

XTR-8LR10 is an half duplex transceiver for long range radio communication based on a patented “**LoRa SSM**” modulation technique, providing high interference immunity, high sensitivity and very low power consumption with +14dBm power.

Compared to standard modulation techniques, XTR-8LR10 improves up to 20 dB the receiver sensitivity, allowing long distances by using low power in transmission and low consumption, inexpensive power supply circuits and low cost batteries.

Transceiver works in 868÷868,6MHz (25mW ver. 8LR10), 869,4÷869,65MHz (25mW, ver. 8LR10), 869,70÷870,00MHz (25mW, ver. 8LR10) European band with possibility to set the channel width.

XTR-8LR10 is a radio-modem with UART input interface, working on data packages (max. size 255 bytes). It can handle addressing schemes for point-to-multipoint star networks. Main radio parameters might be set up smoothly via command mode procedure, offering the user flexibility and multiple solutions to the many problems involved in the field.

Operating voltage is 3,3V, current consumption is 17 mA in reception and 30 mA in transmission (14 dBm ERP).

Module is available in SMD version, for surface and vertical assembling, 18 pin whose size is 33.5 X 15.4 X 2.4 mm. Tape & reel package for automatic assembling for pick and place.

Main features

- **Direct transmission or radiomodem mode**
- **RS-232 interface with store and forward mode**
- **No encoding or preamble requested**
- **AT command mode for set up of parameters**
- **HyperTerminal* compatible**
- **Channels: 3 max**
- **Small form factor (33.5x15.4x2.4 mm)**
- **UART data rate: 9600, 19200, 115200 bps**
- **Emitted power: max 20 mW**
- **Sensitivity from -118 to-144 dBm**
- **Operating voltage: 3,3V**
- **Standard distance: 8000 m**

Applications

- **Agriculture Systems**
- **Irrigation control**
- **Photovoltaic monitor**
- **Industrial sensors**
- **SCADA**
- **Tele-Alarms**
- **Instruments Monitoring**
- **AMR**

Le caratteristiche tecniche possono subire variazioni senza preavviso. AUR°EL S.p.A. non si assume la responsabilità di danni causati dall'uso improprio del dispositivo.

Absolute maximum ratings

| | |
|-----------------------|-------------------|
| Operating temperature | -20 °C ÷ +70 °C |
| Storage temperature | -40 °C ÷ +100 °C |
| Supply voltage | +3,6V |
| Input voltage | -1.0 ÷ Vcc + 0.3V |
| Output voltage | -1.0 ÷ Vcc + 0.3V |

Technical Characteristics

| | Min. | Tip. | Max. | Unit |
|---|---------|---------------|---------|------|
| DC Levels | | | | |
| Supply voltage pin 5,17 | 2.1 | 3.3 | 3.6 | V |
| Current consumption (rx mode) | | 17 | | mA |
| Current consumption (tx mode @ +15 dBm) | 28 | 30 | 35 | mA |
| Current consumption (sleep mode) | | 0,8 | 1,5 | µA |
| “1” level voltage in input/output | 0.7xVcc | | Vcc | V |
| “0” level voltage in input/output | 0 | | 0.3xVcc | V |
| RF TX | | | | |
| Frequency Band 1 | | 868,00÷868,60 | | MHz |
| Frequency Band 2 | | 869,40÷869,65 | | MHz |
| Frequency Band 3 | | 869,70÷870,00 | | MHz |
| Emitted power | 1 | 14 | 15 | dBm |
| Modulation | LORA | | | |
| 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 |
| Antenna pin 1 ESD protection to contact (61000-4-2) | | 8 | | KV |
| RF RX | | | | |
| Rx Sensitivity, band 125KHz (SF:6-10-12) | -118 | -132 | -137 | dBm |
| Rx Sensitivity, band 250KHz (SF:6-10-12) | -121 | -135 | -140 | dBm |
| Adjacent channel selectivity (note 3) | | 50 | | dB |
| Adjacent channel saturation (note4) | | ≥87 | | dB |
| Blocking test at ±2MHz (note5) | 85 | | 90 | dB |
| Blocking test at ±10MHz (note5) | 85 | | 94 | dB |
| Performance | | | | |
| Spreading Factor | 6 | 10 | 12 | |
| Coding Rate | 4/5 | | 4/8 | |
| UART Bit Rate (note 1) | 9600 | 19200 | 115200 | bps |
| Number of byte managed by buffer | 1 | | 247 | Byte |
| Outdoor range | | 8000 | | m |
| Channels Number | | 3 | | |
| Timing | | | | |

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| | | | | |
|-----------------------|----------------------------|-------------|-----|-----|
| PWRDN → RX_NORMAL | | | 1,5 | ms |
| RX_NORMAL → PWRDN | | | 1,5 | ms |
| TX_NORMAL → RX_NORMAL | See : EQ1, EQ2 , EQ3, Fig4 | | | |
| RX NORMAL → TX_NORMAL | See : EQ1, EQ2 , EQ3, Fig4 | | | |
| Default value | | | | |
| Channel | | (CN2) 869,5 | | MHz |
| Emitted power (tx) | | +10 | | dBm |
| UART data rate | | 115200 | | Bps |
| Bandwidth | | 125 | | KHz |
| Spreading Factor | | 8 | | SF |

Note 1: UART data is meant 8,n,1. The rate setting UART (S8 command) concerns the data-communication. In command mode, the setting has no effect, and it will work only at 9600bps

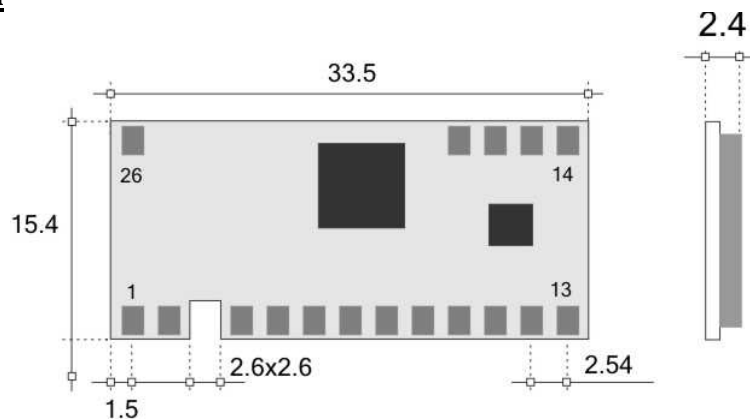
Note2: Test carried out according to method described in ETSI EN 300 220-1 V2.4.1 paragraph 7.6

