WIRELESS FAMILY DEVICES
ZB-CONNECTION
Gateway Modbus RS485
(product code: ZC-GW-485PW-EM)

Document version Number	Date	Firmware Revision	Author
V1.0	12/09/14	V8-34-251 (2082)	Franco Pierazzoli

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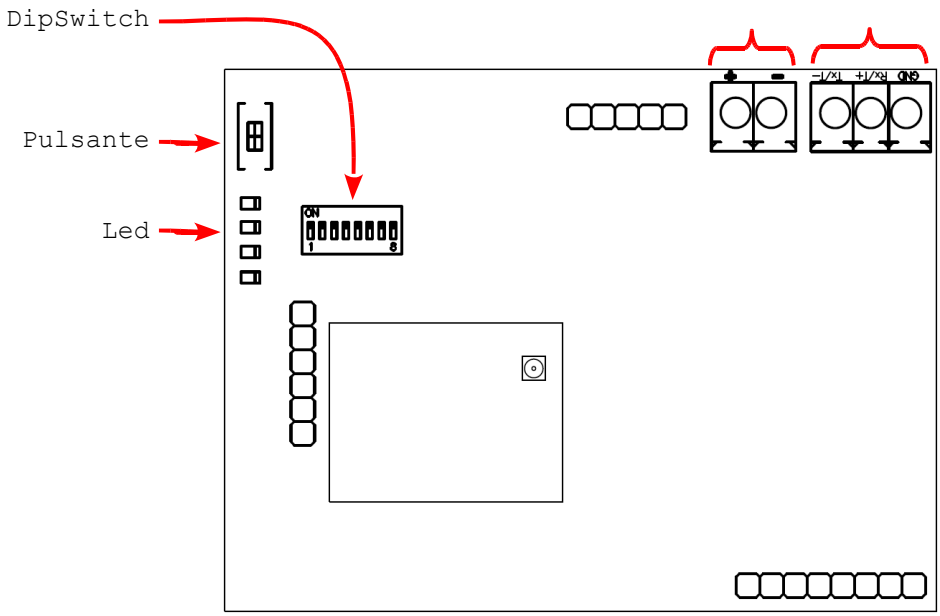
1) GENERAL DEVICE CHARACTERISTICS

Gateway Modbus RS485 (ZC-GW-485PW-EM) belongs to ZB-Connection devices family.
Its purpose is to interface between the external world and a ZB-Connection network.
The device is supplied from external supply (12-24 Vdc/Vac); its role in the network is 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 function as parent device for battery sensors of the same family.

2) DEVICE ELECTRICAL CHARACTERISTICS

POWER SUPPLY:	12 ÷ 24Vdc; 100mA 12 ÷ 24Vac; 50/60Hz; 2,4VA
WIRELESS CHARACTERISTICS:	2405 MHz ÷ 2480 MHz DSSS Modulation Nominal transmission Power +10/+20 dBm IEEE 802.15.4 compliant Stack EmberZNet5.3.1 Stack version 0 Proprietary profile ID Proprietary encryption key
CONNECTIONS:	Pull-out terminals (3,81 mm pitch)
DEGREE OF PROTECTION:	IP55

3) CIRCUIT BOARD AND CONNECTION LAYOUT

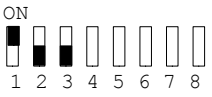
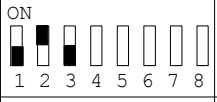
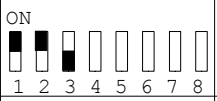
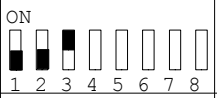
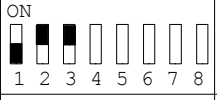
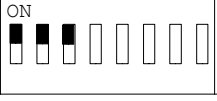


4) DIPSWITCH

The device is equipped with eight-position dip switch with which you can set the Modbus address of the Gateway, the serial communication speed and the radio power transmission. The reading of the dip switch is performed only at the reset of the device.

