Linkplay Wireless Smart Audio Module (A88)

User Manual

Rev 1.5

Apr. 02 2018

HISTORY

Version	Date	Description
1.0	2017/04/14	Specification release
1.1	2017/08/18	Update new version dimensions and features
1.2	2017/09/05	Update RF parameters
1.3	2017/12/04	Update operating temperature range
1.4	2018/03/05	Add plug PCB and NGFF connector dimensions
1.5	2018/04/02	Add key components list

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1. Overview

Linkplay Wi-Fi Audio module - A88, 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 A111 application processor. A111 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-A5 CPU with 32KB L1 instruction and 32KB data cache for each core and a large 512KB L2 unified cache to improve system performance. Each Cortex-A5 CPU can run up to 1.5GHz and has a wide bus connecting to the memory sub-system. The main CPU handles all operating system, networking and user-interface related tasks. 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 audio formats up to 192KHz high resolution including MP3, AAC, WMA, RM, FLAC, OGG, etc and with the flexibility to support future audio standards. A111 also integrates all standard audio input/output interfaces including I2S, PCM and S/PDIF audio input/output for different applications.

A88 module supports IEEE 802.11 a/b/g/n/ac 2.4GHz and 5GHz. It also supports BT4.2 with EDR and BLE.

A88 module also provides USB, I2S, I2C, PWM, 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.

Feature

- 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

1.1. Key Components List

No.	Type	Description	Brand
1	Main SoC	A111 LFBGA 12x12mm 306-ball 0.65 ball pitch RoHS	Amlogic
2	DRAM	DDR3 H5TQ1G63EFR-PBC FBGA96 SMD RoHS	SKHynix
3	FLASH	SLC TC58NVG0S3HTA00 TSOP I 48 SMD RoHS	TOSHIBA
4	Wi-Fi/BT	AP6355SD 2.4G/5G DUAL BAND BT4.2 with EDR and BLE	AMPAK

5	POWER IC	DC-DC SY8089AAAC SOT23-5 RoHS	SILERGY
6	POWER IC	DC-DC SY8088AAC SOT23-5 RoHS	SILERGY
7	RESET IC	SGM809-RXN3L/TR SOT-23 RoHS	SGMICRO

1.2. Parameter

Type	Items	Performance
Wi-Fi	Certification	FCC/CE/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
		802.11 g/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
		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
		- MCS=7 PER @ -69 dBm, ± 2 dB
		- MCS=8 PER @ -65 dBm, ± 2 dB
	Receive Sensitivity (11ac,40MHz) @10% PER	- 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 π/4-DQPSK (2Mbps)	-86 dBm, typical
	Sensitivity @ BER=0.01%	-80 dBm, typical

	for 8DPSK (3Mbps)	
	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℃ ~ 70℃
	Storage temperature	-40℃ ~ 85℃
	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 A88 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
5.725GHz~5.845GHz	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

2. Hardware Description

2.1. Description of Hardware Interface

A88 provides the option to connect with customer board through its 67-pins NGFF golden finger. The detail is as follows.

