LS10: High Performance Wireless Media Module
Data Sheet

Rev: 1.2

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1. Document Information

1.1. Document Revision History

Revision	Date	Description of change	Author
1.2	July 27, 2021	Updated Ordering Info	Chandravel
1.1	June 15, 2021	Updated module image	Chandravel
1.0	May 19, 2021	Final Draft	Chandravel
0.1	April 25, 2021	Initial Draft	Chandravel

2. Introduction

Libre Wireless - LS10 is an advanced high-performance media/audio streaming module for smart audio and smart home appliances. It comes with powerful Quad core Coretex-A53 CPU running at 1.5GHz with Neon and Crypto extensions and unified L2 cache. It also has ARM cortex-M3 MCU in Always On domain to support the low power mode. LS10 module incorporates Wi-Fi/BT (2.4GHz/5GHz + V5.2 BLE) combo chip with USB OTG.

3. Module Feature Summary

Key Features

- Quad Core ARM Cortex-A53 CPU up to 1.5GHz.
- Advanced TrustZone Security System
- ARM Cortex-M3 MCU in Always-On (AO) Domain
- Low power mode supported.
- LCD display support over SPI: 240x320
- Up to 4 DMIC support.
- 2D BitBLT engine.
- 10/100 Ethernet support with internal PHY Chip.
- Inbuild IR TX and RX
- GC4A, Airplay, Home-kit, Spotify-Connect, DLNA DMP/DMR/DMS, etc.
- Hi-Rez Audio 384KHz x 32 Bits x 8 Channel
- Support for SPDIF digital audio input and output
- LPCM, MP3, AAC/AAC+, AC3, OGG Vorbis, HE-AAC, WMA decode capability
- Lossless audio decodes, like FLAC, APE and DSD Support
- Supports WMV9, AVS, GC4A
- Libre in-built code protection and security

- 1DES/3DES/AES/CSS/CPRM/DTCP crypto protection
- 2 - I2S interface. One Dedicated I2S1 and one more I2S2 is muxed with SPI2.

> **Note:** In LS10, SPI2 and I2S2 are mutually exclusive. I2S2 is available only when SPI2 output is disabled, and vice versa.

- LS10 module can be configured only as **I2S-Master mode.**
- DSD over PCM
- 1x USB 2.0 OTG (For Debug Shell, Ethernet, Firmware update, USB Media Playback, USB Tethering)
- 1x UART (Debug communication)
- 1x Full UART1 (For Host communication muxed with I2C2)

> **Note:** In LS10 UART1 and I2C2 are mutually exclusive. I2C2 is available only when UART2 output is disabled, and vice versa.

- 2x I2C, 2x SPI (one muxed with I2S), GPIOs
- Wi-Fi **1x1** 802.11a/b/g/n/ac with Dual Band Antenna
- One optional dedicated BT Antenna.
- Bluetooth 5.2 and Low Energy
- Wi-Fi/BT concurrent coexistence
- Standard RAM/Flash configuration includes 512MB/512MB. Custom memory configuration supported on request.

WLAN Features

- IEEE 802.11 a/b/g/n/ac compliant
- 1x1, Dual Band.
- IEEE 802.11 a/b/g/n/ac STA mode. Below are major STA features:
    1. Support wireless security for WEP, WPA TKIP and WPA2 AES PSK and WPA3-Personal
    2. Excellent WLAN power save modes features
    3. WPS - PIN and PBC Methods
- Soft AP mode
- Wi-Fi-Direct and Miracast

Bluetooth Features

- Bluetooth V5.2
- Bluetooth Low Energy (BLE)
- Best-in-class BT/Wi-Fi coexistence performance
- BT Profiles: A2DP 1.2, AVRCP 1.3, SPP, HFP, HSP, HOGP

4. LibreSync Features

LibreSync modules have extensive software features for connected media streaming and control applications. These include system level control and interface features as well as networking features. Please refer to the full "Master Feature List" for details of supported features.

> **Note:** Platform features can vary based on module configuration/derivatives and commercial engagement details.

