AirGate-Modbus

INSTRUCTIONS MANUAL
V1.1x C

INTRODUCTION

AirGate-Modbus is an equipment with a link interface function between a network with Modbus RTU protocol about RS485 and a wireless network with proprietary protocol about IEEE 802.15.4. Resulting from an advanced technological development, the product stands out in many aspects, such as high performance, high connectivity and easy setup and operation. This technology is presented as the ideal solution for applications which require flexibility and interoperability.

Its main characteristics are:

- SMA connector for antenna;
- 2 dBi antenna;
- Two connectors for one RS485 Modbus RTU interface;
- USB Device (Mini-B);
- Status indicator LEDs;
- Button used to enter setup mode.

SPECIFICATIONS

COMMUNICATION CHARACTERISTICS:

Maximum transmission power: 100 mW;

Range: 1000 meters line-of-sight in open field.

Data rate: RF 250 Kbps;

Baud rate serial: 1.200 to 115.2 Kbps;

Receptor's sensibility - 92 dBm;

Setup via Software Windows®.

NETWORK AND SECURITY:

ISM Operation Band: 2.4 GHz;

DSSS Technology - Direct Sequence Spread Spectrum;

OQPSK Modulation - Offset Quadrature Phase Shift Keying;

Point-to-point, star, or tree network typologies;

15 operation channels;

Network Identifier: (PAN ID);

Data encryption: AES-CBC-128 (Advanced Encryption Standard).

CONNECTIONS:

Power source connector;

USB Device (Mini-B);

RP SMA Female connector (Plug);

Two connectors for RS485 Modbus RTU interface.

POWER SOURCE:

Voltage: from 10 to 35 Vdc;

Maximum energy consumption: 70 mA (in 24 V).

ENVIRONMENTAL CONDITIONS:

Operation Temperature: 0 to 70 °C;

Relative humidity: 80 % up to 30 ºC.

ELECTROMAGNETIC COMPATIBILITY:

EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, CISPR11.

PHYSICAL CHARACTERISTICS:

Weight: 110 g.

PA66 housing for DIN rail mount;

Dimensions: 99.5 x 114 x 17.5 mm.

Protection Degree: IP20

Internal protection against inversion of the power supply voltage polarity.

Wire gauge: 0.1 to 3 mm² (28 to 12 AWG). Recommended torque: 0.4 Nm

CERTIFICATES:

CONNECTION AND INSTALLATION

MECHANICAL INSTALLATION

AirGate-Modbus has its own enclosure, to be installed in a 35 mm trail.

For the installation in the trail, the metallic hook in the base must be located and pressed against the trail.

DIMENSIONS:

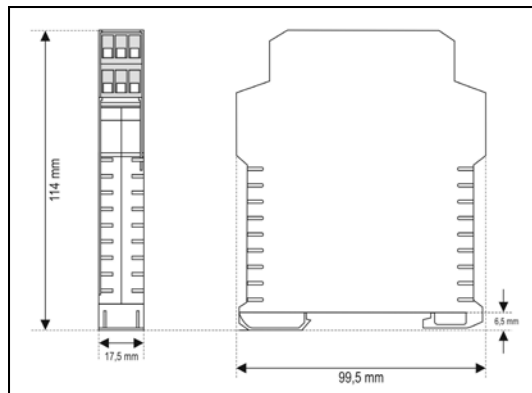The dimensions of *AirGate-Modbus* are shown in **Fig. 1**.

Fig. 1 - Dimensions of *AirGate-Modbus*.

ELECTRICAL INSTALLATIONS

AirGate-Modbus has power supply connectors and serial communication interface RS485 according to Legend: Voltage supply **Fig. 2**.

⚠	Caution when connecting the power supply wires in *AirGate-Modbus*. If the positive conductor of the power source is turned on, even if momentarily, to one of the communication link terminals, the *AirGate-Modbus* may be damaged.
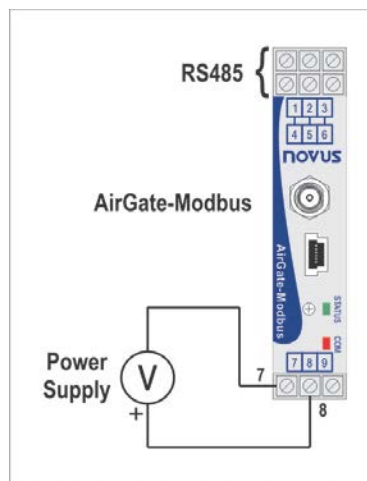
Fig. 2 - Power supply and communication connections of the *AirGate-Modbus*.

Fig. 3 shows the electrical connections needed. Terminals 1, 2 and 3 are destined for the communication with Modbus network. These terminals are internally connected to terminals 4, 5 and 6. The terminals 7, 8 and 9 are used for *AirGate-Modbus* power supply.

Fig. 2 – Electrical connections of *AirGate-Modbus*.

INSTALLATION RECOMMENDATIONS

- Input conductors must go through the system plant separated from the output and power supply conductors, in grounded conduits.

OPERATION

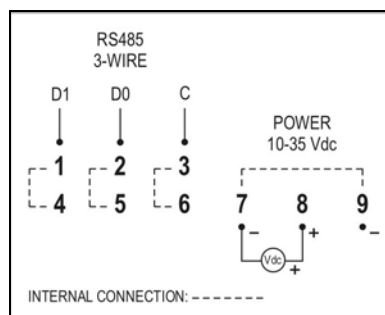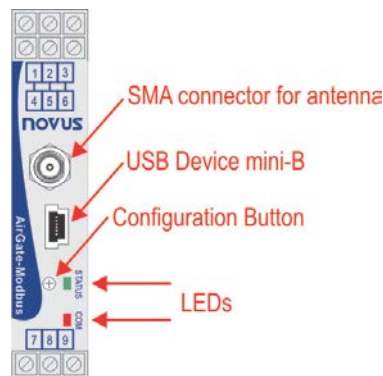In the frontal panel are found an mini-B USB connector, a SMA connector for the antenna, a setup button and two LEDs for status indication. See **Fig. 4**.

Fig. 3 - *AirGate-Modbus* frontal panel

USB

The USB interface of *AirGate-Modbus* is used for setup. Depending on the operation mode set, this interface can be connected to a PC functioning as master of the Modbus RTU network.

SETUP BUTTON

When press the button, *AirGate-Modbus* enters setup mode and waits the configuration by the USB interface. If there is no communication through the USB interface, after 1 minute, this will go back to normal functioning.

LEDS

STATUS COM	When turning the equipment on, the Status LED starts to flash quickly until the *AirGate-Modbus* connects to a wireless network. In the moment that the *AirGate-Modbus* is connected to a wireless network, the Status LED remains turned on.
	When the setup button is pressed, the Status LED flashes slowly until *AirGate-Modbus* quits operation mode. There are 3 possible ways to quit setup mode:
	• Clicking in the setup button again;
	• Applying a configuration successfully;
	• Waiting 1 minute.
	The Communication LED flashes to show that the device is receiving packages through any of its interfaces and is forwarding correctly. The speed of the flashing is according to the communication speed.
	When the Firmware of the *AirGate-Modbus* is being updated, the Communication LED will start to flash and the LED Status will be off.

OPERATION MODES

AirGate-Modbus can be configured with 4 different operation modes:

RS485-MASTER

Simple Forwarding between RS485 and IEEE 802.15.4

In this mode *AirGate-Modbus* uses the RS485 interface to communicate with a Modbus Network. And the wireless interface to communicate with other *AirGate-Modbus* devices in RS485-SLAVES operation modes.

RS485-SLAVES

Simple forwarding between IEEE 802.15.4 and RS485

In this mode *AirGate-Modbus* has the objective of continuing the Modbus network. It uses the wireless interface to communicate with another *AirGate-Modbus*, where the network master is located. The RS485 interface is used to communicate with Modbus slaves.

As of firmware version **V1.23**, when operating in this mode of operation, the AirGate-Modbus can begin to automatically perform the repeater function. This function does not require any special configuration. When configured in this mode of operation, after the AirGate-Modbus finds a father (RS485-Master, USB-Master, Multi-Master, or even another RS485-Slaves) it then is able to offer the option of having children, allowing other AirGates that are also operating with RS485-Slaves to automatically pair with it.

