

# Speech Recognition Module User Manual

**Make sure to read the safety precautions before installing and using the product and always use the product correctly.**

**This information is intended to keep the user and installer safe and prevent property damage. After reading the user manual, keep it in a place where users can access it at any time.**

PWSAF2 (Speech Recognition Module)

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# 1. Introduction

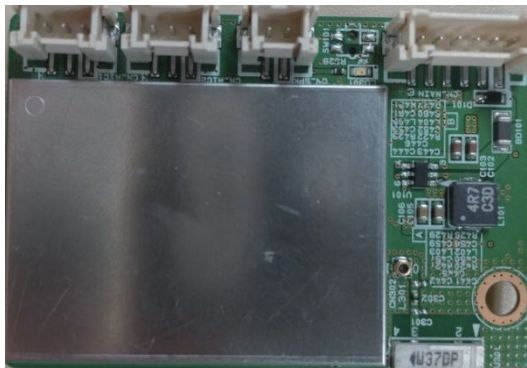
## 1.1 Overview

This module is an integrated microprocessor that supports Wi-Fi wireless communication and air conditioner voice recognition, and is designed to be able to operate as an independent communication module. It supports various interfaces, allowing it to connect with a variety of external devices.

In addition, its cost-effective performance based on RTOS makes it suitable for IoT devices. It provides scalability for connecting with a variety of devices and provides data transfer speeds up to 72 Mbit/s for Wi-Fi. It can be operated as a single Wi-Fi module or connected to the host through a serial interface.

## 1.2 Main Functions and Dimensions

1. ARM Cortex-R4 32bit RISC-based MCU
2. IEEE 802.11b/g/n 1X1 2.4Ghz (up to 72.2Mbps)
3. Supports TX/RX LDPC
4. Supports hardware-based AES/TKIP encryption
5. Supports RTOS-based integrated SW development environment
6. Supports TCP/IP Stack
7. Air conditioner control through server-based natural language speech recognition
8. Input Power: **dual DC 12V/5V**
9. Mic. spec : 2Ch. Analog MEMS Mic.
10. Spk output: 1.9W/4Ω



Product picture

## 2. Hardware Composition

### 2.1 Block Diagram

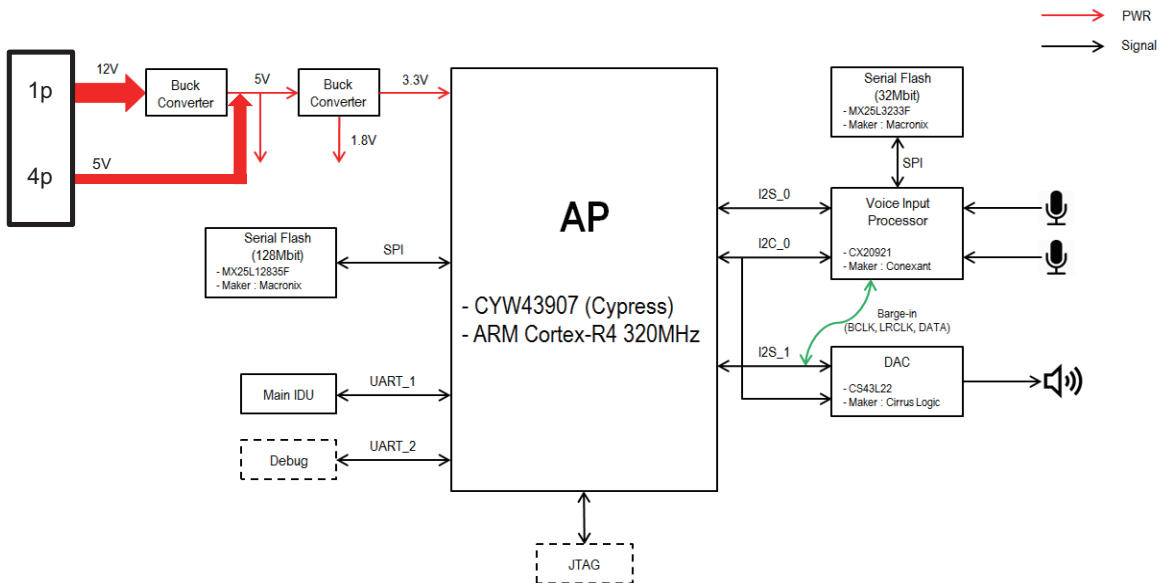


Figure 2-1 Block Diagram

### 2.2 Command Information

Air conditioner uses the Main PCBA and LGAP, for other internal communication, see block diagram in Fig. 2-1.

