



RS485 to radio interface

airGATEWAY





INSTRUCTIONS MANUAL

M98250401-03-13A



Safety Warnings & Symbols

<p>DANGER</p> 	<p>Death, serious injury, or fire hazard could result from improper connection of this equipment. Read and understand this manual before connecting the equipment. Follow all installation and operating instructions while using the instrument.</p> <p>Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as “one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved.”</p> <p>Use always the required personal protective equipment</p>
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<p>WARNING</p> 	<p>Read the instructions manual before using the equipment.</p> <p>If the instructions preceded by this symbol are not met or applied correctly, this can cause personal injury or equipment and / or facilities damage.</p>
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Liability limitations

CIRCUTOR, SA reserves the right to make changes, without previous notice, to devices or specifications of equipment shown in this manual.

The term of the CIRCUTOR guarantee is two years from the date of purchase and is limited to refund of the purchase price, repair free of charge, or replacement of defective equipment that is returned to CIRCUTOR post-sales service within the term of the guarantee.

The latest versions of specifications and the most up to date manuals of this equipment are available to CIRCUTOR, SA customers on its web site: www.circutor.com.

Recommendations prior to use

	<p>In order to use the equipment safely, it is critical that individuals who handle it, follow the safety measures set out in the standards of the country where it is being used, use the necessary personal protection equipment, and pay attention to the various warnings set forth in this instruction manual.</p>
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Before handling, modifying the connection or replacing the equipment, the power supply must be switched off, and the equipment disconnected.

It is important to use only the connection cables and accessories that are delivered along with the equipment . These products are specially designed for use with this apparatus and comply with current safety standards. Also, it is critical to keep the cables in perfect condition in order to avoid accidents, personal injury and damage to installations.

The manufacturer of the equipment is not responsible for any damages resulting from failure by the user or installer to heed the warnings and/or recommendations set out in this manual, nor for damages resulting from the use of non-original products or accessories or those made by other manufactures.

We recommend using only the original material delivered with the equipment in order to ensure the safety of individuals who handle it and the integrity of the equipment itself.

Inspect the work area before install. Do not use the device in dangerous areas or where there is a risk of explosion. Avoid using the device in wet areas

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1. GENERAL OVERVIEW

1.1 INITIAL CHECK OVER

Upon receiving the equipment, test the following points:

- The equipment meets the specifications of your order
- It has not been damaged during shipping.
- The shipment includes the accessories requested from the manufacturer.

1.2 STANDARD COMPONENTS AND ACCESORIES

With the **airGATEWAY** you must have received a compatible antenna.


2. GENERAL CHARACTERISTICS

The **airGateway** is a Modbus RS485 to radio interface. Its purpose is to interface between an external supervisor and a ZB- network. Its role in the network is as coordinator, i.e. it forms an active part of creating the network and maintaining wireless traffic from and to other similar devices. Furthermore it can also work as parent device for battery sensors of the same family.

The device requires an AC or a DC power supply in order to keep communication. (see technical features). See also the manual on ZigBee network Configuration (M98253901-40-13A)

3. TECHNICAL FEATURES

IN (1) Supply	
Rated voltage	100 to 240 VCA
Frequency	50 /60 Hz (± 5%)
Consumption	3 VA
Installation Category	300V CATIII

IN (2) DC Internal supply (*)  Do not connect simultaneously with IN(1) supply		
Rated voltage	12 to 24 Vac	12 to 24 Vcc
Frequency	50 /60 Hz (± 5%)	-
Consumption	2,4 VA	100 mA

COMMUNICATIONS	
Interface between	RS-485 to Radio ; IEEE 802.15.4 compliant
RF range	2405 MHz ÷ 2480 MHz
Modulation	DSSS
RF transmission power	0 dBm (1mW)
Protocol	Modbus RTU
Default configuration	9600 baud / No parity / 1 Stop bit