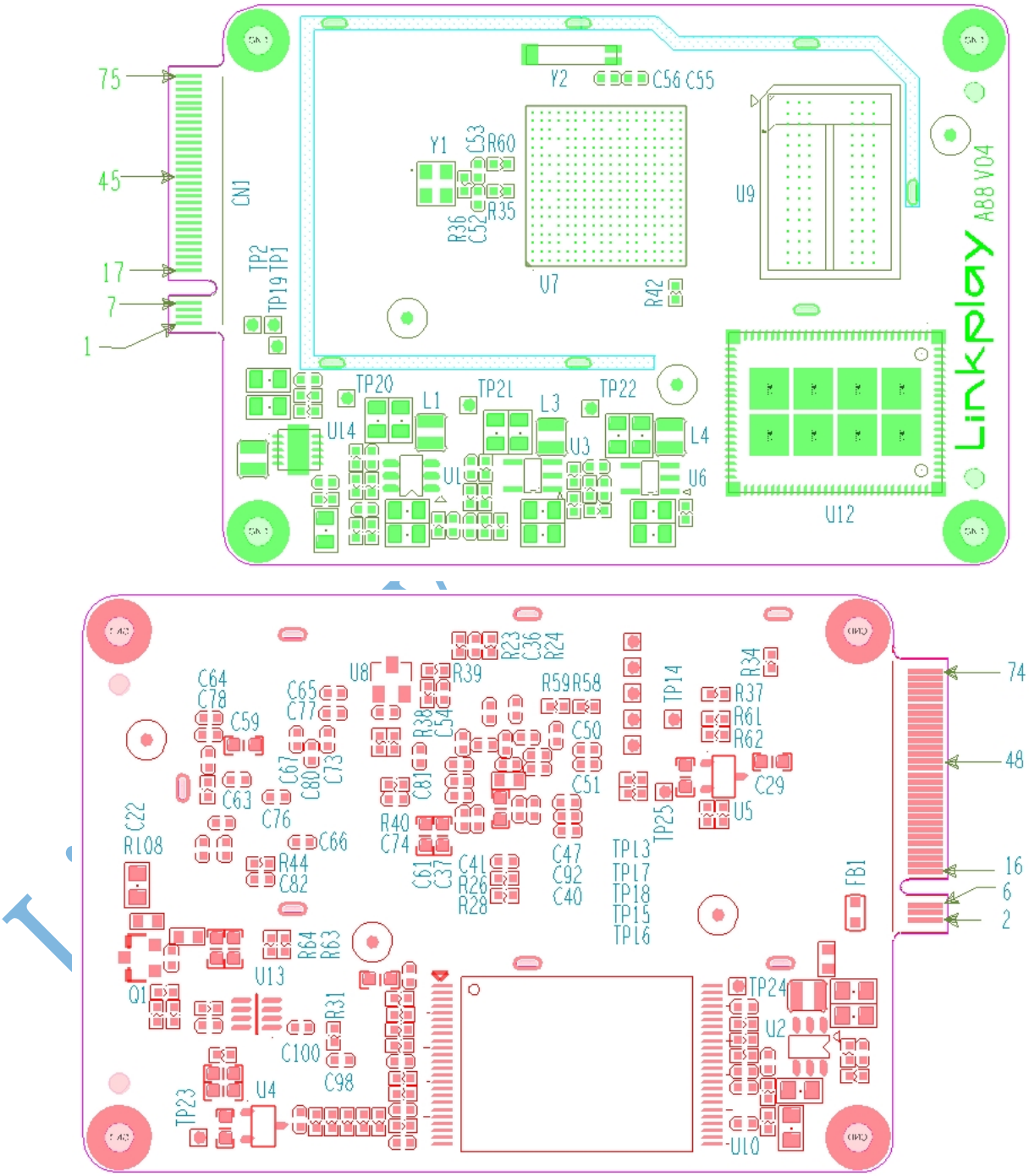


Figure 2-1 A88 interface pins

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	
26，43，48，52，56，62	NC		No connection	
7	GPIO1	I/O	General purpose input output	
17	GPIO3	I/O	General purpose input output	
19	GPIO_M	I/O	General purpose input output	
21	GPIO_SD	I/O	General purpose input output	
29	NC		No connection	
31	GPIOY_9	I/O	General purpose input output	
33	GPIOY_10	I/O	General purpose input output	
35	GPIOY_11	I/O	General purpose input output	
37	GPIOY_12	I/O	General purpose input output	
39	GPIOY_13	I/O	General purpose input output	
41	GPIOY_14	I/O	General purpose input output	
45	PWM2	I/O	PWM	General purpose input output
47	PWM3	I/O	PWM	General purpose input output
49	I2C1_SCL	I/O	I2C bus clock	General purpose input output
51	I2C1_SDA	I/O	I2C bus data	General purpose input output
55	SPI_MISO	I/O	SPI bus MISO	General purpose input output
57	SPI_MOSI	I/O	SPI bus MOSI	General purpose input output
59	SPI_CLK	I/O	SPI bus clock	General purpose input output
61	SPI_CS	I/O	SPI bus chip select	General purpose input output
65	USB1_VBUS	I	USB OTG bus power	
67	USB1_DN	I/O	USB data minus	
69	USB1_DP	I/O	USB data plus	
71	+5V	N/A	NC	
73	USB_ID	I	OTG ID signal	
18	UART0_TXD	O	UART0 transmit	Debug use only
20	UART0_RXD	I	UART0 receive	

22	TW1_SCL	I/O	I2C bus clock	General purpose input output
24	TW1_SDA	I/O	I2C bus data	General purpose input output
30	UART1_TXD	O	UART1 transmit	
32	UART1_RXD	I	UART1 receive	
36	JTAG_TMS	NC	No connection	Test use only
38	JTAG_TDI	NC	No connection	
40	JTAG_TDO	NC	No connection	
42	JTAG_TCLK	NC	No connection	
44	JTAG_TRST	NC	No connection	
60	I2S_DI1	I	I2S data in	
66	I2S_DO1	O	I2S data out	
68	I2S_MCLK	O	I2S master clock	
70	I2S_BCLK	I/O	I2S bit clock	
72	I2S_LRCLK	O	I2S L/R clock	

