XTR-8LR-ENC is a transceiver based on LoRa^{TM} modulation able to guarantee very long range communication (8 Km line of sight), high interference immunity , very high sensitivity and very low current consumption.

Compared to standard modulation techniques, "**LoRa ™**" improves up to 20 dB the receiver sensitivity, allowing long distances by using low power transmission and very low consumption, inexpensive power supply circuits and reduced dimensions.

XTR-8LR-ENC, to be paired with Aurel receiver XTR-8LR-DEC, allows to activate remote loads connected to the receiver. It embeds a secure encrypted RF communication.

It's ideal when it has to activate and control loads at very long distance like, for example, in irrigation or alarms systems applications.

The bidirectional communication allows to know if the XTR-8LR-DEC output has been activated and his status.

The module is designed for SMD assembly.

Size is 35.5 x 18 x 2.4 mm.

Main Features

- **Encrypted data transmission**
- **Reduce dimensions (35.5x18x2.4 mm)**
- **ERP: max 10 mW**
- **Sensitivity -126dBm**
- **Power supply 3,0V**
- **Standard distance: 8000 m**

Applications

- **Agriculture**
- **Irrigation Control**
- **Monitoring of photovoltaic plants**
- **Industrial controls**
- **SCADA**
- **Tele-alarms**
- **Monitoring of instruments**

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.	Typ.	Max.	Unit
DC levels				
Supply voltage pin 7,20	2.1	3	3.6	V
Current consumption (power down)		1	2	uA
Current consumption (Tx)		45		mA
Current consumption (Rx)		16		mA
High level voltage in input/output	0.7xVcc		Vcc	V
Low level voltage in input/output	0		0.3xVcc	V
RF TX				
RF frequency		868,30		MHz
RF radiated power (ERP)		10	12	dBm
Modulation		LORA™		
Channel bandwidth -3dB		125		kHz
RF spurious emissions < 1GHz			-36	dBm
RF spurious emissions > 1GHz			-30	dBm
RF power in adjacent channel in TX			50	nW
RF RX				
RX sensitivity		-126		dBm
Adjacent channel rejection		50		dB
Adjacent channel saturation		≥87		dB
Blocking immunity ±2MHz	85		90	dB
Blocking immunity ±10MHz	85		94	dB
Performance				
Bandwidth		125		kHz
Spreading Factor		8		SF
Coding Rate		4/5		
Outdoor range		8		km
RF channels		1		

Pin description

Figure 1: Pin-out and mechanical drawing
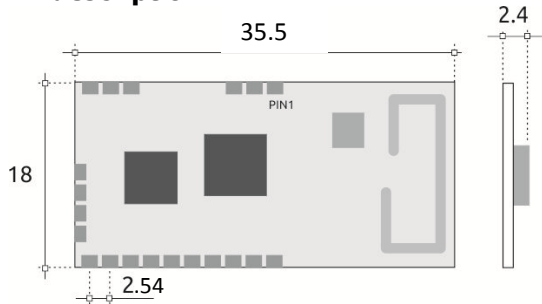
PIN-OUT

1) GND	7) VDD	11) GND
2) GND	8) RESERVED	12) IN 1
3) GND	9) RESET	13) IN 2
4) RESERVED	10) GND	14) IN 3
5) RESERVED		15) IN 4
6) GND		16) TX ON
		17) ACK RECEIVED
		18) RETRY EN
		19) GND
		20) VDD

Pin	Name	Description
1	**GND**	Ground connection.
2	**GND**	Ground connection.
3	**GND**	Ground connection.
4	**RESERVED**	Reserved for future developments.
5	**RESERVED**	Reserved for future developments.
6	**GND**	Ground connection.
7	**VDD**	Connection to a regulated supply voltage 3V-100mA.
8	**RESERVED**	Reserved for future developments.
9	**RESET**	Reset of the module (active low).
10	**GND**	Ground connection.
11	**GND**	Ground connection.
12	**IN 1**	Input channel 1 (active low) – Internal Pull up.
13	**IN 2**	Input channel 2 (active low) – Internal Pull up.
14	**IN 3**	Input channel 3 (active low) – Internal Pull up.
15	**IN 4**	Input channel 4 (active low) – Internal Pull up.
16	**TX ON**	Indicates RF transmission ON - Output active high.
17	**ACK RECEIVED**	Acknowledgment received. Output active if a valid ack has been received.
18	**RETRY EN**	Enables the automatic retries (internal pull-up, active high). Connect to GND to disable the function.
19	**GND**	Ground connection.
20	**VDD**	Connection to a regulated supply voltage 3V-100mA.

