RHT-Air

WIRELESS EQUIPMENT FOR TEMPERATURE AND HUMIDITY – INSTRUCTIONS MANUAL V1.0x A

1 INTRODUCTION

RHT-Air comes with a high precision and stability sensor to measure both temperature and relative humidity. Because it operates with a microprocessor, it can be fully configured through its USB and IEEE 802.15.4 interfaces, using Modbus RTU commands. The software DigiConfig enables for all the equipment's resources to be configured.

RHT-Air can be configured to display the temperature and Relative Humidity measured or even, the temperature and the Dew Point

RHT-Air should be connected (via wireless) to an AirGate-Modbus so that its registers can be read whenever it is in operation.

1.1 IDENTIFICATION

The following elements appear in the front part of the equipment:

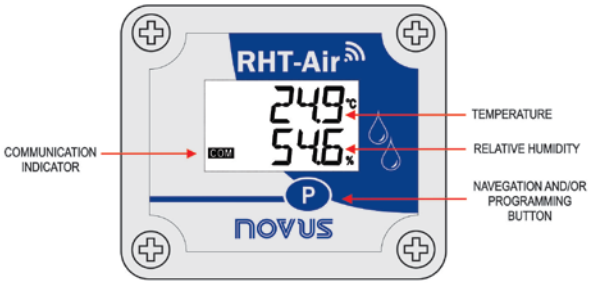


Fig. 1 – RHT-Air main screen

Communication Indicator (COM): It signals that the device is receiving data from the Modbus network.

P Button (Programming): This button is used to configure the Modbus address, the Update Interval and screen changes.

Temperature: Room temperature measured by the equipment.

Relative Humidity: Relative Humidity measurement.

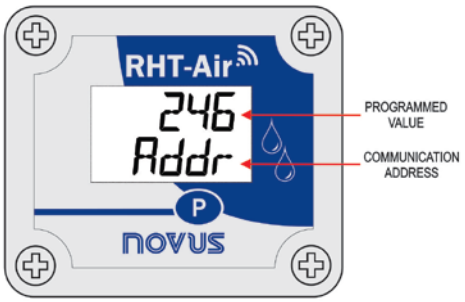


Fig. 2 – RHT-Air's second screen

Communication Address: Programmed value to identify the Modbus network equipment. Programmable between 1 and 246.

2 SPECIFICATIONS

Equipment's operating temperature	RTH-Air = from -10 °C to 70 °C
Electromagnetic compatibility	EMC: EN61326-1:2006 CISPR11/EN55011, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-6, EN61000-4-8
Sensor's measurement range	Temperature: -40.0 °C to 100.0 °C. Relative Humidity (RH): 0.0 to 100.0 % RH. (No Condensation) Dew point: -40.0 °C and 100.0 °C
Precision of measurements	See Fig. 3. Note: measurement errors can be discarded through the software's OFFSET parameter.
Resolution of measurements:	Temperature: 0.1 °C. 14 bits (16383 levels) Relative Humidity (RH): 0.1 %. 12 bits (4095 levels)
Response time (Sensor)	Temperature: Up to 30 s in slow moving air. Humidity: Up to 8 s in softly moving air (20 to 80 % RH).
Interval between updates	A minimum of 15 seconds. No more than 30 minutes (1800 s)
Power supply	12 Vdc to 30 Vdc, consumption < 100 mA or Lithium battery of 3.6 Vcc (1/2 AA), internal.
Connections	• Internal USB Device (Mini-B) for configuration and firmware update. • Groove RP SMA (Plug) connector for antenna. • Power supply connector.
Wireless	• Maximum transmission power of 25,11 mW (14 dBm). • Maximum Range: 500 meters line-of-sight in open field. • Receptor sensibility - 92 dBm. • Operation band ISM 2.4 GHz. • DSSS Technology - Direct Sequence Spread Spectrum. • OQPSK Modulation - Offset Quadrature Phase Shift Keying. • 15 operation channels. • AES-CBC-128 (Advanced Encryption Standard).
Storage	Polycarbonate
Level of protection	The product is suitable for applications that require a level of protection of up to IP65. Electronic module box: IP65; Sensor capsule: IP40.
Dimensions	60 x 70 x 35 mm + antenna 105 mm + sensor 37.2 mm
Weight	171 grams / 40 grams (cable)
DigiConfig software configuration environment	Configuration Software Windows®. Menus in Portuguese, English or Spanish. It configures, reads and displays data on the screen.
Certifications	CE, ANATEL (0172-13-7089)