USB-MASTER

USB Routing for RS485 and IEEE 802.15.4

In this mode *AirGate-Modbus* uses the USB interface to communicate directly with a Modbus master and its RS485 interface to communicate with a Modbus slave's network. The wireless interface is used to communicate with other *AirGate-Modbus* devices in RS485-SLAVES operation mode.

MULTI-MASTER

Multiplexing of the USB and RS485 for IEEE 802.15.4

In this mode *AirGate-Modbus* uses the RS485 and USB interfaces for the multiplexing of Modbus masters. The masters must be directly linked to these interfaces. The wireless interface is used to communicate with other *AirGate-Modbus* devices in RS485-SLAVES operation mode.

When this operation mode is used, a **Timeout** is needed to ensure that each of the masters have an usage time in the network. This **Timeout** is automatically adjusted by *DigiConfig* software according to the baud rate used by the interfaces, as it can be seen in the chapter "CONFIGURATIONS - AIRGATE-MODBUS" in the section "TIMEOUT". Depending on the number of slaves and of the response time of each slave, it may be necessary to adjust this **Timeout** to reduce possible communication errors.

It's important to emphasize that the **Timeout** configured for this operation mode refers to a time interval managed automatically by the *AirGate-Modbus*. The network masters plugged in each one of the USB and RS485 interfaces must have their Timeouts configured with **double** the time set in *AirGate-Modbus* **Timeout**.

COMPLEMENTARY MODES

Only devices with distinct functions form a wireless communication network. The operation form of some modes also imposes connection restrictions. The modes compatible with the wireless connection may be seen in **Table 1**:

| Mode	Connects with
RS485-MASTER	RS485-SLAVES
USB-MASTER	RS485-SLAVES
MULTI-MASTER	RS485-SLAVES
RS485-SLAVES *	RS485-SLAVES

Table 1 - Complementary modes

* The **RS485-SLAVES** operation mode only begins to offer the option of having children (behaving as a repeater) after having paired with a father that is already operating on the network. This entire process is done automatically, without any intervention from the operator.

USING THE OPERATION MODES

## WIRELESS SEGMENTS IN ANY POINT OF AN MODBUS NETWORK

Division of a wired network in wired segments interconnected by wireless segments. The division occurs far from the Modbus master. It uses the RS485 port *AirGate-Modbu*s to communicate with the master and the slaves. Additional wireless segments can be inserted. **Fig. 5** illustrates this possible application.
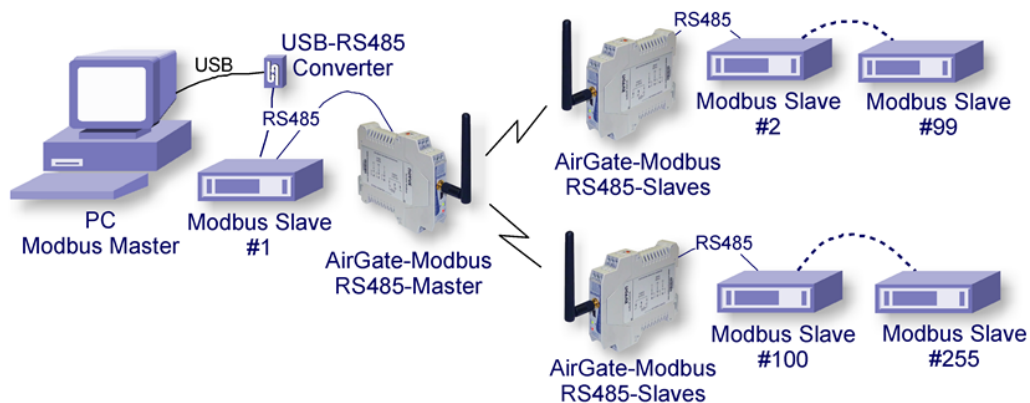
Fig. 4 - Wireless segments in any point of a Modbus network

WIRELESS SEGMENTS CLOSE TO THE MODBUS MASTER

Division of a wired network in wired segments interconnected by wireless segments. Wireless segments located close to the Modbus master which communicates by USB port. It allows the *AirGate-Modbus* using as a USB-RS485 convertor for the first wired segment. **Fig. 6** illustrates this possible application.
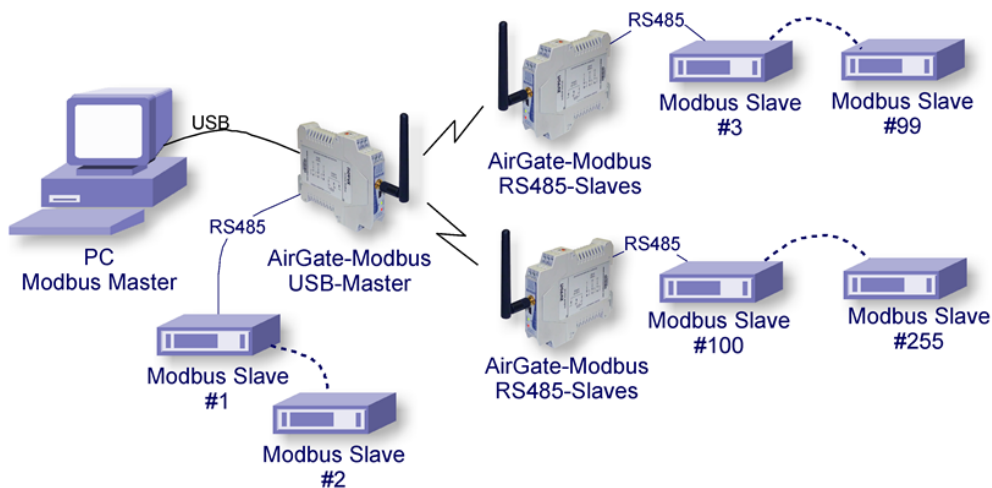
Fig. 5 - Wireless segments close to the Modbus master

WIRELESS SEGMENTS CLOSE TO MULTIPLEXED MODBUS MASTERS

Multiplexing of 2 masters, one connected to the USB interface and another to the RS485. Wireless section located close to the Modbus masters. It also allows the usage of a single master in any of the 2 interfaces (USB or RS485).
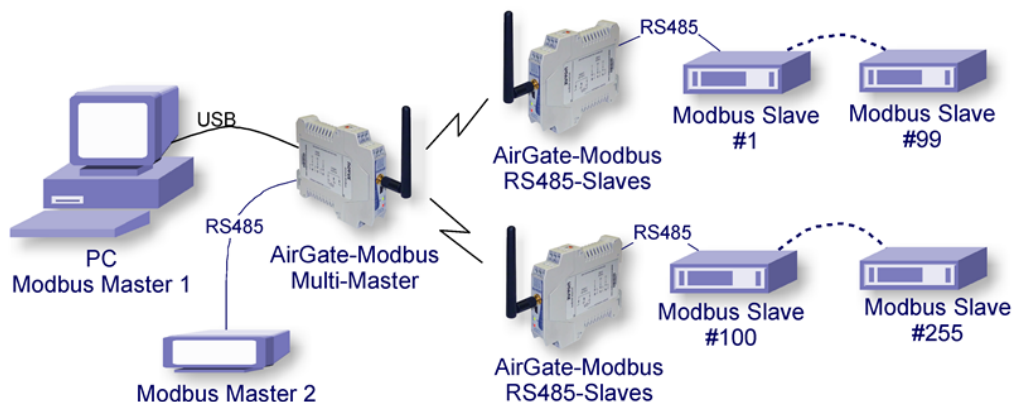
Fig. 7 - Wireless segments close to the multiplexed Modbus masters

