JLR EBA31 Wireless CSC & WGM

1. Introduction

• The CSC and its WGM are an integral part of the JLR scalable Battery Management System (BMS), which enables rapid and efficient re-application of proven High Voltage (HV) systems to support our future electrification strategy.

• The CSC measures voltage across every series-connected cell and measures temperature at different locations within the cell stack. The CSC is also responsible to perform charge balancing to maximize the battery's energy storage and mitigate the effects of cell self-discharge.

• All CSC's communicate with the WGM using a dedicated wireless network.

• The WGM in turn communicates with the BMCM via 2 (two) twisted-pair isolated SPI channels.

• The CSC has an on-board temperature sensor to monitor CSC temperatures generated by balancing resistor heat dissipation.

• Temperature and voltage measurements are taken by the CSC and measures are taken across every bank of parallel cells and temperature sensors.

• Voltage sense wires are also used for the balancing currents.

2. CSC Operating Environment

Entry	Customer Requirements (Specifications)	Design Specification	Remarks (measurement conditions, expected problems, implementation plans, etc.)
1)Operating temperature range	-40 ~ +85℃ Ambient	-40 ~ +105℃ Ambient	AEC – Q Component Usage, Accelerated Test Confirmation
2) Storage temperature range	-40 ~ +85℃	-40 ~ +105℃ Ambient	AEC – Q Component Usage
3)Standard use	-40 ~ +85℃	-40 ~ +105℃ Ambient	AEC – Q Component Usage
7)Use power range	HV Battery : 12.5V ~ 49.5V	HV Battery : 11V ~ 80V	
8)Maximum applied power supply	HV Battery : 0~ 66V	HV Battery : 0V ~ 85V	
9)Other Terms of Use	2 BMIC with dedicated connection Wireless communication	Isolated 2 Bank Circuits RF module with PCB antenna	Securing the separation distance between banks in the PCB (5mm at minimum) RF Battery Simulation for MLA, EMA, JEA Pack
10)Product lifespan	10 years (87600 hours)	10 years (87600 hours)	AEC_Q Verification through component use and reliability testing (long term)
11) Location / Place of use	Inside the Vehicle Battery Pack	Inside the Vehicle Battery Pack	Customer Requirement: IP30

3. WGM Operating Environment

Entry	Customer Requirements (Specifications)	Design Specification	Remarks (measurement conditions, expected problems, implementation plans, etc.)
1)Operating temperature range	-40 ~ +85℃ Ambient	-40 ~ +105℃ Ambient	AEC – Q Component Usage, Accelerated Test Confirmation
2) Storage temperature range	-40 ~ +85℃	-40 ~ +105℃ Ambient	AEC – Q Component Usage
3)Standard use	-40 ~ +85℃	-40 ~ +105℃ Ambient	AEC – Q Component Usage
7)Use power range	LV INPUT : 5V+/-0.125	LV INPUT : 5V+/-0.125	
8)Maximum applied power supply	LV INPUT : 5V+/-0.125	HV Battery : 4.21 ~ 8V	
9)Other Terms of Use	Dual Manager Wireless communication	2 X RF module application RF module with PCB antenna	RF Battery Simulation for MLA, EMA, JEA Pack
10)Product lifespan	10 years (87600 hours)	10 years (87600 hours)	AEC_Q Verification through component use and reliability testing (long term)
11) Location / Place of use	Inserted into an opening provided on the battery lid	Inserted into an opening provided on the battery lid	Customer Requirement: IP30 and IP69K support

4. FCC/IC Compliance Statement

This device complies with Part 15 of the FCC Rules and Industry Canada license-exempt RSS standard(s) .
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.

CAUTION : Any Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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.

A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

Enonce d'Industrie Canada(IC)
Le present appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisee aux deux conditions suivantes : (1) l’appareil ne doit pas produire de brouillage, et (2) l’utilisateur de l’appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d’en compromettre le fonctionnement.

Tout changement ou modification non expressement approuve par la partie chargee de la mise en conformite peut annuler le droit de l’utilisateur a utiliser l’equipement.