5. Block Diagram

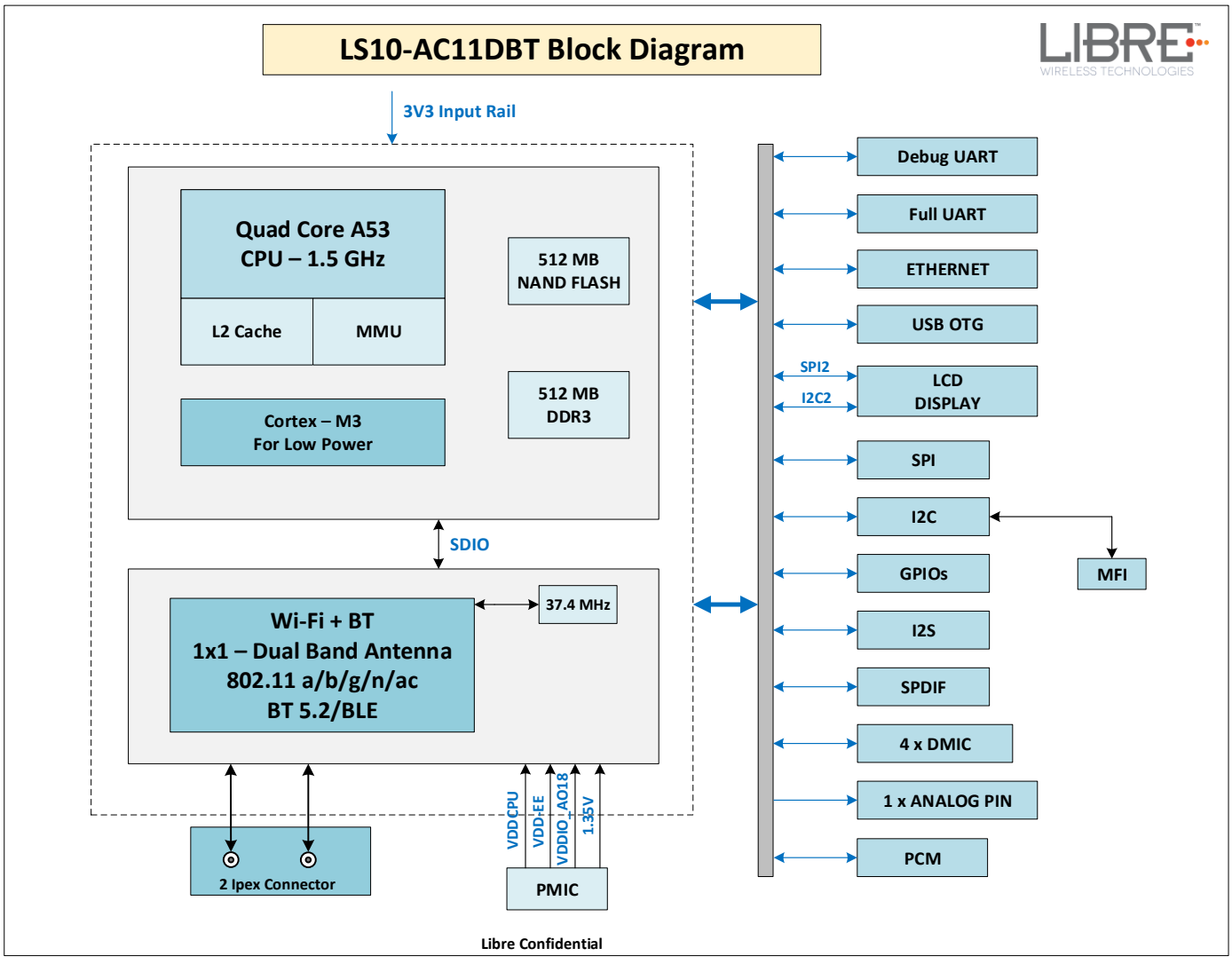


Figure 5-1: LS10 MODULE Block Diagram

6. Specifications

6.1. General Specification

Parameter	Description / Values
Model	LS10 MODULE
Product Name	Network Media Module
Standard	• Wi-Fi – IEEE802.11a, IEEE802.11b, IEEE802.11g, IEEE802.11n, IEEE802.11ac standards • BT – v2.1+EDR, V5.2 BT Low Energy (BLE)
Data Transfer Rate	1,2,5.5,6,11,12,18,22,24,30,36,48,54,60,90,120,150, 300, and maximum of physical layer rate of 390 Mbps
Frequency Band	2.4 / 5.0 GHz
Input Voltage	3.3 V ± 5 %, 20-30 mVpk-pk
USB_VBus (device mode)	4.8-5.2V, 50 mVpk-pk
Operating Temperature	-5˚C to + 70˚C
Dimensions	55 mm x 40 mm x 7 mm (L x W x H) ± 0.2mm

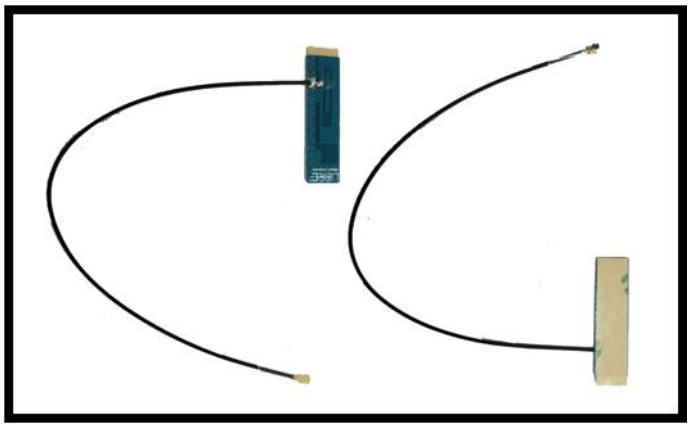
6.2. Wi-Fi Specification

Parameter	Description / Values
Standard	1x1 Dual Band 802.11 a/b/g/n/ac
Operating Band Support	• Dual Band • 2.4GHz: 2.412 ~ 2.483 GHz • 5.0 GHz: 5.180GHz ~ 5.825GHz
Network Architecture	• Infrastructure Mode • Concurrent STA/AP and STA/STA
Transmit Output Power (+/- 2dBm tolerance)	• 2.4 GHz • 802.11b: 18 dBm (11Mbps) • 802.11g: 15 dBm (54Mbps) • 802.11n: 14 dBm (MCS 7) • 5.0 GHz • 802.11a: 14 dBm (54Mbps) • 802.11n: 13 dBm (MCS 7) • 802.11ac: 15 dBm (MCS 0) • 802.11ac: 13 dBm (MCS7) • 802.11ac: 10 dBm (MCS 9)
Receiver Sensitivity	TBD
Security	WEP 64&128 bit, WPA, WPA-PSK, WPA2, WPA2-PSK, WPS, IEEE 802.1x, IEEE 802.11i, WPA3