LONG REACH APPLICATION

In seeking to expand the network, in order to obtain a greater distance, it is possible to assemble a tree shaped topology. As exemplified in **Fig. 8**, to expand the network, an *AirGate-Modbus* configured as a **RS485-SLAVES (Firmware > 1.23)** was inserted with the same **PAN ID (5670)**. In another segment, two *AirGates* were assembled using the RS485 interfaces, an *AirGate-Modbus* operating the **RS485-SLAVES** mode, and an *AirGate-Modbus* operating in **RS485-MASTER** mode. In this segment a new **PAN ID (5671)** was created, starting a new star network.
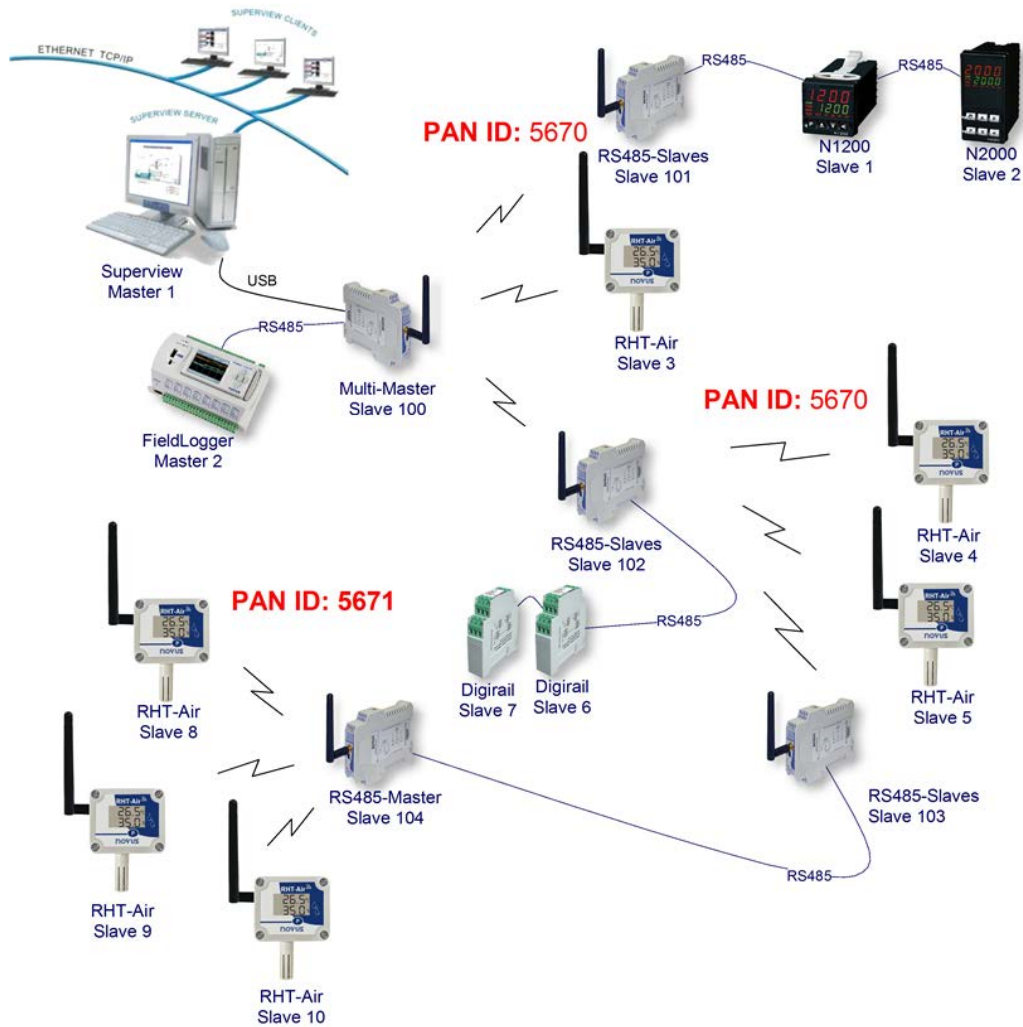

Fig. 6 - Topology in tree style

RESTRICTION

In case there is the need to implement a tree-shaped network, a restriction must be observed. Due to issues imposed by Modbus standard, Modbus slaves must not be connected between *AirGate-Modbus* as signed in **Fig. 9**.
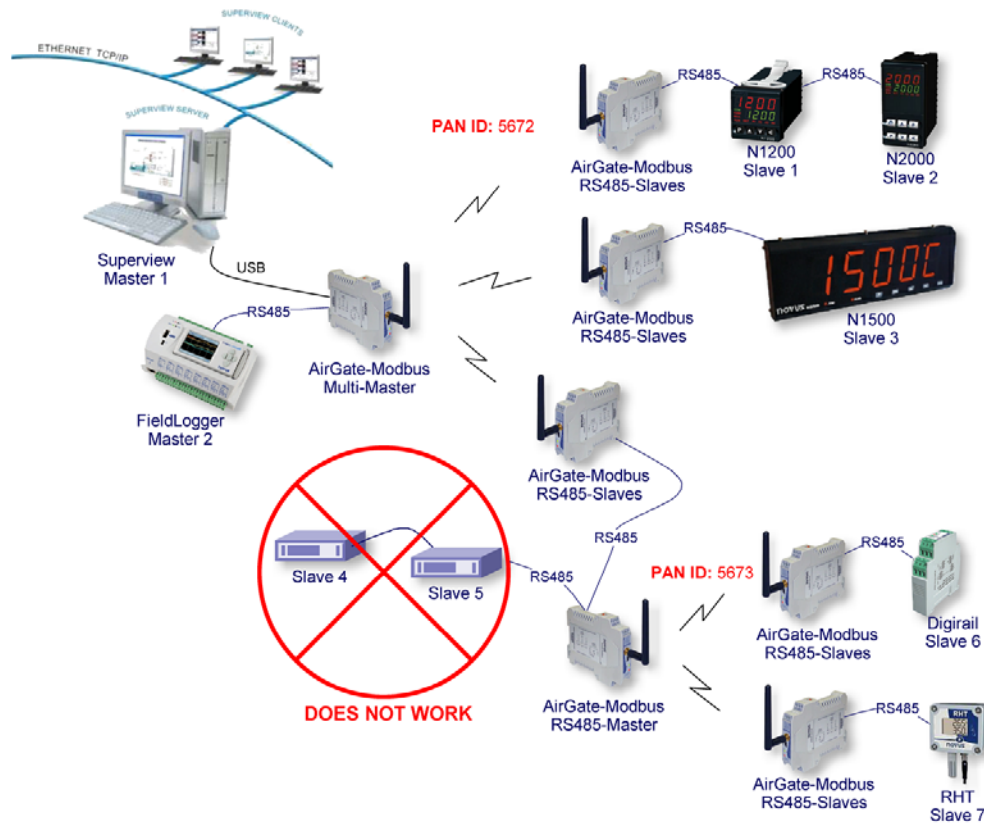
Fig. 7 - Restriction

SETUP SOFTWARE

The ***DigiConfig*** application is a Windows® program used for the configuration of the ***AirGate-Modbus***. For its installation, execute the file "DigiConfigSetup.exe" from the CD. When installing the setup software, the USB Serial Port driver of ***AirGate-Modbus*** may be automatically installed according to **Fig. 10**.
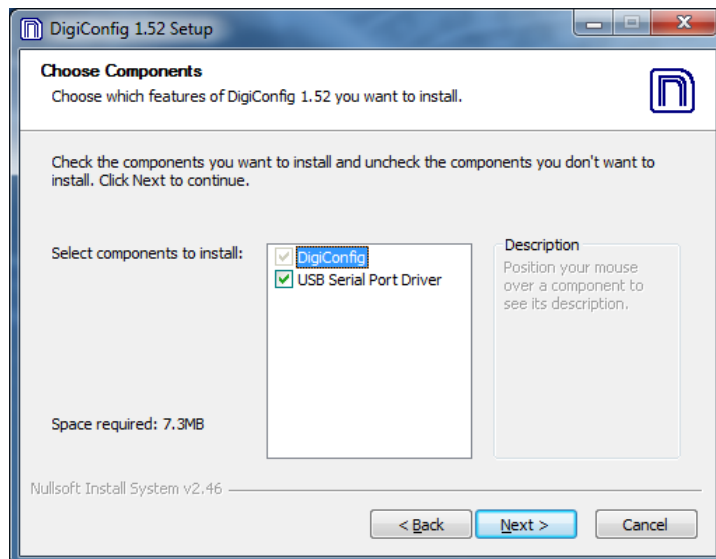
Fig. 8 - Selection of components

DigiConfig has a complete help file, with all necessary information for its full usage. To consult the help, start the application and select the "*Help*" menu or press the "*F1*" key.

In case you don't have the CD which accompanies the ***AirGate-Modbus***, consult the www.novusautomation.com website to get ***DigiConfig*** installer and the additional manuals.

