LibreSync & GC4A
High Performance Network Media Module
1x1 Dual Band 802.11 a/b/g/n/ac
With Integrated Bluetooth 4.1 Low Energy (BLE)

LS9 Data Sheet
Module: LS9-AC11DBT

Rev: 2.3

1. Introduction

Libre Wireless, LS9-AC11DBT is a high performance media / audio streaming module. LS9-AC11DBT comes with Dual core Coretex-A7 CPU and Dual Neon/VFPU subsystems running at 1.3GHz, 256MB of DDR3 DRAM memory and 256MB of NAND Flash, an 802.11a/b/g/n/ac, Bluetooth v4.1 Low Energy (BLE), Multi- standard video encoding, 2D/3D Graphics Engine and a USB OTG.

2. Module Feature Summary

Key Features

- Dual core Cortex-A7 CPU and Dual core Neon/VFPU running ate 1.3GHz
- Features: Hi-Rez Audio (192KHz/24bits), Stereo Decode, HD Graphics and HD Video On Screen Display
- LPCM, MP3, AAC/AAC+,AC3, OGG Vorbis, HE-AAC, WMA decode capability
- Lossless audio decode, like FLAC, APE and DSD
- Support for JPEG/GIF
- Supports WMV9, AVS, VP6,
- Libre's advanced multi-zone audio streaming technology (DDMS)
- Libre Crypto IC for code protection and secure transaction feature options
- Data Transport De-MUX
- 1DES/3DES/AES/CSS/CPRM/DTCP copy protection
- Feature Rich 2D/3D Hardware Graphics Engine,
- I2S interface
    - LS9 module can be configured only as **I2S-Master mode**
    - DSD over PCM
- SPDIF Output (Muxed with I2S port TXD Line - optional)

> **Note:**
> - In LS9, SPDIF and I2S are mutually exclusive. I2S is available only when SPDIF output is disabled, and vise versa.

- HDMI1.4 transmitter MAC and PHY with HDCP 1.4
- 1x USB 2.0 OTG (For Debug Shell, Ethernet, Firmware update, USB Media Playback)
- 1x UART (For HOST-MCU communication)
- 2x I2C, 1x SPI, GPIOs
- Wi-Fi 1x1 Dual Band 802.11a/b/g/n/ac
- 3x Antenna(5 GHz WLAN, 2.4GHz WLAN, and 2.4GHz BT)
- Bluetooth 4.1 and Low Energy
- Standard configuration includes 256MB NAND FLASH and 256MB DDR3

WLAN Features

- IEEE 802.11 a/b/g/n and 802.11ac compliant
- Dual band 1T1R supporting STB and Receive Beamforming

Bluetooth Features

- Bluetooth specification v2.1+EDR
- Bluetooth specification 3.0+HS (802.11 AMP) compliance
- Bluetooth v4.1 Low Energy (LE)
- Best-in-class BT/Wi-Fi coexistence performance
- BT Profiles: A2DP 1.2, AVRCP 1.3, SPP, HFP, HSP, HOGP

3. 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 "LibreSync Feature List" for details of supported features.