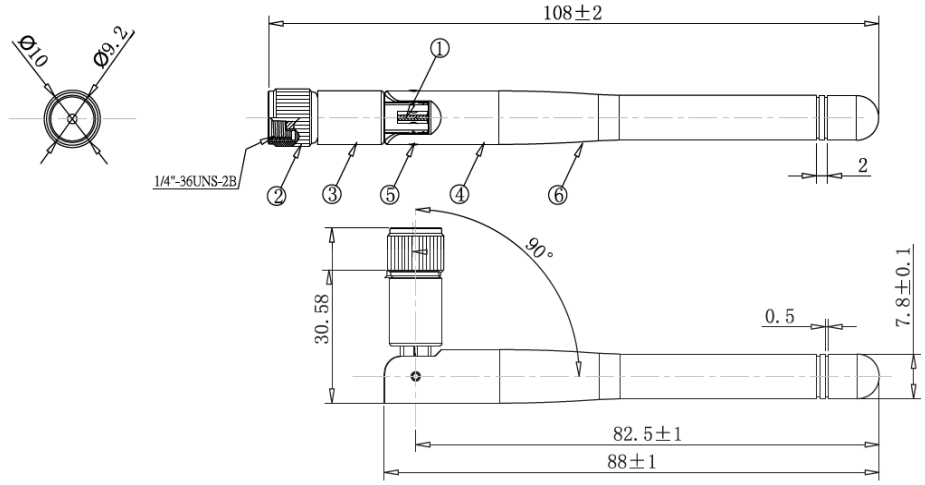
6.3. Bluetooth Specification

Parameter	Description / Values
Standard	V2.1+EDR, V3.0+HS, V5.2 BT Low Energy (BLE)
Audio CODEC Support	SBC
Profile Support	A2DP 1.2, AVRCP 1.3
Sampling Rates	• 44.1 KHz, 48 KHz • Joint Stereo 32 KHz
Coexistence Support	Intelligent AFH (Advanced Frequency Hopping) – Channel Assessment WLAN/Bluetooth Coexistence (BCA) Protocol Support
Data Rate	• GFSK: 1 Mbps • π/4 DQPSK: 2 Mbps • 8DPSK: 3 Mbps
Modulation	GFSK, π/4 DQPSK, 8DPSK
Operation Channel	0 to 78 for BDR / EDR 0 to 39 for BLE
Frequency Range	2.4 GHz (2402 -2480 MHz)
Security	AES Encryption
Transmit Output Power (+/- 1dBm tolerance)	• BDR: 6 dBm • EDR: 4 dBm • LE: 6 dBm
Receiver Sensitivity	• BDR: < -86 dBm • EDR: < - 84 dBm • LE: <-86 dBm

6.4. Antenna Specification

Antenna Module	LSANT-1C-180
Antenna Gain	≤ 3.5dBi
Manufacturer of Antenna	Golden Smart International Co., Ltd
Antenna Images	

6.5. Rubber Antenna Specification

Antenna Model	RC1WFI0886A
Antenna Gain	≤ 2.0 dBi
Manufacturer of Antenna	Suzhou Point Positive Electronic Technology Co., Ltd
Antenna Image	

SPECIFICATION
1.Frequency Range: 2.4--5.8Ghz
2.Impendance:50Ω
3.VSWR：≤2.0
4.Polanization:Vertical
5.Radlation:Omni
6.Gain: 2dBi

NO	PARTNAME	DESCRIPTION	Q'TY	Part P/NO
⑥	Connettor	SM3033 Reverse	1PCS	
⑤	Antenna Cover	L153mm*□13.0mm TPEE Black	1PCS	
④	Rivet	L5.1mm*□2.4mm POM Black	2PCS	
③	Antenna Base	L28.2*□13.0mm PBT Black	1PCS	
②	Antenna Base	L29.4*□13.0mm PC Black	1PCS	
①	Cable	RG-178 Cable 50Ω	1PCS	

6.6. LS10 Module Ordering Information

Product Number	Wi-Fi Tx/Rx	Wi-Fi Bands	Bluetooth	Ethernet	Memory	Module Dimension* (±0.2mm)
LS10-AC11DBT-C	802.11 b/g/n/ac 1x1	2.4 / 5.0 GHz	5.2 BT + BLE	NA	256 MB NAND 256 MB DDR3	55 x 40 x 7mm (L x W x H) ± 0.2mm
LS10-AC11DBT-C-E	802.11 b/g/n/ac 1x1	2.4 / 5.0 GHz	5.2 BT + BLE	Yes	256 MB NAND 512 MB DDR3	55 x 40 x 7mm (L x W x H) ± 0.2mm
LS10-AC11DBT-GV	802.11 b/g/n/ac 1x1	2.4 / 5.0 GHz	5.2 BT + BLE	NA	512 MB NAND 512 MB DDR3	55 x 40 x 7mm (L x W x H) ± 0.2mm
LS10-CR-C-GV-E	802.11 b/g/n/ac 1x1	2.4 / 5.0 GHz	5.2 BT + BLE	Yes	512 MB NAND 512 MB DDR3	55 x 40 x 7mm (L x W x H) ± 0.2mm
LS10-CR-C-I	NA	NA	NA	NA	256 MB NAND 256 MB DDR3	55 x 40 x 7mm (L x W x H) ± 0.2mm

*Supported industrial grade Flash.

The LS10 module height does not include the measurement of bottom-side media-connector.

7. Mechanical, Connectors and Interfaces

7.1. Physical Module

Physical module dimension is 55mm x 40mm x 7mm (L x W x H) ± 0.2mm.
Figure 7.1-1 represent module's top.