To configure a ***AirGate-Modbus*** you must execute the ***Digiconfig*** and in the main screen access "configurations/communication" and edit the configurations, according to **Fig. 11**:
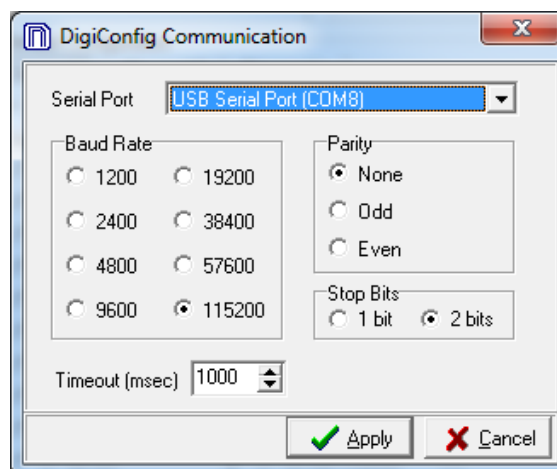
Fig. 9 - Communication of ***DigiConfig***

- Serial Port = USB Serial Port (COM X)
- Baud rate = 115200
- Parity = None
- Stop Bits = 2 bits
- Timeout (msec) = 1000

CONFIGURATION MODES

AirGate-Modbus is configurable through **DigiConfig** software via USB interface, being necessary to put the device in "setup mode". To enter this mode, simply press the SETUP BUTTON, checking that the STATUS LED now flashes slowly (approximately once per second). In "setup *mode*" the device stops behaving as a gateway from a Modbus network and starts to accept the configurations. In the main screen of the **DigiConfig** software (**Fig. 12**) the following configuration must be seen:

· Initial Address = 246
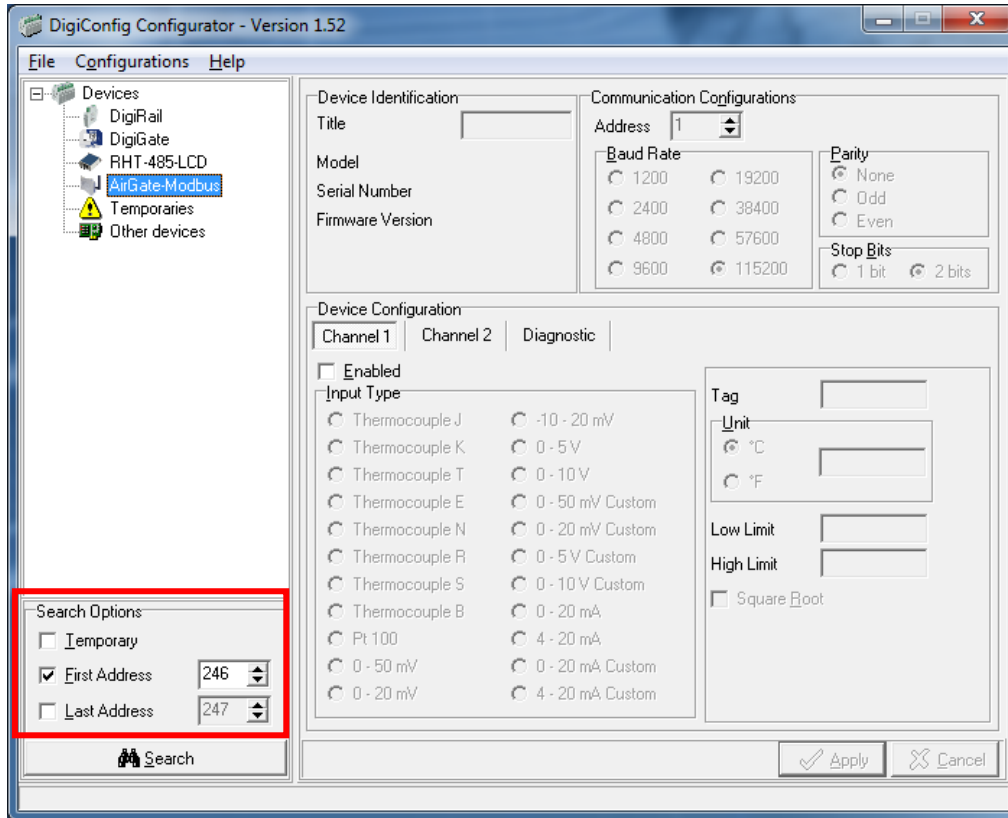
Fig. 10 - **DigiConfig** main screen

To edit the configurations of the **AirGate-Modbus**, after clicking the Search button, you must select it in the tree to the left of the main screen.

To quit "setup *mode*", you must press the SETUP BUTTON again, "Cancel", or "Apply" a configuration. In this moment, the device is reset and starts to operate according to the last applied configuration.

DETERMINATION AND SELECTION OF THE SERIAL PORT (COM) - WINDOWS

DETERMINATION

The serial port associated to the *AirGate-Modbu*s is automatically determined by the operational system a few instants after the connection of the *AirGate-Modbus*. The user may easily identify or alter the COM port associated to the *AirGate-Modbus* accessing the *Windows®* "*Device Manager*":

Control Panel / System/ Hardware / Device Manager / COM & LPT Ports

It's also possible to open the "Device Manager" executing the following command: "*devmgmt.msc*".

After opening the "*Device Manager*" it's possible to verify which is the Serial Port (COM) associated to the *AirGate-Modbus*. As it can be seen in **Fig. 13** the *AirGate-Modbus* is associated to COM7.
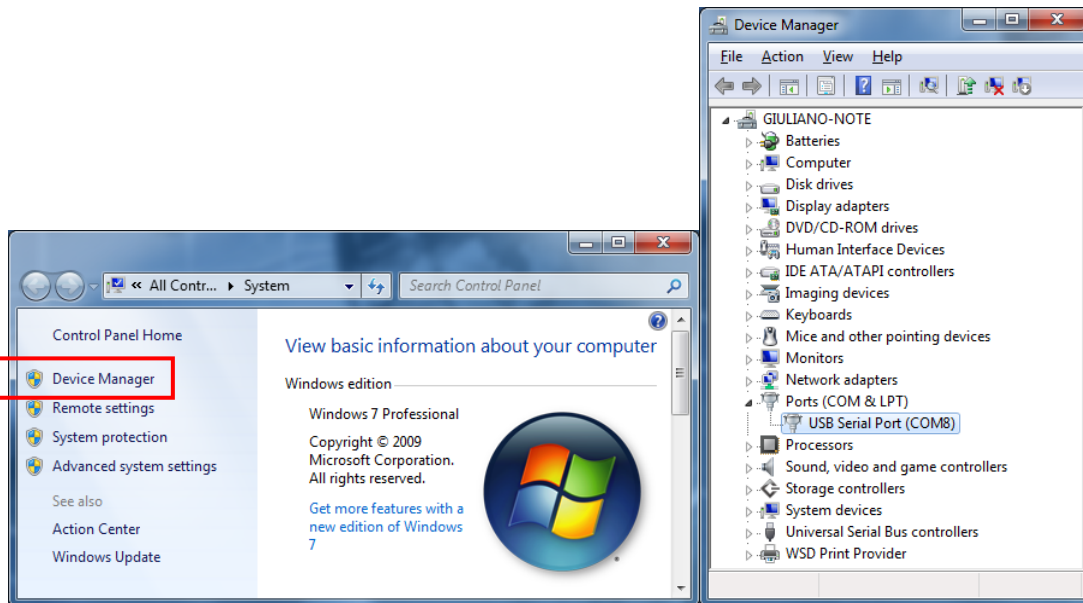
Fig. 13 - Determination of the COM Port

SELECTION

In case it's necessary to modify the Serial Port (COM) associated to the *AirGate-Modbus* select "US*B Serial Port (COM X)*" where the *AirGate-Modbus* is connected. Access "Action/Properties" and in the "*Port Definitions*" tab click "*Advanced...*", according to **Fig. 14**. In case this tab does not appear, the driver was not installed correctly and the *DigiConfig* software must be reinstalled. In the "*Advanced definitions for COMX*" window change the parameter "COM port Number:" for the desired COM, as indicated in **Fig. 15**. Some serial ports may be marked as In Use. Only select one of these ports in case you are sure that it is not being used by another peripheral of your computer.

