USER MANUAL

Z-AIR-1

RADIOMODEM 868-870 MHZ with RS485 interface and internal dipole antenna.
Complies with Directive 2014/53/UE (RED)



CE

SENECA®

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1. DISCLAIMER

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2. TECHNICAL SUPPORT

Our website www.seneca.it contains many useful information, user guides and configuration software and technical documents always update to the latest version.

If you have technical problems or cannot find the required information in the provided documents, contact our Technical Support by email at support@seneca.it or by phone +39 049 8705359.

3. RESTRICTIONS ON USE

SENECA PRODUCTS HAVE NOT BEEN DESIGNED, INTENDED NOR INSPECTED TO BE USED IN ANY LIFE SUPPORT RELATED DEVICE OR SYSTEM RELATED FUNCTION NOR AS A PART OF ANY OTHER CRITICAL SYSTEM INCLUDED AERONAUTICAL / AEROSPACE APPLICATION.
SENECA PRODUCTS ARE GRANTED NO FUNCTIONAL WARRANTY IF THEY ARE USED IN ANY OF THE APPLICATIONS MENTIONED.

SENECA Z-AIR-1 radio modems have been designed to operate on frequency ranges as SRD (Short Range Device), the exact use of which differs from one region and/or country to another. The user of a radio modem must take care that the device is not operated without the permission of the local authorities on frequencies other than those specifically reserved and intended for use without a specific permit.

SENECA Z-AIR-1 can be used in the following countries with E.R.P. and duty cycle limitation, either on licence free channels or on channels where the operation requires a licence. More detailed information is available at the local frequency management authority.

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Country allowed (4)
ALB-AND-AUT-BEL-BIH-BLR-BUL-CYP-CZE-D-DNK-E-EST-F-FIN-G-GRC-HNG-HOL-HRV-I-IRL-ISL-LIE-LTU-LUX-LVA-MDA-MKD-MLT-MNE-NOR-POL-POR-ROU-RUS-S-SRB-SUI-SVK-SVN-TUR-UKR

Allowed use according to ERC Recommendation 70-03					
Z-AIR-1	**Frequency (MHz)**	**Annex (1)**	**E.R.P (2)**	**Duty Cycle (3)**	**Country(4) with restriction of use**
	863,000 – 870,000	1	≤ 25 mW	≤ 0.1 %	BLR-GRC-NOR-RUS-S
	868,000 – 868,600	1	≤ 25 mW	≤ 1 %	RUS
	868,700 – 869,200	1	≤ 25 mW	≤ 0.1 %	BLR-UKR
	869,400 – 869,650	1	≤ 500 mW	≤ 10 %	BLR-RUS-UKR
	869,700 – 870,000	1	≤ 5,0 mW	≤ 100 %	RUS-UKR

NOTE:
Before to install the device check always the latest version of ERC Recommendation 70-03 in order to verify any restriction and limitation in terms of E.R.P and Duty Cycle
(1) Annex 1.xxx refer to SRD (Short Range Device), Annex 2 refer to Tracking, Tracing and Data Acquisition.
(2) E.R.P. = Max Effective Radiated Power allowed from radiomodem and associated antenna takes into consideration transmitter power output, transmission line attenuation, RF connector insertion losses and antenna gain
(3) Duty Cycle is defined as the ratio, expressed as a percentage, of the maximum transmitter “on” time on one carrier frequency, relative to a one hour period
(4) The CEPT country codes can be seen under http://www.cept-org/cept/cept-country-codes

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4. TECHNICAL SPECIFICATIONS

Operating data			
Label	*Description*		*Value*
$V_{S\ (EXT)}$	Power supply, voltage range		9,0 ⟶ 32 Vdc
$P_{S\ (EXT)}$	Max power		max. 5 W
I_{Sleep}	Sleeping current (Power Off)		≤ 150 µA @ 12VDC
P_{RF}	RF transmission power	Livello H	500 mW
		Livello M	150 mW
		Livello L	25 mW
RX_{SENS}	Receiver sensitivity		≤ -105 ± 3 dBm
RF_{MOD}	Modulation mode		***F1D
CH	Canalization		25 – 50 kHz
BR Radio	Baud Rate on radio channel		9.600 – 19.200 bps
Buffer	Memory buffer		1024 bytes
$I_{A,B\ LINES}$	Max current out at RS-485 serial port		± 60 mA
BR DTE	Baud Rate RS-485 serial port		1.200 ⟶ 57.600 bps
IP	IP rating		IP65

NOTE:
(1) with 5 mt cable length, consult SENECA Srl for cable length more then 5 mt

WARNING: Exceed the maximum operating value below (continuos and/or temporary) can damage the device

Maximum operating data		
Label	*Description*	*Value*
$V_{S(EXT)}$	Max power supply voltage	32 Vdc
$V_{P\ RS-485}$	Max peak voltage at the ports A/B RS-485 (1)	± 32 Vdc
$I_{A,B\ LINES}$	Max current out at the A/B RS-485	± 200 mA
$T_{OPERATING}$	Operating temperature range	-30°C +60 °C
$T_{STORAGE}$	Storage temperature range	-40°C +85 °C

NOTE:
(1) Impulse time < 100 millisecond.

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5. WARRANTY – LIABILITY OF THE PRODUCT

Supplier represents and warrants that products are manufactured in accordance with the applicable specifications and are free from defects in materials and workmanship. The warranty, valid for a period of 12 months of use, maximum 18 months from the date of delivery, shall not cover defects caused by accident, Buyer's negligence, improper use or maintenance or by any other reason beyond Supplier's control.

Buyer shall have 10 (ten) working days following receipt of products to inspect the products and to notify to Supplier in writing any defects or non-compliance. In the event that any shipment of products is not accepted by Buyer due to any non-conformity with the specifications, or as a result of a cause occurred prior to placement thereof with the carrier, Buyer shall, if so indicated in writing by the Supplier, promptly return some samples or the full shipment that was rejected by Buyer at Buyer's costs.

Supplier, at its own discretion, shall, within a reasonable period, considering the entity of the complaint: (i) send a replacement shipment of products conforming, or (ii) credit Buyer a sum equal to the value of the defective or non-conforming products. This warranty overwrites all legal warranties for defects and compliance and exempts Supplier from any other responsibility for the supplied products; in particular, Buyer shall not be entitled to any requests for compensation or price reductions.

If one of the products sold by the Supplier to the Buyer is defective, the Buyer will send it, at its own expense, at the headquarters of the Italian Supplier. The product will be repaired or replaced by the Supplier, at no costs to the Buyer.

The Buyer will pay all the shipping costs for the product repaired or replaced and sent back to the Buyer.

The Buyer will bear all costs related to disassembly, assembling and transportation of the product, and any damage caused by the "machinery inactivity".

Supplier shall indemnify Buyer against any liability of the products claims asserted by third parties relating to damages sustained as a result of a defective products. In such case Supplier shall reimburse Buyer exclusively within the limits, terms and conditions of the products liability insurance policy held by Supplier. Buyer shall not make any oral or written representations which vary from the specifications, operating instructions, labels or representations given or made by Supplier with respect to the products. If any liability is incurred because of such varying representations, Buyer holds Supplier harmless with respect to any such representations.

In no event shall Supplier be liable for any indirect, incidental, exemplary or consequential damages, including without limitation any claim for damages based on lost revenues or profits, however caused.

In no event shall the Supplier be liable for any costs or damages arising from any act or omission of Buyer, including, without limitation, relating to the modification, handling, storage and marketing of Products by Buyer or to Buyer's failure to provide its employees, agents and customers or other third parties with adequate instruction as to the proper handling and use of Products.
In this respect we hereby confirm that our products are not designed for nuclear applications neither for aircraft/aerospace industries. For the above mentioned applications warranty do not apply.

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6. WARNINGS AND SAFETY INSTRUCTIONS

Read these safety instructions carefully before using the product:

Warranty will be void, if the product is used in any way that is in contradiction with the instructions given in this manual, or if the radio modem housing has been opened or tampered with.

The radio modem is only to be operated at frequencies allocated by local authorities, and without exceeding the given maximum allowed output power ratings and duty cycle. SENECA and its distributors are not responsible, if any products manufactured by it are used in unlawful ways.

The devices is complies with Directive 2014/53/UE (RED) and Directive 2011/65/UE (ROHS)

The devices mentioned in this manual are to be used only according to the instructions described in this manual. Faultless and safe operation of the devices can be guaranteed only if the transport, storage, operation and handling of the devices is appropriate. This also applies to the maintenance of the products.

Place the antenna at a height greater than or equal to 2 m above the general public walkway that gives general public access.

Do not install the equipment close to a heat source or in damp conditions and direct sunlight is also to be avoided.

The device must not be exposed to aggressive chemical agents or solvents likely to damage the plastic or corrode the metal parts.

The device must not be exposed directly to dusty environment.

Maintenance should only be carried out by qualified persons.

For your own safety, you must ensure that the equipment is switched off before carrying out any work on it.