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

4. Block Diagram

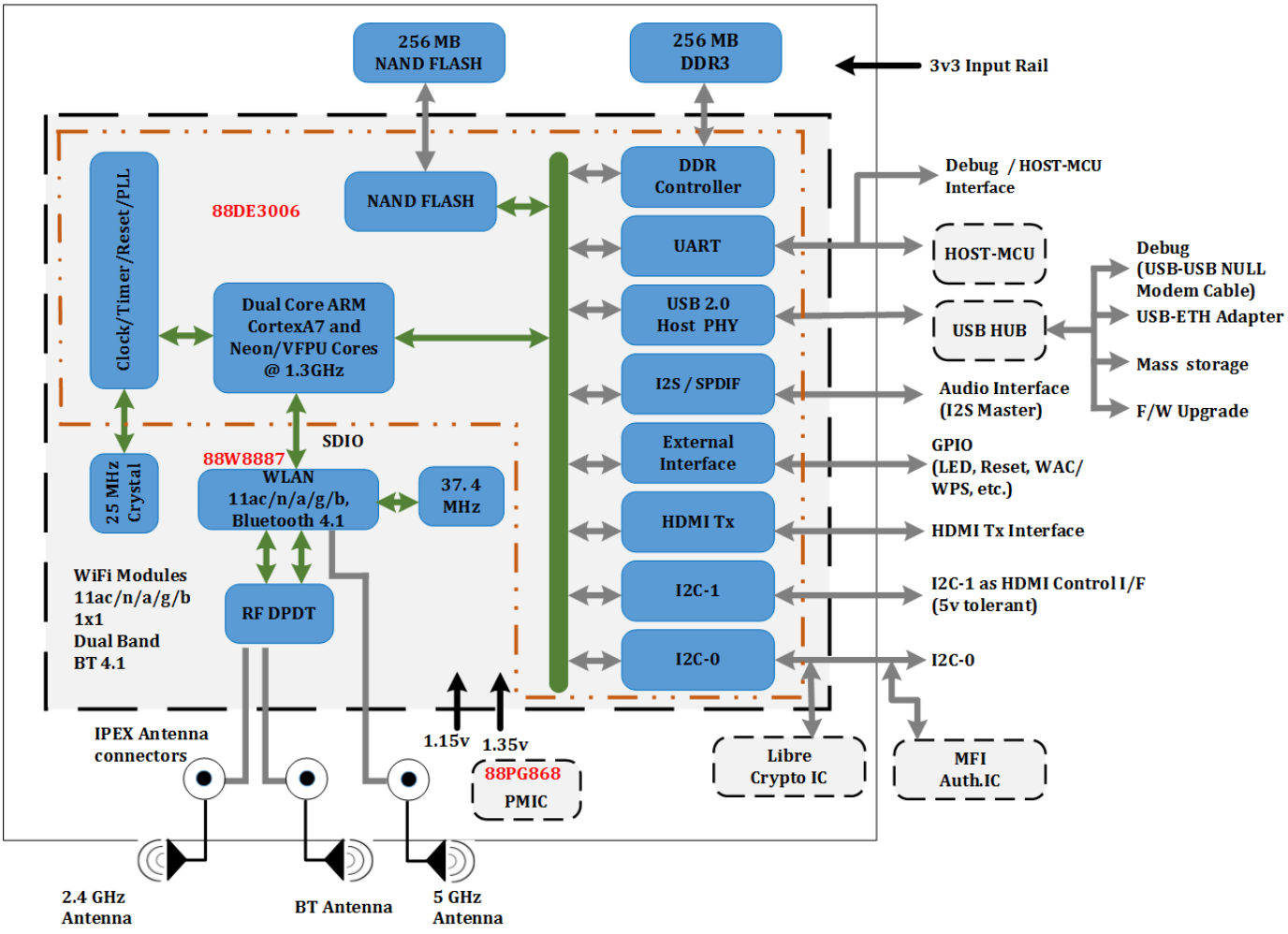


Figure 4-1: LS9-AC11DBT MODULE Block Diagram

5. Specifications

5.1. General Specification

Parameter	Description / Values
Model	LS9-AC11DBT MODULE
Product Name	Network Media Module
Standard	• Wi-Fi – IEEE802.11a, IEEE802.11b, IEEE802.11g, IEEE802.11n, IEEE802.11ac standards • BT – v2.1+EDR, v3.0+HS, v4.1 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 %
Ripple Requirement	20-30 mVpk-pk
Operating Temperature	-5˚C to + 70˚C
Dimensions	63mm x 41 mm x 6.8 mm (L x W x H) ± 0.2mm

5.2. Wi-Fi Specification

Parameter	Description / Values
Standard	IEEE802.11a, IEEE802.11b, IEEE802.11g, IEEE802.11n, and IEEE802.11ac (draft compliant)
Data Rate	• 802.11b : 11, 5.5, 2, 1 Mbps • 802.11g : 54, 48, 36, 24, 18, 12, 9, 6 Mbps

