
Linkplay Wireless Smart Audio Module (A98)

User Manual

Revision 0.6

July 31, 2019

Doc Title	Wireless Smart Audio Module-A98 Datasheet	Number	WMB20180504
		Version	0.6

HISTORY

Version	Date	Description
0.1	05/04/2018	Initial Version Release
0.2	09/13/2018	Hardware Parameter Update
0.3	03/27/2019	Hardware Interface and Mechanical Dimension Update
0.4	05/11/2019	Update Dimension
0.5	06/11/2019	Update Dimension and Package
0.6	07/30/2019	Add I/O Power Domain Information

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1. Overview

Linkplay Wireless Smart Audio module–A98, 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 BCM43455 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® NEON™ 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.

A98 module supports IEEE 802.11 a/b/g/n/ac 2.4GHz and 5GHz. It also supports BT4.2 with EDR and BLE.

A98 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
- 128MB NAND FLASH
- Support IEEE 802.11 a/b/g/n/ac 1x1 antenna diversity Wi-Fi dual band
- Support BT4.2 with EDR and BLE

Application

- Connected speaker, Sound Bar
- Connected audio devices

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1.1. Parameter

Type	Items	Performance
Wi-Fi	Certification	Wi-Fi Alliance
	WLAN Standard	IEEE 802.11 a/b/g/n/ac Wi-Fi compliant
Wi-Fi (2.4G)	Frequency Range	2.400 GHz ~ 2.483 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	802.11b /11Mbps : 16 dBm ± 1.5 dB @ EVM≤-9dB
		802.11g /54Mbps : 15 dBm ± 1.5 dB @ EVM≤-25dB
		802.11n /MCS7@HT20 : 14 dBm ± 1.5 dB @ EVM≤-27dB
	SISO Receive Sensitivity (11b,20MHz) @8% PER	- 1Mbps PER @ -96 dBm, ± 2 dB
		- 2Mbps PER @ -90 dBm, ± 2 dB
		- 5.5Mbps PER @ -88 dBm, ± 2 dB
		- 11Mbps PER @ -86 dBm, ± 2 dB
	SISO Receive Sensitivity (11g,20MHz) @10% PER	- 6Mbps PER @ -90 dBm, ± 2 dB
		- 9Mbps PER @ -88 dBm, ± 2 dB
		- 12Mbps PER @ -87 dBm, ± 2 dB
		- 18Mbps PER @ -85 dBm, ± 2 dB
		- 24Mbps PER @ -83 dBm, ± 2 dB
		- 36Mbps PER @ -80 dBm, ± 2 dB
		- 48Mbps PER @ -76 dBm, ± 2 dB
		- 54Mbps PER @ -73 dBm, ± 2 dB
	Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -89 dBm, ± 2 dB
- MCS=1 PER @ -85 dBm, ± 2 dB		
- MCS=2 PER @ -84 dBm, ± 2 dB		
- MCS=3 PER @ -80 dBm, ± 2 dB		
- MCS=4 PER @ -77 dBm, ± 2 dB		
- MCS=5 PER @ -75 dBm, ± 2 dB		
- MCS=6 PER @ -72 dBm, ± 2 dB		
- MCS=7 PER @ -70 dBm, ± 2 dB		
Maximum Input Level	802.11b : -10 dBm	
	802.11g/n : -20 dBm	
Antenna Reference	External: I-PEX, Small antennas with 0~2 dBi peak gain	
Wi-Fi (5G)	WLAN Standard	IEEE 802.11a/n 2x2, Wi-Fi compliant
	Frequency Range	4.900 GHz ~ 5.845 GHz (5.0 GHz ISM Band)
	Number of Channels	Please see the following table
	Modulation	802.11a : OFDM /64-QAM,16-QAM, QPSK, BPSK

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		802.11n : OFDM /64-QAM,16-QAM, QPSK, BPSK
		802.11ac : OFDM /256-QAM
	Output Power	802.11a /64-QAM(R=3/4) : 14 dBm ± 2 dB @ EVM≤-25dB
		802.11n /64-QAM(R=5/6) : 13 dBm ± 2 dB @ EVM≤-27dB
		802.11ac/256-QAM(R=3/4) : 12 dBm ± 2 dB @ EVM≤-30dB
		802.11ac/256-QAM(R=5/6) : 10 dBm ± 2 dB @ EVM≤-32dB
	SISO Receive Sensitivity (11a,20MHz) @10% PER	- 6Mbps PER @ -90 dBm, ± 2 dB
		- 9Mbps PER @ -88 dBm, ± 2 dB
		- 12Mbps PER @ -87 dBm, ± 2 dB
		- 18Mbps PER @ -85 dBm, ± 2 dB
		- 24Mbps PER @ -81 dBm, ± 2 dB
		- 36Mbps PER @ -78 dBm, ± 2 dB
		- 48Mbps PER @ -73 dBm, ± 2 dB
		- 54Mbps PER @ -72 dBm, ± 2 dB
	SISO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -89 dBm, ± 2 dB
		- MCS=1 PER @ -87 dBm, ± 2 dB
		- MCS=2 PER @ -84 dBm, ± 2 dB
		- MCS=3 PER @ -81 dBm, ± 2 dB
		- MCS=4 PER @ -77 dBm, ± 2 dB
		- MCS=5 PER @ -73 dBm, ± 2 dB
		- MCS=6 PER @ -71 dBm, ± 2 dB
		- MCS=7 PER @ -70 dBm, ± 2 dB
	Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0 PER @ -87 dBm, ± 2 dB
		- MCS=1 PER @ -84 dBm, ± 2 dB
		- MCS=2 PER @ -82 dBm, ± 2 dB
		- MCS=3 PER @ -78 dBm, ± 2 dB
		- MCS=4 PER @ -75 dBm, ± 2 dB
		- MCS=5 PER @ -70 dBm, ± 2 dB
		- MCS=6 PER @ -69 dBm, ± 2 dB
		- MCS=7 PER @ -67 dBm, ± 2 dB
Receive Sensitivity (11ac,20MHz) @10% PER	- MCS=0 PER @ -88 dBm, ± 2 dB	
	- MCS=1 PER @ -86 dBm, ± 2 dB	
	- MCS=2 PER @ -83 dBm, ± 2 dB	
	- MCS=3 PER @ -80 dBm, ± 2 dB	
	- MCS=4 PER @ -76dBm, ± 2 dB	
	- MCS=5 PER @ -72 dBm, ± 2 dB	
	- MCS=6 PER @ -70 dBm, ± 2 dB	

