AI Module User Manual for Refrigerator

Model Name : LAIWB3(AI Module)

-Be sure to read the safety precautions before use and installation, and use it correctly.
-This is to protect the safety of users and installers and prevent property damage.
-After reading the user manual, keep it in a place where the user can see it at any time.

목차

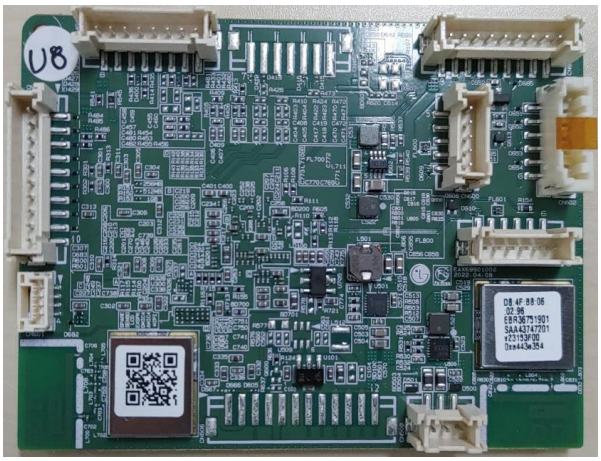
1. Introduce

1.1 Summary

LAIWB3 is a module that supports Wi-Fi, Bluetooth wireless communication, refrigerator voice recognition and artificial intelligence processing and is designed to operate independently. It supports multiple interfaces and has the advantage of being able to connect various external devices.
In addition, it has high performance based on CPU and has specialized functions for artificial intelligence, so it can be applied to home appliances that use artificial intelligence. In addition, it provides scalability to connect with various devices, and provides data transfer rates of up to 72 Mbit/s in case of Wi-Fi. It can operate as a single Wi-Fi module or connect to a host via a serial interface. In case of Bluetooth, music streaming function is provided through paring with other devices.

1.2 Major Features and Specifications

1. ARM Cortex-A53 Quad
2. WLAN: IEEE 802.11b/g/n 1X1 2.4Ghz (up to 72.2Mbps)
3. Support WLAN TX/RX LDPC
4. Hardware-based AES/TKIP encryption support
5. Supports Bluetooth BDR/EDR/LE 5.0
6. Linux-based integrated SW development environment support
7. TCP/IP Stack support
8. Refrigerator control through server-based natural language voice recognition
9. Input power: DC 12V
10. Mic. spec: 2Ch. Analog MEMS Mic.1
11. Speaker: Supports interface connection through external board



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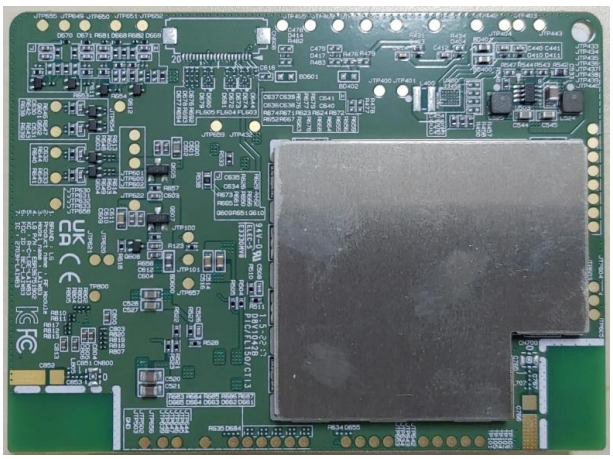