7. DISPOSAL OF WASTE BY USERS IN PRIVATE HOUSEHOLDS WITHIN THE EUROPEAN UNION



According to Directive 2012/19/EU of the European Union on waste electrical and electronic equipment (WEEE) this product must not be disposed off with your other household waste, it is your responsibility to dispose of your waste by taking it to a collection point designated for the recycling of electrical and electronic appliances.

Separate collection and recycling of your waste at the time of disposal will contribute to conserving natural resources and guarantee recycling that respects the environment and human health.

For further information concerning your nearest recycling centre, please contact your nearest local authority/town hall offices.

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8. GENERAL DESCRIPTION

Z-AIR-1 is a radiomodem with RS485 interface and an internal dipole antenna. The device is fully configurable via software. The Z-AIR-1 uses an internal dipole antenna which results in no signal attenuation, due to a connection between the radio and antenna. This allows installation of the Z-AIR-1 at a greater distance from the data signal source.
A robust, multi-pair serial data cable connection allows use in outdoor installations.
Robust construction with surface mounted components, ensure highly-stable electronics. Being housed in an IP65 enclosure, allows the Z-AIR-1 to be located in unfriendly environments.

Z-AIR-1 has 4 operating modes that are software programmable: radiomodem, mirror point to point, ModBUS slave, or ModBUS master; allowing greater flexibility in the field.
Z-AIR-1 uses routing tables to obtain fewer collisions in complex networks and Z-AIR-1 can also be used as a ModBUS hub allowing ModBUS modules (inputs and/or outputs) to be connected through the RS-485 port.

Data Encryption 128bit AES (Advanced Encryption Standard) ensures transmitted data security.

CHARACTERISTICH AND FUNCTION AVAILABLE

Yes= you can choose and/or modify the function
No = the function doesn't exist or is not enabled

	Operating modes						
	Radio	ModBUS Standard		ModBUS Low Energy		Mirror	
	Modem	Master	Slave	Master	Slave	Master	Slave
Radio							
Channel spacing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RF channel	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Frequency Agility	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Listen Before Talk	Yes	Yes	Yes	No	No	No	No
RF power	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Serial Port RS485							
Bit Rate	Yes	Yes	Yes	Yes	Yes	No	Yes
Parity bit	Yes	Yes	Yes	Yes	Yes	No	Yes
DTX Time	Yes	Yes	Yes	Yes	Yes	No	Yes
Data							
AES encrytption	Yes	Yes	Yes	Yes	Yes	No	No
Routing Table	Yes, 1 route	Yes, 255 route	No	No	No	Yes, 1 route	Yes, 1 route
Broadcasting	Yes	No	No	No	No	No	No
Address from DTE	Yes	No	No	No	No	No	No
Address to DTE	Yes	No	No	No	No	No	No

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	Operating modes						
	Radio	ModBUS Standard		ModBUS Low Energy		Mirror	
	Modem	Master	Slave	Master	Slave	Master	Slave
Rx address for Tx	Yes	No	No	No	No	No	No
Request of ACK	Yes	No	No	No	No	No	No
Set number of retries	Yes (max. 255)	No	No	No	No	No	No
NAK to DTE	Yes	No	No	No	No	No	No
Other							
Diagnostic	Yes	No	No	No (always active)	No (always active)	No	Yes
Power Save	Yes	Yes	Yes	No	No	No	No
Link Test	Yes	No	No	No	No	No	No

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9. INSTALLATION

9.1. Mechanical

The device can be installed in an indoor or outdoor location (IP65). Place the device against a stable surface. It is not recommendable to install the radio modem on a strongly vibrating surface. Suitable dampening and/or isolation materials should be used in cases where the installation surface will be subjected to vibration.

9.2. Electrical (wiring)

To prevent damage both the radio modem and any terminal devices must always be switched OFF before connecting or disconnecting the serial connection cable. It should be ascertained that different devices used have the same ground potential. Before connecting any power cables the output voltage of the power supply should be checked.

The product has no disconnecting device. An external disconnecting device must be installed. This must be close to the equipment.

Provide an adequate termination resistance on the RS485 serial line.

To by supplied by class II (LPS) certified AC/DC adaptor.

Cable	
Label	***Colour***
VCC +	Orange
VCC -	White - Orange
RTX Enable (1)	White – Green
RS-485 (line A)	Brown
RS-485 (line B)	White – Brown
Ground (GND)	Green
ON AIR Led	White – Blue
PWR ON Led	Blue

The cable shield is factory connect to GND's device, in order to avoid "Ground Loop" we suggest not to connect the shield to ground

(1) If the RTX Enable is not used, it must be connected to positive supply voltage (max +32 VDC), if it is not connected, Z-AIR-1 is switched off.

9.3. Antenna

The device is complete with lambda/2 (dipole) embedded antenna, it can be fixed on a pole by means of the mounting kit that is supplied. The device must be free and at least 10 cm away from any other conducting material.

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10. CONFIGURATION

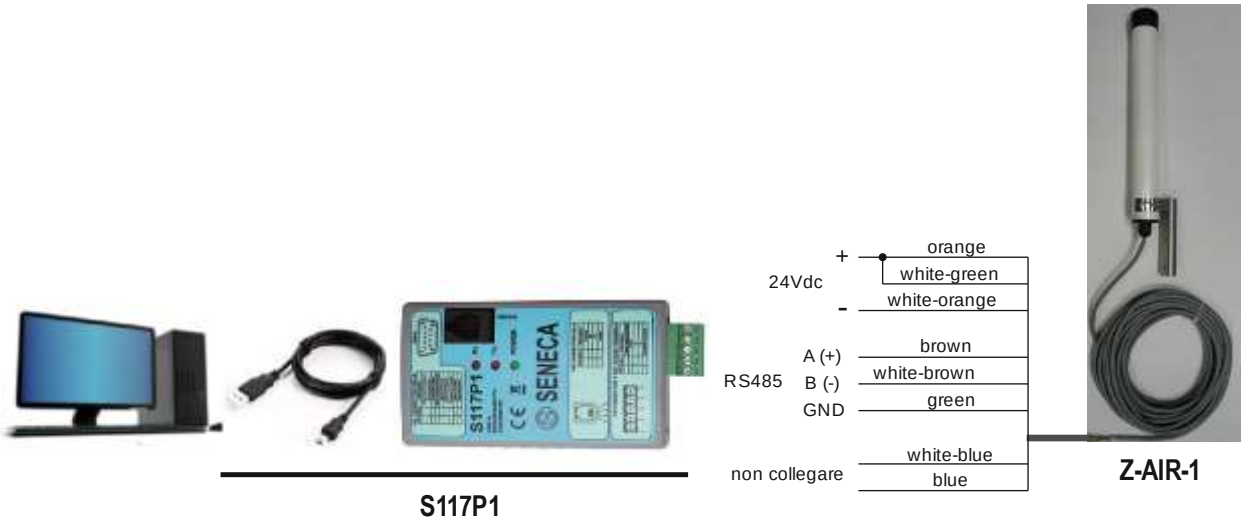
Please download the latest software version about **Z-AIR-1 Setup.** It is available in the software section of the product page at this link **www.seneca.it/products/z-air-1** (for more details www.seneca.it)
The configuration must be done through a RS485 interface like SENECA S117P1 or equivalent.

10.1. System requirements

Operating systems supported: Windows 98 SE, Windows ME, Windows2000, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10.
Minimum screen resolution: 800 x 600 dpi.

10.2. Configuration via USB using S117P1 (RS232/RS485 to USB converter)

1) Install the appropriate driver as explained in the user manual of the S117P1 interface.
2) Connect the interface S117P1 to a personal computer by a USB cable with type A connector (PC side) and microUSB connector (interface side).
3) Go into the options menu of the configurator (Options) and **select the serial port** (Serial port selector).
4) Connect with a cable the signals: Ground, A, and B, of the S117P1 interface to the respective signals of the radio modem.
5) Power up the radio modem.



6) To enter in configuration mode you must follow this step: turn off the radio modem, click on the "**Turn On**" button of the configurator and turn on the radio modem within 4 seconds from the push of the "Turn On" button (while the button is flashing green).

Note:
When the program starts, the buttons "Next Page", "Load Default" and "Write", remain inhibited until you choose the operating mode between: "Mirror", "Low energy", "ModBUS standard" or "Radiomodem". This choice is done by pressing the relevant button in the configurator.

The selection among the various fields of the configuration program is carried out with the TAB key or by positioning the mouse pointer over the field and clicking once with the left button. A function is activated when, in the relative box, the check mark is present.

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Function of the Buttons common to all modes:

Read:
Reads the data from the radiomodem.

Write:
Writes the configuration data into the radiomodem.

Load Default:
Resets all fields to their default values.

Next Page:
Allows you to move to the second page. You can go to the second page only if you have selected an operative mode between the four possible ones.

Exit:
Close the configurator program.

Note:
The buttons **Write**, **Load Default** and **Next Page** are activated only if you have selected an operation mode between the four possible ones, or if you load a configuration file (using the menu File, Open), or if the configuration is read by a radio modem unit.