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

Pin out description



Picture 1: module pin-out and mechanical drawing

PIN-OUT:

- | | |
|----------------|----------------------|
| 1) ANTENNA | 14) GND |
| 2) GND | 15) RESET |
| 3) Not present | 16) RESERVED |
| 4) GND | 17) VDD |
| 5) +VDD | 18÷25)Not present |
| 6) OUT1 | 26) GND |
| 7) OUT2 | |
| 8) SET A | *NI: not implemented |
| 9) SET B | |
| 10) RTS | |
| 11) CTS | |
| 12) RX UART | |
| 13) TX UART | |

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| N° Pin | Name | Description |
|---------|----------------|---|
| 1 | ANTENNA | 50 ohm impedance for antenna |
| 2 | GND | Ground connection or negative supply voltage pin. |
| 3 | - | Not present |
| 4 | GND | Ground connection or negative supply voltage pin. |
| 5 | VDD | Regulated supply voltage 3,3V-100mA Connect a capacitor 10-100uF very close to the pin and GND. |
| 6 | OUT1 | Digital output. In TEST mode, it goes to high level when receives and transmits "PING" message |
| 7 | OUT2 | Digital output. In TEST mode, it set to high level when receives and transmits "PONG" message. |
| 8 | SET_A | Working setting mode |
| 9 | SET_B | Working setting mode |
| 10 | RTS | Request to send. Output set high, when UART buffer is full or during filling/emptying from radio FIFO. Output set low when ready to receive data from UART port. |
| 11 | CTS | Clear to send. Digital input, when it is set to high level, no data transmission on TX_UART line |
| 12 | RX_UART | UART input in TTL RS-232 level logic with 1 start bit (0V), 8 data bit and 1 stop bit (3V). Input must be driven in high level logic (3V) |
| 13 | TX_UART | UART output in TTL RS-232 levels, 1 start bit (0V), 8 data bit and 1 stop bit (3V). Output in high level logic (3V) |
| 14 | GND | Ground connection or negative supply voltage pin. |
| 15 | RESET | Module Reset |
| 16 | NI | Not used |
| 17 | VDD | Regulated supply voltage 3,3V-500mA. Connect a capacitor 10-100uF very close to the pin and GND. |
| 18 ÷ 25 | - | Not present |
| 26 | GND | Ground connection or negative supply voltage pin. |
| | | |

Table 1: Pin description

LoRa Modulation:

The RF modulator and demodulator uses the spread spectrum radio technique and it's possible to set Chip/Symbol ratio from 128 to 4096, depending on RF sensitivity and flying time desired.

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.

In order to be understood, flying time means the radio channel occupation for data package made of a 8 bytes preamble + 8 byte payload + CRC.

| Bandwidth 125KHz | | |
|-------------------------|--------------------------|---------------------------|
| Spreading Factor | Sensibilità (dBm) | Tempo di volo (ms) |
| 6 | -118 | 21 |
| 7 | -123 | 41 |
| 8 | -126 | 82 |
| 9 | -129 | 144 |
| 10 | -132 | 289 |
| 11 | -134 | 496 |
| 12 | -137 | 991 |

| Bandwidth 250KHz | | |
|-------------------------|--------------------------|---------------------------|
| Spreading Factor | Sensibilità (dBm) | Tempo di volo (ms) |
| 6 | -115 | 10 |
| 7 | -120 | 21 |
| 8 | -123 | 41 |
| 9 | -126 | 72 |
| 10 | -129 | 144 |
| 11 | -131 | 248 |
| 12 | -134 | 496 |

As you can see sensitivity increases as far as SF value increases and data rate decreases as far as SF increases and Bandwidth decreases.

Parameters choice has to be made by assessing at first the working band and then the bandwidth.

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.

Below there are the calculating equations of the flight time for radio packets with different payloads from 8 bytes:

$$T_{sym} = \left(\frac{2^{SF}}{BW} \right) \quad \text{EQ1}$$

T_{sym}: duration of a symbol in seconds

SF: Spreading Factor from 6 to 12

BW: radio channel band in Hz (register S2)

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

PayloaddsymbNb: Payload symbol number

nBytePL: payload byte number

CR: coding rate from 1 to 4 (register S6)

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$$T_{pachet} = (Payload_{ymbNb} + 12,25) \times T_{sym} \quad \text{EQ3}$$

T_{pachet}: Total duration of the packet in seconds

12,25: number of symbols used by the preamble

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

Data packet frame:

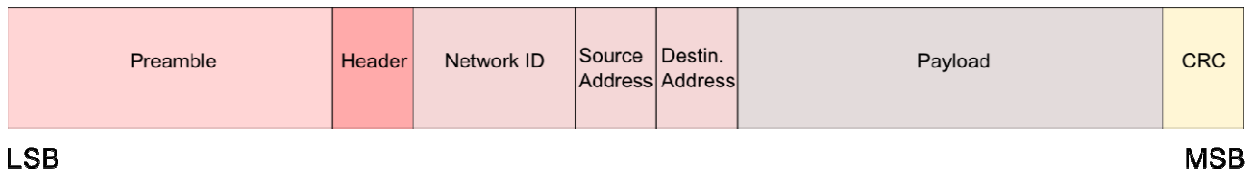
XTR-8LR10 is a radiomodem working in packet mode and handling addresses for point-to-multipoint networks.

Packet has a 255 bytes max length, where 247 bytes are the payload and 8 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 includes payload length in byte, Code Rate, presence of 16 bit CRC.
- Network_ID: every module has got a 4 bytes network ID, changeable via AT command. (present only in network mode **S10=1**)
- Source Address: node or module address from which the packet starts (sender), composed by 2 bytes for a total of 65536 nodes in each network. This address can be changed via AT command. (present only in network mode **S10=1**)
- Destination Address: composed by 2 bytes, it means destination node address where sending the message (payload). Differently from the other parameters, it is not changeable via AT command but it must be forwarded on serial port, before payload.
0xFF (default) address means a broadcasting message: in this case every node joining the network (same network_ID) receives the message (present only in network mode **S10=1**)
- Payload: from 1 to 247 bytes, composed by the sent or received message. When received, the message is forwarded to UART output only in case Network_ID and Destination address are corresponding to the parameters previously memorized in S11 and S12 registers, otherwise it's eliminated. In case of transmission, data coming from UART port are included in payload field of the radio packet transmitted.
- Payload CRC: 2 Bytes

In normal transmission and reception operations, it is mandatory to set up the 2 addresses needed for network functionality in command mode, then move to NORMAL mode and send/receive data (payload). To transmit a radio message the user must send to UART the Destination Address before the payload. In case of reception of radio message, the data forwarded over the TX_UART would have on the beginning 2 Bytes of Source Address. Data are not encrypted.