2.1 PRECISION OF MEASUREMENTS AND OPERATIONAL LIMITS OF SENSORS:

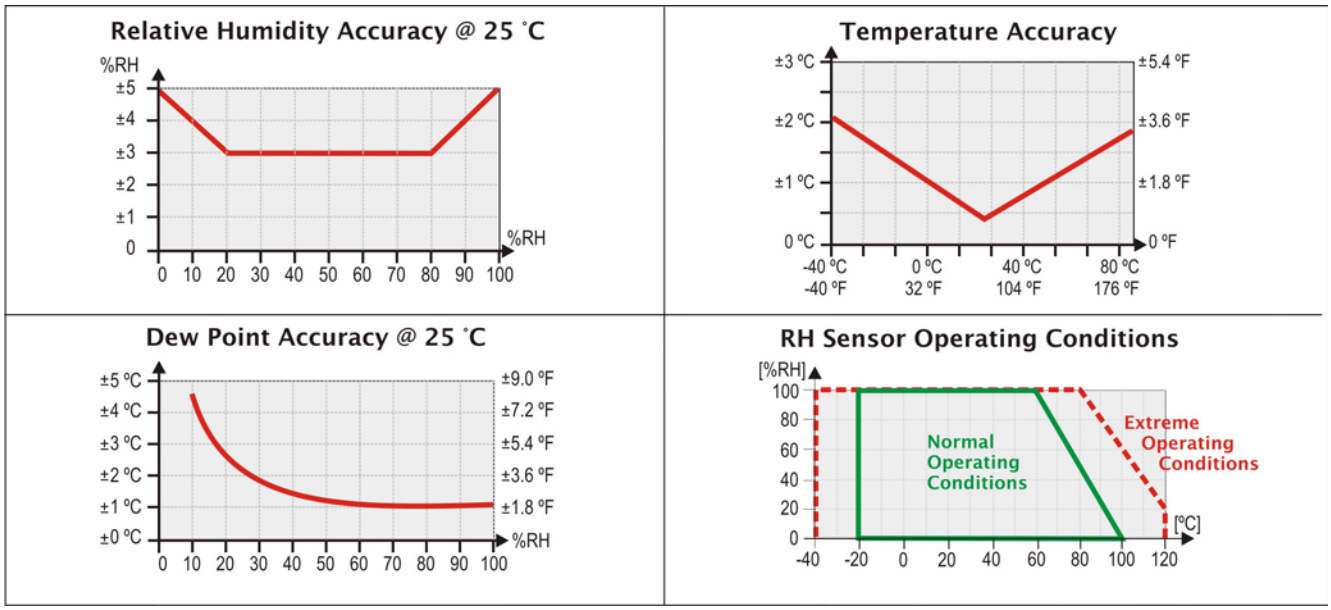


Fig. 3 - Precision of the humidity and temperature measurement

3 MECHANICAL INSTALATION

RHT-Air was designed to be attached to walls. By removing the equipment's cover, users will have access to two molding holes of the base, as shown in Fig. 4. The equipment should be attached with the sensor capsule facing downwards in order to ensure precision and the specified level or protection.

