XTR-8LR-USB with external antenna

XTR-8LR-USB is an half duplex transceiver perfectly suitable for long range communication thanks to its patented "**LoRa ™**" modulation technique, capable to ensure high interference immunity, very low current consumption and high sensitivity.
Comparing this kind of modulation with the classic ones, XTR-8LR-USB has highly improved the sensitivity of the receiver up to 20 dBm, ensuring long budget-link with output power and current consumption much lower.
Transceiver works in 869,40÷869,65MHz (100mW, ver. 8LR100) and 868÷868,6MHz (25mW ver. 8LR10) European bands with possibility to set the channel width .
XTR-8LR-USB is a radio-modem with Usb interface, used as receiver or data concentrator coming from XTR-8LR10 and XTR-8LR100 modules. It can handle addressing data for point-to-multipoint or star networks.
Main radio parameters might be set up smoothly via command mode procedure.

Operating voltage is 5V, current consumption is 20 mA in reception, 135 mA in transmission (+20dBm ERP).

Main features

- **Direct transmission or radiomodem mode.**
- **No encoding or preamble is requested.**
- **AT commands for parameters setting of internal registers.**
- **HyperTerminal* compatible.**
- **Channels: 7 max.**
- **Small form factor (25x70x13mm).**
- **UART data rate: 9600, 19200, 115200 bps.**
- **Emitted power: max 100 mW.**
- **Sensitivity from -118 to-144 dBm.**
- **Operating voltage: 5V.**
- **Standard distance: 8000 m.**

Application

- **Home and building automation**
- **Irrigation control**
- **Energy monitoring**
- **Industrial sensors**
- **SCADA**
- **Alarms**
- **Automatic Meter Reading**

Absolute maximum ratings

Operating temperature	-20 °C ÷ +70 °C
Storage temperature	-40 °C ÷ +100 °C
Supply voltage	+5.5V
Input voltage	-1.0 ÷ Vcc + 0.3V
Output voltage	-1.0 ÷ Vcc + 0.3V

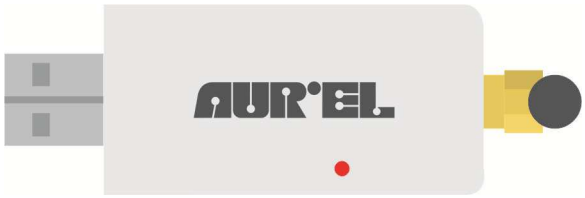
Technical Features:

	Min.	Tip.	Max.	Unit
DC LEVELS				
Supply voltage	4.5	5.0	5.5	V
Current consumption (rx mode)		20		mA
Current consumption (tx mode @ +20 dBm)	90	135	150	mA
Current consumption (command mode)		24		mA
RF TX				
Band		869.4÷869.65		MHz
Emitted power	5	10	20	dBm
Modulation		LORA™		
Channel width -3dB		20.8		KHz
Channel width -3dB		62.5		KHz
Channel width -3dB		125		KHz
Channel width -3dB		250		KHz
Spurious emissions < 1GHz			-36	dBm
Spurious emissions > 1GHz			-30	dBm
Power on adjacent channel in TX (note 2)			50	nW
ESD protection antenna (61000-4-2)		8		KV
RF RX				
Sensitivity in RX, 250KHz band (SF:6-10-12)	-115	-129	-134	dBm
Sensitivity in RX, 125KHz band (SF:6-10-12)	-118	-132	-137	dBm
Sensitivity in RX, 62.5KHz band (SF:6-10-12)	-121	-135	-140	dBm
Sensitivity in RX, 20.8KHz band (SF:6-10-12)	-127	-140	-144	dBm
RF band		6		MHz
Adjacent channel selectivity (note 3)		50		dB
Adjacent channel saturation (note 4)		≥87		dB
Blocking test at ±2MHz (note 5)	85		90	dB
Blocking test at ±10MHz (note 5)	85		94	dB
Performance				
Spreading Factor	6	10	12	
Coding Rate	4/5		4/8	
Serial Bit Rate (note 1)	9600	19200	115200	bps
Package size	1		248	Byte
Outdoor range		8000		m
Channels	1		7	n°
Channel space with 20,8KHz BW		25		kHz
Timing				

PWRDN → RX_NORMAL			1.5	ms
RX_NORMAL → PWRDN			1.5	ms
TX_NORMAL → RX_NORMAL	See : EQ1, EQ2 , EQ3, Picture 4			
RX NORMAL → TX_NORMAL	See : EQ1, EQ2 , EQ3, Picture 4			
Default Settings				
Channel		(CN2) 869.5		MHz
Emitted power (tx)		20		dBm
Serial Bit Rate (only for data) note1		115200		Bps
Bandwidth		62.5		KHz
Spreading Factor		8		SF

Note l: UART data is meant 8,n,1. UART Speed (command S8) is related to data comunication. For command mode communication this set up has no effect and it works basically to 9600bps
Note2: Test carried out according to method described in ETSI EN 300 220-1 V2.4.1 paragraph 7.6
Note3: Test carried out according to method described in ETSI EN 300 220-1 V2.4.1 paragraph 8.3
Note4: Test carried out according to method described in ETSI EN 300 220-1 V2.4.1 paragraph 8.3.4
Note5: Test carried out according to method described in ETSI EN 300 220-1 V2.4.1 paragraph 8.4

Description



Picture 1: XTR-8LR-USB

Normal mode in Rx: indicated through a red led blinking.
Command Mode: indicated through a fixed red light led.
Valid data reception: Blue Light Led blinking.
Data Transmission: Fixed Green light led for the whole transmission.

