

WL-C2400 User Manual

Wavelabs CO., Ltd.

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1. Overview

WL-C2400 provides safe RF wireless communication with Point-to-Point Topology.

WL-C2400 is an RF wireless communication module operating in the 2.4GHz ISM Band Frequency Hopping method and can apply to equipment using serial interface, and long distance communication is possible at high speed.

WL-C2400 can be configured according to the required type by AT command.

Applications are conveniently configured and can be applied in various fields.

1.1 Regulatory Information

SIMPLIFIED EU DECLARATION OF CONFIRMITY

The simplified EU declaration of conformity referred to in Article 10(9) shall be provided as follows:

Hereby, Wavelabs Co., Ltd. declares that the radio equipment type 2.4GHz wireless modem is in compliance with Directive 2014/53/EU.

Frequency Range	Output Power (Max.)
2400~2483.5 MHz	Below 20 dBm

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.

CAUTION : Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Caution: 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 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.

RF Radiation Exposure Statement:

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.

This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with Industry Canada license-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.

RSS-102 RF Exposure

Le dispositif doit être placé à une distance d'au moins 20 cm à partir de toutes les personnes au cours de son fonctionnement normal. Les antennes utilisées pour ce produit ne doivent pas être situées ou exploitées conjointement avec une autre antenne ou transmetteur.

EXTERNAL ANTENNA MODEL SPECIFIC REQUIREMENTS

This radio transmitter IC: 27085-ICWLC2400A1 has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated.

Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio IC: 27085-ICWLC2400A1 a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur

Antenna Name	Antenna Type	Antenna Gain (dBi)
W5E-WO-01	Dipole	4.5 ± 1

This equipment complies with "Industry Canada RSS-102 for radiation exposure limits set forth for an uncontrolled environment". This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

1.2 Characteristics and functions

The main performance features of WL-C2400 are as follows.

- 2.4MHz ISM Band Frequency Hopping Operation
- Link rate : Max. 250kbps
- Can be set by AT command
- UART / USB interface
- Call book function

1.3 WL-C2400 Specification

Electrical / General

Supported Frequency:	2.402 ~ 2.480 GHz
Spreading Method:	Frequency Hopping (FHSS)
Output Power:	Min. +17 dBm (KC)
Link Rate:	100 kbps / 250 kbps (Adjustable)
Serial Baud Rate:	9600 ~ 230400 bps (Adjustable)
Core Voltage:	+5 VDC
Power Consumption:	Max. 0.5A @ +5V

Environmental

Operation Temperature & Humidity : -10°C to +50°C / 95% R.H

Mechanical

Dimensions : 34.4mm X 51.4mm X 15mm

Weight : Under 20g ± 5g (Without antenna)

Connectors : Antenna : SMA

Data : USB (Micro 5Pin) / UART

2 Hardware Description

This document defines the standard and general characteristics applied to the WL-C2400 module.

WL-C2400 composes several interfaces as follows.

- Input DC voltage : +5 VDC
- Power LED indication : RED
- RS232 / UART Data Interface
- Antenna (SMA)
- USB Port (Serial to USB (Micro 5Pin))
- I/O Pins (JST Connector 6Pin (VCC / TX / RX / GPIO1 / GND / GND))



