Radio Controlli
Wireless Modules

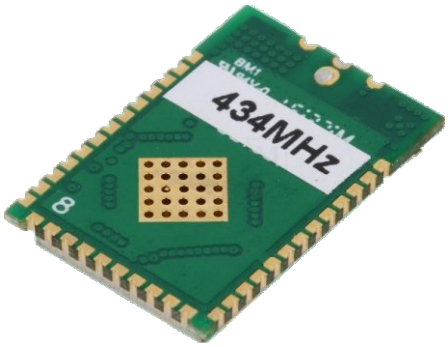
RCQ3-XXX-RM

based on RadioControlli RC-CC1310-XXX component.

- Multichannels Radio Modem

The device **RCQ3-XXX-RM** is based on the CC1310 device from Texas Instruments, and is available at three frequencies band : 433MHz - 868MHz and 915MHz.

Module informations :
RCQ3-434-RM this modem operates in the band from 430-435MHz.
RCQ3-868-RM this modem operates in the band from 866-870MHz.
RCQ3-915-RM this modem operates in the band from 912-917MHz.



The RF modem is very simple to use and provides a wireless RS232 link with a RF data rate of up to 50kbps. The transceivers have 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.
The RCQ3-XXX-RM can use any channel in 100 (200) KHz step.
Possible applications include one-to-one and multi-node wireless links in applications including security, EPOS, wireless sensor network, industrial process monitoring and computer networking.

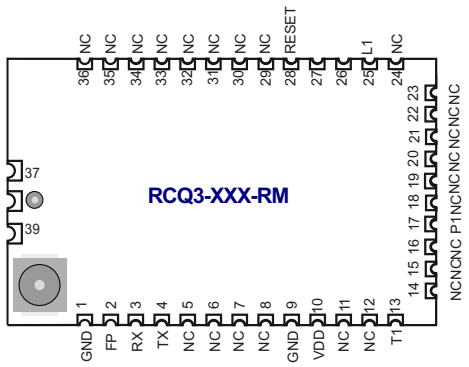
Applications :

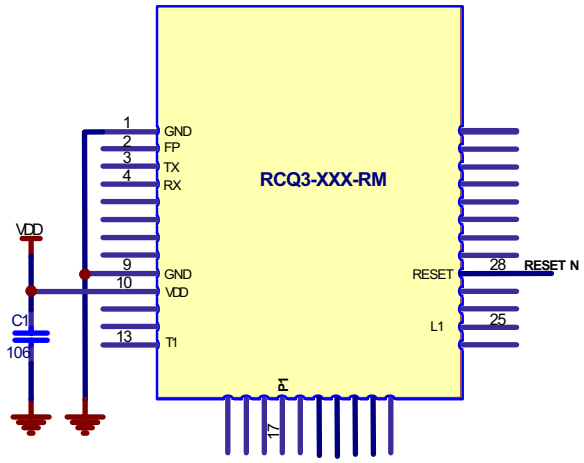
- *Wireless security systems*
- *Home and building automation*
- *Automatic Measure Reading*
- *Industrial Control and Monitoring*
- *Wireless Sensor Network*
- *EPOS Terminal*

Feature :

- *Radio Modems Application Inside*
- *Low consumption technology*
- *RF Data Rate up to 50Kbps*
- *RF Channel Selectable*
- *Serial Data Interface with Handshake*
- *Host Data Rate up to 115200 Baud*
- *Very Stable Operating Frequency*

1.0 Connection





Pin Descriptions			
Pin Number	Name	I/O	Description
1,9,37,39	GND	—	Ground
5,6,7,8,11,12,14 15,16,18,19,20 21,22,23,24,26, 27,29,30,31,32, 33,34,35,36	NC	—	No electrical connection
02	FP(*)	I	Flash Memory Protection. High = Write the data configuration in flash memory. Low = Flash memory write protected.
03	TX	U	UART TX (see example connection)
04	RX	U	UART RX (see example connection)
10	VDD	—	Supply Voltage
13	T1	I	Switch to generate the carrier
17	P1	I	Switch for Test Mode
25	L1	I	Led test Mode
28	RESET	I	Reset (Active low, no internal pullup)

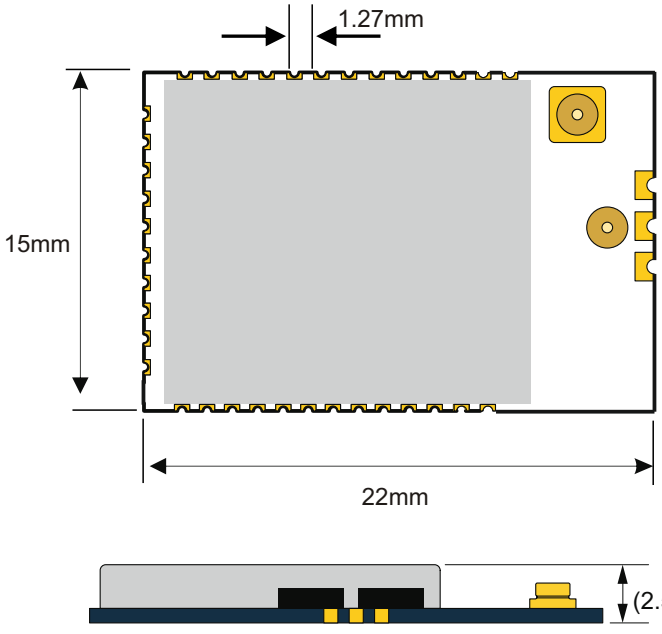
(*) this functionality is active after an HW RESET

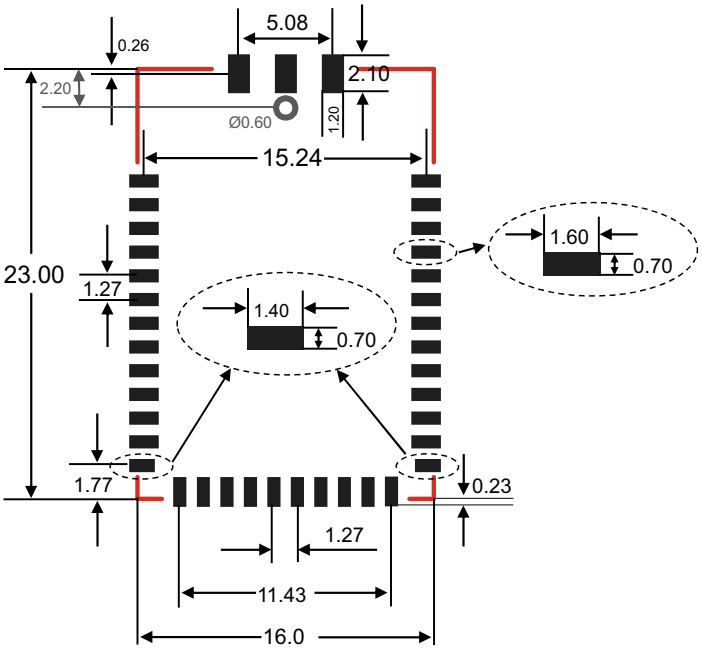
Note:

FP must be always at (0) LOW = flash memory protect.

Set FP to (1) HIGH only for the time necessary to modify the radio parameters, then bring FP back to (0) LOW.

2.0 Dimensioni Meccaniche





Recommended PCB Layout

3.0 Specifiche Tecniche

RCQ3-434-RM RCQ3-868-RM RCQ3-915-RM					
Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Voltage	V_{CC}	1.8	3.00	3.6	VDC
Supply Current RX Mode	I_{CRX}		5.50		mA
Supply Current TX Mode +10dBm	I_{CTX1}		13.40		mA
Supply Current TX Mode +14dBm	I_{CTX2}		23.50		mA
Supply Current Standby Mode	I_{CTXAV}		0.70		µA
Supply Current Shut Down Mode	I_{CTXAV1}		185		nA
Operative Frequency 433MHz Version (*)	F_{of}	430.00		435.00	MHz
Operative Frequency 868MHz Version(*)	F_{of}	865.00		870.00	MHz
Operative Frequency 915MHz Version (*)	F_{of}	912.00		917.00	MHz
Frequency Error	F_{pp}		±10		ppm
RF Power Output 50ohm (*)	P_{oo}	-10.0		+14.0	dBm
RF Sensibility (Long Range Mode 2.5kbps)	S_d		-122.0		dBm
Data Rate	D_{CC}			4.0	Mbit/s
Operative Temperature	T_1	-30.0		+75.0	°C

(*) Programmable parameter.

4.0 Multichannels Radio Modem Functionality

The RCQ3-XXX-RM Radio Modem has applications in many areas where reliable half duplex communications are required over ranges up to 200 meters (with the maximum RF Power is possible to reach up to 400-500meters).
The crystal controlled narrow band design, in the embedded RCQ3-XXX-RM device, gives reliable performance within the sub 1GHz band.
The addressing protocol employed enables many different configurations such including:

one-to-one operation: for point to point data communication;

broadcast operation: where a single master address many RCQ3-XXX-RM modules concurrently (using many RCQ3-XXX-RM modules set to the same address);

one-to-many: a network consisting a master and many slaves (the receivers all have the same address)

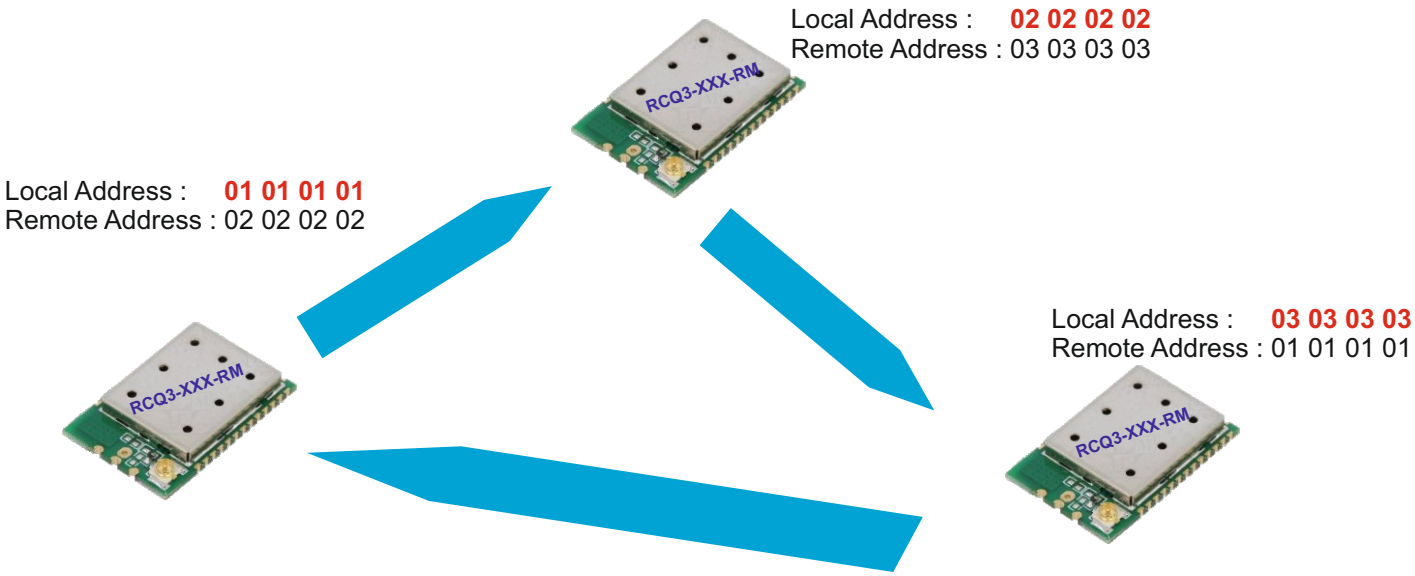
many-to-one: where the transmitters all send to a single receiver address

Since each RCQ3-XXX-RM can contain a unique address, multiple RCQ3-XXX-RM network can co-exist in the same area.
Each Radio Modem (RCQ3-XXX-RM) is pre-configured with a default address «7E 7E 7E 7E», this address can be modified during the configuration.