Toolbar:
The Toolbar on the upper side of the screen contains **File**, **Options** and **Help** Menus. Each menu can be opened as a normal Windows menu using both mouse and keys.
The different menus have the following functions:

FILE menu:
- Open (path/filename): Loads an existing file in the configurator program.
- Save (path/filename): Updates an existing file after a change in the parameters.
- Save As (path/filename): Creates a new file containing all configuration data. The user can select an adequate filename and choose the destination folder. The default destination folder has the same path as the executable program.
- Exit: close the configurator program.

Options menu:
- Serial port selector: Open the serial port selection box. A port number between 1 and 16 can be chosen.
- **Model**: allows a choice between the models of radio modems
- Canalization
25 KHz: the width of the radio channel is **25 KHz** and the speed of radio data is **9600 bps**.
50 KHz: the width of the radio channel is **50 KHz** and the speed of radio data is **19200 bps**.

Help menu:
- Index F1: Open the Help file.
- About: Display the version information about the configuration software.

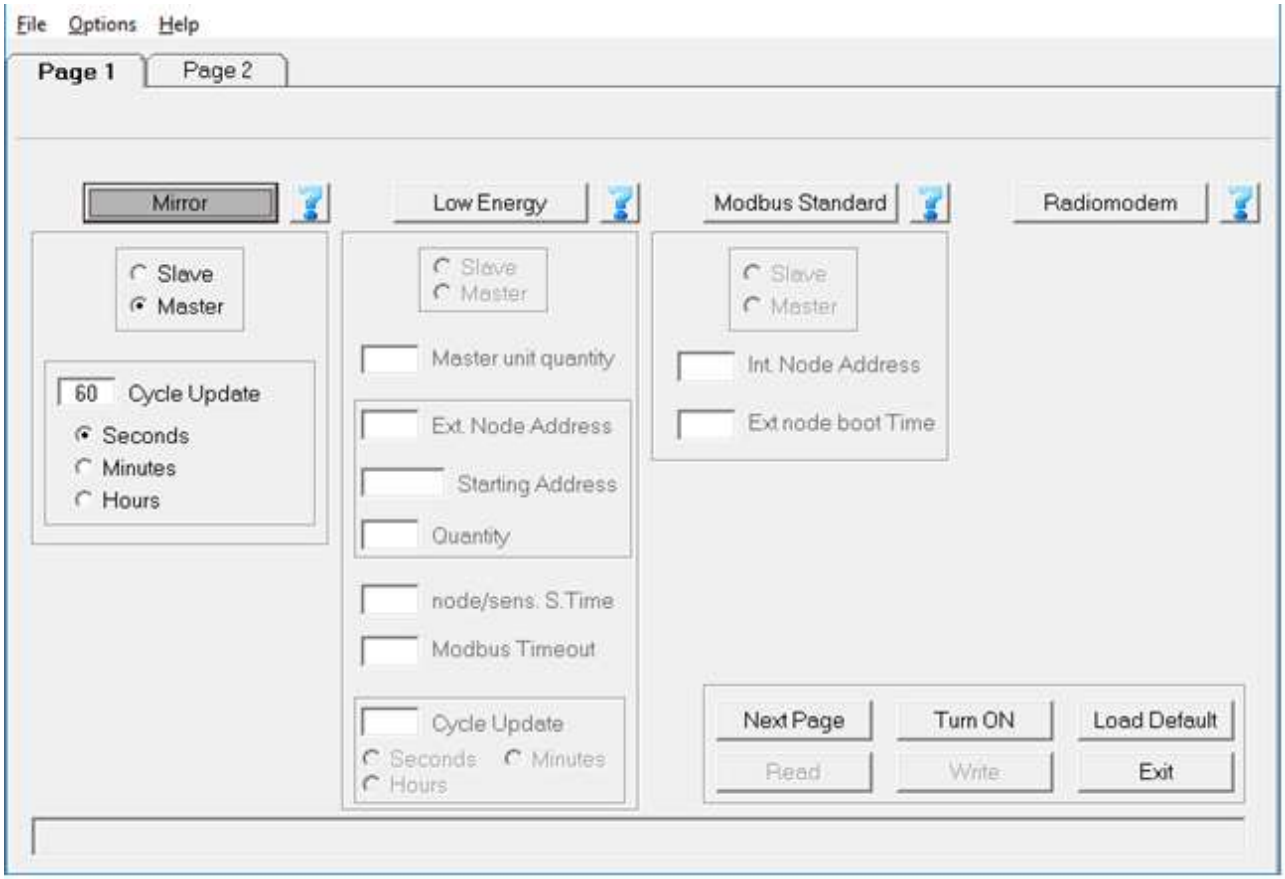
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11. OPERATING MODES AND SETTINGS

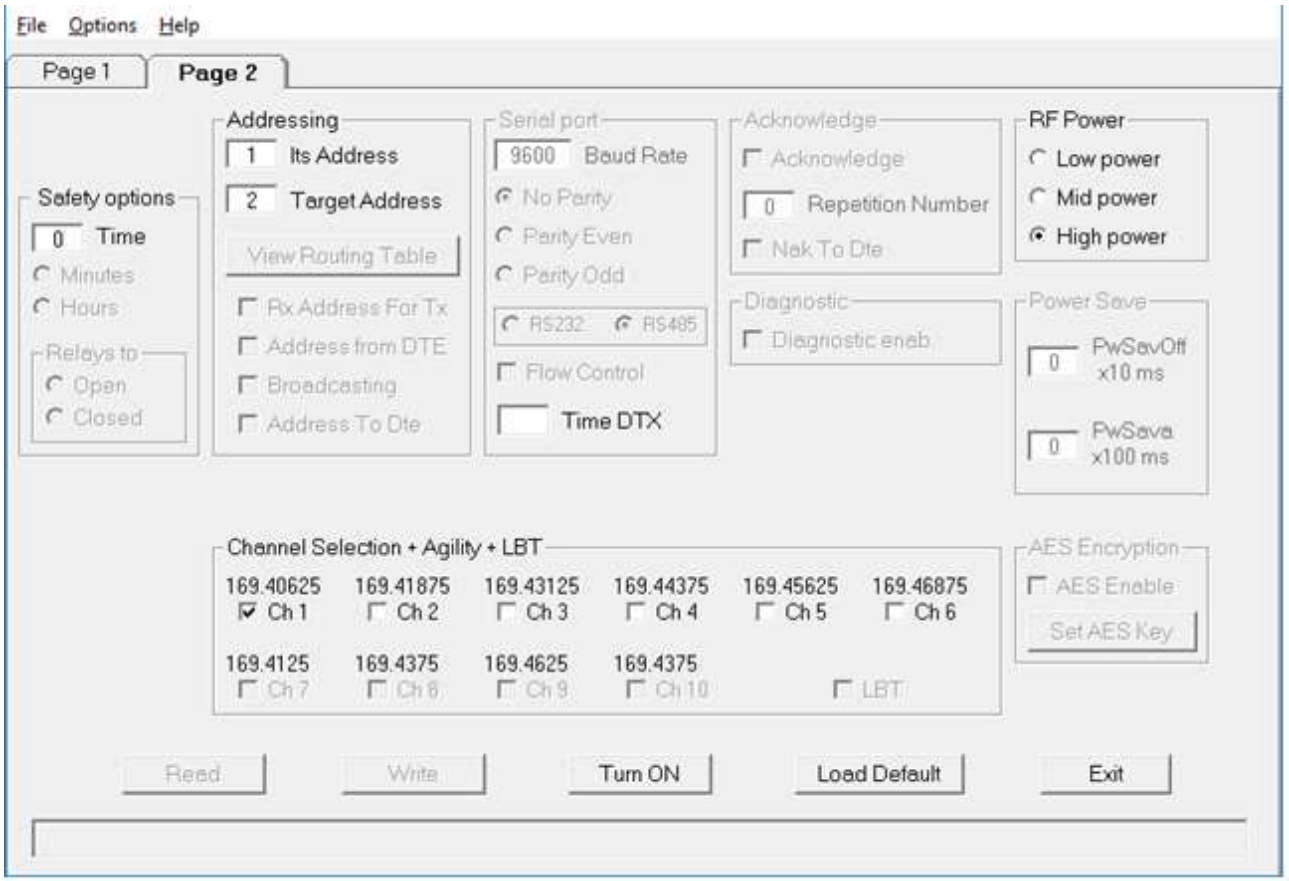
11.1. MIRROR OPERATING MODE

In **Mirror mode**, Z-AIR-1 can be used such as digipeater associated to other radiomodems.



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Its address:
It is the value of the address of this radiomodem. It is advisable to configure each radiomodem with a unique address.

System Code & Digipeater address (**double click of the mouse on "Target" or [Enter] key**):
When the focus is on the Target field, pressing the "Enter" key on the keyboard or by double clicking the mouse, a window opens in which you can enter the system code and the addresses of the digipeater path to include in the radio link. **On the involved units the system code must be the same**.