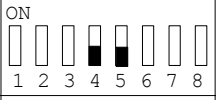
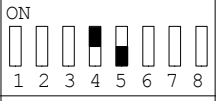
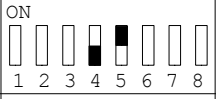
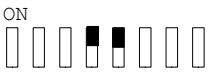
4.1) SETTING MODBUS ADDRESS

The address of the gateway can be set through the dip-switch #1,2,3 and can has values between 1 and 7.
If the value is set to zero then the address of the Modbus Gateway is equal to the value present in HoldingRegister [10].

DIP1	DIP2	DIP3	DipSwitch	Modbus Address
off	off	off	...	HR[10]
on	off	off		1
off	on	off		2
on	on	off		3
off	off	on		4
on	off	on		5
off	on	on		6
on	on	on		7

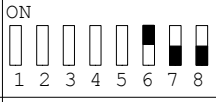
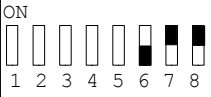
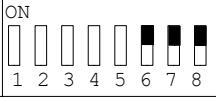
4.2) SETTING SERIAL SPEED

The serial communications speed of gateway is set through dip-switch #4,5.

DIP4	DIP5	DipSwitch	Serial Speed
off	off		9600 BPS
on	off		19200 BPS
on	off		38400 BPS
on	on		115200 BPS

4.3) SETTING RADIO TRANSMISSION POWER

Through the dip-switch, you can set the radio transmission power of the device.

DIP6	DIP7	DIP8	DipSwitch	Radio Power [dB]
off	off	off		10
on	off	off		11
off	on	off	...	12
on	on	off	...	14
off	off	on	...	15
on	off	on	...	17
off	on	on		18
on	on	on		20

5) 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 an 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 ether 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.
It is important to highlight a fundamentally important fact: no two Gateways with the same network parameters must function on the same network; this would generate confusion, as both devices would share the same network address, and thus make it impossible for the network to work properly.
For further explanations on activating network creation by pressing the push button refer to the paragraph "Gateway Led/push-button Interface"; for further explanations on activating network creation by command password refer to the paragraph "Special commands".

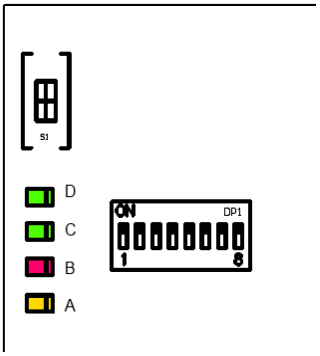
6) OPENING AND CLOSING THE NETWORK

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 devises.
The network formed by ZB-Connection devices is a normally closed network.
The opening of the network can only be carried out by Gateway.
The opening and closing of the network can be done by pressing the push button on the Gateway or by using the modbus protocol to send the Gateway a command.

7) GATEWAY LED/PUSH BUTTON INTERFACE

The Gateway has four leds through which it is possible to obtain information on the device's operating state.
Furthermore, the Gateway has a push-button which makes it possible to send commands to the device.

Nomenclature of Gateway leds:



Behaviour of leds at the start-up:
At the reset of Gateway all leds lighted for 2 seconds, then all leds flash fast for another 2 seconds.
At the end of flashing device starts the normal functioning.

How the leds function when the Gateway is NOT on the network:
Led "A" on steady, leds "B", "C" and "D" off

How the leds function when the Gateway is on the network:

Led "A": Working State
- Slow flashing (1Hz) -> Closed Gateway
- Fast flashing (4Hz) -> Opened Gateway

Led "B" (middle led): Radio Link
- Turned off -> No Router with good link in the proximity
- 1 flash -> One Router with good link in the proximity
- 2 flashes -> Two Routers with good link in the proximity
- 3 flashes -> Four or more Routers with good link in the proximity

Led "C" and "D": Radio Activity
- Usually turned off
- Shortly Lighted on transmitting or receiving a radio message

Creating the network
When the Gateway is not on the network, a pressing of the push button turn led "B" on.
If the push button is not pressed again within ten seconds, the scanning processes 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.