Table 1: Pin description

The technical features can change without forecasting. AUR°EL S.p.A doesn't assume any responsibility of damage due to the improper use of the device.

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Operation of the device

XTR-8LR-ENC (encoder) has a unique serial number therefore it always needs to be paired with Aurel XTR-8LR-DEC (decoder) module by means of learning procedure described in decoder user manual.

XTR-8LR-ENC is a transceiver module with 4 input lines (IN1-4) whom can be connected to buttons.

The device is always in power down mode and it has 2uA maximum current consumption.

When at least one of IN1-4 inputs is activated (forced from high to low level and low level maintained for minimum 30msec) the device wakes up and transmits, with an encrypted rolling code packet, the input lines status, the unique serial number, the battery level and an incremental counter.

Pin 16 (TX ON) of the module is active (high level) for the time of the transmission of RF packets.

Two operative modes are available in relation to input RETRY EN (pin 18) status.

"WITHOUT RETRY" MODE (pin 18 "RETRY EN" forced low)

Operative mode designed for decoder output in monostable mode (see XTR-8LR-DEC user manual).

In this operative mode the device sends RF packets when one of IN1-4 inputs is activated (forced from high to low level and low level maintained for minimum 30msec). The RF transmission carries on if at least one of IN1-4 inputs is active (low level).
The single RF packet has a time duration of about 150msec and the pause between two consecutive packets is about 80msec (the device is in reception mode during this time).

As described above. the encoder transmits the input lines status, the unique serial number, the battery level and the incremental counter.
The input lines status field in the RF packet is updated every time there is a change in input lines.
The counter is increased only before the first RF packet transmission after the device wake up from power down mode.
We suppose, for example, that IN1 is activated (forced from high to low level and low level maintained for minimum 30msec): the device sends RF packets with this input status information and a with counter of value "n". If, for example, IN2 is activated too (forced low), the encoder sends RF packets with information of IN1 and IN2 active and a counter with value "n".
See the XTR-8LR-DEC user manual for information about decoder outputs activation in case of more inputs IN1-4 active.

When all inputs are released the RF transmission ends and the device goes in reception mode for maximum 1.1 seconds waiting for ACK packet from decoder, then the device goes in power down mode.
If the XTR-8LR-DEC has received a valid data packet it sends an acknowledgment packet (ACK) to the XTR-8LR-ENC indicating that the output of the decoder has been activated.
Pin 17 (ACK RECEIVED) will be activate (see below for detail about activation) if XTR-8LR-ENC receives the ACK packet then the device goes in power down mode.

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<u>"WITH RETRY" MODE (pin 18 "RETRY EN" forced high or left open)</u>

Operative mode designed for decoder output in bistable mode (see XTR-8LR-DEC user manual).

In this operative mode, if at least one of IN1-4 inputs is activated (forced from high to low level and low level maintained for minimum 30msec) the device sends one RF packet (RF transmission has a time duration of about 150msec) to the XTR-8LR-DEC and it waits for ACK packet.
Pin 17 (ACK RECEIVED) will be activate (see below for detail about activation) if XTR-8LR-ENC receives the ACK packet.
If the module doesn't receive the ACK packet, it automatically sends another packet to the XTR-8LR-DEC and it waits again for the ACK. The device performs maximum 3 retries with a random time (from 135msec to 235msec) between two transmissions.
Therefore in this operative mode the XTR-8LR-ENC sends only one RF packet (and maximum 3 retries if ACK is not received) even if the input remains active.

As described above the encoder transmits the input lines status, the unique serial number, the battery level and the incremental counter.
All packets contain the same information of input lines status (the input status before the first RF packet transmission) and the same counter even if input lines change during RF transmission.
See XTR-8LTR-DEC user manual to know how decoder output are activated in case of more inputs IN1-4 active.

In both operative modes, if the battery level of the encoder is below the threshold (< 2,4 V), the BATT LOW output on the decoder will be activated (see XTR-8LR-DEC user manual).

In both operative modes, if the device receives the ACK packet from the XTR-8LR-DEC, the ACK RECEIVED pin is activated in different way depending on the activated output status on the decoder:
- if the output is MONOSTABLE the ACK RECEIVED will be ON for 100msec;
- if the output is BISTABLE and it has been ACTIVATED the ACK RECEIVED will be ON for 100msec;
- if the output is BISTABLE and it has been DEACTIVATED the ACK RECEIVED will blink two times (ON time = OFF time = 100msec).