Picture 2: Data radio packet frame in NORMAL mode

In NORMAL mode no network (register **S10=0**), NETWORK ID, SOURCE ID and DESTINATION ADDRESS are not in radio protocol and are available 255 bytes of payload.

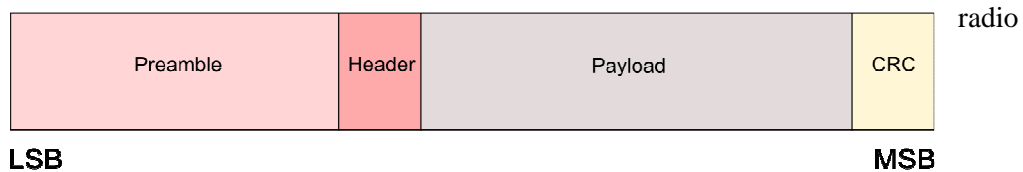


Figura 3: Data radio packet frame in NORMAL mode, no network

Operation modes:

Device works in 4 states operation modes:

1. **SLEEP**
2. **COMMAND MODE**
3. **NORMAL**
4. **TEST MODE**

1. Sleep

When SET_A, SET_B, inputs are open or connected +V, module enters automatically in sleep state: radio and microcontroller chips are in low power state.

It's only allowed the activation of command AT (+++++) via RX UART port, to enter into command-mode.

2. Command Mode

Command mode allows the user to set up operating parameters.

Configuration occurs via AT commands sent to RX_UART (pin.12) with 9600 bps data rate. Likewise return values are received from TX_UART (pin.13).

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To enter command mode, **possible only from sleep mode**, send to RX_UART a sequence of 4 '+' ASCII characters in a row (++++).

In order to execute it, it's recommended to use the RS232 or USB port of PC (pay attention to convert physical levels to 0-3V), connect TX and RX while RTS and CTs are not handled in command mode. Use a program for serial port communication, like Hyperterminal, RealTerm or similar ones, by setting these parameters: data rate: 9600 bps, one start bit, 8 data bit, 1 stop bit, no parity, select CR and LF

Send from PC the sequence +++. If the return value is **COMMAND-MODE** then communication is ok.

When the device is in command mode, it can't send/receive any data to/from/ RF.

In command mode the UART data rate is fixed at 9600 bps and any change to S8 register can't affect data rate in command mode.

Note: in Command-Mode always insert as command terminator CR(carriage return) and LF(line feed).

How to quit command mode

After 2 minutes from last command sent, module automatically switches to sleep mode. Otherwise, in order to force the exit, send **ATCC** command: if everything is right you'll get a **OK EXIT** as confirmation. Modifications become ok only after the exit from Command-Mode.

AT command list:

Commands allow to write and read registers which set the way the module operates.

Configuration registers reading and writing occurs by sending the sequence **AT** followed by command or register name, according to the standard of PSTN modems.

Herebelow 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. Registers reading and writing not in table have the answer **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 | radio module and firmware version | Byte High = Ver. module (model/HW) Byte Low = Ver. firmware |
| S1 r/w | BAND | Operating band frequency | 0= 868,00 – 868,60 MHz (default) 1= 869,40 – 869,65 MHz 2= 869,70 – 870,00 MHz |
| S2 r/w | BANDWIDTH | RF channel bandwidth | 0 = 125 KHz (default) 1 = 250 KHz |

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| | | | | |
|------------------------------|-------------------------|---|---|----------------------|
| S3 r/w (nota 2) | CHANNEL | Operating radio channel | Bw 125 KHz | Bw 250 KHz |
| | | | 0 = 868,30MHz | 0 = 868,30MHz |
| | | | 1 = 869,525MHz | NI |
| | | | 2 = 869,85MHz | 2 = 869,85MHz |
| S4 r/w | POWER | RF power level in output from the device (select at steps of 1 dB) | Min = 0 dBm Max = +14 dBm Default = +10 dBm | |
| 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 correction | 1 = 4/5 (default) 2 = 4/6 3 = 4/7 4 = 4/8 | |
| S7 r/w | RSSI ENABLE | It adds the value RSSI (2 bytes module 2) at the end of the payload | 0 = No RSSI (default) 1 = RSSI queued payload | |
| S8 r/w (nota 3) | UART BPS | UART speed choise (only data communication speed) | 0 = 9.600 bps 1 = 19.200 bps 2 = 115.200 bps (default) | |
| S10 r/w | NETWORK ENABLE | It adds Network ID and Source Address at the beginning of payload | 0 = No Rete (default) 1 = Rete | |
| S11 r/w | NETWORK ID | It sets up the module network address (4 byte hex) | Min = 00000001 (default) Max = FFFFFFFF | |
| S12 r/w | SOURCE ADDRESS | It sets up the module or sender identification address (2 byte hex) module address or message starting | Min = 0001 (default) Max = FFFF (broadcast) | |
| S90 r | REGISTERS STATE | It gives back the registers value | S1 = x (x = returned value) S2 = x S3 = x Sn = x | |
| S91 r/w | DEFAULT VALUES | Set up at "1", it sets up back default values. If a register is modified, it restituisce il valore "0", that is different registers from default. | 0 = Valori modified values (r) 1 = Default values (r/w) | |
| S92 r/w | RADIO TEST_MODE | Ping-Pong radio test mode | 0 = Off (default) 1 = On Tx Master 2 = On Rx Slave | |

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(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, for the others (BW 125 KHz and 250 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 only at 9600 bps.

| Command | Name | Feature |
|---------|------------------|--|
| WR | WRITE | Write registers value to EEPROM |
| CC | COMMAND CLOSE | Command Mode exit |
| Sx | REGISTER NAME | Write and read register identification |

Tab. 2: Commands

Return values to commands and operations on registers

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

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

Forbidden operation: **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, ...,6, ... register to be read]

Return: value stored in the register if the command syntax 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'

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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 in three ways:

- With ATCC command, it exits without saving in eeprom the modifications (they are kept until the module is supplied);
- With ATWR command, it exits and saves in eeprom the modifications;
- For inactivity of Command-Mode after 2 minutes.