Fig 1. WL-C2400

2.1 WL-C2400 Drawings

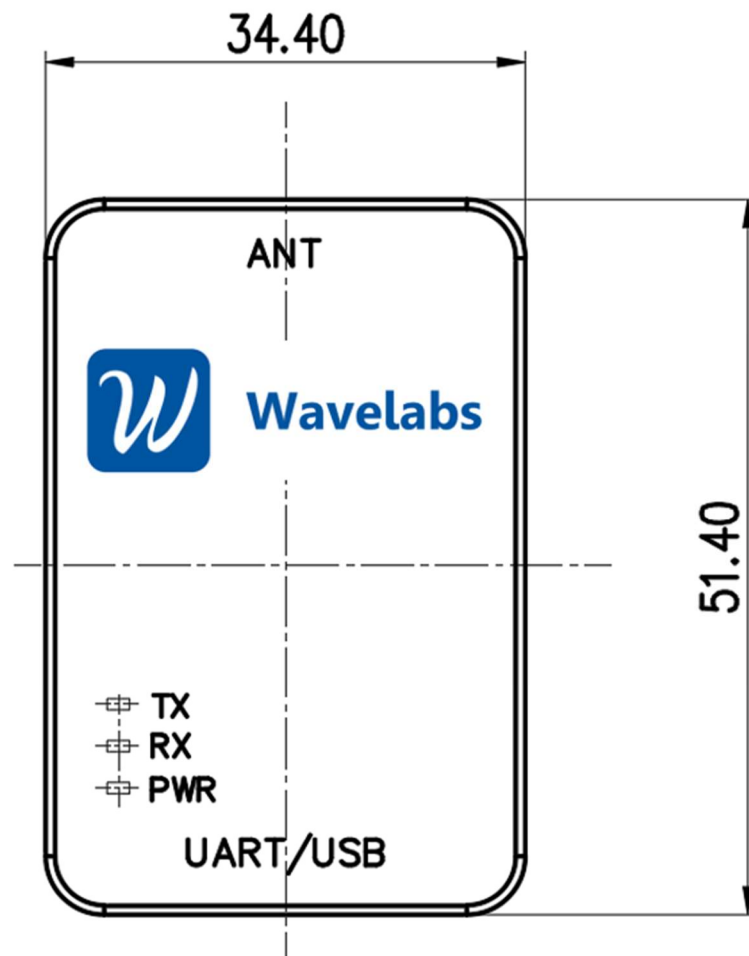


Fig 2. Drawings

2.2 WL-C2400 Connectors & LED indication

LED (PW/RX/TX)

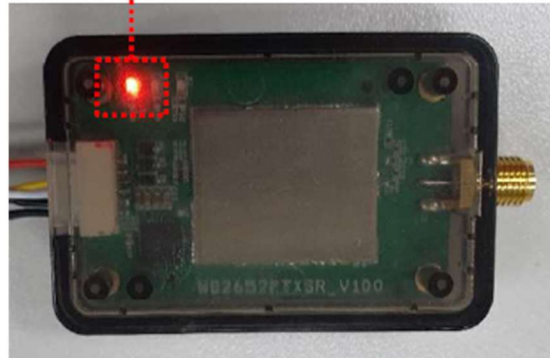


Fig 3. LED indication

- PWR

PWR LED turns on when WL-C2400 input voltage (+5 VDC) is applied

- TX LED

TX LED is ready and blinks repeatedly to indicate data transmission status.

- RX LED

RX LED is ready and blinks repeatedly to indicate data transmission status.

MODE	Unit Type	LED Status		
		PWR	TX	RX
COMMAND	ALL	ON	OFF	OFF
DATA	RX	ON	Blinking : Transmission state	ON : Ready state Blinking : Reception state
	TX	ON	ON : Ready state Blinking : Transmission state	Blinking : Reception state

Table 1. LED Operation



Fig 4. Connector & USB

- USB

When connected to a PC, a USB port provided for user convenience through a serial to USB port.
(Micro 5 Pin to USB)

- JST Connector (6 Pin)

Input DC voltage

: +5 VDC

GPIO1 (COMMAND)

: Using for firmware download

TX/RX (DATA)

: UART communication between devices

Pin No.	Signal
1	+5 VCC
2	TX
3	RX
4	GPIO1
5	GND
6	GND

Table 2. JST Connector Pin

- ANTENNA

SMA Connector

3 RF module command

RF module can be controlled by AT command, and it is composed in the form of
“AT+<Command>[Enter]”

: [Enter] means newline character, CR(0x0D) + LF(0x0A) character

3.1 Enter command mode

- Check whether to enter “Command Mode” for 5 seconds after powering on the RF module.
(When entering “command mode” command is not input, “RF transmit/receive mode” is automatically switched)
- RF module setting can be checked and changed after entering “command mode”
- When changing the RF module setting, the changed setting value is applied only after flash saving is completed. (If Flash cannot be saved, the setting change will not be applied)
- After “command mode” is finished, “RF transmission/reception mode (=RF Mode)” is automatically switched.