When the RCQ3-XXX-RM receive the data via RF, the first operation that make is the check the address header and compare it with its address, only if the two addresses coincide it processes the data and output them on the serial interface otherwise all the data are discarded.

When the RCQ3-XXX-RM sending data has a default remote address «7E 7E 7E 7E» this address can be modified during the configuration.

If the addresses are set appropriately, a network can be created.



5.0 Long Range Mode Functionality

The Radio Modem RCQ3-XXX-RM is based on the CC1310 device from Texas Instrument.
This device can be work also in Long Range Mode (LRM) that is a particulary encoding technique that trades data rate for sensitivity gains. These gains are achieved by digital coding.
For more information you can consult this document : **http://www.ti.com/lit/an/swra642/swra642.pdf**

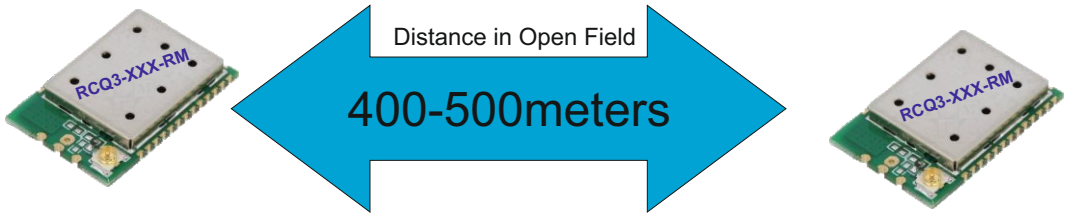
When aiming at lower sensitivity values, you have the option of reducing the symbol rates transmitted over the air. Reducing the symbol rate normally implies a lower signal bandwidth.

This application can be work in two modality :

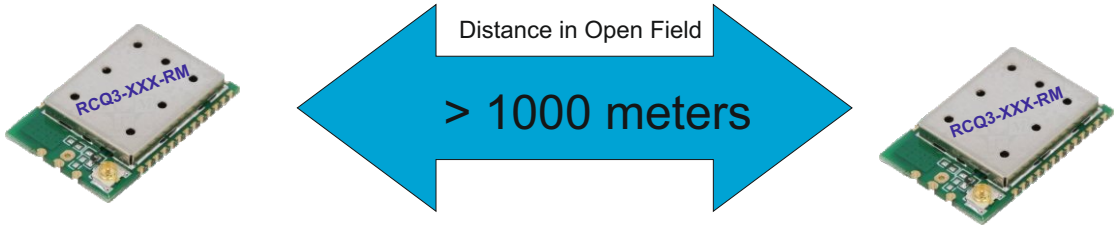
Mode	Parameters	Value
STANDARD MODE	Data Rate	50 kbps
	Modulation	2-GFSK
	Deviation	25KHz
	Frequency Channels	Programmable see table sheet 7
	RF Power Output	Programmable see table sheet 7
LONG RANGE MODE	Data Rate	2.5 kbps
	Modulation	2-GFSK
	Deviation	5KHz
	Frequency Channels	Programmable see table sheet 7
	RF Power Output	Programmable see table sheet 7

To operate the device in LRM (Long Range Mode) uses the command ^ L see pages 11.

STANDARD MODE

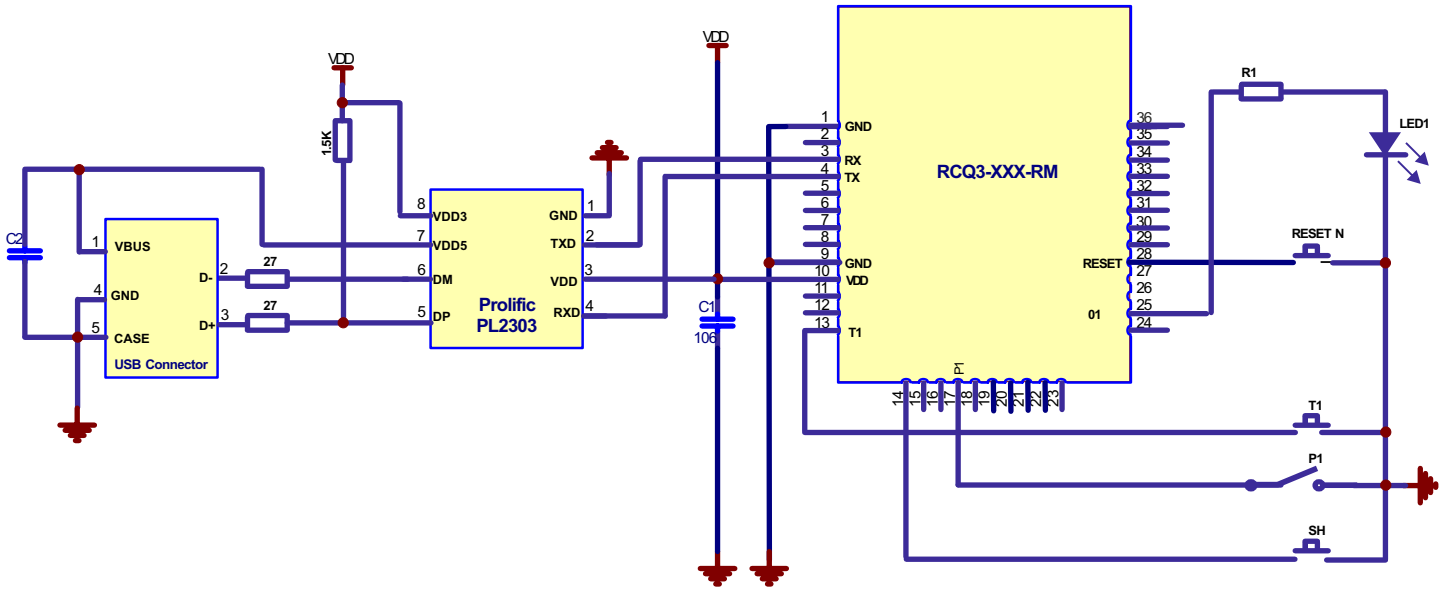


LONG RANGE MODE



6.0 Application

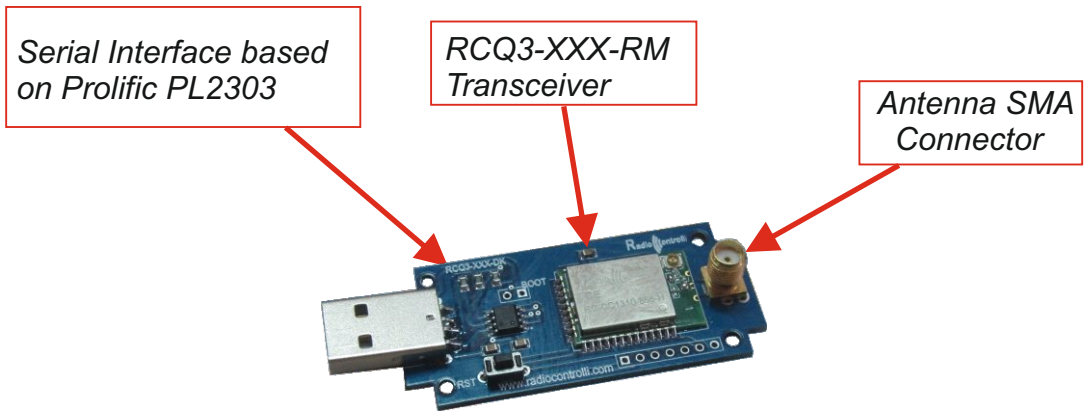
Application Notes



Serial Connection using (PL2303 Prolific) example.

P1 = Switch P1 (pin 17 to GND) to entry in TEST MODE (in TEST MODE the LED1 will light up)

when the device is in TEST MODE you can use Push T1 button (pin 13 to GND) with this operation the carrier with frequency and amplitude value previously set will be present on the antenna.



7.0 Configuration Mode

7.1 Register value 868MHz version

Ï ÑÝÒÐÉÑÓ	Byte	Name	Description	Text Value	HEX Value
01	0	Remote Address	MSB	~	7E
	1			~	7E
	2			~	7E
	3		LSB	~	7E
02	4	Local Address	MSB	~	7E
	5			~	7E
	6			~	7E
	7		LSB	~	7E
03	8	RF CHANNELS	865.0 MHz	2	32
			865.2MHz	4	34
			865.4MHz	6	36
			865.6MHz	8	38
			865.8MHz	:	3A
			866.0 MHz	<	3C
			866.2MHz	>	3E
			866.4MHz	@	40
			866.6MHz	B	42
			866.8MHz	D	44
			867.0MHz	F	46
			867.3MHz	H	48
			867.4MHz	J	4A
			867.6MHz	L	4C
			867.8MHz	N	4E
			868.0 MHz	P	50
			868.2 MHz	R	52
			868.4 MHz	T	54
			868.6 MHz	V	56
			868.8 MHz	X	58
			869.0 MHz	Z	5A
			869.2 MHz	\	5C
			869.4 MHz	^	5E
			869.6 MHz	<	60
			869.8 MHz	b	62
			870,0 MHz	d	64
04	9	RF TX POWER	0 dBm	0	30
			2 dBm	2	32
			4 dBm	4	34
			6 dBm	6	36
			8 dBm	8	38
			10 dBm	:	3A
			12 dBm	<	3C
			14 dBm	>	3E

In **RED color** the default parameters

Register 01 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 02 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 03 - RF CHANNELS

Value Range : **32** - **64**
Default Value : **50**

The **RF Channel is calculated** in the following mode:

FREQ = 860 + (ASCII code / 10) + (Rest division / 10)
for example to character «R» (HEX 52) corresponds to the frequency 868.2 Mhz because :

«R» Ascii Code = 82 ---> Frequency = 860 + int(82/10)

Result + rest division (82/10) = 860+8+0.2 = 868.2

Register 04 - RF TX POWER

Value Range : **30** - **3E**
Default Value : **3A**

The **Power value is calculated** in the following mode :

Power = Ascii code - 48
For example to the character «7» (HEX 37) correspond the value 7dBm because :
«7» Ascii code = 55 -----> Power = 55 - 48 = 7

Nota :
The configuration operations must be carried out when the module is powered by a voltage greater than 2.5Volt and pin 2 (FP) is in 1 (High) condition, when FP is at level logical 0 (Low) the flash memory is write protected. After carrying out the configuration operations, return pin 2 FP to logic level 0 to protect the flash memory.