In some situations the serial ports may be marked as in use even when the associated device is not installed anymore in the computer. In this case it is safe to associate this port to the *AirGate-Modbus*.
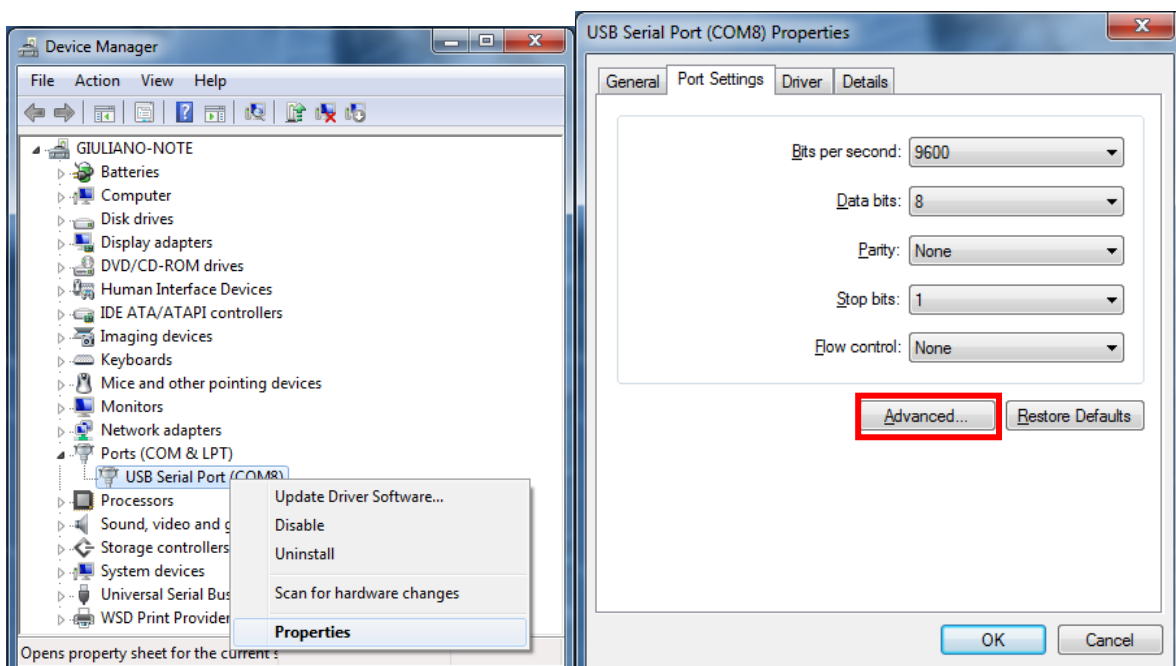
Fig. 14 - Accessing the advanced configuration of the COM port

IMPORTANT RECOMMENDATION

To improve the communication of the USB interface it is recommended the configuration of a Latency Timer. This parameter may be modified accessing "*Advanced definitions for COMX*" window according to **Fig. 14**.

Later it's possible to verify, according to **Fig. 15**, the "Latency Timer (ms): which must be altered to **4**.
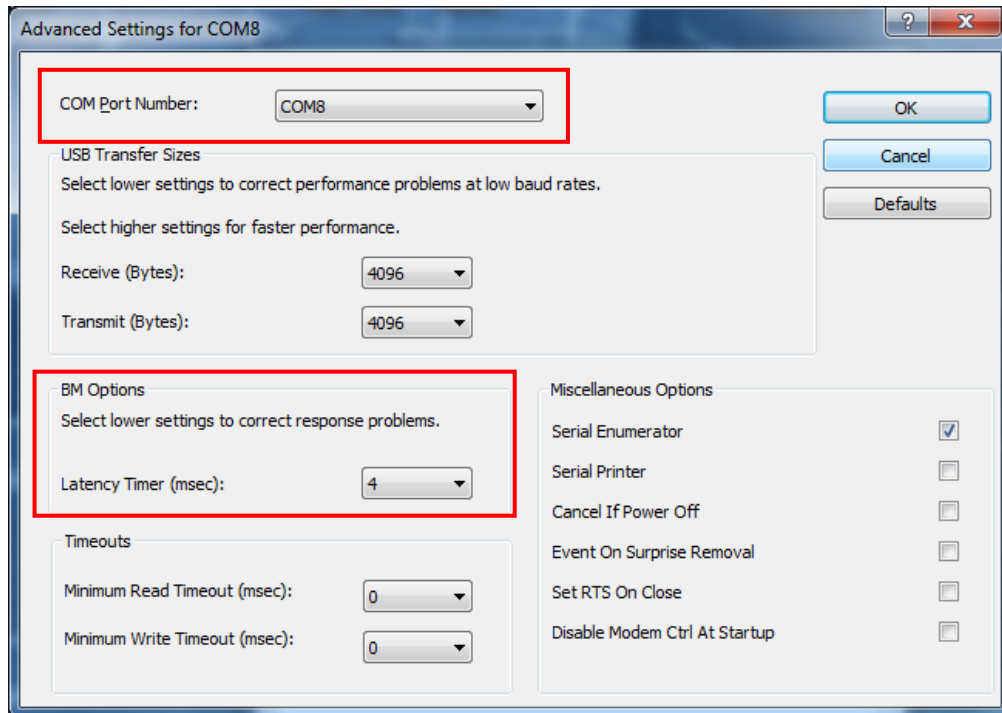
Fig. 11 - Advanced definitions for COM

CONFIGURATIONS - AIRGATE-MODBUS

BASICS

PAN ID

Choose a common identifier for each wireless network. All of the **AirGate-Modbus** devices from a same network must be configured with the same PAN ID.

MODBUS ADDRESS

Each **AirGate-Modbus** must have a unique Modbus address. This address should be set before connecting the device to the network. Modbus communication frames addressed to **AirGate-Modbus** will be handled by itself. Frames with any other address will be forwarded.

This address is set in factory as 248, an invalid Modbus address, to avoid initial conflict with any other already configured Modbus device in the network and should be changed to a unique address as soon as possible. While in Configuration Mode (status LED flashing), communication parameters switch to 115200 bps, no parity, 2 stop bits and address 246.

BAUD RATE

Select for each interface the baud rate used by the Modbus network. All of the devices from the network must be configured with the same baud rate.

PARITY

Select for each interface the parity/stop bits used by the Modbus network. All of the network devices must be configured with the same parity/stop bits.

TIMEOUT

Timeout (in milliseconds) for the receipt of response bytes to the command sent to the slave station. Calculated automatically by the software, according to the select baud rate.

For RS485-Master, RS485-Slaves and USB-Master operation modes, this parameter is only shown in the screen to help the setup of the network master's **Timeout**, which must have its **Timeout** time configured with at least the **Timeout** shown in **DigiConfig** screen.

For Multi-Master operation mode, this parameter is used by the **AirGate-Modbus**, and may have its Timeout altered by the **DigiConfig** according to what is explained in the section "MULTI-MASTER" of the "OPERATION MODES" chapter. Noting that in this case the **Timeout** configured in each network master must be at least **double** the time configured for **AirGate-Modbus**.

OPERATION MODES

According to the desired functionality the **AirGate-Modbus** can be configured with different operation modes. These are distinguished altering the functions of the communication interfaces, as explained in the "OPERATION MODES" chapter. When selecting a operation mode in **DigiConfig**, a figure containing a topology example will help in its setup.

ADVANCED

INTERFRAME TIME

The maximum time allowed (in microseconds) between the receipt of two bytes from a same package. This time is calculated automatically by **DigiConfig** software. It must only be modified it any of the network slaves show a high communication error rate. The "*Minimum time*" and "*Maximum Time*" values are shown in **DigiConfig** and range according to the lowest baud rate selected for the interfaces in the "*Basic Configurations Guide*". When clicking the "*Auto*" button the text box will be available for altering of the "*Interframe Time*" which must obligatorily be within the band.

RF POWER

Alters the value of the transmission of the **AirGate-Modbus**. Valid values from 0 to 20 dBm.

SECURITY

The encryption of the packages may be enabled by selecting the "*Enable Security*" box. In case you wish to modify the security key simply click "*Change Security Key*" and type a new key in the fields "*Typethekeyhere*".

FIRMWARE UPDATE

This **DigiConfig** tab is used for the firmware update of the **AirGate-Modbus**.

The following steps must be followed:

1. Locate the "Firmware" tab "Device Setup".
2. Select "Enable Firmware Update".
3. Click "Open" and search the new firmware file ("*.cbin*").
4. Press the "Apply" button.
5. Wait the Firmware update process conclusion. The **DigiConfig** will show a text box with the information **AirGate-Modbus** firmware recording performed successfully. Click "*OK*".
6. The **DigiConfig** will turn back to the initial screen and the STATUS LED of the **AirGate-Modbus** will start to flash rapidly.