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	Receive Sensitivity (11ac,40MHz) @10% PER	- MCS=7 PER @ -69 dBm, ± 2 dB
		- MCS=8 PER @ -65 dBm, ± 2 dB
		- MCS=0 PER @ -86 dBm, ± 2 dB
		- MCS=1 PER @ -82 dBm, ± 2 dB
		- MCS=2 PER @ -80 dBm, ± 2 dB
		- MCS=3 PER @ -77 dBm, ± 2 dB
		- MCS=4 PER @ -74 dBm, ± 2 dB
		- MCS=5 PER @ -69 dBm, ± 2 dB
		- MCS=6 PER @ -67 dBm, ± 2 dB
		- MCS=7 PER @ -65 dBm, ± 2 dB
		- MCS=8 PER @ -63 dBm, ± 2 dB
		- MCS=9 PER @ -62 dBm, ± 2 dB
	Receive Sensitivity (11ac,80MHz) @10% PER	- MCS=0 PER @ -82 dBm, ± 2 dB
		- MCS=1 PER @ -79 dBm, ± 2 dB
		- MCS=2 PER @ -77 dBm, ± 2 dB
		- MCS=3 PER @ -73 dBm, ± 2 dB
		- MCS=4 PER @ -70 dBm, ± 2 dB
		- MCS=5 PER @ -68 dBm, ± 2 dB
		- MCS=6 PER @ -64 dBm, ± 2 dB
		- MCS=7 PER @ -62 dBm, ± 2 dB
		- MCS=8 PER @ -59 dBm, ± 2 dB
	- MCS=9 PER @ -58 dBm, ± 2 dB	
	Maximum Input Level	802.11a/n : -30 dBm
	Antenna Reference	External: I-PEX, Small antennas with 0~2 dBi peak gain
Bluetooth	Certification	BQB
	Bluetooth Standard	Bluetooth V4.2 of 1, 2 and 3 Mbps
	Antenna Reference	External: I-PEX, Small antennas with 0~2 dBi peak gain
	Frequency Band	2402 MHz ~ 2480 MHz
	Number of Channels	79 channels
	Modulation	FHSS, GFSK, DPSK, DQPSK
	Output Power (Output power can be configured by HCD firmware)	10 dBm (Max.)
	Sensitivity @ BER=0.1% for GFSK (1Mbps)	-86 dBm, typical
	Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)	-86 dBm, typical
	Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	-80 dBm, typical
	Maximum Input Level	GFSK (1Mbps): -20dBm
$\pi/4$ -DQPSK (2Mbps) : -20dBm		

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		8DPSK (3Mbps) : -20dBm
Hardware	Working Voltage	3.5-5.5V
	Working Current	200 ~ 240mA (STA mode)
	Standby Current	5mA
	Operating Ambient Temperature	0°C ~ 40°C
	Storage Temperature	-5°C ~ 45°C
	Wi-Fi Working Distance	2.4G 80 meters/5G 150meters
	IO Extension	USB, I2S, I2C, PWM, SPI, UART
	Dimension	NGFF golden finger 67PIN

Table1-1 Linkplay A98 module parameters

5GHz(20MHz) Channel table

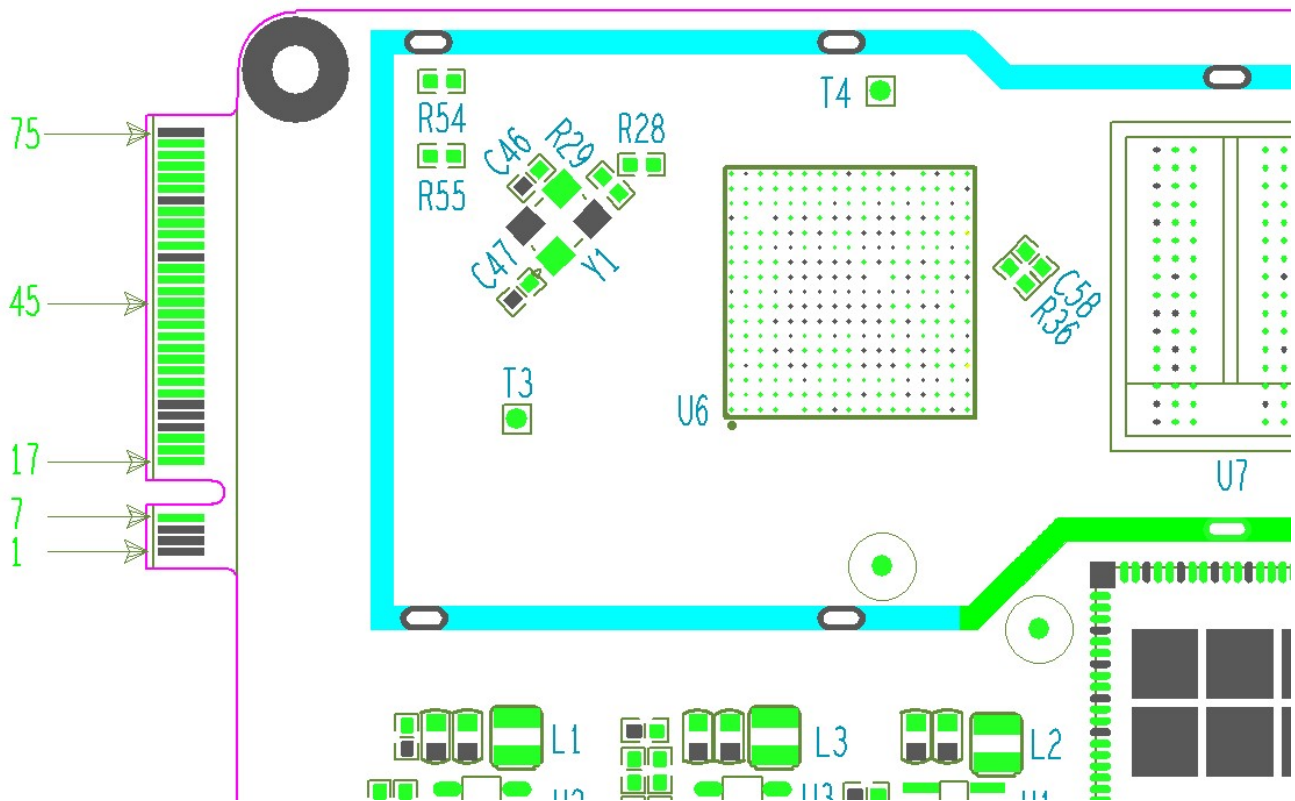
Band (GHz)	Operating Channel Numbers	Channel Center Frequencies(MHz)
5.15GHz~5.25GHz	36	5180
	40	5200
	44	5220
	48	5240
5.25GHz~5.35GHz	52	5260
	56	5280
	60	5300
	64	5320
5.5GHz~5.7GHz	100	5500
	104	5520
	108	5540
	112	5560
	116	5580
	120	5600
	124	5620
	128	5640
	132	5660
	136	5680
5.725GHz~5.845GHz	140	5700
	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

