Light intensity interior sensors - communication ModBus RTU - type RK-ALNM

The sensors are designed for sensing the intensity of indoor lighting. The instrument may be equipped with a PIR detector to indicate the movement of people in the vicinity. The intensity of light sensor is built into the sensors lids together with the possible PIR detector. The electronics in the terminal box is located on the base plate under the lid. Sensors must be protected from dirt, excessive dust or direct exposure to water! The communication with superior system is led in the line RS485 by the protocol Modbus RTU and the device always operates in the "slave" mode. Device configuration is performed by connecting a standard USB mini B cable to PC using Windows free USB_SET application.

The devices are intended for direct mounting on the wall or on the KU68 installation box.

Basic technical parameters:

Supply voltage (Ucc)	10 to 30 VDC
Power consumption	0,5 VA
Max. range of light intensity	0 ÷ 65535 lx
Accuracy	±5 % ± 5 digits
Resolution	1 lx
Peak of the sensitivity spectrum	550 nm
IR sensitivity (850nm)	0,2 %
Max. range of PIR detector	5 m
Max. horizont./vertikal. detection angle PIR	100° / 82°
Communication	RS485, protocol ModBus RTU, 8bitů, 1 stop bit, without parity
Baud rate	1200 ÷ 57600 Bd
Input impedance of the RS485 receiver	min. 96 kΩ , typ. 150 kΩ
Max. number of sensors on the line	254
Galvanic separation RS485	No
Range of working temperature and humidity	-20 ÷ 60°C/ 0 ÷ 90%RH without condensation
Range of recommended storage temp. / RH	10 ÷ 50 °C / 20 ÷ 60 %RH
Protection type	IP40
Terminal board	CPP (wires max. 1 mm^2)
Dimensions	103 x 100 x 25 mm (36mm RK-ALNMPIR)
Configuration and FW upgrade	USBset; freeware; www.regmet.cz

Connection diagram (fig. 1)
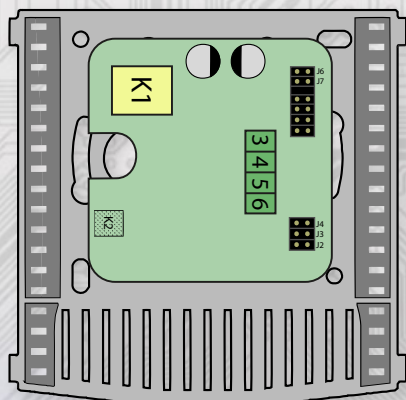
K1...connection of light sensor (+PIR)
K2...connector USB mini B

J2...definition of still stand (conductor A)
J3... definition of still stand (conductor B)
J4...terminal resistor 120R
J6...device configuration
J7... reset

Terminal 3.......+Ucc, positive pole
Terminal 4.......GND, negative pole
Terminal 5.......RS485 - A
Terminal 6.......RS485 - B

2024/06

List of available types:

	PIR	NO	YES
Meas. value			
Lighting		**RK-ALNM**	**RK-ALNMPIR**

1.1 Properties of communication protocol:

Protocol Modbus RTU with adjustable Baud rate 1200 - 57600 Bd, 8 bits, no parity, 1 stop bit, line RS485, half-duplex operation.
Supported features:
03 (0x03): Read Holding Registers
04 (0x04): Read Input Registers
06 (0x06): Write Single Register
16 (0x10): Write Multiple Registers

The communication protocol description is available at www.regmet.cz, in the document named the Implementation of Modbus protocol in devices Regmet of second generation.

2.1 Description of registers of the device:

1Modbus registr = 2 Byte

During the transfer the register addresses are indexed from zero, i.e. register 0x0001 is physically sent through the busbar as 0x0000... (zero based addressing). The Holding registers will be mentioned in the description together with the function code field 4xxxx and the Input registers including 3xxxx. Thus the Holding register 40001 is physically sent through the busbar as register 0000 and the Input register 30001 as 0000.
Examples of communication are shown in Chapter 2.8.