3. NORMAL

Enter in NORMAL mode, by connecting SET_A to GND and leaving open or connected to +V the line SET_B.

The radio and the microcontroller are on, the device is able to receive data both RF and from UART and to forward as consequence.

Module works always in receive mode at RF level and enters into transmission if it receives a packet from UART.

When on the RX_UART (pin 12) input line there is a start bit (low logic level, 0V) and consequently a data byte at least, the device enters into RF transmission mode once completed the acquisition of the data.

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

- Serial Reception unit A / Transmission on RF buffer unit A / RF Transmission unit A
- RF Reception unit B / Serial Transmission unit B [Fig. 4]

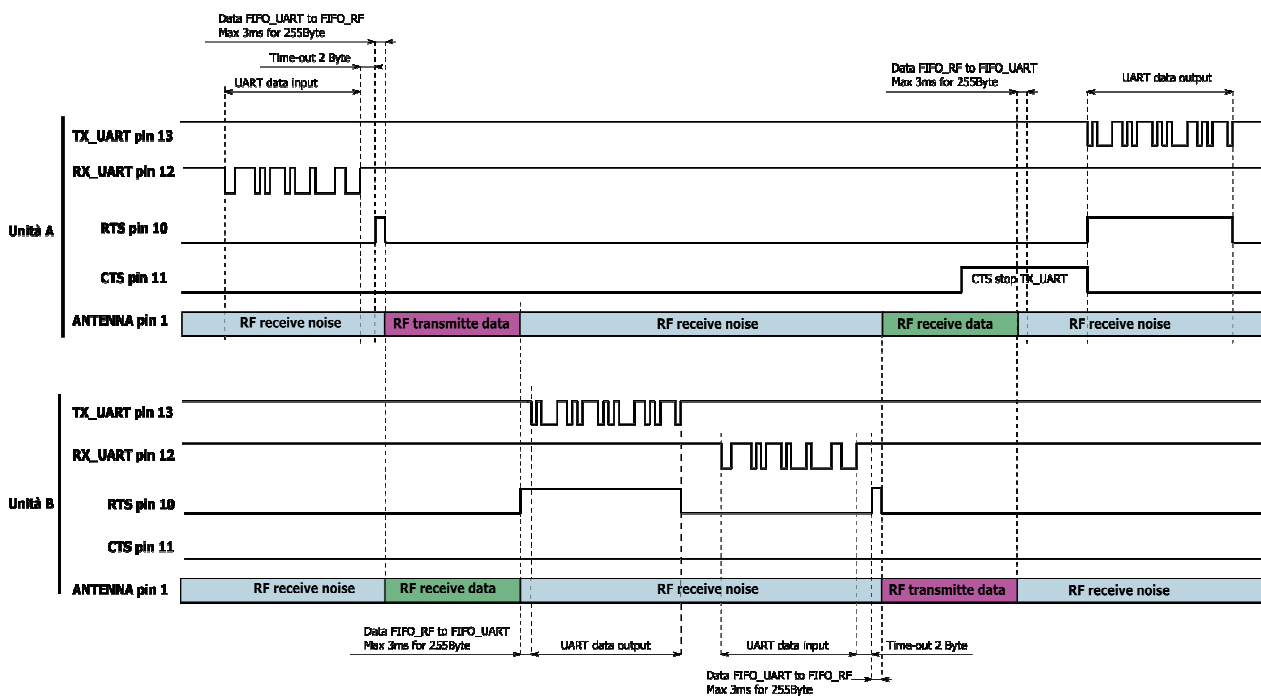
The absence of data input pin 12 is determined by the expiration of a time-out (equal to the time of 2 bytes to the serial data rate used), after which the transceiver does not memorize more incoming data until the complete data transfer within the buffer radio.

Packet has a **247 bytes** max length in network mode (register **S10=1**) and 255 bytes in NORMAL mode no network (register **S10=0**)

The data are transmitted on the RF channel only when it is finished their serial reception, when received by radio from the second unit, the microcontroller analyzes the data proceeding with the transmission on serial data in case of valid data or discarding them if wrong.

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 transmitted on TX-UART (pin 13).

The following diagram explains how RX, TX, RTS and CTS UART lines work:



Picture 4: example of data transmission from unit A → B, and transmission of an ACK from unit B → A

As shown in picture 4, the time interval from start, when data is on pin 12 of unit A (RX UART) to the moment when it is forwarded on pin 13 (TX UART) of unit B, is strictly depending on Bytes number of the packet and of the serial speeds used into reception and transmission.

CTS at high logic level inhibits the module XTR-8LR10 to the transmission of the data on pin 13 (TX_UART).

In order to grant a proper functionality of the transceiver, it's not allowed to overlap phases: i.e. if unit A is filling UART buffer or emptying to radio buffer, data incoming via RF are lost.

Anyway it is able to manage the filling of UART buffer during the transmission RF inside the same unit.

In order to execute properly the exchange of packet from/to UART port, it's recommended to control the RTS and CTS line as go/stop operation signal.

Usage of NORMAL mode with address:

NORMAL mode allows to work with address mode of packets, therefore a network composed from N devices, allows the communication point-point or point-multipoint.

In command-mode the network functionality will be active with **ATS10=1** command, other registers to set up are NETWORK ID register S11 (4bytes which identify the network) and SOURCE ADDRESS register S12 (composed by 2bytes) unique identifier of each device.