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2. Hardware Description

2.1. Description of Hardware Interface

A98 provides the option to connect with customer board through its 67-pins NGFF golden finger. The detail is as follows.



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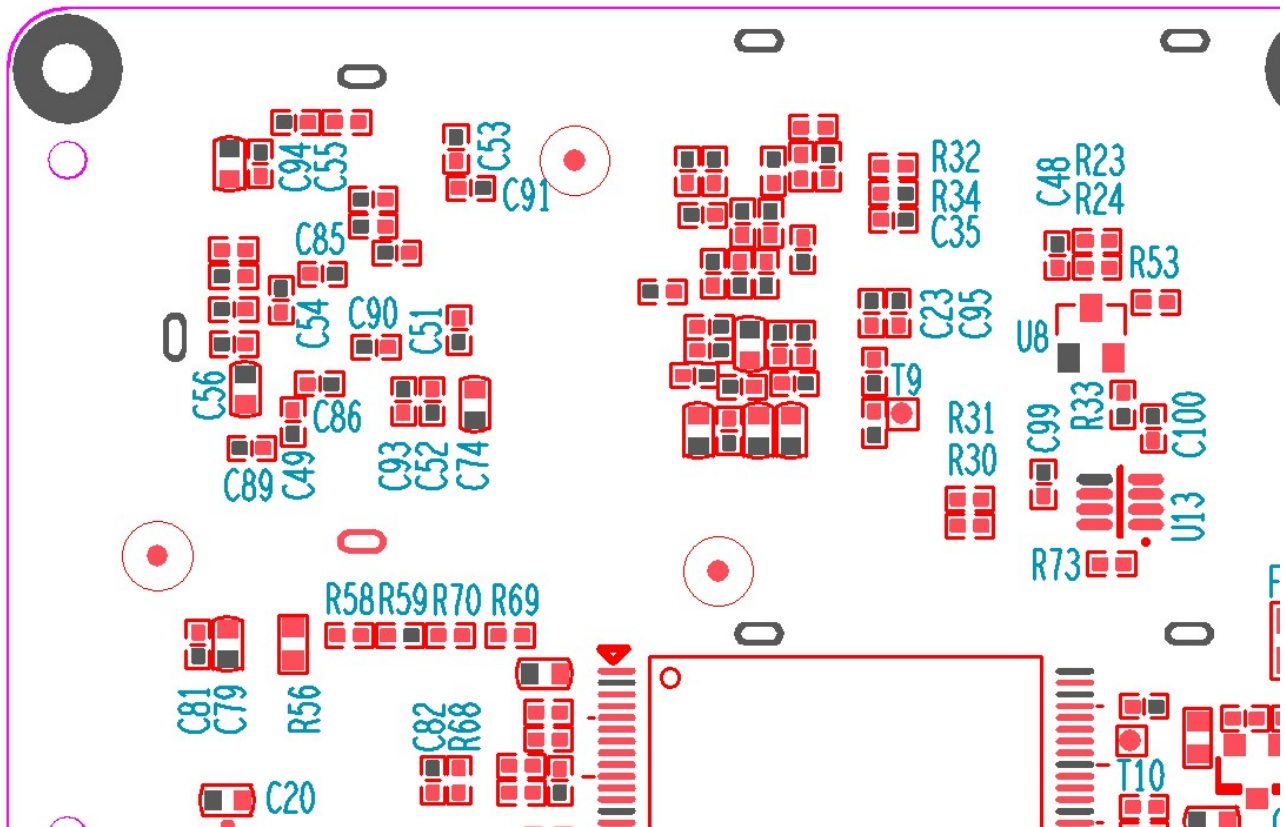


Figure 2-1 A98 Interface Pins

Pin Description:

Pin No.	Pin Name	Type	Description	Power Domain
1, 3, 5, 16, 23, 25, 27, 28, 34, 46, 50, 53, 54, 58, 63, 64, 74, 75	GND	Supply	Digital ground	GND
2, 4, 6	VDD_5V	Power	Power supply input > 800mA	3.5 - 5.5V
7	GPIOZ_7	I/O	General purpose input output	3.3V
17	I2C1_SCL	I/O	I2C bus1 clock	3.3V
19	I2C1_SDA	I/O	I2C bus1 data	3.3V
21	GPIOZ_3	I/O	General purpose input output	3.3V
29	GPIOZ_6	I/O	General purpose input output	3.3V
31	PWM_B	O	Pulse Width Modulation B	3.3V
33	PWM_D	O	Pulse Width Modulation C	3.3V
35	PWMAO_C	O	Pulse Width Modulation AO_C	3.3V