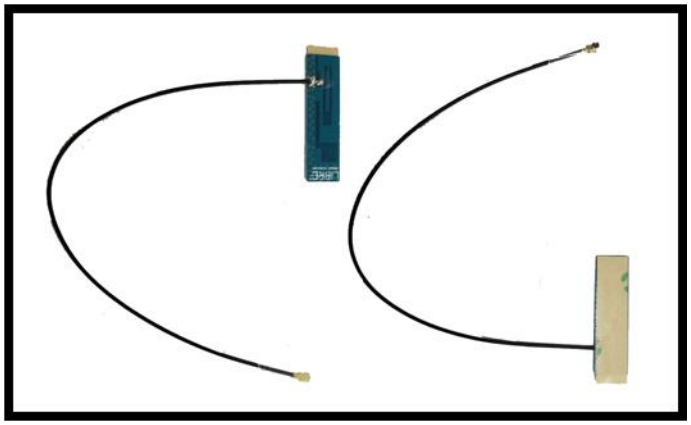
Parameter	Description / Values
	• 802.11n : MCS 0 to 7 for HT20MHz MCS 0 to 7 for HT40MHz • 802.11ac : MCS 0 to 9 for HT40MHz MCS 0 to 9 for HT80MHz
Modulation	• 802.11b : CCK, DQPSK, DBPSK • 802.11g : 64QAM, 16QAM, QPSK, BPSK • 802.11n : 64QAM, 16QAM, QPSK, BPSK • 802.11ac : 256 QAM, 64QAM, 16QAM, QPSK, BPSK
Network Architecture	• Ad-hoc mode (Peer-to-Peer) • Infrastructure Mode
Operation Channel	2.4GHz • 11: (Ch. 1-11) – United States • 13: (Ch. 1-13) – Europe • 5.0 GHz • 21: (Ch. 36, 40, 44, 48, 52……161, and 165) – USA • 19: (Ch. 36, 40, 44, ……..136, and 140) - Europe
Frequency Range	2.4GHz: 2.412 ~ 2.483 GHz 5.0 GHz: 5.150GHz ~ 5.825GHz
Transmit Max Output Power	• 2.4 GHz ○ 802.11b : 16 dBm (11Mbps) ○ 802.11g : 15 dBm (54Mbps) ○ 802.11n : 14 dBm (MCS 7) • 5.0 GHz

Parameter	Description / Values
	○ 802.11a : 15 dBm (54Mbps) ○ 802.11n : 14 dBm (MCS 7) ○ 802.11ac: 13 dBm (MCS 0) ○ 802.11ac: 13 dBm (MCS7) • 802.11ac : 12 dBm (MCS 9)
Receiver Sensitivity	• 2.4 GHz ○ 802.11b : < -92 dBm (1Mbps) ○ 802.11g : < - 70 dBm (54Mbps) ○ 802.11n : < -69 dBm (MCS 7) • 5.0 GHz ○ 802.11a : < -65 dBm (54Mbps) ○ 802.11n : < -64dBm (MCS 7) • 802.11ac : ○ -76 dBm (MCS 0) ○ -60 dBm (MCS7) ○ -54 dBm (MCS 9)
Security	WEP 64&128 bit, WPA, WPA-PSK, WPA2, WPA2-PSK, WPS, IEEE 802.1x, IEEE 802.11i

5.3. Bluetooth Specification

Parameter	Description / Values
Standard	V2.1+EDR, V3.0+HS, V4.1 BT Low Energy (BLE)
Audio CODEC Support	SBC
Profile Support	A2DP 1.2, AVRCP 1.3, SPP, HFP, HSP, HOGP
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

5.4. Antenna Specification

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

5.5. LS9-AC11DBT Module Ordering Information

Product Number	Wi-Fi Tx/Rx	Wi-Fi Bands	Bluetooth	Module Height* (±0.2mm)
LS9-AC11DBT	802.11 b/g/n/ac 1x1	2.4 / 5.0 GHz	4.1 BLE	65 mm x 41mm x 6.8 mm (L x W x H) ± 0.2mm

Note: The LS9-AC11DBT module height does not include the measurement of bottom-side media-connector.

6. Mechanical, Connectors and Interfaces

6.1. Physical Module

Physical module dimension is 63 mm x 41mm x 6.8 mm (L x W x H) ± 0.2mm.

Height of the module varies depending on the LS9 Module variant used; for information on height of the module see Section 5.2.2. LS9-AC11DBT Module Ordering Information.

Figure 6-1 and Figure 6-2 represent module's top and bottom.