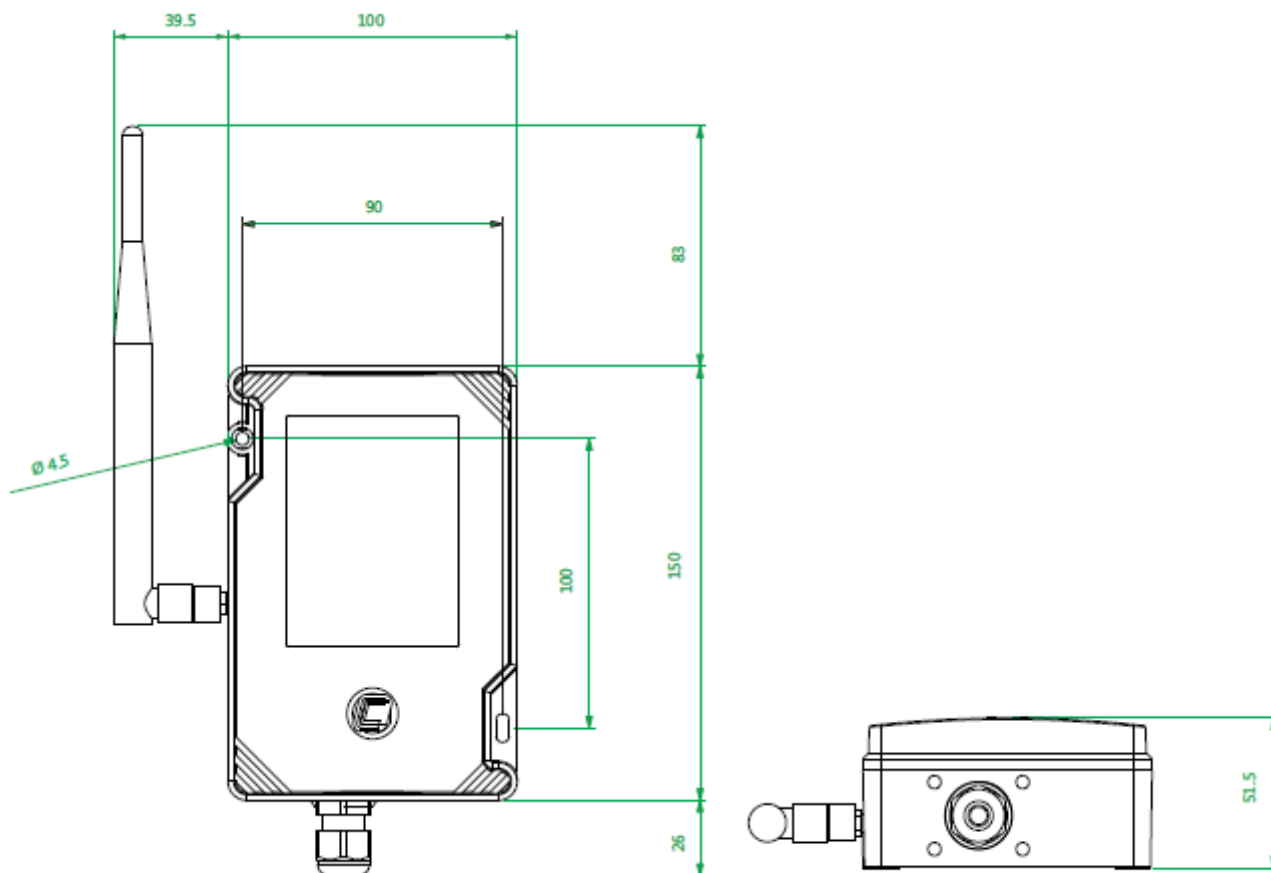
USER INTERFACE	
LED indicators	See paragraph 9

ENVIRONMENT FEATURES	
Working temperature	-5 ... 45 °C
Storage temperature	-10 ... 60 °C
Relative humidity (without condensation)	95 %
Maximum altitude (m)	2.000
Pollution resistance	II
Degree of protection	IP44

MECHANICAL FEATURES	
Weight	335 g
Materials	Polycarbonate
Dimensions	259 x 139,5 x 51,5
Connectors	3,81 mm pitch (pull-out terminals)

STANDARDS	
General Legislation	2006/95 EEC (LV Directive) 99/5 EEC (R&TTE Directive) 2004/108 EEC (EMC Directive)
Electrical and radiation safety	EN 60950-1 (2006) +A11 (2009) EN 62479 – (2010)
Electromagnetic Compatibility	EN 61000-6-2 (2005) EN 61000-6-3 (2007)
Electromagnetic compatibility and Radio spectrum Matters (ERM)	ETSI EN 301 489-1 v1.8.1 ETSI EN 300 328 v1.7.1 ETSI EN 301 489-17 v1.2.1
Communications	IEEE 802.15.4 ZigBee , MiWi compatible

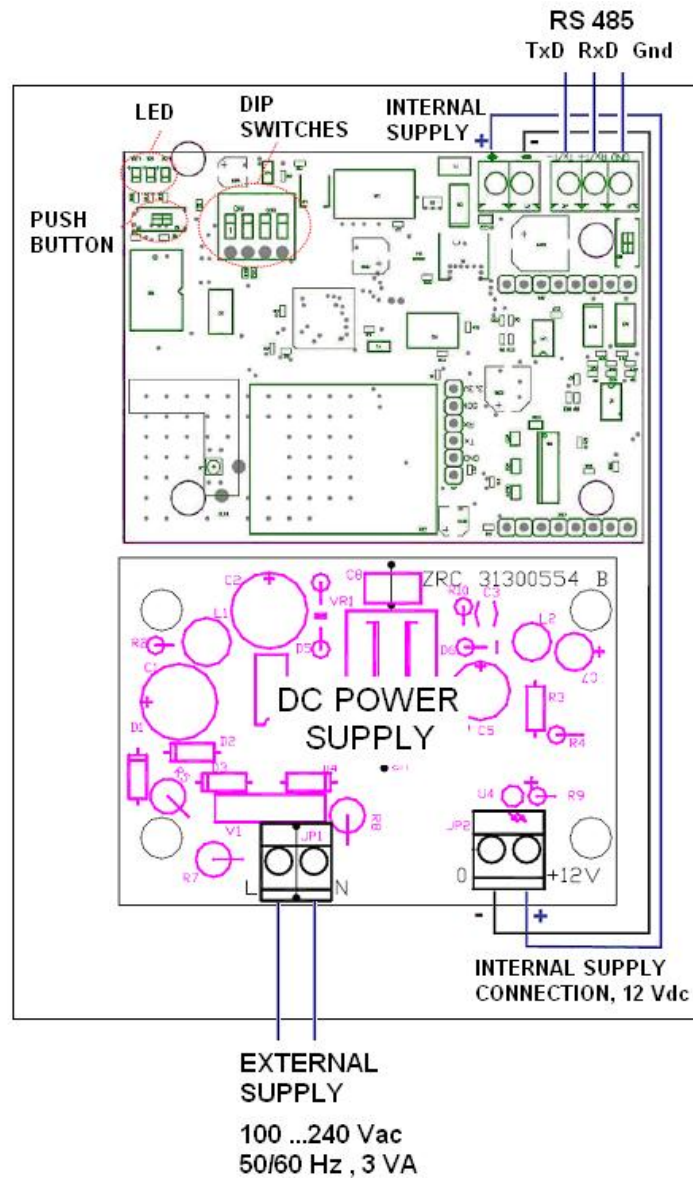
4. DIMENSIONS



5. CIRCUIT BOARD AND CONNECTION LAYOUT



Equipment must be connected to external supply through a suitable overcurrent protective device