LoRa modulation:

The RF modulator and demodulator use the spread spectrum radio technique and it's possible to set Chip/Symbol ratio from 128 to 4096, depending on the desired RF sensitivity and flying time.
Improvement of sensitivity is outstanding compared to standard FSK modulation technique: 7,5 dB with 128 Chip/Symbol value and 20 dB with 4096 Chip/Symbol value.
Furthermore it is granted a general improvement of interference immunity, adjacent channel immunity and blocking tests compared to FSK demodulator.
The tables here below show how to properly set modulation parameters depending on sensitivity and flying time desired.
For a better clarification, flying time identifies the radio channel occupation for a data package composed of 8 bytes preamble + 8 bytes payload + CRC.

Bandwidth 250KHz		
Spreading Factor	**Sensitivity (dBm)**	**Flying Time (ms)**
6	-115	10
7	-120	21
8	-123	41
9	-126	72
10	-129	144
11	-131	248
12	-134	496

Bandwidth 125KHz		
Spreading Factor	**Sensitivity (dBm)**	**Flying Time (ms)**
6	-118	20
7	-123	41
8	-126	82
9	-129	144
10	-131	287
11	-134	495
12	-137	990

Bandwidth 62,5KHz		
Spreading Factor	**Sensitivity (dBm)**	**Flying Time (ms)**
6	-121	41
7	-126	82
8	-129	164
9	-132	288
10	-135	577
11	-137	990
12	-140	1980

Bandwidth 20,8KHz		
Spreading Factor	**Sensitivity (dBm)**	**Flying Time (ms)**
6	-127	124
7	-130	246
8	-134	492
9	-137	862
10	-140	1730
11	-142	2960
12	-145	5940

Above Charts show increased sensitivities for increased SF values; decreased data rate for increased SF and decreased Bandwidths.
The parameters choice have to be made by assessing at first, the bandwidth: if more channels are requested it's mandatory to choose 20,8 KHz BW, otherwise, 62,5 or 125 KHz BW.
In this case SF value equals to 8-10 is the best trade-off between RF sensitivity and flying time.
Very often in radio control applications, payload is not more than 8-10 bytes and 0,5 sec is a reasonable time for transmission and feedback (ACK) reception.

Here below the calculation equations of flight times for packet radio with payloads greater than 8Bytes:

$$Tsym = \left(\frac{2^{SF}}{BW} \right) \qquad \textbf{EQ1}$$

Tsym: Time symbol
SF: Spreading Factor from 6 to 12
BW: Bandwidth in Hz (S2 Register)

$$PayloadsymbNb = 8 + \left\{ ceiling\left[\left[\frac{(8 \times nBytePL) - (4 \times SF) + 44}{4 \times (SF - 2)} \right] \right] \times (CR + 4) \right\} \qquad \textbf{EQ2}$$

PayloadsymbNb: Payload symbol quantity
nBytePL: Payload byte quantity
CR: coding rate from 1 to 4 (register S6)

$$Tpachet = (PayloadsymbNb + 12{,}25) \times Tsym \qquad \textbf{EQ3}$$

Tpachet: data packet total timing in seconds
12,25: Symbols quantity used on preamble

From Aurel website you can download an Excel spreadsheet that automatically calculates the flight time radio according to selected parameters.

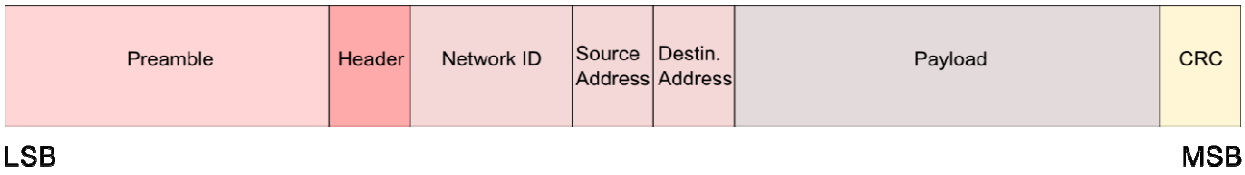
Data packet frame:

XTR-8LR100 is a radio modem working in packet mode and handling addresses for point-to-multipoint networks.
Packet has a 255 bytes max length, where 247 bytes are the payload and 7 the addresses.
It's made up of:

- Preamble: it comprises 8 bytes of variable length depending on data rate, used for synchronization purposes..
- Header: it comprises information related to the payload lengths, Code Rate, and CRC presence of payload 16 bit
- Network_ID: every module has got a 4 bytes network ID, editable via AT command. (It's present only in net modality S10=1)

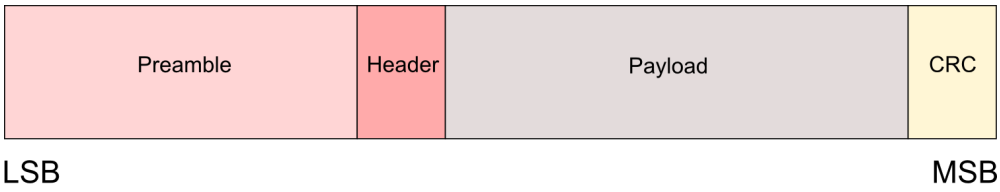
- Source Address: Module or Node address from which the data packet starts (sender), composed by 2 bytes for a maximum node capability of 65536 nodes each network editable via AT command. (It's present only in net modality S10=1)
- Destination Address: 2 bytes destination node address. This address can be changed via AT command. It must be forwarded on serial port before the payload.
- 0xFF (default) address means a broadcasting message: in this case every node joining the network (same network_ID) receives the message (It's present only in net modality S10=1)
- Payload: from 1 to 247 bytes. When received, the message is forwarded to UART output only in case Network_ID and Destination address are corresponding, otherwise it's eliminated. In case of transmission, data coming from UART port are included in payload field.
- Payload CRC: checksum 2 Bytes

In normal TX and RX operations, it is mandatory to set up the 2 needed addresses for network functionality in command mode, then move to NORMAL mode and send/receive data (payload) via UART port. To transmit a radio data packet, User must sent on UART the Destination address before the payload. Data are not yet encryped.



