RF Module user manual for Air conditioner

Model name : LAMWBD1

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1. Introduction

1.1 Outline

The RF Module supports WIFI and Bluetooth communication based on the MT8385 (i500) of Mediatek.

And WIFI / Bluetooth RF module is MT6631

It is designed to support video and voice recognition, camera and artificial intelligence processing, and display driving functions of large display products such as air conditioners and refrigerators, and it has the advantage of connecting various external devices by supporting multiple interfaces.

It provides upgradeable content through Android OS, can be applied to home appliances that utilize large-screen displays, and provides scalability to connect with a variety of devices.

For Wi-Fi, Dual-band (2.4GHz and 5GHz) 802.11a/b/g/n/ac support provides data transfer rates up to 433 Mbps.

Bluetooth provides music streaming via Paring with other devices.

1.2 Key features

1. Core : Cortex-A73 Quad@2.0GHz, Cortex-A53 Quad@2.0GHz
2. DIMPS : 56,800 (4.8/2.3DMIPS/MHz)
3. AI Performance : 0.75 TOPS (NPU+CPU+GPU), NPU Only : 0.53 TOPS
4. Security : ARM ® TrustZone ® security
5. WLAN : IEEE 802.11b/g/n/ac 1X1 Dual band (2.4GHz and 5GHz)
6. Bluetooth : BDR/EDR/LE v4.1
7. Interface : USB3.0, UART, SPI, I2C, GPIO
8. Android OS based upgradeable content delivery
9. Voice recognition : Refrigerator control through sever-based natural language voice recognition
10. Image recognition: There is a GPU block that can drive the display, so after processing the image signal, convert the MIPI signal into an LVDS signal, and drive the display
11. Input voltage : DC 12V, 19V
12. MIC, Speaker : Interface connection support for MIC and Speaker