RF Power:
Allows the choice between three different levels of power: High, Medium, Low. If the RSSI value displayed in diagnostic parameters of the Slave unit is good (-70 dBm or better), and if the low power of the Master unit is an important factor, it is advisable to choose a medium or low power level.

Channel selection + Agility + LBT:
In this box you choose the radio channel to be used. If you want to use the agility feature (transmission on the less noisy channel among the active channels), you can select more than one radio channel. The maximum number of active channels is dependent on the canalization setting. **It is mandatory that in the same network all the radiomodems use the same radio channels.** In Mirror mode the LBT function cannot be activated.

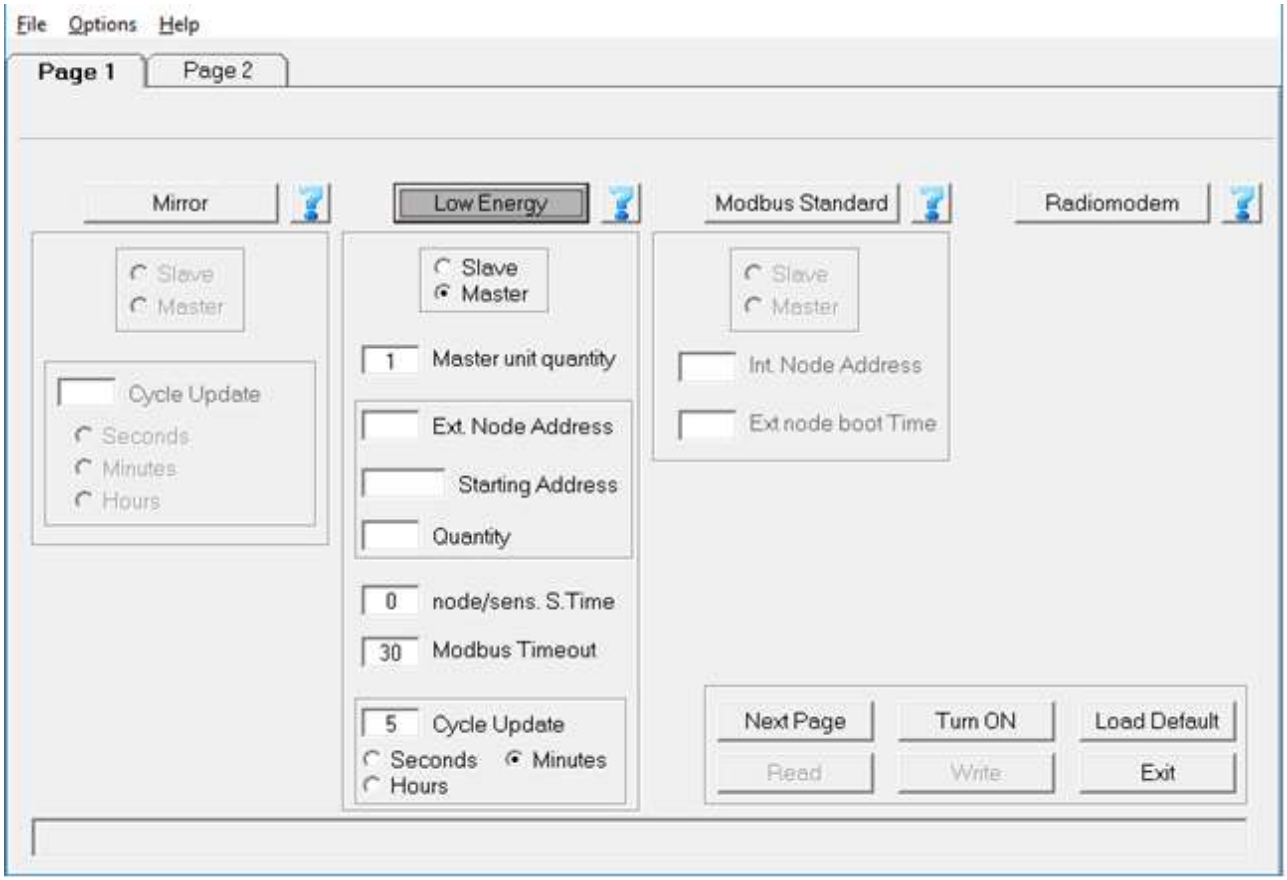
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11.2. MODBUS LOW ENERGY OPERATING MODE

In this operating mode the network is composed of one Slave unit and one or more (up to 16) Master unit. The Slave unit is connected to a PC (or PLC) on which there is a running SCADA software. The slave device is always in reception, never takes the initiative of the transmission and transmits only in response to a packet received from a Master unit. The Master units send a packet to the Slave unit using the ModBUS RTU Protocol. The function "Write multiple registers (function code 0x10) is used. The transmission of the Master units is triggered by the expiration of the timer dedicated to the periodical sending.
On each Master device, it is possible to connect, by the RS485 interface, an external ModBUS node (ModBUS device that can read digital or analog inputs) in order to extend the number of monitored signals.

In the Master unit, when a transmission is triggered, the value of the digital and analog inputs is first acquired, the external node (if present) is read, then the radio modem sends the packet consisting of the collected data. The slave device receives the packet, controls it, and if there are no errors, it sends the data (payload) to the SCADA application via the RS485 interface. At this point the SCADA software, connected to the Slave radiomodem, sends the response packet, which is transmitted back to the Master unit. At the end of the communication, the Master unit returns in sleep mode, waiting for a new transmission event.



Slave / Master:
Allows you to select the functionality of the radiomodem between Master and Slave. The unit configured as a Master uses the energy saving and transmits due to events. The unit configured as a slave is always active and never takes the initiative of the transmission.
In case of unit used as digipeater the unit must to set as Slave unit

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Master unit quantity:
Defines the number of the Master radiomodems present in the network. The allowed values range from 1 to 16.

Ext node address:
In this field the address of the external ModBUS node is set, which it must be identical to the address assigned to the ModBUS node device.

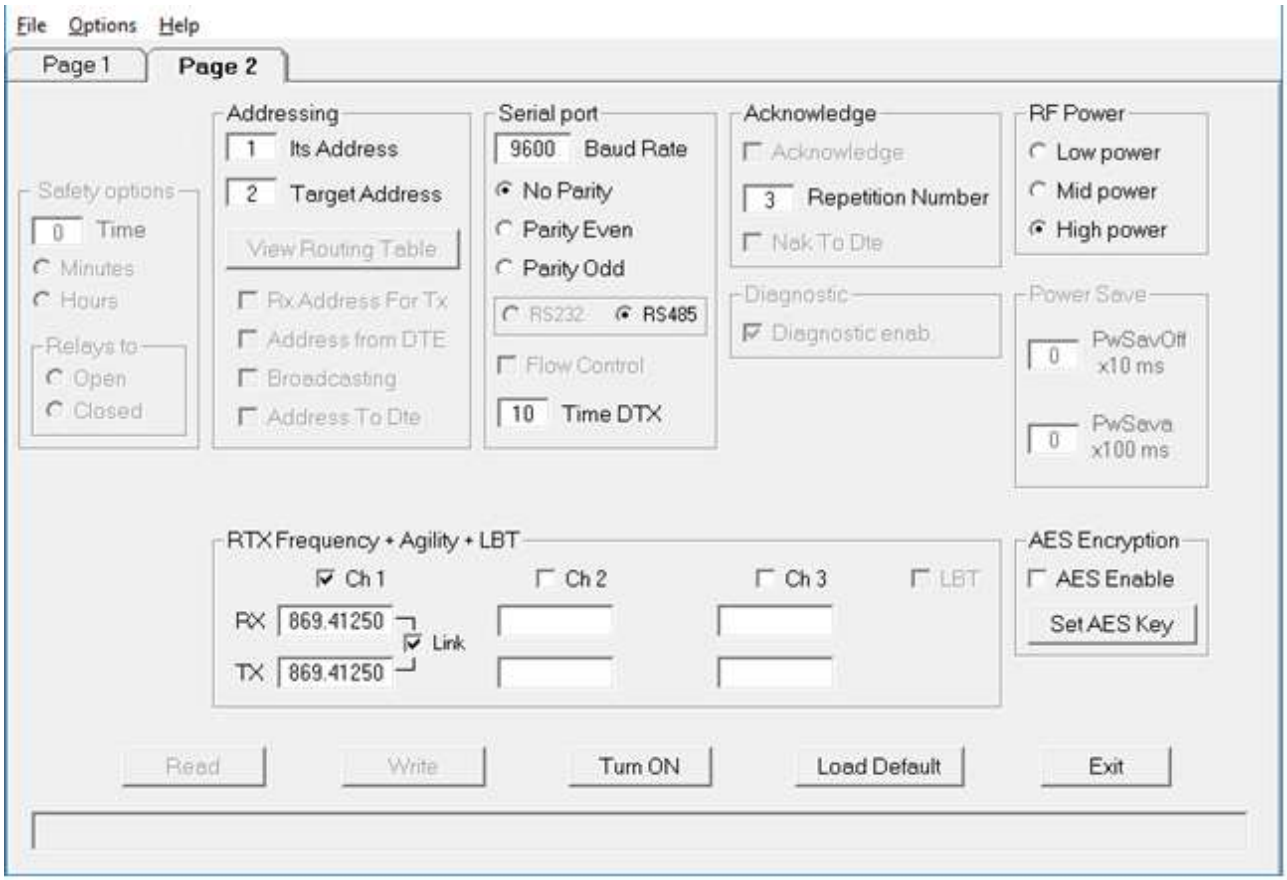
Starting address:
In this field the address of the first register to be read from the external node is set.