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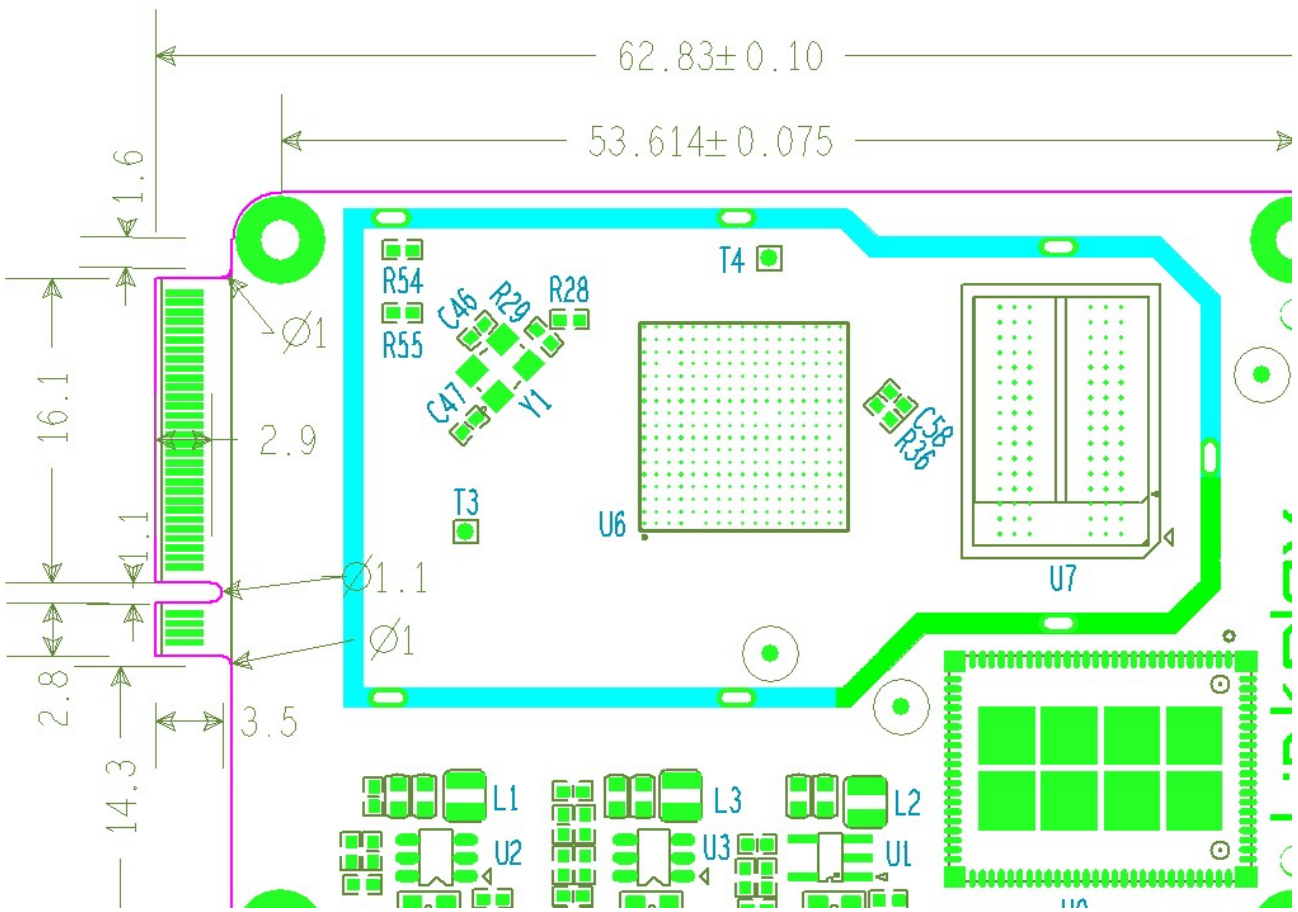
37	PWMAO_D	O	Pulse Width Modulation AO_D	3.3V
39	UART0_RXD	I	UART0 receive	3.3V
41	UART0_TXD	O	UART0 transmit	3.3V
43	GPIOAO_7	I/O	General purpose input output	3.3V
45	GPIOAO_6	I/O	General purpose input output	3.3V
47	PWMAO_A	O	Pulse Width Modulation AO_A	3.3V
49	I2C0_SDA	I/O	I2C0 bus data	3.3V
51	I2C0_SCL	I/O	I2C0 bus clock	3.3V
55	GPIOA_19	I/O	General purpose input output	3.3V
57	ADC_CH0	I/IPU	ADC input	1.8V
59	MCLK_C	O	Master clock C	3.3V
61	GPIOAO_13	I/O	General purpose input output	3.3V
65	GPIOA_20	I/O	General purpose input output	3.3V
67	USB_DM	I/O	USB data minus	3.3V
69	USB_DP	I/O	USB data plus	3.3V
71	USB_VBUS	I	USB voltage detection	5V
73	USB_ID	I	USB ID	1.8V
18	GPIOZ_5	I/O	General purpose input output	3.3V
20	GPIOZ_1	I/O	General purpose input output	3.3V
22	GPIOZ_0	I/O	General purpose input output	3.3V
24	PWM_C	I/O	Pulse Width Modulation C	3.3V
26	GPIOZ_2	I/O	General purpose input output	3.3V
30	UART1_RXD	I	UART1 receive	3.3V
32	UART1_TXD	O	UART1 transmit	3.3V
36	PDM_DIN3	I	PDM input data 3 signal	3.3V
38	PDM_DIN1	I	PDM input data 1 signal	3.3V
40	PDM_DIN2	I	PDM input data 2 signal	3.3V
42	PDM_DCLK	O	PDM output clock	3.3V
44	PDM_DIN0	I	PDM input data 0 signal	3.3V
48	TDMB_DIO1	I/O	TDM B input and output data 1	3.3V
52	TDMB_SCLK	I/O	TDM B bit clock	3.3V
56	TDMB_DIO0	I/O	TDM B input and output data0	3.3V
60	TDMB_FS	I/O	TDM B L/R clock	3.3V
62	TDMC_DIO1	I/O	TDM C input and output data 1	3.3V
66	TDMC_DIO0	I/O	TDM C input and output data0	3.3V
68	TDMC_FS	I/O	TDM C L/R clock	3.3V
70	TDMC_SCLK	I/O	TDM C bit clock	3.3V
72	MCLK_B	O	Master clock B	3.3V