## 3. Electrical Data

### 3.1 Absolute maximum ratings

Table 3-1 Absolute maximum ratings. Exceeding one of the absolute maximum ratings can lead to performance degradation or damage. Values are conditions that apply one at a time.

Rating	Min.	Max.	Unit
Supply voltage	4.5	17	V
Input RF level		17	dBm
Storage temperature	-20	+70	°C

### 3.2 Electro Static Discharge (ESD)

Wi-Fi modules can withstand ESD voltages up to 1000 V HBM (Human Body Model).

According to JESD22-A114 and JESD22-A115, it can withstand up to 450 V CDM (Charge Device Model).

### 3.3 Recommended Operation Conditions

Table 3-2 Recommended operation conditions

Rating	Min.	Typ.	Max.	Unit
*Supply Voltage $V_{CC}$	4.5	12	17	V
*Supply Voltage $V_{CC}$	2.7	5	6.6	V
Operating temperature Wi-Fi module	-20	+25	+70	°C

※ You can select between 12V/5V input by changing the wiring of the Wafer Connector. Do not apply voltage at the same time.

### 3.4 Power consumption

#### 3.4.1 Current consumption

Table 3-3 Current consumption of the WiFi module when the system clock is 320MHz in Normal mode

Mode	Conditions	Parameter	Voltage	Min.	Typ.	Max.	Unit
All modes	Peak	$V_{CC}$	3.3 V			480	mA
TX [802.11b], 11 Mbps	25°C	$V_{CC}$	3.3 V		380	480	mA
TX [802.11g], 54 Mbps	25°C	$V_{CC}$	3.3 V		320	420	mA
TX [802.11n], MCS7	25°C	$V_{CC}$	3.3 V		310	410	mA
RX [802.11b], 11 Mbps	25°C	$V_{CC}$	3.3 V		100	150	mA
RX [802.11g], 54 Mbps	25°C	$V_{CC}$	3.3 V		100	150	mA
RX [802.11n], MCS7	25°C	$V_{CC}$	3.3 V		100	150	mA

### 3.4.2 Power consumption

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

Conditions:  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{CC} = 12\text{V}$

Table 3.4 Power consumption in Normal mode. \*Output power value WLAN module's antenna port Typ. Output value.

Max Output Power*	Typ. Power Consumption	Comments
+17 dBm	1100 mW	11 Mbps, 320 MHz, when voice is speaking

### 3.5 RF performance

Conditions: WLAN module's antenna port radiation test  $V_{CC} = 12\text{V}$ ,  $T_{amb} = -20$  to  $+70^{\circ}\text{C}$ , Shield Can applied

Table 3-5 RF performance

Frequency(MHz)	Efficiency (%)	Avg. Gain(dBi)	Peak Gain(dBi)
2400	70.02	-1.55	1.80
<b>2442</b>	<b>74.40</b>	<b>-1.28</b>	<b>2.18</b>
2485	62.27	-2.06	1.63

## 4. Interface

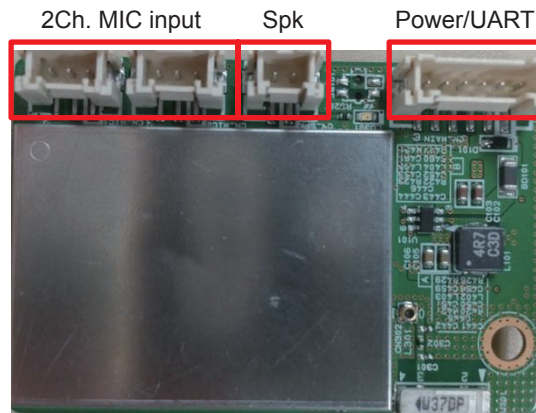


Figure 4-1 Voice recognition module pin

	Connector type	Description
CN_MAIN	6 pin 2.00 mm pin header	Power Supply and UART (Application dependent)
CN_MIC1	3 pin 2.00 mm pin header	Left MIC input
CN_MIC2	3 pin 2.00 mm pin header	Right MIC input
CN_SPK	2 pin 2.00 mm pin header	Mono Speaker output (1.9W / 4Ω)
TP102 / TP103	Test Point	UART (to Main PCBA)
TP312 - TP317	Test Point	JTAG for development (development only)
TP305 / TP306	Test Point	UART for debugging (function test only)

## 5. Applied Information

### 5.1 Power Supply Device

The voice recognition module must be powered by a DC 5 V or 12 V constant voltage supply unit.