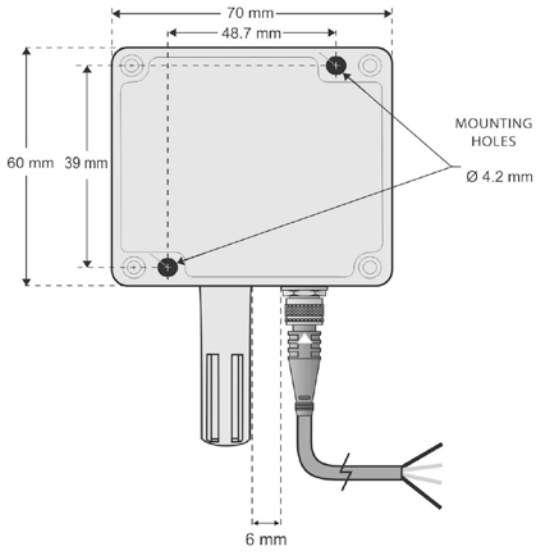


Fig. 4 - RHT-Air mounting holes and measures

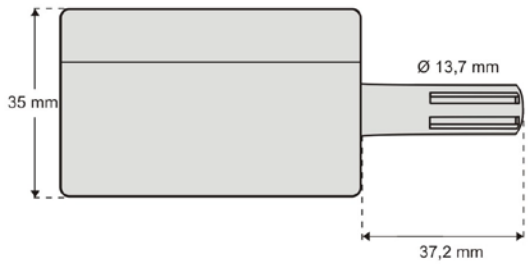


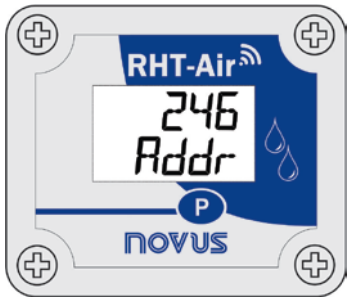
Fig. 5 - RHT-Air Measurements

4 CONFIGURATION

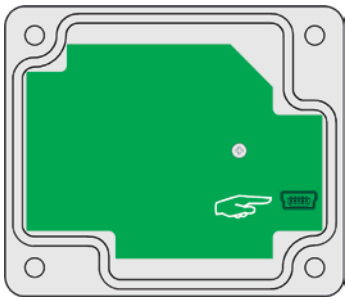
4.1 CONFIGURATION VIA USB INTERFACE

Initially, the first configuration must be done through USB interface.

- Remove the four set screws of the front panel of the equipment RHT-Air, taking the necessary precaution not to apply force on the internal connector of the electronic circuit.



- In order to configure it through a USB interface, connect the cable as shown below. The external power cord should not be used during the configuration.



5 ELECTRICAL INSTALLATION

5.1 EXTERNAL POWER SUPPLYING

Fig. 6 below shows RHT-Air's necessary electrical connection. Terminals 1 and 2 are to be used in the electrical connection and terminals 3 and 4 are not used.

1	- VDC	Power Supply	Black wire
2	+ VDC	Power Supply	White Wire
3		Not used	Blue wire
4		Not used	Brown Wire

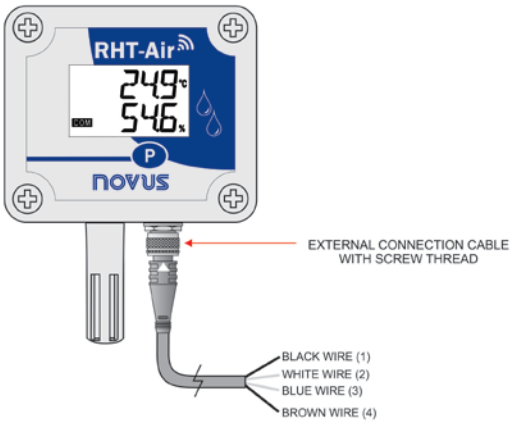
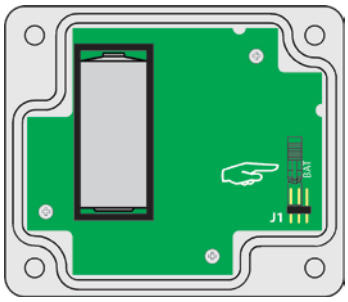


Fig. 6 - Electrical wiring

- RHT-Air is manufactured with the jumper (J1) set in the position “EXT” for external power supply.



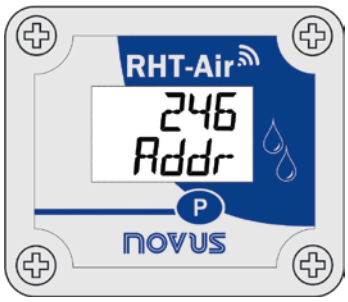
5.1.1 RECOMENDATIONS FOR INSTALLATION

- Conductors of small electric signals must be separated from activation conductors or higher current or power in the system’s plan, if possible in grounded electroducts.
- The instrument’s supply must come from a network proper for instrumentation.
- In control and monitoring applications, it is essential to consider what may happen when any part of the system fails.
- The use of RC FILTERS (47 Ω and 100 nF, series) in parallel with contactor and solenoid coils, etc. is recommended.