Une distance de séparation minimale de 20 cm doit être maintenue entre l'antenne et la personne pour que cet appareil satisfasse aux exigences d'exposition aux RF

CUSTOMER : wBMS for JLR

DATE : 2024. 04. 24.

SPECIFICATIONS FOR APPROVAL

PRODUCT NAME : Slave RF Communication Module for wBMS

MODEL NAME : APBR000L02.KM00

CUSTOMER P/N : 8MDW00004A

FIRMWARE Ver. :

APPROVAL	REMARK

APPENDIX

Designed	Checked	Approved	LG Innotek Co., Ltd.	
			DOCUMENT No.	Doc No.
			PAGE	1 / 32

TITLE : Specifications for approval (Doc No.)	REV 0.2 (2 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

Change History of Revision

Revision	Date	Contents of Revision Change	Remark
0.1	2023.08.23	Establishment	
0.2	2024.04.24	Updated Packing Label	△a

REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (3 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

Change History of Firmware version

Firmware version	Date	Remark
Version check	2023.08.23	Update Firmware Version

REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (4 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

Table of Contents

REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (5 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

1. Application

This specification is applied to Wireless communication between the Battery cell monitoring Module and the Battery management system controller

2. Quality

Quality should meet each condition which mentioned on this specification. However, the items which are not mentioned on this specification follow the inspection agreements and standards which are agree with both companies.

3. Appearance and Characteristics

1) Appearance

Appearance should not contaminated by harmful materials and should not have cracks etc. Mechanical dimensions should meet the contents of clause 8.

2) Characteristics

Electrical characteristics should meet the contents of clause 10.

4. Application of Bluetooth Low Power module

1) Wireless battery management systems

5. Maximum Rating

PARAMETER	MIN	MAX	UNIT
Temperature, Junction Range	-40	+115	℃
Temperature, Storage Range, Ambient	-40	+125	℃
Operational temperature range	-40	+85	℃
Supply voltage VDD	3.135	3.465	V

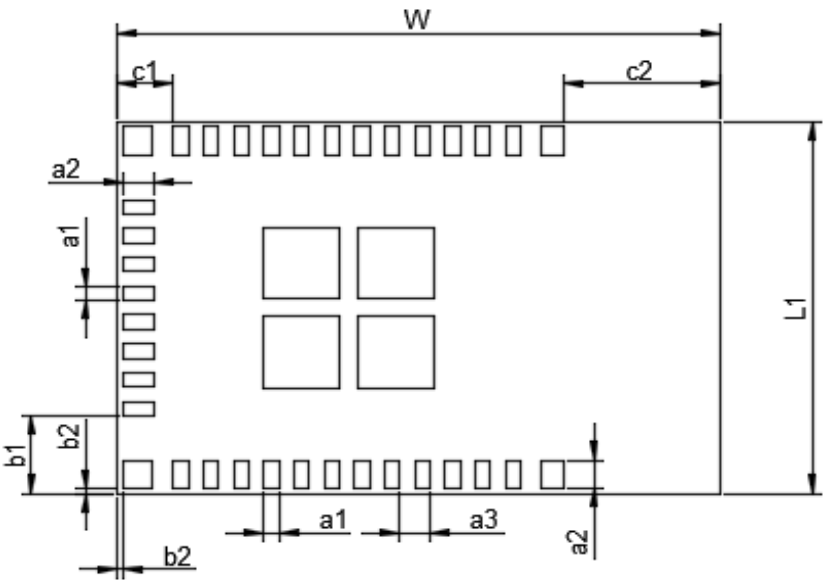
REV							
R	0.1	2023.08.23	Revision 0.1 released	LG Innotek Co., Ltd			
E	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
V							DOCUMENT NO. Doc No.