### 5.2 FLASH

Out of the speech recognition module's 16 MB, 16 MB is available for a user application.

### 5.3 RTOS boot

RTOS booting finishes about 10 seconds before the console interface can be used.

### 5.4 UART Serial Interface

It has two UART interfaces for communicating with the speech recognition module.

#### 5.4.1 UART 1

This interface is a user application.

#### 5.4.2 UART 2

The UART2 interface is used for configuration and debugging.

The pins are configured as follows. Pin 1 is located on the PCB's outer edge.

- Pin 1: DC 12 V
- Pin 2: GND
- Pin 3: Reset
- Pin 4: DC 5 V
- Pin 5 : RX\_D (B18 on AP)
- Pin 6 : TX\_D (B15 on AP)

The UART port's maximum baud rate is 115200.

### 5.5 RF Interface

The voice recognition module has high-performance chip antennas like the basic RF interface.

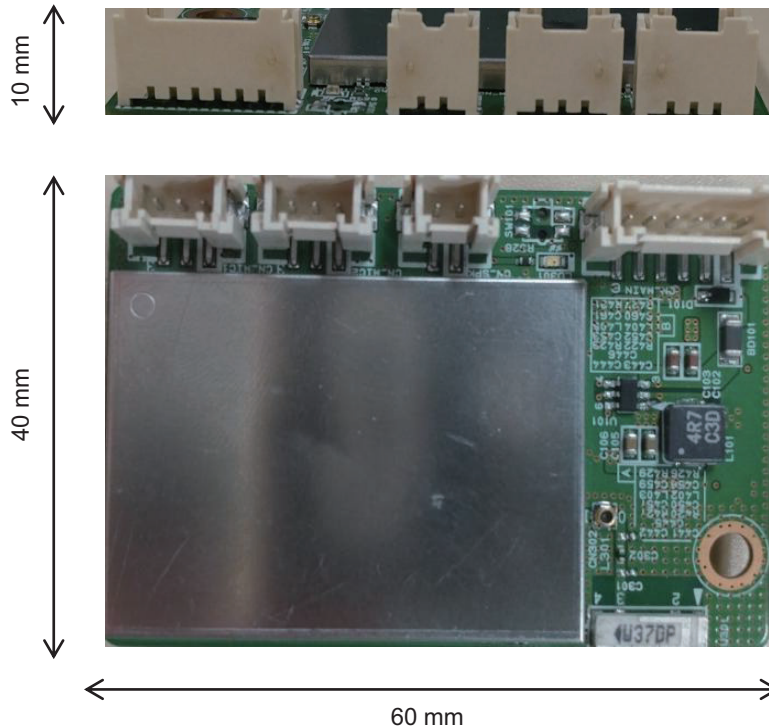
### 5.6 Environmental Guidelines

Speech recognition modules are designed and produced in compliance with ROHS regulations and environmental guidelines.



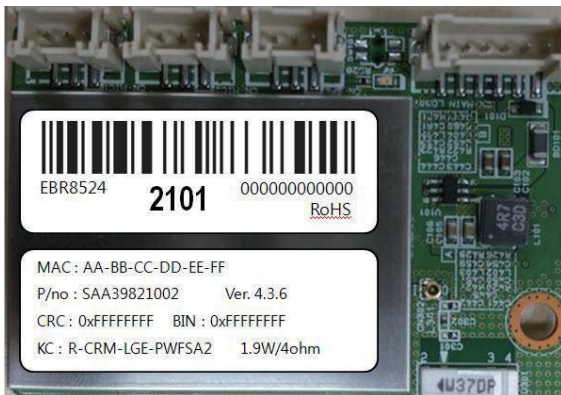
## 6. Package Specifications

### 6.1 Mechanical overview of speech recognition module circuit board



### 6.2 Label attached to the speech recognition module

P/no, S/W version information and MAC address are displayed.