2. Hardware Configuration

2.1 Block Diagram

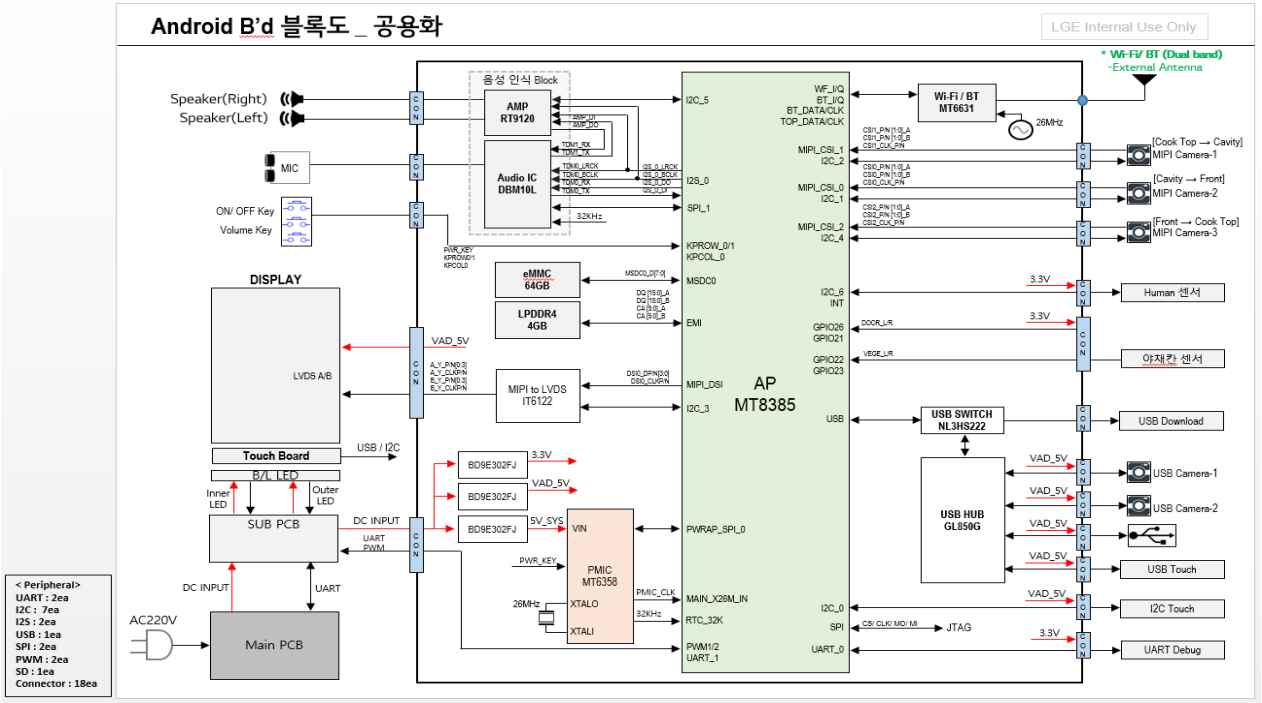


Figure 2-1 Public Block Diagram

2.2 Command information

Product functions communicate through interfaces such as UART and USB.
Check the block diagram in Fig2-1 for interface of product function.

2.3 Operating Conditions

Rating		Min.	Typ.	Max.	Unit
Supply voltage		10.8	12	13.2	V
		17.1	19	20.9	V
WIFI /BT RF Module	Operating temperature	-40		+85	˚C

2.4 Power Consumption

This is a measure of power consumption in a scenario used in the WIFI operating mode of the RF Module.

Condtion: T_{amb}=25ºC, V_{CC}=19 V / 12V

Max Output Power *	Typ. Power consumption		Comments
17.5dBm	19V	205mA	802.11b 11Mbps
	12V	305mA	

3. MT6631 (WIFI/BT) Electrical characteristic

3.1 Absolute Maximum Ratings

Item	Specification	Rating	Unit
AVDD33_WBT	WIFI 3.3V supply for PA and Tx modulator	-0.3 ~ 3.96	V
AVDD18_WBT	1.8V supply of WIFI and Bluetooth radio	-0.3 ~ 2.16	V
T_{STG}	Storage temperature	-60 ~ 120	˚C
T_A	Operating temperature	-40 ~ 85	˚C

3.2 Recommended Operating Ratings

Item	Specification	Min.	Typ.	Max.	Unit
AVDD33_WBT	WIFI 3.3V supply for PA and Tx modulator	3.0	3.3	3.6	V
AVDD18_WBT	1.8V supply of WIFI and Bluetooth radio	1.62	1.8	1.98	V
T_J	Commercial junction operating temperature	0	25	115	˚C
	Industry junction operating temperature	-20	25	125	˚C
T_A	Operating temperature	-40	25	85	˚C
T_{STG}	Storage temperature	-60	25	150	˚C

3.3 Power Consumption and Supply Specifications

3.3.1 AVDD18 Specifications

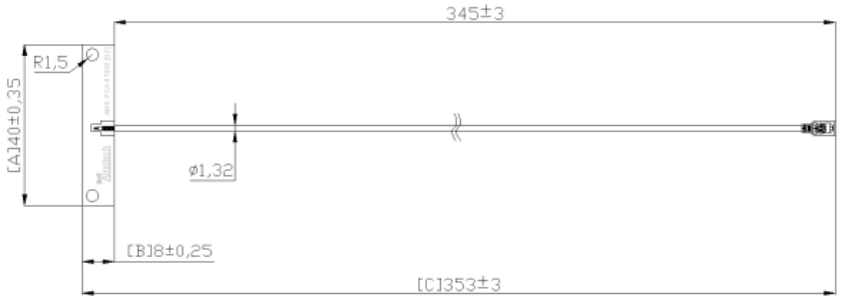
Item	Min.	Typ.	Max.	Unit	Notes
Output Voltage, VDD	1.62	1.8	1.98	V	
Output Current	150			mA	
Output Noise			550	nV/sqrt (Hz)	
PSRR	40			Db	< 1 MHz
Load transient	-200		200	mV	Transient slew rate 100mA/us
Turn-on rising time	10		270	usec	10% → 90% output voltage
Power-off setting time		2	4	ms	90% → 10% output voltage