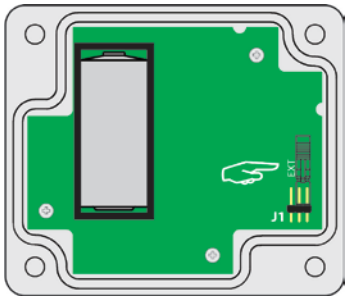
5.2 BATTERY POWER SUPPLY

RHT-Air can be supplied by an internal battery whenever the equipment is not energized by the electrical grid. Below are guidelines on how to proceed for supplying power with a battery:

- Remove the four set screws of the front panel of the equipment RHT-Air, taking the necessary precaution not to apply force on the internal connector of the electronic circuit.



- After removing the front panel, change the position of the jumper (J1) to “BAT” so that it can be supplied through the battery. Replace the front panel, by placing the four set screws, taking the necessary precaution not to apply force on the internal connector of the electronic circuit.



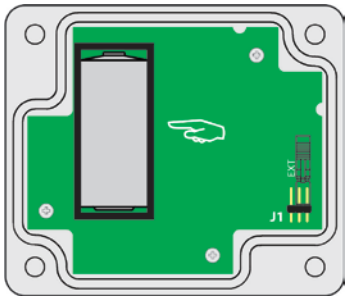
5.2.1 REPLACING THE INTERNAL BATTERY

It is possible to check the battery’s charge through register “29”. A fully charged battery typically has a power above 3.6 V. As you use the RHT-Air, the power of the battery will gradually decrease. It is recommended that you check the value of registry “29” regularly so that when it reaches below 3.3 V, the battery can be replaced.

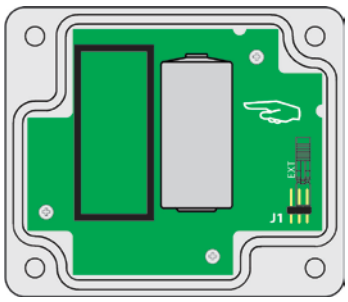
Note: Even when the power is below 100 %, the equipment will operate normally.

⚠	Only suitable replacement battery for this product is: MANUFACTURER: OMNICELL MODEL: ER14250HD

- Remove the four set screws of the front panel, taking the necessary precaution not to apply force on the internal connector of the electronic circuit. After removing the front panel, replace the battery, taking the necessary precaution not to touch the electronic circuit.



- Insert a new battery and replace the front panel carefully, placing the four molding screws.



6 CONFIGURATION / OPERATION

The application *DigiConfig* is a *Windows*® software used for configuring RHT-Air. In order to install it, please run the file “*DigiConfigSetup.exe*” from the CD that comes with the equipment and follow the instructions therein.

DigiConfig comes with an unabridged help tutorial, containing all the necessary information for you to use it. If you want to use help tutorial, start the application and select the "*Help*" menu or press "*F1*".

If you do not have the CD that comes with the equipment, go to www.novusautomation.com to get the *DigiConfig* installer and the additional manual guides.

Users will receive the fully calibrated adjustment-free equipment. The original configuration is shown below:

Addr (Communication address) = 246

Time (Update interval) = 60

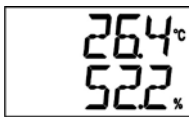
In order to configure it for the first time, it is necessary to remove the front cover and connect it to a computer through a mini-B USB cable. The initial configurations for wireless are described as follows:

PAN ID (Network Identifier) = 22350 (0x574E)

RF Power (Power Level) = 0 dBm

6.1 RHT-Air SCREENS

Indication screen of the values measured in the equipment:



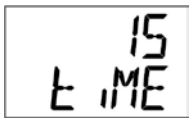
1st Screen: Main

In order to configure the communication parameters, you should press the Button P (for about 5 seconds) until it starts to blink, release it and press it again to expand it. When the expected value appears, release the button and wait until the screen stops blinking (for about 10 seconds). If you want to move on to the following screens, press the button P.

Configuration screen of the Modbus Address – Sets the address of the module on the Modbus network. Between 1 and 246.

2nd Screen: Modbus address

Time configuration screen – Sets the update interval.

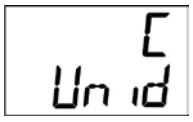


3rd Screen: Update interval

Mode's configuration screen – Sets the indication mode.

4th Screen: Indication mode

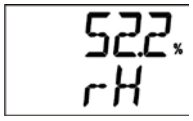
Configuration screens of the Unit: It sets which temperature unit should be used (ºC or ºF).



