Radio((controlli ®

WIRELESS MODULES

Radio Modem AT Command

The RCQ5-XXX module is a module with multiple features:

- Radio Modem with AT Command
(Transparent Transmission Protocol)
The RF modem is very simple to use and provides a wireless
RS232 link with a RF data rate of up to 200kbps (2-GFSK modulation).
The module can work also in Long Range Mode (LRM) with a RF data
rate egual to 2.5kbps.
The transceivers has the functions of a complete radio modem and
simply require CMOS/TTL data at the transmit input and the
corresponding transceiver(s) output the same data. Preamble and CRC
are automatically generated and added to the RF transmission.

- Over The Air Command (OTA Command)
The module has the ability to manage No. 4 digital outputs and No. 4
digital inputs both locally and remotely (OTA Command) by sending
simple AT commands.

- Alarm Function
With this function, when a digital input change status a message will be
transmitted via UART to the remote device : "Alarm_0_1 "

- Remote I/O Functionality
Remote I/O functionality, this is a type of transmission bidirectional used
in the field of automatic controls. When you enable this, every time the
digital input changes state on station A, also the digital output of remote
station B it will reflect these states simultaneously and vice versa.

Working into European bandwidth : 433/868MHz
Available also the version at 915MHz.

The hardware is based on the module RC-CC1312R-XXX designed by
RadioControlli (CC1312R based from Texas Instruments).

For more information and details, please refer to :
- RC-CC1312R-434 datasheet (www.radiocontrolli.com)
- RC-CC1312R-868 datasheet (www.radiocontrolli.com)
- RC-CC1312R-915 datasheet (www.radiocontrolli.com)
- CC1312R datasheet (www.ti.com)

Applications:

- Smart meters
- Wireless security systems
- Home and Building automation
- 6LoWPAN systems
- Automatic Measure Reading
- Low-Power Wireless Systems

- Wireless Sensor Networks
- Remote Control
- Street Lights System
- Parking Sensors
- Environmental Sensors
- Smart Grid and Automatic Meter Reading

RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

MODULE INFORMATION

RC-RCQ5-433 $\longrightarrow$ 433MHz standard Version (UFL Connector)

RC-RCQ5-433-H $\longrightarrow$ 433MHz pad version

RC-RCQ5-868 $\longrightarrow$ 868MHz standard Version (UFL Connector)

RC-RCQ5-868-H $\longrightarrow$ 868MHz pad version

RC-RCQ5-915 $\longrightarrow$ 915MHz standard Version (UFL Connector)

TECHNICAL CHARACTERISTICS

RC-RCQ5-XXX					
Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Voltage	V_{CC}	1.8	3.00	3.8	VDC
Supply Current RX Mode	I_{CRX}		5.80		mA
Supply Current TX Mode +10dBm	I_{CTX1}		13.40		mA
Supply Current TX Mode +14dBm	I_{CTX2}		24.90		mA
Supply Current Standby Mode	I_{CSTB}		2.0		µA
Supply Current Sleep Mode	I_{CSHU}		2.0		µA
Operative Frequency	F_{of}		433/868/915		MHz
Frequency Error	F_{pp}		±10		ppm
RF Power Output 50ohm (*)	P_{oo}	-10.0		+14.0	dBm
RF Sensitivity 50kbps	S_d		-110.0		dBm
RF Sensitivity Long Range Mode 2.5kbps	S_{LR}		-118.0		dBm
Data Rate (*)	D_{CC}	0,01		4.0	Mbit/s
Operative Temperature	T_{LR}	-20		+75	°C

(*) Programmable parameter.

BLOCK DIAGRAM
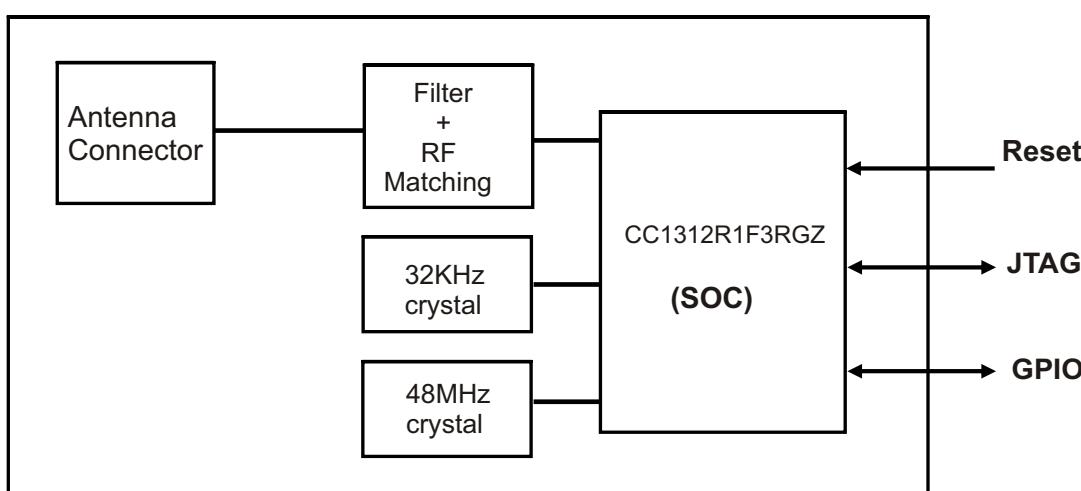
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RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

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WIRELESS MODULES

REFERENCE SCHEMATICS

For cJTAG

VDD
GND
RESET N
JTAG-TMSC
JTAG-TCKC

For JTAG

VDD
GND
RESET N
JTAG-TDI
JTAG-TDO
JTAG-TMSC
JTAG-TCKC

MECHANICAL DIMENSION

1.27mm

15mm

22mm

(2.50 mm)

Antenna Pad (H version)

Antenna UFL

Antenna hole

RCQ5-XXX

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RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
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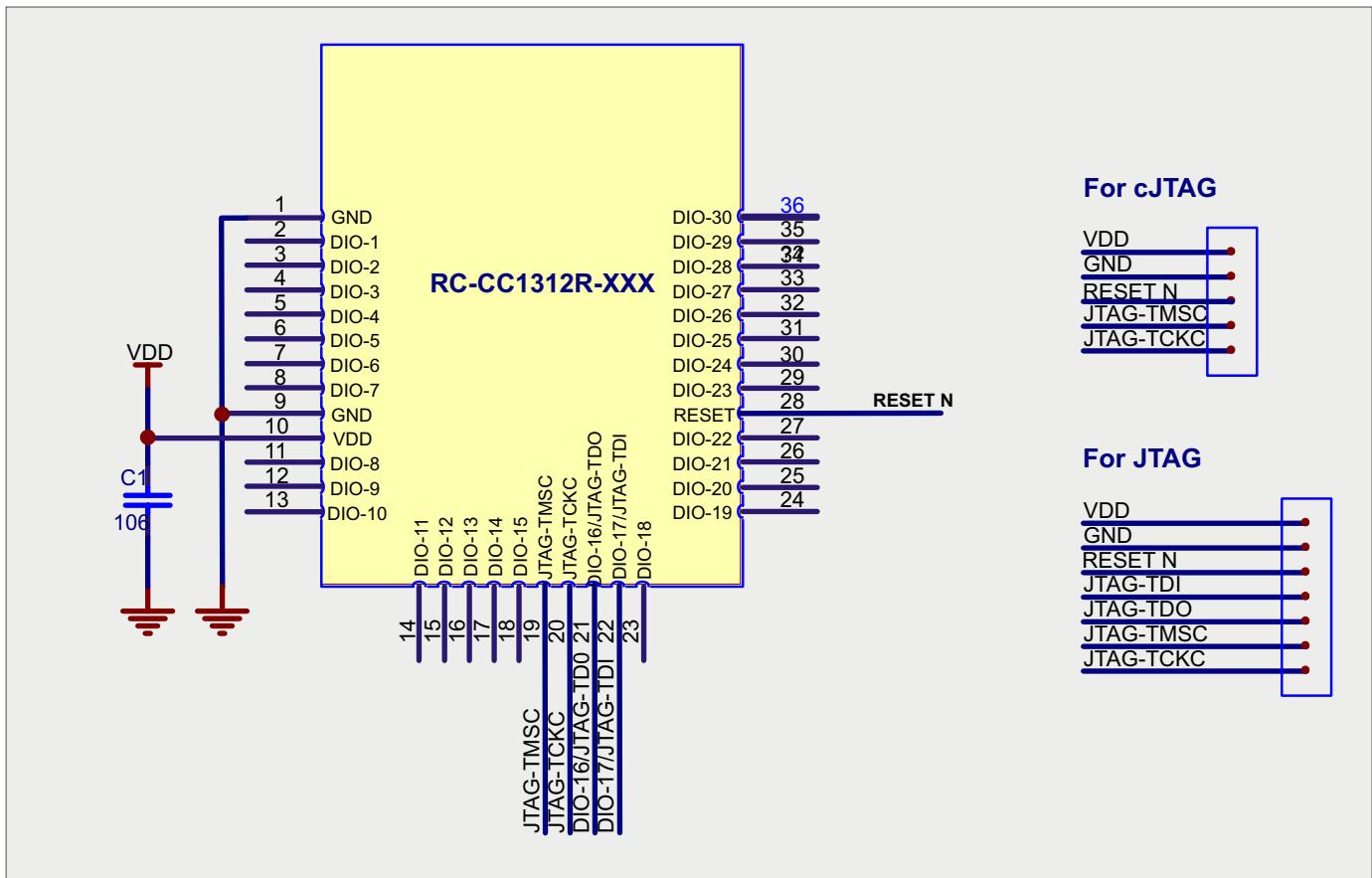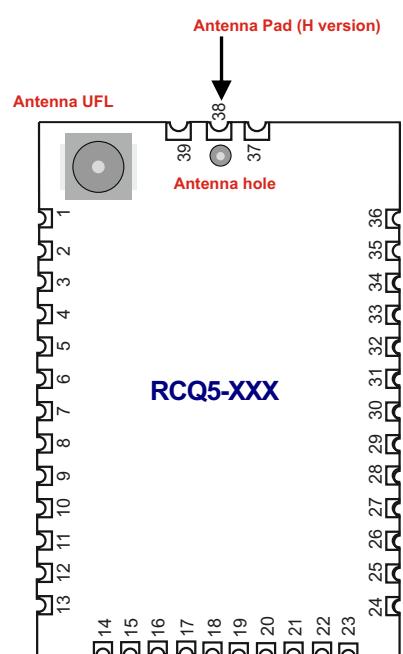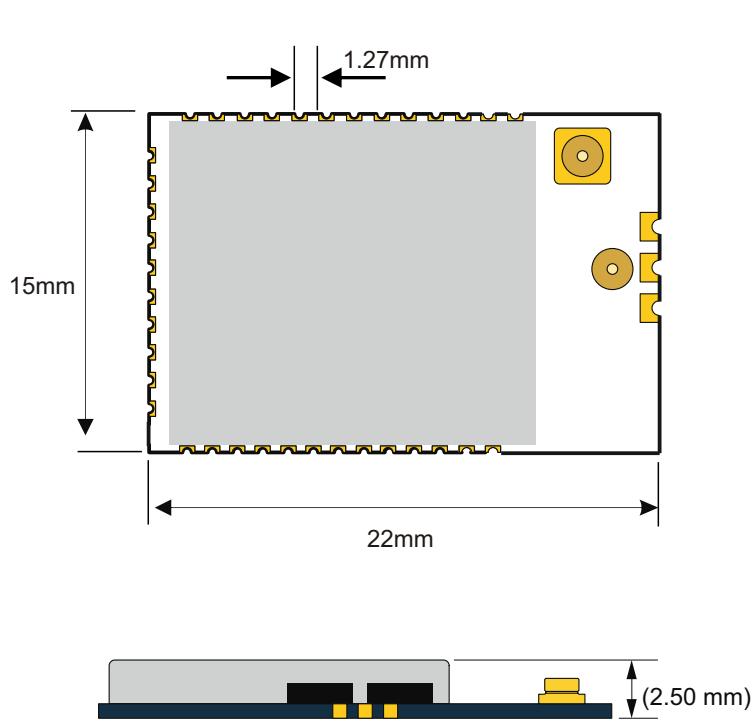
PINOUT
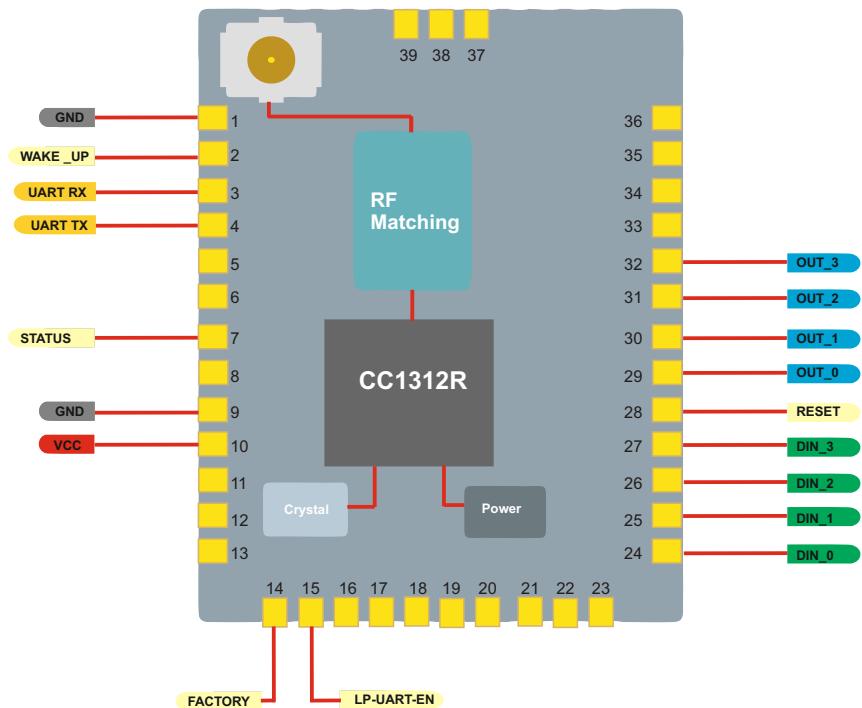
Pin Descriptions			
Pin Number	**Name**	**Pin Type**	**Description**
1,9,37,39	GND	Ground pin	Connect to GND
2	Wake-Up	INPUT	Wake Up from Sleep mode (Low Active)
3	RX	INPUT	UART RX
4	TX	OUTPUT	UART TX
7	STATUS	OUTPUT	- When the system operates normally is HIGH - When the system is in Sleep mode is LOW - When will use Factory Reset this will flash
10	VDD	POWER	1.8Volt ÷ 3.8Volt main chip supply
14	FACTORY	INPUT	- Factory Reset Low Active After pull down this pin, and then powering ON again the pin 7 (STATUS) will flash 5 times and then stay on, means that the factory reset has been restored.
15	LP-UART	INPUT	LP-UART enable low active
24	DIN-0	INPUT	Digital Input DIN-0
25	DIN-1	INPUT	Digital Input DIN-1
26	DIN-2	INPUT	Digital Input DIN-2
27	DIN-3	INPUT	Digital Input DIN-3
28	RESET	INPUT	RESET (Active Low internal pullup)
29	OUT-0	OUTPUT	Digital Output OUT-0
30	OUT-1	OUTPUT	Digital Output OUT-1
31	OUT-2	OUTPUT	Digital Output OUT-2
32	OUT-3	OUTPUT	Digital Output OUT-3