7.2 Register value 433MHz version

Ï ÑÝÒÈÑ	Byte	Name	Description	Text Value	HEX Value
01	0	Remote Address	MSB	~	7E
	1			~	7E
	2			~	7E
	3		LSB	~	7E
02	4	Local Address	MSB	~	7E
	5			~	7E
	6			~	7E
	7		LSB	~	7E
03	8	RF CHANNELS	430.0MHz	2	32
			430.2MHz	4	34
			430.4MHz	6	36
			430.6MHz	8	38
			430.8MHz	:	3A
			431.0MHz	<	3C
			431.2MHz	>	3E
			431.4MHz	@	40
			431.6MHz	B	42
			431.8MHz	D	44
			432.0MHz	F	46
			432.2MHz	H	48
			432.4MHz	J	4A
			432.6MHz	L	4C
			432.8MHz	N	4E
			433.0MHz	P	50
			433.2MHz	R	52
			433.4MHz	T	54
			433.6MHz	V	56
			433.8MHz	X	58
			434.0MHz	Z	5A
			434.2MHz	\	5C
			434.4MHz	^	5E
			434.6MHz	<	60
			434.8MHz	b	62
			435.0MHz	d	64
04	9	RF TX POWER	0 dBm	0	30
			2 dBm	2	32
			4 dBm	4	34
			6 dBm	6	36
			8 dBm	8	38
			10 dBm	:	3A
			12 dBm	<	3C
			14 dBm	>	3E

In **RED color** the default parameters

Register 01 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 02 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 03 - RF CHANNELS

Value Range : **32** - **64**
Default Value : **50**

The **RF Channel is calculated** in the following mode:

FREQ = 425 + (ASCII code / 10) + (Rest division / 10)
for example to character «R» (HEX 52) corresponds to the frequency 433.2MHz because :

«R» Ascii Code = 82 ---> Frequency = 425+ int(82/10)

Result + rest division (82/10) = 425+8+0.2 = 433.2

Register 04 - RF TX POWER

Value Range : **30** - **3E**
Default Value : **3A**

The **Power value is calculated** in the following mode :

Power = Ascii code - 48
For example to the character «7» (HEX 37) correspond the value 7dBm because :
«7» Ascii code = 55 -----> Power = 55 - 48 = 7

Nota :
The configuration operations must be carried out when the module is powered by a voltage greater than 2.5Volt and pin 2 (FP) is in 1 (High) condition, when FP is at level logical 0 (Low) the flash memory is write protected. After carrying out the configuration operations, return pin 2 FP to logic level 0 to protect the flash memory.

7.3 Register value 915MHz version

Index	Byte	Name	Description	Text Value	HEX Value
01	0	Remote Address	MSB	~	7E
	1			~	7E
	2			~	7E
	3		LSB	~	7E
02	4	Local Address	MSB	~	7E
	5			~	7E
	6			~	7E
	7		LSB	~	7E
03	8	RF CHANNELS	912.0MHz	2	32
			912.2MHz	4	34
			912.4MHz	6	36
			912.6MHz	8	38
			912.8MHz	:	3A
			913.0MHz	<	3C
			913.2MHz	>	3E
			913.4MHz	@	40
			913.6MHz	B	42
			913.8MHz	D	44
			914.0MHz	F	46
			914.2MHz	H	48
			914.4MHz	J	4A
			914.6MHz	L	4C
			914.8MHz	N	4E
			915.0MHz	P	50
			915.2MHz	R	52
			915.4MHz	T	54
			915.6MHz	V	56
			915.8MHz	X	58
			916.0MHz	Z	5A
			916.2MHz	\	5C
			916.4MHz	^	5E
			916.6MHz	<	60
			916.8MHz	b	62
			917.0MHz	d	64
04	9	RF TX POWER	0 dBm	0	30
			2 dBm	2	32
			4 dBm	4	34
			6 dBm	6	36
			8 dBm	8	38
			10 dBm	:	3A
			12 dBm	<	3C
			14 dBm	>	3E

In **RED color** the default parameters

Register 01 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 02 - Remote Address

Value Range : 01010101 - **FEFEFEFE**
Default Value : **7E7E7E7E**

Register 03 - RF CHANNELS

Value Range : **32** - **64**
Default Value : **50**

The **RF Channel is calculated** in the following mode:

FREQ = 907+ (ASCII code / 10) + (Rest division / 10)
for example to character «R» (HEX 52) corresponds to the frequency 915.2MHz because :

«R» Ascii Code = 82 ---> Frequency = 907+ int(82/10)

Result + rest division (82/10) = 907+8+0.2 = 915.2

Register 04 - RF TX POWER

Value Range : **30** - **3E**
Default Value : **3A**

The **Power value is calculated** in the following mode :

Power = Ascii code - 48
For example to the character «7» (HEX 37) correspond the value 7dBm because :
«7» Ascii code = 55 -----> Power = 55 - 48 = 7

Nota :
The configuration operations must be carried out when the module is powered by a voltage greater than 2.5Volt and pin 2 (FP) is in 1 (High) condition, when FP is at level logical 0 (Low) the flash memory is write protected. After carrying out the configuration operations, return pin 2 FP to logic level 0 to protect the flash memory.

7.5 Configuration Check (Test Procedure)

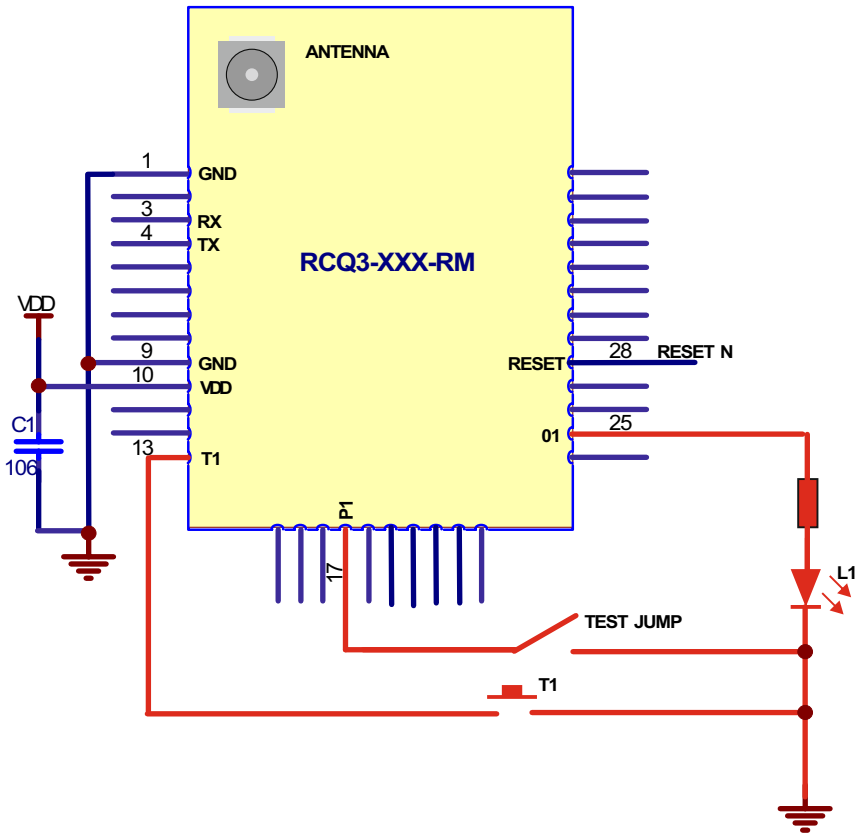
It is possible to entry in Test Mode with the following procedure :

1) Close the TEST JUMP

2) The L1 will turn ON

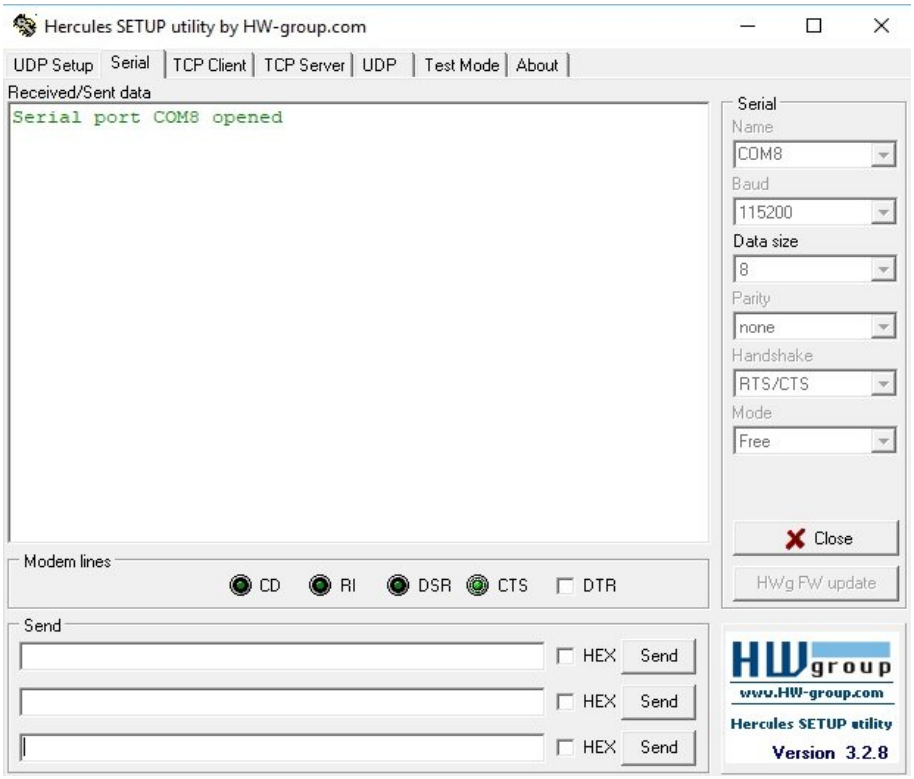
3) Push T1 button.

With this operation the carrier with frequency and amplitude value previously set (see previous paragraphs) will be available on the antenna connector (UFL).



This procedure can be performed using the evaluation board described subsequently.
The radio signal will be present on the SMA connector

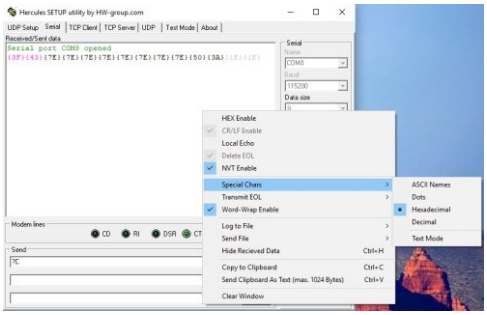
7.5 Example of Configuration

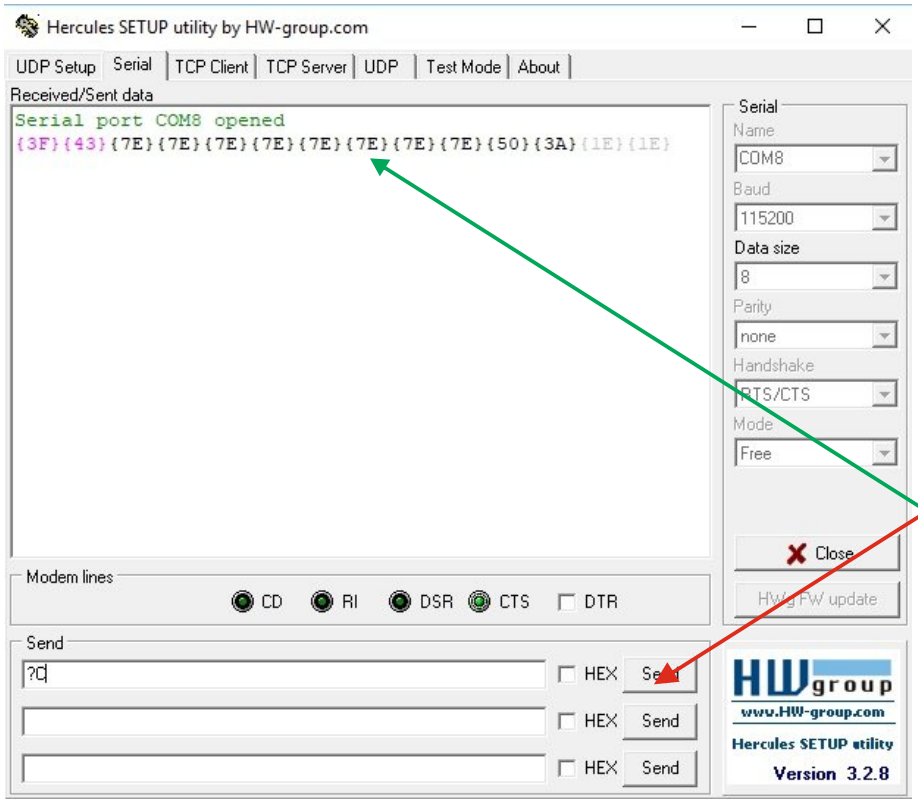


Software used : Hercules SETUP utility (free use)

