UI416 Solar irradiation integrator

Summary **UI416 calculates cumulated energy on an area unit based on actual irradiation value. The cumulated energy is used for long-term efficiency calculations of a PV plant operation. The energy may be read at the pulse output to be processed in an external pulse counter, or may be directly read out over a bus – the communication protocol is Modbus RTU / RS485.**
Different versions of unit may contain display, backlight and knob:

Application

- **PV monitoring systems**
- **Integration of any analogue value represented by a 0...10 V signal**

Function

The solar radiation integrator acquires input voltage which is proportional to the solar radiation intensity from an external sensor with 0...10 V output (must be ordered separately). The actual intensity in kW/m2 is displayed at the LCD display. This value is integrated in time once per second and available at the potential free output as pulses which are proportional to the energy corresponding to 1 m^2 of the measured area. The output pulses may be brought to any counting device which cumulates the resulting energy. The cumulated values are used for comparison to the real plant production to determine both short-term and long-term efficiency of the plant.

All actual and cumulated values are available at the open RS485 bus. The protocol used is Modbus RTU and therefore the UI416 integrator may be connected to most of the PLC and SCADA systems on the market. See table below for register description. The most important available values are:

Daily cumulated energy
The integration starts at midnight (00:00) and its value increases throughout the day. At next midnight (24:00) it is copied to the Last day cumulated energy and then reset to zero.

Last day cumulated energy
For the next 24 hours it contains the accumulated energy of yesterday. This is for comfortable readout of the daily cumulated energy.

Total energy
This value integrates the total cumulated energy since commissioning of the device. The value is backupped by a battery.

In the registers, another set of values is calculated:

Cumulated energy above the irradiation limit
This register integrates only if the actual irradiation exceeds a predefined limit (settable over the bus as an analogue value, default 300 W/m^2). This cumulated value is useful because the inverters start operation only above certain irradiation level, and the measuring errors caused by night residual light cumulation are avoided.

Cumulated energy when inverters active
This register integrates only if the integration is enabled by a binary value written over the bus from a PLC or another Modbus master. The binary value indicates operating inverters and thus the comparison of the real produced energy (read at the inverters or at the main meter) and this value gives an image of efficiency of the inverters and distribution components.

The integrator contains real time clock backupped by a battery. There is also integrated thermometer on the PCB, the value of which is available on the bus. The temperature may be used as informative value for monitoring of enviromental conditions at the installation place (switchboard, transformer room etc.).

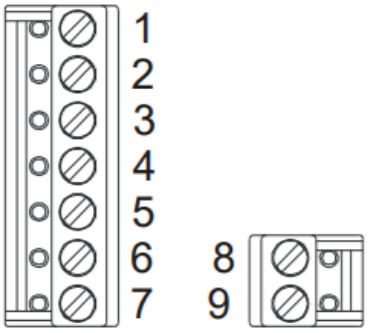
The constant of Wh/m2 is changeable and therefore the integrator may be used with various sensor types and even for integration of another values than solar irradiation.

Technical data

Power supply	24 V AC/DC ±20 %, 1.5 W
Temperature measuring range	-20...55 °C (accuracy ±1 ˚C)
Humidity measuring range	10...90 % rH (accuracy ±3 %)
Protection degree	IP20 (EN 60529 + A2:2019)
Analog input for exposure sensor	1 × AI (0...10 V, input resistance 10 kOhm)
Measuring range	adjustable, 10 V corresponds to 1...65 000 W/m^2 default value is 0…10 V corresponds to 0…1300 W/m^2
Measuring principle	integration of current exposure 1/s corresponds to EN 61724 photovoltaic system performance control - Guidelines for measurement, data exchange and analysis