Quantity:
In this field the quantity of registers to be read from the external node (max 96 registers) is set.

Ext node boot time:
This is the interval of time required to the external ModBUS node to become ready after the switch on.

ModBUS timeout:
Represents the time interval (in hundreds of milliseconds) within which the ModBUS answer on the packet sent by the Master unit must be received.

Cycle Update:
In this field the time of the periodical transmission is set. The time base is selectable between seconds, minutes or hours. The time range can vary from one second (minimum) to 255 hours (maximum). In this field you cannot insert a value less than the time interval assigned to the field "External node boot time".



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Its address:
Contains the value of the address of this radiomodem. Each unit must have a unique address. In the Master device the maximum value of this field is dependent on the number of units in the network (parameter selected in the field "Unit quantity").

Target address:
This field sets the value of the destination address. In the Master units, this field must contain the same address used in the field "Its address" of the Slave unit. In the Slave units this field is not taken into account because the mode "RX Address for TX" is used in the response packet.
When a device working as digipeater this value is uninfluenced.

System Code (**double click of the mouse on "Target" or [Enter] key**):
When the focus is on the Target field, pressing the "Enter" key on the keyboard or by double clicking the mouse, a window opens in which you can enter the system code. **The system code must be the same for all the radiomodem in the network**.

Serial port:
In this frame (collection of options) the parameters choice of the RS485 serial line is performed. In the Master units, these parameters configuration is referred to the data exchange between the radiomodem and the external ModBUS node. In the Slave unit, these parameters configuration is referred to the data exchange between the radiomodem and the SCADA application. The format of the frame on the RS485 serial port uses one stop bit.

Baud rate:
This field is used to set the communication speed of the serial line RS485. The legal values are: 1200, 2400, 4800, 9600, 19200, 38400, 57600 bps.

Parity:
By this selector it is possible to enable and choose the parity type on the serial line. It is possible to choose between: None (parity disabled), parity Even, parity Odd.

Time DTX:
Defines the time between the stop of the data received from the serial port and the sending of the packet via radio. In the "modus low energy" mode this parameter only affects the unit configured as a Slave. If you realize that the data transmitted from the slave unit are incomplete, try to increase this time.

Repetition number:
It is active only in the devices configured as Master. In this field you can set the number of repetitions of a packet when there is no answer.

RF Power:
Allows the choice between three different power levels: High, Medium, Low. If the value of the RSSI, present in the diagnostic parameters sent to the SCADA software, is good (-70 dBm or better), and if the low power of the Master unit is an important factor, it is advisable to choose a medium or low power level.

Channel selection + Agility + LBT:
In this box you choose the radio channel to be used. If you want to use the agility feature (transmission on the less noisy channel among the active channels), you can select more than one radio channel. The maximum number of active channels is dependent on the canalization setting. **It is mandatory that in the same network**

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all the radiomodems use the same radio channels. In "ModBUS Low Energy" mode the LBT function cannot be activated.

AES Enable:
Enable or disable the AES-128 data encryption. In the transmitted packet, the encoding and decoding is done on the payload only.

Set AES Key:
By pressing this button a window opens where the value of the 128-bit AES key is set. The user must insert 16 ascii character. The configurator displays an error message if, upon pressing the "OK" button, the string of the AES key is incomplete (i.e. less than 16 characters are inserted).
Note: If the AES is used, all the radiomodems in the same network **must use the same AES key**. If the key setting is not the same, the data transiting on the serial line are not interpretable by the connected SCADA software.

11.3. MODBUS OPERATING MODE

This operating mode provides one Master unit (star centre) and one or more slave units. The Master unit must be connected via the RS485 interface to a PC (or PLC) on which a SCADA application is running, which uses the communication protocol ModBUS RTU. The SCADA application is the heart of the system and has the task to read and/or write the parameters of the different nodes of the network using the ModBUS protocol. The Master radiomodem, connected to the SCADA, uses the radio link to transmit the packets received from the serial line. The required addressing is realised by the use of an internal routing table. To do this the Master radiomodem evaluates the first byte of the received ModBUS packet, which, in the ModBUS protocol, corresponds to the address of the node which you want to communicate with. Each node address (1 to 254) may be associated with an independent radio path.

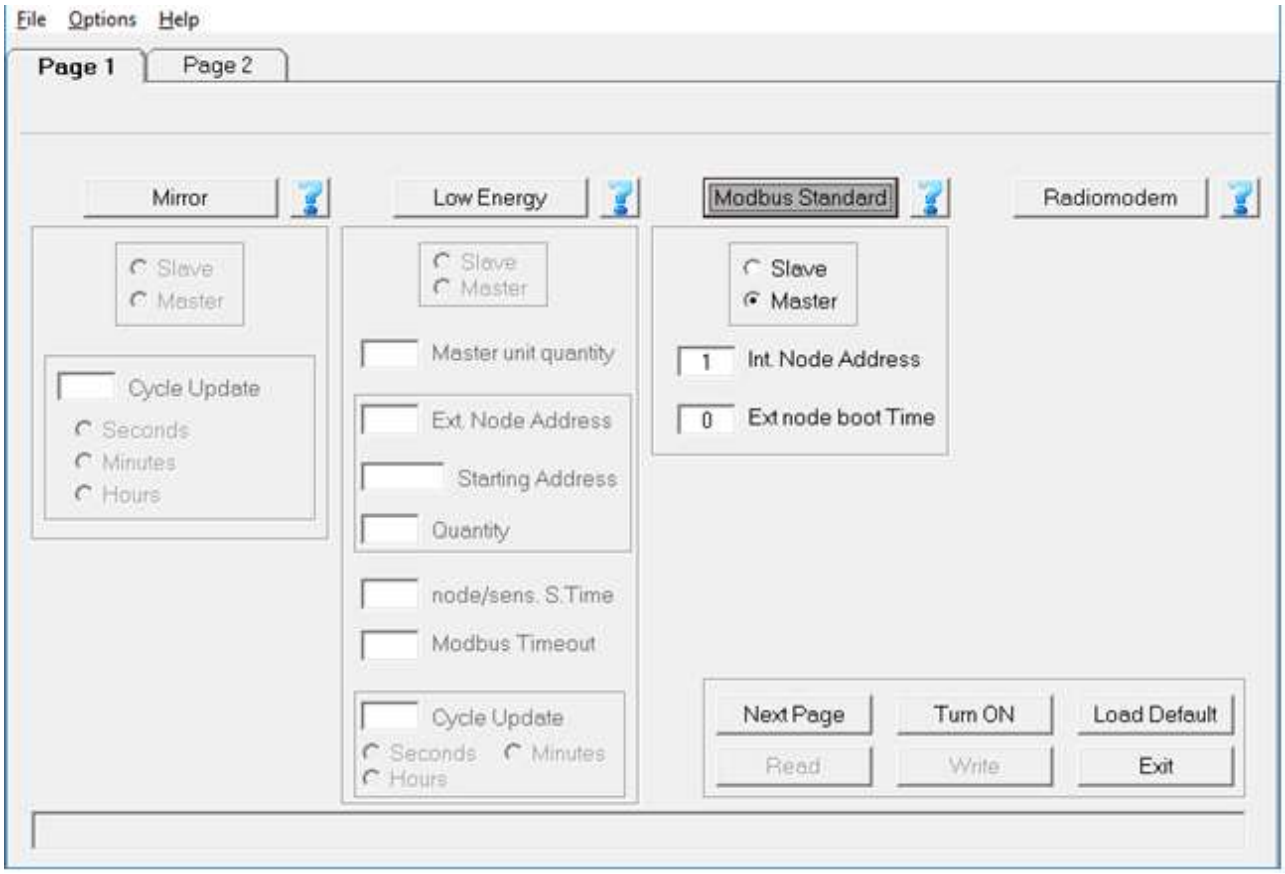
All radio modems in the network (both Masters and Slaves) must be configured with an unique address (the "Its address" field). The routing table is used to indicate the path of the packet radio, in this way, the packet arrives to the target radiomodem directly or via all the interested digipeaters. In the routing table, the node address number 255 is reserved for the broadcasting ModBUS packet. In this case, the Master radiomodem, when it receives a packet with address zero (packet broadcasting type) from the SCADA application, uses the node number 255 of the routing table to route properly the radio packet. The broadcasting mode cannot be implemented if there is a radio modem unit that cannot communicate with all the other units of the network, because in this case one or more units would not receive the broadcasting packet. This is the case of a network geographically widespread in mountainous areas or where there are many obstacles.