If the last packet received from decoder has button status field with two or more buttons pressed, the decoder sends an ACK packet with a "warning information". In this case on the encoder the ACK RECEIVED will blink three times (ON time = OFF time = 100msec).
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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 transceiver should be mounted on a printed circuit taking into account the following:

Power Supply:

1. XTR-8LR-ENC must be supplied from very low voltage safety source protected against the short circuits. Maximum voltage variations allowed: $2.1 \div 3.6$ V. However it is preferable to maintain a stable voltage to a predetermined value in the range of voltage as specified above, using a "fast transient response" voltage regulator.
2. Decoupling, close to the transceiver, with a ceramic capacitor of minimum 100nF.
3. Connect electrolytic capacitor 100uF, low ESR, close to pins 7,20 (+VDD).

Input pin interface:

Put 100pF capacitors close to the corresponding input pin IN1-4, connected between them and the ground plane.

Ground:

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

Antenna:

Embedded Antenna, leave it free from metal materials.
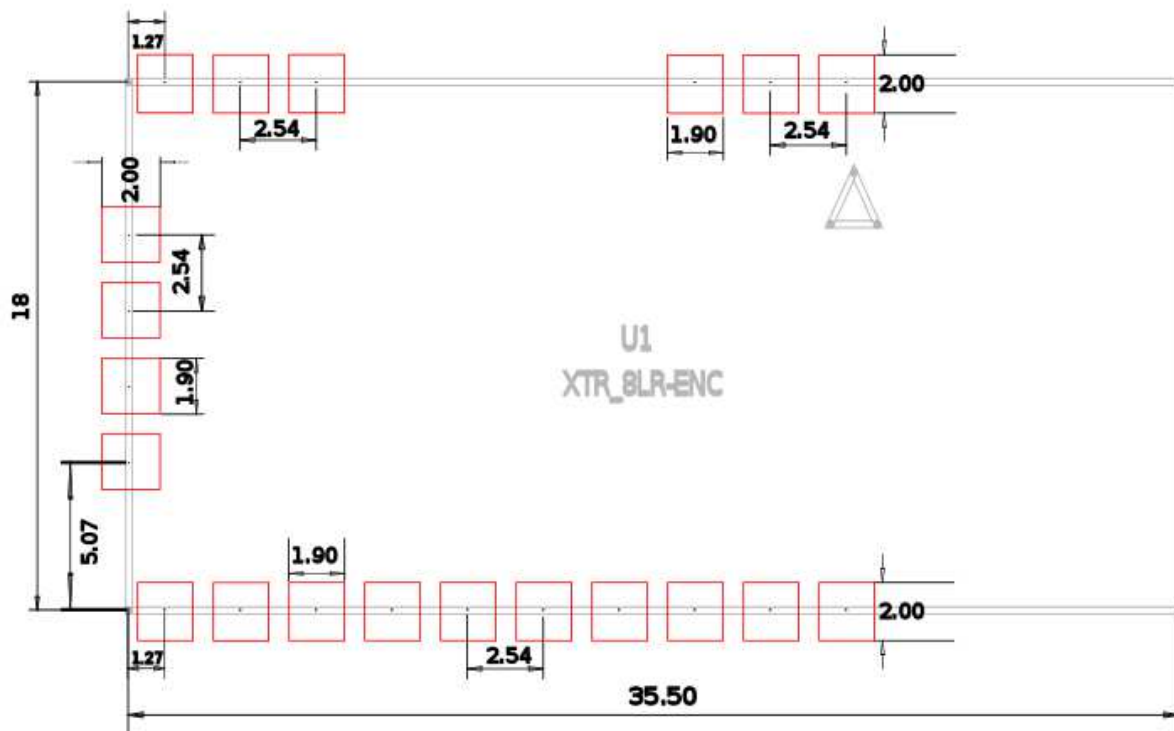
Soldering and assembling SMD layout

Figure 2: suggest layout for host board.

In order to ensure the correct assembly of the module you are required to apply a production process observing carefully the following recommendations:

- Soldering paste: use soldering paste as SAC305 (96,5% Sn, 3% Ag, 0,5% Cu), screen printed according the layout of Figure 2, 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 "J-STD-020E" standard 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 soldering paste reflow.

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Profile Feature	Pb-Free Assembly
Preheat/Soak Temperature Min (T_{smin}) Temperature Max (T_{smax}) Time (t_s) from (T_{smin} to T_{smax})	150 °C 200 °C 60-140 seconds
Ramp-up rate (T_L to T_P)	2 °C/second max.
Liquidous temperature (T_L) Time (t_L) maintained above T_L	217 °C 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.	