## TYPE OF ANTENNA CONNECTION

Chip selector

*UFL connector*

Antenna pad connector
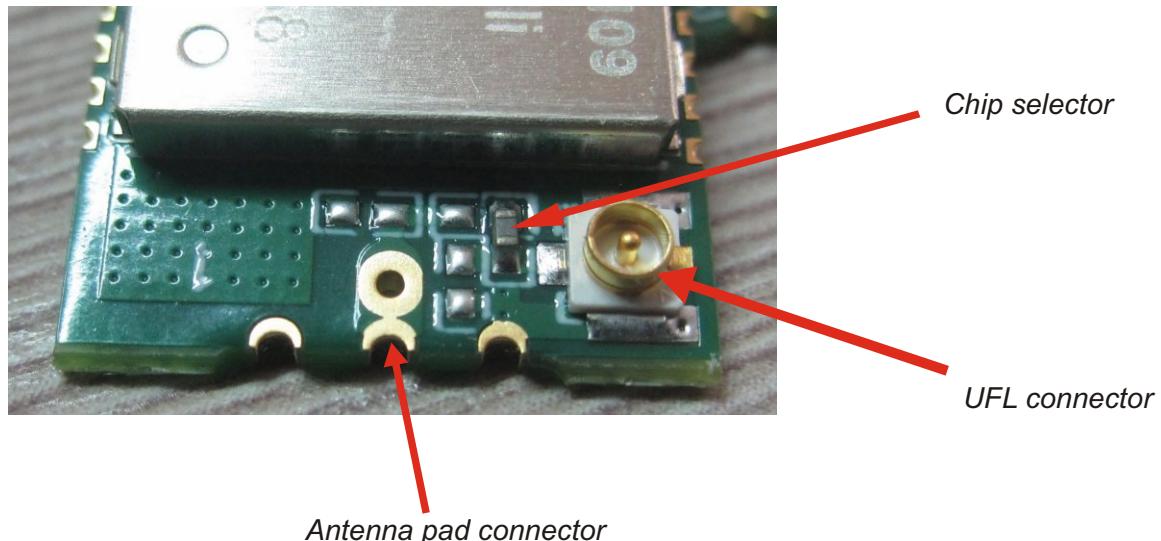
Difference between standard version and «H» version
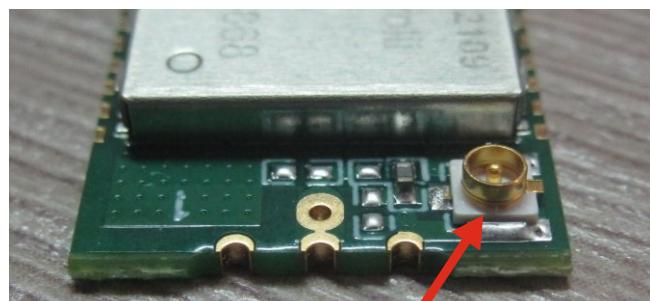
RCQ5-XXX

RCQ5-XXX-H

- With UFL Connector
- Antenna connection to the UFL connector

- Without UFL Connector
- Antenna connection to hole and pad

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RECOMMENDED HARDWARE DESIGN

1) Hardware

All unused pins should be left floating; do not ground.
All GND pins must be well grounded.
Traces should not be routed underneath the module.

2) Power Supply

The transceiver module must be powered from a regulated voltage.
It is recommended to keep the power supply line for VCC as short and low impedence
as possible.   Near the power pins it is recommended to insert a ceramic the decoupling
capacitor (100nF).

3) Ground Plane

It is recommended to have a copper ground plane under the shielded zone of the
module. The ground plane should be unbroken.
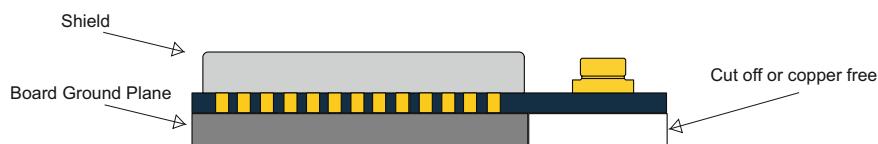
4) Module Placement

The antenna on the PCB has an omnidirectional radiation pattern. To maximize antenna
efficiency, an adequate grounding plane must be provided under the module. Instead the
areas underneath and surrounding the antenna area must be free of copper.
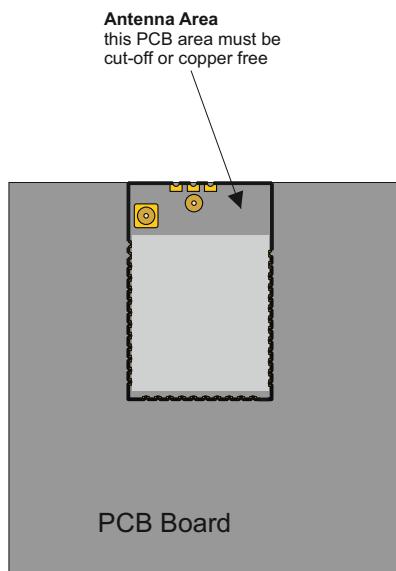

Recommended location XY plane
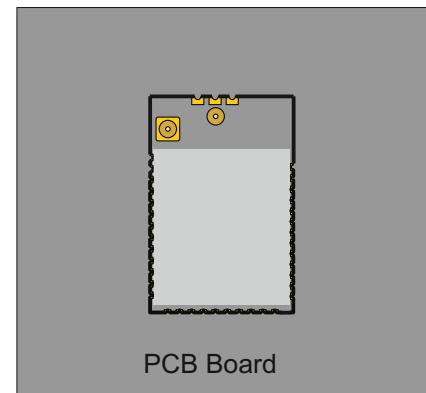
Not Recommended location XY plane

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RECOMMENDED PCB LAYOUT
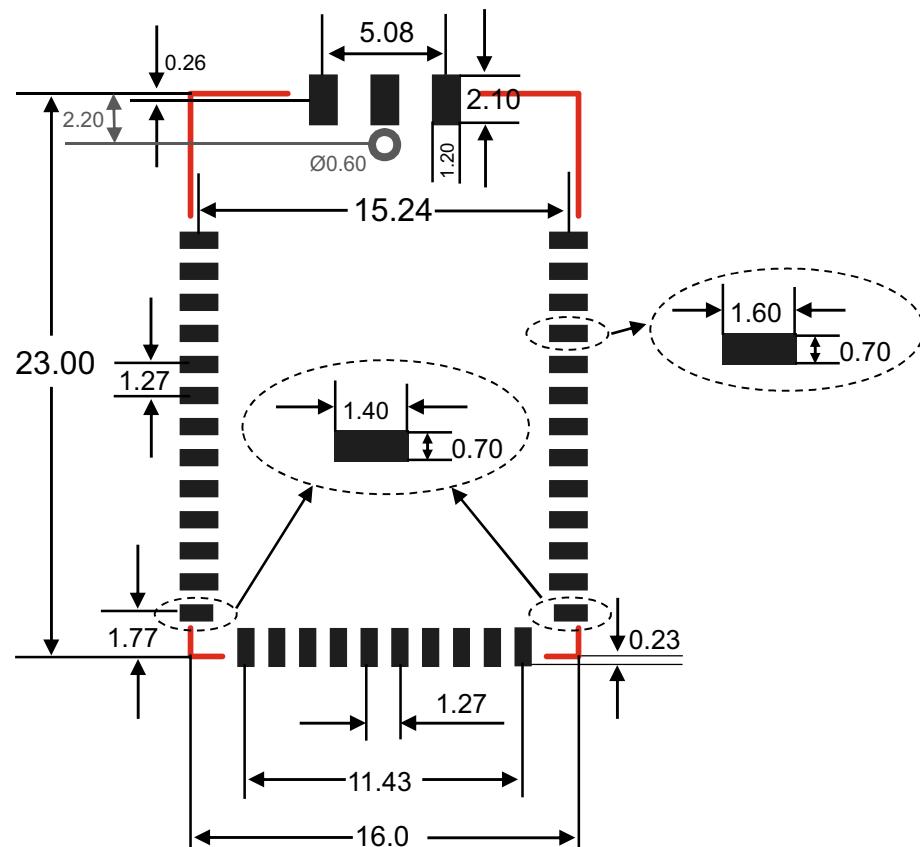
Recommended Reflow Profile for Lead Free Solder