The registers are divided in four basic memory zones:

Operational registers are situated at addresses 40001, 40002 and 40006. To read these registers use command no. 03 "register reading" (0x03 Read Holding Registers)

The configuration registers are situated in the zone of Holding registers at addresses 40041 to 40082. They are used for configuration of the device. The registration in registers is protected and allowed under the configuration mode, i.e. when the jumper shorts out the link J6. In this mode the device communicates at dedicated address 255 of the Baud rate 19200 Bd. The configuration registers can be rewritten only using the communication protocol and under the above stated conditions. The change of setting and at the same time the registration in FLASH is done only after writing 0xC003 (49155 dek) to 40029 – the Register Status

The information registers are situated in the zone of Input registers at addresses 30001 to 30032. They serve for unchanged preservation of device identification data.

The Status Register serves for two-way communication between the device and the superior system. The device notifies the superior system of the internal status and the superior system sends requests for performance of commands.

STATUS Information messages from the device to the superior system:
- Normal Run,   0x0000 (0 dek) the device works in normal operational mode
- Menu Active,   0xB000   (45056 dek) the user has opened the manual menu
- Memory Read,   0xB001   (45057 dek) the device is reading from FLASH
- Memory Write   0xB002   (45058 dek) the device is registering to FLASH

STATUS Error messages from the device to the superior system:
- CRC Error0xBE00   (48640 dek)   Application program is damaged in the FLASH memory
- LCD Error0xBE01   (48641 dek)   Error of communication with LCD
- Sensor Error   0xBE02 (48642 dek) Error of communication with the sensor
- Memory Error   0xBE03 (48643 dek) Error of communication with FLASH

STATUS Commands for the device issued from the superior system:
- Clear STATUS 0x0000 (0 dek) writes 0 to the register
- Write Area 3   0xC003   (49155 dek) it rewrites the Configuration registers to FLASH

In brackets behind the registers described, abbreviations of possible features may appear:
R   Read for reading
W   Write for writing
WP   Write protect for protected writing
M   Parallel manual access from the device menu

2.2 Description of operational registers:

				Modbus registr [dek]
-	-	Measured light intensity	-	1 - 4
-	-	-	-	5 - 8
-	-	-	-	9 - 12
-	-	-	-	13 - 16
-	-	-	-	17 - 20
-	PIR	-	-	21 - 24

40003 (R) - Measured light intensity:
Is sensed by a digital sensor located in the sensor cap. The value is sent in lx units in form of 16-bit number with sign.

40022 (R) - PIR detektor:
If installed, this passive infrared sensor is mounted in the sensor cap and responds to motion within its detection zone. The maximum sensor range is 5m, with a horizontal detection angle of max. 100° and vertical detection angle of max. 82°. The PIR sensor can be used e.g. for automatic control of lighting or monitoring movement within a building. The number format is 16bit unsigned integer, with a range of 1bit of Lsb register; every motion detected generates "1" in this register.

2.3 Description of the Status Register

				Modbus registr [dek]
Status registr				29

40029 (R,W) - Status Register:
It provides the superior system with information on the internal status of the device, for example the current error statuses or information that the manual setting menu is currently activated by the user. At the same time it serves as the receiving register for special commands, for example rewrite/backup of working registers to FLASH.
The number format is 16-bit unsigned integer.
See the detailed description in the Status Register in Chapter 2.1 Description of device registers.

2.4 Description of configuration registers

Saving into the Flash is done only after writing 0xC003 (49155 dec) to 40029 - Registry status.

Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
-	-	Measured ligt., Offset	-	77 – 80

40041 ÷ 40048 (R,WP) - Text
The custom text field. It is determined for the client´s identification of the device. The number format is 16-bit unsigned integer. Two ASCII signs can be in one Modbus Register

40049 (R,WP) – Network address
The network address of the sensor. The number format is 16-bit unsigned integer. It acquires the values 0 ÷ 255 dek, whereas the address 0 is reserved for the broadcast and the sensor does not respond to it, the address 255 is reserved for the controller configuration. Thus the range of available addresses is 1 ÷ 254