The node addresses must be unique, in the same network can exist up to 254 nodes distributed according to need among the slave units in the network.

On each radiomdem up to 32 external ModBUS nodes (I/O analog, digital or mixed) can be connected via the RS485 serial interface Each of these external nodes has its own ModBUS address, to be able to interrogate each node is necessary that all the nodes belonging to the same slave units use the same routing, that is, the same sequence of radiomodem addresses, which, in this case will be common to more node addresses (simply copy the addresses of the radio path in every node address connected to the same radiomodem) given that the ModBUS packet must pass through the same radiomodem.

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Slave / Master:
Allows you to select the functionality of the radiomodem between Master and Slave. The units configured as a slave never takes the initiative of the transmission.

External node boot time:
This field specifies the amount of time required for the external ModBUS nodes to be operational. This field has a value in steps of 100 milliseconds. Set this parameter considering the node that takes longer to start-up.

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Its address:
It is the value of the address of the radiomodem. Each unit must have a unique address. This constraint applies both to the Slaves and to the Master radiomodems.

Node address (Master unit):
It is the value of the target ModBUS node. Each node address is associated with the sequence of addresses of the radiomodems through the routing table.

Routing table (double click of the mouse on "Target" or [Enter] key):
When the focus is on the "Node address" field, pressing the "Enter" key on the keyboard or by double clicking the mouse, a window opens in which you can enter the sequence of radiomodem addresses to associate to a particular node address.

System Code: it is the system code of the radiomodem. The purpose of this parameter is enabling the communication only between those units that have the same system code value. **This value must be the same for all the radiomodems in the network**.

Digipeaters: they are the addresses of the radiomodems, which have the task to retransmit the packet to a subsequent radiomodem (another digipeater or the target unit). The purpose of these units is to extend the coverage area of the radio network.
Target: it is the addressee station in the radio network.

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View Routing Table:
Pressing this button with the mouse, a window opens where you can view all the values of the addresses of the nodes and, for each one, its routing associations. Use the "Page Up", "Page Down" or the arrow keys to move along the text. Press the key "Esc" or "Enter" or the spacebar on the keyboard to close this window.

Serial port:
In this frame (collection of options) the choice of the RS485 serial line parameters is performed. In the Master unit these settings refer to the communication with the SCADA application, while in the Slave units these settings refer to the communication with the external ModBUS node.

Baud rate:
This field is used to set the communication speed of the serial line RS485. The legal values are: 1200, 2400, 4800, 9600, 19200, 38400, 57600 bps.

Parity:
By this selector it is possible to enable and choose the parity type on the serial line.

Time DTX:
Defines the time between the stop of the data received from the RS485 serial line and the transmission of the radio packet. If the received packets are incomplete you must increase this time to mask any pauses between the bytes of the packet sent from the SCADA application to the Master radiomodem. The steps are in milliseconds.

RF Power:
Allows the choice between three different levels of transmission power: High, Medium, Low.

Power Save
PwSavOff:
When a number greater than zero is inserted, the Power Save feature is enabled. This field allows you to set the value of the "OFF" time interval for the energy savings. The step is in tens of milliseconds.
PwSava:
When the power save is used, through this field you can set the time when the radiomodem remains operational after an event (the reception of a radio packet) has temporarily awakened the unit. The step is in hundreds of milliseconds.

Channel selection + Agility + LBT:
In this box you choose the radio channel to be used. If you want to use the agility feature (transmission on the less noisy channel among the active channels), you can select more than one radio channel. The maximum number of active channels is dependent on the canalization setting. **It is mandatory that in the same network all the radiomodems use the same radio channels.**
In the "ModBUS standard" mode you can enable the **LBT** feature: the radiomodem waits that the active channel is free before transmitting the radio packet.
When the LBT function is active the device counts the seconds of data ON-AIR transmission in order to operate according to EN300 220-1 standards that require to not exceed a transmission time of 100 seconds in a 1 hour period. After 100 seconds the device stop the transmission and wait the 1 hour period before to allow a new transmission.

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AES Enable:
Enable or disable the AES-128 data encryption. In the transmitted packet, the encoding and decoding is done on the payload only.

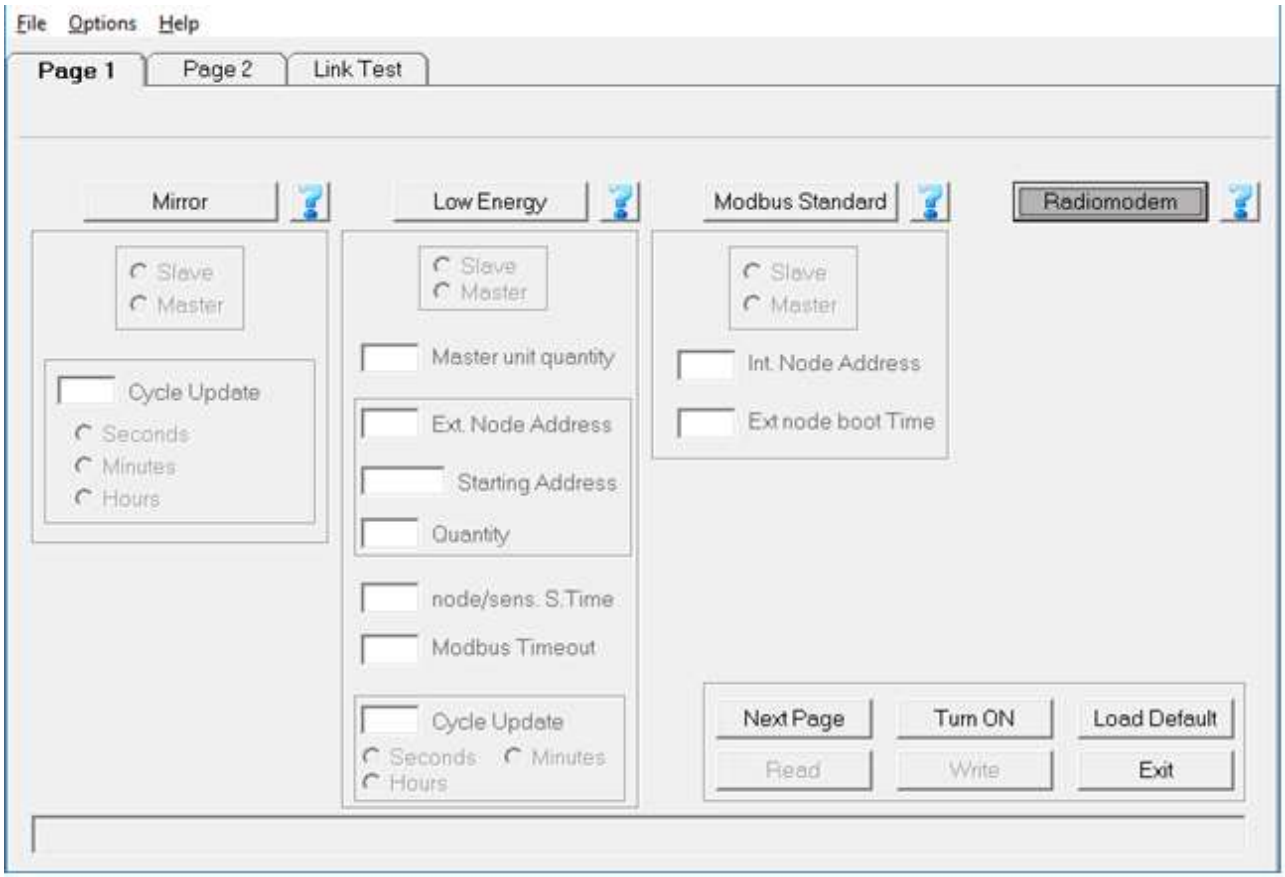
Set AES Key:
By pressing this button a window opens where the value of the 128-bit AES key is set. The user must insert 16 ascii characters. The configurator displays an error message if, upon pressing the "OK" button, the string of the AES key is incomplete (i.e. less than 16 characters are inserted).
Note: If the AES is used, all the radiomodems in the same network **must use the same AES key**. If the key setting is not the same, the data transiting on the serial line are not interpretable by the connected hardware.