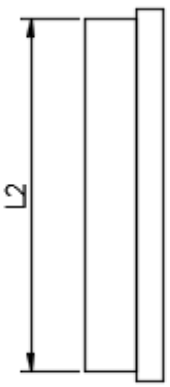
TITLE : Specifications for approval (Doc No.)	REV 0.2 (6 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

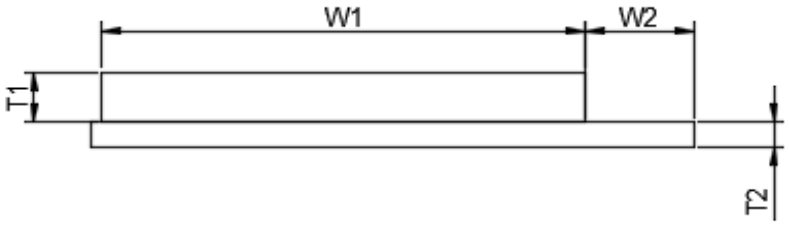
8. Mechanical Dimension

1) Module Dimension

<Top Through View>







Mark	Dimension	Mark	Dimension	Mark	Dimension	Mark	Dimension	Mark	Dimension
a1	0.60±0.05	a2	1.20±0.1	a3	1.20±0.1	b1	3.25±0.1	b2	0.20±0.05
C1	2.20±0.1	c2	6.22±0.1	L1	15.5 - 0.15/+0.3	L2	14.7±0.1	W	23.9 - 0.15/+0.3
W1	19.2±0.1	W2	4.30±0.1	T1	2.10±0.1	T2	1.0±0.1		
Unit : mm									

Module package is LGA (Land Grid Array) type .

Notice) If the module attached to the set board is flipped during the reflow process, shield case of the module may detach or fall apart.

Notice) Bur on the router bride surface is allowed up to -0.15(Without copper foil)+0.6

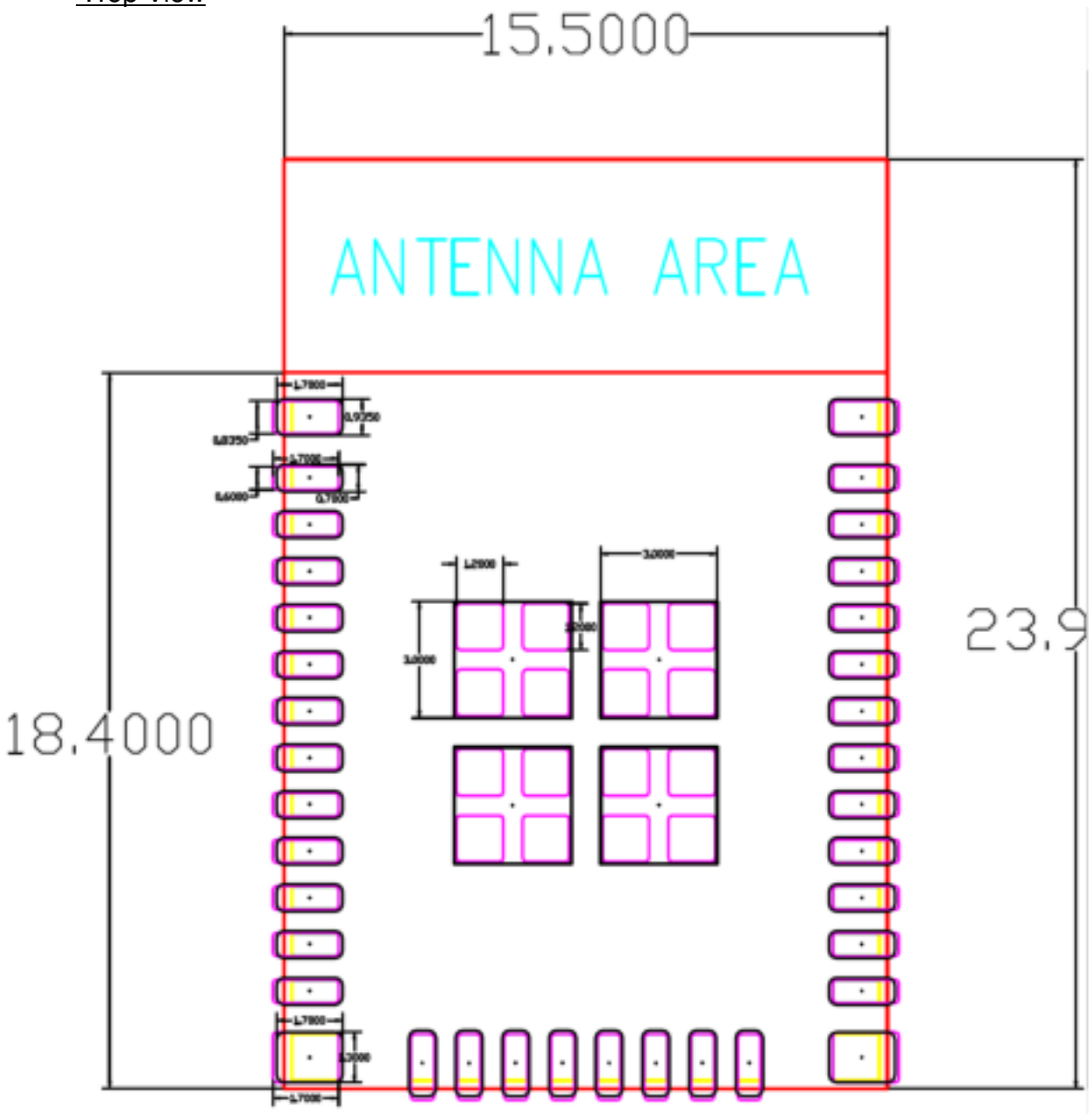
REV							
R	0.1	2023.08.23	Revision 0.1 released	LG Innotek Co., Ltd			
E	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
V							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (7 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