7.1.1. Module Manufacturer

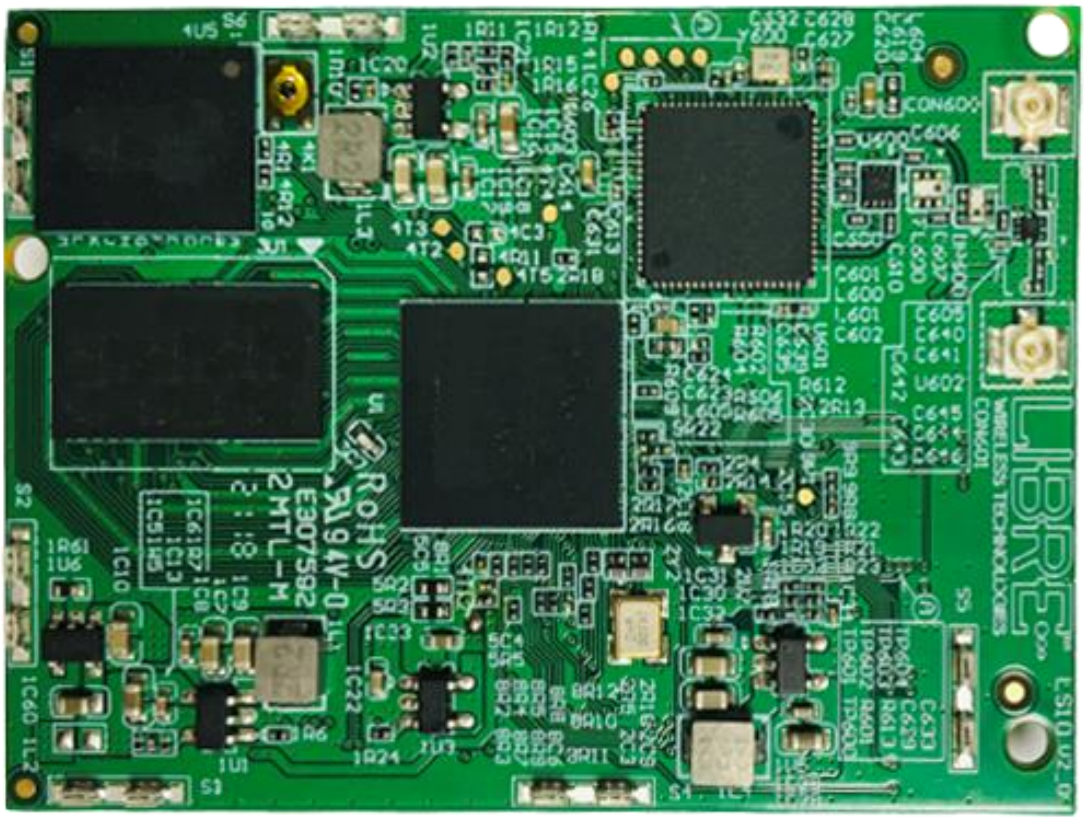


Figure 7.1-1: LS10 Module Top View

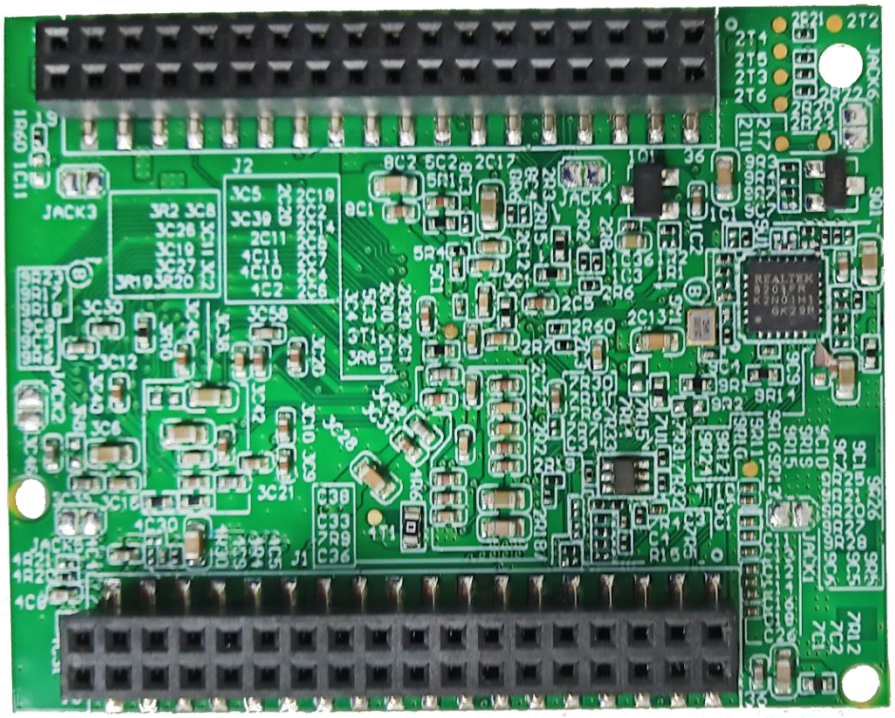


Figure 7.1-2: LS10 Module Bottom View

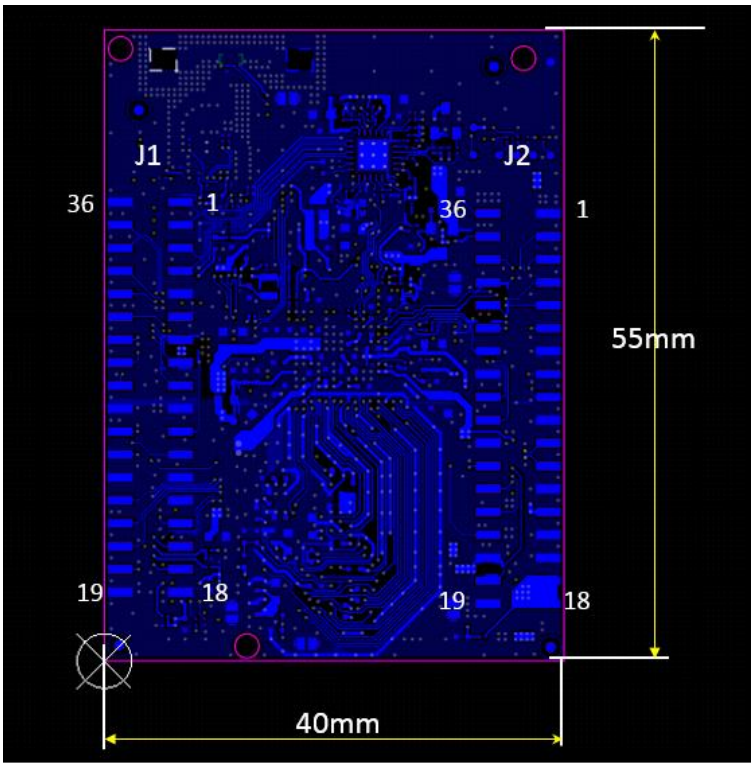


Figure 7.1-3: LS10 Top View - Mechanical Dimension 1