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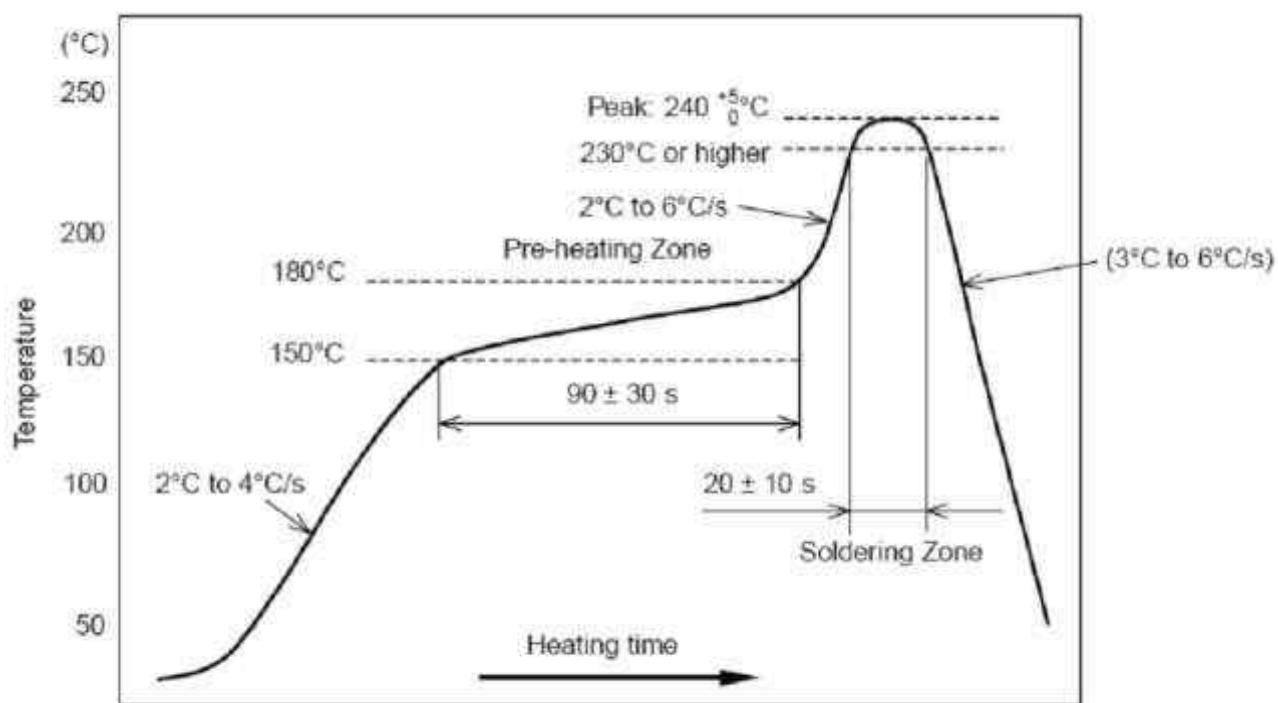
AT Command instruction

AT command is based on ASCII code.
Request message: AT+<CMD>[OP][parameter-1,parameter-2,…,parameter-n]<CR><LF>
The default UART baudrate is 115200bps.

token	Description
AT+	prefix
CMD	command name
OP code	operational character, use OP code : [OP1]"=" : setting [OP2]"?" : inquiry current command instruction [OP3]"" : execution [OP4]"=?" : inquiry current command content
Parameter-1, parameter-n	Parameters setting
<CR><LF>	

Response format :   <CR><LF>[+CMD:] [parameter-1,parameter-n]<CR><LF>
Or <CR><LF><STATUS><CR><LF>

token	Description
+CMD:	command
Parameter-1 ... parameter-n	Back to current character
STATUS	execution status "OK" : exe success "ERROR": exe failure

EVENT Actively report events

When a specific state occurs, the module will send an Event by itself.
Event events are show in the table below.

ID	EventType	Description
01	+EVT:TXDone	TXDone
02	+EVT:RXDone	RXDone
03	+EVT:FACTORY_RESET	Factory reset
04	+EVT:RSSI=xxxdBm	Report RSSI value

AT Command List

No.	Command name	Op code	description
01	AT+VER	=?	Get FW version number.
02	AT+DEVID	=?	Get device ID
03	AT+LpNode	=? =[val]	Set\Get whether the module is an LP node.
04	AT+RX	""	Let the RF enter the receiving state.
05	AT+Standby	""	Let the RF enter the Standby state.
06	AT+Freq	=? =[val]	Set\Get the RF operating Frequency
07	AT+TXPW	=? =[val]	Set\Get the RF operating TX power
08	AT+SYNC	=? =[val]	Set\Get the RF operating SYNC Word
09	AT+Group	=? =[val]	Set\Get the RF operating Group ID
10	AT+DR	=? =[val]	Set\Get the RF operating DataRate
11	AT+Baud	=? =[val]	Set\Get the UART baudrate
12	AT+AutoRx	=? =[val]	Enable/Disable AutoRx mode.
13	AT+ACKRSSI	=? =[val]	Enable/Disable auto report RSSI mechanism.
14	AT+Sleep	""	Enter sleep mode.
15	ATZ	""	Reset the module
16	AT+FACTORY_RESET	""	Factory reset
17	AT+LpUart	=? =[val]	Enable/Disable Low Power UART mechanism.
18	AT+UDT_EVT	=? =[val]	Enable/Disable EVT report mechanism.

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AT Command List

No.	Command name	Op code	description
19	AT+OUTX	=? =[val]	Set \ Get the local Digital Output OUT-0 ÷ OUT-3
20	AT+DINX	=?	Get the local value of the Digital Input (DIN0 ÷ DIN3)
21	AT+OTA_OUTX	=? =[val]	Set \ Get the Remote Digital Output OUT-0 ÷ OUT-3
22	AT+OTA_RDINX	=?	Get the Remote value of the Digital Input (DIN0 ÷ DIN3)
23	AT+RDINX	=? =[val]	ALARM FUNCTION If this parameters is setted at 1, when the INPUT go to low level will be trasmitted an ALARM (throught UART) to Remote device
24	AT+REMOTEIO	=? =[val]	REMOTE I/O FUNCTION Remote I/O functionality actived.
25	AT+ED	=?	Read current background RSSI value
26	AT+LBT	=? =[val]	Enable or disable listen before send mechanism.
27	AT+LBTP	=? =[val]	Set/Get Listen before send parameters.

Parameter	Default value
LpNode	0
SYNC	Aabbccdd
Group	170
AutoRx	1
ACKRSSI	0
LPUart	0
UDT_EVT	1
WOR_Duration	1
DR (DataRate)	0
UART BaudRate	0
TX Power	0

Data Rate List

	Deviation	Bandwidth	Symbol rate
0	25KHz	98KHz	50Kbaud
1	50KHz	195.9KHz	100Kbaud
2	100KHz	273.1KHz	200Kbaud
3	5KHz	34.1KHz	2.5Kbaud

TX Power table

0	14dBm	8	6dBm
1	12.5dBm	9	5dBm
2	12dBm	10	4dBm
3	11dBm	11	3dBm
4	10dBm	12	2dBm
5	9dBm	13	1dBm
6	8dBm	14	0dBm
7	7dBm	15	-3dBm

UART BaudRate

0	115200
1	57600
2	38400
3	19200
4	9600
5	4800
6	2400

AT Command (Basic Command)

Description	Read Firmware version
Syntax	+VER=?<CR><LF>
Format	AT+VER=? <CR><LF>
Response	<CR><LF>+VER:[parameter-1]<CR><LF>
ResultCode	<CR><LF>OK<CR><LF>

```
1[12:19]>>>AT+VER=?
[12:19]<<<
+VER:v1.2.2_1

OK
```

Description	Read Device ID
Syntax	+DEVID=?<CR><LF>
Format	AT+VER=? <CR><LF>
Response	<CR><LF>+DEVID:[parameter-1]<CR><LF>
ResultCode	<CR><LF>OK<CR><LF>

```
[12:22]>>>AT+DEVID=?
[12:22]<<<
+DEVID:035f272a004b1200

OK
```

Description	Sleeping Mode
Syntax	+Sleep=[parameter-1] <CR><LF>
Format Command	AT+Sleep<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

```
[[12:35]>>>AT+Sleep
[12:35]<<<
OK
```

AT+Sleep means that both BB (BaseBand) and RF enter the lowest power consumption state.
After this command the module will no longer respond to any AT command, it will be necessary to use the wake-up pin to return to the previous conditions.

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AT Command (Basic Command)

Description	*Reeboot the module*
Syntax	ATZ
Format	ATZ <CR><LF>
Response	<CR><LF>OK<CR><LF>

```
[14:12]>>>ATZ
[14:12]<<<
OK
```

Description	*Reset to default value*
Syntax	+FACTORY_RESET
Format	AT+FACTORY_RESET<CR><LF>
Response	<CR><LF>OK<CR><LF>
	<CR><LF>+EVT:FACTORY_RESET<CR><LF>

```
[14:16]>>>AT+FACTORY_RESET
[14:16]<<<
OK

+EVT:FACTORY_RESET
```

Description	*Get/Set UDT_EVT*
Syntax	+UDT_EVT
Format Command	AT+UDT_EVT=[parameter-1] <CR><LF>
Response Command	<CR><LF>
Format Query	AT+UDT_EVT=? <CR><LF>
Response Query	<CR><LF>+UDT_EVT=[parameter-1]<CR><LF>
	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

```
[[14:23]>>>AT+UDT_EVT=1
[14:23]<<<
OK
```

```
[[14:22]>>>AT+UDT_EVT=?
[14:22]<<<
+UDT_EVT:1

OK
```

If is not necessary to report +EVT:TxDone and +EVT:RxDone during transmission and reception, this command can be used to turn off EVT reporting events.

Description	*Change RF to be wait mode*
Syntax	+Standby
Format	AT+Standby<CR><LF>
Response	<CR><LF>OK<CR><LF>

```
[[14:34]>>>AT+Standby

[14:34]<<<
OK
```

When we want to leave the receiving state, is possible to use this command to leave the receiving state.

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RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

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AT Command (Low Consumption)

Description	*LpNode functionality*
Syntax	+LpNode
Format Command	AT+LpNode=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+LpNode=? <CR><LF>
Response Query	<CR><LF>+LpNode:[parameter-1]
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

```
[14:54]>>>AT+LpNode=1

[14:54]<<<
OK
```

```
[14:54]>>>AT+LpNode=?

[14:54]<<<
+LpNode:1

OK
```

When LpNode is turned on (enabled = 1) , when transmitting data, a longer preamble will be added to wake-up the remote receiving module.
When the receiving module is receiving a sleep wake-up reception mechanism will be used to reduce average power consumption.

Description	*Get/Set WOR Duration*
Syntax	+WOR_Duration
Format Command	AT+WOR_Duration=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+WOR_Duration=? <CR><LF>
Response Query	<CR><LF>+WOR_Duration:[parameter-1]
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 = wakeup every 1000ms
1 = wakeup every 500ms
2 = wakeup every 250ms
3 = wakeup every 125ms

```
[[15:09]>>>AT+WOR_Duration=1
[15:09]<<<
OK
```

```
[15:10]>>>AT+WOR_Duration=?
[15:10]<<<
+WOR_Duration:1

OK
```

When LpNode is turned on (enable = 1) , entering the receiving state will periodically wake up to receive.
This command can set how many seconds to wake-up and enter the receiving state.

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AT Command (Low Consumption)

This is another instruction to reduce the consumption when the module is managed from UART.

| Description	*Get/Set LpUART*
Syntax	+LpUart
Format Command	AT+LpUart=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+LpUart=? <CR><LF>
Response Query	<CR><LF>+LpUart:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

```
[10:04]>>>AT+LpUart=1
[10:04]<<<
OK
```

```
[10:05]>>>AT+LpUart=?
[10:05]<<<
+LpUart:0

OK
```

When LpUart is turned on, when we need to send text or AT command to the module, we need to pull down LP_UART_EN, then the module can receive the command.

1) **Send the command : AT+LPUart=1**
    When you execute this command the UART has been turned off and therefore there will be no response to the commands sent.

2) **Pull down pin 15 (LP-UART-EN)**
    When you pull down pin 15, UART will be opened. This is the condition of lowest possible consumption.
    It is recommended that after using Pin 15 to turn on the UART, there is a short delay to 20ms to allow the UART to complete initialitation.