6. DEVICE ADDRESSING

The device can be addressed by means of a set of Dip Switches (see schematic in paragraph 5). Valid addresses range from 1 to 7. **The default configuration is peripheral Nr 1.** The Dip Switches are read only once, when switching the circuit board ON or after a RESET. A modification of the Dip Switches position is only taken into consideration after a RESET. Set the Dip Switches before switching the device ON. The device is configured from factory as slave. By default, the lower address allowed for devices connected via a router-bridge is 50 and the maximum is 240. These parameters can be set by writing the HOLDING REGISTERS 000B and 0000C by means of a MODBUS command (Function 06). See also paragraph 13.2 GATEWAY HOLDING REGISTERS

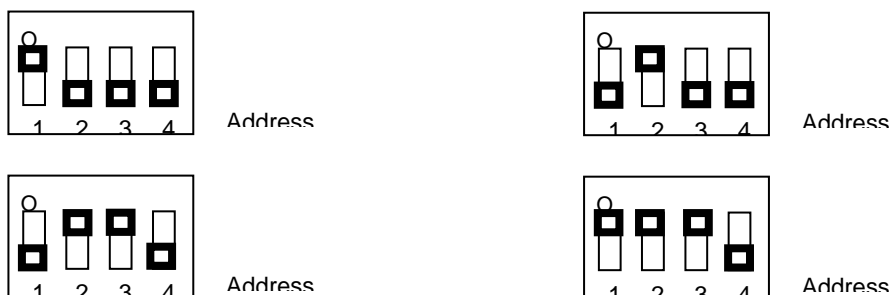
Example of MODBUS commands for minimum and maximum address setup:

0106000B0032 CRC Minimum peripheral number allowed for devices connected in bridge
 0106000C00F0 CRC Maximum peripheral number allowed for devices connected in bridge

1.3 GATEWAY address

The GATEWAY address is set by means of Dip Switches 1 to 3 following a binary code where DIP1 is the least significant bit (LSB) and DIP3 is the most significant bit (MSB).

Examples:



Be careful when assigning Gateway addresses to avoid being unable to communicate with it and therefore being unable to set it via remote.

1.4 Speed setup

DIP4 is used to setup the speed of the serial port. (DIP4 : OFF->9600Baud; ON->19200Baud) . See paragraph 12

7. CREATING THE NETWORK

Creating a network for the Gateway node involves the same process followed for other types of ZB-Connection coordinators.

Creating the network is the first operation to be completed when forming a ZB-Connection device network; Gateway is the only device which can complete this operation.

To create the network it is necessary to determine the parameters that completely describe the network; they are the channel (ranging from 11 to 26), the panID (ranging from 0 to 32767) and the Extended PanID (number on 8 bytes).

Create the network at the moment of the first installation of the Gateway; the network parameters found during the process remain indefinitely in the device's non-volatile memory, as long as the device is not voluntarily disassociated.

This process can be activated only if the device does not already have network parameters (non-joined device).

There are two ways of creating a network on a Gateway which is not on the network:

1. Activation by pressing the push button
2. Activation by sending the appropriate command password

Activation by pressing the push button causes automatic network creation; this means the Gateway scans all available channels to find the one with the least interference. When the most suitable channel has been chosen, the Gateway generates randomly panID and extended panID parameters (ensuring that there are no other networks with the same value).

After the parameters have been chosen, the network creation takes place.

Since Gateway is able to find the most suitable channel, it is recommended to create the network directly in the final installation place.

Instead, when activating by sending the command password, choosing the channel, panID and extended panID is left to the operator.

This second option is useful when a broken Gateway need to be replaced; by supplying network parameters which are the identical to those of the no-longer working device it is possible to substitute the Gateway without necessarily recreating the entire network.



IMPORTANT !! : Two Gateways **should never have the same network parameters** when working on the same network; this would generate confusion, as both devices would share the same network address, and thus it will be impossible for the network to work properly.

For further explanations on network creation by pressing the push button refer to the paragraph 9 "Gateway LED/push-button Interface"

For further explanations on network creation by command password refer to the paragraph 14 "Special commands".

8. OPENING AND CLOSING THE NETWORK

An open network is a network that allows the joining of new devices; a closed network is a network that does not allow the joining of new devices.

The network formed by ZB-Connection devices is normally a closed network.

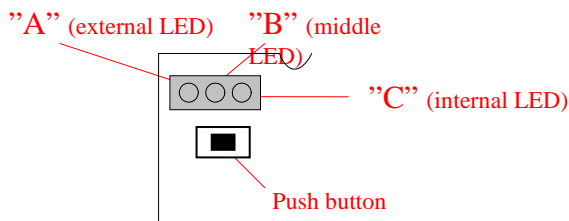
The opening of the network can only be carried out by a Gateway.

The opening and closing of the network can be done by pressing the push button on the Gateway (see paragraph 5 or 9) or by sending the suitable Modbus command to the Gateway.

9. GATEWAY LED INDICATORS AND PUSH BUTTON (Internal)

The Gateway has three LED through which it is possible to obtain information on the device's operating status. Furthermore, the Gateway has a push-button which makes possible to command the device.

Nomenclature of Gateway LED (These LED are inside the box)



LED behavior at the start-up:

After a RESET of the Gateway , all the LED light for 2 seconds, then all flash fast during another 2 seconds. At the end of flashing , the device starts the normal operation.