Table 2-1 A98 Module Pin Description

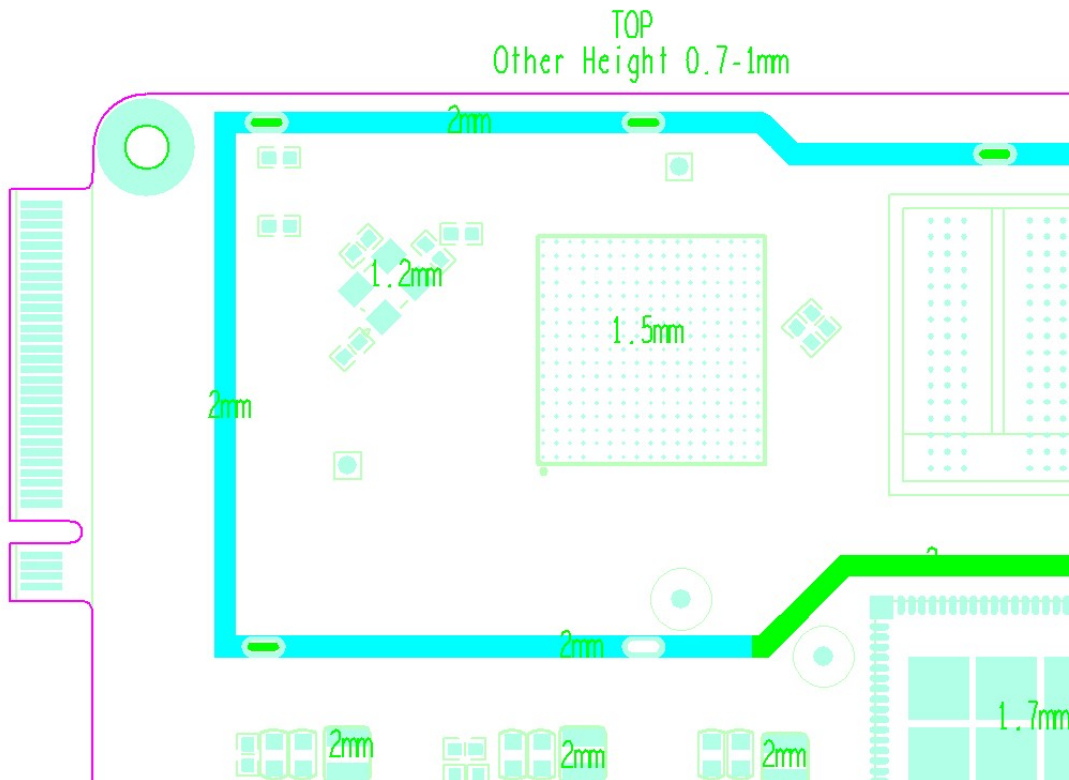
Notes:

1. I: Input

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TOP Components Height Limit



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Bottom Components Height Limit