Open the serial port with this parameters

Set the Hercules software to receive hexadecimal character (press the right mouse button) and :
- In the Special Chars menù choise HEX after
- Choice HEX Enable

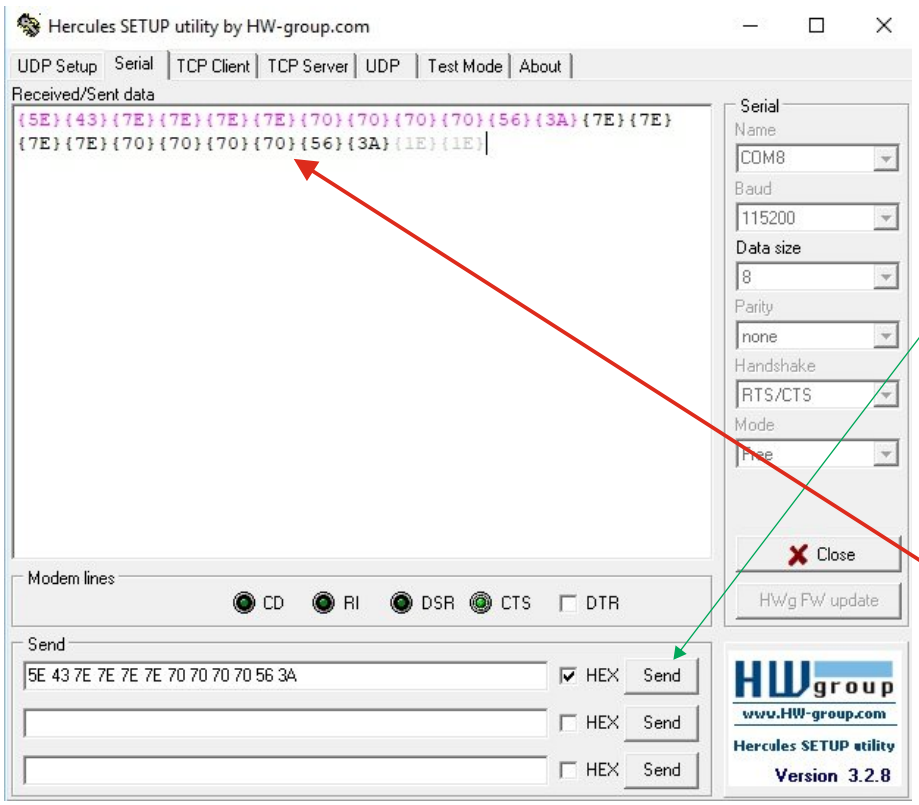




Push this button, in this mode the string “?C” is transmitted (request of configuration)

The module responds by sending the default configuration parameters
7E 7E 7E 7E 7E 7E 7E 7E 50 3A

Remote Address
Local Address
Frequency Channels
RF Power



Push this button, in this mode we sent the new Configuration String 7E 7E 7E 7E **70 70 70 70 56** 3A (hexadecimal string)
We have changed the parameters in red :

70 70 70 70 Local address

56 Frequency = 868.6MHz
(RCQ3-868-RM version)

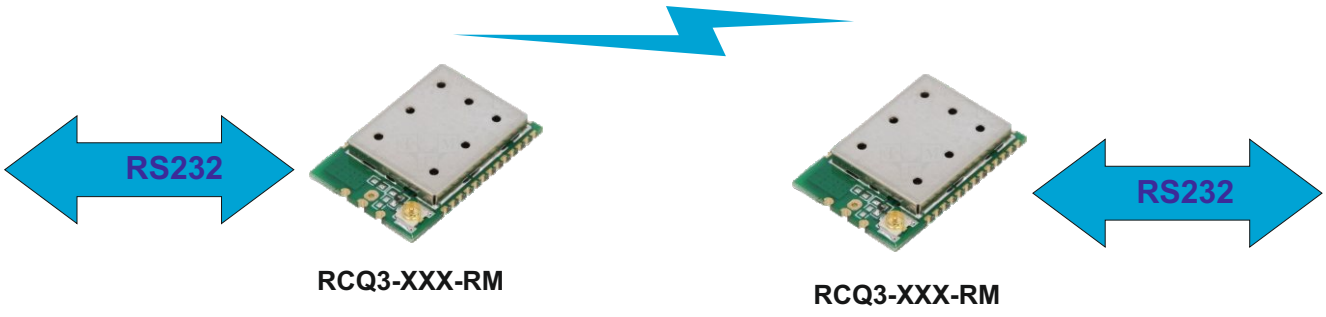
The module answer with the new configurazion :
7E 7E 7E 7E **70 70 70 70 56** 3A

These operation can be done also in Text Mode instead that in Hex Mode, in this case the default string is :
«**~~~~~~~~P:**» (7E 7E 7E 7E 7E 7E 7E 7E 50 3A
To modify is necessary send the following text string «**3C~~~~ppppV:**» (53 43 7E 7E 7E 7E 70 70 70 70 56 3A)

8.0 Example of Operation Mode (One to One)

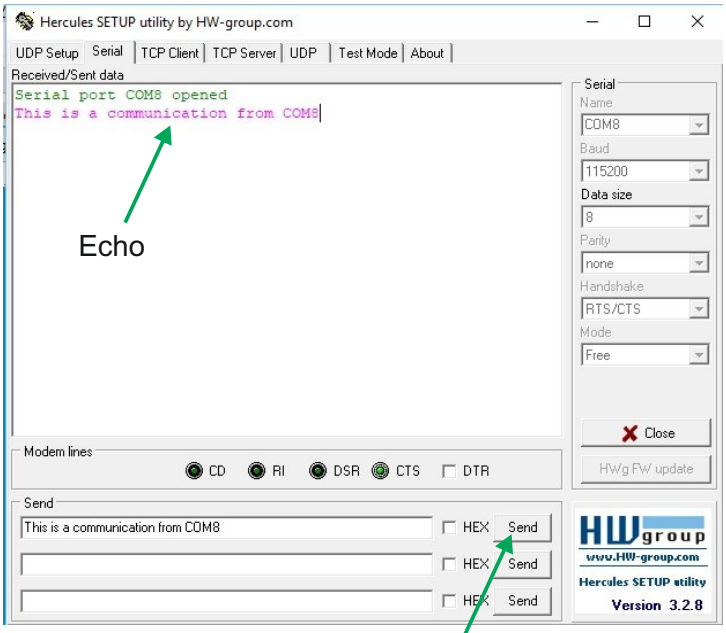
This example is performed according to the following schematics and using the software Hercules SETUP utility (free use).
The maximum length of the single packet that can be transmitted is 25byte.

On Air 400-500meter in open field STANDARD MODE)
> 1Km in open field LONG RANGE MODE **LRM**

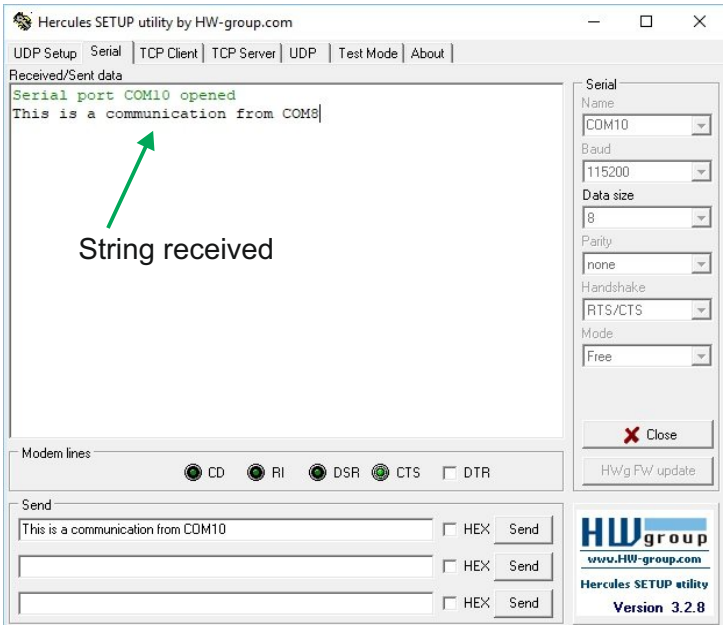


RCQ3-XXX-RM **RCQ3-XXX-RM**

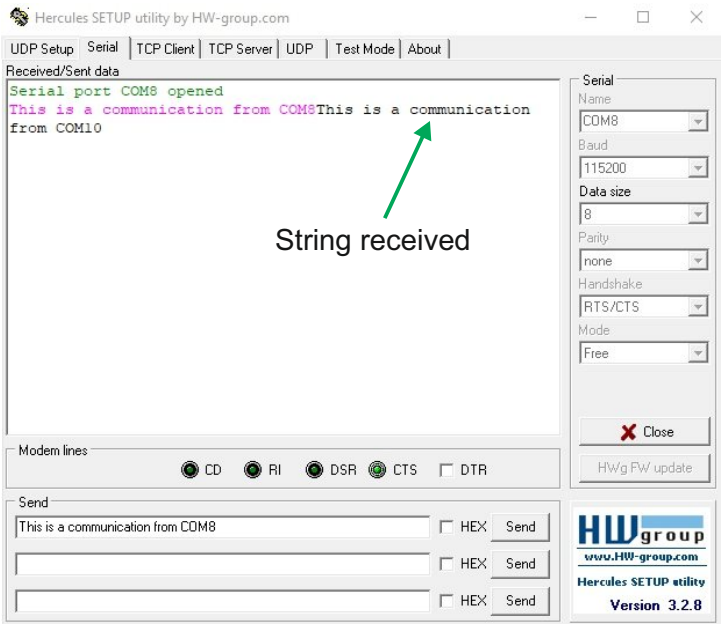
Serial Port COM8

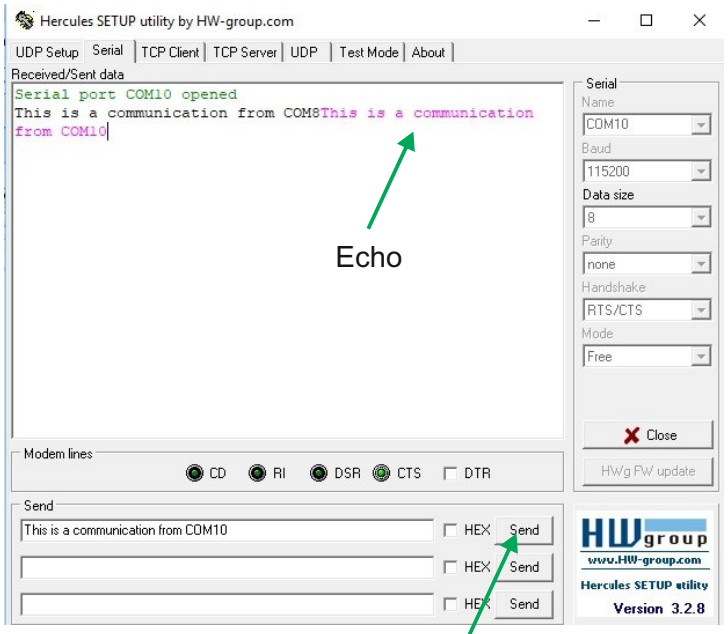


Serial Port COM10



Push this button, in this mode we sent the following string "This is a communication from COM8"