LED indications when the Gateway is NOT on the network:

LED "A" is permanently ON , LED "B" and LED "C" are permanently OFF

LED indications when the Gateway is on the network:

LED "A": Shows the Working Status

Slow flashing (1Hz) --> Closed Gateway

Fast flashing (4Hz) --> Open Gateway

LED "B" (middle LED): Shows the Radio Link status

OFF -> No Router with good link in the proximity

1 flash + pause -> One Router with good link in the proximity

2 flashes + pause -> Two Routers with good link in the proximity

3 flashes + pause -> Four or more Routers with good link in the proximity

LED "C": Shows the Radio Activity

Most of time it is OFF, indicating that here is no activity in the radio communications channel

LED C gives a short flash when a radio message is received or transmitted.

10. NETWORK CREATION, OPENING AND CLOSING

Creating a network

When the Gateway is not on the network, a pressing of the push button turns LED "B" on. If the push button is not pressed again within ten seconds, the scanning process starts to search for the best wireless channel.

This scanning process takes approximately 20 seconds, during which only LED "B" is on. Once the scanning process has been completed, the Gateway has created a network and LED "B" starts flashing when transmitting or receiving data.

Opening a network

When the Gateway is on a network, pressing the push button on the circuit board opens the network (in this case LED "A" starts flashing).

Closing a network

When the network is open, pressing the push button on the circuit board closes the network. If the network is left open, it closes automatically 15 minutes after it having been opened.

11. GATEWAY DISASSOCIATION

Disassociation of the Gateway causes the loss of the network parameters and the restore of the default settings.

The disassociation is executed by pressing the push button for 10 seconds.

12. SERIAL COMMUNICATION

The Gateway can access to its own data and to the data of all other devices which form the network using Modbus-RTU serial communication protocol. For a more detailed description of the Modbus protocol standard refer to relevant specific documentation.

1.5 Default serial communication parameters:

Speed: 9600 Bps (DIP4=off) / 19200 Bps (DIP4=on)
Data bits: 8
Parity: None
Stop bits: 2
Flow control: None

1.6 Memory areas

According to Modbus protocol the data of all devices, including that of the Gateway are divided into four areas of memory:

- InputRegisters (16 bit variables, read only)
- InputStatus (1 bit variables, read only)
- HoldingRegister (16 bit variables, generally non volatile)
- CoilStatus (1 bit variables)

1.7 MODBUS functions implemented in the GATEWAY

The MODBUS function codes implemented in the Gateway are:

01 - READ COIL STATUS
02 - READ INPUT STATUS
03 - READ HOLDING REGISTER
04 - READ INPUT REGISTER
05 - FORCE SINGLE COIL
06 - PRESET SINGLE REGISTER

13. GATEWAY DATA MAP

24 (+16)	InputRegisters
128	InputStatus
14	HoldingRegister
16	CoilStatus

1.8 GATEWAY INPUT REGISTERS

InputRegister[0]	Device Type (=112)
InputRegister[1]	Firmware Version (Major/Minor)
InputRegister[2]	Transmission Power (dB+100)
InputRegister[3]	Network Channel (11-:26)
InputRegister[4]	Network PanId (0 -: 32767)
InputRegister[5]	Seconds from reset
InputRegister[6]	Counter of messages received from reset
InputRegister[7]	Number of used agent slots (number of sensors)
InputRegister[8]	Gateway Address
InputRegister[9]	Gateway EUI64 (bytes 0,1)
InputRegister[10]	Gateway EUI64 (bytes 2,3)
InputRegister[11]	Wireless Signal Level of the last message received from Gateway (dB+100)
InputRegister[12]	Number of Device connected through Router-Bridge
InputRegister[13]	Number of End-Device children of Gateway
InputRegister[14]	Number of Resets
InputRegister[15]	Reset Type
InputRegister[16]	Number of free Packet Buffer
InputRegister[17]	Extended panID
InputRegister[18]	Extended panID
InputRegister[19]	Extended panID
InputRegister[20]	Extended panID
InputRegister[21]	Total Number of Routers present in the network
InputRegister[22]	Total Number of Routers neighbours
InputRegister[23]	Number of good Routers neighbours
InputRegister[24]	Copy of InputStatus[00...15]
InputRegister[25]	Copy of InputStatus[16...31] – Presence Sensors 16-31
InputRegister[26]	Copy of InputStatus[32...47] – Presence Sensors 32-47
InputRegister[27]	Copy of InputStatus[48...63] – Presence Sensors 48-63
InputRegister[28]	Copy of InputStatus[64...79] – Presence Sensors 64-79
InputRegister[29]	Copy of InputStatus[80...95] – Presence Sensors 80-95
InputRegister[30]	Copy of InputStatus[96...111] – Presence Sensors 96-111
InputRegister[31]	Copy of InputStatus[112...127] – Presence Sensors 112-127
InputRegister[32]	Copy of InputStatus[128...143] – Data validity sensors 16-31
InputRegister[33]	Copy of InputStatus[144...159] – Data validity sensors 32-47
InputRegister[34]	Copy of InputStatus[160...175] – Data validity sensors 48-63
InputRegister[35]	Copy of InputStatus[176...191] – Data validity sensors 64-79
InputRegister[36]	Copy of InputStatus[192...207] – Data validity sensors 80-95
InputRegister[37]	Copy of InputStatus[208...223] – Data validity sensors 96-111
InputRegister[38]	Copy of InputStatus[224...239] – Data validity sensors 112-127