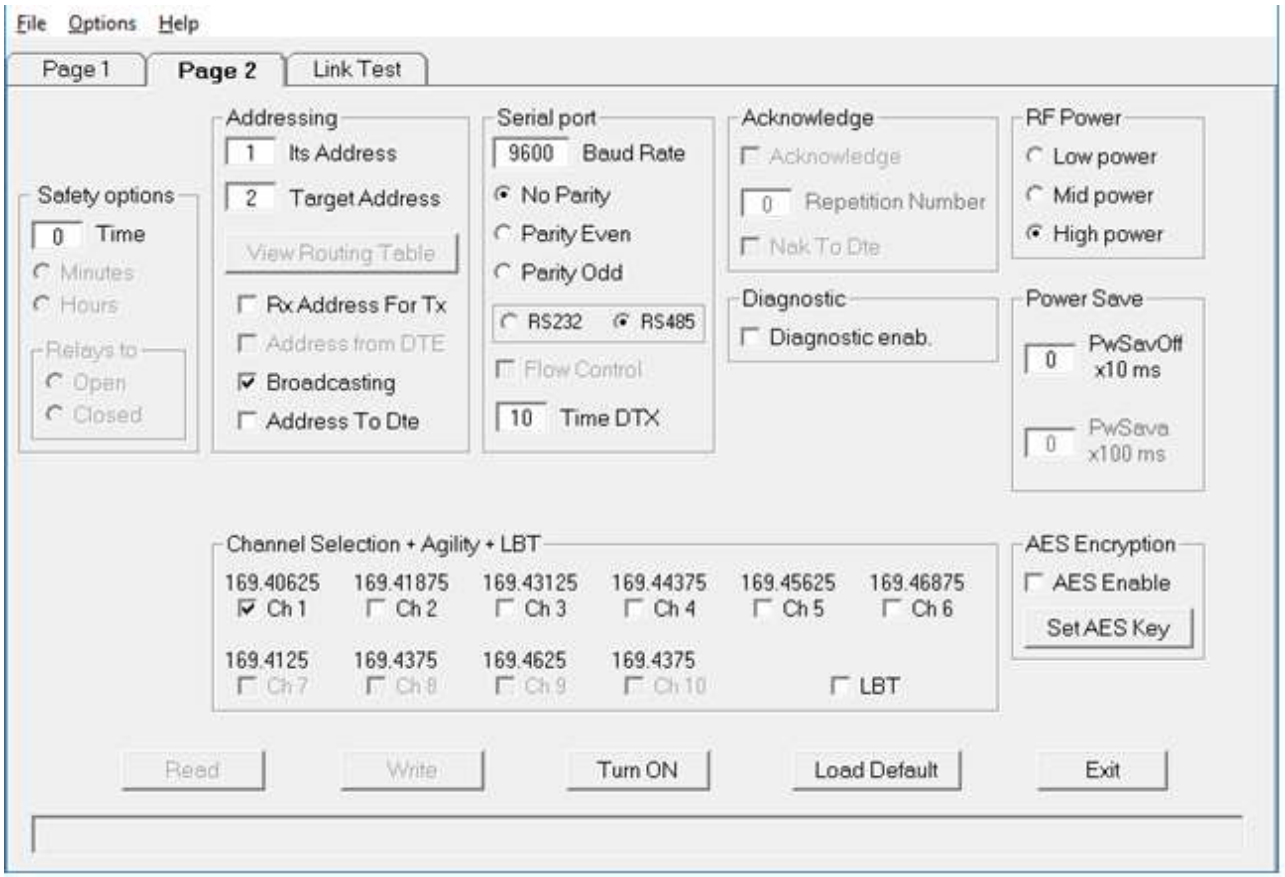
11.4. RADIOMODEM OPERATING MODE

This operating mode is normally used for the exchange of data between different locations. In the same network the presence of a master unit as well as of one or more slave units is expected. If the power save feature is not used, each unit can receive data via the serial port RS485 (except during radio communications) up to a maximum of 1024 bytes.
When the reception of the data is completed (i.e. when 1024 bytes are received or when the "Time DTX" timer is expired), the radio modem send the packet to the target unit. It is possible to include in the radio path up to 8 digipeater to increase the coverage distance. If the Power Save feature is used, the logic behaviour is as follows: the Master unit can always receive characters from the RS485 serial line (except during radio communications). The slave units can receive characters from the serial line only during the time interval referred to as "PwSava" i.e. the period in which a slave unit remains active after the reception of a radio packet.
In the configurator, when the radiomodem mode is selected, an additional page called "Link Test" is available. Refer to the relevant page of this manual for details.

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Its address:
It is the value of the address of this radiomodem. It is advisable to configure each radiomodem with a unique address.

Target address:
It is the address of the target radiomodem, the destination unit.
When a device working as digipeater this value is uninfluenced.

System Code & Digipeater address (**double click of the mouse on "Target" or [Enter] key**):
When the focus is on the Target field, pressing the "Enter" key on the keyboard or by double clicking the mouse, a window opens in which you can enter the system code and the addresses of the digipeater path to include in the radio link. **The system code must be the same for all units in the network**.

Rx Address For Tx:
If enabled, the radiomodem stores the full address (digipeaters and target address) of the unit from which it received the last packet and uses these addresses to send the data received from the DTE connected to it. This function is available only if "Address from DTE" is inactive.

Address from DTE:
If active, the DTE must also provide the addressing for each transmitted packet. To do this, some bytes must be added before of the data bytes. The bytes to add are in this order: one byte for the system code [1....255], one byte-flag with the corresponding bits having the following scope: **bit 0 (lsb) = Broadcasting ; bit1 = ECHO ; bit 2 = ACK request ; bit3 = Diagnostic**. One Byte indicating the number of units [1 .... 9] which includes the target and all the digipeaters used. From 0 to 8 bytes of digipeater addresses disposed in the exact sequence of use. One Byte indicating the target address followed by the data bytes (from 1 to 1024). This function is available only if "Rx Address For Tx" is inactive.

Broadcasting:
If enabled, the radiomodem transmits a special packet that will be received by all the radiomodem that have the same System Code. This function is available only when the ACK is disabled.

Address to DTE:
If enabled, the data downloaded to the DTE will be preceded by the address of the sender. This feature allows the identification of the source of the message.

Baud rate:
This field is used to set the communication speed of the serial line RS485. The admitted values are: 1200, 2400, 4800, 9600, 19200, 38400, 57600 bps

Parity:
By this selector it is possible enable and choose the parity type on the serial line.

Time DTX:
Defines the time between the stop of the data received from the serial line and the transmission of the radio packet. If the packets received are incomplete you must increase this time to mask any pauses between the bytes of the packet sent from the DTE to the radiomodem. The steps are in milliseconds

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Diagnostic enab:
When enabled, the radiomodem sends before of the data and, after the address of the sender if "Address to DTE" is enabled, the diagnostic parameters in the following format:
remote rssi (16 bit signed integer, the first byte received is the least significant). The value is expressed in steps of 0.0625 dbm.
remote Vbatt (unsigned 16-bit integer, the first received byte is the least significant). This value is not available, overlook this value.
local rssi (16 bit signed integer, the first byte received is the least significant). The value is expressed in steps of 0.0625 dbm.

ACK:
If enabled, the radiomodem that sent a packet waits for the acknowledge from the target radiomodem. If this response it is not received within a fixed time, the last packet is re-sent many times as set in the "Repetition" field. The function is available only if "Broadcasting" and "Address from DTE" are inactive.

Repetition Number:
In this field you can define the number of repetitions of the packet if the acknowledge is not received. This function is available only when the ACK is enabled.

Nak To DTE:
If enabled, the radio modem sends a NAK character (ASCII 21) to the DTE in the case where all repetition are sent without receiving any acknowledge. This function is available only when the ACK is enabled.

RF Power:
Allows the choice between three different levels of power: High, Medium, Low.

PwSavOff:
Inserting in this field a number greater than 0, the power save feature is enabled. This is the value corresponding to the off period of the energy savings cycles. The step is in the tens of milliseconds. The Master unit is always active but uses this value to size the length of the preamble of the packets sent to a sleeping device (digipeater or slave). If you intend to use the power save feature **all units in the network must have the same "PwSavOff" value**. Note: If the Power Save feature is used, only the Master unit can always receive characters from the serial line; the Slave can only do it during the PwSava period.

PwSava:
When the Power Save is used, by this field you can set the time interval in which the radio modem remains operational (On) after it has been temporarily enabled by an event (i.e.: reception of a packet radio). This value is in steps of hundreds milliseconds. This field is also used to differentiate the device between Master and Slave: **a value of 255 identifies the unit as Master** and keeps it always On. The unit so configured is therefore not affected by the ON-OFF cycles, but the packets are sent with a suitable (longer) preamble time in order to be received by the slave devices that use the Power Save.

Channel selection + Agility + LBT:
In this box you choose the radio channel to be used. If you want to use the agility feature (transmission on the less noisy channel between the active channels), you can select more than one radio channel. The maximum number of active channels is dependent on the canalization setting. **It is mandatory that in the same network all the radiomodems use the same radio channels**. It is possible to enable the LBT feature: the radio modem waits for the channel to become free before proceeding with the transmission of the packet.

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When the LBT function is active the device counts the seconds of data ON-AIR transmission in order to operate according to EN300 220-1 standards that require to not exceed a transmission time of 100 seconds in a 1 hour period. After 100 seconds the device stop the transmission and wait the 1 hour period before to allow a new transmission.

AES Enable:
Enable or disable the AES-128 data encryption. In the transmitted packet, the encoding and decoding is done on the payload only.