Opening the network
When the Gateway is on a network, pressing the push button on the circuit board opens the network (in this case led "A" flash).

Closing the 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.

8) GATEWAY DISASSOCIATION

Disassociation of the Gateway cause the loss of the network parameters and the restore of the default settings.
The disassociation is executed by pressing the bottom for 10 seconds.

9) SERIAL COMMUNICATION PARAMETERS

The Gateway can access to its own data and those of all other devices which form the network using ModBus-RTU serial communication protocol.
For a fuller dealing of the ModBus standard refer to the relevant documentation.

The parameters of serial communication are:

Speed: 9600 Bps (Dip4=off, Dip5=off)
19200 Bps (Dip4=on, Dip5=off)
38400 Bps (Dip4=off, Dip5=on)
115200 Bps (Dip4=on, Dip5=on)

Data bits: 8
Parity: None
Stop bits: 2
Flow control: None

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

InputRegister (16 bit variable read only)
InputStatus (1 bit variable read only)
HoldingRegister (16 bit variable generally non volatile)
CoilStatus (1 bit variable)

The function codes implemented into 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
15 - PRESET MULTIPLE REGISTER

10) GATEWAY DATA

Gateway data:

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

10.1) GATEWAY DEVICE 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*

10.2) GATEWAY DEVICE 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). Reset 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 =1)
HoldingRegister[12]	Maximum Address allowed for devices connected via Router-Bridge (default value =247)
HoldingRegister[13]	Password Z-HandZer special functions

10.3) GATEWAY DEVICE COIL STATUSES

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

10.4) GATEWAY DEVICE INPUT STATUSES

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

11) SPECIAL COMMANDS - COMMAND PASSWORD

The command password (HoldingRegister[0]) makes it possible to send special command to the Gateway.
The command password is executed only after that 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	Set the number of received packets from a joined sensor equal to the number of transmitted packets from the same sensor.	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

12) WORKING MODE

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).

12.1) 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 time 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 behaviour with reference to the timeout status of the sensors is managed by bit#0 of Working Mode parameter.

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 deducted 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 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.

12.2) Bit#1 of Working Mode – Exception response management

The bit#1 of Working Mode manages the behaviour of the Gateway in case it is requested 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

12.3) 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.

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

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

Working Mode, bit#4=0:
Feature disabled.

Working Mode, bit#4=1:
Address 200-254 are reserved to extraction of information about Routers in the network.

12.6) 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.

12.7) WORKING MODE Summary table

HR[3]	Response Delay	Router table access	HR Reading	Communication to Bridges	Time-Out Management
0			value presents into sensor	Bridge communication enabled	answers even if time-out
1			value presents into sensor	Bridge communication enabled	no answer if time-out
2			value presents into sensor	Bridge communication enabled	answers even if time-out
3			value presents into sensor	Bridge communication enabled	exception response if time-out
4			value presents into sensor	Bridge communication disabled	answers even if time-out
5			value presents into sensor	Bridge communication disabled	no answer if time-out
6			value presents into sensor	Bridge communication disabled	answers even if time-out
7			value presents 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 presents into sensor	Bridge communication enabled	answers even if time-out
17		adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	no answer if time-out
18		adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	answers even if time-out
19		adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	exception response if time-out
20		adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	answers even if time-out
21		adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	no answer if time-out
22		adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	answers even if time-out
23		adr 200-247 reserved to routers	value presents 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
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 presents into sensor	Bridge communication enabled	answers even if time-out
33	Response delayed		value presents into sensor	Bridge communication enabled	no answer if time-out
34	Response delayed		value presents into sensor	Bridge communication enabled	answers even if time-out
35	Response delayed		value presents into sensor	Bridge communication enabled	exception response if time-out
36	Response delayed		value presents into sensor	Bridge communication disabled	answers even if time-out
37	Response delayed		value presents into sensor	Bridge communication disabled	no answer if time-out
38	Response delayed		value presents into sensor	Bridge communication disabled	answers even if time-out
39	Response delayed		value presents 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 presents into sensor	Bridge communication enabled	answers even if time-out
49	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	no answer if time-out
50	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	answers even if time-out
51	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication enabled	exception response if time-out
52	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	answers even if time-out
53	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	no answer if time-out
54	Response delayed	adr 200-247 reserved to routers	value presents into sensor	Bridge communication disabled	answers even if time-out
55	Response delayed	adr 200-247 reserved to routers	value presents 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

13) 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.
These information are not requisite in the normal functioning 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 are reserved 12 consecutive InputRegisters.
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.