1.9 GATEWAY HOLDING REGISTERS

HoldingRegister[0]	Command password (1)
HoldingRegister[1]	Command password (2)
HoldingRegister[2]	Command password (3)
HoldingRegister[3]	Gateway working mode. Default value 21.
HoldingRegister[4]	Absolute Time (100*hour + minutes). Resetted each 24 hours.
HoldingRegister[5]	Period of transmission of regeneration routes message [sec] (default value=20sec)
HoldingRegister[6]	Command password (4)
HoldingRegister[7]	Command password (5)
HoldingRegister[8]	Command password (6)
HoldingRegister[9]	Command password (7)
HoldingRegister[10]	Gateway Alternate Address (used if dip-switch=0, default value=1)
HoldingRegister[11]	Minimum Address allowed for devices connected via Router-Bridge (default value =50)
HoldingRegister[12]	Maximum Address allowed for devices connected via Router-Bridge (default value =240)
HoldingRegister[13]	Password Z-HandZer special functions

1.10 GATEWAY COIL STATUS REGISTERS

CoilStatus[0]	Activation of command password
CoilStatus[1]	Not used
...	...
CoilStatus[15]	Not used

1.11 GATEWAY INPUT STATUS REGISTERS

InputStatus[0]	Gateway Network State (0= disconnected, 1= connected to a Network)
InputStatus[1]	Network closing/opening state (0= Network Close, 1= Network Open)
InputStatus[2]	Not used
...	...
InputStatus[15]	Not used
InputStatus[16]	Presence Sensor 16
InputStatus[17]	Presence Sensor 17
InputStatus[18]	Presence Sensor 18
InputStatus[19]	Presence Sensor 19
InputStatus[20]	Presence Sensor 20
InputStatus[21]	Presence Sensor 21
InputStatus[22]	Presence Sensor 22
InputStatus[23]	Presence Sensor 23
...	...
InputStatus[i]	Presence Sensor i (i = 16-:-127)
...	...
InputStatus[120]	Presence Sensor 120
InputStatus[121]	Presence Sensor 121
InputStatus[122]	Presence Sensor 122
InputStatus[123]	Presence Sensor 123
InputStatus[124]	Presence Sensor 124
InputStatus[125]	Presence Sensor 125
InputStatus[126]	Presence Sensor 126
InputStatus[127]	Presence Sensor 127
InputStatus[128]	Data validity Sensor 16
InputStatus[129]	Data validity Sensor 17
InputStatus[130]	Data validity Sensor 18
InputStatus[131]	Data validity Sensor 19
InputStatus[132]	Data validity Sensor 20
InputStatus[133]	Data validity Sensor 21
InputStatus[134]	Data validity Sensor 22
InputStatus[135]	Data validity Sensor 23
...	...
InputStatus[112+i]	Data validity Sensor i (i = 16-:-127)
...	...
InputStatus[232]	Data validity Sensor 120
InputStatus[233]	Data validity Sensor 121
InputStatus[234]	Data validity Sensor 122
InputStatus[235]	Data validity Sensor 123
InputStatus[236]	Data validity Sensor 124
InputStatus[237]	Data validity Sensor 125
InputStatus[238]	Data validity Sensor 126
InputStatus[239]	Data validity Sensor 127

14. SPECIAL COMMANDS : COMMAND PASSWORD

The command password (HoldingRegister[0]) makes possible to send special commands to the Gateway. The command password is executed only if the Gateway detects CoilStatus[0] set to one.

Command Name	Command Description	Value (dec)	Value (hex)
OPEN_NETWORK	Opens Network (like pressing push button)	5266	1492
CLOSE_NETWORK	Closes Network (like pressing push button)	5267	1493
DEVICE_BOOT	Sets up Gateway Bootloader	6504	1968
DEVICE_RESET	Resets Gateway	6512	1970
DEVICE_DISASSOCIATION	Disassociates Gateway	6515	1973
SET_NETWORK(1)	Network settings channel in CommandPassword2 (11-:26) panID in CommandPassword3 Extended panID in CommandPassword4,5,6,7	8193	2001
CHOSE_NETWORK(1)	Network automatic choice (like pressing push button) – ether scan	8195	2003
CLEAR_AGENT_SLOT	Clear sensor (agent) slot (index passed in CommandPassword2)	12545	3101
CLEAR_ROUTER_SLOT	Clear router slot (index passed in CommandPassword2)	14337	3801
SWAP_ROUTER_SLOT	Swap router slots (index passed in CommandPassword2,3)	14338	3802
EQUALIZE_TXRXCOUNTER	Equalizes for each probe the number of received packets, equal to the number of transmitted packets	14593	3901
BROADCAST_ROUTER_RESET(2)	Launches broadcast message of reset of all Routers	16785	4191
BROADCAST_ROUTER_DISASSOCIATION(2)	Launches all Routers disassociation broadcast message	16787	4193
BROADCAST_ROUTER_BOOT(2)	Launches broadcast message of set up of all Routers bootloader	16789	4195
BROADCAST_ROUTER_REINIT-NETWORK(2)	Launches network re-initialize Broadcast Message	16793	4199
BROADCAST_ROUTER_VERSION_QUERY(2)	Launches Broadcast Version Query Message	20481	5001
BROADCAST_ROUTER_PING_QUERY(2)	Launches Broadcast Ping Query Message	20482	5002

(1) These commands work only when the Gateway is not on the network (disassociated Gateway).

(2) These messages can be sent also in unicast, passing the ShortID of the destination Router in CommandPassword2

15. WORKING MODE REGISTER

The non volatile variable HoldingRegister[3](working mode) manages some actions of the Gateway

Bit#0 of Working Mode – Timeout communication management

Bit#1 of Working Mode – Exception response management

Bit#2 of Working Mode – Transmission towards Router-Bridges management

Bit#3 of Working Mode – Holding Register modality reading

Bit#4 of Working Mode – Enabling access to the Routers Information Table

Bit#5 of Working Mode – Serial Response Delay

The default value for the Working Mode parameter is equal to 21 (Bit#0=1, Bit#1=0, Bit#2=1, Bit#3=0, Bit#4=1, Bit#5=0).