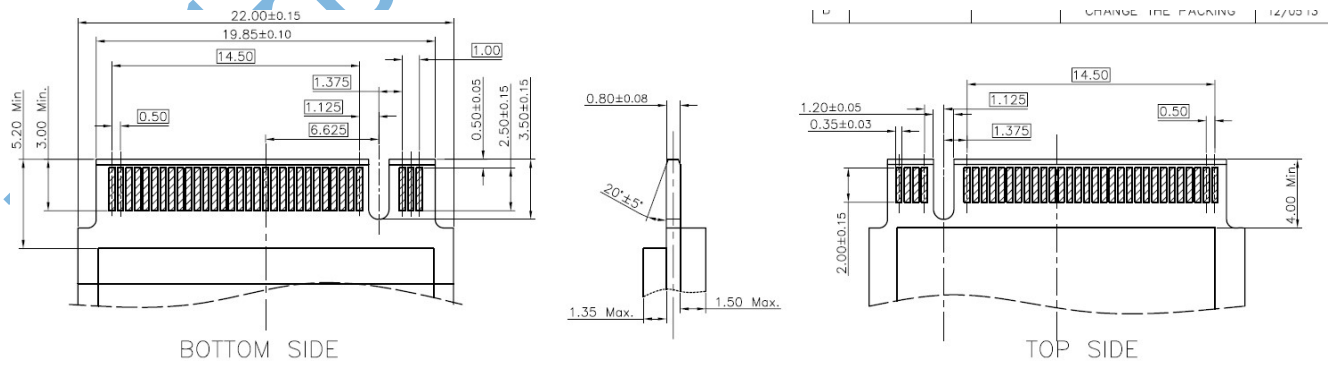
Table 2-1 Linkplay A88 module pin description

Notes:

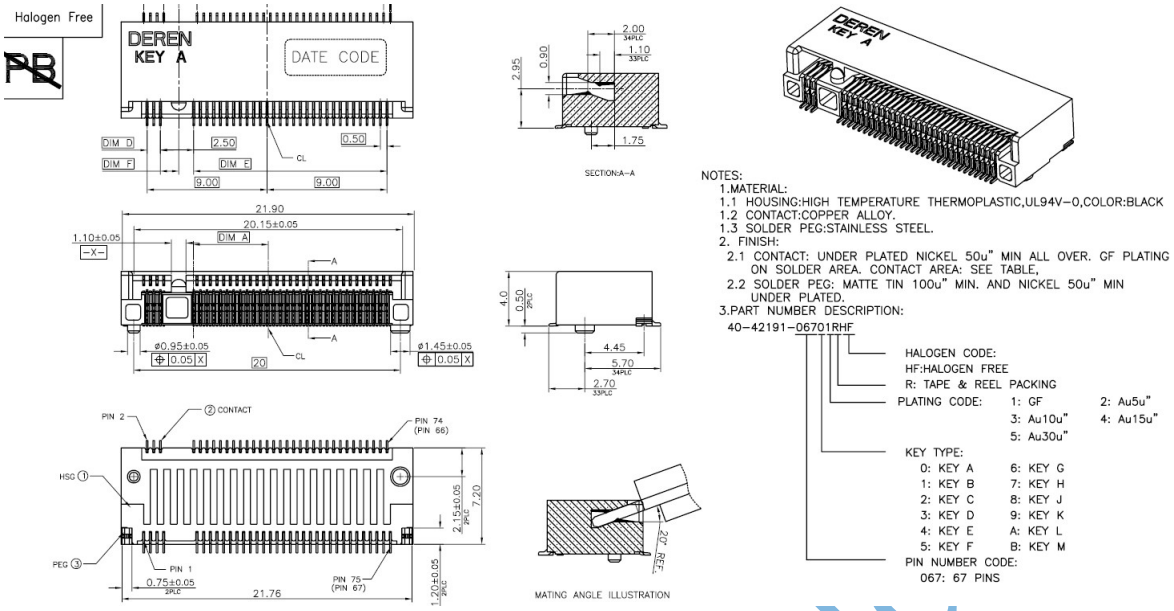
1. I：Input
2. O：Output
3. P：Power
4. PU：Internal Pull Up
5. PD：Internal Pull Down