Figure 6.1-1: LS9-AC11DBT Module Top

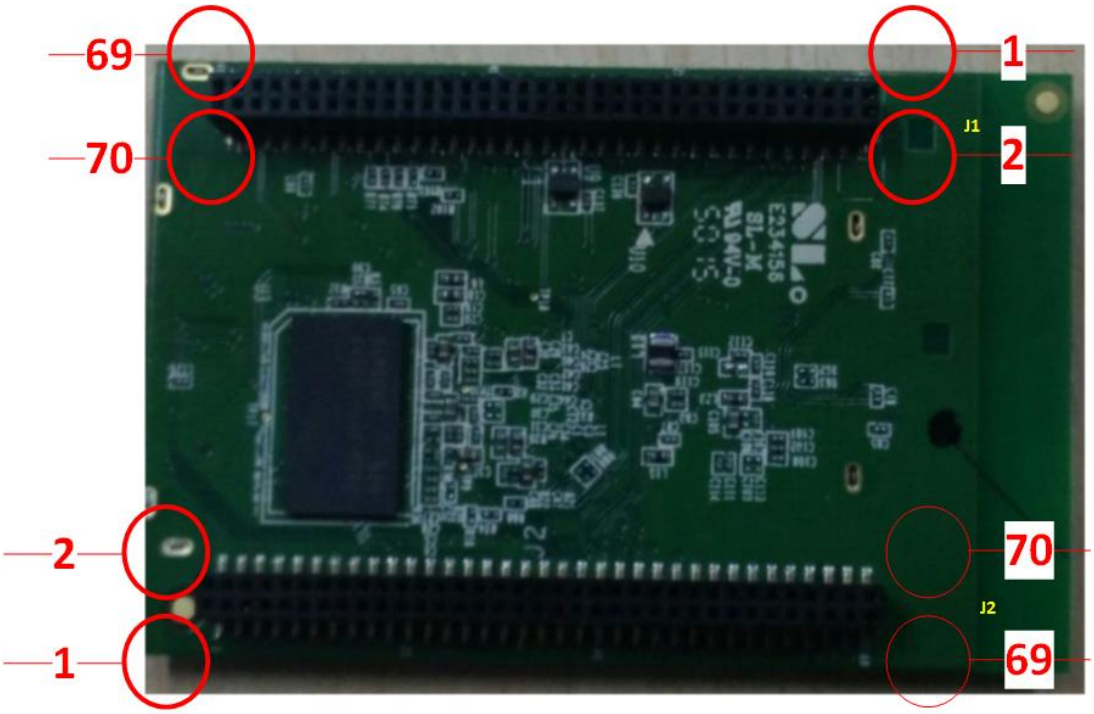


Figure 6.1-2: LS9-AC11DBT Module Bottom

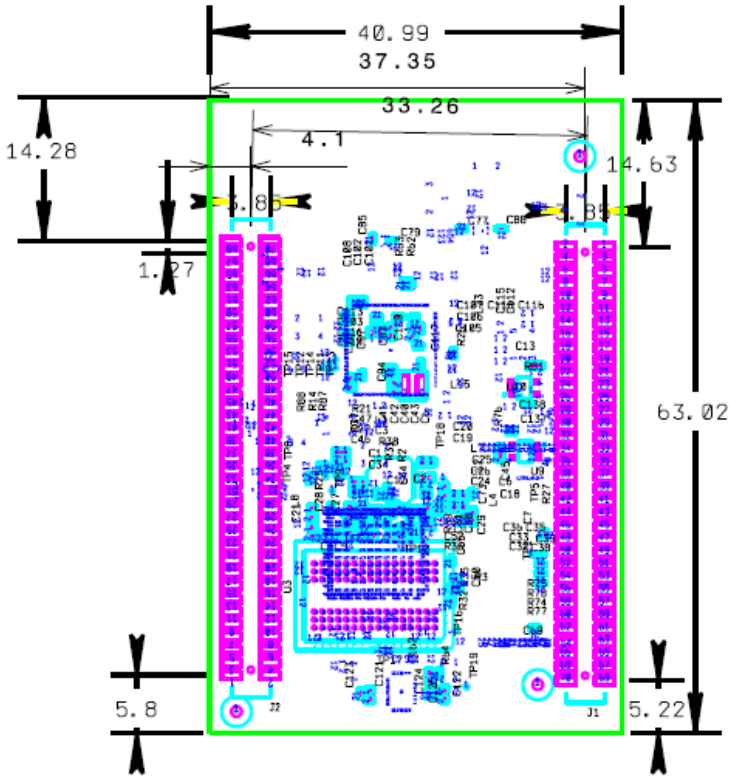


Figure 6.1-3: LS9-AC11DBT MODULE Top view Mechanical Dimension (1)