Picture 2: Data radio packet frame in NORMAL Mode with addressing

In NORMAL mode no network (register S10=0) fields NETWORK ID, SOURCE ID e DESTINATION ADDRESS will not present on radio protocol and 255 bytes payload will be at disposal



Picture 3: Data radio packet frame in NORMAL Mode no network

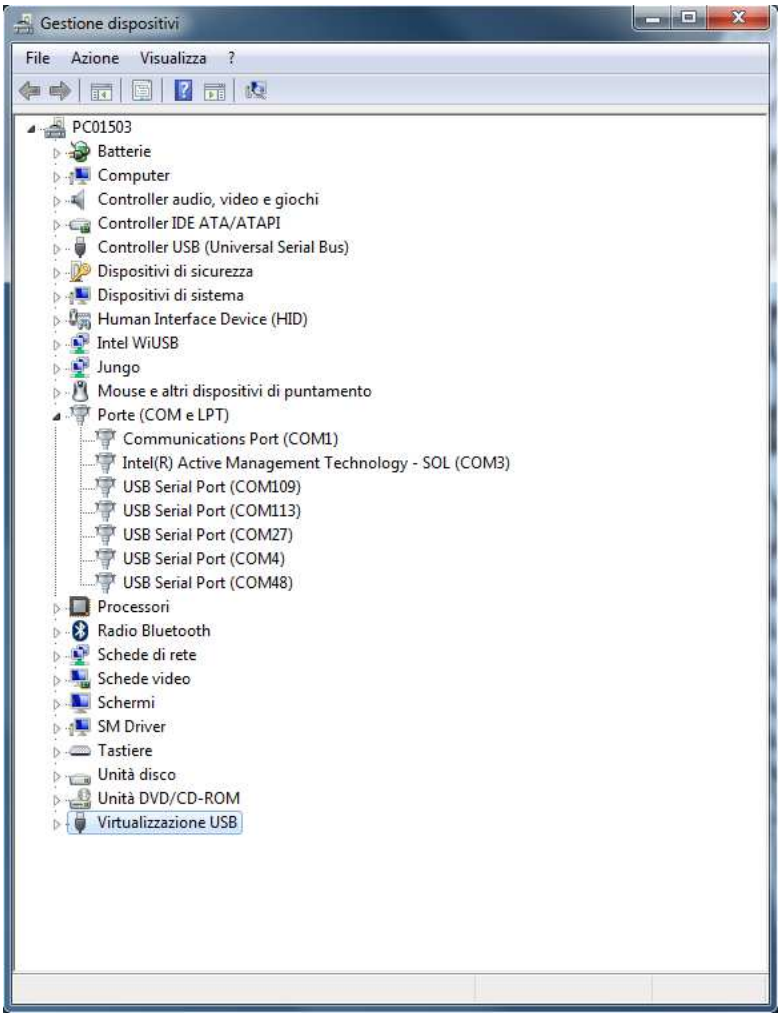
Note: By selecting spreading factor 6, the Header field is excluded. The payload must be length 15 Byte. This method is expected to LORA modulation in order to limit flight time and duty-cycle transmission .
Payload of different length of 15 Byte, will be transmitted but rejected by the receiving unit.