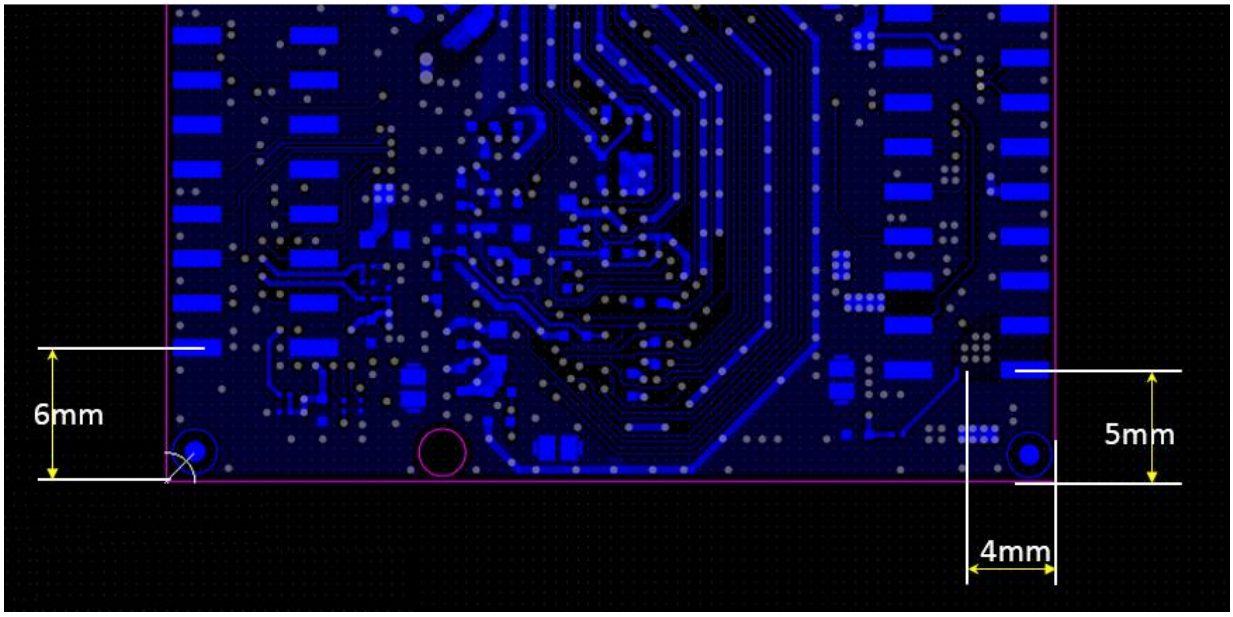


Figure 7.1-4: LS10 Top View - Mechanical Dimension 2

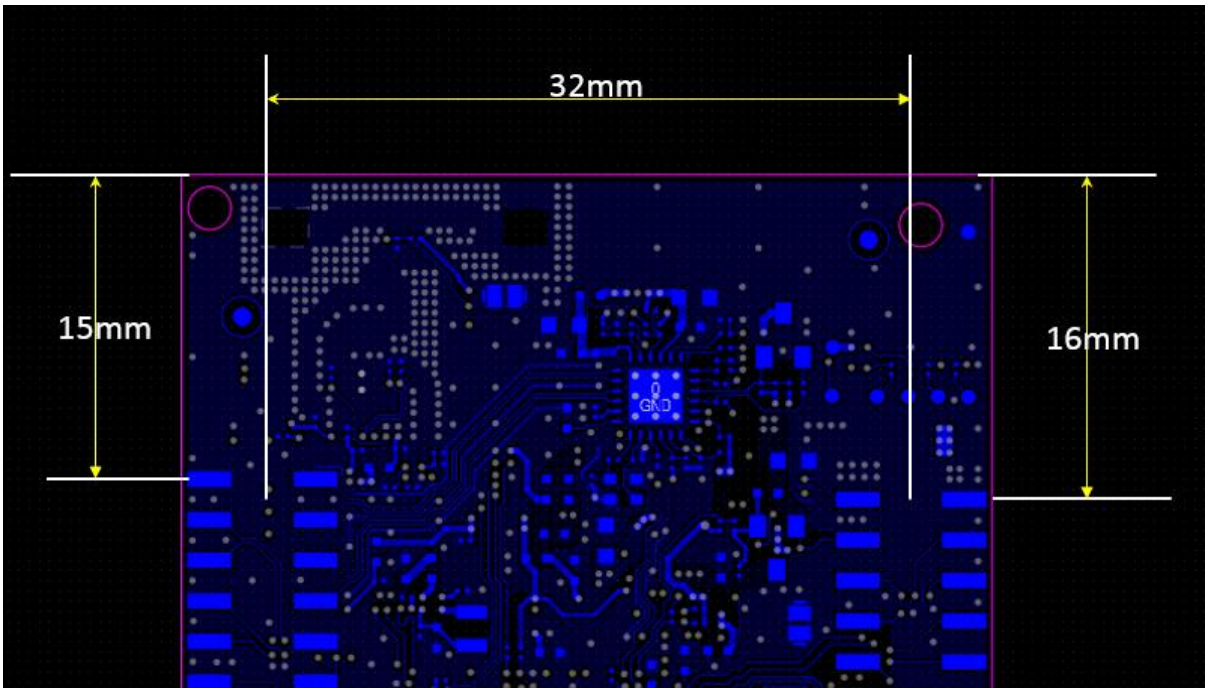


Figure 7.1-5: LS10 Top View - Mechanical Dimension 3

> **Note:** The module dimension is measured in millimeters (mm).