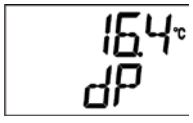
5th Screen: Unit

Screens for viewing the values measured in the equipment only:

6th Screen: Temperature



7th Screen: Relative Humidity



8th Screen: Dew point

7 BATTERY LIFE

The battery is estimated to last for over a year. There is a fine line between its life and how the equipment is used. The lower the sensor's reading interval, the shorter it will last, as it may, in the worst case scenario, last for 30 days only.

If you wish to save the battery's energy, it should be set to the lowest interval possible between updates. The level of transmission power to communicate with the AirGate-Modbus of the network has an effect on its life, too. So, the equipment should be configured to operate under the minimum power and as close to an AirGate-Modbus of the network as possible.

8 WIRELESS

RHT-Air has an IEEE 802.15.4 wireless connection to connect with AirGates-Modbus that has its firmware updated to a version more recent than V1.23. The first RHT-Air configuration must be done through a USB through Software *DigiConfig*, as the necessary parameters for communication with AirGates should be set. After the first time it is configured and matched with a AirGate-Modbus, RHT-Air will operate as a Modbus RTU slave. From this moment on, all its resources can be accessed through the reading of its registers in any Modbus RTU site. The Programming button P can be used for configurations.

The information necessary for data reading without *DigiConfig* can be found in this item. Software *DigiConfig* should be used in order to ensure the equipment's correct configuration. After it is configured, its data can be accessed by any other software with Modbus RTU communication capacity.

7.1 MODBUS COMMANDS

The following Modbus RTU commands (functions) are implemented: For further information on each one of these functions and on the Modbus protocol in general, go to www.modbus.org.

READ HOLDING REGISTERS – 0x03

This function can be used to read a value of one or up to 42 retentive registers, as per the "Retentive Registers Table".

WRITE HOLDING REGISTERS – 0x06

This function can be used to write in a retentive register, as per the "Retentive Registers Table".

7.2 DESCRIPTION OF SOME REGISTERS

Once the RHT-Air meets an AirGate-Modbus and is matched, this AirGate will be last published by RHT-Air. Therefore, when the Master of the Modbus network requires that the RH-Air address be read, the response is sent immediately and the expiration of this publication can be checked through register 30, which shows how long it has been since the last publication.

REGISTER 6 – PAN ID

A common identifier for each IEEE 802.15.4 wireless network. All machines from a common network (AirGates-Modbus and RHTs-Air) must be configured with the same PAN ID

REGISTER 7 – ENCRYPTION

This register should be used to enable or disable the use of encryption. If it is enabled, the encryption key should be the same used for all equipment configured with the same PAN ID.

REGISTER 16 – POWER LEVEL

The power level may be adjusted as needed, according to the variations presented in the table below: The higher the power set, the higher the reach, but the higher the consumption. It is suggested that the lowest value possible be configured, since in the event that RHT-Air is not able to communicate with the AirGate-Modbus, it will automatically increase the transmission power gradually, until it is able to communicate with AirGate-Modbus or reach the highest configurable limit. It may be that this register is configured with a value and, after some time, this value may be altered to adjust to a communicable power.

CODE	POWER LEVEL
0	0 dBm
1	2 dBm
2	4 dBm
3	6 dBm
4	8 dBm
5	10 dBm
6	12 dBm
7	14 dBm

