TBD
	Bluetooth Standard	GFSK、DQPSK、8DPSK、LE(1Mbps)、2LE(2Mbps)
	Antenna Interface	External: I-PEX I shared with Wi-Fi 0~2 dBi peak gain
	Frequency Band	2402 MHz ~ 2480 MHz
	Number of Channels	79 channels for classic、40 channels for BLE
	Modulation	FHSS, GFSK, DPSK, DQPSK
	BDR Output Power	CL1: 6dBm、CL2: 2dBm
	EDR Output Power	CL1: 4dBm、CL2: 2dBm
	LE Output Power	CL1: 5dBm、CL2: 2dBm
	Sensitivity @ BER=0.1% for GFSK (1Mbps)	-86 dBm, Typical
	Sensitivity @ BER=0.01%	-87 dBm, Typical

	for π/4-DQPSK (2Mbps)	
	Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	-83 dBm, Typical
	Sensitivity @ BER=0.01% for LE (1Mbps)	-90 dBm, Typical
	Sensitivity @ BER=0.01% for LE (2Mbps)	-90 dBm, Typical
	Maximum Input Level	GFSK (1Mbps): -20dBm
		π/4-DQPSK (2Mbps) : -20dBm
		8DPSK (3Mbps) : -20dBm
Hardware	Work voltage	3.5-5.5V
	Work current	200 ~ 240mA (STA mode)
	Standby current	5mA
	Operating ambient temperature	0℃ ~40℃
	Storage temperature	-5℃ ~45℃
	Wi-Fi work distance	2.4G 80 meters/5G 150meters
	IO Extension	USB, I2S, I2C, PWM, SPI, UART
	Dimension	NGFF golden finger 67PIN

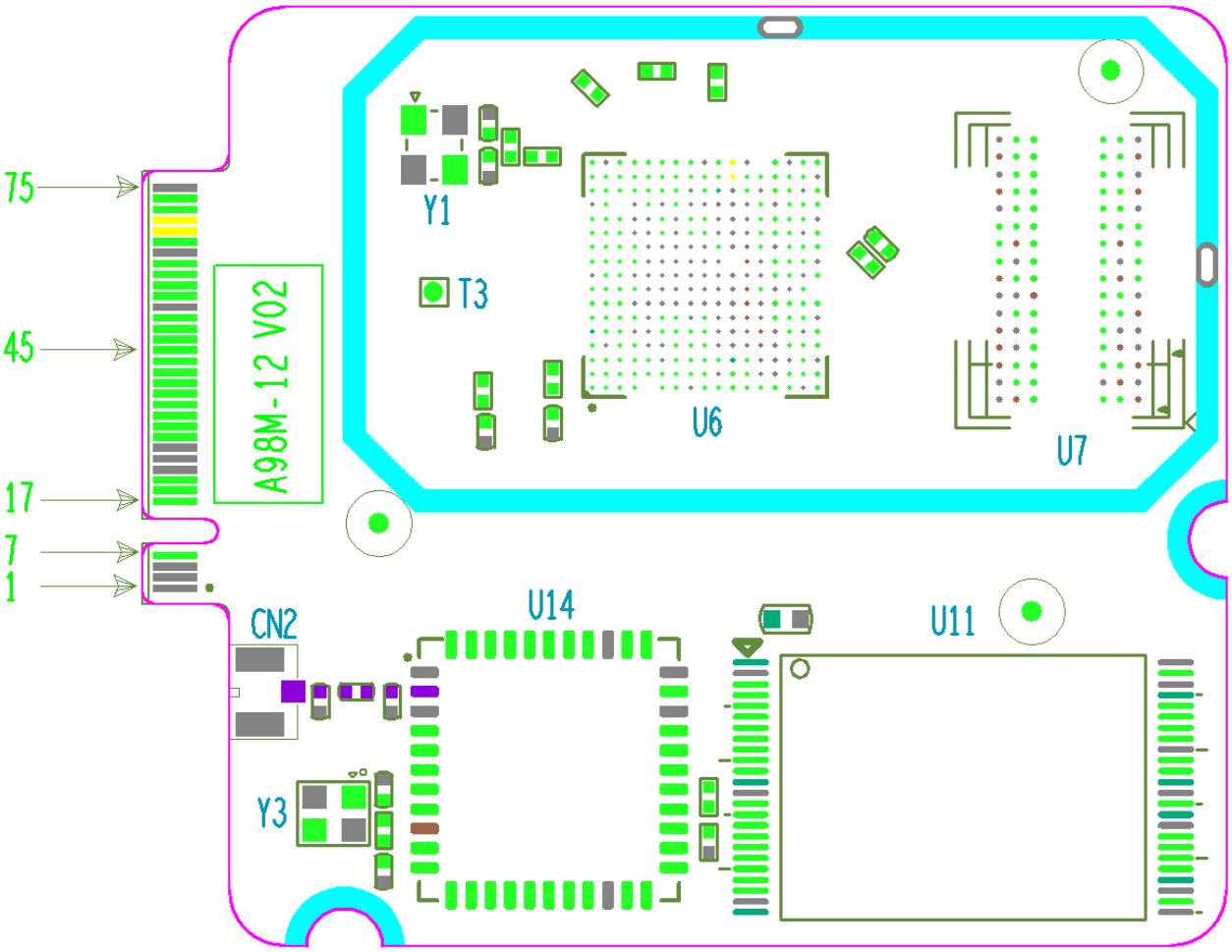
Table1-1 Linkplay A98M-12 module parameters

Note: The bluetooth output power is able to be configured by firmware (hcd file).

2. Hardware Description

2.1. Description of Hardware Interface

A98M-12 provides the option to connect with customer board through its 67-pins NGFF golden finger. The detail is as follows.