Set AES Key:
By pressing this button a window opens where the value of the 128-bit AES key is set. The user must insert 16 ascii characters. The configurator displays an error message if, upon pressing the "OK" button, the string of the AES key is incomplete (i.e. less than 16 characters are inserted).
Note: If the AES is used, all the radiomodems in the same network **must use the same AES key**. If the key setting is not the same, the data transiting on the serial line are not interpretable by the connected hardware.

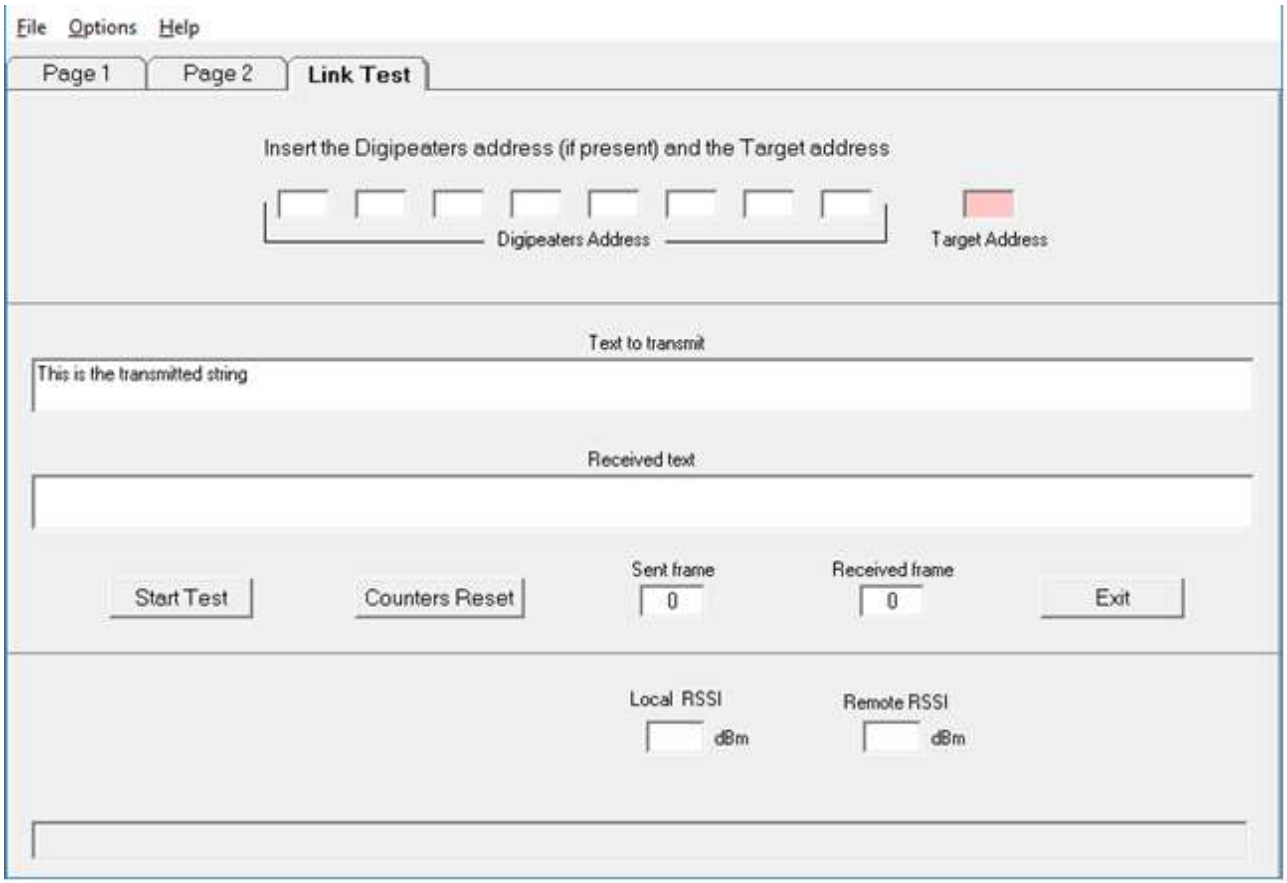
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12. UTILITY

12.1. Link Test

The access to this page is only allowed if, on the first page of the configurator, the "radiomodem operating mode" is chosen. On this page you can test the communication with the remote radiomodem, valuate the quality of the radio signal and the level of the battery voltage on the selected units. This feature is only allowed in radiomodem mode therefore the remote units reply to the link test packets only if they are configured in the same mode. This functionality is available only in Configuration mode, enable the configuration mode as describe at configuration paragraph of this manual.
When the use of the Link Test is finished it is necessary to switch off the radiomodem, then switch it on again. This must be done in order to restore the normal operational functionality.



On the page 2 of the configuration program enter the same "system code" and the same power_save settings as the one of the remote radiomodem you want make the link test with.
In order to avoid errors it is advisable to read the configuration from the local radiomodem via the Read button (the radiomodem must be forced in configuration mode before read). In the "Link Test" page, enter the value of the address of the target radiomodem and, if used, enter the values of the addresses of the digipeaters in the exact order of use.

To start testing the reliability of the radio link, press the "Start Test" button: the string present in the "text to transmit" text box is sent. In the "received text" box the received string is displayed; if no errors are found, this string is equal to the sent string, vice versa an error message will be displayed. Each time a string is sent, the "Sent frame" counter is incremented. The "Received frame" counter will be incremented only if the received

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message is correct. Using the button "Counter Reset", you can reset the counter to zero. During the communications test the diagnostic parameters are also sent. These are: Local RSSI, Remote RSSI, Remote VBatt. These values enable the assessment of the intensity of the radio signal received both from the remote and local units. The RSSI fields are expressed in dBm and have a resolution of 0,0625 dbm. In another box the value of the supply voltage of the remote radiomodem is displayed.
The RSSI provides a correct measurement in the range from -100 to -50 dBm. Values less than -100 dBm (for example -105, -110 dBm) may create communication problems. The saturation of the measured RSSI restricts the maximum value indicated approximately to -47 dBm ± 3dBm, signals of greater intensity return the same indication.

Note: If, in the radio link, one or more digipeater units are used, the level of the RSSI is always referred to the last received signal of the radio stations chain. Example: with four units present in the network (Master "A", first digipeater "B" , second digipeater "C", slave "D") the RSSI read from the slave "D" is referred to the reception of the digipeater "C", while the RSSI read from the master A is referred to the reception of the digipeater "B".
If you wish to use the readings of diagnostic (RSSI and VBatt) outside the configurator, the communication with the radiomodem must use the serial data format "9600,N,8,1". The radiomodem send the following hex string: **System code** (one byte), **Flag options** (one byte, value 0x08), **quantity of addresses** (one byte), **digipeater addresses** (from 0 to 8 bytes), **target address** (one byte), one **character** (one byte).

Example: 0x01, 0x08, 0x01, 0x01, 0x55. This example uses the system code 1 with only one address: the target (1). The last character (here 0x55) can be of any other value.

The radio modem returns a string consisting of **six bytes**: **Remote RSSI** (two bytes), **VBatt remote** (two bytes), **local RSSI** (two bytes). For each pair, the first byte received is always the least significant byte.

The value of the RSSI is in the format 16-bit signed integer and has a resolution of 0.0625 dbm. Divide the RSSI value by 16 to obtain the result with a step of 1 dbm.

The value of the battery voltage is in the format 16-bit unsigned integer. The formula used to derive the supply voltage in volts is the following: read value * 0.0048828125.

The diagnostic request (bit 3 of the byte flag = set) excludes the normal data exchange.

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13. ANNEX

13.1. MODBUS Register

Read of registers
In order to read the register select the address node, set the starting address and the number of register to read (max 8).

13.2. MODBUS LOW ENERGY Register

The Slave unit when receive the data from Master units write on SCADA register the data received starting from register 100 as follows:

Master setup:
-External node connected (register "n")

Byte	Description	Note
0	Slave Address	Z-AIR-1 Address setted as Slave unit
1	Function Code	Preset Multiple Register 16
2	Data Address	Address of first register, always 0064
3		
4	Register quantity	Value in function of external node register quantity
5		
6	Number of bytes to follow	CRC not included, value in function of external node register quantity
7	Register "n"	External node register quantity "n" connected to PIN 14 and 16. This value must to setted also in "Ext Node Address Quantity" tab.
8		
	After register's node:	
8+(n*2)+2	Register 2 – Battery voltage	Not available, overlook this value.
8+(n*2)+3		
8+(n*2)+4	Register 3 – RSSI Master unit	RSSI Value of Master unit related to previous data transmission (dBm, signed int16)
8+(n*2)+5		
8+(n*2)+6	Register 4 – RSSI Slave unit	RSSI Value of Slave unit related to previous data transmission (dBm, signed int16)
8+(n*2)+7		
8+(n*2)+8	Register 5 – Master address	Address of Z-AIR-1 setted as Master unit (data sender)
8+(n*2)+9		
8+(n*2)+10	CRC	Cyclic Redundancy Check
8+(n*2)+11		

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