13.1) ROUTERS INFORMATION TABLE MAPPING

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

13.2) ALTERNATIVE ACCESS TO THE ROUTERS INFORMATION TABLE

The access to the Routers Information Table is also possible through reading InputRegister[0,11] of address from 200 to 254.
In this case the function have to be enabled by appropriate flag mode (Working Mode, bit#4=1), by default this mode is enabled.
If a Router is not available (for lack of the Router or in the case of time-out) a reading request doesn't generate response or generates an exception response (depending Working Mode, bit#0,1).

Modbus Address #200	1° Router joined to the network
Modbus Address #201	2° Router joined to the network
Modbus Address #202	3° Router joined to the network
Modbus Address #203	4° Router joined to the network
Modbus Address #204	5° Router joined to the network
…	…
Modbus Address #200+(i-1)	i° Router joined to the network
…	…
Modbus Address #254	55° Router joined to the network

13.3) ROUTERS INFORMATION TABLE ENTRY

These are the information that can be extracted from the Table, related to each Router presents 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

13.4) ROUTER INFORMATION RETRIEVAL

The information showed in the table are 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.

13.5) ROUTERS TIME-OUT BEHAVIOUR

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

13.6) MANAGEMENT OF ROUTER INFORMATION TABEL

There are two commands (interfaced with password command) to erasing and to swapping 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]
```

13.6) ROUTER-BRIDGE NETWORK ADDRESS TABLE

Besides the Routers Information Table there is another table from where it can be possible read the network address (ShortID) of the Router-Bridge linked to a Modbus device with a specific Modbus address.
These information are accessible in InputRegister form (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

14) 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].

15) COMMUNICATION WITH MODBUS DEVICES CONNECTED VIA ROUTER-BRIDGE

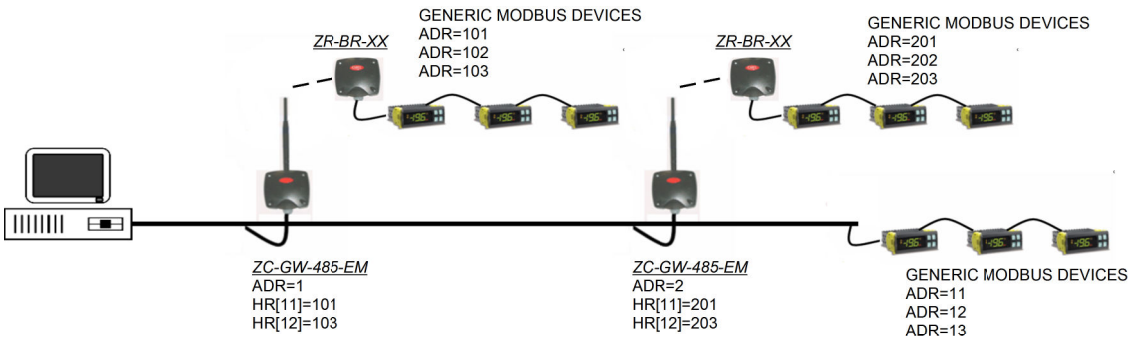
Communication with Modbus devices connected through Router-Bridge by default is disabled. To enable this functionality you need to reset bit#3 of the mode parameter (HR[3]).

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 it possible to connect to the 4-noks Gateway serial line others Modbus devices.
In the absence of this filtering system, the network is still able to function, but any message addressed to a device in the serial line would be transformed in a radio message by 4-noks 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