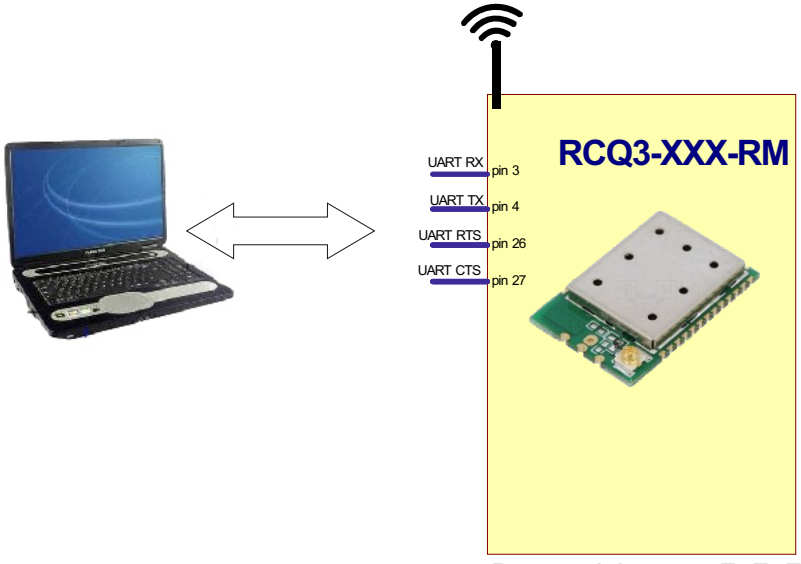




Push this button, in this mode
we sent the following string
"This is a communication from COM10"

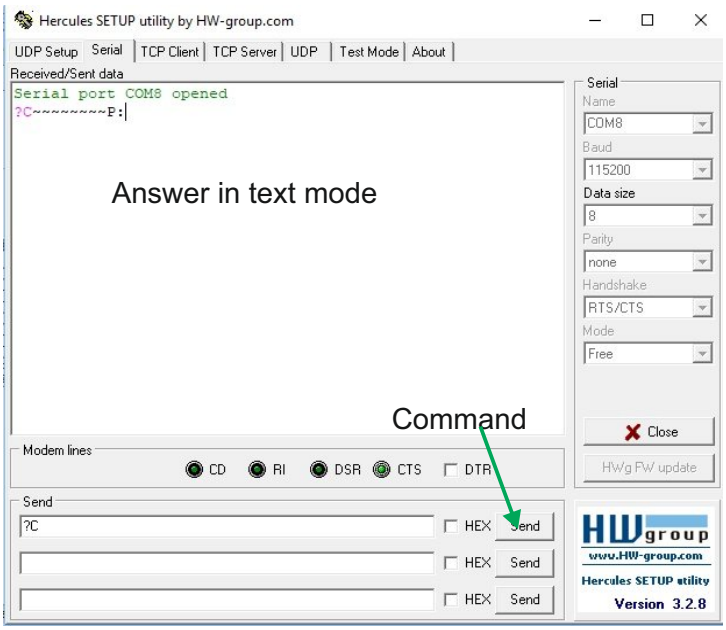
9.0 Local List Command

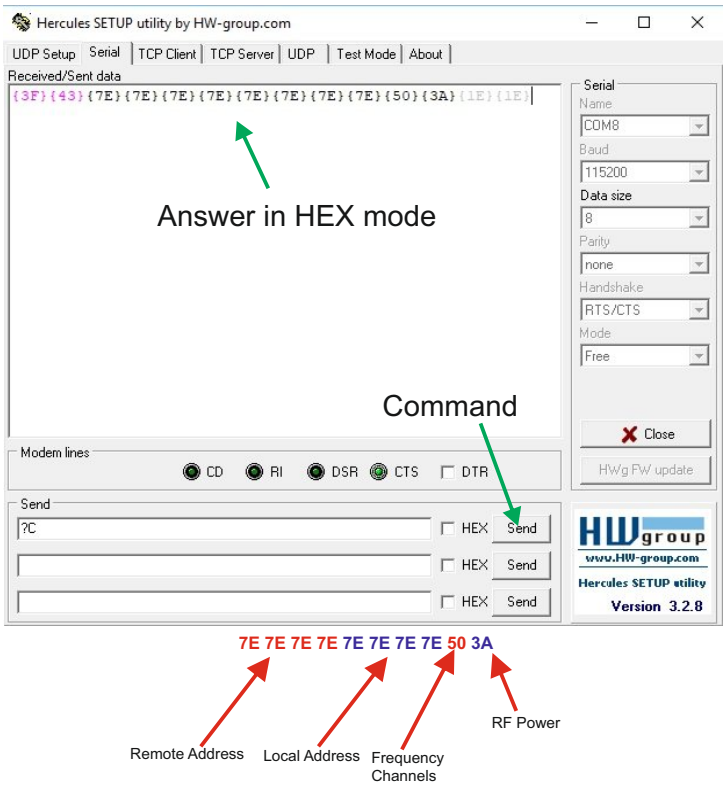
	Local Command	Description	Example
1	?C	Returns the configuration parameters : 1) Remote Address, 2) Local Address, 3) Frequency, 4) Power Value	see par. 9.1
2	?T	Returns the temperature value (°C)	see par.9.2
3	?B	Returns the value of battery (Volt)	see par. 9.2
4	?V	Return the local Fw version	see par. 9.3
5	?BR	Return the local UART Baud Rate	see par. 9.3
6	?S	Returns the general information	see par. 9.4
7	^C+CONF	Allows to modify the configuration of the module example : ^C~~~~~~~~~T2 (text) or 5E 43 7E 7E 7E 7E 7E 7E 7E 7E 54 32 (Hex)	see par. 9.5
8	^B+BAUDRATE	Value accepted : 115200,57600,38400,19200,9600,4800,2400,1200 Example : ^B115200 . After this command you must reset the device.	see par. 9.6
9	^L0	The device go in Long Range Mode LRM	see par. 9.7
10	^L1	The device go in standard Mode	see par. 9.8



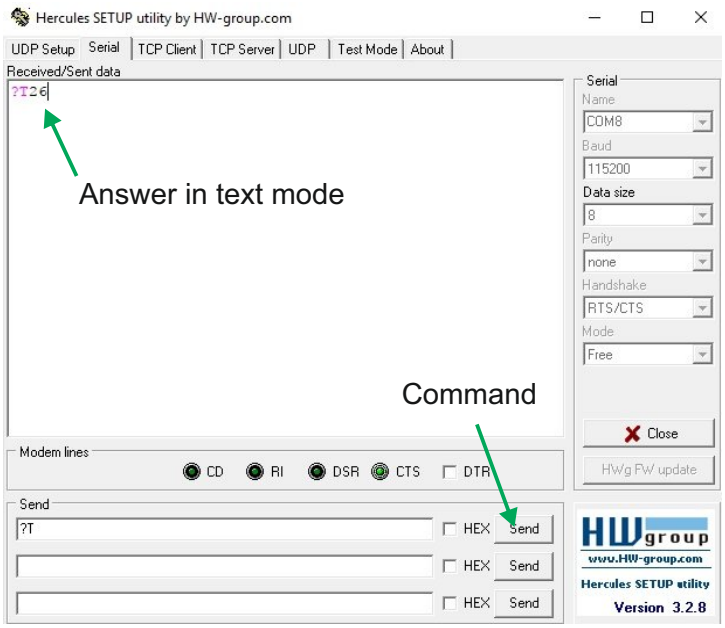
Remote Adress = 7E7E7E7E
Local Address = 7E7E7E7E

9.1 «?C» Command

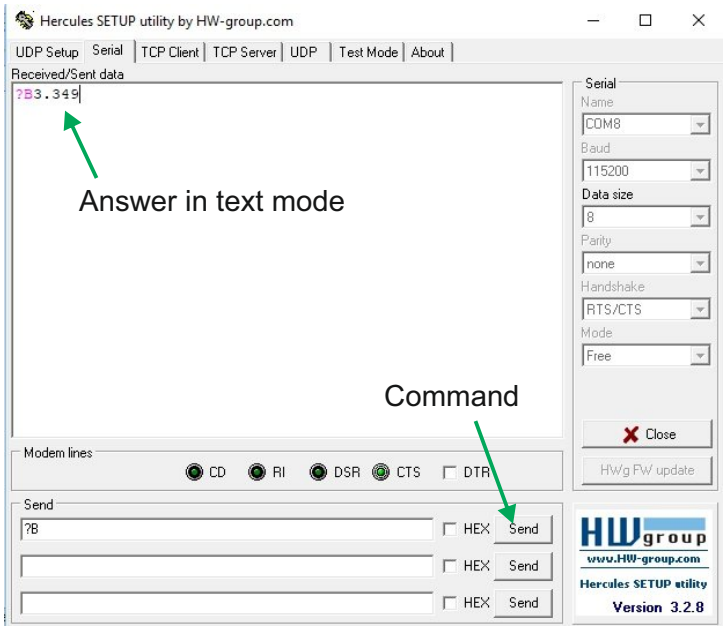




9.2 «?T» and «?B» Command

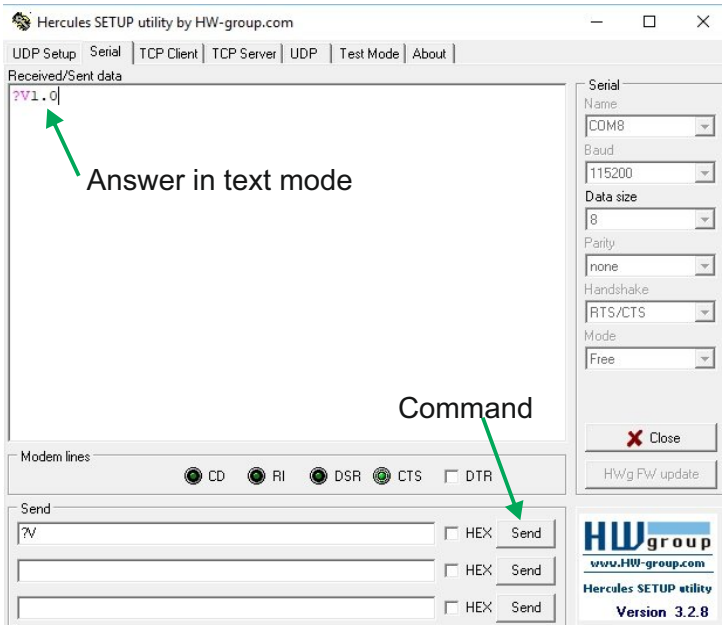


Return the value in °C.