2.2. Mechanical Dimension

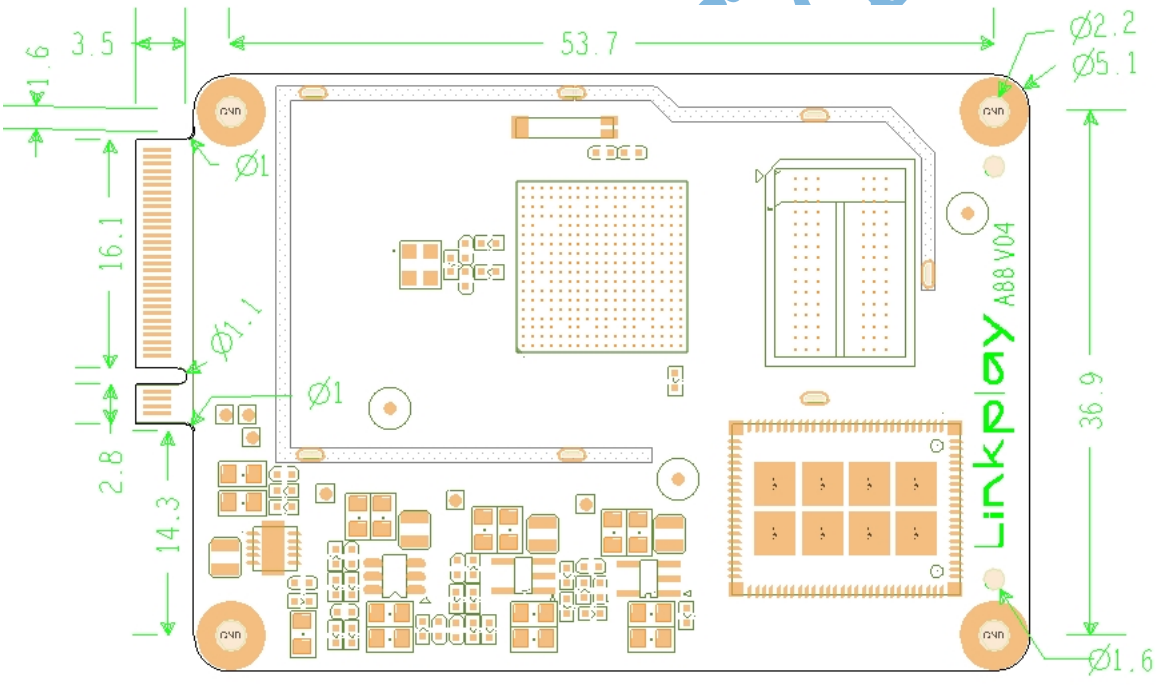
Linkplay A98 module has the dimension of 58.5mm x 41.7mm. The detailed layout will be given shortly below.
PCB thickness is 0.8mm, must match with NGFF female connector.
Unit: mm
PLUG PCB dimensions:



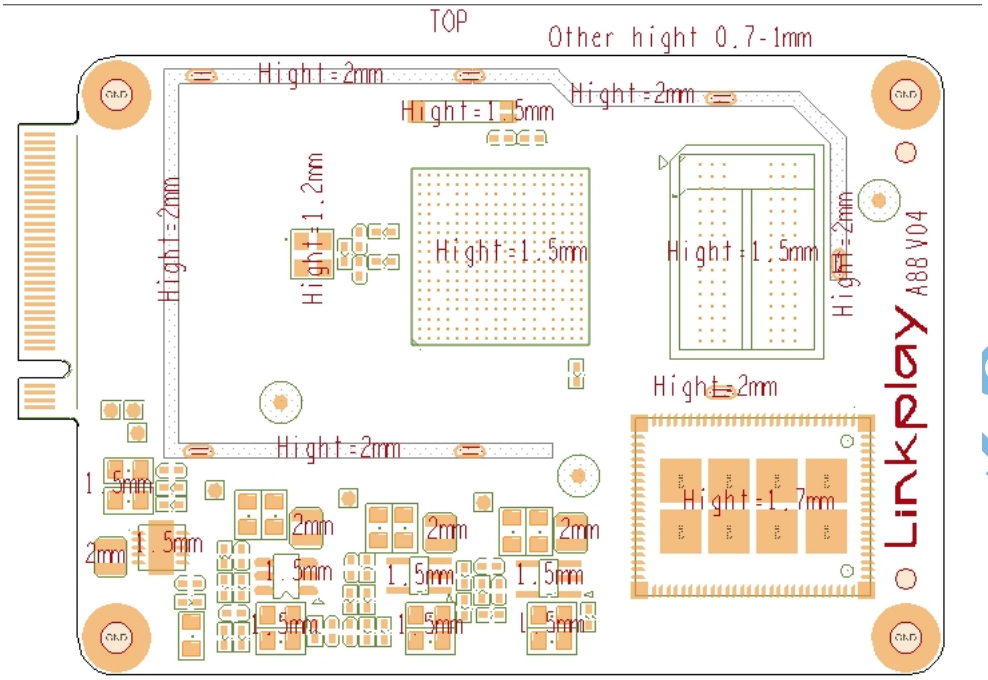
NGFF connector dimensions:



Top View



TOP Components High Limit



Bottom Components High Limit

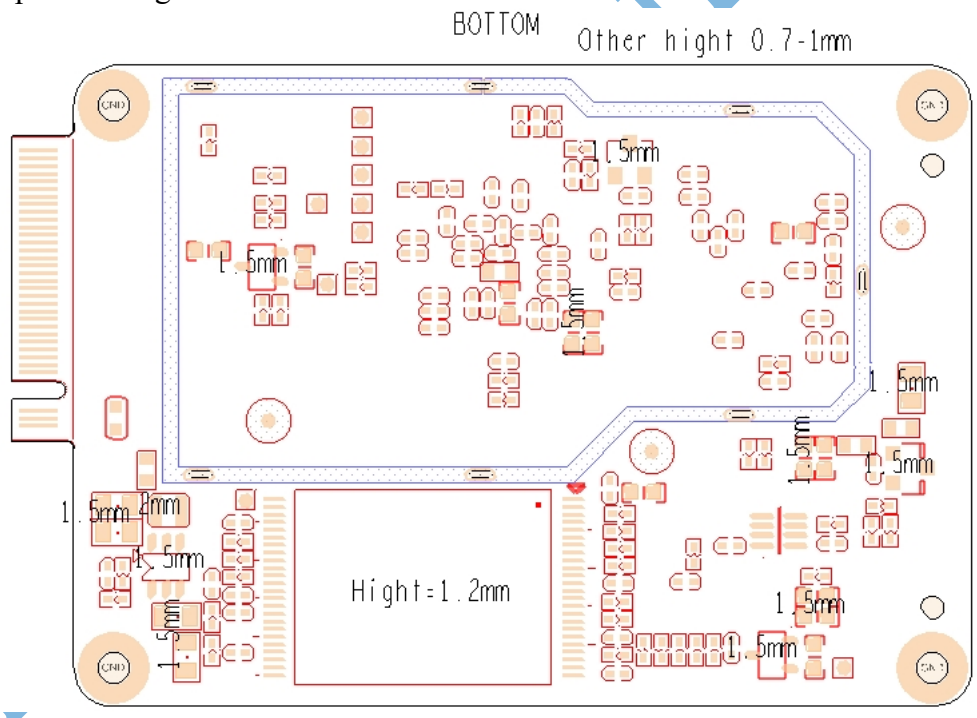


Figure 2-2: Linkplay A88 physical dimension

2.3. External Antenna

A88 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.

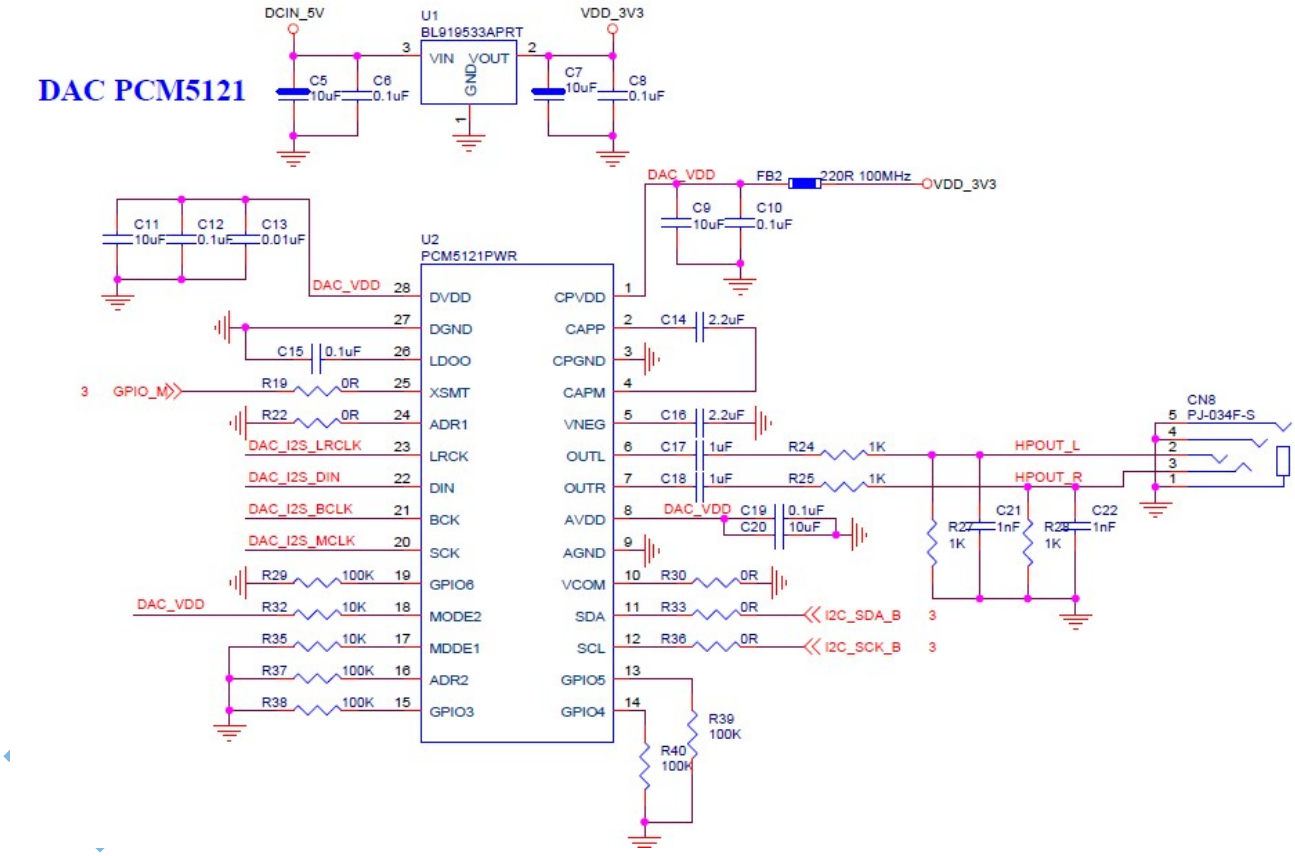
Item	Parameter
Frequency range	2.4 ~ 2.5GHz/4.9 ~ 5.8GHz
Impedance	50 Ohm
VSWR	2 (Max.)
Reflection loss	1.43 dBi (@2.4~2.5GHz) 2.77 dBi (@5.15 ~ 5.85 GHz)
Connector	I-PEX or populate directly