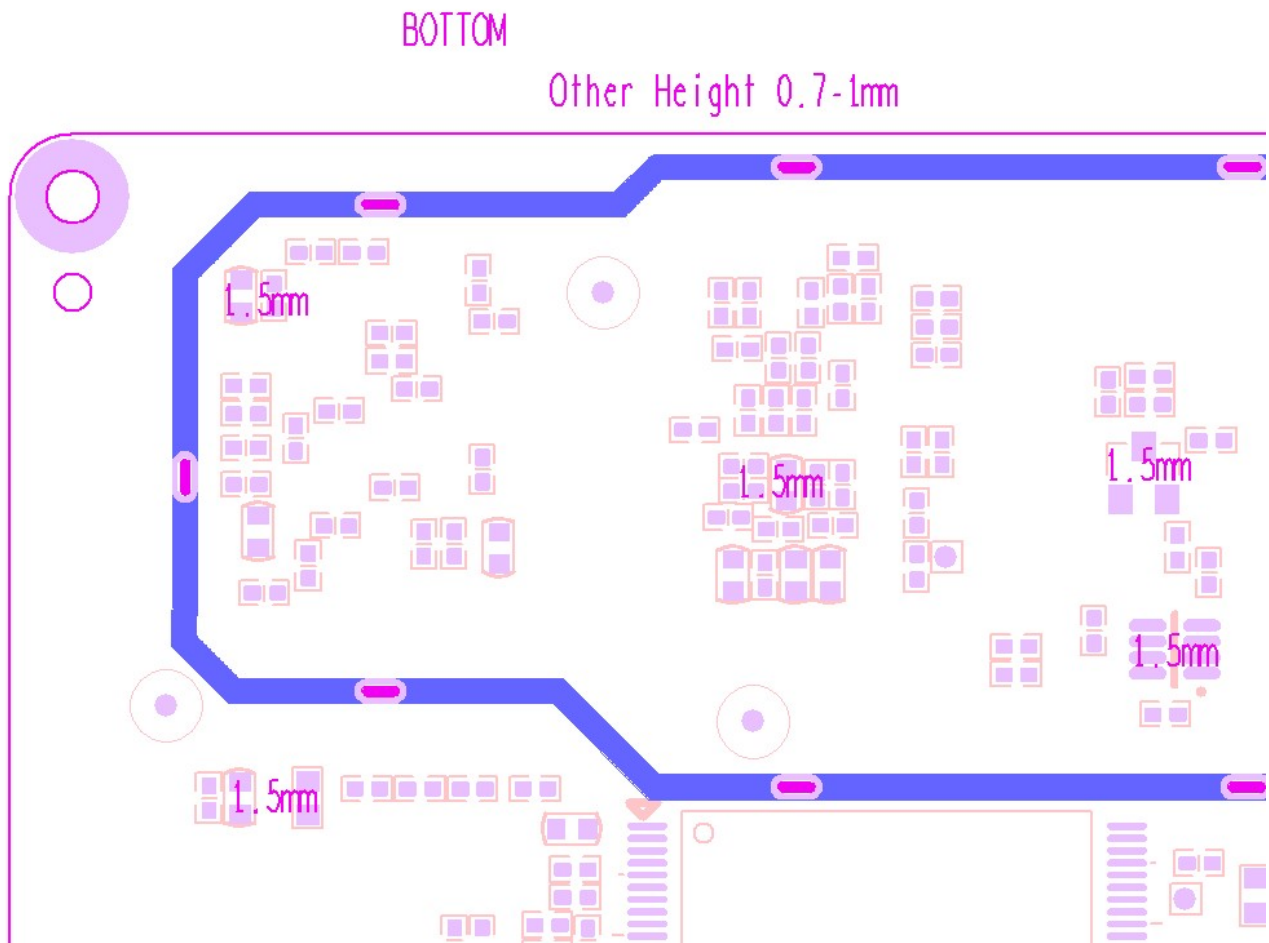


Figure 2-2 A98 Physical Dimension

2.3. External Antenna

A98 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

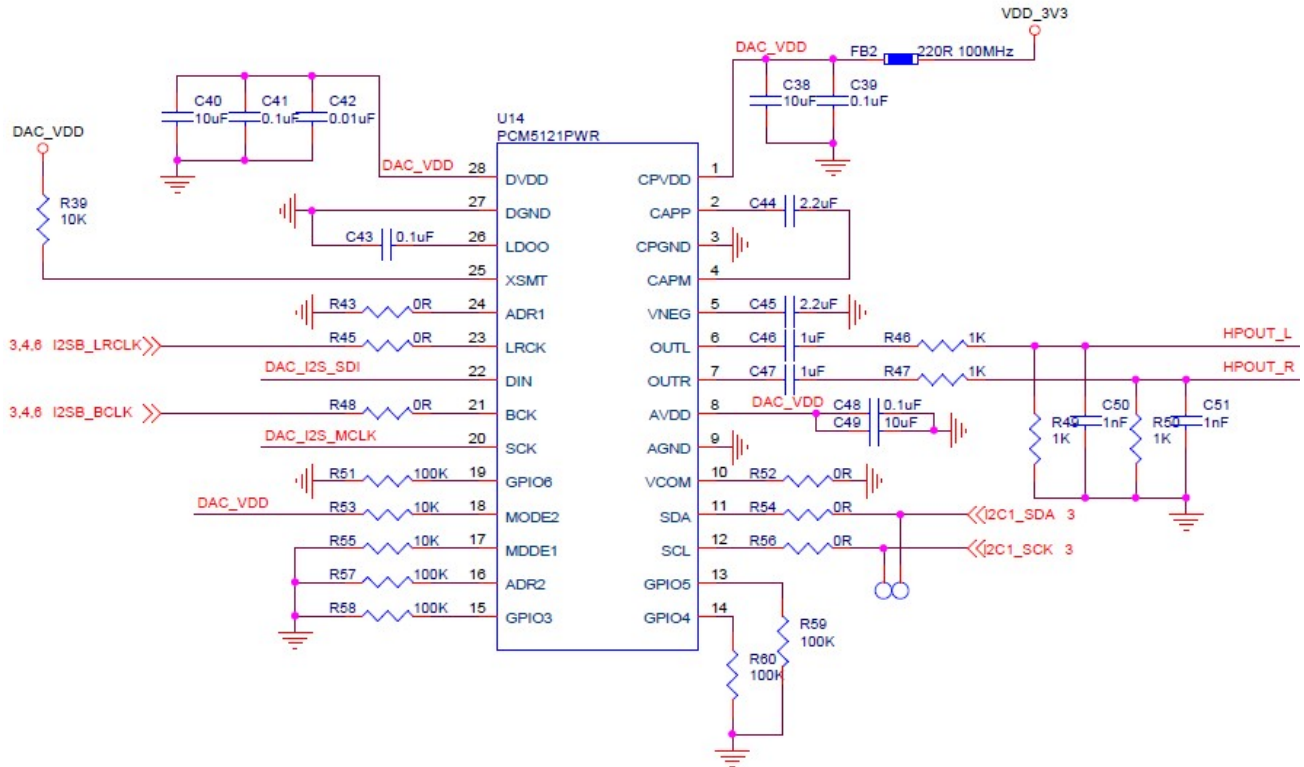
Table 2-5 External Antenna Parameters for A98

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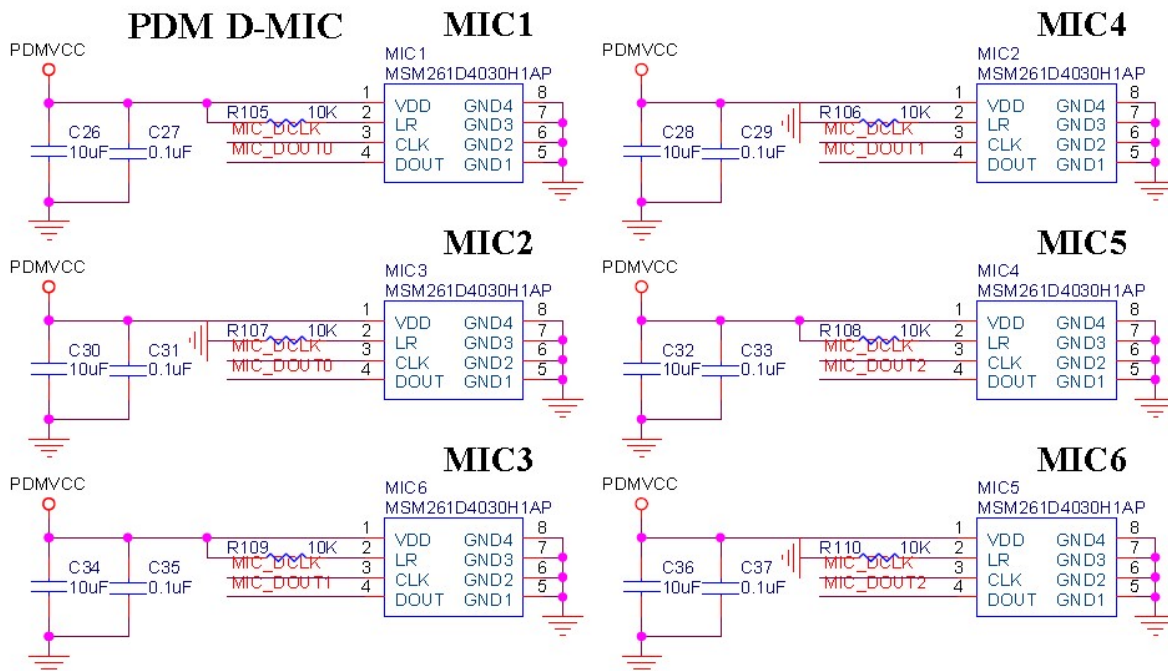
2.4. Typical Application