1. PCB Ass'y P/no
2. MAC Address
3. S/W P/no
4. S/W Version
5. CRC Check Sum
6. Byte Check Sum
7. KC certification number
8. Rated output

## 7. Compliance with Standards

### 7.1 IEEE / IETF

Table 7.1 Relevant IEEE Standards

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 <sup>th</sup> 2009	Longer Range, Faster Throughput
802.11r	Draft 9.0, 2008	Fast BSS transition
802.11h	1997 edition	Bridge tunneling
RFC1023	Inherent	Frame encapsulation

### 7.2 Wi-Fi

Table 7.2 Relevant Wi-Fi Standards

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



Company name: LG Electronics Inc.

Device name: Specified low-output wireless device (**PWFSA2**)

Manufacture year/month: 2017. 12.

Manufacturer/Country of Origin: LG Electronics Inc./Republic of Korea

Authentication identifier: **R-CRM-LGE-PWFSA2**

- ※ The relevant wireless device may experience radio interference, which could make safety related services unavailable.
- ※ This device is registered for electromagnetic compatibility at home (Class B), it is mainly intended for use at home, and can be used in any region.
- ※ The user should keep a distance of 20 cm or more from the wireless device.

## 8. Product specifications

<b>Model</b>	<b>PWFSA2</b>	
<b>Equipment</b>	Specific low-power wireless data communication system (Wireless devices for wireless data communication system)	
<b>Operating Temperature</b>	-20 °C ~ 70 °C	
<b>Power usage</b>	DC 12.0 V / 5.0 V	
<b>Frequency</b>	Transmit	2412 MHz ~ 2462 MHz (11b, 11g, 11n_HT20)
	To	2412 MHz ~ 2462 MHz (11b, 11g, 11n_HT20)
<b>Output</b>	10 mW	
<b>Name of company receiving conformity assessment</b>	LG Electronics, Inc.	
<b>Manufacturer</b>	LG Electronics, Inc.	
<b>Country of Manufacture</b>	Korea	
<b>Authentication number</b>	R-CRM-LGE-PWFSA2	

**[USA ]****FCC Notice**

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 the receiver.
- Connect the equipment to 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.

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 of the device.

Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**FCC RF Radiation Exposure Statement**

This equipment complies with FCC 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 equipment should be installed and operated with a minimum distance of 20 cm (7.8 inches) between the antenna and your body. Users must follow the specific operating instructions for satisfying RF exposure compliance.

## [CANADA]

### Industry Canada Statement

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.

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.

### IC Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm (7.8 inches) between the antenna and your body.

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.

**NOTE:** THE MANUFACTURER IS NOT RESPONSIBLE FOR ANY RADIO OR TV INTERFERENCE CAUSED BY UNAUTHORIZED MODIFICATIONS TO THIS EQUIPMENT. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

NOTA: EL FABRICANTE NO ES RESPONSABLE DE NINGUNA INTERFERENCIA DE RADIO O TV CAUSADA POR MODIFICACIONES NO AUTORIZADAS A ESTE EQUIPO. DICHAS MODIFICACIONES PODRÍAN ANULAR LA AUTORIDAD DEL USUARIO PARA OPERAR EL EQUIPO.

## [Wireless Spec. Information for USA & CANADA]

Wireless LAN module Specifications	
Model	PWFSA2
Frequency Range	2412 MHz - 2462 MHz
Output Power (Max)	IEEE 802.11b: 23.42 dBm IEEE 802.11g: 21.11 dBm IEEE 802.11n: 20.28 dBm

## **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(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 than an antenna listed in 2.7 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.

### **Antennas list**

This module is certified with the following integrated antenna.

- Type: Dielectric Chip antenna (Peak gain (dBi): 2.87 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:

“Contains FCC ID: BEJ-PWFSA2”

“Contains IC: 2703N-PWFSA2”

### **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.

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### Étiquetage du produit final (IC)

Le module PWFSA2 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- PWFSA2

« Contient module émetteur IC : 2703N-PWFSA2

### [CE]

#### Simplified EU Declaration of Conformity

Hereby, LG Electronics Inc. declares that the radio equipment type Voice Recognition Module is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: <http://www.lg.com/global/support/cedoc/cedoc#>

#### 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

Manufacturer name: LG Electronics Inc.

The postal address: LG Electronics European Shared Service Center B.V. Krijgsman 1, 1186 DM Amstelveen, The Netherlands

The host manufacturer has the responsibility that the host device should be compliance with all essential requirement of RED.