Mode switching	Input string	Remark
RF Module Initial → CMD Mode	AT+SET1[Enter]	In “RF transmission / reception mode”, can not enter “command mode”
CMD Mode → RF Mode	AT+SET0[Enter]	

Table 3. Entering/exiting command mode

3.2 Configuration Command

- Basic command

Command	Description
AT+I	Display module information
AT+F	Module frequency band setting
AT+C	Calling up default settings related to module control
AT+S	Save module current settings flash memory
AT+V	Module current setting output

Table 4. Command table

3.2.1 AT+I

Function	Module information output	
Example	TX	AT+I<Index>[Enter]
Example	RX	<Information>[Enter]
Parameter	<Index>	0 : Product Name 1 : Firmware Version 2 : Module MAC Address
Remark		

Table 5. AT+I description

3.2.2 AT+F

Function	Module frequency band setting	
Example	TX	AT+F<Space><Fstart><Space><Fstop> <Space><Spacing><Space><Count>[Enter]
Example	RX	OK
Parameter	<Fstart>	Communication frequency start value, unit : MHz (Default : 2405.0, Min : 2402.0)
	<Fstop>	Communication frequency end value, unit : MHz (Default : 2480.0, Max : 2480.0)
	<Spacing>	Communication frequency interval, unit : MHz (Default : 5.0, Min : 1.0 / Max : 5.0)
	<Count>	Frequency hopping number, unit : ea (Default : 16, Min : 1 / Max : 79)
Remark	Separation of parameters is determined by spaces(=space, 0x20) For <Spacing> and <Count>items, Min & Max values are automatically changed according to the value. → Spacing = (1.0) / Count = (Min : 1, Max : 79) → Spacing = (5.0) / Count = (Min : 1, Max : 16) Ex : (<Fstart>) + (<Spacing>*<Count>) <= (<Fstop>)	

Table 6. AT+F description

3.2.3 AT+C

Function	Calling up default settings related to module control	
Example	TX	AT+C<Index>[Enter]
Example	RX	OK [Enter]
Parameter	<Index>	0 : Master (Transmit Mode) 1 : Slave (Receive Mode)
Remark	Set to the default setting of the selected <index> mode	

Table 7. AT+C description

3.2.4 AT+S

Function	Saving the module current setting to the flash memory	
Example	TX	AT+S[Enter]
Example	RX	OK[Enter]
Parameter		
Remark	After changing the settings in “command mode”, go to “RF transmission/reception mode” without saving, previously changed values are not applied when switching	

Table 8. AT+S description

3.2.5 AT+V

Function	Module current setting output	
Example	TX	AT+V[Enter]
Example	RX	<Information>[Enter]
Parameter		
Remark	The previously saved Flash value and the current changed value are separated and output.	

Table 9. AT+V description

3.3 Setting Register Command

- Checking and changing settings related to module communication

Setting Register Value Query = AT+R<Register Number>?[Enter]

(Ex : AT+R102?[Enter])

Setting Register Value Change = AT+R<Register Number>=<Value>[Enter]

Setting Register Value Type Query = AT+R<Register Number><Space>/?[Enter]

Command	Description
AT+R101	RF mode setting
AT+R102	Serial Baud Rate setting
AT+R103	RF link rate setting
AT+R120	RF paring module setting
AT+R130	RF hopping mode setting
AT+R140	Serial communication path setting

Table 10. Command table

3.3.1 AT+R101

Function	RF mode setting	
Example	TX	AT+R101=<Mode>[Enter]
Example	RX	OK[Enter]
Parameter	<Mode>	0 : Slave (Receive Mode) (Default) 1 : Master (Transmit Mode)
Remark	[Transmit Mode] Drone - Receive standby after packet sending (RX Timeout) [Receive Mode] GCS - Packet receive status, if received Echo TX sending	

Table 11. AT+R101 description

3.3.2 AT+R102

Function	Serial Baud Rate setting	
Example	TX	AT+R102=<Serial Baud Rate>[Enter]
Example	RX	OK[Enter]
Parameter	<Serial Baud Rate>	0 : 9600 1 : 19200 2 : 38400 3 : 57600 (Default) 4 : 115200 5 : 230400 6 : 460800
Remark	Serial(UART) Baud Rate change When setting above 115200bps, RF link rate must be 250kbps.	

Table 12. AT+R102 description

3.3.3 AT+R103

Function	RF link rate	
Example	TX	AT+R103=<RF Baud Rate>[Enter]
Example	RX	OK[Enter]
Parameter	<RF Baud Rate>	0 : 100kbps (Default) 1 : 250kbps
Remark		

Table 13. AT+R103 description

3.3.4 AT+R120

Function	RF pairing module setting	
Example	TX	AT+R120=<Mac Address>[Enter]
Example	RX	OK[Enter]
Parameter	<Mac Address>	R120=FFFFFFFFFFFFFFFF (Default) Point to Point : 00124B00219ED80D "Mac Address"
Remark	Point to Point communication (1:1) * Mac Address can be checked by "AT+I or AT+V" Ex) Master Mac Address : 00124B00219EE627 AT+R120=00124B00219ED81B "Master setting value" Slaver Mac Address : 00124B00219ED81B AT+R120=00124B00219EE627 "Slave setting value"	