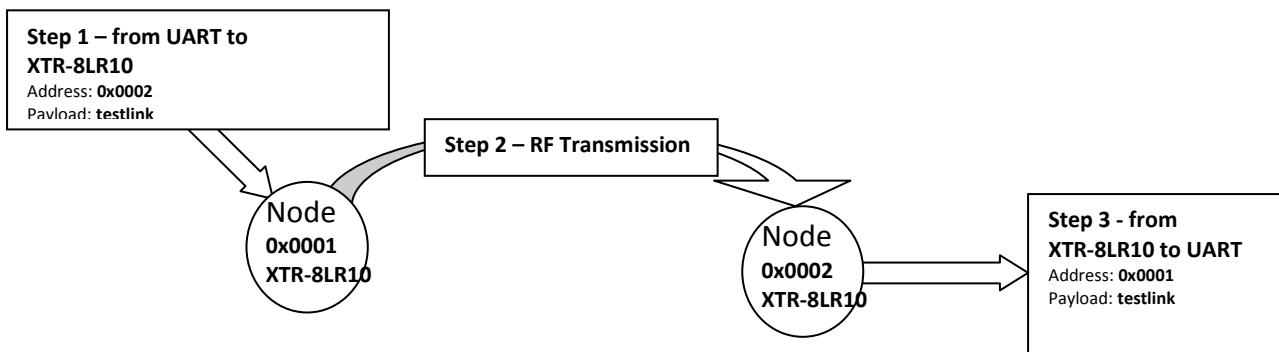
A wireless network can be composed by 2 to 65536 nodes, the unique code of the device (2bytes) will be called SOURCE ADDRESS identifier of the device from which the message leaves and DESTINATION ADDRESS the device destination of the message.

From this condition, XTR-8LR10 module in reception filters the radio packets and forwards to UART only those ones with the same network address (NETWORK ID) and the same destination address (DESTINATION ADDRESS), when XTR-8LR10 module transmits, the destination address (DESTINATION ADDRESS) must always precede the payload.

In order to execute a multi-point communication, it is recommended to set up the destination address FFFF, in this case all the devices belonging to the same network (same NETWORK ID) will receive the payload preceded by 0xFFFF.

There is no ACK automatic system of messages.

In order to explain the above-mentioned, it is represented below an example of communication between the devices 1 and 2 of the network called A of the message “testlink”:



Picture 5: Diagram of transmission reception of the message “testlink” of node 1 to node 2.

Below there are the operations necessary to realize the example of Fig.5.

From sleep mode of the device 1, send the following sequence of AT commands:

| Command | Answer | Note |
|------------------------|------------|-----------------------------|
| +++<CR><LF> | OK<CR><LF> | Enters into command-mode |
| ATS10=1<CR><LF> | OK<CR><LF> | Starts up the NETWORK mode |
| ATS11=0000000A<CR><LF> | OK<CR><LF> | Gives network address “A” |
| ATS12=0001<CR><LF> | OK<CR><LF> | Gives address of device “1” |
| ATWR<CR><LF> | OK<CR><LF> | Saves and goes out |

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The module 1 has been set up into NORMAL mode with addressing, network address (NETWORK ID = A) and source address (SOURCE ADDRESS = 1).

The command ATWR memorizes the new settings up on eeprom and the device returns into SLEEP mode.

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

| Command | Answer | Note |
|------------------------|------------|-----------------------------|
| ++++<CR><LF> | OK<CR><LF> | Enters into command-mode |
| ATS10=1<CR><LF> | OK<CR><LF> | Starts up the NETWORK mode |
| ATS11=0000000A<CR><LF> | OK<CR><LF> | Gives network address "A" |
| ATS12=0002<CR><LF> | OK<CR><LF> | Gives address of device "2" |
| ATWR<CR><LF> | OK<CR><LF> | Saves and goes out |

As for mode "1", the sequence of commands repeat itself except the command ATS12 which gives the device address (SOURCE ADDRESS = 2).

Shut SET A toward GND (NORMAL mode) on both the devices and forward on the line RX UART of the device "1" the sequence "\x0 \x2 testlink" ⁽¹⁾.

The device 1 will forward the message via radio.

Among the devices in listening, (potentially more than 65000) only the device called "2" will forward on its own line TX_UART the message "01testlink".

As you can see from the above example, the address method is obtained by preceding the payload, in this case "testlink", from the destination address; the device 2 in listening will receive the payload preceded by the sender address "\x0 \x1 testlink" ⁽¹⁾.

⁽¹⁾: Right Syntax per the usage of the terminal PC "Realterm". The network address is written in "hex" the message "testlink" in ASCII, the usage of different programs from Realterm can have different syntaxes. For further information about the usage of Realterm, read the user manual of the "DEMO_XTR_8LR10".

7. Test Mode

It's an operation mode which allows the user to test seamlessly the radio link performance.

It is triggered by closing to GND and by driving input SET_B to low level and setting (or leaving floating) +V pins SET_A.

This mode allows to connect two devices as Master and Slave. The former sends 12 ASCII characters "PING xxxxx\n\r" and in case the latter receives, it will answer with an ACK value of 12 ASCII characters "PONG xxxxx\n\r " (where xxxxx increasing counter packets sent/received, \n line feed, \r carriage return).

Communication is reported by outputs:

OUT_1 (pin 7) goes high when Master sends or Slave receives a "PING"

OUT_2 (pin 6) goes high when Master receives or Slave sends a "PONG"

The selection between Master/Slave configuration is made through ATS9 command:

0 = disabled feature

1 = module set as Master

2 = module set as Slave

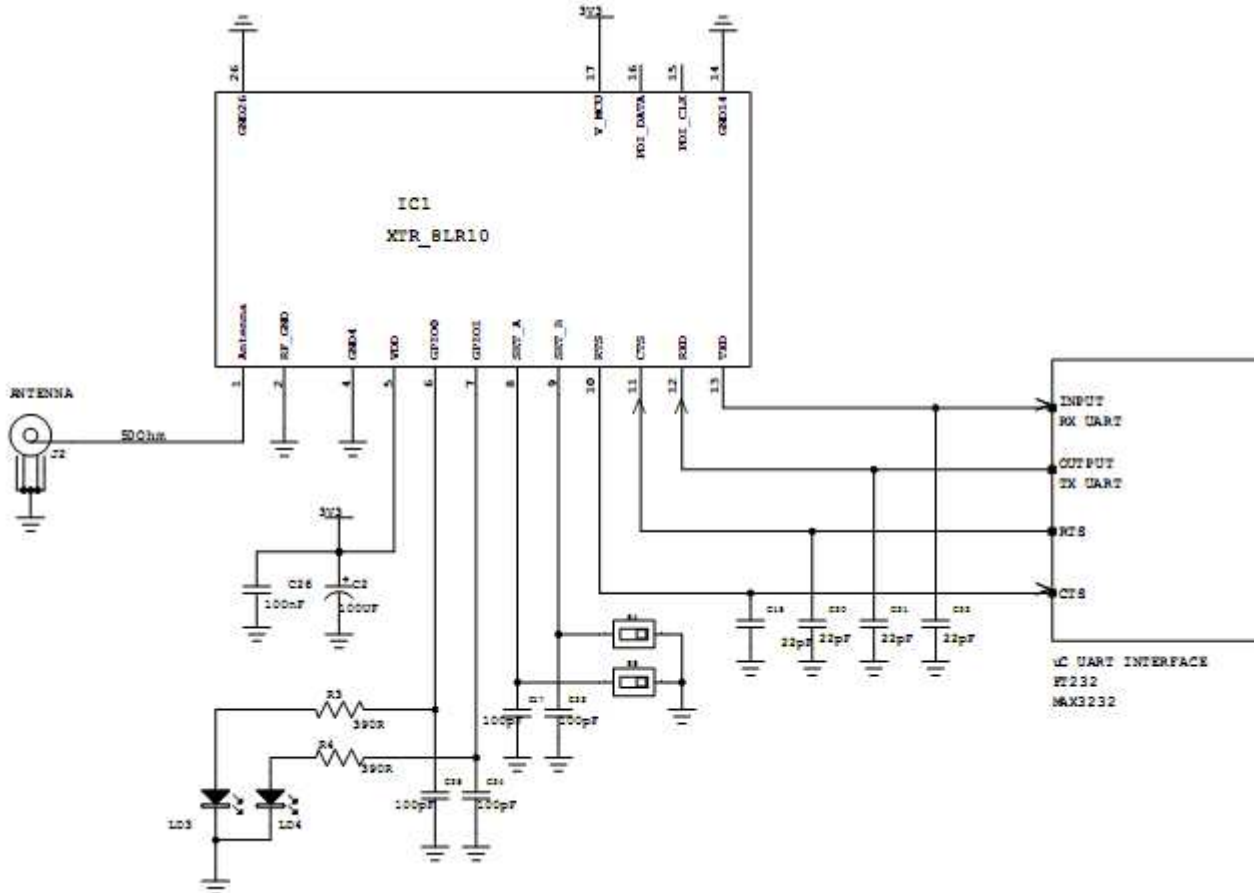
Note: When the tests in Test Mode are finished, before working in other modes, it is indispensable to disable test functionality with the command ATS92=0

Le caratteristiche tecniche possono subire variazioni senza preavviso. AUR°EL S.p.A. non si assume la responsabilità di danni causati dall'uso improprio del dispositivo.

Application Scheme:

The connection of the mode for the working in NORMAL is extremely simple. The transmission signals, reception and radio module settings up, are obtained through communication asynchronous serial interface input output.

The module always works in reception mode, the commutation from reception to transmission starts up automatically when the first data packet has entered into port 12 (RX_UART).



Picture 7: Application electric scheme

Device usage

In order to obtain the performances described in the technical specifications and to comply with the operating conditions which characterize the Certification, the transmitter should be mounted on a printed circuit taking into account the following:

Power Supply:

1. XTR-8LR10 must be supplied from very low voltage safety source protected against the short circuits. Maximum voltage variations allowed: $2.4 \div 3.6$ V. However it is preferable to maintain a stable voltage to a predetermined value in the range of voltage as specified above, using a voltage regulator "Fast transient response"
2. Decoupling, next to the transmitter, with a ceramic capacitor of minimum 100nF.
3. Connect electrolytic capacitor 100uF, low ESR, close to the pin 5 and pin 17 (+VDD).

Pin interface:

Put a capacity of 22-100pF close to the corresponding pins of signal connection, connected between them and the ground plane. The capacitance value varies according to the pin of the module, so please follow the lay-out of figure 7.

Ground:

The GND must surround at the best the soldering area of the module and must also be realized in the lower face in order to obtain the optimal result, with the through holes connecting the two ground planes.

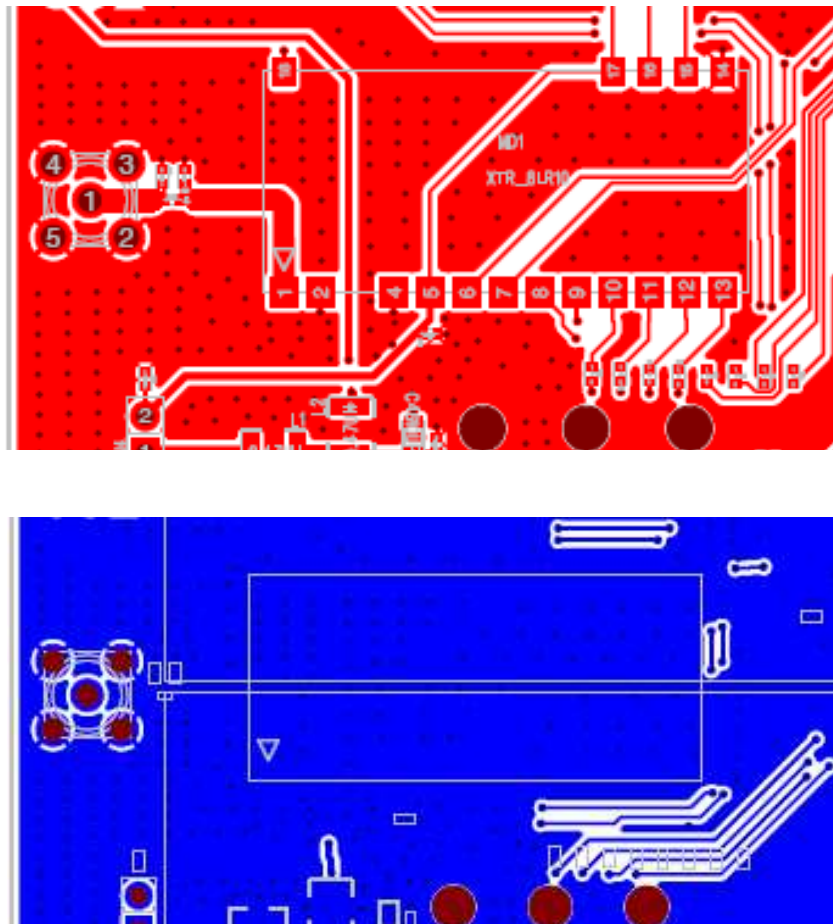
Antenna:

Connect pin 1 (antenna) to the coaxial connector or antenna, with 50 ohm constant impedance microstrip, width 3.2 mm for PCB with thickness 1.6 mm and 1.6 mm for PCB with thickness 1mm (see Figure 8). The antenna is a typical rigid copper wire (insulated or not) of 8cm length and cross-section of 0.5 mm² placed vertically to the ground plane.