1.12 Bit#0 of Working mode : Timeout communication management

The Gateway continuously monitors the time elapsed between successive messages of all the devices belonging to its network (except for the devices connected to Router-Bridge devices).

If the time elapsed from the reception of the last message is more than four times the automatic transmission time of the device (HoldingRegister[1] for all ZB-Connection devices) then the sensor data must be considered in timeout status.

The Gateway behavior with reference to the timeout status of the sensors is managed by bit#0 of Working Mode register.

Working Mode, bit#0=0:

The Gateway lets accessing the sensor data also in timeout status. In that case the information of “validity” can be deduced from the Presence Flag of the sensor itself (InputStatus[64]).

Working Mode, bit#0=1:

The Gateway doesn't let access the sensor data when the sensor is in timeout status.

A possible data request of a sensor being in timeout status doesn't obtain an answer (or an error response is given).

NB:

If the time elapsed from the reception of the last message of a given sensor is greater than 100 minutes, the Gateway deletes the relevant agent.

In that case whichever is the status of Working Mode bit#0, a possible data request doesn't obtain answer.

1.13 Bit#1 of Working Mode – Exception response management

The bit#1 of Working Mode manages the behavior of the Gateway in case that it is requested on data related to a device which is not joined to the network or in timeout status.

Working Mode, bit#1=0:

No response is given to a data request related to a device which is not joined to the network or in timeout status.

Working Mode, bit#1=1:

An exception response is given to a data request related to a device which is not joined to the network or in timeout status.

The error code given by the exception response is 05 (acknowledge exception).

Example: data request to a device whose address is 38

0x26, 0x02, 0x00, 0x04, 0x00, 0x02, 0xBE, 0xDD

Example: response of node 38 in timeout status

0x26, 0x82, 0x05, 0x30, 0xA8

1.14 Bit#2 of Working Mode – Transmission towards Router-Bridges management

Working Mode, bit#2=0:

It enables the message transmission towards devices connected to Router-Bridge devices.

A possible data request sent to a device not mapped on the Gateway implies the transmission of wireless broadcast message by the Gateway (message which is sent to all the Routers belonging to the network).

The purpose of this kind of message is to find the requested device; by its very nature it is a message weighing down the wireless traffic therefore, in case of activation of the transmission towards Router-Bridge devices, it is recommended to call only the devices actually joined to the network.

Working Mode, bit#2=1:

It disables the message transmission towards devices connected to Router-Bridge devices. In such case the network is made only by ZB-Connection devices.

Warning:

By Default the communication with devices connected through Router-Bridge is disabled.

1.15 Bit#3 of Working Mode – Holding Register modality reading

Working Mode, bit#3=0:

The reading of any Holding Register of a sensor mapped in the Gateway is composed of data actually present in the sensor (data copied from the last message that sensor sent to the Gateway).

Reading a Holding Register after its writing returns the value previously present in the sensor until the actual deliver of the variation.

Working Mode, bit#3=1:

The reading of any Holding Register of a sensor mapped in the Gateway is composed of data actually present in the sensor and data possibly modified by a writing but not yet delivered.

Reading a Holding Register after its writing returns the value just changed without any care if the data was delivered or not.

1.16 Bit#4 of Working Mode - Enabling access to the Routers Information Table

Working Mode, bit#4=0:

Feature disabled.

Working Mode, bit#4=1:

Addresses 200-254 are reserved for extraction of information about Routers in the network.

1.17 Bit#5 of Working Mode – Serial Response Delay

Working Mode, bit#5=0:

Feature disabled.

Working Mode, bit#5=1:

Gateway responds to any Modbus serial request after a fixed delay of 50ms.

1.18 WORKING MODE Summary table

HR[3]	Response Delay	Router table access	HR Reading	Communication to Bridges	Time-Out Management
0			value present into sensor	Bridge communication enabled	answers even if time-out
1			value present into sensor	Bridge communication enabled	no answer if time-out
2			value present into sensor	Bridge communication enabled	answers even if time-out
3			value present into sensor	Bridge communication enabled	exception response if time-out
4			value present into sensor	Bridge communication disabled	answers even if time-out
5			value present into sensor	Bridge communication disabled	no answer if time-out
6			value present into sensor	Bridge communication disabled	answers even if time-out
7			value present into sensor	Bridge communication disabled	exception response if time-out
8			value not yet sent	Bridge communication enabled	answers even if time-out
9			value not yet sent	Bridge communication enabled	no answer if time-out
10			value not yet sent	Bridge communication enabled	answers even if time-out
11			value not yet sent	Bridge communication enabled	exception response if time-out
12			value not yet sent	Bridge communication disabled	answers even if time-out
13			value not yet sent	Bridge communication disabled	no answer if time-out
14			value not yet sent	Bridge communication disabled	answers even if time-out
15			value not yet sent	Bridge communication disabled	exception response if time-out
16		adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	answers even if time-out
17		adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	no answer if time-out
18		adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	answers even if time-out
19		adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	exception response if time-out
20		adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	answers even if time-out
21		adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	no answer if time-out
22		adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	answers even if time-out
23		adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	exception response if time-out
24		adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	answers even if time-out
25		adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	no answer if time-out