3.3.2 AVDD33 Specifications

Item	Min.	Typ.	Max.	Unit	Notes
Output Voltage		3.3	3.6	V	
Output Current (Normal operation)	500			mA	
Output Current (Calibration mode)	900			mA	No need to meet noise and PSRR requirements in this mode
Output Noise			550	nV/sqrt (Hz)	
PSRR	40			dB	< 1 MHz
Load transient	-200		200	mV	Transient slew rate 100mA/us
Turn-on rising time	10		270	usec	10% → 90% output voltage
Turn-on overshoot			10	%	
Power-off setting time		2	4	ms	90% → 10% output voltage

4. Antenna information and performance

4-1. Antenna information



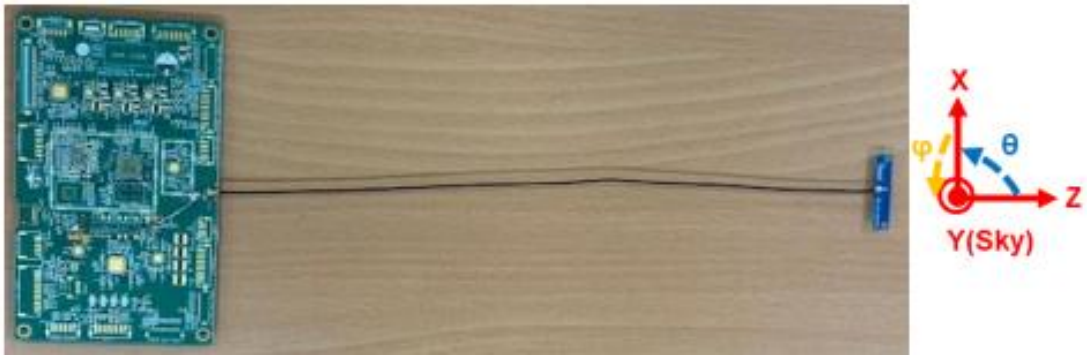
Unit : mm

No	Item	Specification
1	PCB	40 * 8 (mm), FR4 1.0T, 1/2oz, single-side
2	Adhesive tape	100um, Blue PET
3	Cable	Ø 1.32mm, 350mm, Black color
4	Connector	Compatible RF connector, IPEX MHF I LK

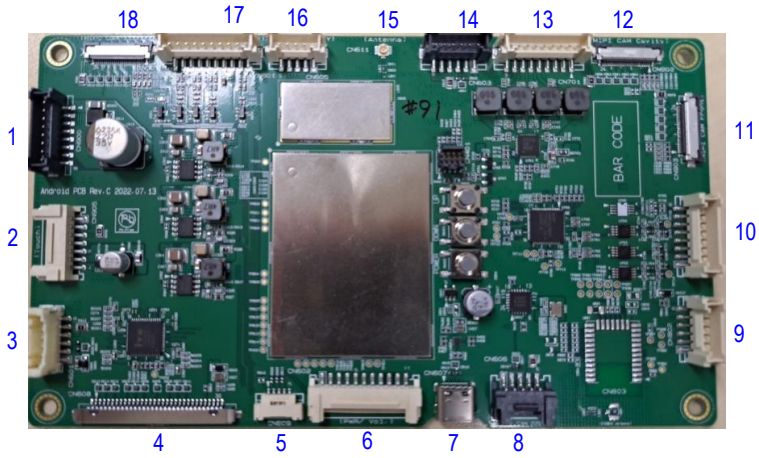
4-2. Antenna performance (Dual band)