Table 14. AT+R120 description

3.3.5 AT+R130

Function	RF hopping mode setting	
Example	TX	AT+R130=<FHSS Mode>[Enter]
	RX	OK[Enter]
Parameter	<FHSS Mode>	0 : Disable 1 : Enable (Default)
Remark		

Table 15. AT+R130 description

3.3.6 AT+R140

Function	Serial communication path setting	
Example	TX	AT+R140=<Serial Direction>[Enter]
	RX	OK[Enter]
Parameter	<Serial Direction>	0 : UART (JST 6Pin Connector) (Default) 1 : USB (Micro 5Pin)
Remark	AT+R140=0 "UART Communication (JST 6Pin Connector)" AT+R140=1 "USB Communication (Micro 5Pin)"	

Table 16. AT+R140 description

4 Installation

There are several factors to consider when preparing to deploy a wireless network, and several factors are described below in no specific order.

4.1 Network Topology

WL-C2400 operates in 2.4GHz ISM band and supports Point to Point Topology.

4.2 Throughput

WL-C2400 supports up to 250kbps asynchronous transmission speed

4.3 Distance

Physical distance between products is affected by required antenna performance and height

4.4 Terrain

Along with distance, terrain should take into account antenna performance considerations. The term “line of sight” (LOS) means being able to see one location from another location, which is the minimum requirement for a radio signal path. That is, the LOS should be secured to minimize the effect on the RF communication link.

4.5 Power requirements

WL-C2400 uses DC input voltage +5 VDC.

(If the supply voltage/current does not meet the requirements, normal operation may not be possible or the product may be damaged)

4.6 Interference

WL-C2400's FHSS (Frequency Hopping Spread Spectrum) operation works normally in environments where there may be in-band interference, and Frequency Limiting (Hopping Zone) is a built-in function that can be used to avoid a specific frequency or frequency range.

5 User description

5.1 POWER SUPPLY

The module supply power is +5V, and the user should consider the current capacity when applying power.

5.2 UART PORT

It processes transmission/reception data by connecting it to the UART Port of the connecting device.



**Power/UART
Connector**

Fig 5. PWR/UART Connector

5.3 USB PORT

USB PORT is an added function for user convenience, and it is directly connected to the PC without using a separate conversion device. Also, power can be supplied through the USB port without a power supply.



**Power/USB
Connector**

Fig 6. PWR/USB Connector

5.4 LED status indication

LED status indication is as follows

Item	Description	Number of LED
TX	RF data transmission status indication	1 EA
RX	RF data reception status indication	1 EA
POWER	Module power status indication	1 EA

- * In command Mode, only the power LED is on

LED (PW/RX/TX)

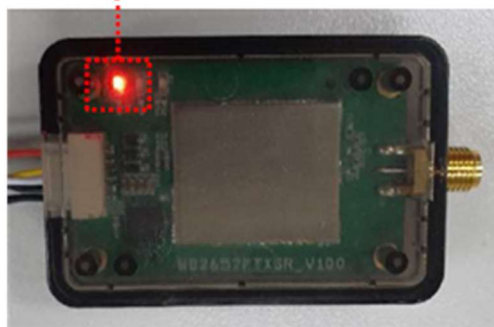
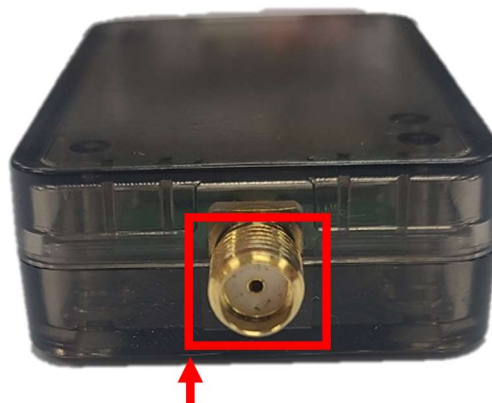


Fig 7. LED indication

5.5 ANTENNA

When using the WL-C2400, it is recommended to use the antenna listed below.

Item	Type	Part name	Gain (dBi)
1	Dipole antenna	W5E-WO-01	4.5 ± 1



**Antenna/SMA
Connector**

Fig 8. ANTENNA Connector