3) **Pull up pin 15 (LP-UART-EN)**
    After you pull high pin 15, the UART will be turned off again.

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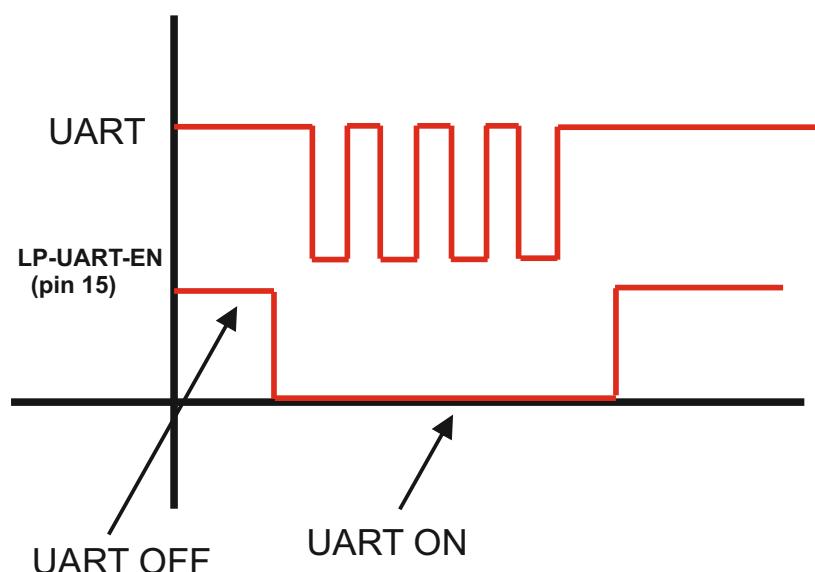
AT Command (Radiofrequency Command)

Description	Get/Set Frequency
Syntax	+Freq
Format Command	AT+Freq=[parameter-1] <CR><LF>
Response Command	<CR><LF>
Format Query	AT+Freq=? <CR><LF>
Response Query	<CR><LF>+Freq:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 433000000-436000000 ---> 433Mhz version
parameter-1 = 866000000-870000000 ---> 868MHz version
parameter-1 = 913000000-917000000 --->   915MHz version

```
[[15:25]>>>AT+Freq=868100000
[15:25]<<<
OK
```

```
[15:26]>>>AT+Freq=?
[15:26]<<<
+Freq:868100000

OK
```

Description	Set and get TX power
Syntax	+TXPW
Format Command	AT+TXPW=[parameter-1] <CR><LF>
Response Command	<CR><LF>
Format Query	AT+TXPW=? <CR><LF>
Response Query	<CR><LF>+TXPW:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 0 : 14dBm   9 : 5dBm
               1 : 12.5dBm   10 : 4dBm
               2 : 12dBm   11 : 3dBm
               3 : 11dBm   12 : 2dBm
               4 : 10dBm   13 : 1dBm
               5 : 9dBm   14 : 0dBm
               6 : 8dBm   15 : -3dBm
               7 : 7dBm
               8 : 6dBm

```
[15:34]>>>AT+TXPW=4
[15:34]<<<
OK
```

```
[15:34]>>>AT+TXPW=?
[15:34]<<<
+TXPW:4

OK
```

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AT Command (Radiofrequency Command)

Description	Get/Set Datarate
Syntax	+DR
Format Command	AT+DR=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+DR? <CR><LF>
Response Query	<CR><LF>+DR:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1

	Deviation	Bandwidth	Symbol rate
0	25KHz	98KHz	50Kbaud
1	50KHz	195.9KHz	100Kbaud
2	100KHz	273.1KHz	200Kbaud

```
[15:51]>>>AT+DR=0
[15:51]<<<
OK
```

```
[15:51]>>>AT+DR=?
[15:51]<<<
+DR:0

OK
```

Description	Rx Mode
Syntax	+RX
Format	AT+RX<CR><LF>
Response	<CR><LF>OK<CR><LF>

```
[15:56]>>>AT+RX
[15:56]<<<
OK
```

AT+RX, it is only valid for one time. Once the module is restarted or you transfer a piece of data, its state machine will change to idle mode after the transfer is completed.

Description	Get/Set AutoRx
Syntax	+AutoRx
Format Command	AT+AutoRx=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+AutoRX=? <CR><LF>
Response Query	<CR><LF>+AutoRX:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

```
[16:01]>>>AT+AutoRx=1
[16:01]<<<
OK
```

```
[16:01]>>>AT+AutoRx=?
[16:01]<<<
+AutoRx:1

OK
```

When AutoRx is turned on (enabled = 1) the system will be in the RX connection state when idle, waiting to receive data.

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RC-RCQ5-XXX

- *Radio Modem*
- *Over The Air Command*
- *Alarm Function*
- *Remote I/O Functionality*

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AT Command (Radiofrequency Command)

Description	**Get/Set SYNC word**
Syntax	+SYNC
Format Command	AT+SYNC=[parameter-1] <CR><LF>
Response Command	<CR>OK<LF>
Format Query	AT+SYNC=? <CR><LF>
Response Query	<CR><LF>+SYNC:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   Default is « aabbccdd»
SYNC word is consisting of a total of 4 bytes. The SYNC word in TX and RX need to be consistent and the Group ID also needs to be consistent to transmit data to each other.

```
[16:25]>>>AT+SYNC=aabbccdd
[16:25]<<<
OK
```

```
[16:25]>>>AT+SYNC=?
[16:25]<<<
+SYNC:aabbccdd

OK
```

Description	**Get/Set Group Id**
Syntax	+Group
Format Command	AT+Group=[parameter-1] <CR><LF>
Response Command	<CR>OK<LF>
Format Query	AT+Group=? <CR><LF>
Response Query	<CR><LF>+Group:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   value between 0÷255 (default is 170)
When receiving and transmitting, both the SYNC word and the Group Id need to be consistent to transmit data to each other.

```
16:34]>>>AT+Group=170
[16:34]<<<
OK
```

```
[[16:35]>>>AT+Group=?
[16:35]<<<
+Group:170

OK
```

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Rev 2.2

RadioControlli

WIRELESS MODULES

AT Command

Description	**Get/Set UART baudrate**
Syntax	+Baud
Format Command	AT+Baud=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+Baud=? <CR><LF>
Response Query	<CR><LF>+Baud:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   value between 0-6
0=115200   1=57600
2=38400   3=19200
4=9600   5=4800
6=2400

```
[09:58]>>>AT+Baud=0
[09:58]<<<
OK
```

```
[09:58]>>>AT+Baud=?
[09:58]<<<
+Baud:0

OK
```

Description	**Receiving data setting, reply RSSI report**
Syntax	+ACKRSSI
Query Command	AT+ACKRSSI=?<CR><LF>
Response Command	<CR><LF>+ACKRSSI:<parameter-1><CR><LF>
Format Command	AT+ACKRSSI=<parameter-1> <CR><LF>
Response Query	<CR><LF>+ACKRSSI:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

```
[15:44]>>>AT+ACKRSSI=1
[15:44]<<<
OK
```

```
[15:45]>>>AT+ACKRSSI=?
[15:45]<<<
+ACKRSSI:1

OK
```

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Listen before send mechanism.

"Listen Before Send" (LBS) is a protocol used in radio frequency (RF) communications to avoid interference and ensure efficient use of the spectrum. Before transmitting data, a device listens to the channel to check if it is free. If the channel is clear, the device proceeds to send its data. However, if the channel is occupied, the device waits until it becomes available. This approach helps prevent collisions between signals, reduces the likelihood of communication errors, and ensures more reliable and efficient communication in environments with multiple transmitting devices. LBS is commonly used in wireless communication systems such as Wi-Fi, Bluetooth, and various other RF technologies.

AT Command (Listen Before Send)

Description	Enable/Disable Listen Before Send Instruction
Syntax	+LBT
Format Command	AT+LBT=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+LBT=? <CR><LF>
Response Query	<CR><LF>+LBT:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 disable   1 enable

Description	Read current background RSSI
Syntax	+ED
Format Command	AT+ED=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+ED=? <CR><LF>
Response Query	<CR><LF>+ED:[parameter-1]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   RSSI value between -127 to 128

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AT Command (Listen Before Send)

Description	Set/Get LBT (Listen Before Send) parameters
Syntax	+LBTP
Format Command	AT+LBTP=[TH],[retry_count],[random_ms],[random_ms_offset] <CR><LF>
Format Query	AT+LBTP=? <CR><LF>
Response Query	<CR><LF>+LBPT:[TH].[retry_count],[random_ms],[random_ms_offset] <CR><LF>

[TH]:carrier sense threshold, value between -127~128
[retry_count]:max retry count,value between 1-255
[random_ms]:when channel is busy,module will generate delay random
ms+random_ms_offset,the random_ms
[random_ms_offset]:random_ms offset value.

e.g. AT+LBTP=-60,5,50,100<CR><LF>
1.carrier sense -60dbm threshold.
3.when channel is busy,the module will generate 100~150ms random delay time.
4.recheck carrier sense threshold,it will recheck 5 times.
5.when retry_count>5 times,module will print +EVT:LBT_Timeout

A similar mechanism **CSMA/CD (Carrier Sense Multiple Access with Collision Detection)** has been used.

Before to send, will be necessary to check the RSSI strength of this channel. The threshold of this RSSI is [TH].
When the RSSI signal is strong, it means that this channel is being used.

When this channel is being used, it's possible delay a random ms, [random_ms], and then try to detect the RSSI value.

It's possible to define a random time, not from 0~N ms, but from 100-500ms.
Therefore, I add a parameter [random_ms_offset], which is a fixed value, and put [random_ms at offset. Value goes up]

For example, I hope that when I have a collision, I want to stay for a random time between 500ms-1500ms.
In this way, your parameters should be using random_ms_offset:500, random_ms:1000
500+0ms=500ms(random_min)
500+1000ms=1500ms(random_max)

If your random_ms_offset is 0
Then it will become a random value from 0-1000ms.
0+0ms=0ms(random_min)
0+1000ms=1000ms(random_max)

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Rev 2.2

Listen before send mechanism

A similar CSMA/CD (Carrier Sense Multiple Access with Collision Detection) mechanism has been used to solve data collision problems during transmission. The main goal of CSMA/CD is to minimize collisions between devices on the network to improve transmission efficiency.

CSMA/CD Working Principle:

1. Carrier Sense: When a device needs to send data, it first checks whether the communication medium (such as cable) is free. If the network is busy, the device waits until the network becomes free.

2. Multiple Access: All devices share the same communication medium, and any device can start a transmission if it detects that the network is free.

3. Collision Detection: During transmission, the device monitors whether other devices are transmitting at the same time. If it detects a collision, it immediately stops transmitting and sends a "collision signal" to inform all devices on the network.

4. Backoff and Retransmission: After a collision, the device waits a random amount of time and then tries to send data again. This random waiting time reduces the probability of further collisions.

Flochart description:

- **Start**: The device needs to transmit data.

- **Channel State Detection**: The device checks whether the network is free.

    o   If the network is busy, it waits until it is free.

    o   If the network is free, it proceeds to the next step.

- **Start of Transmission**: The device starts transmitting data and continues to monitor whether a collision occurs.

    o   If a collision is detected, it stops transmitting and sends a collision signal.

    o   If no collision occurs, the data transmission is successful.

- **Retransmission after Collision**: If a collision occurs, the device waits a random amount of time and tries to transmit again.

- This mechanism ensures that multiple devices can share the same communication medium by avoiding data

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Rev 2.2

AT Command (local GPIO functionality)

| Description	Get/Set OUT0÷OUT3 local GPIO
Syntax	+OUT[parameter-1][parameter-2]
Format Command	AT+OUT[parameter-1]=[parameter-2] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+OUT[parameter-1]=? <CR><LF>
Response Query	<CR><LF>+OUT[parameter-1]:[parameter-2]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 0 : OUT0   1: OUT1   2:OUT2   3:OUT3
parameter-2 = 0 : Low Level   1: High Level

```
[[10:21]>>>AT+OUT0=1
[10:21]<<<
OK
```

```
[10:21]>>>AT+OUT0=?
[10:21]<<<
+OUT0:1

OK
```

With this command is possible to set the OUTPUT (OUT0÷OUT3) of the local device to the desidered logic state (0 - 1).