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2. Hardware Configuration

2.1 Block Diagram

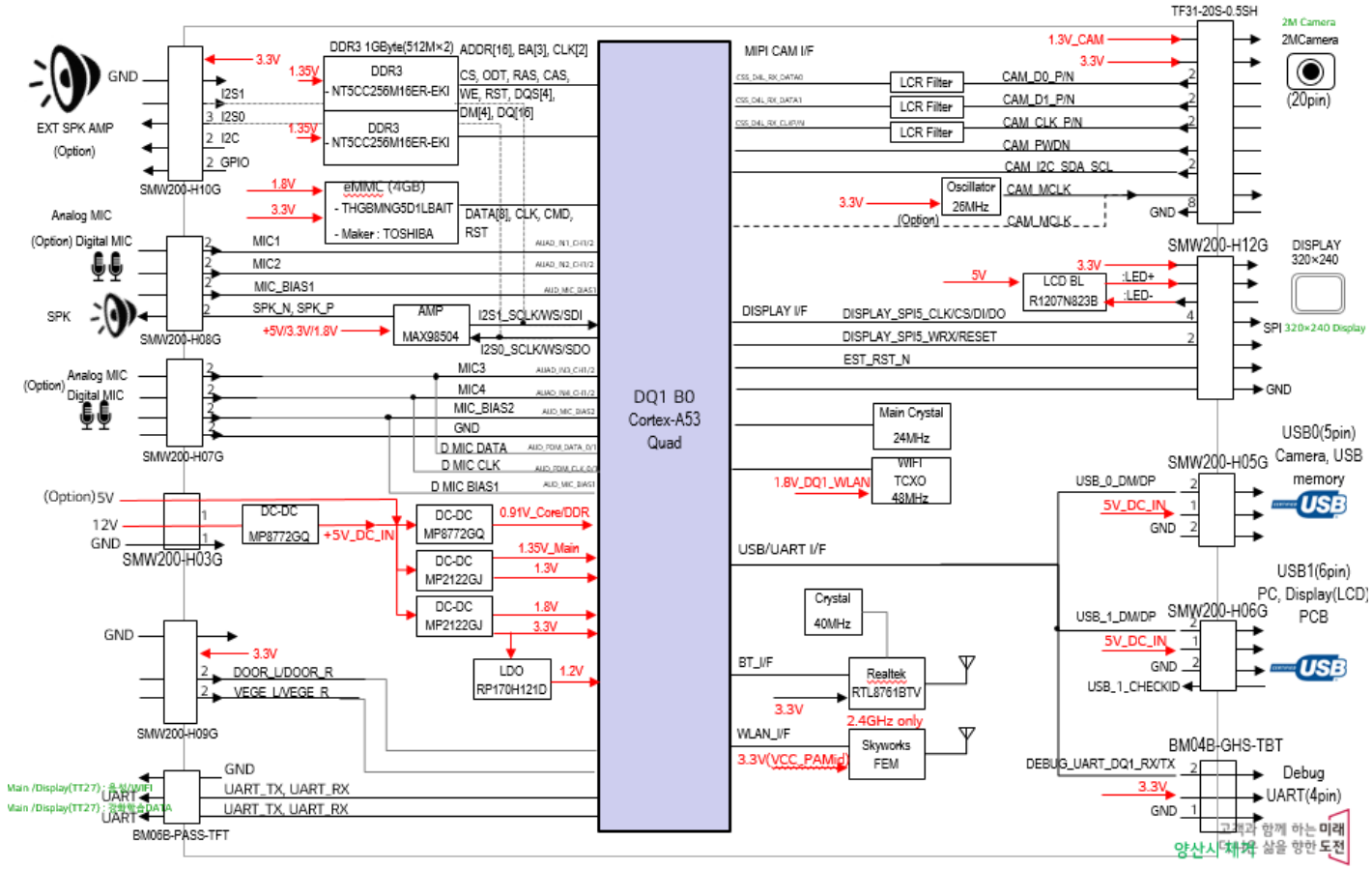


Figure 2-1 Block Diagram

2.2 Command Information

UART communication with refrigerator PCBA via CN602. For other internal communication, refer to block diagram of FIg2-1.

3. Electrical Characteristics

3.1 Absolute maximum ratings

Table 3-1 Absolute maximum ratings. Exceeding one of the absolute maximum ratings will result in poor performance or It can be caused damage.