REGISTER 27 – OPERATION CHANNEL

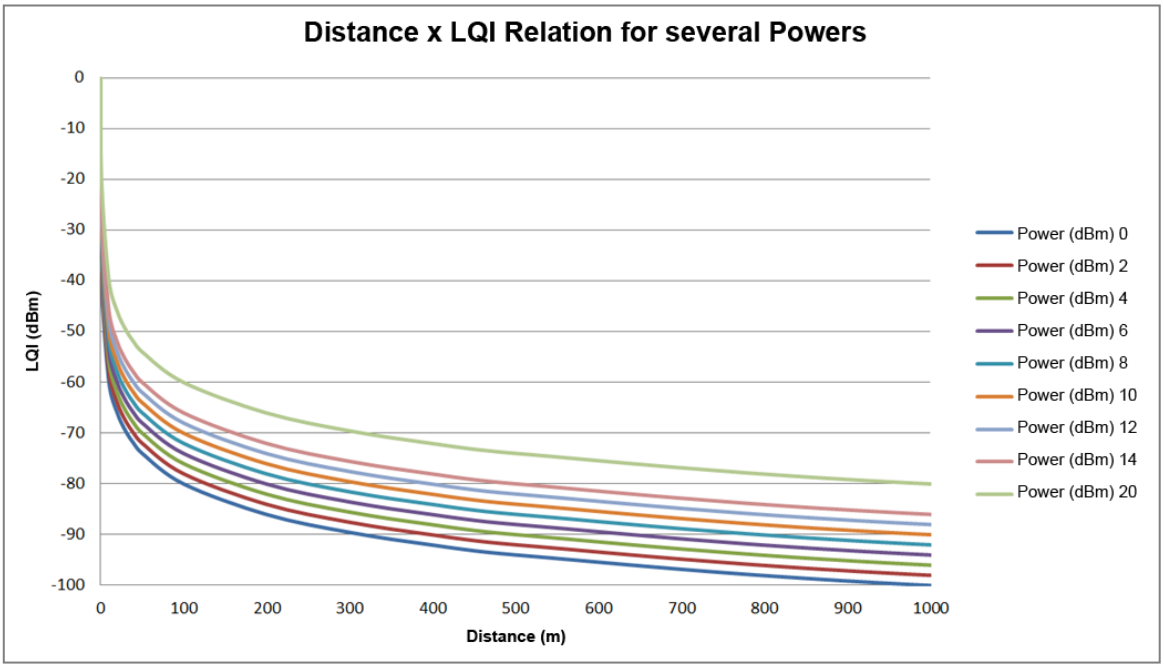
It indicates the operation channel in which the equipment is operating in the network. It may vary from 11 to 25, in that every channel is equivalent to one frequency of operation. The network will always operate on the channel with less interference among all the 15 possible ones.

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

REGISTER 28 – LINK QUALITY INDICATOR

It serves to inform the quality of the reception link of the connection between the equipment and the AirGate-Modbus with which it is matched. This value is obtained by measuring the power of the last package received. This power is measured in dBm, which is a logarithmic power unit in mW. The LQI may vary from -100 dBm (worst reception quality) to -15 dBm (best reception quality).

For equipment operating in ideal settings, with no obstacles and no electromagnetic interference, LQI will display a graphic similar to the one below, wherein the different power levels for the Distance vs. LQI relation are compared.



The table below relates the values obtained in the reading of the LQI to the evaluation of the quality of the signal. The same information can be viewed in a more intuitive way in the tab DigiConfig Software Diagnosis.

REGISTER VALUE	QUALITY	ICON
0	USB-connected device	
-15 to -60	Great	
-60 to -70	Very Good	
-70 to -80	Good	
-80 to -90	Regular	
-90 to -100	Bad	

NOTE: The model described in the graphic takes in consideration the propagation channel only. LQI may vary due to several factors, such as due to peripheral obstacles such as trees, buildings, hills that interfere in the propagation channels as explained by the *Fresnel Zone* phenomenon.

REGISTER 29 – BATTERY POWER

It has the value of the measurement of the battery power's level in an engineering unit. The decimal point is fixed in three places, the value has no point and must be provided in the reading software.

A fully charged battery typically has a power above 3.6 V. As you use the RHT-Air, the power of the battery will gradually decrease. It is recommended that you check the value of this register regularly so that when it reaches below 3.3 V, the battery can be replaced.

The verification of the capacity of the battery can be done through the DigiConfig Software Diagnosis tab, which will display an icon. The evaluation of battery capacity can be done according to the criteria presented below:

REGISTER VALUE	BATTERY CAPACITY	ICON
0	USB-connected device	
3500 to 3700	Great	
3400 to 3500	Very Good	
3300 to 3400	Good	
3200 to 3300	Average – Get ready to replace your battery	
Lower than 3200	Bad – Replace the battery as soon as possible	

NOTE 1: Even when the power is below 1100, the equipment will operate normally.

NOTE 2: The gradual failure of the battery's power is not linear, therefore, though the equipment is able to continue working under tensions below 3.0V, when it reaches this level, there is little left for its life, since the power will fail more quickly.

NOTE 3: When the equipment is being supplied by an external power source, the value presented represents the power supply of the circuit after the power regulator reaches 3.6 V. This value may vary according to the setting's conditions, but should not be lower than 3.3V.