40050 (R,WP) – Baud rate
The Baud rate. The number format is 16-bit unsigned integer. It acquires the values 0 ÷ 6 dek.
value [dek]
rate [Bd]

value [dek]	0	1	2	3	4	5	6
rate [Bd]	1200	2400	4800	9600	19200	38400	57600

40079 (R,WP) – Measured light intensity, Offset
Setting the measured light intensity.
The value is in lx units in form of 16 bit number with a sign (signed integer).
For example, when it seems that the device shows a value 10 lx higher, value – 10 will be set in this register and the device will display and send the lx value decreased by 10 lx than the actually measured value is.
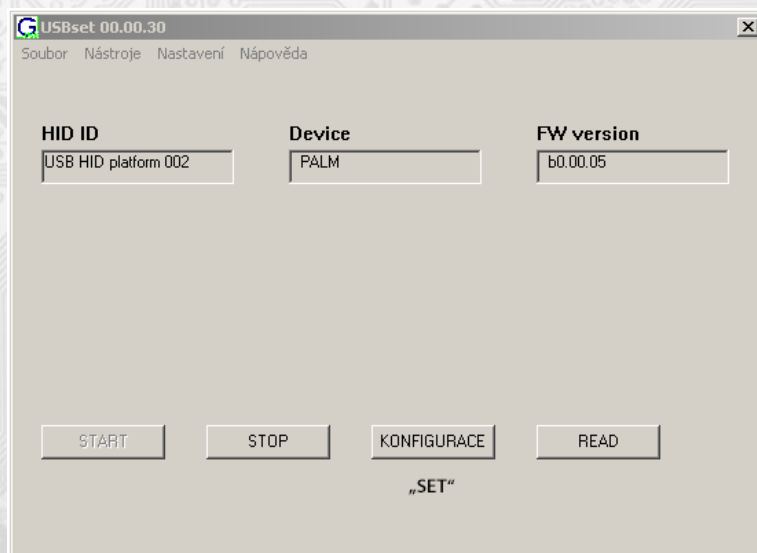

With clicking on the button "SET" the configuration window gets opened

With clicking on the button "READ" the conguration values from the ash memory of sensor are read.

Shift of measured value (T, RH, light intensity)
For example, when it seems the device measures over by 1° C (for example due to the inappropriate location, own heating at often communication with loaded line...), the value – 1,0 is set and the device will display and send the temperature value lower by 1°C than the really measured value is.

Text field ...intended for the client´s identification of the controller (title, location...).

Address...selection of network address in the range 1 ÷ 254 for the operation of sensor in the serial line

Baud rate...selection of Baud rate in the range 1200 ÷ 57600 Bd for the operation of sensor in the serial line

P20M mode: By choosing this mode, the sensor is set to a compatibility regime with older REGMET P20M sensors.
This means that the intensity of lighting is transmitted in register 4005 and register 4006 transmits the value of the customers' range in percent. However, the measured values will not be exactly compatible with the values from the older P20M types because these instruments did not act as luxmeters but only as guiding light sensors. The information from the PIR detector stays in register 22.
0%: a value corresponding to 0% of the customer's range of lighting. The value relates to the measured value of light intensity (register 4005).
100%: a value corresponding to 100% of the customer's range of lighting. The value relates to the measured value of light intensity (register 4005).
A type that ends with the letter D also allows local displaying of the measured values using the display that is installed into the transparent lid of the sensors.

After setting of required values and quantities the new configuration values are saved in the flash memory of the device by clicking on the button "Write"
The writing into the flash memory is conditioned by insertion of jumper J6 (authorisation for configuration values recording) before the clicking on the button "Write"
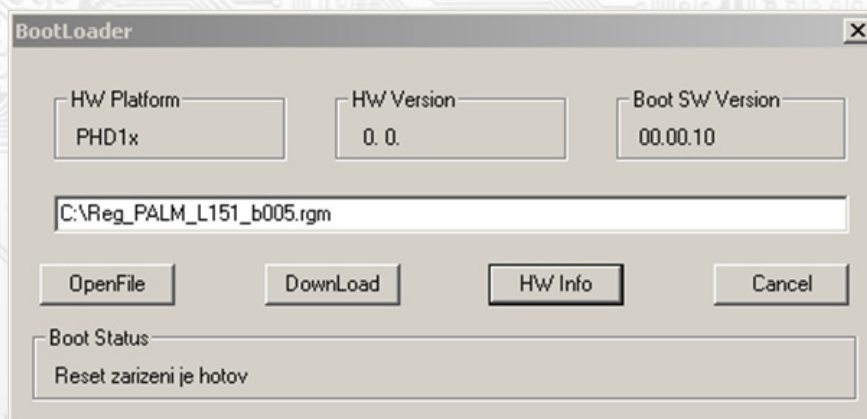By clicking on the button "Cancel" the configuration windows gets closed.