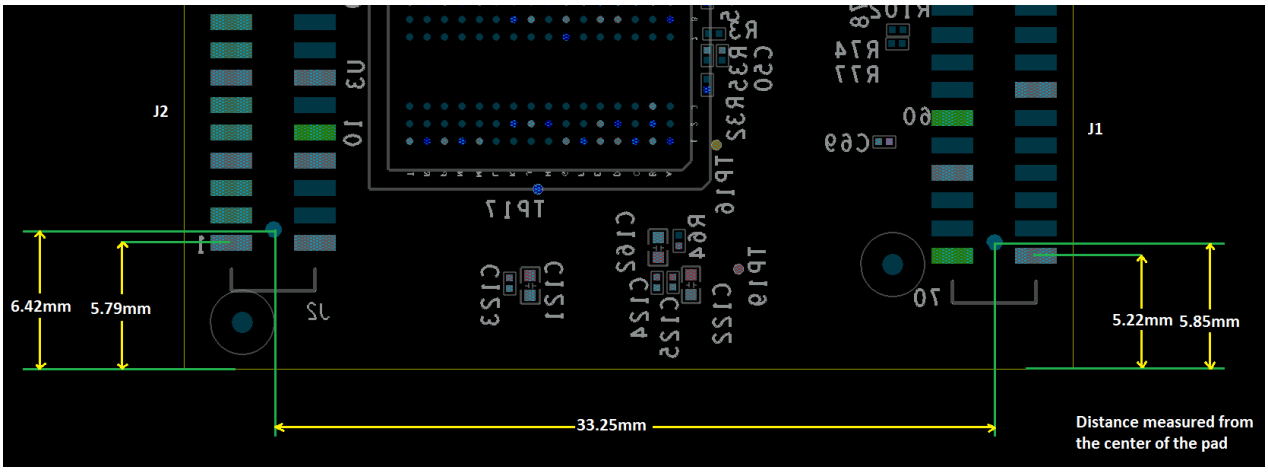


Figure 6.1-4: LS9-AC11DBT MODULE Top View Mechanical Dimension (2)

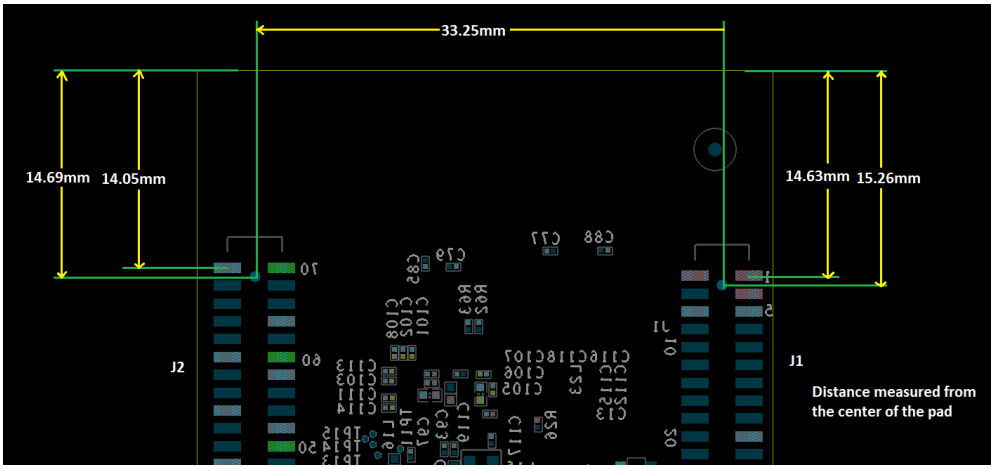


Figure 6.1-5: LS9-AC11DBT MODULE Top View Mechanical Dimension (3)

> **Note:** The module dimensions are measured in millimetres (mm).