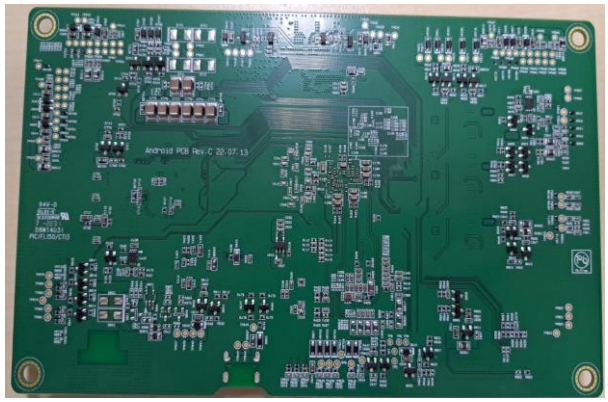
Condition : Antenna radiation (Antenna efficiency) test under RF Module conditions

Frequency(MHz)		Efficiency (%)	Avg. Gain(dBi)	Peak Gain(dBi)
2.4G	2400	34.89	-4.55	-0.72
	2442	38.76	-4.12	-0.10
	2485	53.20	-2.74	1.18
5G	5150	21.21	-6.74	-2.45
	5500	34.69	-4.60	0.74
	5850	38.86	-4.10	1.40



5. Pin Configuration



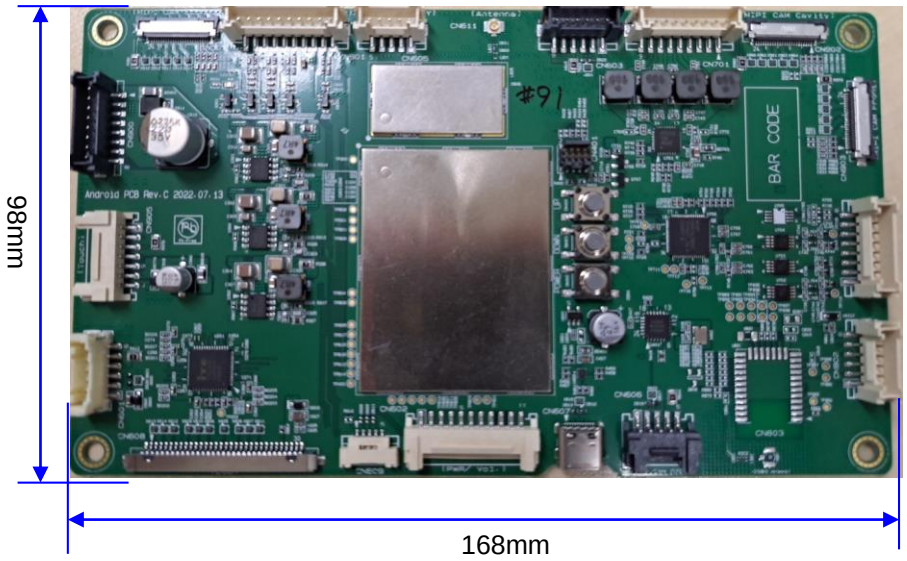


		Connector type	Description
1	CN900	8 pin, 2.0 mm pitch	Power Supply
2	CN905	7 pin, 2.0 mm pitch	I2C interface for Touch
3	CN601	6 pin, 2.0 mm pitch	USB interface for Touch
4	CN608	30 pin, 1.0 mm pitch	LCD support
5	CN609	5 pin, 1.25mm pitch	UART Debug
6	CN602	11 pin, 2.0 mm pitch	UART interface for Power key
7	CN607	24 pin, 0.65mm pitch	USB Device
8	CN606	5 pin, 2.0 mm pitch	USB interface for Camera
9	CN802	6 pin, 2.0 mm pitch	UART interface for Sensor
10	CN700	8 pin, 2.0 mm pitch	UART interface for MIC (Analog MEMS)
11	CN903	24 pin, 0.5 mm pitch	MIPI interface for Camera
12	CN902	24 pin, 0.5 mm pitch	MIPI interface for Camera
13	CN701	9 pin, 2.0 mm pitch	UART interface for Speaker
14	CN603	6 pin, 2.0 mm pitch	USB interface for Memory stick
15	CN611	-	Antenna Connector
16	CN605	5 pin, 2.0 mm pitch	USB interface for Camera
17	CN801	10 pin, 2.0 mm pitch	Door switch input port
18	CN904	24 pin, 0.5 mm pitch	MIPI interface for Camera

6. Module size

6.1

- PCB dimension (LxW) : 168mm x 98mm, 1.0t



Regulatory Statement (FCC)

• **Part 15.19 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.