⚠️	During the Firmware update process of the **AirGate-Modbus**, there must not have any interruption. In case there is power outage, disconnection of the USB cable or interruption of the **Digiconfig** software during the process, the **AirGate-Modbus** will probably cease operating normally and must be forwarded to the technical support of the supplier.

DATA COMMUNICATION - SERIAL

The *AirGate-Modbus* possesses two communication interfaces:

· RS485, acting as communication interface with Modbus RTU protocol.

· USB device, acting with the communication interface of Modbus RTU protocol.

RS485 AND USB INTERFACE

The RS485 and USB interfaces may be configured to operate in the following speeds (baud rates): 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200. Besides that, it may be configured to operate with one or two stop bits, and in the parities even, uneven and none.

More details about the implementation of a Modbus devices network via RS485 can be found in the document "Basic RS485 and RS422 Concepts", available in the CD which accompanies the product or in the www.novusautomation.com website. The **Table 2** helps the connection of the RS485 communication interface connectors.

D1	D	D+	B	Bidirectional data line	Terminals 1 and 4
D0	D	D-	A	Inverted bidirectional data line.	Terminals 2 and 5
C				Optional connection which improves the communication performance	Terminals 3 and 6
GND					

Table 2 - RS485 connections

DATA COMMUNICATION – WIRELESS

The AirGate-Modbus has a IEEE 802.15.4 Wireless communication interface to connect to the other Novus equipment that uses the same communication interface. As of firmware version **V1.23**, the AirGate-Modbus allows, not only communication with other AirGates, as described in the chapters **Operation Modes** and **Using the Operation Modes**, but also the option to communicate the RHT-Air equipment units, which are Wireless transmitters of temperature, humidity, and dew point. Each AirGate-Modbus can support the connection of 8 AirGate-Modbus equipment units and 35 RHT-Air equipment units. Each of these 8 AirGate-Modbus equipment units allows the connection of over 8 AirGates and

35 RHT-Air up to the limit of 4 levels of depth, as illustrated in **Fig. 16**. This network topology is formed automatically at the moment the network begins. One only needs to configure at least one AirGate-Modbus as a Multi-Master operation mode, USB-Master or RS485-Master and the other equipment: (i) AirGate-Modbus, with the RS485-Slaves operation mode; and (ii) RHT-Air, all with the same PAN ID. After the configuration, the equipment units will automatically be paired based on the best communication link (LQI) that is found.

For a correct functioning of the wireless communication network, it is important for all equipment to have the same firmware version. If you have AirGate-Modbus equipment with a firmware version below **V1.23** and wish to use the new functionalities available in this version, such as a tree network topology that is totally wireless, or operation with RHT-Air equipment, you only have to update the firmware of all the equipment or use a AirGate-Modbus with the new version of the firmware operating - such as RS485-Master - in another PAN ID, connected to interface RS485 in one of the AirGates operating as RS485-Slaves of the first PAN ID, as shown in the **Long Reach Application**.
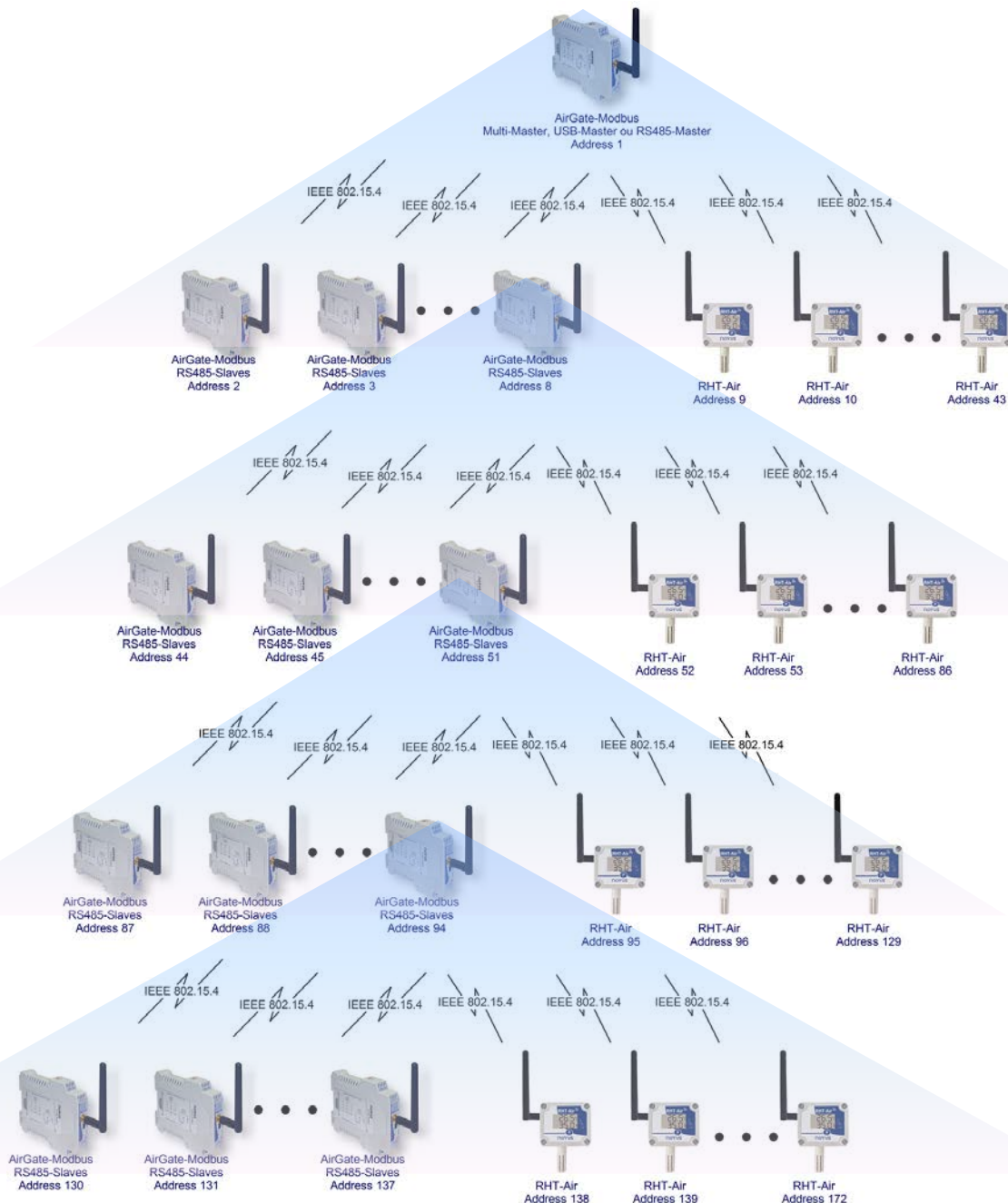
Fig. 12 - Totally wireless Tree network topology with AirGate-Modbus and RHT-Air equipment

MODBUS COMMANDS

As of the **V1.23** Firmware version, the AirGate-Modbus begins to respond to Modbus commands that are forwarded to your Modbus address, operating as a network slave. Commands forwarded to other slaves will be sent transparently. The Modbus RTU commands (functions) are implemented and listed below, and they are interpreted by AirGate-Modbus. For more information about each command and the Modbus protocol in general, access the site www.modbus.org.

READ HOLDING REGISTERS – 0X03

This command can be used to read the value of one, or up to the maximum amount of consecutive holding registers, as shown in the "Holding Registers Table."

WRITE HOLDING REGISTERS – 0X06

This command can be used to write in a holding register, as shown in "Holding Registers Table."

DESCRIPTION OF SOME REGISTERS

REGISTER 35 – OPERATION CHANNEL

Shows the operation channel that the equipment is operating on the network. It can vary from 11 to 25, where each channel is equivalent to an operation frequency. Among these 15 possible channels, the network operates on the channel that has the lowest interference.

CHANNEL	OPERATION FREQUENCY
11	2405 MHz
12	2410 MHz
13	2415 MHz
14	2420 MHz
15	2425 MHz
16	2430 MHz
17	2435 MHz
18	2440 MHz
19	2445 MHz
20	2450 MHz
21	2455 MHz
22	2460 MHz
23	2465 MHz
24	2470 MHz
25	2475 MHz

Table 3 – Operation Channels

REGISTER 36 - LINK QUALITY INDICATOR RX FATHER

States the quality of the reception link of the connection between the equipment and the AirGate-Modbus father with which it is paired. This value is obtained when measuring the power of the last packet received. This power is measured in dBm, which is a logarithmic measurement of power in mW. The LQI can vary between -100dBm (worst reception quality) to -15 dBm (best reception quality).