6.2. Media Connector Specification

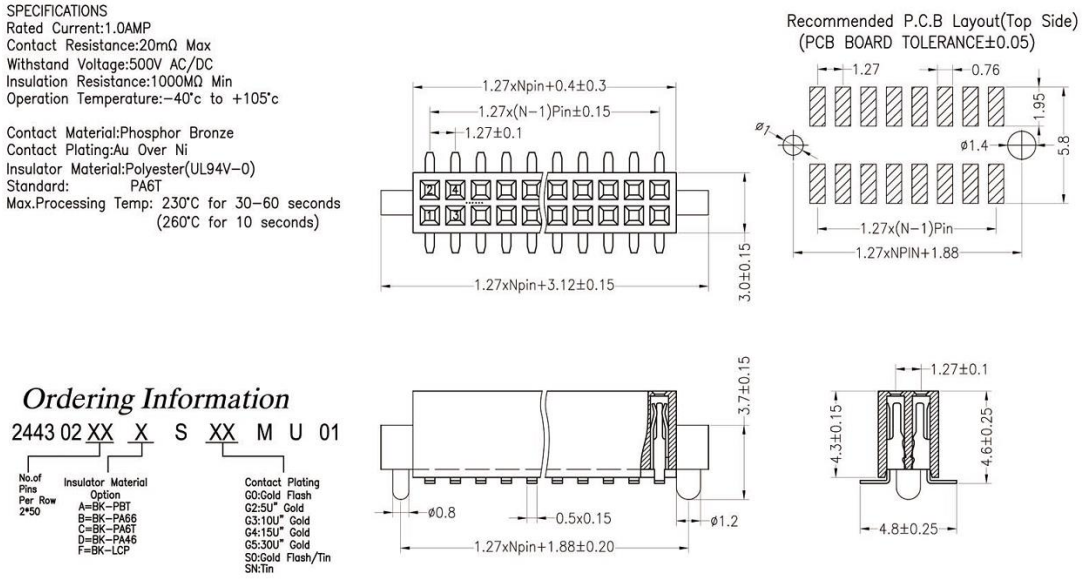


Figure 6.2-1: Media Connector

6.3. Pin Descriptions

6.3.1. Connector-1

LS9-Media Connector J1 pin outs					
Functionality	**Signal Name**			**Signal Name**	**Functionality**
3V3 Power Supply Input	3V3	1	2	3V3	3V3 Power Supply Input
3V3 Power Supply Input	3V3	3	4	NC	No Connect
Ground	GND	5	6	GND	Ground
I2C Serial Clock output.	I2C0_SCL	7	8	MCLK	I2S Mater Clock Output
I2C Serial Data.	I2C0_SDA	9	10	BCLK	I2S Bit Clock Output
Power On Reset input. Active Low. Add RC network (10k, 0.1uF)	RESET#	11	12	LRCLK	I2S LR clock Output

No Connect	NC	13	14	I2S_TXD1/I2S_RXD2 /SPDIF Output	I2S_TXD1/I2S_RXD2 /SPDIF Output *1 (LS9 supports one I2S input output in I2S Master mode or LS9 supports two I2S input in I2S Slave/Master mode or this pin can be used for SPDIF Output)
No Connect	NC	15	16	NC	No Connect
USB VBUS power input required only for USB device mode operation	USB VBUS	17	18	NC	No Connect
Ground	GND	19	20	I2S_RXD1	I2S Receive Data 1
USB DP	USB DP	21	22	NC	No Connect
USB DM	USB DM	23	24	NC	No Connect
Ground	GND	25	26	GND	Ground
No Connect	NC	27	28	NC	No Connect
No Connect	NC	29	30	NC	No Connect
No Connect	NC	31	32	NC	No Connect
No Connect	NC	33	34	I2S_RXD1	I2S Receive Data 1
Ground	GND	35	36	NC	No Connect
No Connect	NC	37	38	GND	Ground
No Connect	NC	39	40	NC	No Connect

No Connect	NC	41	42	GND	Ground
Debug UART TXD. Add 10k Pullup	UART1_TXD	43	44	NC	No Connect
Debug UART RXD. Add 10k Pullup.	UART1_RXD	45	46	GND	Ground
Ground	GND	47	48	NC	No Connect
Host MCU UART interface. Use 10k Pullup.	UART0_TXD	49	50	NC	No Connect
Host MCU UART interface. Use 10k Pullup.	UART0_RXD	51	52	NC	No Connect
SPI Clock Output or GPIO08	SPI_SCLK/GPIO 8	53	54	NC	No Connect
SPI Data Out or GPIO09	SPI_SDO/GPIO9	55	56	NC	No Connect
Ground	GND	57	58	NC	No Connect
SPI Data In or GPIO10	SPI_SDI/GPIO10	59	60	NC	No Connect
No Connect	NC	61	62	NC	No Connect
No Connect	NC	63	64	GND	Ground
SPI CS or GPIO05	SPI_CS/GPIO5	65	66	NC	No Connect
USB_ID	USB_ID	67	68	NC	No Connect
Ground	GND	69	70	NC	No Connect