8. Mechanical Dimension

2) Recommended Land Pattern

-.Top View



Stencil: 90% of PCB LAND

* The larger copper cut area is better.

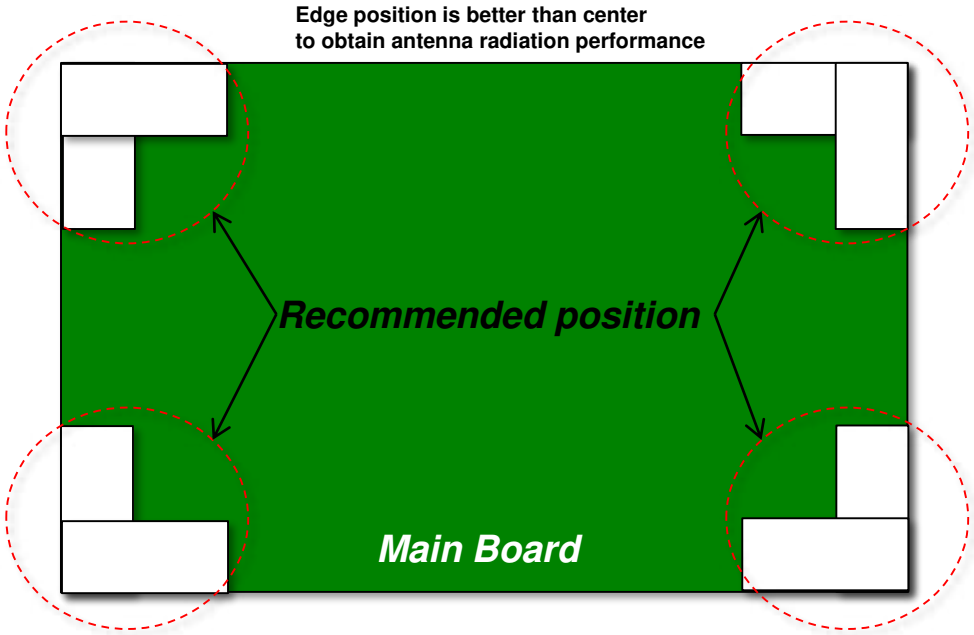
REV							
	0.1	2023.08.23	Revision 0.1 released	LG Innotek Co., Ltd			
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (8 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

8. Mechanical Dimension

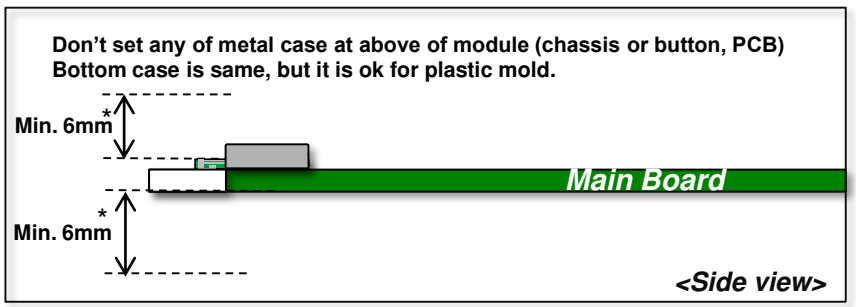
3) Recommended module position

Must has no copper at red-dashed circle area for all layers.