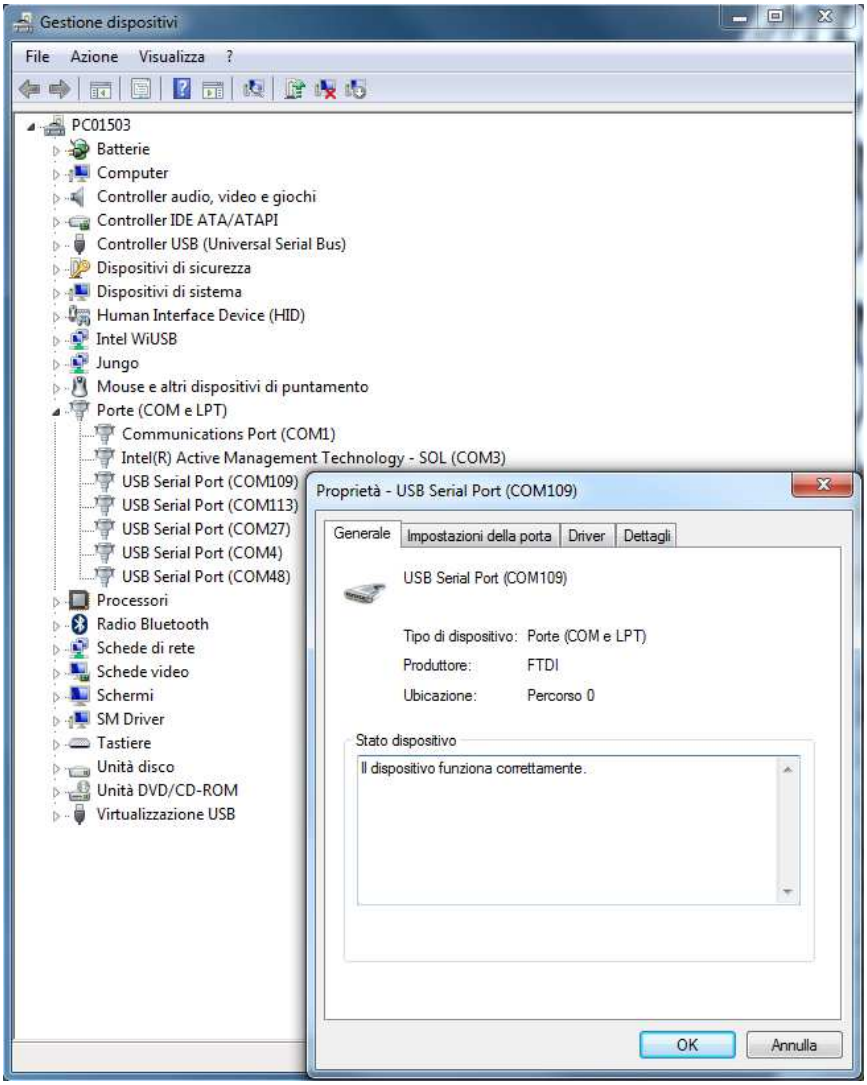
Installing procedure and use

To start using the XTR-8LR-USB, proceed as follows:

1. Install computer drivers for the USB port, for this purpose use the following link http://www.ftdichip.com/Drivers/D2XX.htm taking care to identify the appropriate driver for your operating system from the PC.

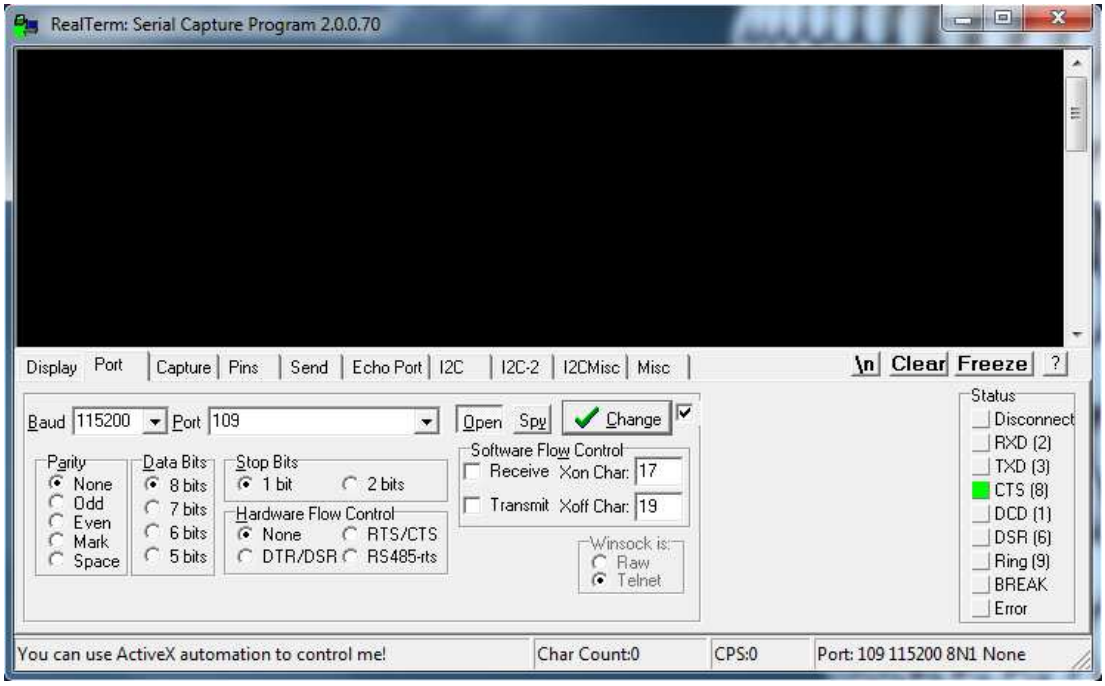
2. Connect the XTR-8LR-USB to the PC's USB port: the computer should report the detection of USB and communicate the outcome of the installation of the drivers and the COM number in use. If this were not reported, so it is advisable to open the Windows page about managing devices, click on the "Port (COM menu and LPT)", right-click on the installed USB ports, and the properties of each of them, seek COM associated with the FTDI driver.