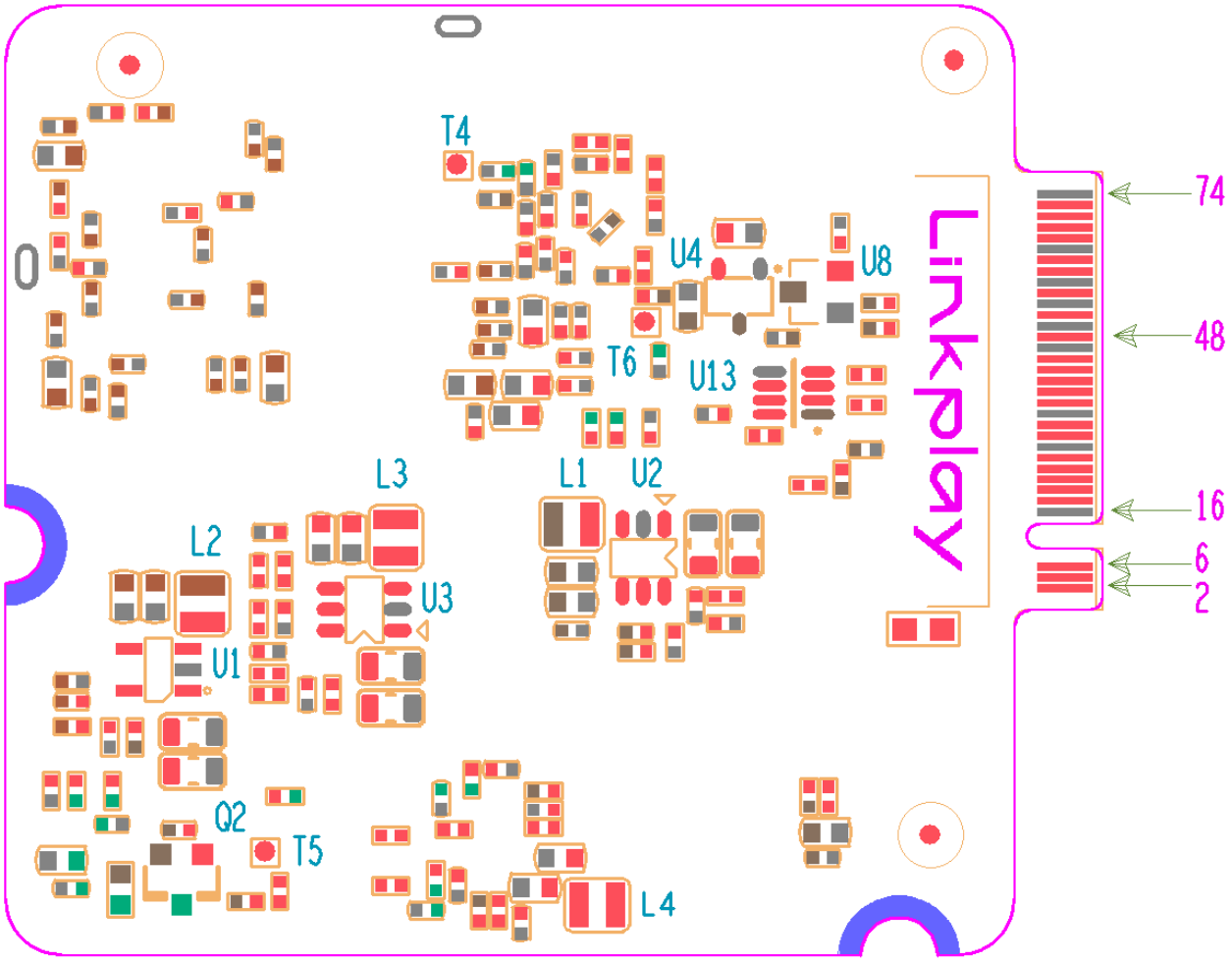


Figure 2-1 A98M-12 Interface Pins

Pin Description:

Pin No.	Pin Name	Type	Function0	Function1
1, 3, 5, 16, 23, 25, 27, 28, 34, 46, 50, 53, 54, 58, 63, 64, 74, 75	GND	Supply	Digital ground	
2，4，6	VDD_5V	Power I	Power supply input > 500mA	
7	GPIOZ_7	I/O	General purpose input output	
17	I2C1_SCL	I/O	I2C bus1 clock	
19	I2C1_SDA	I/O	I2C bus1 data	