REGISTER 39 - LINK QUALITY INDICATOR RX CHILD

States the quality of the reception link of the connection between the AirGate-Modbus child whose Modbus address was filled-out in the ADDR_FILHO register. This value is obtained when measuring the strength of the last packet received. This power is measured in dBm, which is a logarithmic measurement of power in mW. The LQI can vary between -100dBm (worst reception quality) to -15 dBm (best reception quality).

LINK QUALITY INDICATOR

To evaluate if the equipment was installed in an appropriate manner, it is recommended to verify the quality of the connection between each of the AirGate-Modbus and RHT-Air equipment units. This verification should be made by an analysis of registers **36** and **39**, while the network is operating. To make this analysis, it is possible to use the Diagnostic tab of the DigiConfig that states the network typology and the quality of the link between each of the wireless connections in an intuitive fashion.

For equipment operating in ideal conditions, where there are no obstacles and no type of electromagnetic interference, the LQI will behave similarly to the contents of the graph shown in **Fig. 17**, where a comparison between different levels of power for the Distance versus LQI ratio is made.
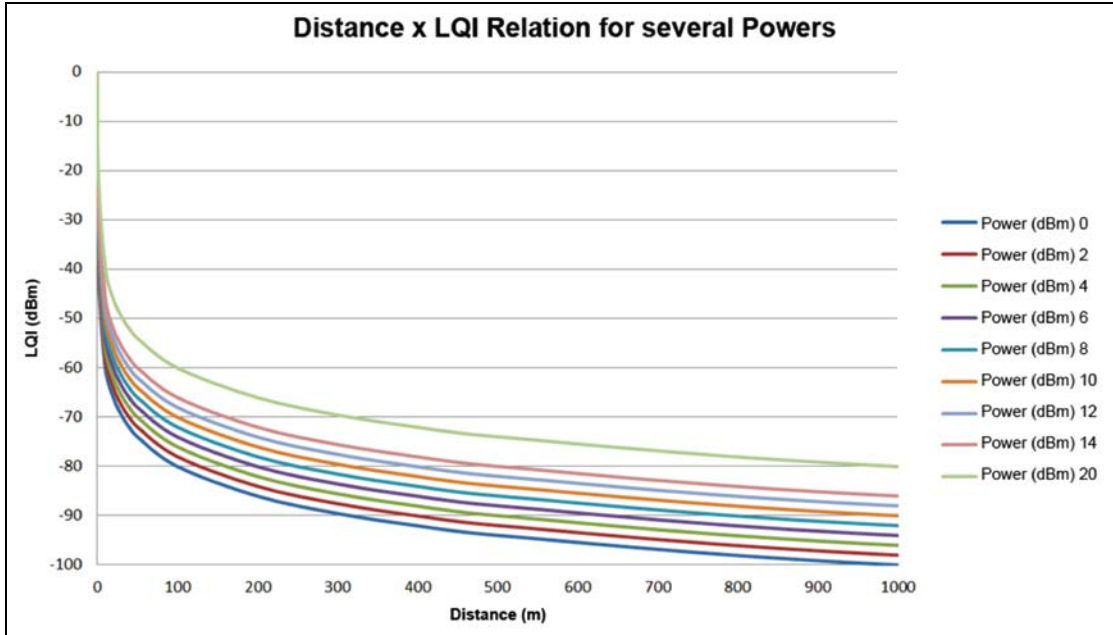
Fig. 13 – Ratio between Distance and LQI for several power levels

Table 4 lists the values obtained in the LQI reading with an evaluation of the signal quality. This same information can be seen in a more intuitive fashion on the Diagnostic tab of the DigiConfig Software.

REGISTER VALUE	QUALITY	ICON
0	Device connected via USB	
-15 to -60	Great	
-60 to -70	Very Good	
-70 to -80	Good	
-80 to -90	Average	
-90 to -100	Poor	

Table 4 – Relation between LQI and Signal Quality

NOTE: The model described graphically considers only the means of propagation. The LQI may vary due to various factors, such as peripheral obstacles such as trees, buildings, hills that interfere in the midst of the propagation, as explained by the Fresnel Zone phenomenon.

HOLDING REGISTERS TABLE

SUPPORTED MODBUS REGISTERS

ADDRESS	DESCRIPTION	MINIMUM	MAXIMUM	R/W
0	Used by the configuration software to place the equipment in firmware update mode. The equipment only accepts writing in this register if it is in configuration mode. If 1 is written on the register outside the configuration Software, the only was to return to the operation mode is turning off and turning back on the device.	0 – Standard mode 1 – Enters in Bootloader mode		R/W
1	Used by the configuration software to place all the registers, minus the protected ones, in compliance with the factory standards. After written in this register it saves the configurations on the flash. Only available in configuration mode.	0 – Standard mode 1 – Places all the registers inn default mode		R/W
2	Used by the configuration software to restart the device. If it is in configuration mode, it returns to operation mode. If not, then it restarts. Some configurations will only be applied after the device restarts.	0 – Standard mode 1 – Resets the device		R/W
3	Used by the configuration software to save all the configurations on the device's flash memory. If this register is not activated, the configurations made are saved on the FLASH, and when the device restarts, it returns to the previous configurations.	0 – Standard mode 1 – Saves the configurations on the FLASH		R/W
4	Shows if the device is a coordinator of the IEEE 802.15.4 network. Remember that there can only be one coordinator per PAN ID.	1 – It is the Coordinator 0 – It is a Router		R
5	Used to configure the product in one of the 4 operation modes. The operation modes operate as described in the chapter **Operation Modes**.	0- RS485-Master 1- RS485-Slaves 2- USB-Master 3- Multi-Master		R/W
6	Configured the least significant PAN ID byte	0	255	R/W
7	Configured the most significant PAN ID byte	0	255	R/W
8	Enables and disables the device when verifying the CRC of the package every time it receives packages in the RS485 or USB interface. If enabled can the CRC is not correct, the packet is not forwarded to the rest of the network.	0 - Disabled 1 - Enabled		R/W
9	Enables on inhibits the use of cryptography in wireless communication When enabled, all the devices of a single PAN ID should have their cryptography enabled and use the same SECURITY_KEY.	0 - Disabled 1 - Enabled		R/W
10	1st Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	1	R/W
11	2nd Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
12	3rd Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
13	4th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
14	5th Byte of the SECURITY KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
15	6th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
16	7th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
17	8th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
18	9th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
19	10th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
20	11th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
21	12th Byte of the SECURITY KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
22	13th Byte of the SECURITY KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
23	14th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W