<Key design guide>

1. **Distance of module edge is minimum 6mm * from ground area in main board.**
2. **Must has no copper plate around antenna position for all layers.**
3. **Do not routing any of power and clock signal under Module digital path**



* The minimum distance may vary depending on the set environmental conditions. The larger open area is better.

REV							
	0.1	2023.08.23	Revision 0.1 released	LG Innotek Co., Ltd			
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

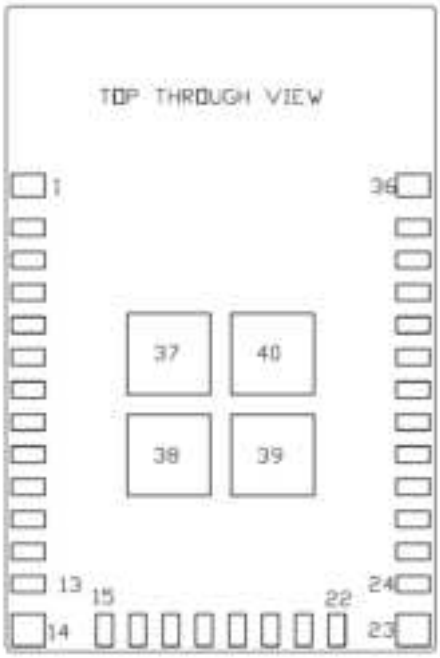
9. General Features

9.1 RF Module for wBMS

- ADRF Chipet Features

- Low Power 2.4GHz radio
- RF frequency range : 2400MHz to 2483.5 MHz ISM band
- 1Mbps data rate options
- Transmit output power : +8dBm
- On-chip temperature sensor
- On-chip LDO power
- Integrated RF match
- Integrated transmit and receive switch
- Microcontroller with a memory protection unit (MPU)
- Secure JTAG port supporting code download
- Security
  - Hardware root of trust
  - Secure boot
  - Secure update with roll-back protection
  - Hardware accelerator supporting AES-128, AES-256, ECC-256, and SHA-256
  - True random number generator (TRNG)
- Memory
  - SRAM with SECDED ECC
  - Flash with SECDED ECC
  - ROM with SECDED ECC
  - Anti-fuse OTP
- SPI x 2
- GPIO ports
- UART x 2
- On-chip POR