Rating	Min.	Max.	Unit
Supply voltage	10.8	13.2	V
Typical WIFI Output Power(Conduction)		17(±1)	dBm
Typical Bluetooth Output Power(Conduction)		7 (±1)	dBm
Storage temperature	-20	+85	℃
WIFI Frequency		2412 - 2462	MHz
Bluetooth Frequency		2402 - 2480	MHz

3.2 Electro Static Discharge (ESD)

The LAIWB3 can withstand ESD voltages up to 1000 V Human Body Model (HBM).According to JESD22-A114, JESD22-A115, it can withstand up to 450 V CDM (Charge Device Model).

3.3 Recommended Operation Condition

Table 3-2 Recommended operation condition

Rating	Min.	Typ.	Max.	Unit
*Supply Voltage V_{CC}	11.4	12	12.6	V
Operating temperature of module	-20	+25	+85	°C

3.4 Current Consumption

This is the data measuring power consumption in a scenario where the voice recognition module is in operation mode and the voice recognition function is used.

Condition : T_{amb}=25°C, V_{CC}=12 V

Table 3.4 Power consumption in Normal mode. *Output power value is based on WLAN module's antenna port Typ. output

Max Output Power*	Typ. Current	Comments
+17 dBm (Tolerance ±1 dBm)	180 mA	11 Mbps, 320MHz, In Case of voice recognition operation.

Max Output Power*	Typ. Power Consumption	Comments
+17 dBm (Tolerance ±1 dBm)	2,160 mW	11 Mbps, 320MHz, In Case of voice recognition operation.

3.5 Antenna Characteristics(WLAN, Bluetooth Antenna)

Condition: antenna port radiation test of WLAN module VCC= 12 V, Temp= 0 to +70C, covered with shield-can.

Table 3-5 RF Characteristics

Frequency(MHz)	Efficiency (%)	Avg. Gain(dBi)	Peak Gain(dBi)
2400	53.01	-2.76	+1.83
2442	**70.55**	**-1.52**	**+2.6**
2485	62.75	-2.02	+1.36

4. Interface

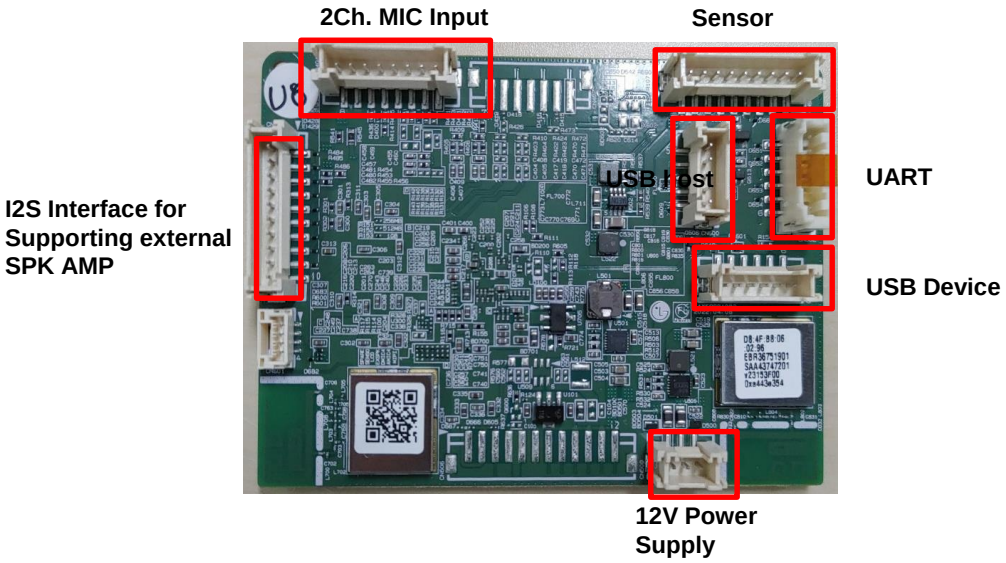
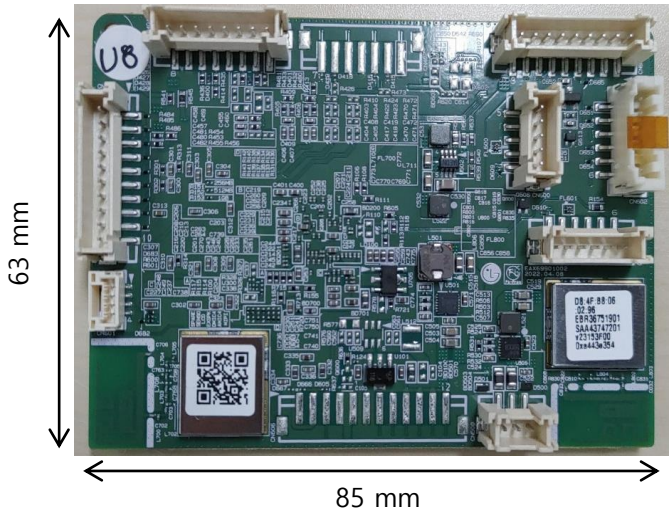