NOTE 4: The machine's operating temperature has a significant impact on the battery's capacity. Temperatures below 0 °C will typically shorten the battery's life.

NOTE 5: The update time, as well as the operating power, have a significant impact on the battery's capacity. If the equipment is configured for the lowest update interval, the battery will typically last less. The same happens when the equipment is far from the AirGate-Modbus with which it should be matched, needing a higher transmission power to operate.

REGISTER 30 – LAST POLL'S DURATION

Every time the RHT-Air publishes something on AirGate-Modbus, this register gets a zero value. Every 100 ms, this register is increased in one unit in order to indicate how long it has been since the last publication.

REGISTER 31 – MODBUS

It sets the address of the equipment on the Modbus network. This address identifies the equipment on the Modbus network. Its configuration may range from 1 and 247, and it should be stressed that there cannot be more than one piece of equipment with the same address on the same network. RHT-Air is originally manufactured with the address 246. When connected to a USB interface, it always responds to Modbus functions through the address 246 to a BaudRate 115200 that has no parity and with 2 Stop Bits. When it is in operation, it always responds through the address it was configured for in this register according to the communication parameters of the Modbus network on which it was installed.

REGISTER 32 – UPDATE TIME

It sets the configuration for how often the equipment wakes to publish information on the AirGate-Modbus with which it is matched and update the IHM screen.

The shorter the update time, the more recent the data available to the master of the Modbus network will be, but the higher the energy consumption spent and the battery's life will be proportionately shorter. On the other hand, the higher the update time set, the lower the energy consumption spent will be, thus providing a longer life for the battery.

REGISTER 33 – INDICATION MODE

It sets the mode of indication of the values read on the display. The equipment is originally manufactured with the indication of temperature and relative humidity.

CODE	DESCRIPTION
0	Indicates the temperature and relative humidity.
1	Indicates the temperature and dew point.
2	Indicates relative humidity and dew point.
3	Indicates the temperature only.

It has the value of the measurement in an engineering unit. The decimal point is fixed in one place, the value has no point and must be expected for the reading software.

REGISTER 34 – CONFIGURATION OF THE MEASUREMENT UNIT

It sets the measurement unit for both temperature and dew point. The equipment is originally configured in (ºC).

CODE	UNIT
0	ºC
1	ºF

REGISTER 35 – DISABLES CONFIGURATION THROUGH A BUTTON

It sets the alteration of configuration through a button.

CODE	DESCRIPTION
0	Original standard value.
1	Disables the alteration of configuration of communication parameters through a button.

REGISTER 36 – USER OFFSET DE FOR TEMPERATURE

It sets the user's offset value in engineering units for temperature. The equipment's offset value is originally zero.

REGISTER 37 – USER OFFSET DE FOR HUMIDITY

It sets the user's offset value in engineering units for relative humidity. The equipment's offset value is originally zero.

REGISTER 38 – ERROR VALUE

It contains the error value that is transmitted when the sensor has a problem. The equipment's original value is -9999.

REGISTER 39 – TEMPERATURE VALUE (ºC or ºF)

It contains the value of temperature measurement in an engineering unit, including the users' offset corrections for temperature. The decimal point is fixed in one place, the value has no point and must be provided in the reading software.

REGISTER 40 – RELATIVE HUMIDITY VALUE (%)

It contains the value of relative humidity measurement in an engineering unit, including the users' offset corrections for temperature. The decimal point is fixed in one space, the value has no point and must be provided in the reading software.

REGISTER 41 – DEW POINT VALUE (ºC or ºF)

It has the value of the measurement in an engineering unit. The decimal point is fixed in one place, the value has no point and must be provided in the reading software.

TABELA DE REGISTRADORES RETENTIVOS

The specified addresses correspond to lower level physical addresses, as zero (0) corresponds to the PLC 40001 address. The columns reserved for minimum and maximum contain a range of valid values for each parameter. The column reserved for R/W indicates whether the parameters are meant for reading and writing (R/W) or reading only (R).