Description	Get IN0÷IN3 local GPIO
Syntax	+RDIN[parameter-1]
Format Query	AT+RDIN[parameter-1]=? <CR><LF>
Response Query	<CR><LF>+RDIN[parameter-1]:[parameter-2]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 0 : IN0   1: IN1   2:IN2   3:IN3   parameter-2 = 0 : low level   1: high level

```
[10:34]>>>AT+RDIN0=?
[10:34]<<<
+RDIN0:1

OK
```

With this command is possible to interrogate the 4 digital inputs of the local device (IN0÷IN3).
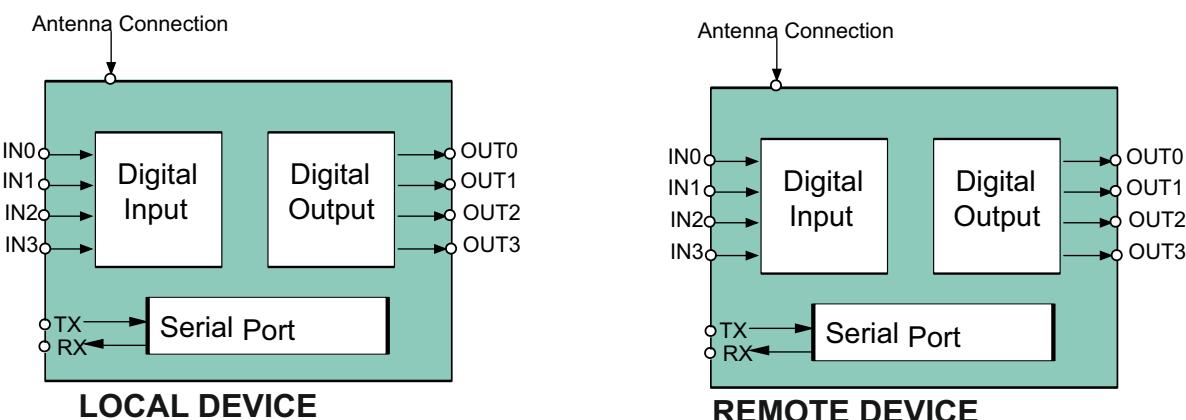
LOCAL DEVICE

REMOTE DEVICE

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AT Command (Over The Air GPIO functionality)

Description	Get/Set OUT0÷OUT3 Over The Air GPIO
Syntax	+OTA_OUT[parameter-1][parameter-2]
Format Command	AT+OTA_OUT[parameter-1]=[parameter-2] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+OTA_OUT[parameter-1]=? <CR><LF>
Response Query	<CR><LF>+OTA_OUT[parameter-1]:[parameter-2]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 0 : OUT0   1: OUT1   2:OUT2   3:OUT3
parameter-2 = 0 : Low Level   1: High Level

```
[10:41]>>>AT+OTA_OUT1=1
[10:41]<<<
+EVT:TxDone

OTA_OK

+EVT:RxDone
```

```
[10:42]>>>AT+OTA_OUT1=?
[10:42]<<<
+EVT:TxDone

+OTA_OUT1:1

OTA_OK

+EVT:RxDone
```

With this command is possible to set the
OUTPUT (OUT0÷OUT3) of the remote device
to the desidered logic state (0 - 1).

Description	Get IN0÷IN3 Over The Air GPIO
Syntax	+OTA_RDIN[parameter-1]
Format Query	AT+OTA_RDIN[parameter-1]=? <CR><LF>
Response Query	<CR><LF>+OTA_RDIN[parameter-1]:[parameter-2]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 = 0 : IN0   1: IN1   2:IN2   3:IN3   parameter-2 = 0 : low level   1: high level

```
[10:47]>>>AT+OTA_RDIN1=?
[10:47]<<<
+EVT:TxDone

+OTA_RDIN1:1

OTA_OK

+EVT:RxDone
```

With this command is possible to interrogate
the 4 digital inputs of the remote device (IN0÷IN3).

LOCAL DEVICE

REMOTE DEVICE

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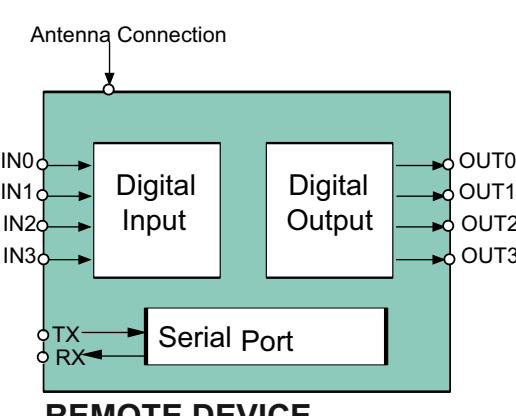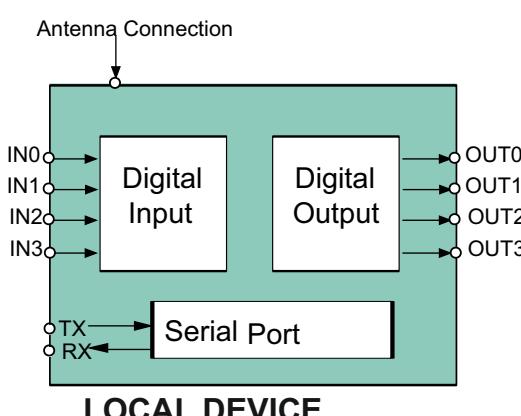
AT Command (ALARM Notification Function)

Description	*Get/Set DINX*
Syntax	+DIN[parameter-1]=[parameter-2]
Format Command	AT+DIN[parameter-1]=[parameter-2] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+DIN[parameter-1]=? <CR><LF>
Response Query	<CR><LF>+DIN[parameter-1]:[parameter-2]<CR><LF>
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 : DIN-0   1: DIN-1   2:DIN-2   3:DIN-3
parameter-2 =   0 : Low Level   1: High Level

```
[15:38]>>>AT+DIN0=1
[15:38]<<<
OK
```

```
[[15:38]>>>AT+DIN0=?
[15:38]<<<
+DIN0:1

OK
```
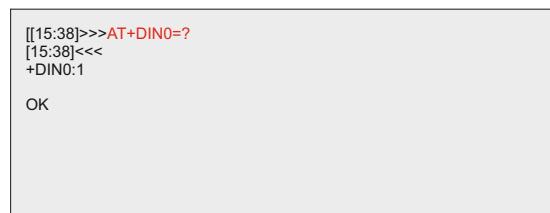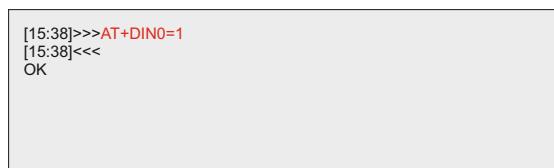
When this function is enable (on the single DIN-0 ÷DIN-3) if for any reason the DIN_X input will go to low level, the module will send the «Alarm_X_1» string throught the AIR. When we restore DIN-X to a high level, it wil send the «Alarm_X_0» string trought RF.

LOCAL DEVICE

REMOTE DEVICE

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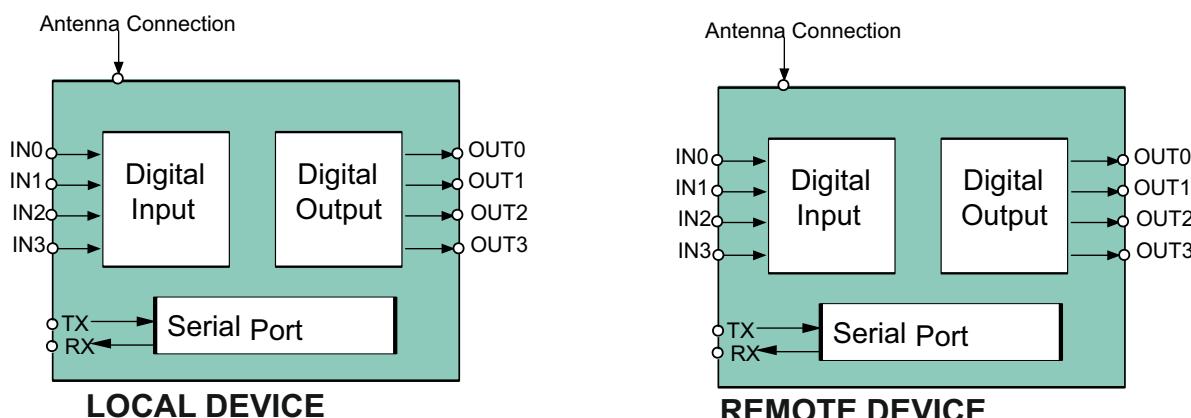
AT Command (IO Mirroring Function)

Description	Get/Set RemoteIO
Syntax	+RemoteION=[parameter-1]
Format Command	AT+RemoteIO=[parameter-1] <CR><LF>
Response Command	<CR><LF>OK<CR><LF>
Format Query	AT+RemoteIO=? <CR><LF>
Response Query	<CR><LF>+RemoteIO:[parameter-1]
Result Code	<CR><LF>OK<CR><LF>

parameter-1 =   0 : disable   1: enable

```
[16:07]>>>AT+RemoteIO=1
[16:07]<<<
OK
```

```
[16:07]>>>AT+RemoteIO=?
[16:07]<<<
+RemoteIO:1

OK
```

When the RemoteIO function is enabled :

- the status value of the digital inputs IN0÷IN3 (local device) is mirrored on the digital outputs OUT0÷OUT3 (remote device).
- the status value of the digital inputs IN0÷IN3 (remote device) is mirrored on the outputs digital OUT0÷OUT3(local device).

Point to point transmission
When the RemoteIO function is turned on, the AutoRx function will be automatically enabled.
Whne the RemoteIO function is turned on, AT+OUTx an AT+DINx will be temporarirly disabled.
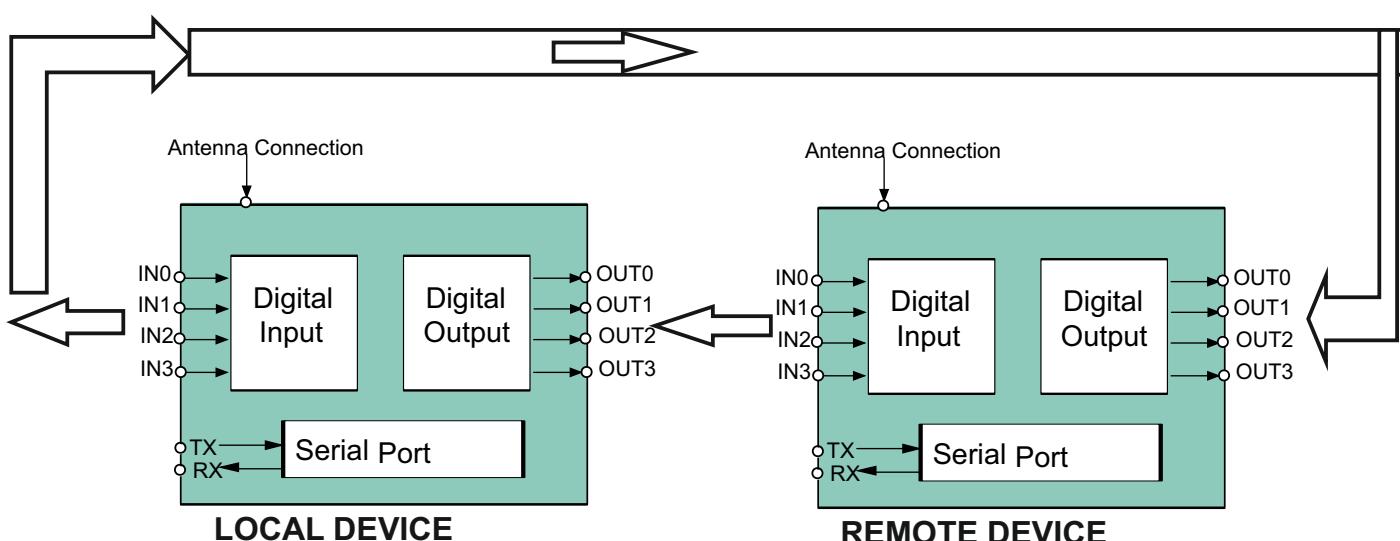
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RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

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WIRELESS MODULES

Quick Start Guide (Evaluation Board)

Serial Interface based on Prolific PL2303

The demoboard uses a USB / RS232 interface based on the PL2303 Prolific chip. The related drivers can be downloaded on the website: http://www.prolific.com.tw.