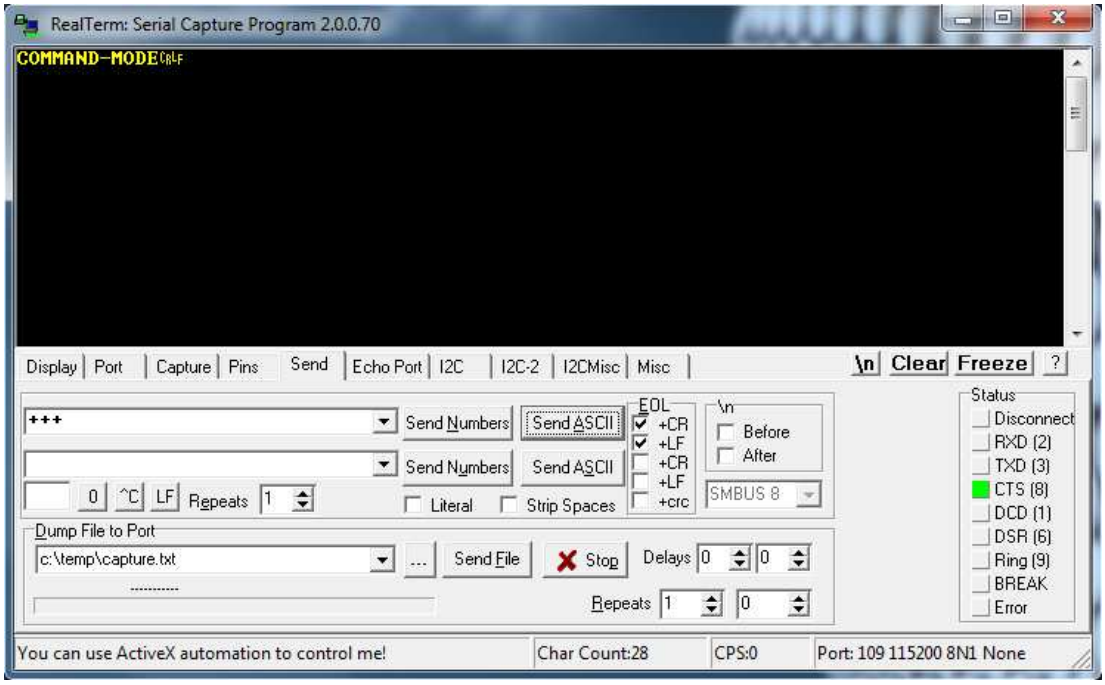


3. Open a communications software to serial ports, we recommended to use RealTerm free download on the following link: http://sourceforge.net/projects/realterm/files/Realterm/
All the examples cited in this manual have been performed with Realterm.
Many communication programs are available for serial ports suitable for this purpose, however, in order to exclude errors introduced by them and to get adequate support from the vendor, it is recommended to perform the experiments described below using Realterm, at least until it reaches an appropriate level of confidence with the XTR-8LR100 form or XTR-8LR10.

4. Start the program and set the communication parameters as shown below.
Communication speed 115200 bps, the START bit, 8 data bits, and a STOP bit, no parity. Select the port number that has been associated with XTR-8LR-USB, in this case the port associated with the XTR-8LR-USB is the "Port 109".
After each change of the working parameters of the serial port, remember to press the button "Change" to Realterm, the set values are visible at any time in the small box at the bottom right of the screen Realterm.

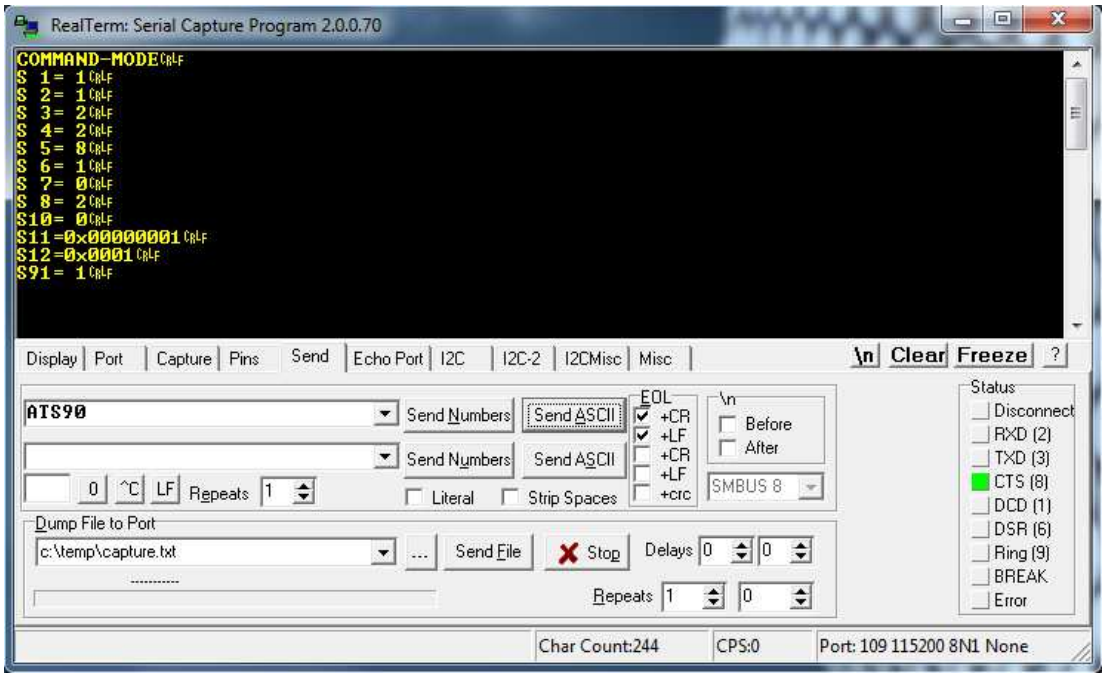


5. Click on the menu Send, and select CR and LF, then insert on the blank window "+++" and press "Send ASCII." If communication is successful, you will receive an answer as the following screen, and the RED LED will be lit:

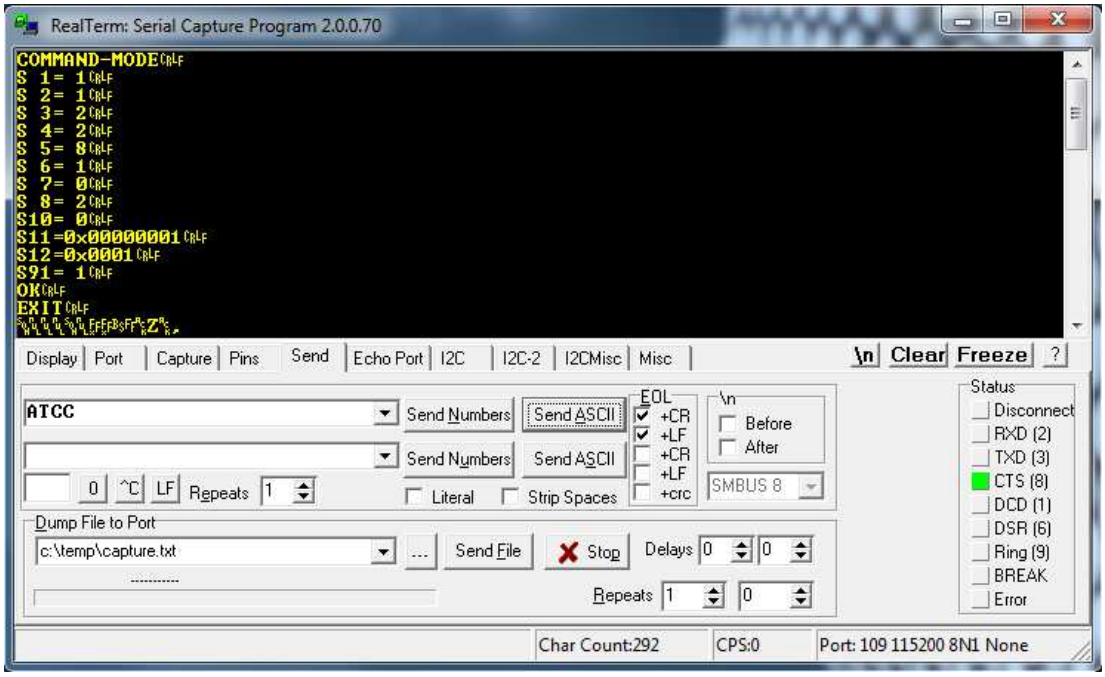


6. By now, you can send AT commands to the XTR-8LR-USB.
Send ATS90 command as below, you will receive as a response status of all setting records, with the exception of ATS0 register (hardware and firmware).

If never used it shall respond with the default settings tab.



7. Change the desired parameters, type the ATCC command to exit the state of the Command Mode, or ATWR to save the new parameters on EEPROM and exit the command mode, as a confirmation of the command, the XTR-8LR-USB will respond with OK EXIT and red LED turns off (see below).
Once out of the Command Mode will recover in Normal receive mode (Blink RED LED every 3 seconds)



Operation modes:

Device works in 2 states operation modes:

1. **COMMAND MODE**
2. **NORMAL MODE**

1. Command Mode

Command mode allows the user to set up operating parameters.
Configuration occurs via AT commands sent to RealTerm software or a dedicated PC interface.
"Command Mode" status allows to the user to configure the working parameters of the device. Programmation is carried out from AT commands sent through Real Term or a dedicated PC interface.
Set the communication with the usb serial port, Realterm or other similar, with the following parametes:
Data rate 115200, one Start bit, 8 data bit and one Stop bit, no parity, select CR and LF.
Note: in Command-Mode insert CR (carriage return) and LF (Line Feed) as termination command.

COMMAND-MODE escape

After 2 minute from last command sent, module comes back to receiver mode. Otherwise, in order to force the exit, send **ATCC** command: if everything is right you'll get a **OK EXIT** as confirmation and the red led light switches off. All modifications became effective only after the Command-Mode Escape.

AT commands list:

Possible commands sent to the module are referred to the reading and writing of registers containing settings of the device functionality.
Configuration registers reading and writing occurs by sending the sequence **AT** followed by command or register name, according to the standard of PSTN modems.
Here below you find the list of available commands: in order to use them, please abide by the examples of registers reading and writing shown in next page. The writing and reading of registers and the commands sent to the module are carried out with sequence **AT** before the command or register name (AT stands for attention), as the standard used in the PSTN modem.
Here below you find the list of available commands: in order to use them, please abide by the examples of registers reading and writing shown in next page. The writing or reading of registers not included in the chart will return the reply **NO ACCESS**.

AT	COMMAND	<CR> <LF>
Uppercase characters that come before a command or a register	Commands are codes including one or more characters	Command ends always with <CR> Carriage Return <LF> line feed

Register	Name	Function	Values
S0 r	**VER. HW/FW**	It mean the radio module version HW and FW	**Byte High =** Hw Version (modello/HW) **Byte Low** = Ver. firmware

S1 r/w	**BANDA**	Operating band frequency	**0=** 868,00 – 868,60 MHz (NI, disponibile per altre versioni) **1=** 869,40 – 869,65 MHz (default)		
S2 r/w	**BANDWIDTH**	RF channel bandwidth	**0 =** 20,8 KHz **1 =** 62,5 KHz (default) **2 =** 125 KHz **3 =** 250 KHz		
S3 r/w (nota 2)	**CANALE**	Operating radio channel To apply with limits imposed by EN300 220 normative, channeling is viable only with BW 20,8 KHz; for the others BW (62,5 KHz e 125 KHz) setting of channel is useless and module will work only on default channel			
			0= 869,45MHz		
			1= 869,475MHz		
			2= 869,5MHz (default)		
			3= 869,525MHz		
			4= 869,55MHz		
			5= 869,575MHz		
			6= 869,6MHz		
			7= 868,3MHz		
			8= 869,850MHz		
S4 r/w	**RF POWER**	RF power emitted in antenna	**0 =** +5dBm **1 =** +10dBm **2 =** +20dBm (default)		
S5 r/w	**SPREADING FACTOR**	Spreading factor	**6** = 64 (chip/symbol) **7** = 128 **8** = 256 (default) **9** = 512 **10** = 1024 **11** = 2048 **12** = 4096		
S6 r/w	**ERROR CODING**	Error recovery	**1** = 4/5 (default) **2** = 4/6 **3** = 4/7 **4** = 4/8		
S7 r/w	**RSSI ENABLE**	Adds in rear of payload the RRSI value (2 bytes)	**0** = No RSSI (default) **1** = RSSI in coda al payload		
S8 r/w (nota 3)	**UART BPS**	UART data rate	**0** = 9.600 bps **1** = 19.200 bps **2** = 115.200 bps (default)		
S10 r/w	**NETWORK ENABLE**	Adds on top of payload, the ID network and Source address	**0** = No Rete (default) **1** = Rete		
S11 r/w	**NETWORK ID**	It sets the device network address (4 byte hex)	**Min** = 00000001 (default) **Max** = FFFFFFFF		
S12 r/w	**SOURCE ADDRESS**	It sets the device ID or sender (2 bytes)start address message	**Min** = 0001 (default) **Max** = FFFF (broadcast)		