After USB cable disconnection the jumper J6 is pulled out and the device is ready for operation.

3.2 Variation of the application part FW:

After the USBset program launching click on the Tools – BootLoader and the windows gets opened:

The work with application is conditioned by insertion of the jumper J6 (authorisation for configuration values recording).
Using the button "OpenFile" the new application FW is chosen and using the button "DownLoad" the FW variation gets started, being automatically controlled by PC and the device.
For the maximum simplicity and safety every device has unambiguous identification of HW platform. This designation describes HW topology and also defines what application FW can be sued for the specific type of HW. This information can be read through the button "HW info".
The application FW are distributed in data format ".reg ". In case of application variation the information on HW platform and HW version are always read after the connection of PC with the device. At the same time, the HW platforms descriptors and HW versions from the file ".reg " are read. Provided HW platform and HW version are not compatible, the FW variation cannot be done. Provided the communication failure occurs during the application FW variation, for example due to the supply voltage drop, the application SW will not be functional. In such case the automatic launching of "bootload" process as well as the automatic reading of HW info will not work. The Bootloader in the device gets always activated after the reset, thus it is necessary to reset manually. Using the RESET jumper or the simple disconnection and subsequent connection of supply voltage.

Provided the automatic sequence of FW variation launching is damaged:
- switch off the device or connect the jumper at RESET pins
- launch the bootload process using the button "DownLoad"
- switch on the supply voltage or release the RESET jumper
- delay between the activation of button "DownLoad" and the switching on or by the RESET shall be shorter than 2s.
After the USB cable disconnection the jumper J6 is pulled out and the device reset is performed using the short shorting of RST jumper (J7).

The integrity check of content of memory:
The bootloader as well as the application are protected by control total sums. Provided the data integrity is broken, the content of FLASH memory MCU is damaged and the damaged program will not be launched.

4.1 Examples of communication:

Command 03 (0x03): Read Holding Registers:

Master: 02 03 00 02 00 01 Crc Crc
Number of read registers (1 registers)
Address of initially read register (0x0003)
Command (Read Holding Registers)
Address of device (device with address 2)

Slave: 02 03 02 00 90 Crc Crc
Data
Number of bytes (2)
Command (Read Holding Registers)
Address of device (device with address 2)

The starting register address is 0x0003 **, the number of read registers is 1. Thus: the measured value of the lighting is 0x0090 = 144 lx.

Command 16 (0x10) Write Multiple Registers:

Master:

FF 10 00 30 00 02 04 00 02 00 03 Crc Crc
- Registered data 2. Regist. reg. (0x0003)
- Registered data 1. Regist. reg. (0x0002)
- Number of bytes (4)
- Number of registered registers (2)
- Address of first registered register (0x0031**)
- Command (Write Multiple Registers)
- Address of device (with inserted jumper J6 - address 255)

Slave:

FF 10 00 30 00 02 Crc Crc
- Number of registered registers (2)
- Address of first registered register (0x0031**)
- Command (Write Multiple Registers)
- Address of device (with inserted jumper J6 - address 255)

With writing of the value 2dek in register 0x0031* (40049 – Network address) the network communication address 2 is set and with the writing of the value 3dek in register 0x0032** (40050 – Baud rate) the Baud rate 9 600 Bd is set.