• **Part 15.105 Statement (Class B)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.

• **Part 15.21 Statement**
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

• **Responsible Party Information (Supplier's Declaration of Conformity)**
LG Electronics USA
1000 Sylvan Avenue Englewood Cliffs
New Jersey, United States, 07632

Regulatory Statement (FCC)

Regulatory notice to host manufacturer according to KDB 996369 D03 OEM Manual v01

List of applicable FCC rules
This module has been granted modular approval as below listed FCC rule parts.
- **FCC Rule parts 15C, E(15.247, 15.407)**

Summarize the specific operational use conditions
The OEM integrator should use equivalent antennas which is the same type and equal or less gain then an antenna listed in this instruction manual.

RF exposure considerations
The module has been certified for integration into products only by OEM integrators under the following condition:

- The antenna(s) must be installed such that a minimum separation distance of at least 20 cm is maintained between the radiator (antenna) and all persons at all times.
- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.
- Mobile use

As long as the three conditions above are met, further transmitter testing will not be required.
OEM integrators should provide the minimum separation distance to end users in their end-product manuals.

Regulatory Statement (FCC)

Antennas list
This module is certified with the following integrated antenna.

- Type: PCB type
- Max. peak Antenna gain
BT 2400-2485 MHz (1.18 dBi)
WIFI
2400 - 2485MHz (1.18 dBi)
5150 - 5500MHz (0.74 dBi)
5500 - 5850 MHz (1.40 dBi)

Any new antenna type, higher gain than listed antenna should be met the requirements of FCC rule 15.203 and 2.1043 as permissive change procedure.

Label and compliance information

End Product Labeling The module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are 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. In that case, the final end product must be labeled in a visible area with the following: Label and compliance information

- Contains FCC ID: BEJ-LAMWBD1
- Contains IC: 2703N-LAMWBD1

• Information on test modes and additional testing requirements
OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, additional transmitter in the host, etc.).

• Additional testing, Part 15 Subpart B disclaimer
The final host product also requires Part 15 subpart B compliance testing with the modular transmitter installed to be properly authorized for operation as a Part 15 digital device.

Note EMI Considerations
Note that a host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties

For standalone mode, reference the guidance in D04 Module Integration Guide and for simultaneous mode; see D02 Module Q&A Question 12, which permits the host manufacturer to confirm compliance.

How to make changes
Since only Grantees are permitted to make permissive changes, when the module will be used differently than granted, please contact the module manufacture.

Regulatory Statement (ISED)

RSS-GEN, Sec. 7.1.3–(licence-exempt radio apparatus)
This device complies with Industry Canada licence-exempt RSS standard(s). 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure
The antenna (or antennas) must be installed so as to maintain at all times a distance minimum of at least 20 cm between the radiation source (antenna) and any individual. This device may not be installed or used in conjunction with any other antenna or transmitter.

l'exposition aux RF
L'antenne (ou les antennes) doit être installée de façon à maintenir à tout instant une distance minimum de au moins 20 cm entre la source de radiation (l'antenne) et toute personne physique.

É tiquetage du produit final (IC)
Le module LAMWBD1 est étiqueté avec sa propre identification FCC et son propre numéro de certification IC. Si l'identification FCC et le numéro de certification IC ne sont pas visibles lorsque le module est installé à l'intérieur d'un autre dispositif, la partie externe du dispositif dans lequel le module est installé devra également présenter une étiquette faisant référence au module inclus. Dans ce cas, le produit final devra être étiqueté sur une zone visible avec les informations suivantes :
Contient module émetteur identification FCC ID: BEJ-LAMWBD1
Contient module émetteur IC : 2703N-LAMWBD1

"The 5150-5250 MHz band is restricted to indoor use only"