21	GPIOZ_3	I/O	General purpose input output	
29	GPIOZ_6	I/O	General purpose input output	
31	PWM_B	O	Pulse Width Modulation B	
33	PWM_D	O	Pulse Width Modulation C	
35	PWMAO_C	O	Pulse Width Modulation AO_C	
37	PWMAO_D	O	Pulse Width Modulation AO_D	
39	UART0_RXD	I	UART0 receive	
41	UART0_TXD	O	UART0 transmit	
43	GPIOAO_7	I/O	General purpose input output	
45	GPIOAO_6	I/O	General purpose input output	
47	PWMAO_A	O	Pulse Width Modulation AO_A	
49	I2C0_SDA	I/O	I2C0 bus data	
51	I2C0_SCL	I/O	I2C0 bus clock	
55	GPIOA_19	I/O	General purpose input output	
57	ADC_CH0	I	ADC input	
59	MCLK_C	O	Master clock C	
61	GPIOAO_13	I/O	General purpose input output	
65	GPIOA_20	I/O	General purpose input output	
67	USB_DM	I/O	USB data minus	
69	USB_DP	I/O	USB data plus	
71	USB_VBUS	I	USB voltage detection	
73	USB_ID	I	USB ID	
18	GPIOZ_5	I/O	General purpose input output	
20	GPIOZ_1	I/O	General purpose input output	
22	GPIOZ_0	I/O	General purpose input output	
24	PWM_C	I/O	Pulse Width Modulation C	
26	GPIOZ_2	I/O	General purpose input output	
30	UART1_RXD	I	UART1 receive	
32	UART1_TXD	O	UART1 transmit	
36	PDM_DIN3	I	PDM input data 3 signal	
38	PDM_DIN1	I	PDM input data 1 signal	
40	PDM_DIN2	I	PDM input data 2 signal	
42	PDM_DCLK	O	PDM output clock	
44	PDM_DIN0	I	PDM input data 0 signal	
48	TDMB_DIO1	I/O	TDM B input and output data1	
52	TDMB_SCLK	I/O	TDM B bit clock	
56	TDMB_DIO0	I/O	TDM B input and output data0	
60	TDMB_FS	I/O	TDM B L/R clock	
62	TDMC_DIO1	I/O	TDM C input and output data1	
66	TDMC_DIO0	I/O	TDM C input and output data0	
68	TDMC_FS	I/O	TDM C L/R clock	

70	TDMC_SCLK	I/O	TDM C bit clock	
72	MCLK_B	O	Master clock B	

Table 2-1 Linkplay A98M-12 module pin description

Notes:

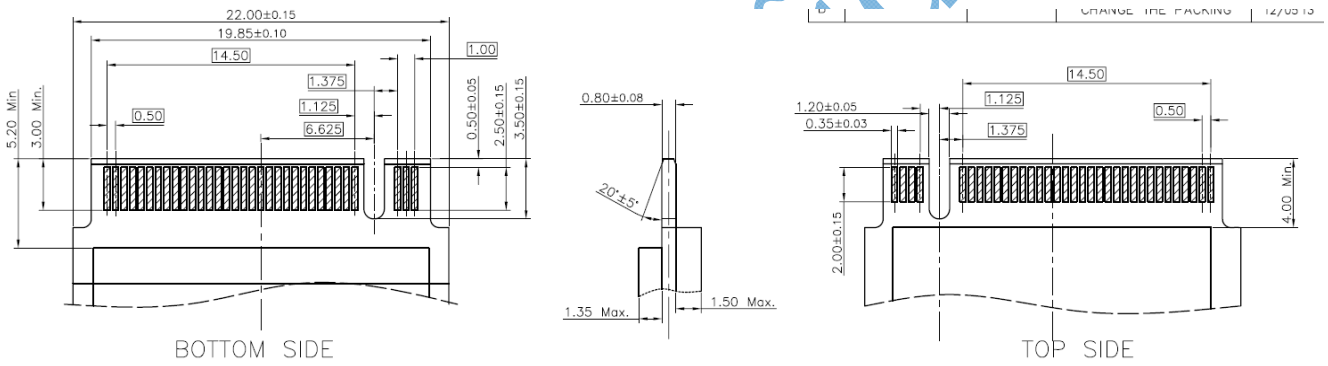
1. I：Input
2. O：Output
3. P：Power
4. PU：Internal Pull Up
5. PD：Internal Pull Down

2.2. Mechanical Dimension

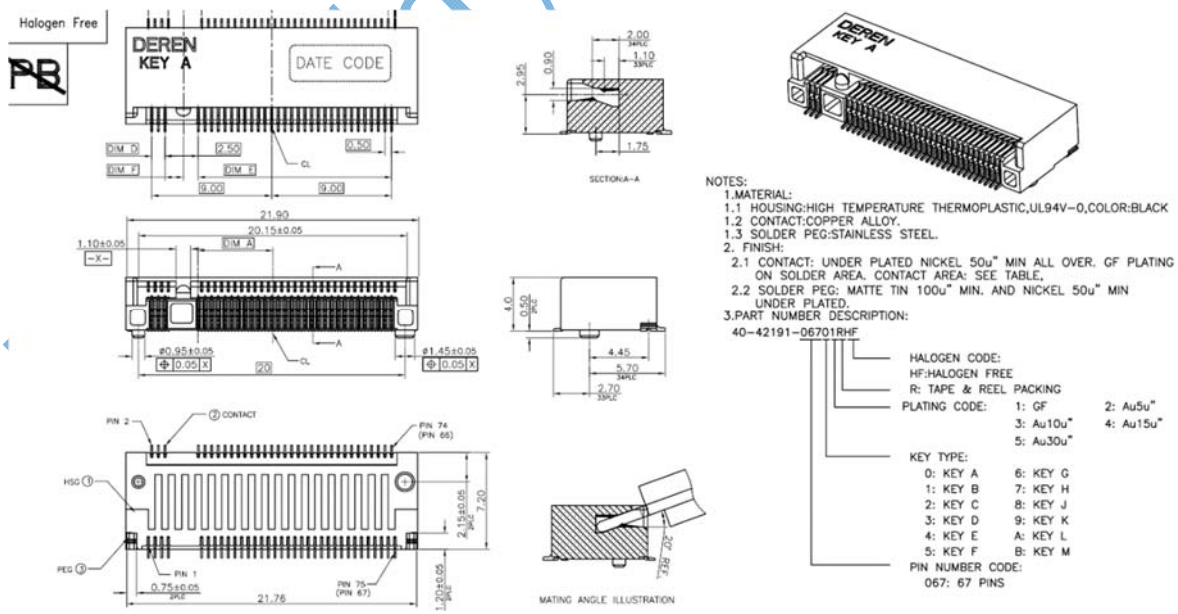
Linkplay A98M-12 module has the dimension of 50mm x 43.33mm. The detailed layout will be given shortly below.