HR[3]	Response Delay	Router table access	HR Reading	Communication to Bridges	Time-Out Management
26		adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	answers even if time-out
27		adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	exception response if time-out
28		adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	answers even if time-out
29		adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	no answer if time-out
30		adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	answers even if time-out
31		adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	exception response if time-out
32	Response delayed		value present into sensor	Bridge communication enabled	answers even if time-out
33	Response delayed		value present into sensor	Bridge communication enabled	no answer if time-out
34	Response delayed		value present into sensor	Bridge communication enabled	answers even if time-out
35	Response delayed		value present into sensor	Bridge communication enabled	exception response if time-out
36	Response delayed		value present into sensor	Bridge communication disabled	answers even if time-out
37	Response delayed		value present into sensor	Bridge communication disabled	no answer if time-out
38	Response delayed		value present into sensor	Bridge communication disabled	answers even if time-out
39	Response delayed		value present into sensor	Bridge communication disabled	exception response if time-out
40	Response delayed		value not yet sent	Bridge communication enabled	answers even if time-out
41	Response delayed		value not yet sent	Bridge communication enabled	no answer if time-out
42	Response delayed		value not yet sent	Bridge communication enabled	answers even if time-out
43	Response delayed		value not yet sent	Bridge communication enabled	exception response if time-out
44	Response delayed		value not yet sent	Bridge communication disabled	answers even if time-out
45	Response delayed		value not yet sent	Bridge communication disabled	no answer if time-out
46	Response delayed		value not yet sent	Bridge communication disabled	answers even if time-out
47	Response delayed		value not yet sent	Bridge communication disabled	exception response if time-out
48	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	answers even if time-out
49	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	no answer if time-out
50	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	answers even if time-out
51	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication enabled	exception response if time-out
52	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	answers even if time-out
53	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	no answer if time-out
54	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	answers even if time-out
55	Response delayed	adr 200-247 reserved to routers	value present into sensor	Bridge communication disabled	exception response if time-out
56	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	answers even if time-out
57	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	no answer if time-out
58	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	answers even if time-out
59	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication enabled	exception response if time-out
60	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	answers even if time-out
61	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	no answer if time-out
62	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	answers even if time-out
63	Response delayed	adr 200-247 reserved to routers	value not yet sent	Bridge communication disabled	exception response if time-out

16. ROUTERS INFORMATION TABLE

Starting with version 7.48.123, it is possible to extract some information from the Gateway about all Routers present in the network.

This information is not requisite in the normal working of devices but could be a useful tool for debugging and network maintenance.

These information are accessible in InputRegister form (read-only registers) of the Gateway, starting from address 1000.

For each Router in the network 12 consecutive InputRegisters are reserved

The order of Routers in the table reflects the order of their joining to the network.

The position taken by a router remains always the same unless manual cancellation or swap.

1.19 ROUTERS INFORMATION TABLE MAPPING

InputRegister[1000] - InputRegister[1011]	1st Router joined to the network
InputRegister[1012] - InputRegister[1023]	2 nd Router joined to the network
InputRegister[1024] - InputRegister[1035]	3 rd Router joined to the network
InputRegister[1036] - InputRegister[1047]	4 th Router joined to the network
InputRegister[1048] - InputRegister[1059]	5 th Router joined to the network
...	...
InputRegister[1000+12*(i-1)] - InputRegister[1011+12*(i-1)]	i th Router joined to the network
...	...
InputRegister[2524] - InputRegister[2535]	128 th Router joined to the network

1.20 ALTERNATIVE ACCESS TO THE ROUTERS INFORMATION TABLE

The access to the Routers Information Table is also possible through the reading of InputRegister[0,11] of addresses from 200 to 254.

In this case the function has to be enabled by appropriate flag mode (Working Mode, bit#4=1), by default this mode is enabled.

If a Router is not available (lack of the Router or in case of time-out) a reading request doesn't generate response or generates an exception response (depending on Working Mode, bit#0,1).

Modbus Address #200	1 st Router joined to the network
Modbus Address #201	2 nd Router joined to the network
Modbus Address #202	3 rd Router joined to the network
Modbus Address #203	4 th Router joined to the network
Modbus Address #204	5 th Router joined to the network
...	...
Modbus Address #200+(i-1)	i th Router joined to the network
...	...
Modbus Address #254	55 th Router joined to the network

1.21 ROUTERS INFORMATION TABLE ENTRY

This is the information that can be extracted from the Table, related to each Router present in the network:

InputRegister[...0]	State of the entry (0xFF=empty slot; 0=Router in time-out; 1=working Router)
InputRegister[...1]	Router Type (e.g. 101=Router ZR-BR-xx; 108=Router ZR-REP-xx)
InputRegister[...2]	Firmware Version
InputRegister[...3]	Router EUI64 (bytes 0,1)
InputRegister[...4]	Router EUI64 (bytes 2,3)
InputRegister[...5]	Router ShortID
InputRegister[...6]	Cost (distance from the Gateway in terms of hop)
InputRegister[...7]	Wireless Signal Level of the last message received (dB+100)
InputRegister[...8]	Number of Routers neighbours
InputRegister[...9]	Number of good Routers neighbours
InputRegister[...10]	Number of End-Device children of Router
InputRegister[...11]	Number of Presence Messages transmitted by Router and received from Gateway

1.22 ROUTER INFORMATION RETRIEVAL

The information shown in the table is extracted from the notification messages that Routers send to Gateway.

These notification messages are sent upon receipt of the signal MTOR (Many-To-One-Route discovery) generated by the Gateway.

The MTOR signal is generated at regular intervals; its main purpose is to create, maintain and update routing to the Gateway.

The MTOR signal transmission frequency is programmable (HoldingRegister [5] of the Gateway), its default value is 20 seconds.

1.23 ROUTERS TIME-OUT BEHAVIOR

The Routers status (the first InputRegister of each Router slot) are managed from Gateway considering the times of the notification messages received.

A Router is considered in off-line state (state=0) if Gateway doesn't receive notification messages from it for a period of more than 4 times MTOR time.