ADDRESS	DESDRIPTION	MINIMUM	MAXIMUM	R/W
0	Retentive register used to manage the RHT-Air configuration stages. (Used by DigiConfig)	0	7	R/W
1	Title	-	-	R/W
2	Title	-	-	R/W
3	Title	-	-	R/W
4	Title	-	-	R/W
5	Title	-	-	R/W
6	PANID	0	65535	R/W
7	Encryption	0	1	R/W
8	Security keys 0 and 1	0	65535	R/W
9	Security keys 2 and 3	0	65535	R/W
10	Security keys 4 and 5	0	65535	R/W
11	Security keys 6 and 7	0	65535	R/W
12	Security keys 8 and 9	0	65535	R/W
13	Security keys 10 and 11	0	65535	R/W
14	Security keys 12 and 13	0	65535	R/W
15	Security keys 14 and 15	0	65535	R/W
16	Power Level	0	7	R/W
17	Reserved	-	-	R
18	Serial Number (*word high*)	0	65535	R
19	Serial Number (*word low*)	0	65535	R
20	*Long MAC address* 0 and 1	0	65535	R
21	*Long MAC address* 2 and 3	0	65535	R
22	*Long MAC address* 4 and 5	0	65535	R
23	*Long MAC address* 6 and 7	0	65535	R
24	*Short MAC address*	0	65535	R
25	Firmware version	0	65535	R
26	Product code	103	103	R
27	Operation channel	11	25	R
28	LQI – Link quality indicator	-100	-15	R
29	Battery power (V) **	0	3700	R
30	Time of last publication (100 ms)	0	65535	R
31	Modbus Address	1	247	R/W
32	Update time (s)	15	1800	R/W
33	Indication mode	0	3	R/W
34	Measurement unit configuration	0	1	R/W
35	Disables Configuration through a Button	0	1	R/W
36	User Offset For Temperature *	-100	100	R/W
37	User Offset For Humidity *	-100	100	R/W
38	Error value	-9999	9999	R/W
39	Temperature value (ºC or ºF) *	-400	800	R
40	Relative Humidity value (%) *	0	1000	R
41	Dew Point Value (ºC or ºF) *	-400	800	R

* For the abovementioned table ranges, one decimal place should be considered. Example: -100 means -10.0.

** For the abovementioned table ranges, three decimal places should be considered. Example: 3600 means 3600 V.

9 SPECIAL CARE

The equipment needs special care since it is electronic:

- When opening it for fixation, you should keep away from the electronic circuit due to the risk of damages caused by static electricity.
- The wiring should be carefully observed.
- When closing the box, the cover must be replaced properly, thus ensuring that it is sealed.

9.1 CARE WITH SENSORS

The calibration of the humidity sensor can be altered if it is exposed to contaminating vapors or extreme humidity or temperature conditions for longer periods. In order to speed up the calibration, do as follows:

- Remove the sensor from the capsule.
- If solid particles are deposed on the sensor, wash it with water.
- Place the sensor in an oven at 80 °C (+ -10 °C) for 24 hours.
- Place the sensor for 48 hours in a place at around 20 and 30 °C and humidity higher than 75% RH.
- Replace the sensor into the capsule.

9.2 BATTERY CARE

The Lithium battery, due to its chemical behavior, may present some passivation symptoms when not used for long periods of time. This can be observed by checking the battery voltage after 2 hours of equipment operation. If the battery voltage measures less than 3.5 V, then the battery may be passivated (not necessarily worn out). If this is the case, please try applying the following procedures to recover the battery.

- Operate the equipment at its maximum power (14 dBm) and minimum sample period (15 s).
- Let the instrument operate continuously in the above conditions for 24 h while monitoring the battery voltage through reading register number 29 or the Diagnostic menu of the DigiConfig software.
- If the battery voltage exceeds 3.5 V, the battery can be considered rehabilitated (depassivated). The equipment is then ready to use.
- In case the above doesn't work, please remove the battery from the equipment and discharge it for 5 minutes connecting a 220 ohm resistor across the terminals.
- Then, reinstall the battery in the equipment and let it operate for 2 hours. If the battery voltage remains above 3.5 V, then the depassivation procedure was successful.
- If after going through the above procedures the battery still fails to work properly, please contact Novus technical assistance for arranging battery replacement.

IMPORTANT

The sensor used in this equipment may be damaged or de-calibrated if exposed to contaminated atmospheres with chemical agents. Hydrochloric acid, nitric acid, sulfuric acid and ammonia in high concentrations may damage the sensor. Acetone, ethanol and propylene glycol may cause reversible measurement errors.