7.2. Media Connector Specification

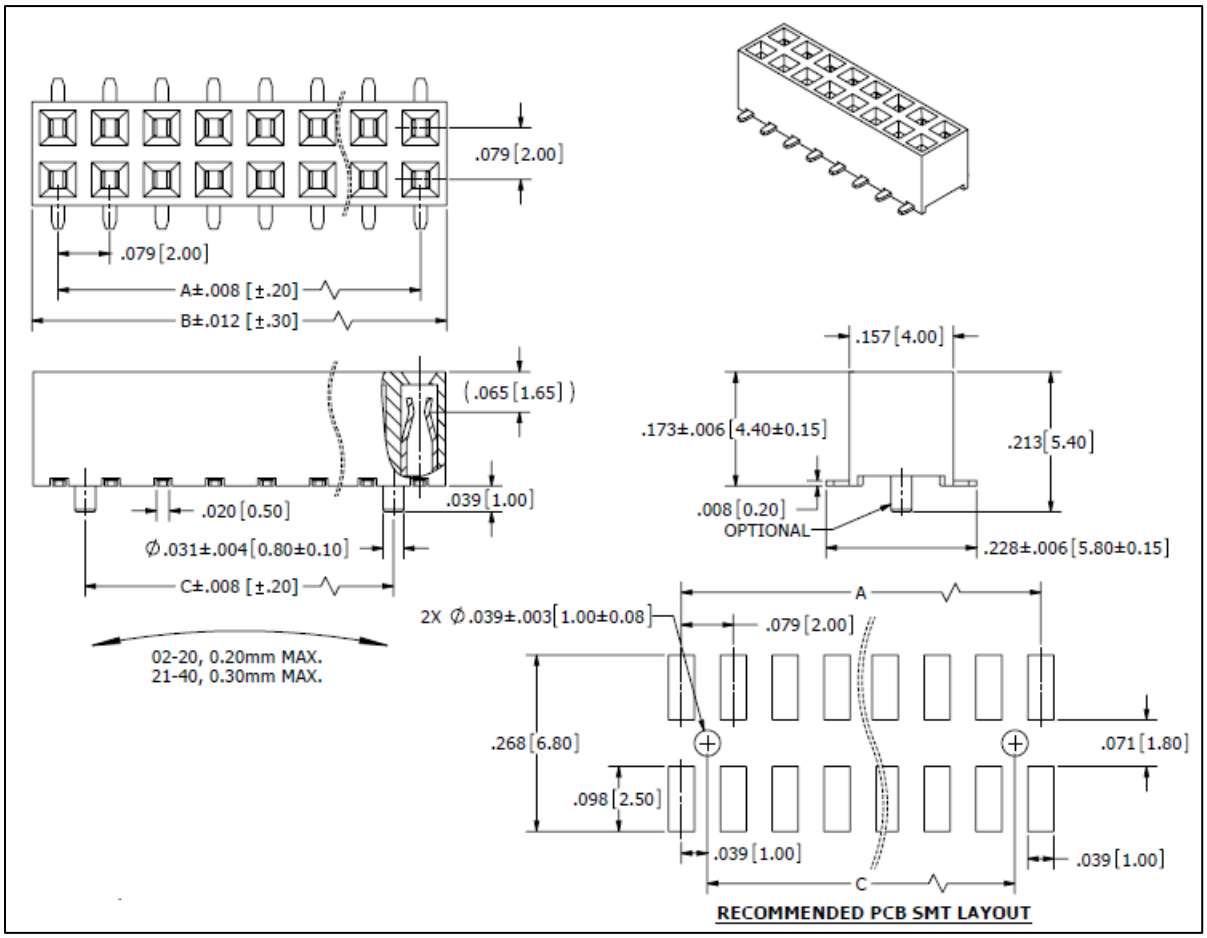


Figure 7.2-1: Media Connector

7.3. Pin Descriptions

7.3.1. Connector

Connector J1		
Pin No.	**Signal Name**	**Functionality**
1	MDI_RN	MEDIUM DEPENDENT INTERFACE RX POSITIVE
2	MDI_RP	MEDIUM DEPENDENT INTERFACE RX NEGATIVE
3	MDI_TN	MEDIUM DEPENDENT INTERFACE TX POSITIVE
4	MDI_TP	MEDIUM DEPENDENT INTERFACE TX NEGATIVE
5	GND	GROUND
6	PCM_CLK	BT PCM BIT CLOCK
7	PCM_IN	BT PCM RXD
8	PCM_OUT	BT PCM TXD
9	PCM_SYNC	BT PCM LRCLK
10	GND	GROUND
11	UART1_RTS	UART1_RTS/GPIOZ_7
12	UART1_CTS	UART1_CTS/GPIOZ_6
13	NC	NC
14	PHY_LED0_AD0	Link/ Status LED
15	CHELSEA_RST/IR_IN	GPIOAO_6/IR_IN
16	BUTTON1	GPIOAO_3
17	CHELSEA_IRQ/IR_OUT	GPIOAO_7/IROUT
18	GND	GROUND

Connector J1		
Pin No.	**Signal Name**	**Functionality**
19	GND	GROUND
20	SPI0_SS0_A	SPI0 CHIP SELECT/GPIOZ_3
21	SPI0_MISO_A	SPI0MISO/GPIOZ_2
22	SPI0_MOSI_A	SPI0 MOSI/GPIOZ_1
23	SPI0_CLK_A	SPI0 CLOCK/GPIOZ_0
24	GND	GROUND
25	I2C_AO_SDA	I2C0 DATA
26	I2C_AO_SCL	I2C0 CLOCK
27	GND	GROUND
28	LS10_MCLKB	AUDIO O/P MASTER CLOCK
29	LS10_BCLK	AUDIO O/P BIT CLOCK
30	LS10_LRCLK	AUDIO O/P LR CLOCK
31	LS10_I2S_RXD	I2S1_TXD
32	LS10_I2S_TXD	I2S1_RXD
33	CPU_RESET	RESET PIN
34	HOST_UART_RX	HOST UART Communication
35	HOST_UART_TX	HOST UART Communication
36	GND	GROUND

Connector J2		
Pin No.	**Signal Name**	**Functionality**
1	GND	GROUND
2	USB_OTG_ID	USB OTG IDENTIFICATION
3	LEDB	GPIOX_11
4	LEDG	GPIOA_16
5	LEDR	GPIOA_15
6	BUTTON3	GPIOX_7
7	GND	GROUND
8	UART1_TX/I2C1_SCL	DEBUG UART1_TX/I2C1_SCL/GPIOZ_8
9	UART1_RX/I2C1_SDA	DEBUG UART1_RX/I2C1_SDA/GPIOZ_9
10	GND	GROUND
11	USB_DP	USB DATA PLUS
12	USB_DM	USB DATA MINUS
13	GND	GROUND