Note:

- Revision 1.1 module of LS9, HOST MCU communication is on pin 43(Tx) and 45(Rx).
- Revision 1.2 module of LS9, HOST MCU communication is on pin 49(Tx) and 51(Rx).

6.3.2. Connector-2

LS9-Media Connector J2 pin outs					
Functionality	**Signal Name**	**Pin #**	**Pin #**	**Signal Name**	**Functionality**
Ground	GND	1	2	GND	Ground
HDMI TX DATA2 +	HDMI_TX_2P	3	4	NC	No Connect
HDMI TX DATA2 -	HDMI_TX_2M	5	6	NC	No Connect
Ground	GND	7	8	GND	Ground
HDMI TX DATA1 +	HDMI_TX_1P	9	10	NC	No Connect
HDMI TX DATA1 -	HDMI_TX_1M	11	12	NC	No Connect
Ground	GND	13	14	GND	Ground
HDMI TX DATA0 +	HDMI_TX_0P	15	16	NC	No Connect
HDMI TX DATA0 -	HDMI_TX_0M	17	18	NC	No Connect
Ground	GND	19	20	GND	Ground
HDMI TX CLOCK +	HDMI_TX_CLKP	21	22	NC	No Connect
HDMI TX CLOCK -	HDMI_TX_CLKM	23	24	NC	No Connect
Ground	GND	25	26	GND	Ground
HDMI TX CEC/ GPIO14	CEC	27	28	NC	No Connect
HDMI I2C CLOCK/ GPIO12	HDMISCLK	29	30	NC	No Connect
HDMI I2C DATA / GPIO13	HDMISD	31	32	NC	No Connect
HDMI HOT PLUG / GPIO15	HTPLG	33	34	NC	No Connect
Ground	GND	35	36	NC	No Connect
No Connect	NC	37	38	GND	Ground
No Connect	NC	39	40	NC	No Connect

Ground	GND	41	42	GND	Ground
No Connect	NC	43	44	NC	No Connect
No Connect	NC	45	46	NC	No Connect
Ground	GND	47	48	NC	No Connect
No Connect	NC	49	50	NC	No Connect
No Connect	NC	51	52	GND	Ground
Ground	GND	53	54	NC	No Connect
No Connect	NC	55	56	NC	No Connect
No Connect	NC	57	58	GND	Ground
Ground	GND	59	60	NC	No Connect
SPI Data Out	SPI_SDO	61	62	NC	No Connect
SPI CS	SPI_CS	63	64	GND	Ground
SPI Clock output	SPI_SCLK	65	66	NC	No Connect
SPI Data In	SPI_SDI	67	68	NC	No Connect
Ground	GND	69	70	GND	Ground

7. Power Consumption

- The default power consumption when not connected to Access-Point is **330mA** at average operational condition and **360mA** at peak operational condition.
- Power consumption during Google Cast for Audio (GCast) play back is **360mA** at average operational condition and **375mA** at peak operational condition.

- Input voltage measured is **3.3V** rail at the module connector pin.

8. Environmental

8.1. Storage Conditions

The calculated shelf life in a sealed bag is 12 months if stored between -5°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 maintained at <10%RH.
- Baking is necessary if the customer exposes the component to air for over 168 hrs.
  - Baking conditions: 125°C for 8hrs.