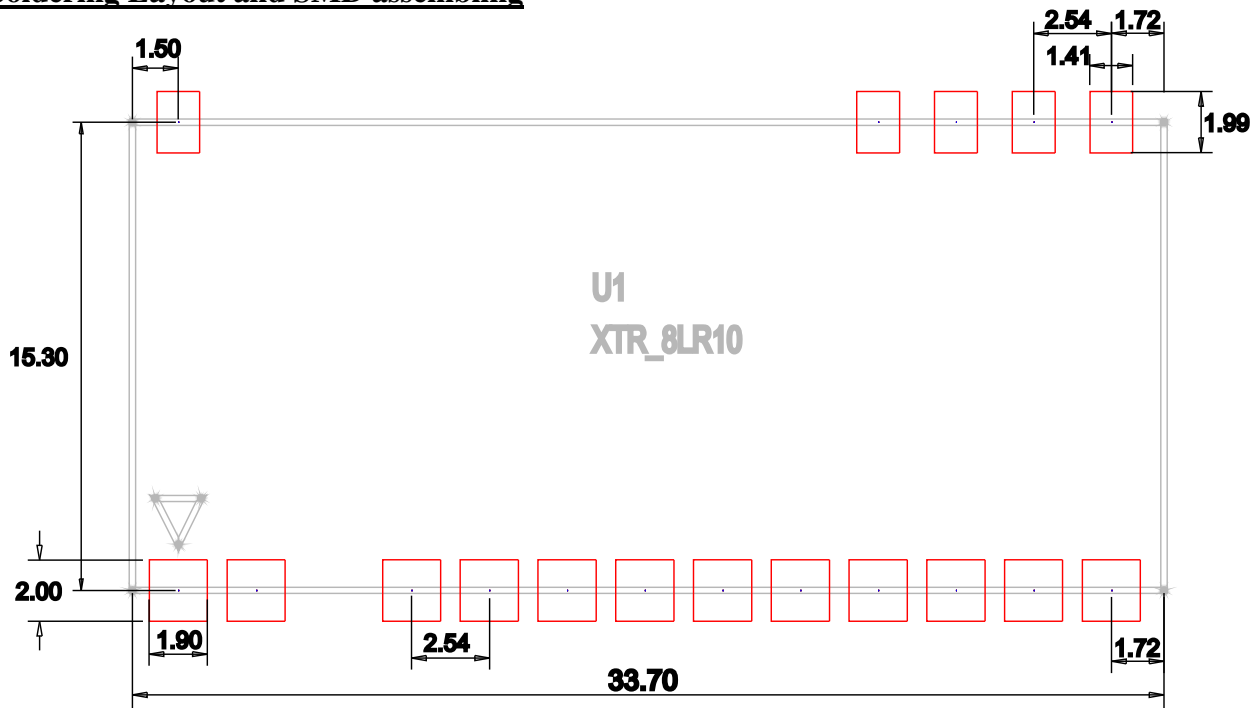
Other placements of antenna (bend, spiral) will work but performance are not predictable.

As an alternative to connect the module to an external antenna, connect an SMA connector into CS using 50ohm microstrip.

The proposed lay-out below, for example, shows the connections of signals and power supply on the top and a ground plane on the bottom side of the extended CS that surrounds the radio module. The cross-link antenna impedance 50ohm is 3.2 mm wide, specifically, calculated for double-sided Fr-4 epoxy glass 1.6 mm thick.



Picture 8: Example of lay-out, the connection tracks on PCB on the top side and ground plane in the button side

Soldering Layout and SMD assembling


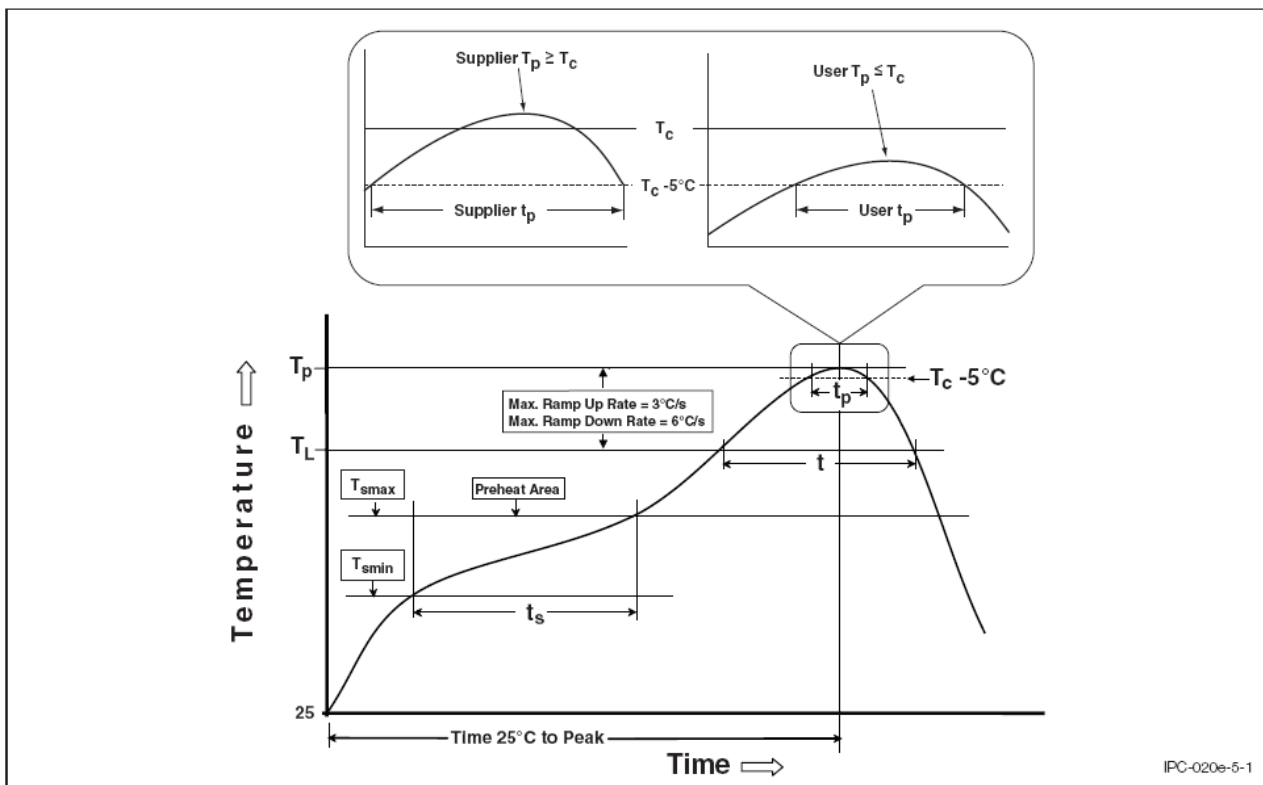
Picture 9: Soldering layout suggested for host board.