11. Pin Configuration



<Top Through View>

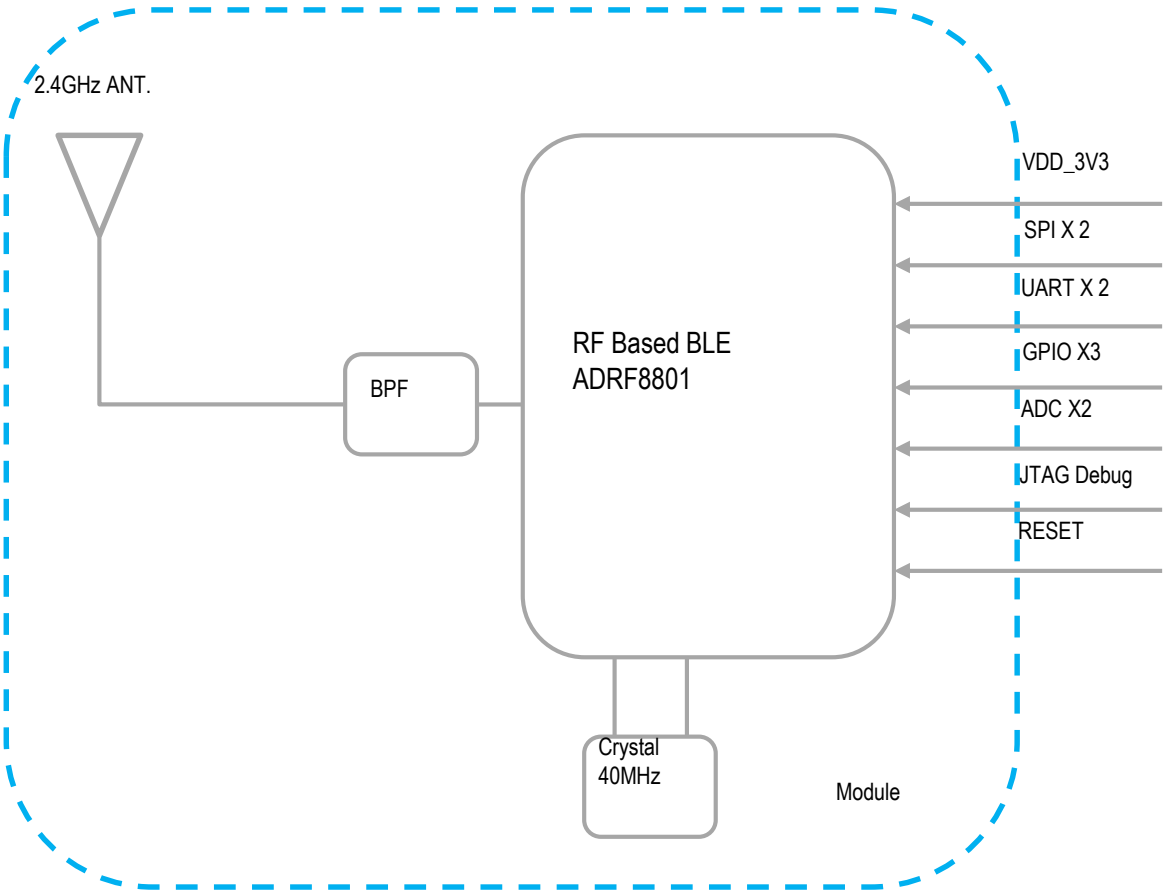
No.	Pin Name	I/O	Description
1	GND		Ground
2	SPI2_MISO	I	SPI2_MISO for BMIC
3	SPI2_SCK	I	SPI2_SCK for BMIC
4	SPI2_CS	I	SPI2_CS for BMIC
5	SPI2_MOSI	O	SPI2_MOSI for BMIC
6	GND		GND
7	SPI1_MISO	I	SPI1_MISO for Master MCU
8	SPI1_SCK	I	SPI1_SCK for Master MCU
9	SPI1_CS	I	SPI1_CS for Master MCU
10	SPI1_MOSI	O	SPI1_MOSI for Master MCU
11	GND		Ground
12	SPI0_MOSI	O	Serial DATA OUT
13	SPI0_MISO	I	Serial DATA IN
14	GND		GND
15	SPI0_SCK	I	Pull-up during Reset to enter Secure debug area
16	SPI0_CS	I	Chip Select
17	GND		GND
18	UART1_RX	I/O	UART Rx Interface to Manufacturing Test Firmware
19	UART1_TX	I/O	UART Tx Interface to Manufacturing Test Firmware
20	GPIO9	I/O	Gneneral-Purpose Input and Output

11. Pin Configuration

No.	Pin Name	I/O	Description
21	ADC1_IO	I	Analog Input
22	ADC2_IO	I	Analog Input
23	GND		Ground
24	VDD	I	3.3 Supply input
25	VDD	I	3.3 Supply input
26	GND		GND
27	/RESET	I	Hardware Reset
28	JTAG_TDI	I	JTAG Data In.
29	JTAG_TCK	I	JTAG Clock
30	JTAG_TMS	I/O	JTAG Mode Selection
31	JTAG_TDO	O	JTAG Trace Data Output
32	GPIO0	I/O	Gneneral-Purpose Input and Output
33	UART0_TX	I/O	Wired Manager to Manager Interface
34	UART0_RX	I/O	Wired Manager to Manager Interface
35	GPIO1	I/O	Gneneral-Purpose Input and Output
36	GND		GND
37	GND		GND
38	GND		GND
39	GND		GND
40	GND		GND