OUT1÷OUT4 Digital Output

IN-1 ÷ IN-4 Digital Input

Antenna SMA Connector

RC-CC1312R-XXX Transceiver Module

Power JUMP

With this JUMP is possible to Power ON the board, from the USB or from the

RESET

SLEEP

Push this button to WAKE-UP from Sleep mode.

Factory Reset

Push this button and in the same time push the RESET button.
The LED Status will flash for 5

LED STATUS

When the system :
- operates normally is turned ON
- is in SLEEP mode is turned OFF
- is ib Factory Reset will flash for 5

The Evaluation KIT is composed :

- N.2 Evaluation board
- N.2 Antenna SMA
- N.2 Battery Pack
- N.2 USB Cable

Battery Pack

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W I R E L E S S   M O D U L E S

Quick Start Guide

USB Connector
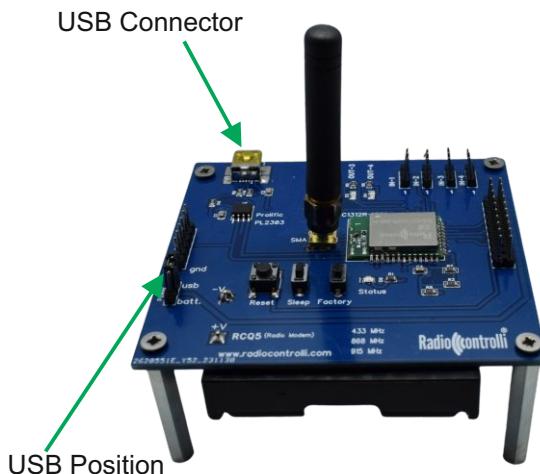
USB Position

- Make sure the jumper is in the USB position
  (USB powered)

- Connect the Personal computer to the USB connector
  check the correct recognition of the drivers
  Prolific, in case of problems these drivers can be
  downloaded from the website: http://www.prolific.com.tw.

.

For user to start quickly to use the smart radio modem RCQ5, it
will be necessary to use a standard windows serial terminal
(for example Putty, Real Term ect) or you can use a RadioControlli
application downloadable from the following link :

DOWNLOAD AT COMMAND

The test will be done using two modules : one as RX, the other as
TX. Launch the application denominated RCQ5-XXX.exe.

Setting radio parameters

1) Input the Comport and set the baudrate (115200 by default).
2) Click «Open UART»
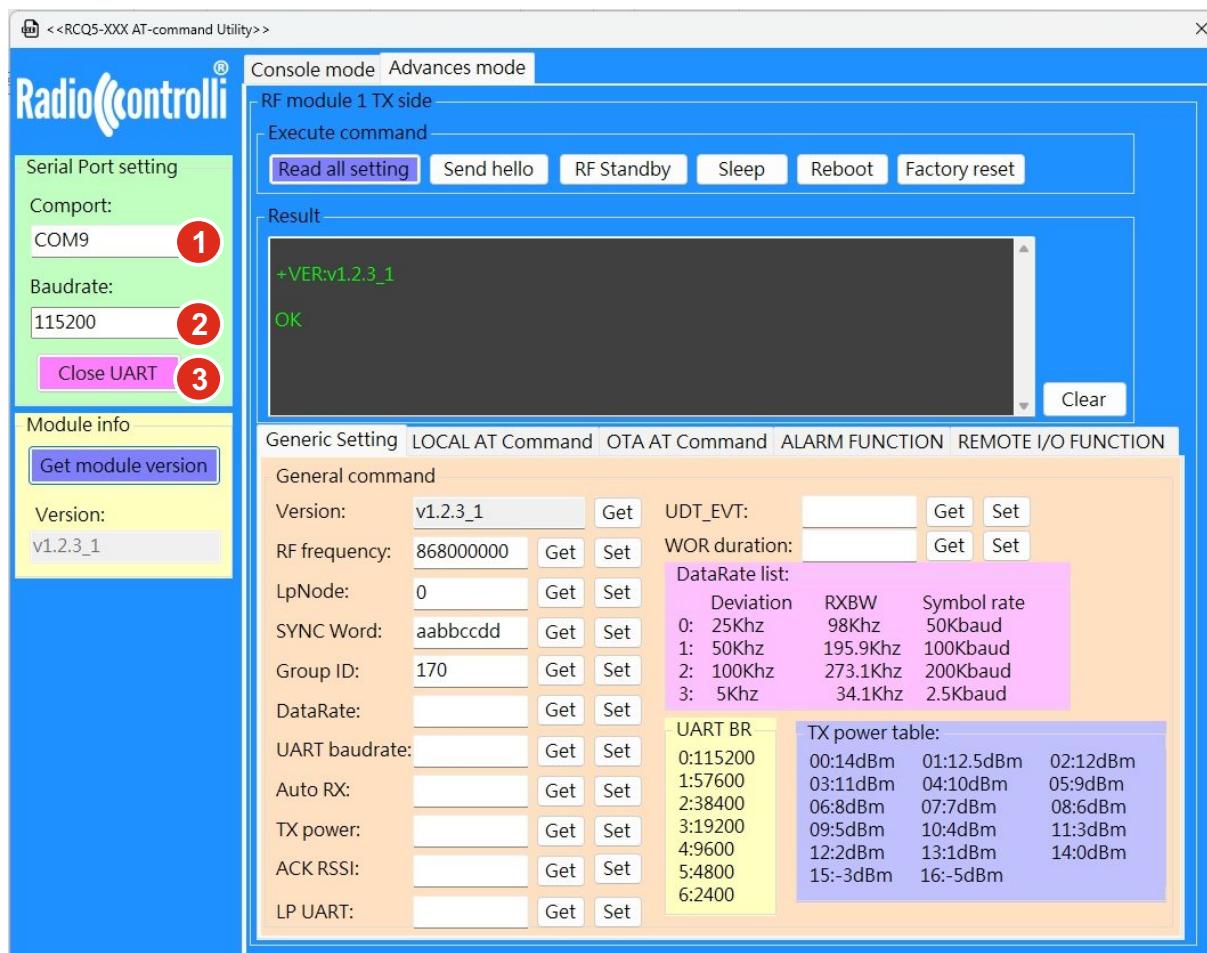
1 Entry the port number

2 Entry the baud rate default (115200)

3 Open serial port

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Setting radio parameters

1) It is possible to verify the single parameter through the «GET« command
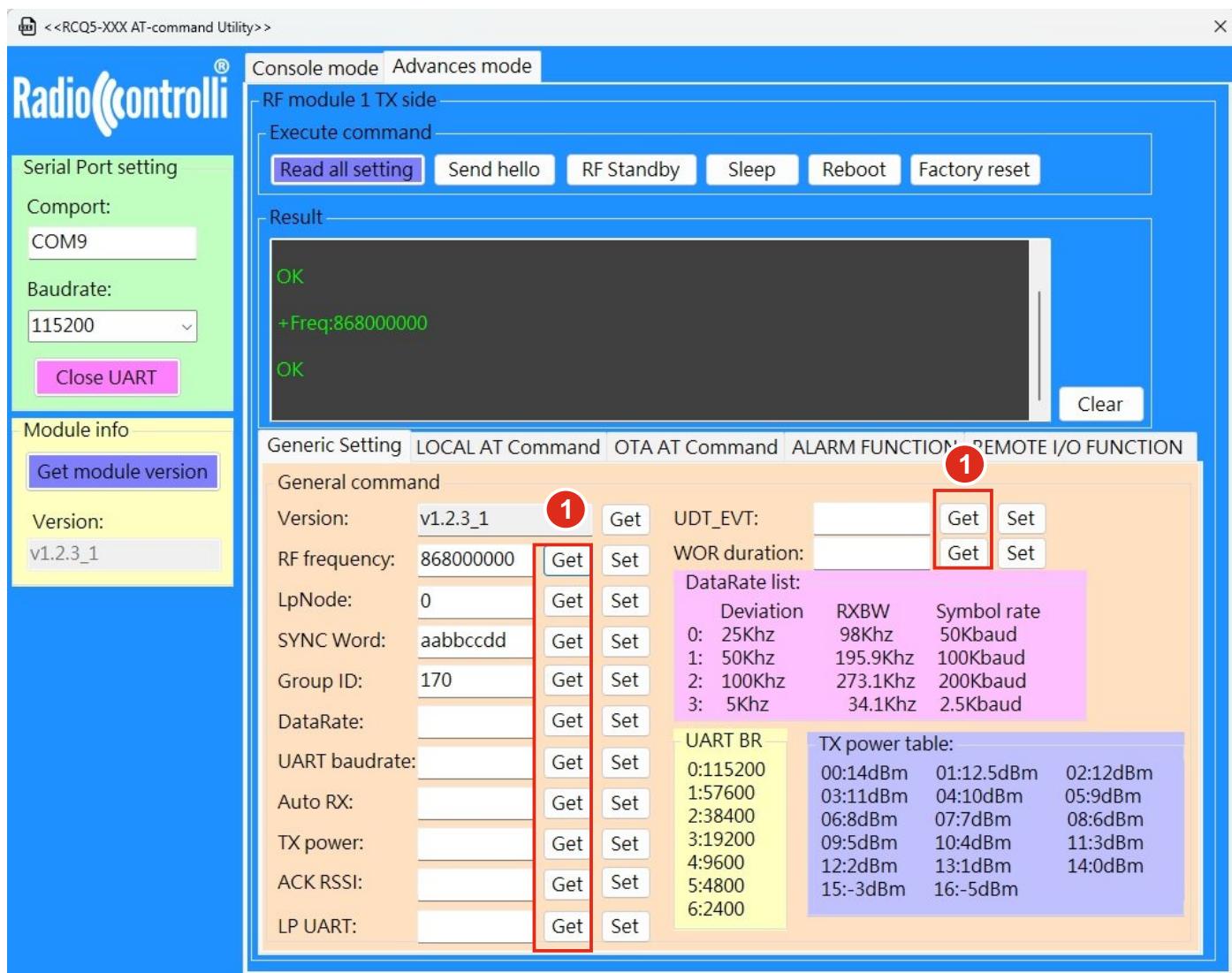
433MHz Default Setting

RF Frequency	433920000
DataRate	0 (25KHz 50Kbaud)
TX Power	+10dBm
LpNode	0
SYNC Word	aabbccdd
Group ID	170
UART Baudrate	0 (115200)
AutoRX	1
ACK RSSI	0
Lp UART	0
UDT_EVT	1
WOR_duration	1 (wake-up 500ms)

868MHz Default Setting

RF Frequency	868000000
DataRate	0 (25KHz 50Kbaud)
TX Power	+14dBm
LpNode	0
SYNC Word	aabbccdd
Group ID	170
UART Baudrate	0 (115200)
AutoRX	1
ACK RSSI	0
Lp UART	0
UDT_EVT	1
WOR_duration	1 (wake-up 500ms)

915MHz Default Setting

RF Frequency	915000000
DataRate	0 (25KHz 50Kbaud)
TX Power	+14dBm
LpNode	0
SYNC Word	aabbccdd
Group ID	170
UART Baudrate	0 (115200)
AutoRX	1
ACK RSSI	0
Lp UART	0
UDT_EVT	1
WOR_duration	1 (wake-up 500ms)