A98's typical reference design:

DAC

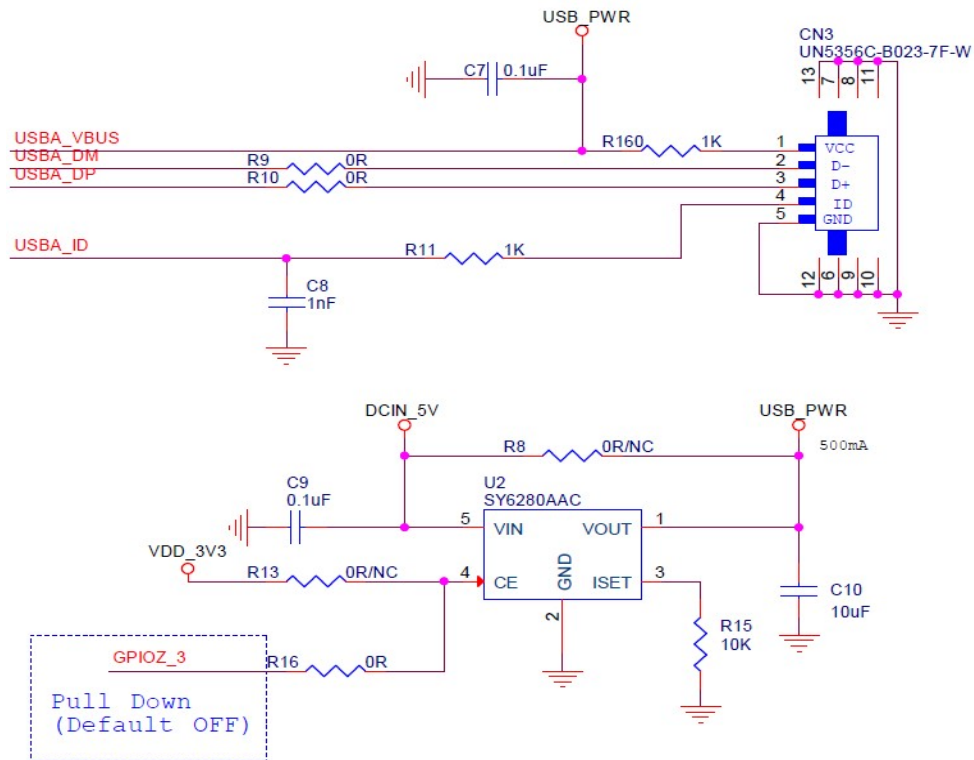


2/4/6-MIC Far-Field



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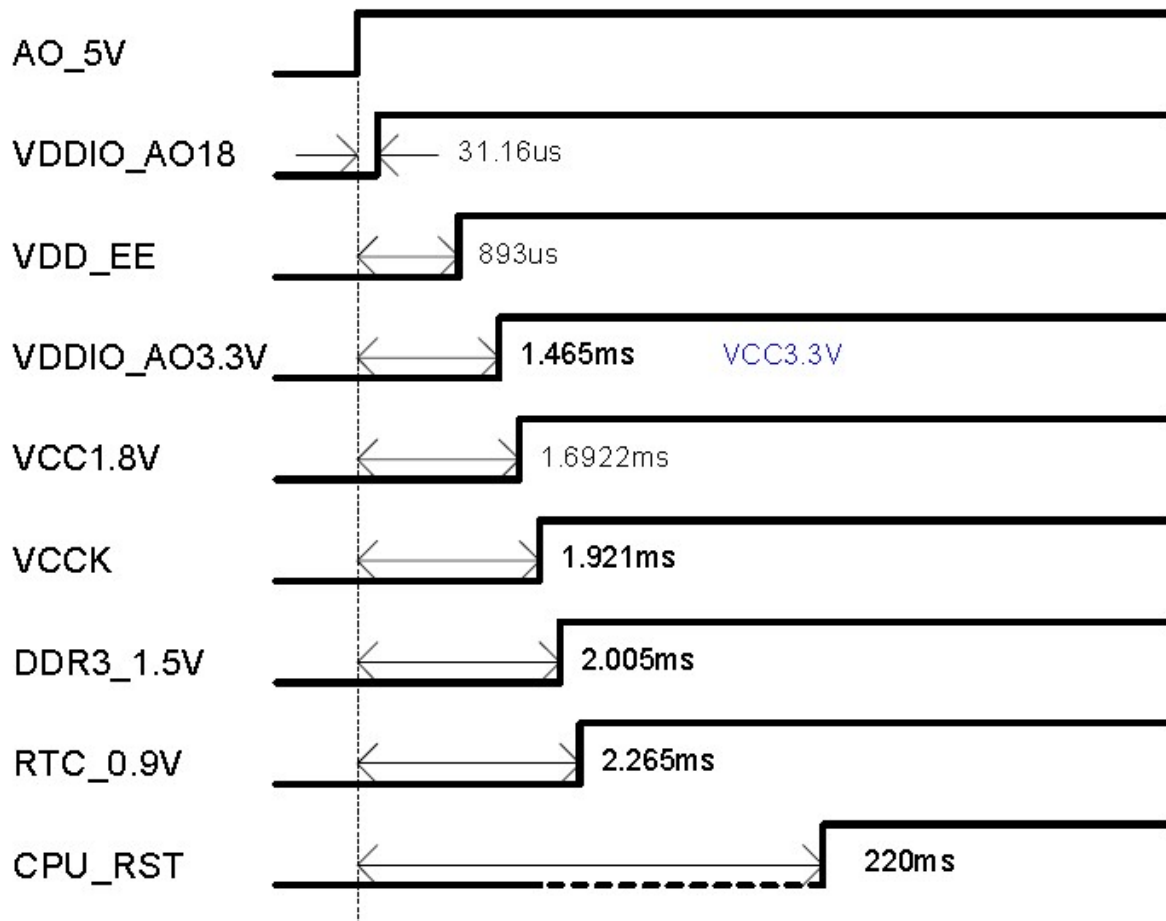
Power and OTG