S90 r	**REGISTERS STATUS**	Registers value restores	**S1** = x (x = returned value) **S2** = x **S3** = x …. **Sn** = x
S91 r/w	**DEFAULT VALUES**	Setted at 1 it stores on register, the default values Impostato a "1" reimposta i valori di default. Se un registro è modificato, restituisce il valore "0", cioè registri differenti da default.	**0** = Modified values (r) **1** = Default values (r/w)

(note 1) NI means not implemented yet. Command execution doesn't have any effect
(note 2) To apply with limits imposed by EN300 220 normative, channeling is viable only with BW 20,8 KHz; for the others BW (62,5 KHz e 125 KHz) setting of channel is useless and module will work only on default channel.
(note 3) UART data rate setting (command S8), refers exclusively to data communication. In command mode this setting has no effect and it will work onlt at 9600 bps.

Command	Name	Function
WR	**WRITE**	Write registers value to EEPROM
CC	**COMMAND CLOSE**	Command Mode exit
Sx	**NOME REGISTRO**	Register ID to be read or write

Tab. 2: commands

Return values to commands and operations on registers

Positive return: **OK*<CR><LF>***

Negative return: ***<bl>* ERROR*<CR><LF>***

Forbidden operation: ***<bl>* NO ACCESS*<CR><LF>***

Command mode exit **EXIT*<CR><LF>***

<CR> Carriage Return, ASCII character 13; <LF> Line Feed, ASCII character 10; <bl> ASCII character 32.

Readout of a register

Syntax: **ATSx*<CR><LF>*** [x = 1, ...,16 register to be read]

Return : value stored in the register if the command sintax is correct followed by <CR><LF>.

Register value is given digit after digit as ASCII characters.

Example: '16' is given as the sequence of ASCII characters 0x31,0x36, corresponding to digit '1' and '6'. Same procedure must be applied in case of writing a new value in a register.

Writing of a register

Syntax: **ATSx=Y*<CR><LF>*** [x = 2, 3, 4 register to write on, y = value to add]

Return: as described in 'Return values'

All values stored in the registers will be lost when the module is turned off, unless the changes are saved in microcontroller EEPROM memory by means of the specific command ATWR: in this case the saved values will be active even if the module is turned off and then on.

Command to save registers value in EEPROM

Syntax: **ATWR*<CR><LF>***
Return: as described in 'Return values'

Command to quit command mode

Syntax: **ATCC*<CR><LF>***
Return: as described in 'Return values'

Command mode exit occurs, even without ATCC command, automatically after 10 sec. of idle state, or after the command ATWR.

3. NORMAL

Enabled once the XTR-8LR-USB is inserted in a PC USB port and also once it comes back from "Command Mode". Normal mode is shown by the red led blinking each three seconds. The device is able to receive data thought RF and through Usb and forward consequently. The device is always in reception and it enters in transmission once it receives data though Usb.

The way the *store & Forward* mechanism works is described by couples of sequence operations:

- Store from UART on unit A /Forward to RF buffer on unit A/ RF TX unit A
- RF RX unit B/Forward to UART output on unit B [Picture 4]

The absence of data towards the usb is given by a Timeout (equal to the 2 serial byte time based on the data rate); expired it the transceiver does not memorize other data in input until the whole data forwarding inside the radio buffer.
Max packet size is 247 bytes (S10=1 register) in the addressing NORMAL modality and 255 byte (S10=0 register) in the not addressing NORMAL modality.
Data are sent on air only when the UART storage phase is over. Microcontroller checks the incoming packets from radio receiver and enables forwarding to UART output port only in case of valid packets (corrupted packets are eliminated).
RTS line is helpful to monitor UART buffer status: it's normally low level and goes high when buffer is full or during emptying of UART buffer towards radio buffer, or when data are sent on TX_UART.

In order to grant a proper functionality of the transceiver, it's not allowed to overlap phases: i.e. if unit is emptying UART buffer to radio buffer, any data incoming from USB port are lost.
Likewise is not allowed to receive data from RF until the previous packet is still to be transmitted through USB port.
Furthermore consider that USB reception has priority over radio reception : when a byte is received from USB the radio reception in stopped and the device waits until the USB packet is completed. Therefore in that phase eventually radio data are lost.
In order to execute properly the exchange of packet from/to UART port, it's recommended to control the RTS line as go/stop operation signal.