24	15th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
25	16th Byte of the SECURITY_KEY. When the cryptography is enabled, all of the devices of a single PAN ID should have the same value in this register.	0	255	R/W
26	Configures which Baud Rate will be used in the operation mode in the USB interface of the device. In configuration mode, as described in chapter **Configuration Software**, the device always Uses Baud Rate 115200.	0 – Baud Rate 1200 1 – Baud Rate 2400 2 – Baud Rate 4800 3 – Baud Rate 9600 4 – Baud Rate 19200 5 – Baud Rate 38400 6 – Baud Rate 57600 7 – Baud Rate 115200		R/W
27	Configures which Baud Rate will be used in the operation mode in the RS485 interface of the device.	0 – Baud Rate 1200 1 – Baud Rate 2400 2 – Baud Rate 4800 3 – Baud Rate 9600 4 – Baud Rate 19200 5 – Baud Rate 38400 6 – Baud Rate 57600 7 – Baud Rate 115200		R/W
28	Configures the parity and how many stops bits will be used in the operation mode in the USB interface of the device. In configuration mode, as described in chapter **Configuration Software**, the device always uses ParityNone_StopBits2.	0 - Parity None Stop Bits 1 1 - Parity None Stop Bits 2 2 - Parity Even Stop Bits 1 3 - Parity Odd Stop Bits 1		R/W
29	Configures the parity and how many stops bits will be used in the operation mode in the RS485 interface of the device. To facilitate connectivity with devices from different manufacturers, when configured with ParityNone_StopBits1 or ParityNone_StopBits2, the device always transmits using 2 stop bits and receives with 1 stop bit. This allows for communication with devices with both configurations, but this feature is only available with the RS485 interface.	0 - Parity None Stop Bits 1 1 - Parity None Stop Bits 2 2 - Parity Even Stop Bits 1 3 - Parity Odd Stop Bits 1		R/W
30	Interframe is the time used to characterize the fact that 2 bytes are part of the same Modbus frame (packet). When two bytes are spaced in less time than the time configured in this register, they are part of the same packet. When this time is exceeded, the frame is considered to be finished. In this register the Interframe Modbus for USB is configured. When configured with 1749, it automatically takes on the values according to the Baud Rate in compliance with the Modbus protocol. If the network master connected to the USB interface has a high rate of errors, it is possible that it is not following the Modbus rule. In this case, increasing the value of the register may solve the problem.	1749	40000	R/W
31	Interframe is the time used to characterize the fact that 2 bytes are part of the same Modbus frame (packet). When two bytes are spaced in less time than the time configured in this register, they are part of the same packet. When this time is exceeded, the frame is considered to be finished. In this register the Interframe Modbus for USB is configured. When configured with 1749, it automatically takes on the values according to the Baud Rate in compliance with the Modbus protocol. If a master or slave connected to the RS485 interface has a high rate of errors, it is possible that it is not following the Modbus rule. In this case, increasing the value of the register may solve the problem.	1749	40000	R/W
32	As explained in the chapter **Configurations – AirGate-Modbus**, this register is used to configure the Modbus address, i.e., the address that identifies the device on the network. As a standard, since it is a gateway and to not conflict with other network devices, all of the AirGate-Modbus leave the factory with the address 248. When in configuration mode, as explained in the **Configuration Mode** chapter, the device always answers for the Modbus 246 address using the USB interface.	1	254	R/W
33	When operating in Multi-Master mode, as explained in the **MULT-MASTER** chapter, the gateway uses the **Multiplexar** function that needs a time-out to release the interface in case the response does not return to one of the masters. The Time-out is configured in this register. This is the maximum amount of wait time for a response from a slave	300	65535	R/W

34	Used to configure the transmission power of the Wireless interface. The larger the configured value, the greater the reach.	0 – 0 dBm, 1 – 2 dBm 2 – 4 dBm 3 – 6 dBm 4 – 8 dBm 5 – 10 dBm 6 – 12 dBm 7 – 14 dBm 8 – 20 dBm		R/W
35	Indicates the operation channel which can vary from 11 to 25, According to Anatel guidelines, the device can operate in the frequencies of channels 11 to 25 for power levels of up to 20 dBm.	11	25	R
36	LQI RX Father Register Lists the LQI RX Father, i.e., the quality of the reception link to the network father. The LQI Rx is a power measurement of the last packet received by the father. This amount is measured in dBm and varies between -100dBm (worst reception quality) to -15 dBm (best reception quality). This register has a value of 0 when the device is in configuration mode or is the network coordinator (that does not have a father).	-100	-15	R
37	Indicates the number of children (AirGates in operation mode RS485-Slaves + RHTs-Air) that the device has.	0	43	R
38	ADDR_FILHO register. This register is used to request the AirGate-Modbus information about its children. This register should include the Modbus address of the child that requires the information contained in the registers **39** to **48**. The information will only be filled out is the Modbus address corresponds to a device that is in a branch below the one the father belongs to. If the Modbus address does not belong to a direct child, the information will correspond to the child en route to the destination.	0	255	R/W
39	LQI RX Child Register. States the LQI RX Child, i.e., the LQI of the last packet received by the AirGAte of the child en route to ADDR_FILHO. If ADDR_FILHO is of a child, the LQI corresponds to it, otherwise, the LQI corresponds to the child of Short Mac ROTA_FILHO_SHORT_MAC_0 ROTA_FILHO_SHORT_MAC_1.	-100	-15	R
40	States the number of packets requested to the child with the address ADDR_FILHO as long as AirGate has started until reaching the limit of the register.	0	65535	R
41	States the number of packets answered by the child with the address ADDR_FILHO as long as AirGate has started until reaching the limit of the register.	0	65535	R
42	Lists the error rate in % * 100. To obtain the error rate in %, divide the register value by 100.	0	10000	R
43	States the size of the last requested packet to the child with the address ADDR_FILHO.	0	4096	R
44	States the size of the last requested answered by the child with the address ADDR_FILHO.	0	4096	R
45	States the throughput of the last transaction that occurred with the slave of address ADDR_FILHO considering the time from the first byte received by the master's request interface until the last byte transmitted from the child's response to the master's interface and the size of the request and response packets. Information available in Bytes/Second.	0	65530	R
46	States the response time of the last transaction that occurred with the slave of address ADDR_FILHO considering the last byte received by the master's requisition interface until the first byte transmitted from the slave's response packet to the master's interface. Information available in milliseconds.	0	65535	R
47	Register ROTA_FILHO_SHORT_MAC_0. First Byte of the Short Mac of the AirGate-Modbus route to the child with Modbus address ADDR_FILHO.	0	255	R
48	Register ROTA_FILHO_SHORT_MAC_1. First Byte of the Short Mac of the AirGate-Modbus route to the child with Modbus address ADDR_FILHO.	0	255	R

49	Noise in channel 11 (frequency: 2405 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
50	Noise in channel 12 (frequency: 2410 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
51	Noise in channel 13 (frequency: 2415 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
52	Noise in channel 14 (frequency: 2420 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
53	Noise in channel 15 (frequency: 2425 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
54	Noise in channel 16 (frequency: 2430 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
55	Noise in channel 17 (frequency: 2435 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
56	Noise in channel 18 (frequency: 2440 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
57	Noise in channel 19 (frequency: 2445 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
58	Noise in channel 20 (frequency: 2450 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
59	Noise in channel 21 (frequency: 2455 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
60	Noise in channel 22 (frequency: 2460 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
61	Noise in channel 23 (frequency: 2465 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
62	Noise in channel 24 (frequency: 2470 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
63	Noise in channel 25 (frequency: 2475 MHz, band: 2 MHz) obtained when starting the network. The noise is measured with the power of the noise level of the channel measures in dBm, and can vary from -100 dBm (clean channel) to -15 dBm (dirty channel).	-100	-15	R
64	Used so the user can identify the device. Each byte corresponds to an ASCII character.	0	65535	R/W
65	Used so the user can identify the device. Each byte corresponds to an ASCII character.	0	65535	R/W
66	Used so the user can identify the device. Each byte corresponds to an ASCII character.	0	65535	R/W

67	Used so the user can identify the device. Each byte corresponds to an ASCII character.	0	65535	R/W
68	Used so the user can identify the device. Each byte corresponds to an ASCII character.	0	65535	R/W
From here on out are the protected registers				
1000	Reserved	0	1	R
1001	Long MAC address 0	0	255	R
1002	Long MAC address 1	0	255	R
1003	Long MAC address 2	0	255	R
1004	Long MAC address 3	0	255	R
1005	Long MAC address 4	0	255	R
1006	Long MAC address 5	0	255	R
1007	Long MAC address 6	0	255	R
1008	Long MAC address 7	0	255	R
1009	Short MAC address 0	0	255	R
1010	Short MAC address 1	0	255	R
1011	BaudRate of the configuration mode. Standard 115200.	7	7	R
1012	Parity/Stop Bots of configuration mode. None Standard/ 2 Stop Bits	1	1	R
1013	Interval for association retry. 1 second standard	1	60	R
1014	Maximum number of packet loss before the device quits and restarts.	5	5	R
1015	Reserved	0	0	R
1016	Interval between Polls when there is no ack from father to child.	6000	6000	R
1017	Maximum wait time for a wireless fragment packet.	30	30	R
1018	Version of MAC layer of the device.	214	214	R
1019	Serial number (word high)	0	65535	R
1020	Serial number (word low)	0	65535	R
1021	Product code	102	102	R
1022	Device firmware version	0	65535	R

ACCESSORIES

Extension Cable: With 2.5 meters and a magnetic base, the extension cable allows a better positioning of the AirGate-Modbus antenna. On its ends there are RP SMA Male connectors for connection with AirGate-Modbus and RP SMA Female for connection with the Antenna. There is no need to buy a new antenna because the one from AirGate may be used.

WARRANTY

Warranty conditions are available on our web site www.novusautomation.com.