14	USB_VBUS	USB POWER. **5V SHOULD COME FROM EXTERNAL IF IT IS IN DEVICE MODE.**
15	GND	GROUND
16	GND	GROUND
17	3.3V	POWER RAIL
18	3.3V	POWER RAIL

Connector J2		
Pin No.	**Signal Name**	**Functionality**
19	GND	GROUND
20	SARADC_CH0	ANALOG INPUT CHANNEL
21	GND	GROUND
22	BUTTON2	GPIOAO_4
23	DM1_DATA	MIC DATA
24	DM0_DATA	MIC DATA
25	DMIC_CLK	MIC CLOCK
26	GND	GROUND
27	SPDIF_OUT	SPDIF INPUT
28	SPDIF_IN	SPDIF OUTPUT
29	GND	GROUND
30	SPI1_SS0_B/I2S_RX	SPI1 CS/I2S2 RX/GPIOA_5
31	SPI1_CLK_B/I2S_TX	SPI1 CLOCK/I2S2 TX/GPIOA_4
32	SPI1_MISO_B/I2S_LRCLK	SPI1 MISO/I2S LRCLK/GPIOA_3
33	SPI1_MOSI_B/I2S_BCLK	SPI1 MOSI/I2S BCLK/GPIOA_2
34	LCD_RESET	LCD RESET/GPIOA_0
35	LCD_BL_PWM/BUTTON5	LCD BACKLIGHT PWM /GPIOZ_5
36	LCD_BL_EN/BUTTON4	LCD BACKLIGHT ENABLE/GPIOZ_4

7.4. GPIO Details

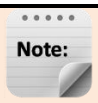
Interface	Signal Name	Availability/Usage
SPI	SPI0_SS0	YES
	SPI0_SCLK	
	SPI0_MOSI	
	SPI0_MISO	
	SPI1_SS0	I2S2 AND SPI1 are mutually exclusive
	SPI1_SCLK	
	SPI1_MOSI	
	SPI1_MISO	
	UART_TX	Debug UART
	UART_RX	
UART	UART1_RXD	Yes Full UART and I2C1 are mutually exclusive
	UART1_TXD	
	UART1_RTS	
	UART1_CTS	
I2C interface	I2C0_SCL	Yes ACP CODEC and HOST-MCU Communication (optional)
	I2C0_SDA	
	I2C1_SCL	
	I2C1_SDA	

7.5. Power Consumption

TBD

LS10 GCast Configuration

	Idle	Active Mode	Network Standby Mode
I (mA)	248	300	185
V (V)	3.3	3.3	3.3
P (mW)	818.4	990	610.5



Power numbers may vary based on features.
Power numbers are calculated theoretically.

8. Environmental

8.1. Storage Conditions

The calculated shelf life in a sealed bag is 12 months if stored between 0°C and 70˚C at less than 90% relative humidity (RH).