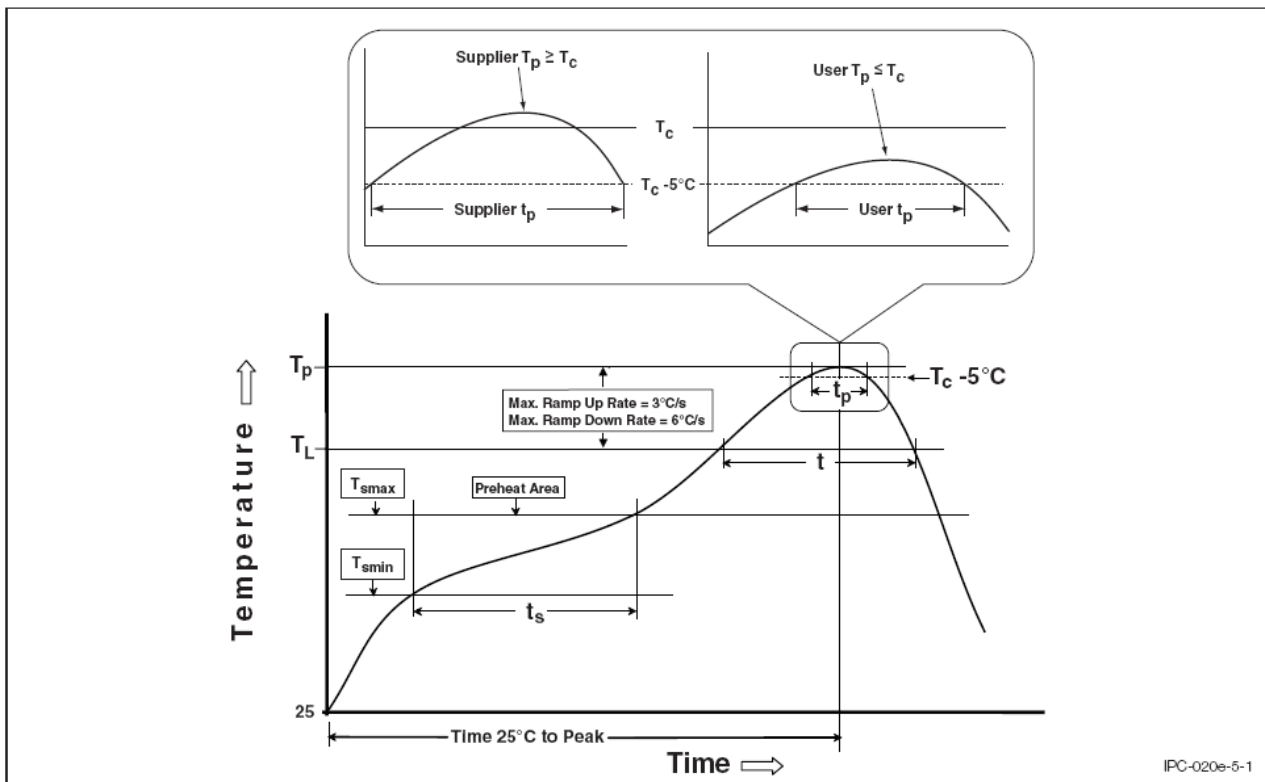**Table 2:** Detailed time/temperature soldering profile for XTR-8LR-ENC

Figure 3: Soldering profile for XTR-8LR-ENC

Reference Rules

XTR-8LR-ENC transceiver is compliant with the European set of rules **EN 300 220-2**, and **EN 301 489-3**. The transceiver must be supplied by a very low voltage safety source protected against short circuits.

The usage of the module is foreseen inside enclosures that guarantee the **EN 61000-4-2** normative not directly applicable to the module itself.

This device is compliant with **EN 62479**, connected to the electromagnetic field human exposition, if used with temporal duty cycle not higher than 1% like foreseen in CEPT 70-03 recommendation.

CEPT 70-03 Recommendation

XTR-8LR-ENC recommendation is referred to the 868.0 - 868.6 MHz harmonized bandwidth and therefore, in order to comply with local regulations, the device must be used on the time scale with maximum duty-cycle time of 1% (equivalent to 36 seconds of usage on 60 minutes).

Firmware version summary

Release date	Firmware version	Changes from the previous version
28/11/2016	0.3	First stable version
16/02/2017	0.5	Minor bugs fixed
30/01/2018	1.0	Changes in input lines and counter management.
08/05/2018	1.1	Added a different ACK RECEIVED activation depending on the activated output status on the decoder.

User manual revision summary:

Release date	Revision user manual	Changes from the previous revision
28/11/2016	1.0	Preliminary
16/02/2017	2.0	First release
30/01/2018	3.0	Added description of firmware version 1.0 behaviour
09/05/2018	4.0	Added description of ACK RECEIVED activation in firmware version 1.1

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