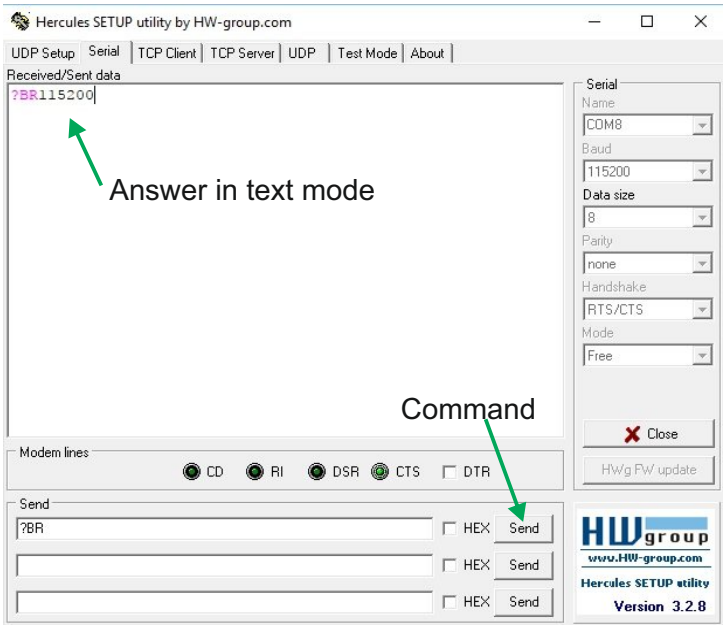


Return the value in Volt.

9.3 «?V» and «?BR» Command

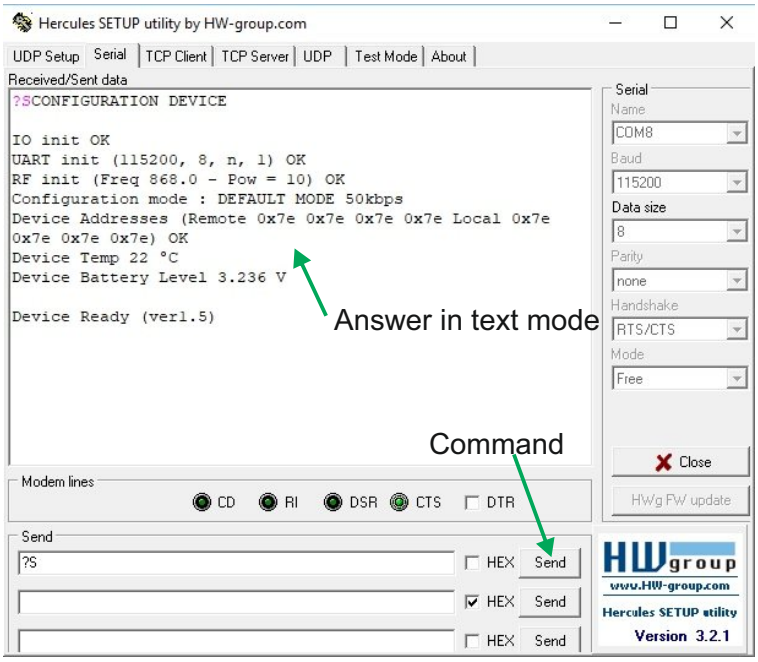


Firmware version



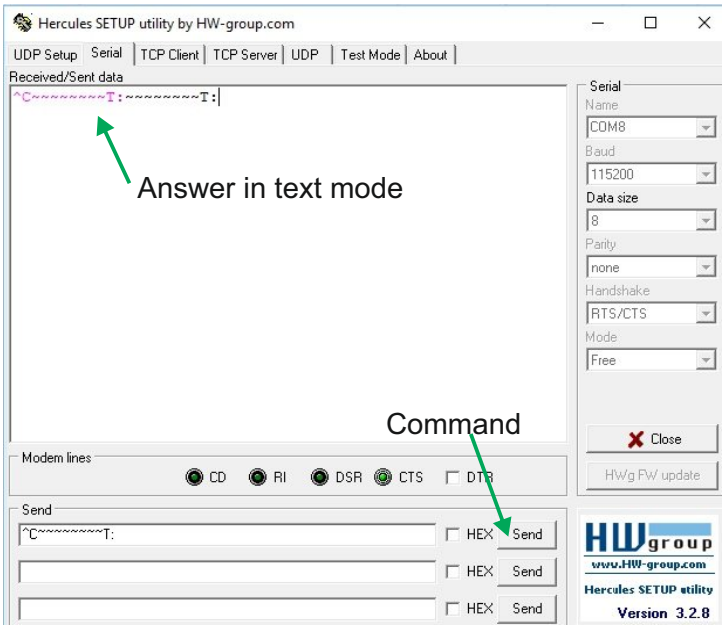
Baud rate

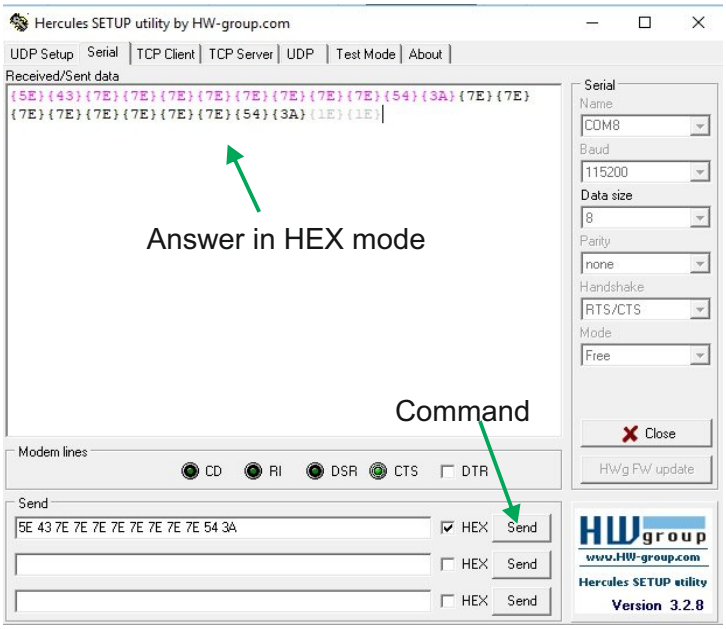
9.4 «?S» Command



General information

9.5 «^C+Configuration» Command

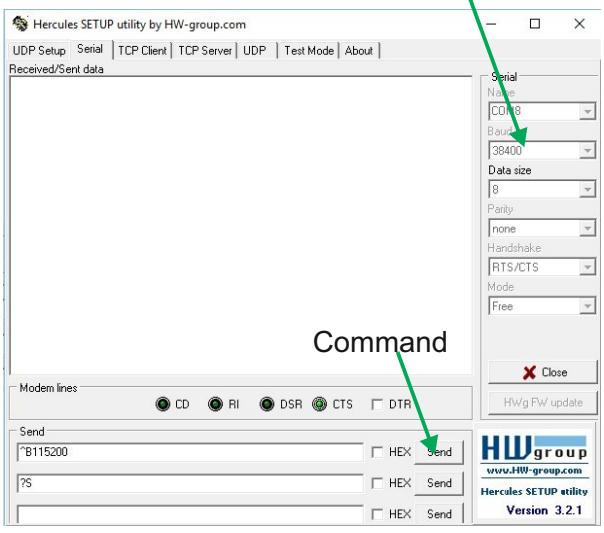




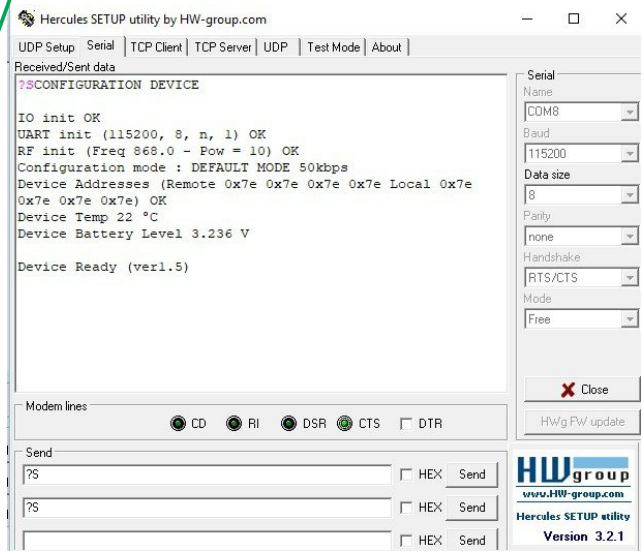
Example of configuration in text mode and in Hex Mode

9.6 «^B+Baudrate» Command

Il device initially is configured at 38400 baud rate



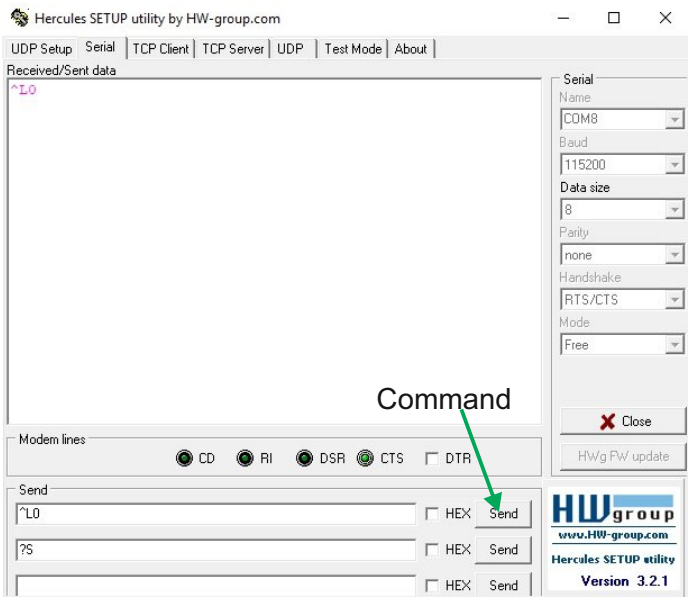
Open device at 115200 baud rate
Send the command ?S and you can verify the configuration.

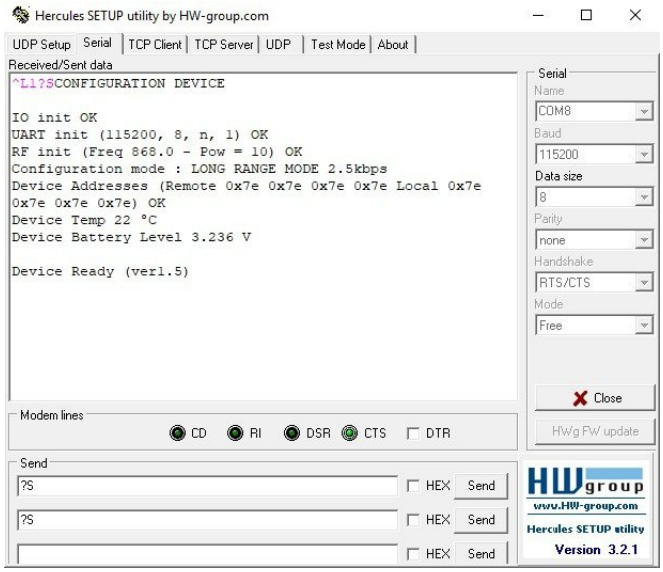


After the command **^B115200** is necessary to make an hardware RESET.