In order to ensure the right assembly of the module, it is necessary to apply a production process by observing carefully the following instructions:

- **Soldering paste:** Use soldering paste as SAC305 (96,5% Sn, 3% Ag, 0,5% Cu), screen printed according the layout of Picture 8, with a thickness > 150um.
- **Assembly:** the module can be assembled with automatic machine by using a suction cup tool, applied on bigger integrated circuit
- **Soldering:** the module can be soldered on host board, through a reflow profile for Lead-free components.
- Jedec standard “J-STD-020E”
- Lo standard Jedec “J-STD-020E” defines temperatures and exposure times, is attached below graph and profile table time / temperature recommended for the purpose.
- For host that provide more reflow cycles it is recommended to perform the soldering of the module at the end of the soldering cycle, taking care to limit excessive vibrations during the terminal phase of reflow soldering paste.

| Profile Feature | Pb-Free Assembly |
|---|------------------|
| Preheat/Soak | |
| Temperature Min (T_{smin}) | 150 °C |
| Temperature Max (T_{smax}) | 200 °C |
| Time (t_s) from (T_{smin} to T_{smax}) | 60-140 seconds |
| Ramp-up rate (T_L to T_p) | 2 °C/second max. |
| Liquidous temperature (T_L) | 217 °C |
| Time (t_L) maintained above T_L | 60-150 seconds |
| Peak package body temperature (T_p) | 240° |
| Time (t_p)* within 5 °C of the specified classification temperature (T_c), see Figure 9. | 30* seconds |
| Ramp-down rate (T_p to T_L) | 6 °C/second max. |
| Time 25 °C to peak temperature | 5 minutes max. |
| * Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum. | |

Table 3: Detailed time / temperatures profile for soldering XTR-8LR10



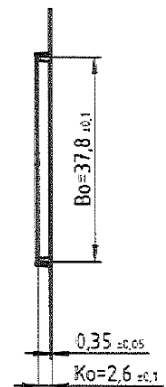
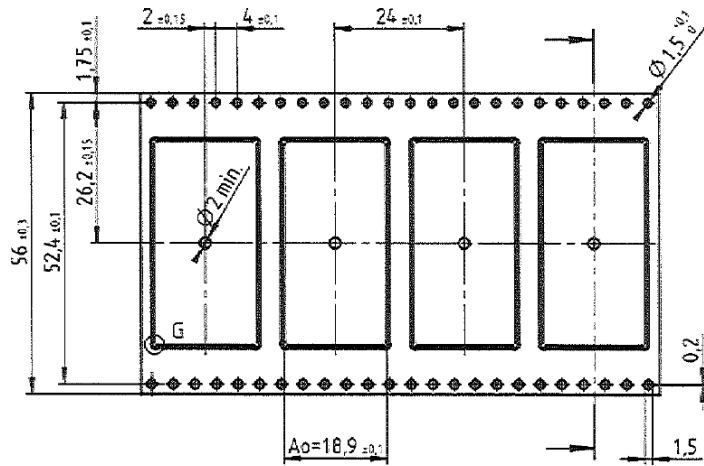
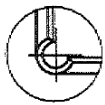
Picture 10: Soldering profile for XTR-8LR10

Le caratteristiche tecniche possono subire variazioni senza preavviso. AUR°EL S.p.A. non si assume la responsabilità di danni causati dall'uso improprio del dispositivo.

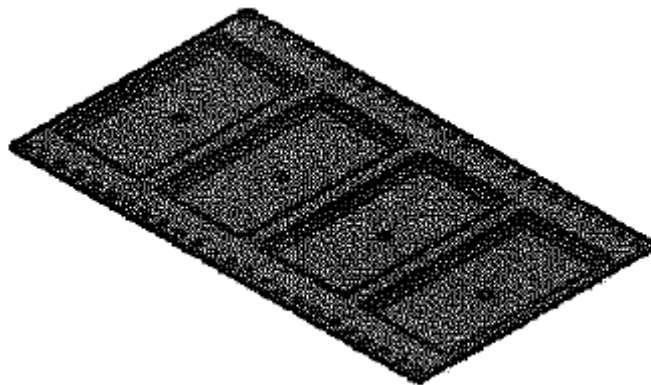
Specifications Packaging Tape and Reel:

XTR-8LR10 is packed in Tape and Reel composed by an embossed carrier tape and antistatic cover tape. In this way the modules are ESD protected and can be handled by machines for the automatic assembly of SMD components.

DETAIL G
SCALE 5 : 1



Picture 11: Tape and Reel drawing (in mm)



Picture 12: External aspect of the embossed

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Reference Rules

XTR-8LR10 transceiver is compliant with the European set of rules **EN 300 220 V2.4.1 (2012-05)**, and **EN 301 489-3 V1.5.1 (2012-07)**. Tests has been performed through transmissions of Pseudo Code Random at 500bps. 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** and it can be utilized inside a special insulated housing that assures the compliance with the above mentioned rules. The transceiver must be supplied from a very low voltage source, safety protected against short circuits.

The usage of the transceiver is foreseen inside housings that assure the overcoming of the rule **EN 61000-4-2** not directly applicable to the module itself.

Recommendation CEPT 70-03

XTR-8LR10 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 1% (equivalent to 36 sec to 60 minutes of usage).

Revision:

| Release date | revision user manual | Firmware correspondent | Changes from the previous revision |
|---------------------|-----------------------------|-------------------------------|---|
| 15/07/2015 | 1.0 | 0101 | First release |
| 04/03/2016 | 1.1 | 0101 | Pin reset documented |
| 19/05/2016 | 1.2 | 0102 | Replaced schematic connection, minium voltage |
| | | | |

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