Command 06 (0x06) Write Single Register:

Master:

FF 06 00 1C C0 03 Crc Crc
- Registered data (0xC003 = 49155dek)
- Address of registered register (0x001D**)
- Command (Write Single Register)
- Address of device (with inserted jumper J6 - address 255)

Slave:

FF 06 00 1C C0 03 Crc Crc
- Registered data (0xC003 = 49155dek)
- Address of registered register (0x001D**)
- Command (Write Single Register)
- Address of device (with inserted jumper J6 - address 255)

By writing the value 49155dek in register 0x001D** (40029 -Status Register),the configuration registers are saved in the flash memory of the device. If, for example, the communication address and rate pursuant to the previous example are changed through the network, then after this registration in the Status Register this change will be valid even after the device is reset or switched off.**

During the transfer the addresses of registers are indexed from zero, i.e. register 0x0001 is physically sent through the bus bar as 0x0000... (zero based addressing).

<u>Content Modbus Holding Registers (Table 2):</u>

Description of operational registers:

				Modbus register [dek]
-	-	Measured light intensity	-	1 - 4
-	-	-	-	5 - 8
-	-	-	-	9 - 12
-	-	-	-	13 - 16
-	-	-	-	17 - 20
-	PIR	-	-	21 - 24

Description of the Status Register:

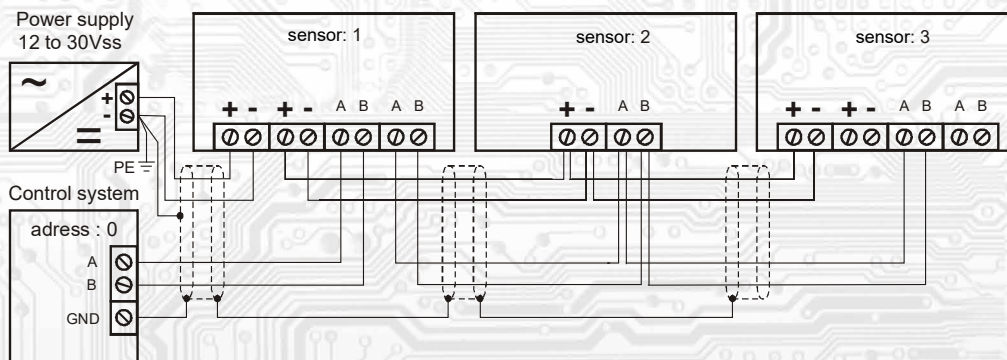| Status register				29

Description of configuration registers:

Saving into the Flash is done only   after writing   0xC003 (49155 dec) to 40029 - Registry status.

Text_1	Text_2	Text_3	Text_4	41 - 44
Text_5	Text_6	Text_7	Text_8	45 - 48
Network address	Baud rate	-	-	49 - 52
-	-	-	-	53 - 56
-	-	-	-	57 – 60
-	-	-	-	61 – 64
-	-	-	-	65 – 68
-	-	-	-	69 – 72
-	-	-	-	73 – 76
-	-	Measured light intensity., Offset	-	77 – 80

Example of wiring the sensors in the system

Assembly and connection:

The devices are intended for direct mounting on the wall or on the KU68 installation box. First, the lid is removed, which makes the terminal block and mounting holes accessible. The base is screwed to the interior wall or to a standard installation box with a spacing of 60mm using two screws. The electrical connection of the lead wire of the recommended cross-section and diameter is made on the terminal block (Fig. 1).

The signal terminals A and B on the sensors are connected to the serial line as per the rules for connection of devices in RS485 serial lines. The use of J2 to J4. jumpers is subject to general rules for communication through RS485 lines (note: at end points of the RS485 line, it is necessary to connect a terminating resistor through the J4 jumper). The sensors are supplied from a single 12 to 30 VDC power supply, while the supply voltage is connected to the terminals marked by (+) Ucc and (-) GND. It is recommended to interconnect the devices using a multi-core shielded cable, which hosts data as well as power supply wires. The cable shield must be interconnected between individual segments of the line and only connected to the lowest potential (PE terminal) in the switchboard. We recommend cables with twisted pair cables with a cross section of 0.35 to 0.8 mm2 with impedance near 120, eg STP CAT5 and higher.

By connecting the K1 connector and attaching the perforated cover, the sensor is ready for operation.