9.7 «^L0 Long Range Mode» Command

With the command L0 the device go in Long Range Mode.

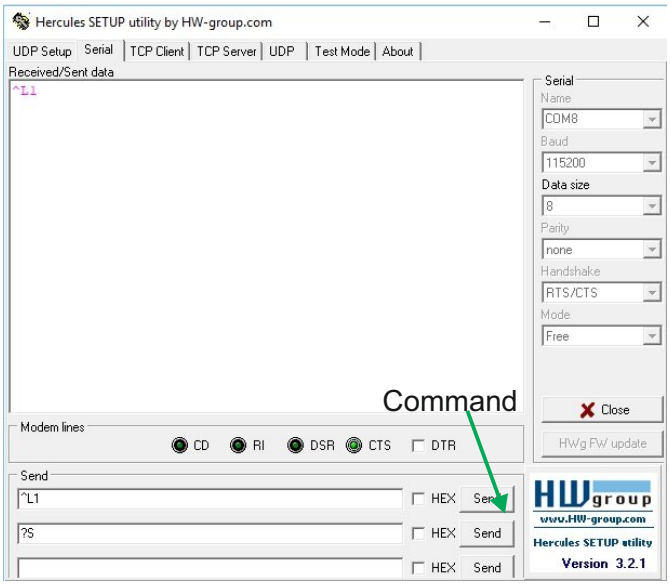


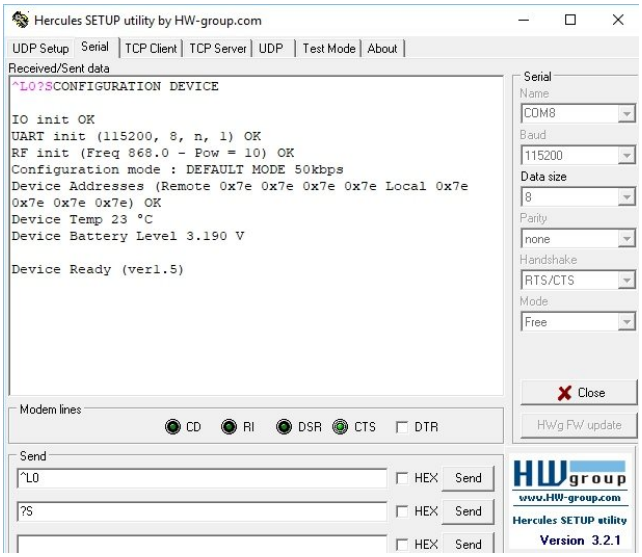


?S to verify the configuration of the device

9.8 «^L1 Standard Mode» Command

With the command L1 the device go in Standard Mode.

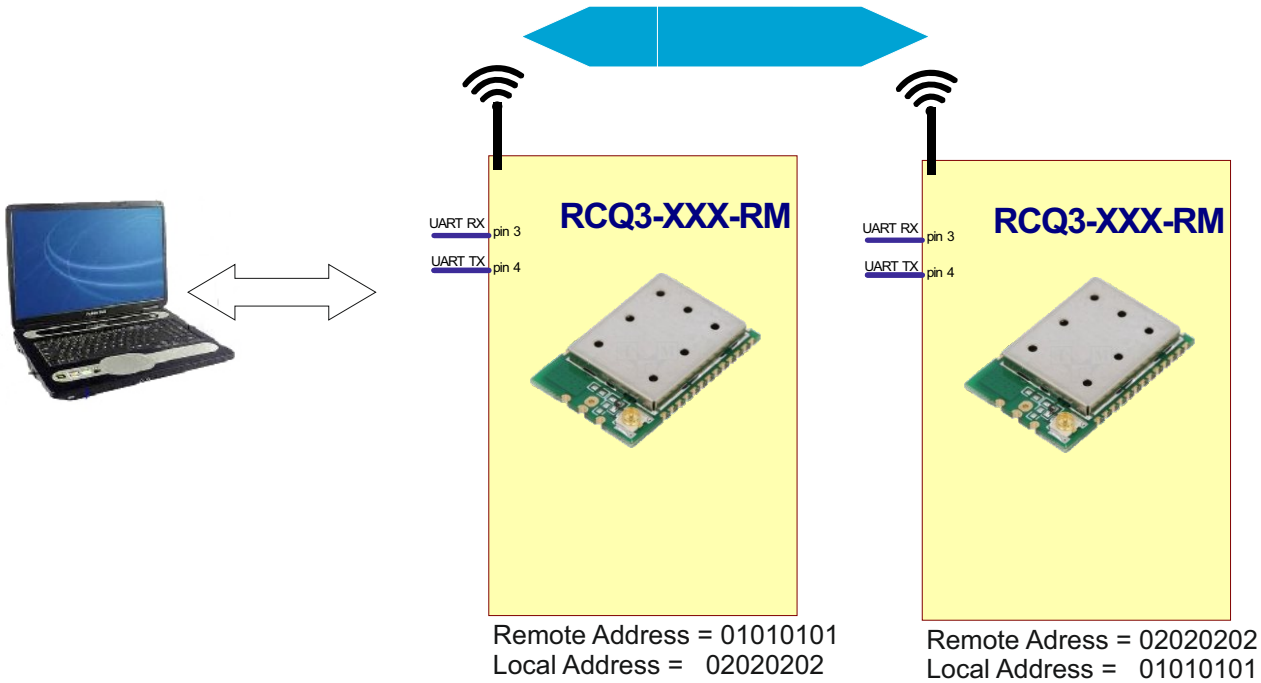




?S to verify the configuration of the device

10.0 Remote List Command

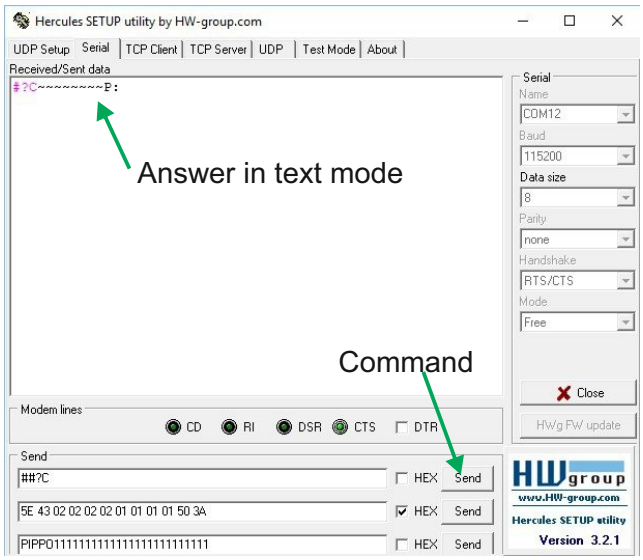
	Remote Command	Description	Example
1	##?C	Returns the configuration parameters : 1) Remote Address, 2) Local Address, 3) Frequency, 4) Power Value	See par. 10.1
2	##?T	Returns the temperature value (°C)	See par. 10.2
3	##?B	Returns the value of battery (Volt)	See par. 10.2
4	##?V	Returns the FW version	See par. 10.3
5	##?RS	Returns the RSSI value	See par. 10.4
6	##^C+Configuration	Allows to modify the configuration of the module example : ^C~~~~~~~~~T2 (text) or 53 43 7E 7E 7E 7E 7E 7E 7E 7E 54 32 (Hex)	See par. 10.5

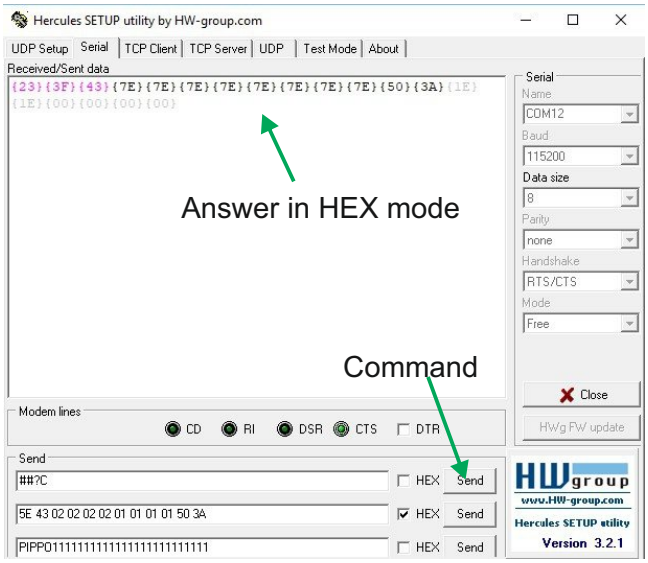


Remote Address = 01010101
Local Address = 02020202

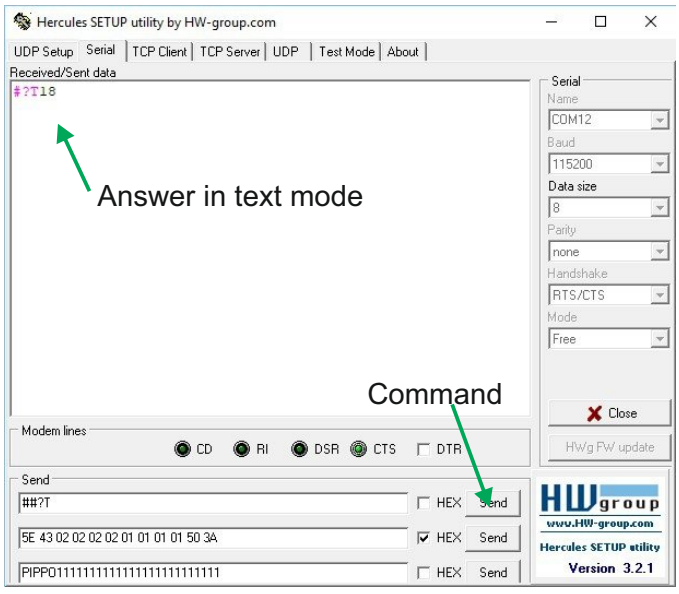
Remote Adress = 02020202
Local Address = 01010101