Table 2-5 External antenna parameters for A88

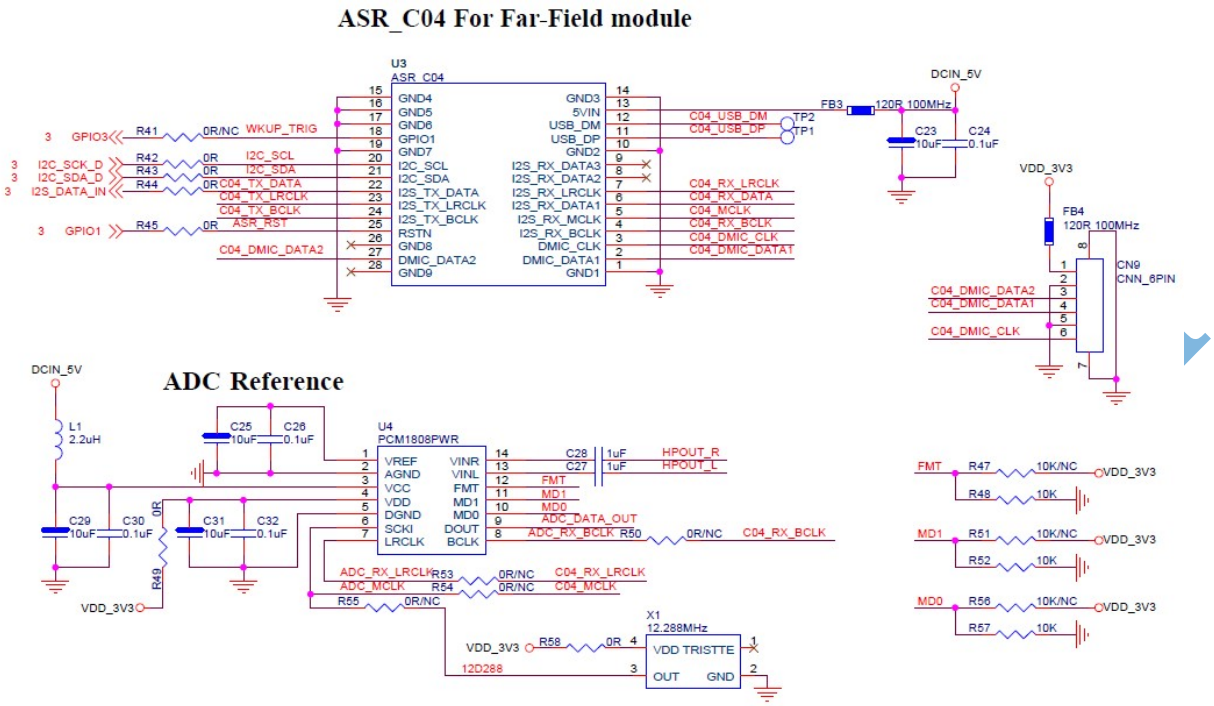
2.4. Typical Application

WiFiAudio-A88's typical reference design:

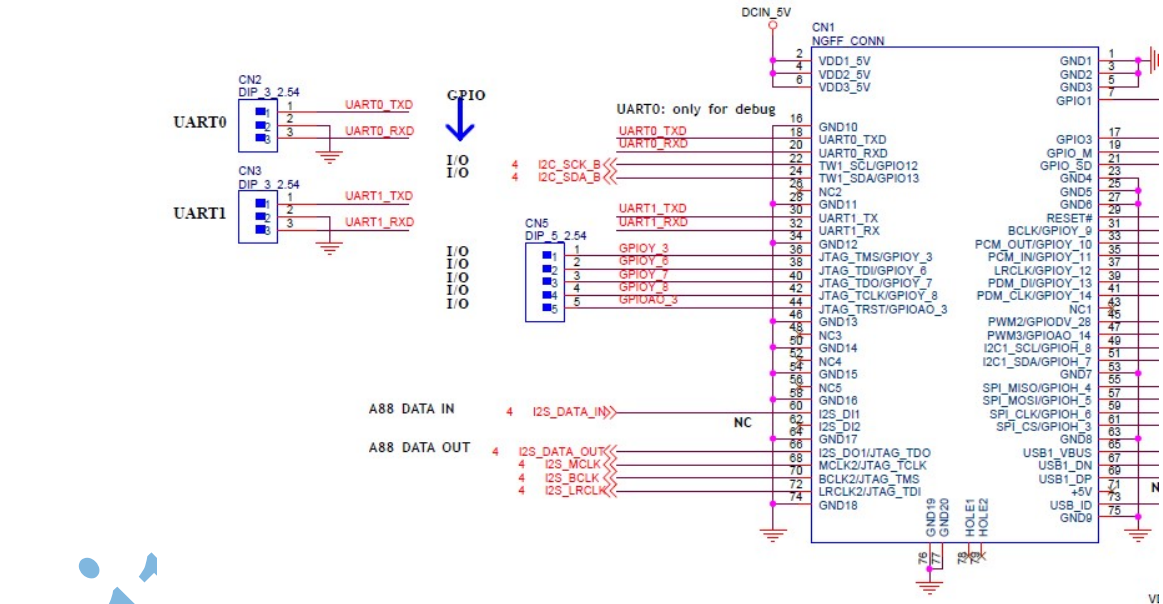
DAC

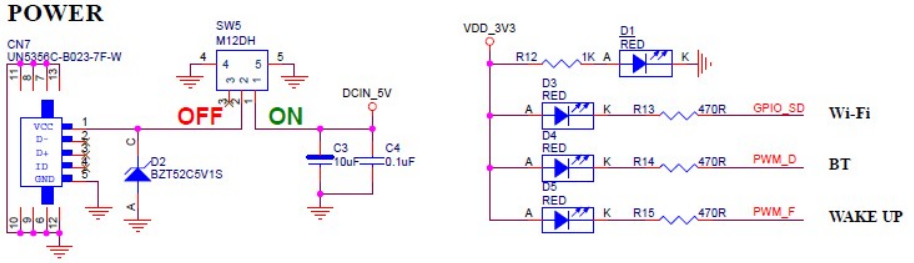


Far-Field

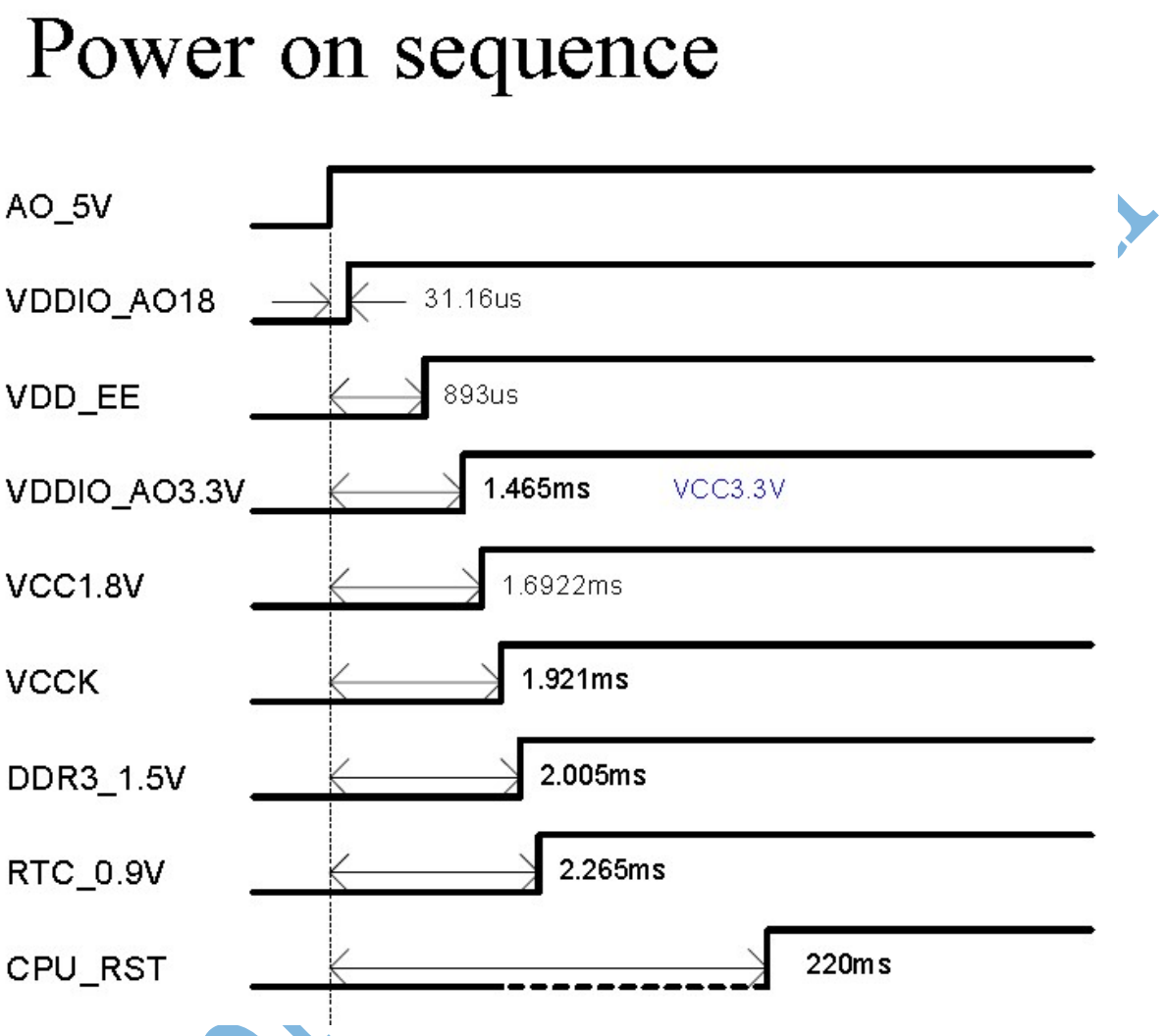

ASR_C04 For Far-Field module
U3
ASR_C04
DCIN_5V
FB3
120R 100MHz
C23
10uF
C24
0.1uF
VDD_3V3
FB4
120R 100MHz
CN9
CNN_6PIN
C04_DMIC_DATA2
C04_DMIC_DATA1
C04_DMIC_CLK
ADC Reference
U4
PCM1808PWR
L1
2.2uH
C25
10uF
C26
0.1uF
C28
1uF
C27
1uF
HPOUT_R
HPOUT_L
C29
10uF
C30
0.1uF
C31
10uF
C32
0.1uF
R49
0R
R50
0R/NC
C04_RX_BCLK
R53
0R/NC
C04_RX_LRCLK
R54
0R/NC
C04_MCLK
R55
0R/NC
X1
12.288MHz
R58
0R
VDD TRISTTE
OUT
GND
12D288
FMT
R47
10K/NC
R48
10K
MD1
R51
10K/NC
R52
10K
MD0
R56
10K/NC
R57
10K

Power


DCIN_5V
CN1
NGFF_CONN
CN2
DIP_3_2.54
UART0
UART0_TXD
UART0_RXD
CN3
DIP_3_2.54
UART1
UART1_TXD
UART1_RXD
GPIO
I/O
UART0: only for debug
CN5
DIP_5_2.54
A88 DATA IN
A88 DATA OUT
I2S_DATA_IN
I2S_DATA_OUT
I2S_MCLK
I2S_BCLK
I2S_LRCLK
NC


POWER
CN7
UN5356C-B023-7F-W
SW5
M12DH
OFF
ON
DCIN_5V
D2
BZT52C5V1S
C3
10uF
C4
0.1uF
VDD_3V3
D1
RED
R12
1K
D3
RED
R13
470R
GPIO_SD
Wi-Fi
D4
RED
R14
470R
PWM_D
BT
D5
RED
R15
470R
PWM_F
WAKE UP

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 A88 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 A88. 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.

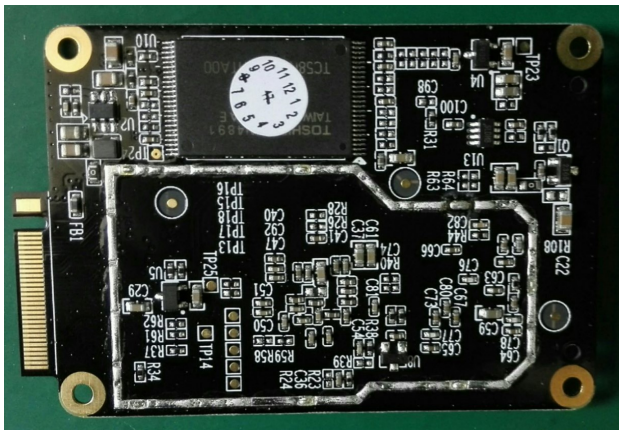
3.3. Certifications

Linkplay can help you to finish follow certifications:

- Wi-Fi Logo
- BQB
- Amazon Alexa
- MFI
- Spotify Connect
- DLNA
- QPlay

4. Module picture and package

1）A88 module picture



Notes:
Linkplay: Linkplay logo
A88: Module No.
V04: MP version of A88 module

2）Delivery

Notes：

One tray = 100pcs

One carton = 5 trays

On carton in total: 5*100pcs = 500pcs

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-A88 Or ContainsFCC ID: 2ANOG-A88”

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 requirement, Only if the test result comply with FCC equirement, then the host can be sold legally.

IC statement

This device complies with Industry Canada’s licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme aux CNR exemptes de licence d'Industrie Canada . Son fonctionnement est soumis aux deux conditions suivantes :

(1) Ce dispositif ne peut causer d'interférences ; etc

(2) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

A separation distance of at least 20 cm is maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

Une distance de séparation d'au moins 20 cm est maintenue entre l'émetteur rayonnant structure (s) et le corps de l'utilisateur ou des personnes à proximité.

For a host manufacture's using a certified modular, if (1) the module's IC number is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the IC number of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module IC: " 23153-A88 " or "Contains IC: 23153-A88" must be used.

Warning:

This radio transmitter [ISED: 23153-A88] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.