After the bag is opened, devices that are subjected to solder reflow or other high temperature processes must be handled in the following manner:

- Mounted within 168 hours in factory conditions, i.e., <30°C at 60% RH.
- Storage humidity needs to be maintained at <10%RH.
- Baking is necessary if the customer exposes the component to air for over 168 hrs.
    - Baking conditions: 125℃ for 8hrs.

9. Reference Schematics

> **Note:** For detailed schematics of LS10 refer to the latest LS10-EVK Schematic, file in the portal.

9.1. EVK Block Diagram

TBD.

9.2. MFI 3.0C Authentication Circuit

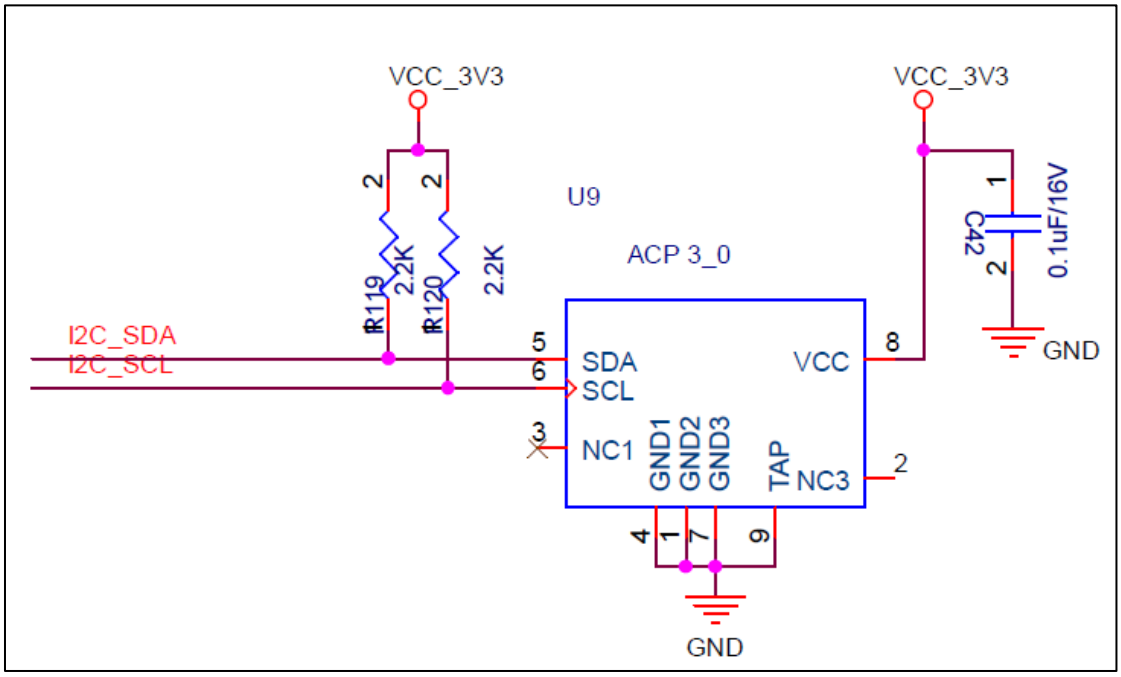


Figure 9.2-1: LS10 EVK ACP 3.0

10. Disclaimer

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FCC regulatory conformance

FCC ID: 2ADBM-LS10

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.
NOTE: This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help

NOTE: Unauthorized changes will result in loss of device operating privileges.

RF Exposure

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

IC regulatory conformance

IC: 20276-LS10

This device complies with CAN ICES-003 (B)/NMB-003(B).This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
Cet appareil est conforme à la norme CAN ICES-003 (B)/NMB-003 (B).
Cet appareil contient des émetteurs / récepteurs exempt (s) de licence qui sont conformes aux RSS exemptes de licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes:

(1) Cet appareil ne doit pas provoquer d'interférences.
(2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

RF Exposure
This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Cet équipement est conforme aux limites d'exposition aux rayonnements de la IC établies pour unenvironnement non contrôé. Cet équipement doit être installé et fonctionner à au moins 20cm de distance d'un radiateur ou de votre corps.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

OEM must certify the final end product to comply with unintentional radiators (FCC Sections 07 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2ADBM-LS10". Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and

(2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end-use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

IC labeling requirement for the final end product:

The final end product must be labeled in a visible area with the following “Contains IC: 20276-LS10”

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

Unauthorized modifications could void the user's authority to operate the equipment.

This radio transmitter [lC: 20276-LS10] 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 in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Frequency range	Manufacturer	Peak gain	Impedance	Antenna type
2400-2483.5MHz	Hansong(NanJing)Technology Ltd	3.3dBi	50Ω	FPC Antenna
2400-2483.5MHz	Libre Wireless Technologies, Inc.	3.5dBi	50Ω	PCB Antenna
2400-2483.5MHz	Hansong(NanJing)Technology Ltd	2.6651dBi	50Ω	Dipole Antenna
5150 to 5250 MHz 5250 to 5350 MHz 5470 to 5725 MHz 5725 to 5850 MHz	Hansong(NanJing)Technology Ltd	3dBi	50Ω	FPC Antenna
5150 to 5250 MHz 5250 to 5350 MHz 5470 to 5725 MHz 5725 to 5850 MHz	Libre Wireless Technologies, Inc.	5.9dBi	50Ω	PCB Antenna
5150 to 5250 MHz 5250 to 5350 MHz 5470 to 5725 MHz 5725 to 5850 MHz	Hansong(NanJing)Technology Ltd	2.73919dBi	50Ω	Dipole Antenna