Using the NORMAL mode with addressing:

NORMAL mode allows to work with addressing data packet, so a potential network composed by many devices permit a point-to-point communication, or point-multipoint.
From command-mode network function is achievable with **ATS10=1** resigter, other registers to be setted are NETWORK ID reg.number S11 and SOURCE ADDRESS S12 (2 bytes) a unique identifier for each device.
A wireless network could be composed by 2 to 65536 devices. SOURCE ADDRESS identifies from which device the message starts, DESTINATION ADDRESS identifies who is the device to which the message is meant. From this condition the device forwards on UART the radio data packet received, but only those who have the same NETWORK ID and DESTINATION ADDRESS. When the device transmit the DESTINATION ADDRESS must be applied ever before the payload.
In case of point –multipont network, it's necessary to set up the DESTINATION ADDRESS on FFFF, then all the related devices with same NETWORK ID will receive the payload preceded by 0xFFFF.
No automatic messages ACK is provided.

As an example here below a communication between device 1 and 2 on network A for a message "provalink"

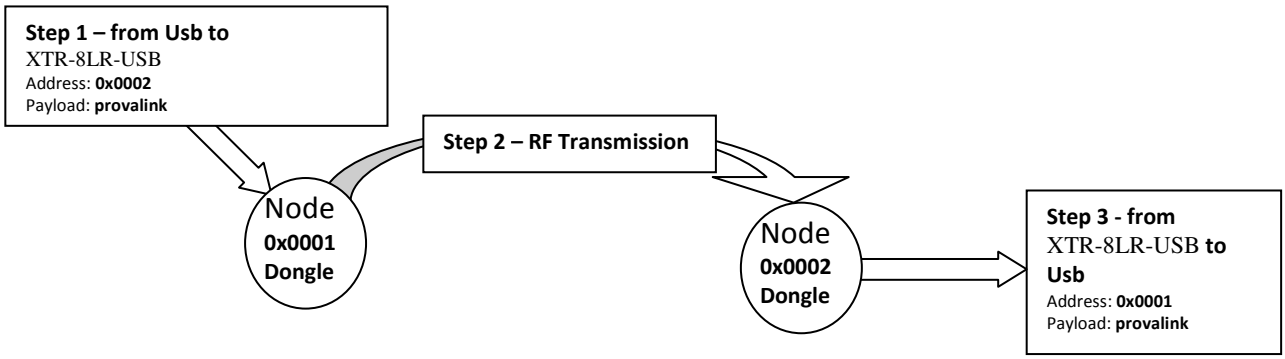


Figura 5: Diagramma di trasmissione ricezione del messaggio "provalink" dal nodo 1 al nodo 2.

Hereinafter are described necessary operations to realize the example on picture 5
From command-mode of device 1, send the following AT command string:

Commands	Answer	Note
+++<CR><LF>	OK<CR><LF>	Command-mode enters
ATS10=1<CR><LF>	OK<CR><LF>	Network mode activates
ATS11=0000000A<CR><LF>	OK<CR><LF>	Assigns network address "A"
ATS12=0001<CR><LF>	OK<CR><LF>	Assigns device address "1"
ATWR<CR><LF>	OK<CR><LF>	Save and exit

Node 1 has been set in NORMAL Mode with addressing, NETWORK ID = A and SOURCE ADDRESS = 1. ATWR stores new settings on EEprom and brings back the device on SLEEP

From command-mode of device 2, send the following AT command string:

Commands	Answer	Note
+++<CR><LF>	OK<CR><LF>	Command-mode enters
ATS10=1<CR><LF>	OK<CR><LF>	Network mode activates
ATS11=0000000A<CR><LF>	OK<CR><LF>	Assigns network address "A"
ATS12=0002<CR><LF>	OK<CR><LF>	Assigns device address "2"
ATWR<CR><LF>	OK<CR><LF>	Save and exit

As per node 1 Commands string is repeated excluding command ATS12 that assigns device address SORUCE ADDRESS = 2

Modalità NORMAL su entrambi i dispositivi e inoltrare sulla Usb del dispositivo "1" la sequenza "\x0 \x2 provalink" (1).
Device 1 sends the message via radio.
From all devices in reception (potentially more than 65000), only the device called "2" will forward on its own TX_UART line "01provalink" message.
Same as mentioned in the above example, addressing method is obtained placing ahead to the payload, in this case "provalink" the receiver address. Listening device "2" will receive the payload preceded by the sender address "\x0 \x1 provalink" (1).

([1]): Correct syntax to PC realterm terminal. Network address is write in "hex" and "provalink" message in ASCII. Different programs used from Realterm could require different syntax. For more information related to Realterm using please look at the DEMO BOARD_XTR_8LR100 user manual

Antenna:
The device has a SMA connector for having an external antenna.

Reference Rules

XTR-8LR-USB transceiver **is compliant with the European set of rules** EN 300 22-2 **and** EN 301 489-3. Tests has been performed through transmissions of Pseudo Code Random at 500bps(CEPT 70-03). The occupancy of bandwidth has been performed through transmissions of Pseudo Code Random at 500bps. In addition, the product has been tested according to **EN 60950.**
This device is compliant with EN 62479, connected to the electromagnetic field human exposition, if used with temporal duty cycle not higher than 10% like foreseen in CEPT 70-03 recommendation.

CEPT 70-03

XTR-8LR-USB transceiver operates in a harmonized frequency band and therefore, in order to comply with local regulations, the device must be used on the time scale with maximum duty-cycle time 10% (equivalent to 6 to 60 minutes of usage).

Version:

DATE	Revision	Firmware	Main variation concerning the previous version
	1.0	0112	First Release
15/05/2016	1.1	0112	Introduced part related to installing USB driver
17/10/2016	1.2	0112	Update photos and product name, LoRa ™ Included Note about SF6 on page 7
18/11/2019	1.3	0114	Various fixes