Quick Start : RADIO MODEM ==> First message sent

After all these sets, we are ready to send the first message :
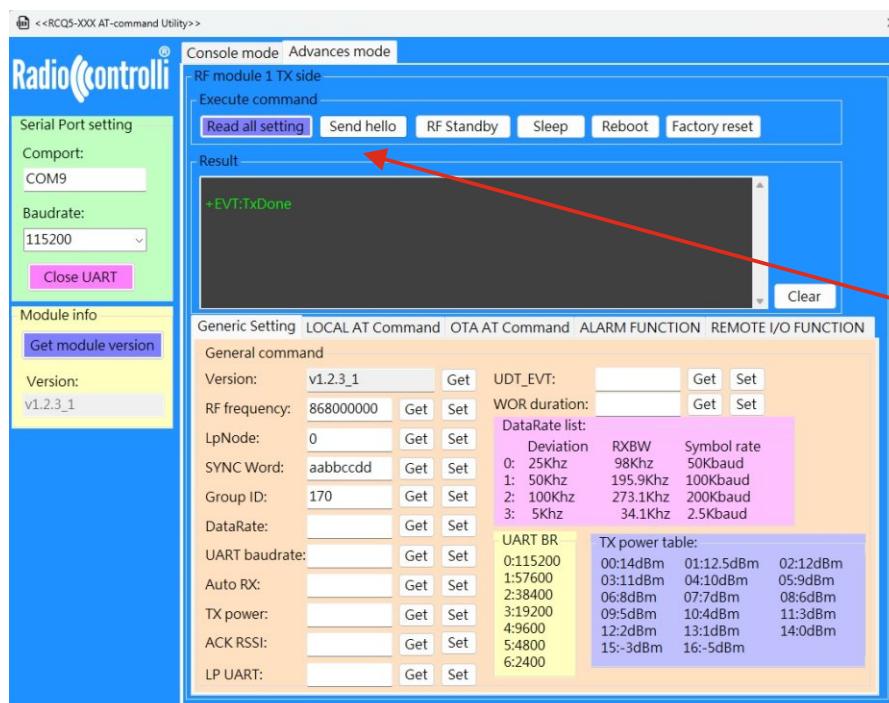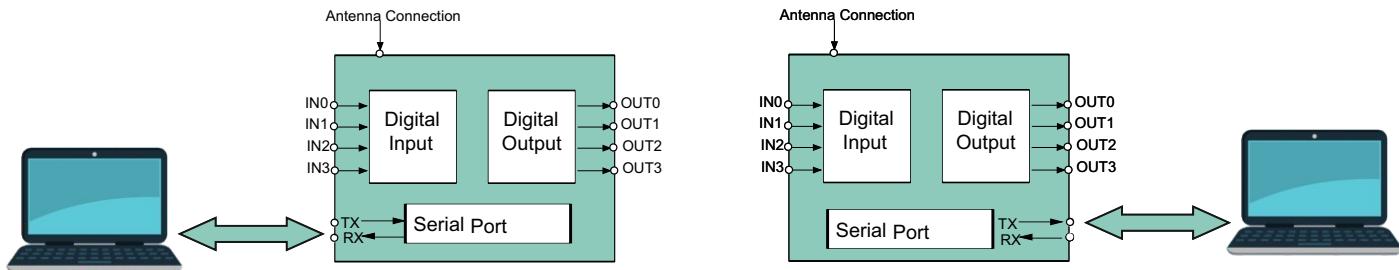
Transmission Station :

Push this button
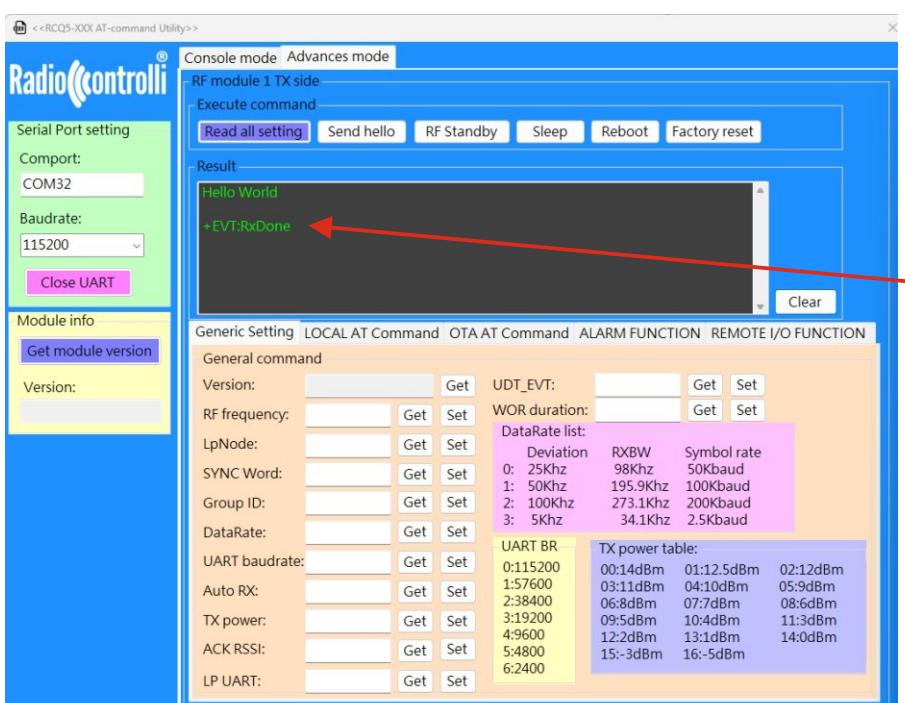
Receiving Station :

Message received

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RC-RCQ5-XXX

- *Radio Modem*
- *Over The Air Command*
- *Alarm Function*
- *Remote I/O Functionality*

Message Sent

Message Received from STATION-B

Message Sent
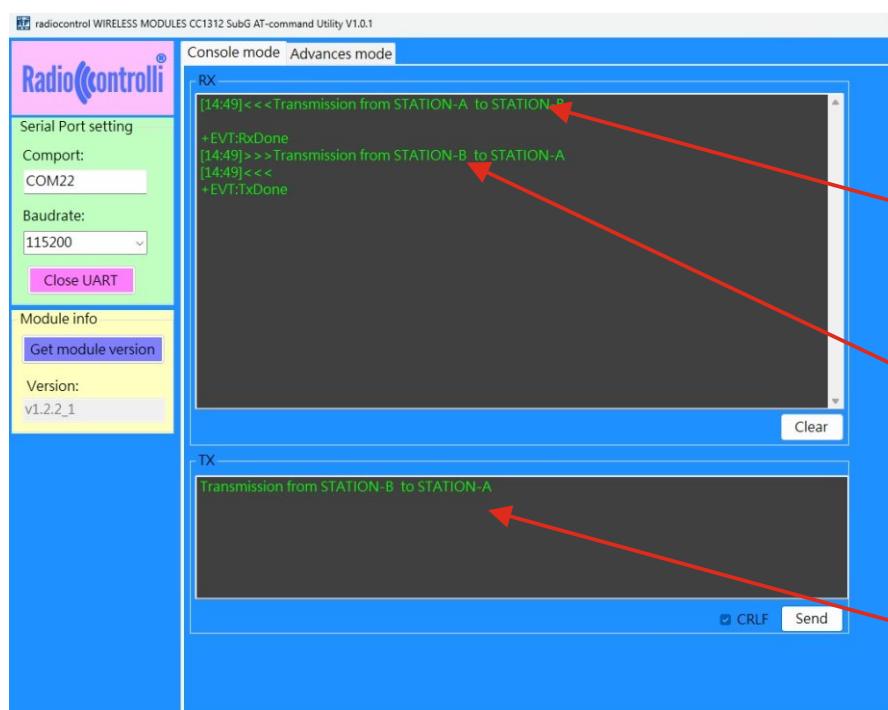
Message Received from STATION-A

Message Sent

Message Sent

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RC-RCQ5-XXX

- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

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WIRELESS MODULES

Quick Start : LOCAL AT COMMANDS

It is possible to :
- Set The Digital Output OUT0÷OUT3 to the desired logical state.
   AT+OUT1=1 with this command the OUT1 go to high level.
   AT+OUT1=0 with this command the OUT1 go to low level.

- Verify the logic state of the Digital Output OUT0÷OUT3
   AT+OUT1=? the value of the logical state of the OUT1 output will be returned.

- Verify the logic state of the Digital Input IN0÷IN3
   AT+RDIN1=?   the value of the logical state of the IN1 input will be returned.

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RC-RCQ5-XXX
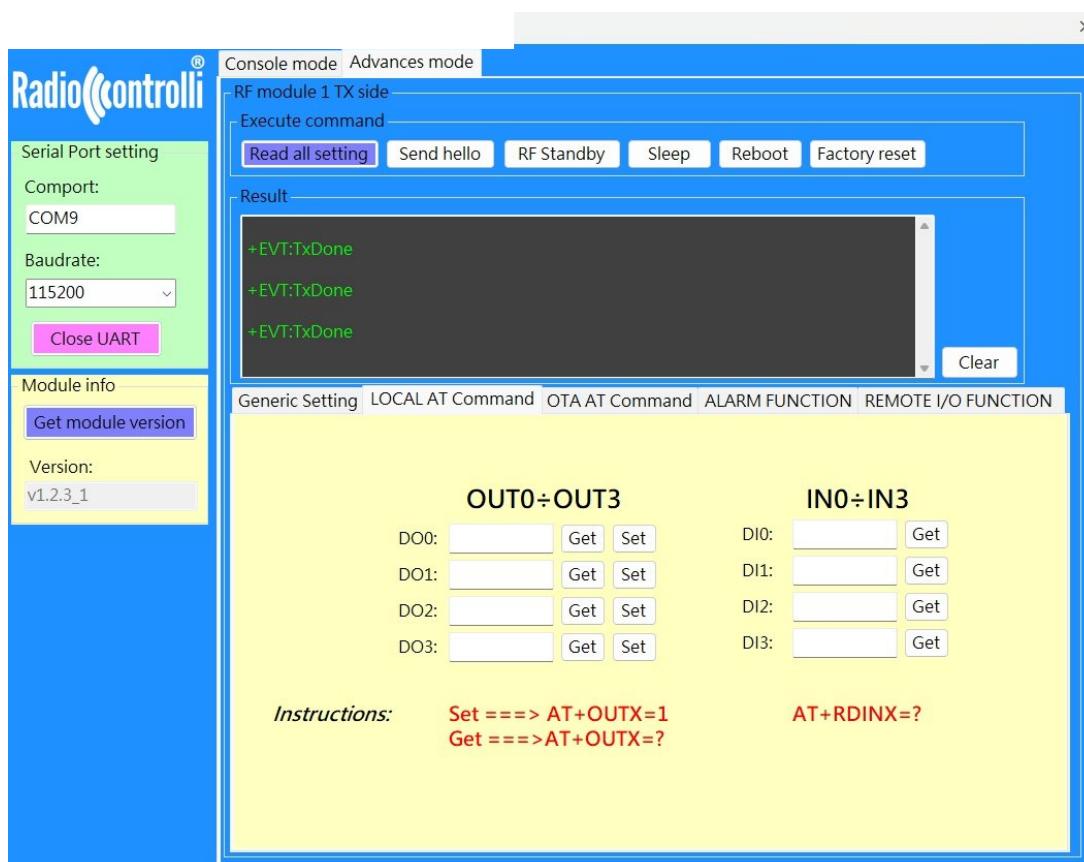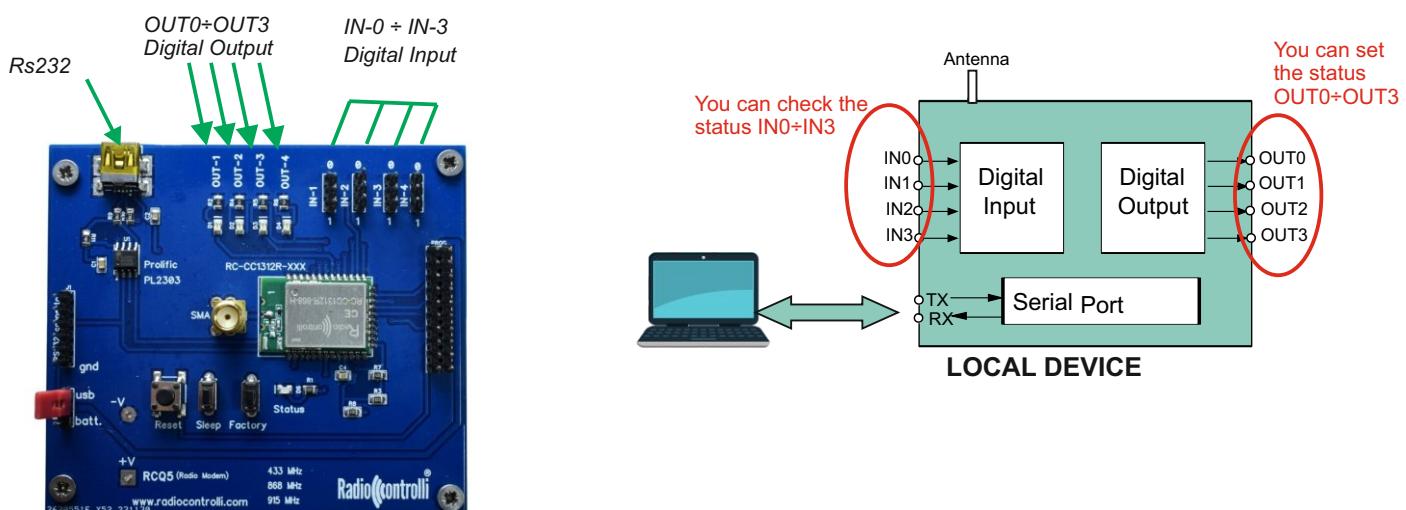
- Radio Modem
- Over The Air Command
- Alarm Function
- Remote I/O Functionality