9. Reference Schematics

> **Note:** For detailed schematics of LS9 refer to the latest ***LS9-EVK Schematic***, file in the portal

9.1. EVK Block Diagram

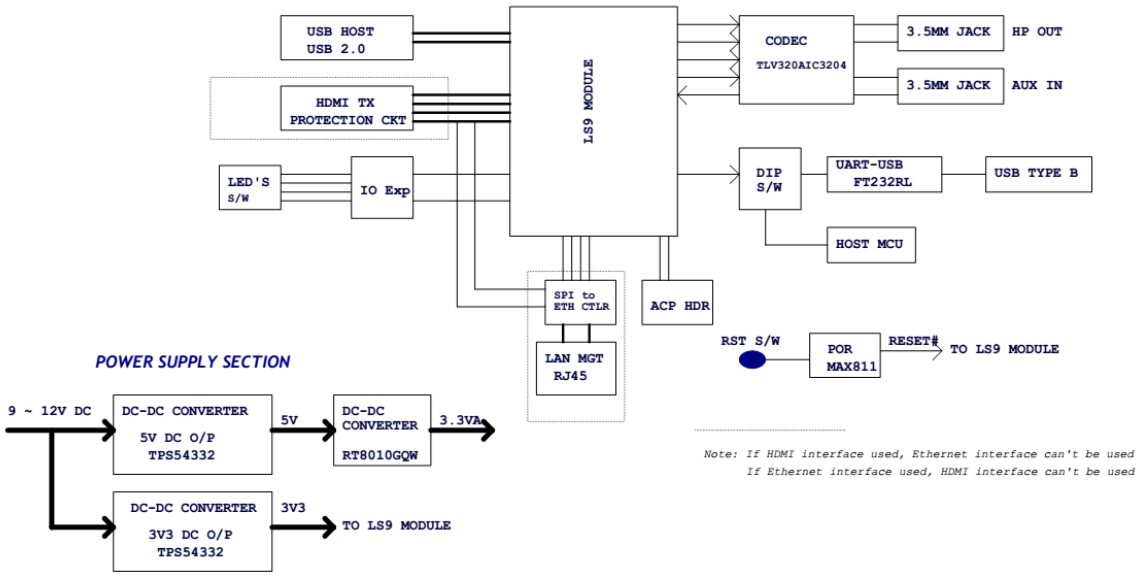


Figure 8-1: LS9 EVK Block Diagram

9.2. MFI 2.0C Authentication Circuit

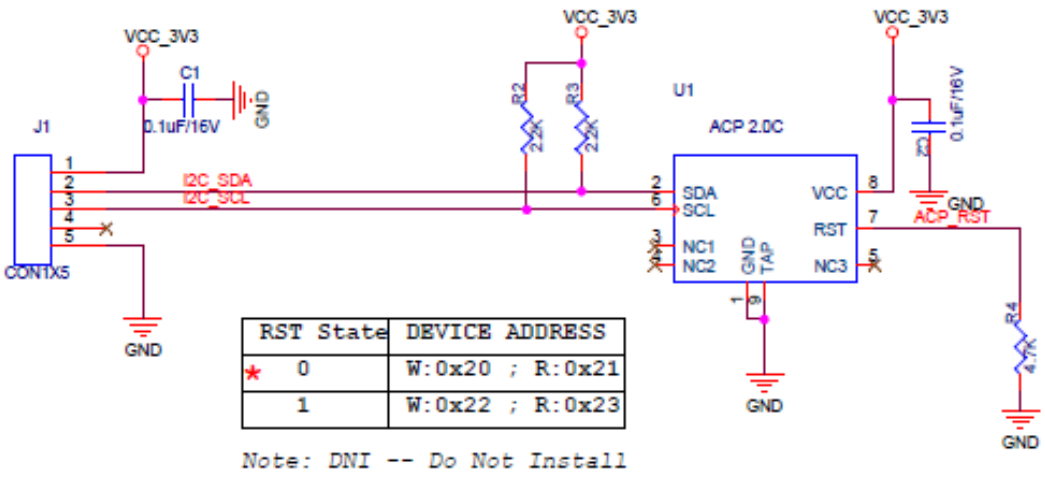


Figure 8-2: LS9 EVK Block Diagram

10. Disclaimer

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11. Appendix

11.1. FCC Statement

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

i. This device may not cause harmful interference, and

ii. 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: 2ADBM-LS9AC11DBT Or Contains FCC ID: 2ADBM-LS9AC11DBT

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:
    i. This device may not cause harmful interference.
    ii. 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 limit modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C: 15.247, 15.407 and 15.209 requirement, Only if the test result comply with FCC part 15C : 15.247 , 15.407 and 15.209 requirement, then the host can be sold legally.