Figure 4-1 LAIWB3(AI Module) Connector option for connection of external Interface

	Connector type	Description
CN500	3 pin 2.00 mm pin header	Power Supply
CN602	6 pin 2.00 mm pin header	UART Interface to connect Refidgerator Board
CN401	8 pin 2.00 mm pin header	MIC input(2ch)
CN600	5 pin 2.00 mm pin header	USB Host
CN605	6 pin 2.00 mm pin header	USB Device
CN403	10 pin 2.00 mm pin header	I2S Interface for supporting external SPK AMP
CN611	9 pin 2.00 mm pin header	Sensor(GPIO)

5. Package Characteristics

5.1 Mechanical Characteristics of LAIWB3(AI Module) PCB



6. Standard Compliance

6.1 IEEE / IETF

Table 6.1 IEEE Standard

Standard	Revision	Description
802.11	802.11 R2003	WLAN MAC& PHY
802.11b	802.11 R2003	High rate DSSS (5,5/11 Mbit/s)
802.11d	802.11 R2003	Operation in different regulatory domains
802.11e	D9,0 Aug. 2004	QoS enhancements
802.11g	-2003	Extended rate PHY (ERP-PBCC, DSS-OFDM)
802.11i	-2004	Security enhancements
802.11k	Draft 11.0, 2008	Wireless network management
802.11n	Spec released Oct 29^{tn} 2009	Longer Range, Faster Throughput
802.11r	Draft 9.0, 2008	Fast BSS transition
802.11h	1997 edition	Bridge tunneling
RFC1023	Inherent	Frame encapsulation

6.2 Wi-Fi

Table 6.2 Wi-Fi Standard

Specification	Description	Revision
Wi-Fi 802.11b with WPA system inter Operability test plan for IEEE 802.11b devices	802.11b devices with WPA	2.1
Wi-Fi 802.11g with WPA system inter Operability test plan	802.11g devices with WPA	2.0

6.3 Bluetooth

Table 6.3 Bluetooth Characteristic

Specification	Description	Revision
Bluetooth 5 Dual Mode(BR+EDR/Low Energy Controller)	Compliance with previous version(v2.1+LE)	5.0
Support Profile	A2DP, AVRCP, GAVDP, SPP	-

7. Regulation Statement

7.1 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

7. Regulation Statement

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 15.247

- **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:

1) 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.

2) 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.

As long as the two 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.

- **Antennas List**

This module is certified with the following integrated antenna.

1) Type: Pattern Antenna

2) Max. peak Antenna gain : 2.6 dBi (2400 – 2485 MHz)

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.

7. Regulation Statement

Label and compliance information

- **End Product Labeling**

The module is labeled with it sown 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:

- Contains FCC ID: BEJ-LAIWB3
- Contains IC: 2703N-LAIWB3

- **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.

7. Regulation Statement

7.2 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 devicemay 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 doitpas 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 LAIWB3 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-LAIWB3
- Contient module émetteur IC : 2703N-LAIWB3