Digital output	1 × DO SSR solid state relay, for load 60 V / 550 mA AC / DC
	AC1 - non-inductive load 400 mA
	AC3 - motor, 50 mA AC
	AC1 - ballast, 125 mA AC
	ČSN EN 60947-4-1
	galvanic insulation 1 kV
Output pulses	pulse output 1 or 10 Wh / m2 (DIP switch setting)
	fixed pulse length 100 ms
Setpoint setting	using the ModComTool configuration program
Communication	RS485 - Modbus RTU, slave
	selectable speed 1200 ... 115200 bps, parity and bits are set in service SW
	default 9600/N/8/1
	the interface is optically separated 1 kV
Display	LCD 60 × 60 mm
Terminals	screw terminals for conductors 0.14…1.5 mm^2
Cover	ABS, RAL9010
Weight	0.13 kg
Dimensions	90 × 115 × 24 mm, see below
Ambient conditions	from -20…50 °C; 5…85 % relative humidity; non-condensing gases, chemically non-aggressive conditions, fog, ice and frost (according EN IEC 60721-3-3 ed. 2:2019 climatic class 3K22, 1K21, 3M11)
	for installation at high altitude, it is necessary to consider the reduction of dielectric strength and a limited cooling air (EN IEC 60664-1 ed.3: 2020)
Storage conditions	5…45 °C; 5…95 % relative humidity; non-condensing gases and chemically non-aggressive conditions (according EN 60721-3-1 climatic class 1K3)
Standards conformity	EMC EN IEC 61000-6-2 ed. 4:2019, EN IEC 61000-6-4 ed. 3:2019 (industrial environment)
	electrical safety EN IEC 62368-1 ed. 2:2020+A11:2020
	hazardous substances reduction EN IEC 63000:2019

Terminals

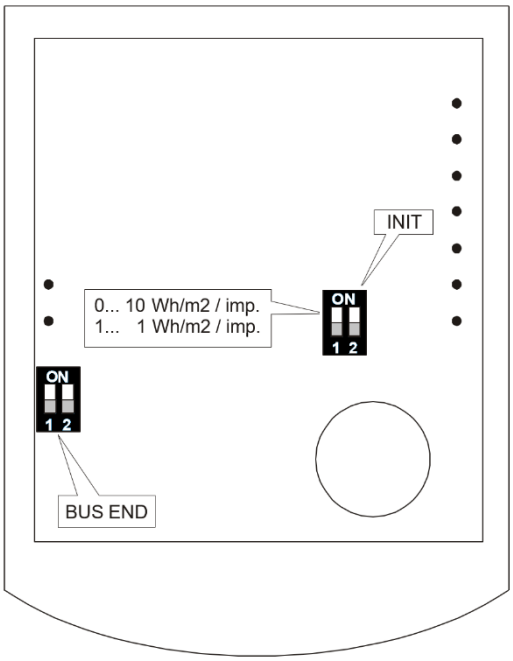


1: AI1 input 0...10 V for exposure intensity sensor
2: AGND
3: DO1 A pulse output (SSR relay)
4: DO1 B pulse output (SSR relay)
5: G0 supply (-), input - reference point
6: G0 supply (-), input - reference point
7: G power supply (+)

8: K - RS485 communication
9: K + RS485 + communication

Terminals 5 and 6 (supply ground) and 2 (input ground) are galvanically connected. We recommend powering the UI416 from the same source as the exposure sensor.

DIP switches



Back of the PCB

BUS END: if ON, the bus is terminated (if last device on the line)

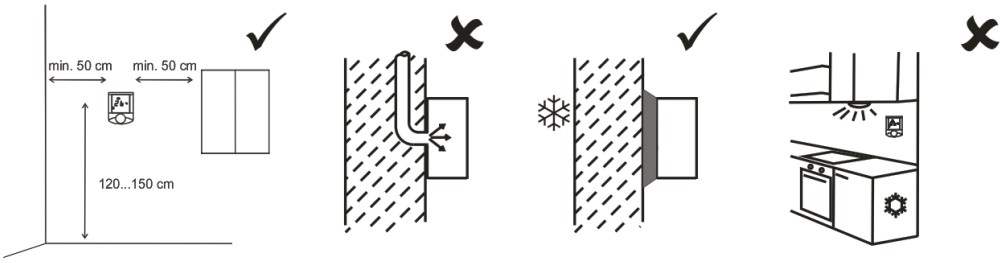
USR: in position 0 the output gives 10 Wh / m2 per pulse (normal setting), in position 1 the output gives 1 Wh / m2 per pulse (usually for tests)

INIT: sets the device to the default communication parameters: Modbus address 1, baud rate 9600 bps.