Unit: mm

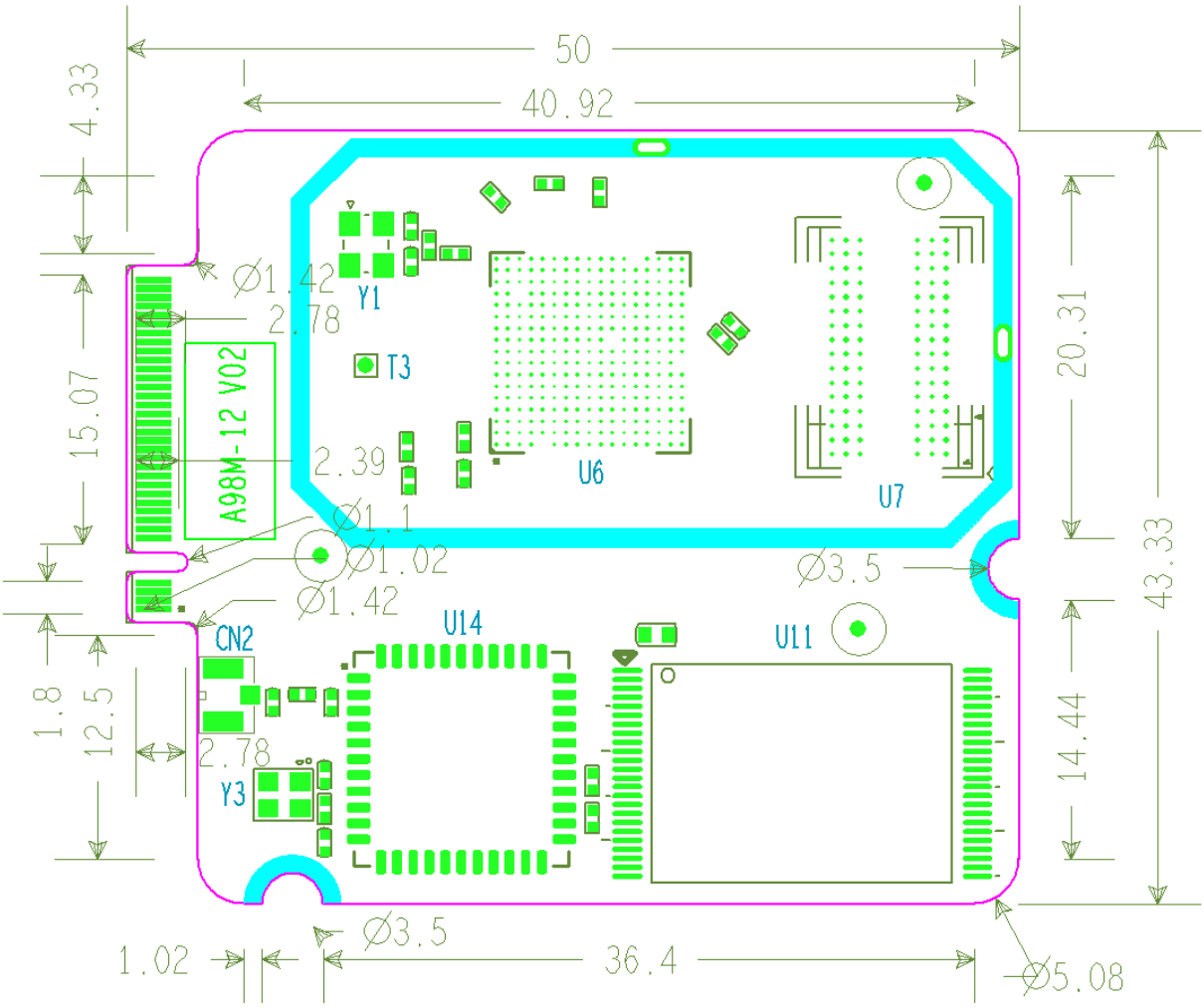
PLUG PCB dimensions:



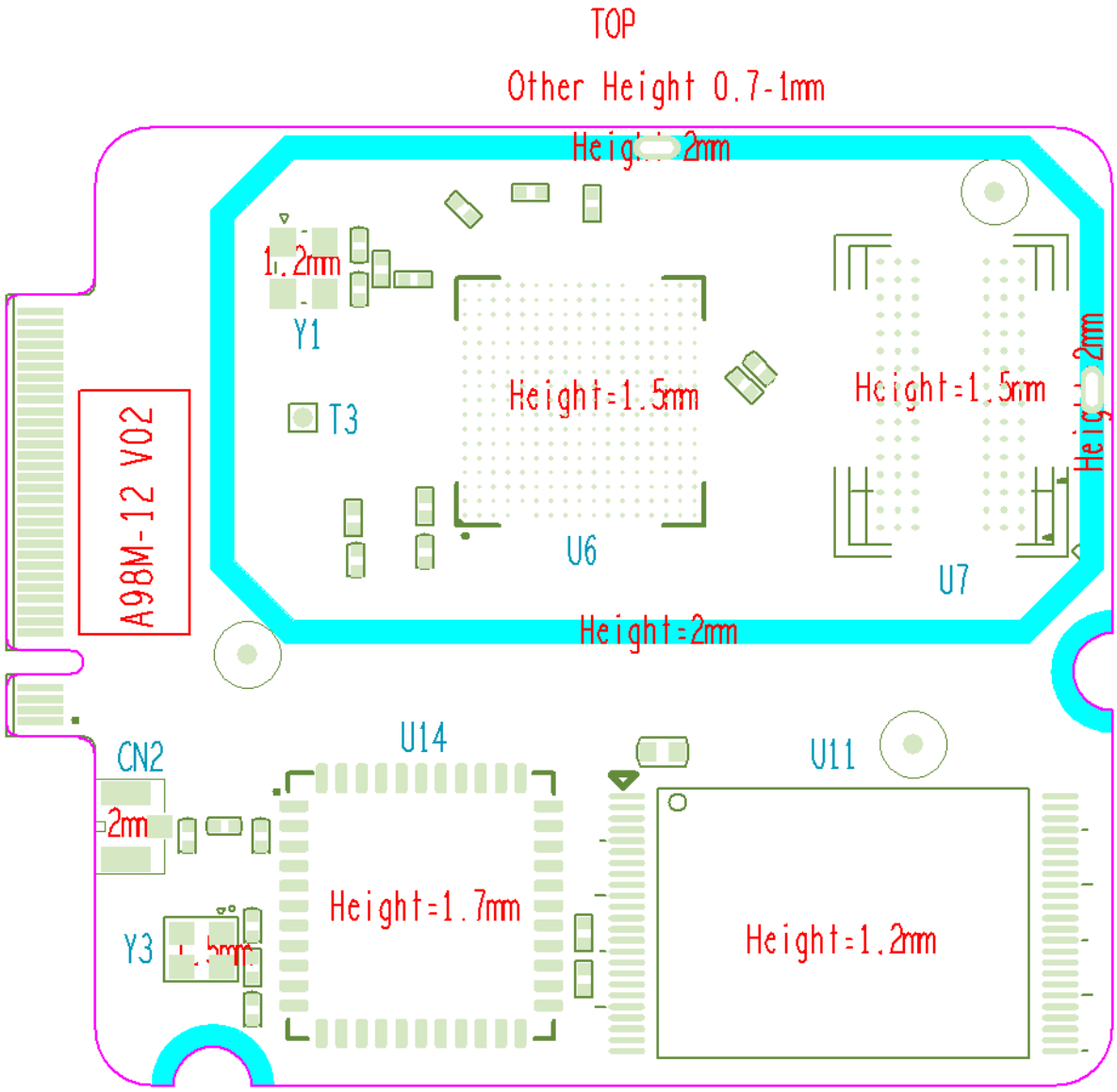
NGFF connector dimensions:



Top View Dimensions



Top Height Limit



Bottom Height Limit

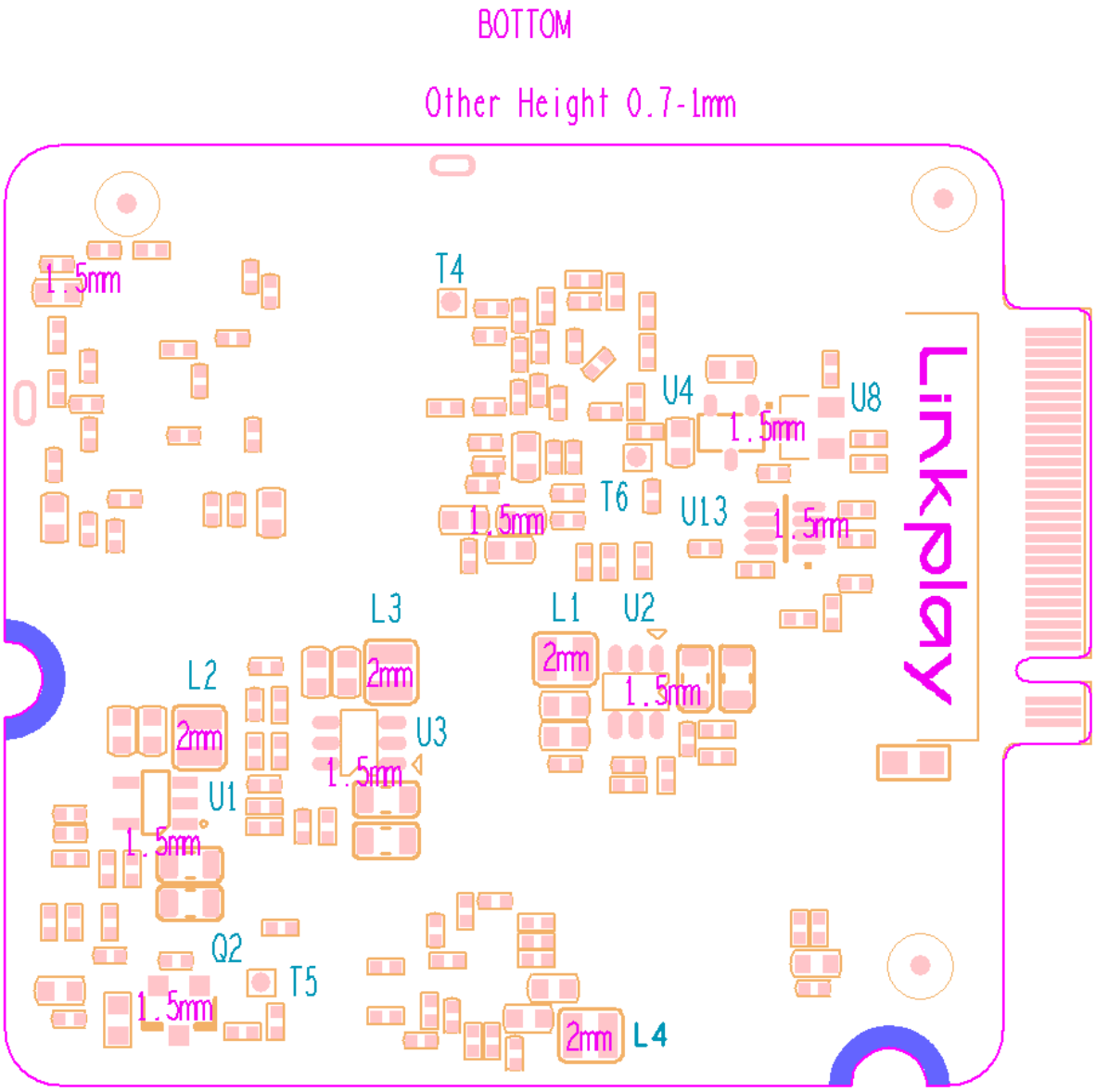


Figure 2-2: Linkplay A98M-12 physical dimension

2.3. External Antenna

A98M-12 uses the external antenna for the best Wi-Fi performance. To use external antenna, please choose the antenna type that meets the requirement of IEEE 802 a/b/g/n/ac Wi-Fi standard running at 2.4GHz/5GHz frequency. The detailed parameters are shown in the table below.

Item	Parameter
Frequency range	2.4 ~ 2.5GHz/4.9 ~ 5.8GHz
Impedance	50 Ohm
VSWR	2 (Max.)
Reflection loss	-10dB (Max.)