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2.5. Power on Sequence

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 \pm 10%
Trace Width	4 mils
Serpentine Spacing (center to center)	8.5 mils

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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 A98 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 A98. 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

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- 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 Logo
- BQB
- Amazon Alexa
- MFi
- Spotify Connect
- DLNA
- Qplay

4. Module Environmental and Package

4.1. Environmental Ratings

The environmental ratings are shown as following table.

Characteristic	Value	Units	Conditions/CommentsA
Storage Temperature	-5 ~ 45	°C	
Relative humidity	Less than 60	%	Storage
	Less than 80	%	Operation

4.2. Electrostatic Discharge Specifications

Extreme caution must be exercised to prevent electrostatic discharge (ESD) damage. Proper use of wrist and heel grounding straps to discharge static electricity is required when handling these devices. Always store unused material in its antistatic packaging.

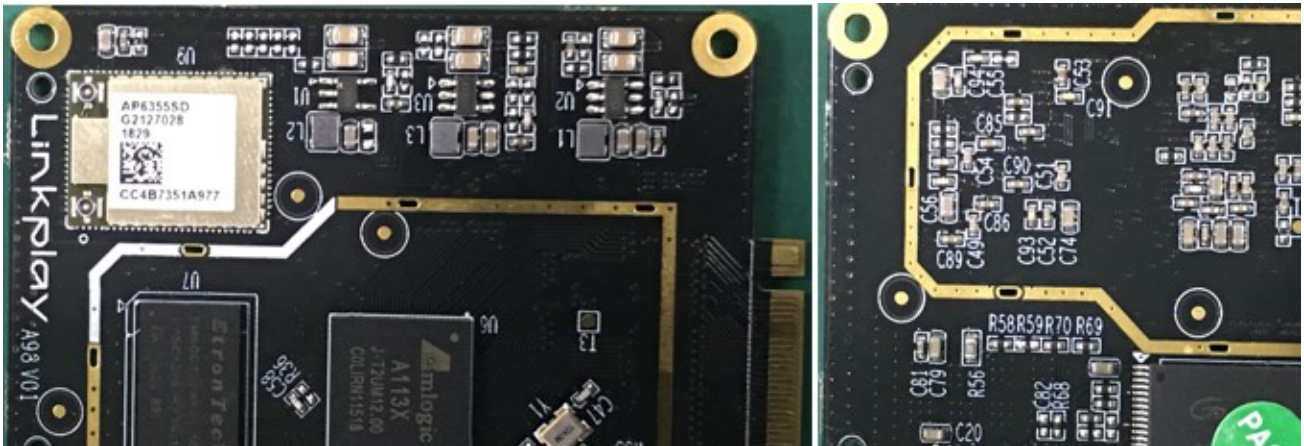
ESD Specifications

Type	Symbol	Condition	ESD Rating	Unit
ESD Handling	ESD_HAND_HBM	Human Body Model Contact Discharge per JEDEC EID/JESD22-A114	1000	V
Machine Model (MM)	ESD_HAND_MM	Machine Model Contact	30	V

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CDM	ESD_HAND_CDM	Charged Device Model Contact Discharge per JEDEC EIA/JESD22-C101	300	V
-----	--------------	------------------------------------------------------------------	-----	---

4.3. A98 Module Picture



Notes:

Linkplay: Linkplay logo

A98: module number

V01: MP version of A98 module

4.4. Sticker Specification



Notes:

Line 1. Model Name: AP6355SD

Line 2. Lot Code (Tracking No.): Coding by 98P Manufacture order, 8 characters in total.

Line 3. Date Code: YYWW, 4 characters in total base on week of testing

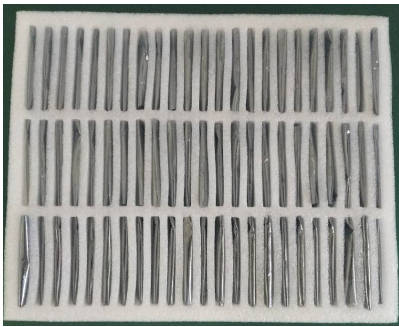
Line 4. Wi-Fi MAC, CODE SYMBOLOGY: data matrix, Configuration by Manufacture order.

Line 5. Wi-Fi MAC, 12 characters, Configuration by Manufacture order.

Sticker size: 10mm*9mm (High temperature sticker)

1) Delivery

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Notes:

One tray = 69pcs

1 box in total 4*69 pcs= 276 pcs

Carton with the size= 350*260*270 mm

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Single Module

FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device.

FCC Radiation Exposure Statement

This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:
 "Contains Transmitter Module FCC ID: 2ANOG-A98XX Or Contains FCC ID: 2ANOG-A98XX"

When the module is installed inside another device, the user manual of the host must contain below warning statements;

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Any company of the host device which install this modular with Single modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C : 15.247 and 15.407 requirement, Only if the test result comply with FCC part 15C : 15.247 and 15.407 requirement, then the host can be sold legally.

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The module complies with FCC Part 15.247/ Part 15.407