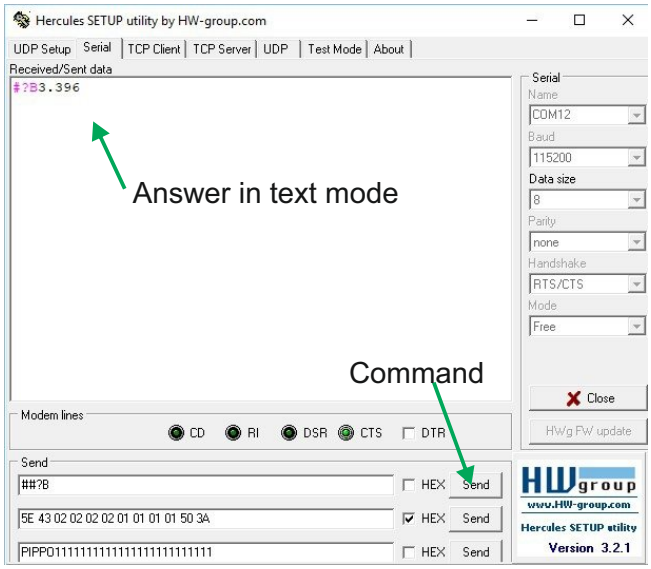
10.1 «##?C» Command



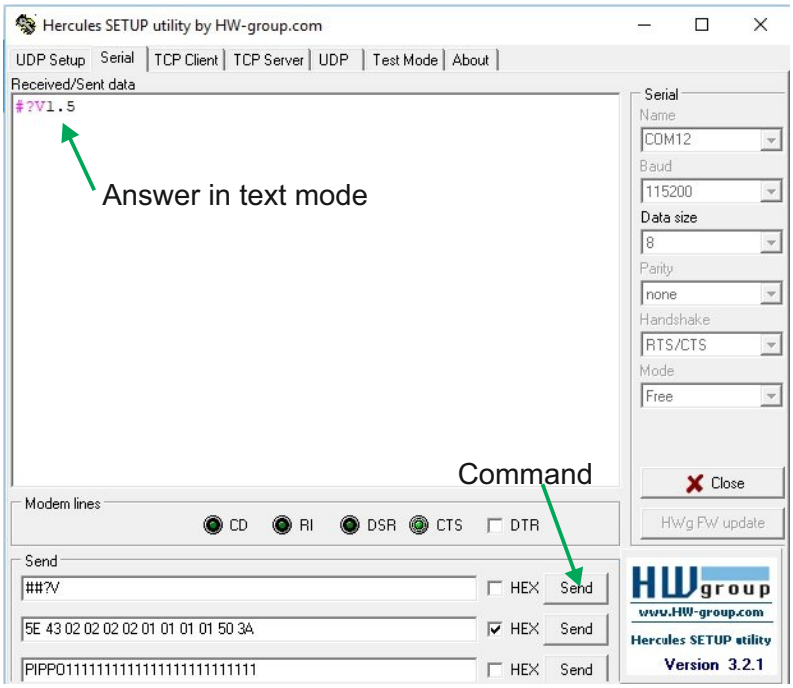


10.2 «##?T» and «?B» Command

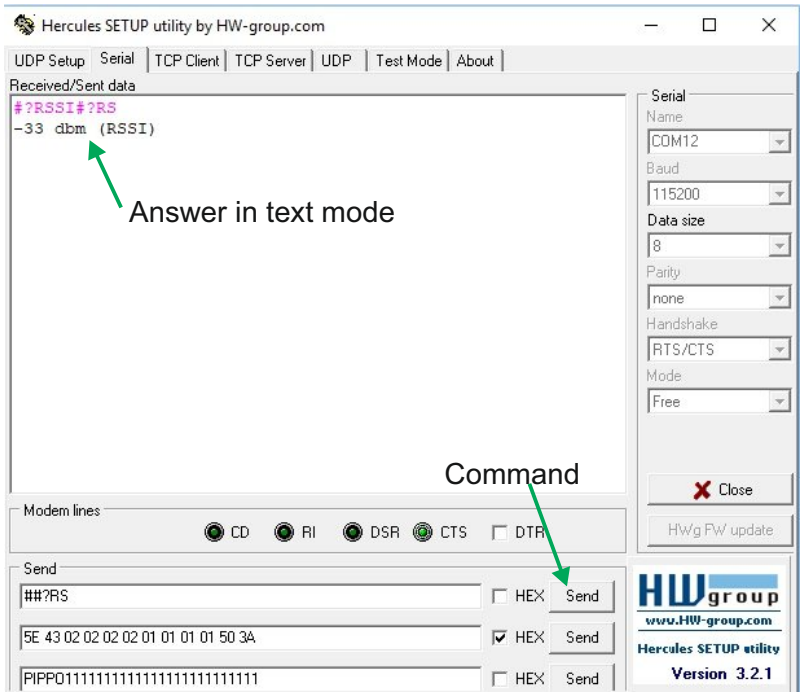




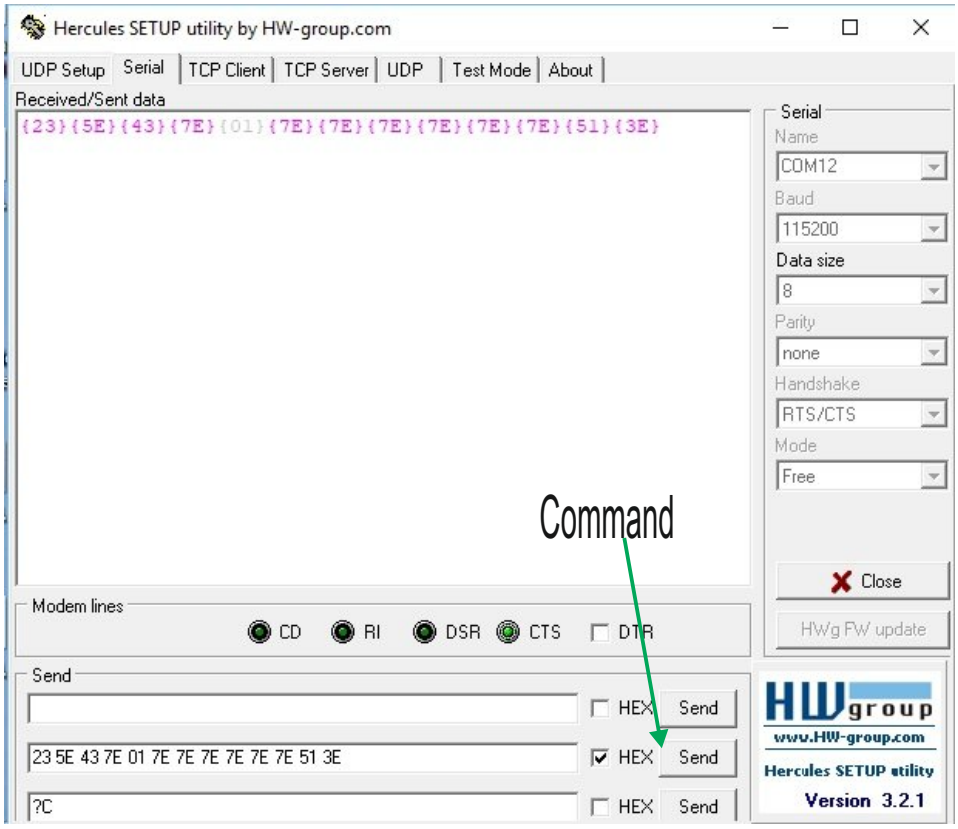
10.3 «##?V» Command



10.4 «##RS» Command



10.5 «##^C+ Configuration» Command

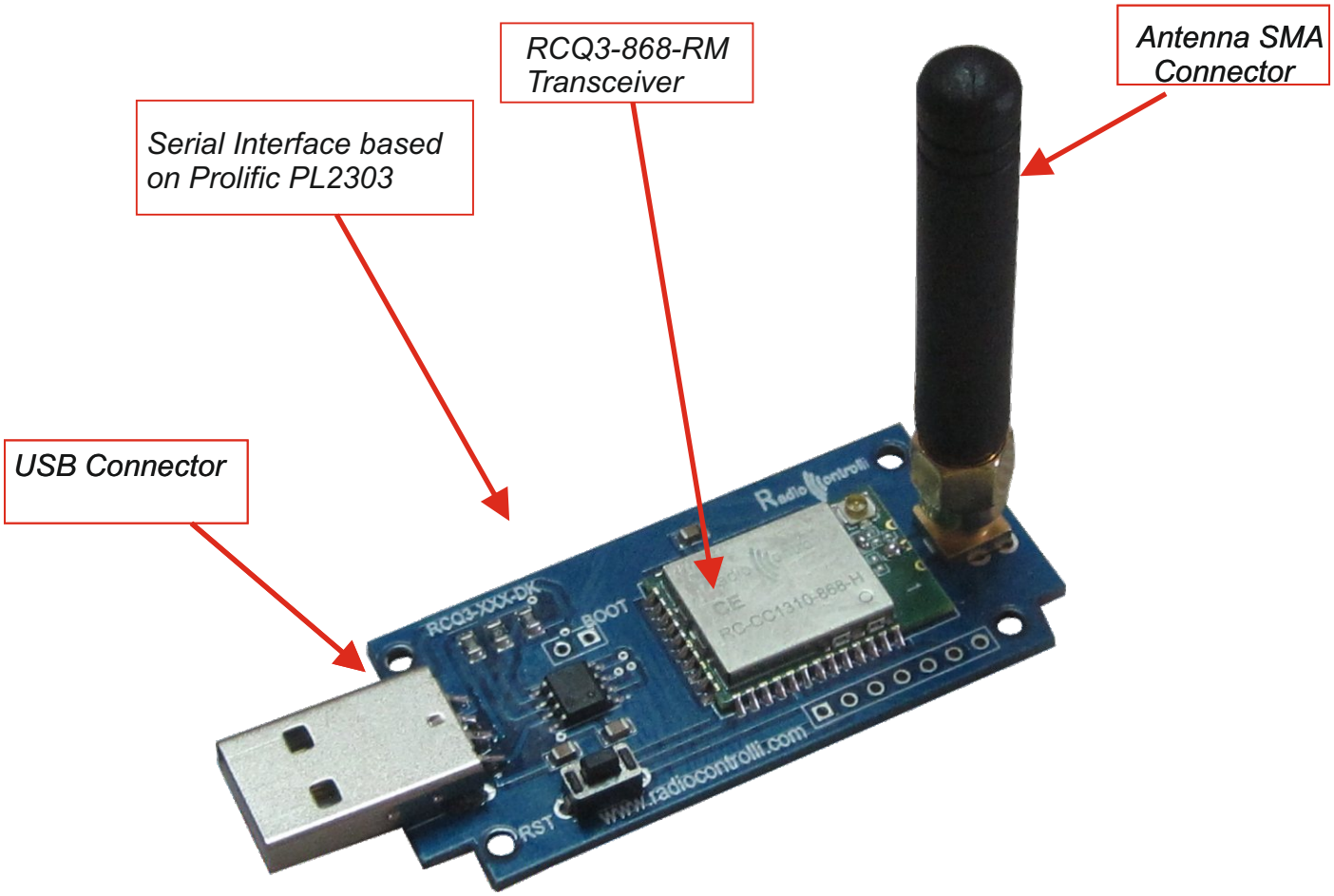


Note :
The configuration operations must be carried out when the module is powered by a voltage greater than 2.5Volt and pin 2 (FP) is in condition 1 (High), when FP is at logic level 0 (Low) the flash memory is write protected.
- Set FP to 1 (High)
- Carry out a hardware reset of the module (pin 28 active low)
- The Module is ready to be configured
- Make the new configuration
- Set FP to 0 (Low)
- Reset the module (pin 28 active low)
- The module's flash memory is write protected

11.0 Scheda di valutazione RCQ3-XXX-DK

Sono disponibili N.3 versions :

- **RCQ3-434-DK** utilizza il modulo RCQ3-434-RM per la banda 433MHz
- **RCQ3-868-DK** utilizza il modulo RCQ3-868-RM per la banda 868MHz
- **RCQ3-915-DK** utilizza il modulo RCQ3-915-RM per la banda 915MHz



- La scheda di valutazione mostrata nella figura sopra, è completa di Antenna 868 Mhz..

- È necessario installare il driver PL2303 sul computer, è possibile trovare questo driver sul sito web Prolific.