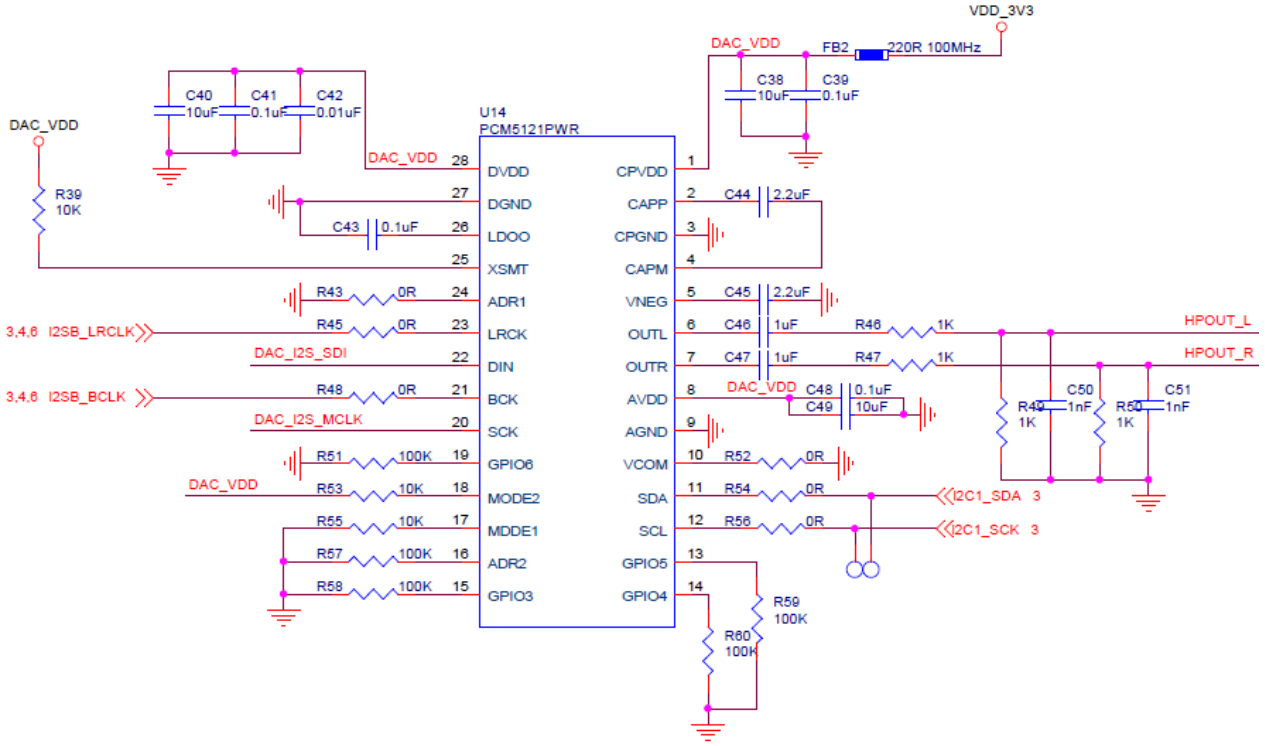
Connector	I-PEX or populate directly

Table 2-5 External antenna parameters for A98M-12

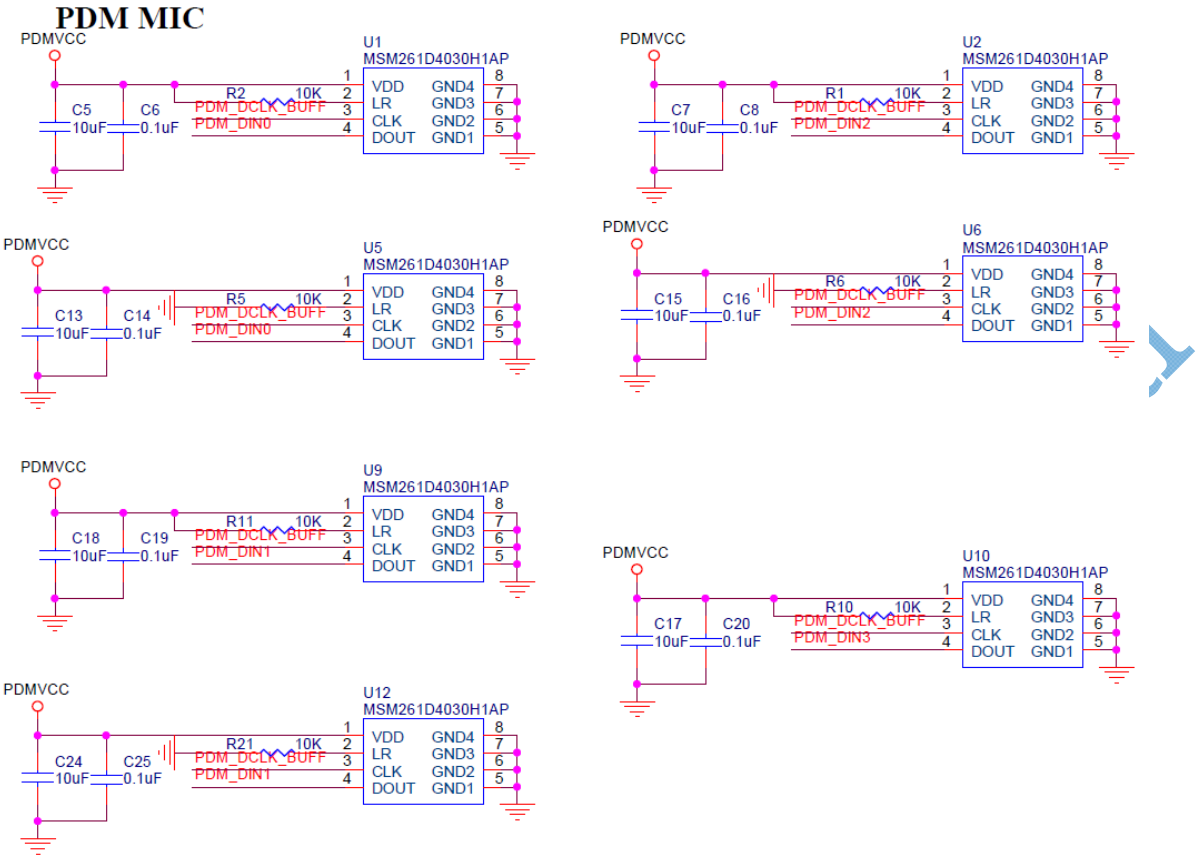
2.4. Typical Application

WiFiAudio-A98M-12's typical reference design:

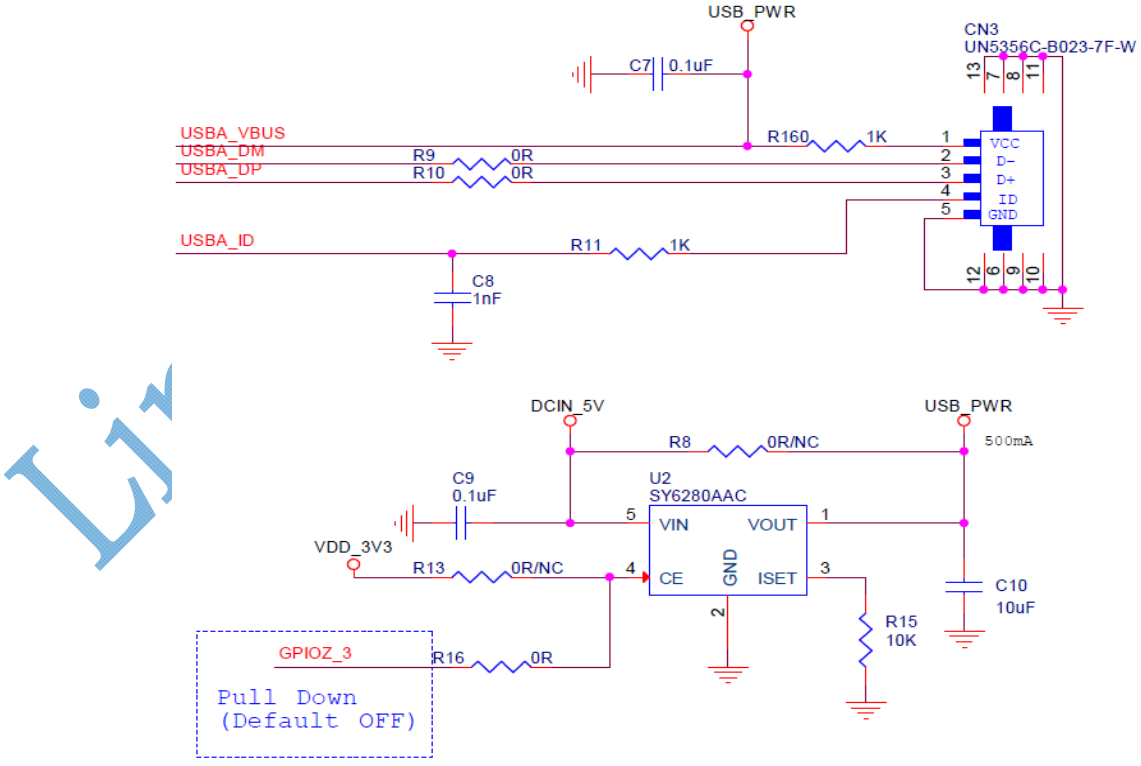
DAC



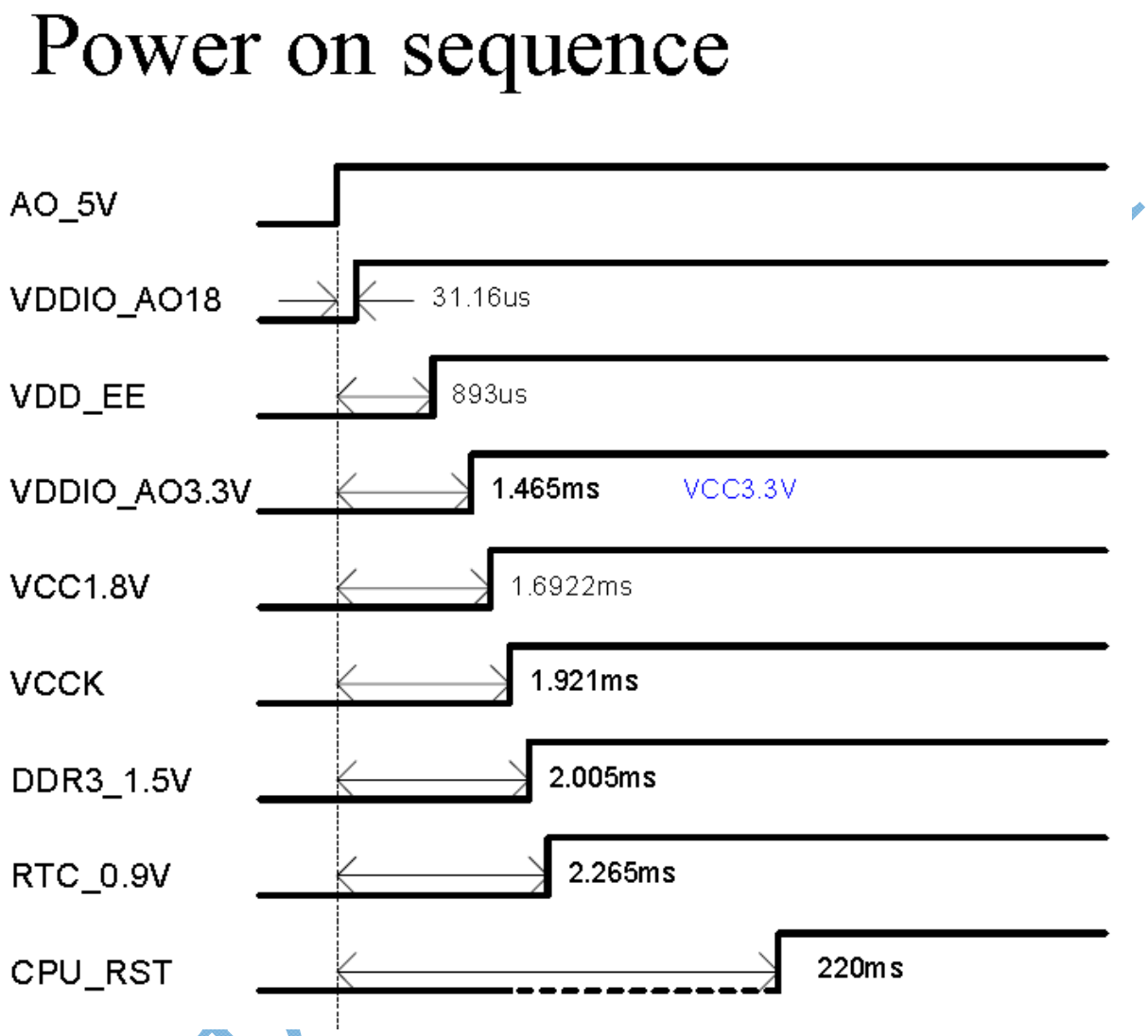
2/4/6-MIC Far-Field



Power and OTG



2.5. Power on Sequence



2.6 USB OTG Port

Please follow the design rule below to populate the USB host interface:

Item	Parameter
Signal Group	USB
Topology	Differential Pair Point-to-Point
Reference Plane	Ground Referenced
Characteristic Trace Impedance (Zo)	90 Ω ±10%
Trace Width	4 mils
Serpentine Spacing (center to center)	8.5 mils

Minimum Isolation Spacing to Clock Signals	50 mils
Minimum Isolation Spacing to Low-Speed Signals	20 mils
Minimum Isolation Spacing to other USB Pair	20 mils
Total Length (with package length)	< 8000 mils
Maximum Recommended Via Count	2 (per side)
DM to DP Length Matching (with package length)	Match total length to within ±10 mils

Table 2-2 A98M-12 USB design rule

3. Software Introduction

3.1. Feature list

- "Easy Setup" to setup your network, with the help of one button of your device, you can connect the device to your home router quickly.
- Music stream protocol
  Support Spotify Connect, Airplay, DLNA and QPlay protocol
- Amazon Alexa
- Music content
  Support iHeartRadio, Napster/Rhapsody, Tidal, Deezer, vTune, Qobuz, Audible, Radio.de, NPR， Ximalaya，Qingting FM, QQ FM, Douban FM inside, with the help of App, you can search, stream, playback and preset the musics of the above music services.
- Multiroom
  Support multiroom.
  Support Airplay, Spotify, Bluetooth, Aux-in multiroom playback.
- Music format
  HTTP/HTTPS/RTSP/MMS/TS protocol
  HLS/ASX/M3U playlist format
  MP3/AAC/FLAC/ALAC/WMA/APE/OGG codec
- BT
  Support 4.2： A2DP, AVRCP, HFP, HID profiles
  Support BLE
  Support EDR
- Preset
  With the help of App, you can store the music account token and playlist in the A98M-12. Then the end user can play the playlist by the button/voice or timer even without the App.

3.2. APP support

- iOS App

≥ iOS6.1， suggest iOS10 and above

- Android APP
  ≥ Android 4.3.3
- Quick Customization
  With the help of the Linkplay compile server, you can change the brand and some strings, change the logo and some pictures to get a customization App.

3.3. Certifications

Linkplay can help you to finish follow certifications:

- Wi-Fi Alliance
- BQB
- Amazon Alexa
- MFi
- Spotify Connect
- DLNA
- QPlay