Installation

Units are intended for operating in a normal and chemically non-aggressive environment. They do not need any servicing or maintenance. Install them in a vertical position at places where they can be operated easily and measure correct values of temperature, i.e. in the height of about 150 cm, with no direct sunlight or other heat / cool source (AHU outlets, refrigerators, electrical appliances). The device consists of two parts: bottom with screw terminal block and cover containing PCB, display, and the knob. The bottom part is fixed by 2 or 4 screws to any flat surface or a flush-mounting box Ø 60 mm. At the back of the bottom there is an aperture for cabling. The bottom should be installed and cabling connected first, and the upper part inserted after the construction works have been finished to prevent damage to the unit.

Seal the conduits to avoid influencing the sensor by draught. Use insulating pad when installing the sensor on cold walls. Avoid sensor exposition to sunlight or other heat sources.

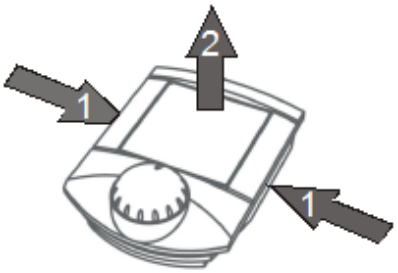


Opening the cover

When removing the display part, proceed as follows:

- press gently the side parts of the unit and pull the right of the display part by several milimeters
- pull the left of the display part
- pull the display part and remove it from the bottom.

Do not bend the display part too much, the connector pins could be damaged. The locks are only at the sides of the display part, not at the top nor bottom.



Communication

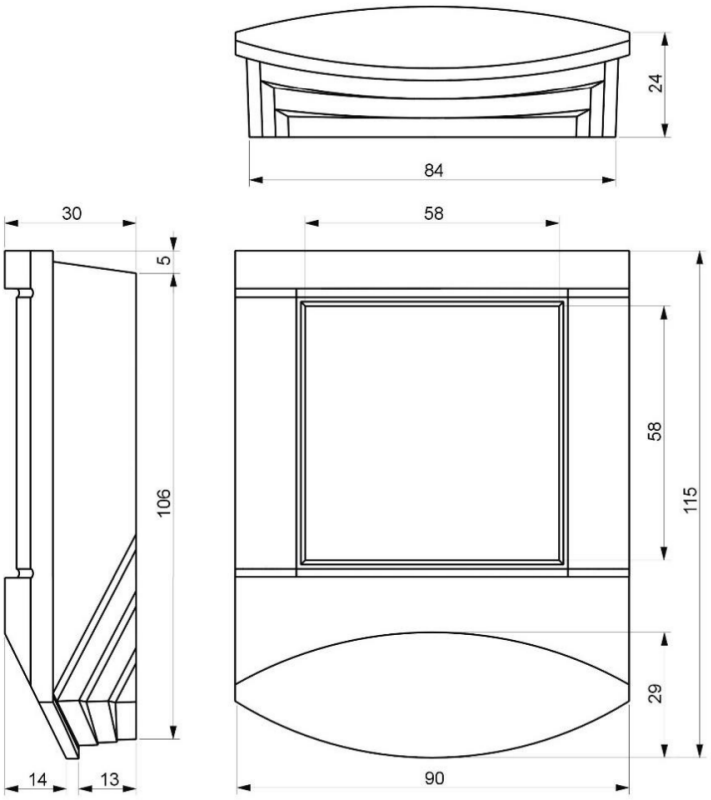
The units communicate with a controller (master) over RS485 using Modbus RTU and thus they can be used in a number of control and SCADA systems. The register description is available in a separate document *Room units UI... – Communication description.* User manual for domat.exe and detailed description of the room unit functions find in the document *Room units configuration – User manual.*

Display

A large (60 × 60 mm) display clearly shows actual room temperature and controller status with 7-segment digits and standard Day, Night, Off, and Time scheduler symbols. Active output is indicated by a heating symbol. In the upper part, there are week days used for time scheduler setup. Other symbols are not used.

LCD symbol set

Dimensions **UI416**



All dimensions in *mm*.

WEEE notice The device contains a non-rechargeable battery which backups the real-time clock and part of the memory. After the device is not operable, please return it to the manufacturer or dispose of it in compliance with local regulations.

Safety note The device is designed for monitoring and control of heating, ventilation, and air conditioning systems. It must not be used for protection of persons against health risks or death, as a safety element, or in applications where its failure could lead to physical or property damage or environmental damage. All risks related to device operation must be considered together with design, installation, and operation of the entire control system which the device is part of.

Changes in versions	01/2022 – First datasheet version.