Quick Start : OVER THE AIR (OTA) AT COMMANDS

It is possible to :
- Set The Digital Output OUT0÷OUT3 of the REMOTE DEVICE to the desired logical state.
    AT+OTA_OUT1=1 with this command the OUT1 of the REMOTE DEVICE go to high level.
    AT+OTA_OUT1=0 with this command the OUT1 of the REMOTE DEVICE go to low level.

- Verify the logic state of the Digital Output OUT0÷OUT3
    AT+OTA_OUT1=? the value of the logical state of the OUT1 output will be returned.

- Verify the logic state of the Digital Input IN0÷IN3
    AT+OTA_RDIN1=?   the value of the logical state of the IN1 input will be returned.

LOCAL DEVICE

REMOTE DEVICE

RadioControlli Application

OTA AT Command

Radio(((controlli ®

WIRELESS MODULES

Quick Start : ALARM FUNCTIONS

It is possible to Enable the ALARM FUNCTION for every Digital Input with the following AT command :

AT+DINX=1 with this command, when the digital input IN**X** DEVICE A IN0÷IN3) change
status a message will be transmitted via UART to the DEVICE B : Alarm_0_1
mean : The input IN0 has moved to logical level 1.
when this digital input come back to low level a message will be sent via UART :
Alarm_0_0

This is valid for all 4 digital input IN0÷IN3.

When an digital Input go to LOW LEVEL the message will be transmitted via UART to the REMOTE DEVICE.

IN0 -------> **Alarm_0_1**   IN1 ------------> **Alarm_1_1**   IN2 ----------> **Alarm_2_1**   IN3 ------> **Alarm_3_1**

If the digital Input change status from LOW LEVEL to HIGH LEVEL another message will be transmitted via UART to the REMOTE DEVICE :   **Alarm_X_0**


LOCAL DEVICE
Command sent AT+DIN»X»=
X = IN0÷IN3

REMOTE DEVICE

Alarm_X_1

Alarm_X_1

LOCAL DEVICE

REMOTE DEVICE
Command sent AT+DIN»X»=
X = IN0÷IN3

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WIRELESS MODULES

Quick Start : ALARM FUNCTIONS

Below the RadioControlli application to verify this functionality.
On the remote station the alarm had been enabled on IN0.

IN-0 CHANGE STATUS3

DEVICE A

DEVICE B
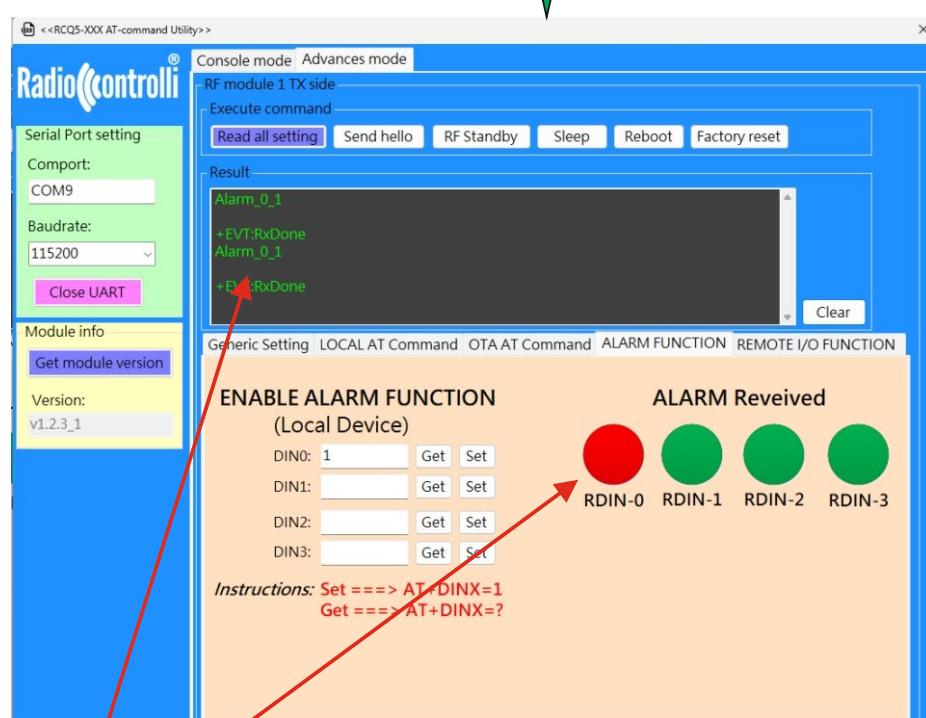
Alarm Received
mean that the digital input In0 of the remote station went to logical level 0

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Quick Start : REMOTE I/O FUNCTIONS

It is possible Turn ON and turn OFF the remote IO mirroring function.
When we enable the Remote I/O function, if any Digital Input is change on the Station A, the digital output of the remote Station B will also mirror these states at the same time.
The instruction to turn ON this functionality is : AT+RemoteIO=1
The instruction to turn OFF this functionality is : AT+RemoteIO=0

- Since this is two-way mirror, it is recommended to use point to point trasnmission.
- When the RemoteIO function is turned on, the AutoRx function will be automtically enabled.
- When the RemoteIO function is turned on, AT+OUTx and AT+DINx will be temporarily disabled.
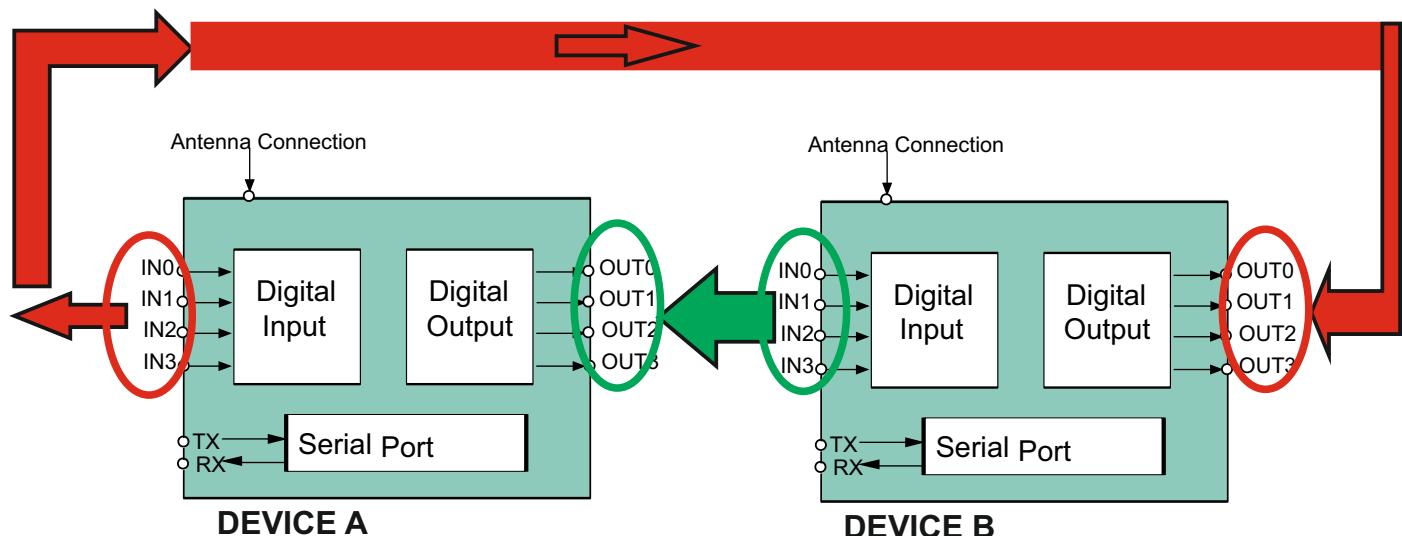
When this function is enabled :

The digital outputs of Station B will follow the states of the digital inputs of Station A in lockstep.
If the digital input INx (Station A) is at logical zero level then the digital output OUTx (Station B) will be at logical level 0, if the digital input INx (Station A) is at logical level 1 the output will also digital OUTx (station B) will be at logic level 1.

The digital outputs of Station A will follow the states of the digital inputs of Station B in lockstep.
If the digital input INx (Station B) is at logical zero level then the digital output OUTx (Station A) will be at logical level 0, if the digital input INx (Station B) is at logical level 1 the output will also digital OUTx (station A) will be at logic level 1.

Radiocontrolli s.r.l refuses any responsibility for irregular uses of the devices and for any possible lack or inaccuracy of the data and reserves the right to change in whole or in part these information without notice.

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Rev 2.2

RC-RCQ5-XXX

- *Radio Modem*
- *Over The Air Command*
- *Alarm Function*
- *Remote I/O Functionality*

Radio(((controlli®

WIRELESS MODULES

Quick Start : REMOTE I/O FUNCTIONS

IN-0=CLOSE=LOW LEVEL
IN-1=OPEN=HIGH LEVEL
IN-2=CLOSE=LOW LEVEL
IN-3=OPEN=HIGH LEVEL
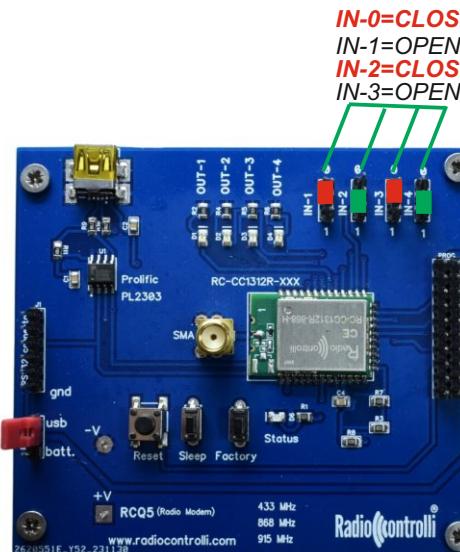
DEVICE A

OUT-0 = TURN ON = LOW LEVEL
OUT-1 = TURN OFF = HIGH LEVELL
OUT-2 = TURN ON = LOW LEVEL
OUT-3 = TURN OFF = HIGH LEVELL

DEVICE B

OUT-0 = TURN OFF = HIGH LEVELL
OUT-1 = TURN ON = LOW LEVEL
OUT-2 = TURN ON = LOW LEVEL
OUT-3 = TURN OFF = HIGH LEVELL

DEVICE A

IN-0=OPEN=HIGH LEVEL
IN-1=CLOSE=LOW LEVEL
IN-2=CLOSE=LOW LEVEL
IN-3=OPEN=HIGH LEVEL

DEVICE B

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