1.24 MANAGEMENT OF ROUTER INFORMATION TABLE

There are two commands (interfaced with password command) to erase and to swap the slots associated with routers.

```
HoldingRegister[0]=14337-->      Erase slot pointed in HoldingRegister[1]
HoldingRegister[0]=14338-->      Swap slots pointed in
                                   HoldingRegister[1] and HoldingRegister[2]
```

1.25 ROUTER- BRIDGE NETWORK ADDRESS TABLE

Beside the Routers Information Table there is another table from which it is possible to read the network address (ShortID) of the Router-Bridge linked to a Modbus device with a specific Modbus address.

This information is accessible in InputRegister (read-only registers) of the Gateway, starting from address 100 to address 354.

InputRegister[100]	ShortID of Router-Bridge linked to Modbus device address 0
InputRegister[101]	ShortID of Router-Bridge linked to Modbus device address 1
InputRegister[102]	ShortID of Router-Bridge linked to Modbus device address 2
...	...
InputRegister[100+i]	ShortID of Router-Bridge linked to Modbus device address i
...	...
InputRegister[354]	ShortID of Router-Bridge linked to Modbus device address 254

17. GATEWAY ALTERNATE ADDRESSING

Starting with version 7.50.125, it is possible to give to the Gateway any address between 1 and 247. This is possible by writing the desired value for the gateway address in the register HoldingRegister[10].

The alternate address is used only if the address of the Dip-Switch is set to zero.

Following the steps to set the desired address for the Gateway (outside the normal range 1.. 7):

1. Set a normal address to the Gateway (1..7) by dip-switch.
2. Write in HoldingRegister[10] the desired value for the new address of the gateway (communicating with Gateway through the address set by dip-switch)
3. Turn-Off Gateway
4. Set address 0 in the dip-switch
5. Turn-On Gateway; from this moment Gateway will respond to the Address set by HoldingRegister[10].

18. COMMUNICATION WITH MODBUS DEVICES CONNECTED VIA ROUTER-BRIDGE

Communication with Modbus devices connected via Router-Bridge by default is disabled. To enable this feature, you must act on the mode parameter mode (by setting bit#2 = 0).

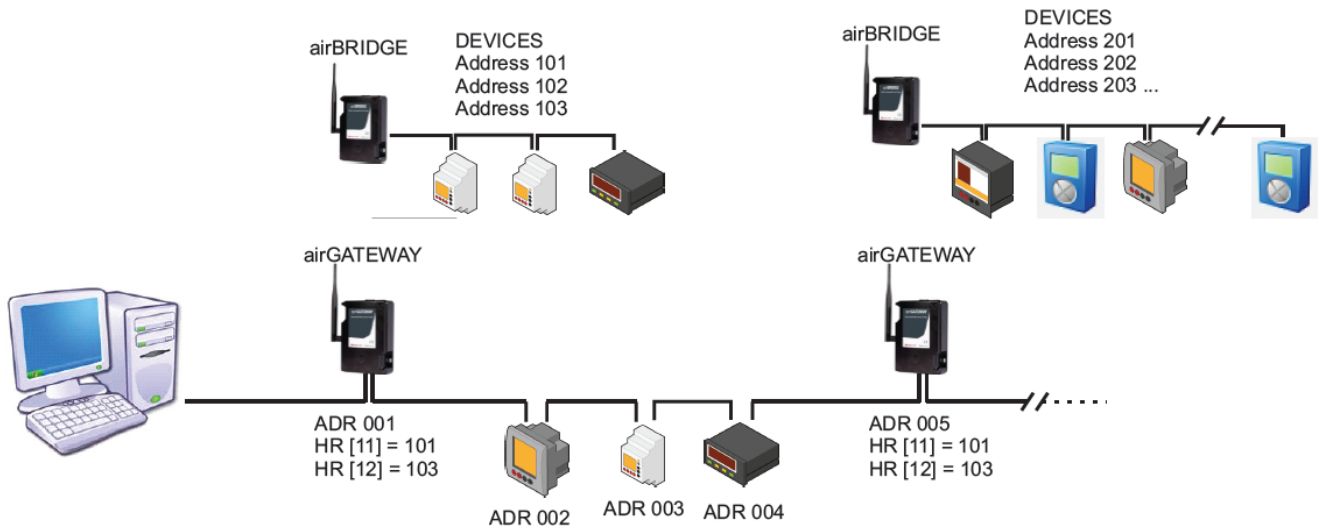
Starting with version 7.50.125, it is possible to set the minimum and the maximum address allowed for devices connected via Router-Bridge.

```
HoldingRegister[11] =      Minimum Address allowed for devices
                             connected via Router-Bridge (default value =1)
```

```
HoldingRegister[12] =      Maximum Address allowed for devices
                             connected via Router-Bridge (default value =247)
```

These parameters allow Gateway to ignore serial requests to devices whose address is out of the range set.

This makes possible to connect to the Gateway serial line other than Modbus devices.
 In the absence of this filtering system, the network is still able to work, but any message addressed to a device in the serial line would be transformed in a radio message by the Gateway, and this could lead to a worsening performance of the network.



Example of a system composed by multiple devices on the same serial line

19. IN CASE OF MALFUNCTION

In the event of questions or concerns regarding operation or malfunction of the equipment, notify **Technical Assistance Service (S.A.T.) of CIRCUTOR, SA.**

SPAIN	902 449 459
INTERNATIONAL	(+34) 93 745 29 00

Technical assistance Post-sales Department

Vial Sant Jordi, s/n –

08232 – Viladecavalls

Barcelona – Spain

e-mail: sat@circutor.es

Web: www.circutor.es