TITLE : Specifications for approval (Doc No.)	REV 0.2 (12 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

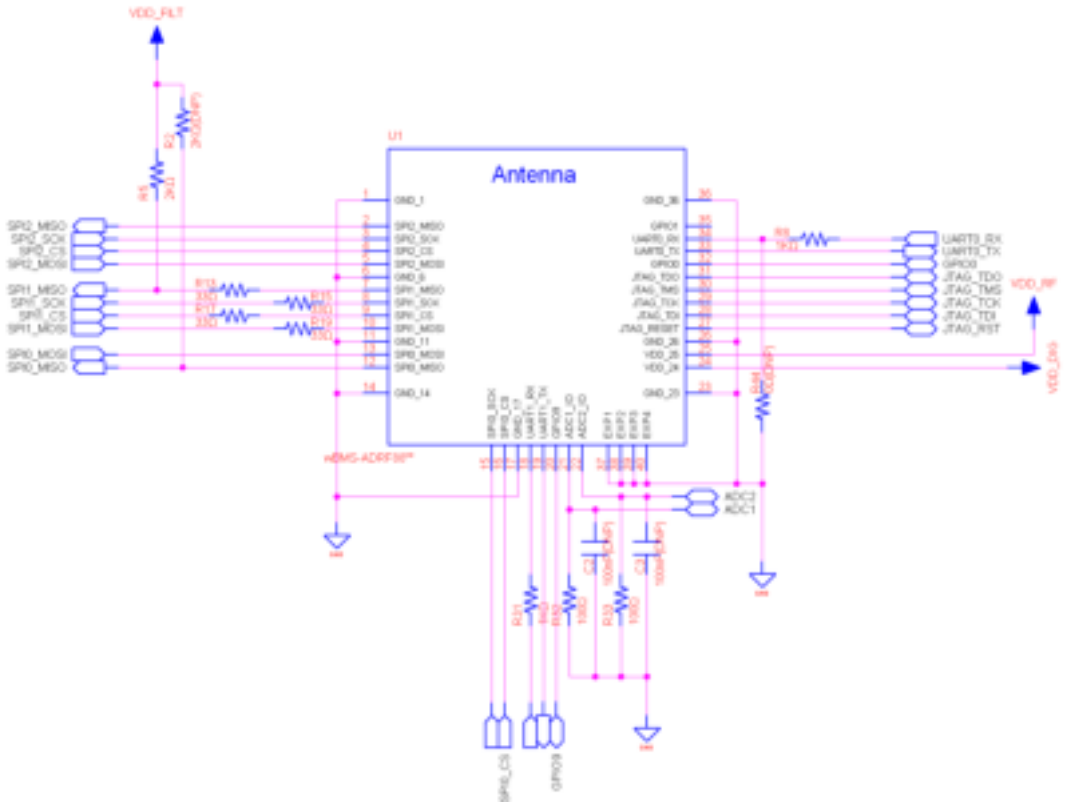
13. Block Diagram



REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (13 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

14. Reference Circuit (Slave)



REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.

TITLE : Specifications for approval (Doc No.)	REV 0.2 (14 / 32)
(CUSTOMER P/NO: **8MDW00004A**)	

FCC/IC Compliance Statement

This device complies with Part 15 of the FCC Rules and Industry Canada license-exempt RSS standard(s).
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.

CAUTION : Any Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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.

A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

Enonce d'Industrie Canada(IC)
Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisee aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

Tout changement ou modification non expressement approuve par la partie chargee de la mise en conformite peut annuler le droit de l'utilisateur a utiliser l'equipement.

Une distance de séparation minimale de 20 cm doit être maintenue entre l'antenne et la personne pour que cet appareil satisfasse aux exigences d'exposition aux RF

REV				LG Innotek Co., Ltd			
	0.1	2023.08.23	Revision 0.1 released				
	0.2	2024.04.24	Revision 0.2 released	DSGD	CHKD	APPD	Doc No.
							DOCUMENT NO. Doc No.