WATTROUTER M - USER MANUAL

FOR MODELS:
WATTROUTER M SSR (WRM 01/06/12 AND WT 02/10)
WATTROUTER M MAX (WRM 01/06/12 AND WT 03/11)

HOW TO FIT AND SETUP THE DEVICE

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GENERAL INFORMATION

WATTrouter M is a programmable controller to optimize self-consumption of energy produced by photovoltaic or wind power plant (hereinafter referred to as PV-plant). It is a smart home energy management system. After correct installation and configuration, the controller perfectly optimizes self-consumption of energy produced by your PV-plant. WATTrouter M consists of a current sensing module and the regulator itself.

WATTrouter M has the following features:

- Three-phase indirect current measurement.
- Single phase detection of voltage necessary to determine the power direction in phase L1, for other phases it is determined by software.
- Evaluation of active power outputs in individual phases, necessary to determine the surplus of produced electric power.
- Regulation based on the sum of power outputs (summary surplus) from all three phases or based on surplus in each phase.
- Switching for up to 6 outputs (2 triacs, 2 relays and 2 external solid state relays SSR) based on configured priorities.
- Optimal use of surplus energy produced by PV-plant on triac and SSR outputs through the application of proportional synchronous regulation of resistive loads, compliant to European standards EN 61000-3-2 and EN 61000-3-3. This regulation modulates connected load's power exactly according to the available surplus energy.
- Very short average dynamic response of the controller (up to 10 s)
- Optional CombiWATT function used for switching loads under a combined mode where energy is taken both from PV-plant and public grid (especially suitable for water heating and also for swimming pool filtering system).
- Input for low tariff signal (nightly low price electricity) for CombiWATT. This is for households where double tariff rates will apply.
- 3 inputs for connection of impulse outputs of external energy meters, which may measure any power outputs. Measured values are displayed in WATTconfig M application and also on web interface.
- Separated current sensing module and regulator for easy installation into existing household wiring.
- WATTconfig M software designed for Microsoft Windows, Linux and MAC OS X, provides comfortable controller configuration and monitoring via USB and Ethernet.
- Integrated web interface allows comfortable controller configuration and monitoring using regular Internet browser.
- Real-time module backed with a lithium battery for advanced management of outputs and CombiWATT function.
- S-Connect protocol for sharing devices over existing network or wireless infrastructure.
- Daily, weekly, monthly and annual statistics.
- Firmware update.

DESCRIPTION OF BASIC FUNCTION

The current sensing module measures electric current in real time and on all phases. The regulator evaluates the measured electric currents and if it determines the available surplus energy produced by the PV-plant, it will switch on connected loads according to adjustable priorities, while constantly trying to maintain zero energy flow through the current sensing module, the so called "virtual zero" (the sum of active power outputs on all three phases = 0) or optionally, on each phase separately, so called "phase zero".

Switching according to priorities is done in the following way:

By default (during night), all loads are turned off. If surplus energy generated by PV-plant is determined in the morning, the output with the first (highest) priority is switched on.

The switching time is different according to selected output function.

- Triac/SSR/PWM outputs (proportional outputs) are switched on almost immediately after surplus energy is detected and the controller is gradually (synchronous control or PWM modulation) maintaining "virtual zero" or "phase zero", according to the control settings.
- Relay outputs are switched on only if the surplus energy exceeds the preset load‘s nominal power. Alternatively, relay outputs may be operated in "prepend" mode if there is sufficient power at any proportional output with nearest higher priority. This allows for maximum utilization of the produced surplus power even for relay outputs - refer to the "Prepend before triacs/SSRs" function.

When load with 1st priority is switched on (for proportional output it means switching on the maximum power), the system waits until the power output of PV-plant increases again (beginning of dawn). If electric production is determined even when this load is switched on, load with second priority in the same mode is switched on as well.

If the power output of PV-plant is still increasing, additional connected loads are switched on in the same mode.

If the power output of the PV-plant decreases, or if another load - not connected to the WATTrouter device is switched on, the switched (active) outputs are disconnected - again according to preset priorities but in reverse order (the load with lower priority is disconnected first).

For relay outputs there may be set a minimum switching time. If, simultaneously with a relay output the proportional output with higher priority is switched on, and the available surplus energy is reduced, then this proportional output will reduce the power output of the of the load (even down to zero) in order to maintain virtual zero or phase zero on the current sensing module, if possible.

Except for the situation specified in the paragraph above, the controller never violates the established priorities.

The above specified principle applies only to standard connection of the current sensing module, connected right behind the facility’s main energy meter, so the WATTrouter device uses only the actual PV-plant surpluses (recommended settings). However, WATTrouter controller is versatile device and can be connected according to your needs. For example, you can place the current sensing module just next to the PV inverter and then you can maintain the virtual or phase zero on that line.

The above specified basic control mode may be combined with another mode of output switching, provided that low tariff signal (double tariff rate) is available (CombiWATT mode), or with switching based on preset time conditions (time schedules).

This device is not designed for precise active power measurement (it is not a replacement for a wattmeter or electricity meter). Active power is measured with sufficient precision in order to maintain all control functions.

PACKAGING CONTENTS

Contents of packaging:

1 WATTrouter M regulator

1 WATTrouter M current sensing module

1 USB cable

1 short manual with links to this manual, software and firmware updates.

SAFETY WARNING

When you receive your package, inspect the packaging unit for damages. After opening your package, inspect the regulator and the current sensing module for damages. Do not fit the regulator or the current sensing module if you see signs of mechanical damages!

Always have the regulator and the current sensing module fitted by a person with the necessary electrical qualification. It is necessary that you read this manual thoroughly and observe all safety warnings and requirements specified herein.

The regulator and the current sensing module must be fitted in a dry room without excessive dust level. The room must be protected from direct sunlight and the ambient temperature must be maintained within the range mentioned in chapter Technical specifications. Do not place the regulator or other electronic components of this system near flammable objects!

When power SSRs are connected to SSR outputs or built-in triacs are used, it is absolutely necessary to fit these into a distribution box equipped with adequate heat dissipation system (with ventilation grid or vents)!

Make sure that unauthorized persons, mainly children, cannot access the location where the controller is fitted. There is a serious risk of electric shock!

Only connect outputs of the controller to electrical loads which have been designed for this operation mode and for which the manufacturer does not explicitly prohibit connection via switching element!

The manufacturer is not liable for any damages occurred due to improper fitting or operation of the device! The owner is fully responsible for operation of the entire system.

FITTING THE DEVICE

WATTrouter M regulator may be fitted in a regular distribution board onto a 35 mm DIN rail or attached to a wall using 2 screws with round or countersink head and with diameter up to 6 mm.

WATTrouter M current sensing module may be fitted in a regular distribution board onto a 35 mm DIN rail.

Measuring inputs of the current sensing module may be connected as single, double, or triple-phase connections.

The recommended maximum distance of the current sensing module and the regulator is 2 meters. Bigger distance is acceptable, but it will slightly affect the measuring accuracy.

If CYKY or other thick and hard cables cannot pass through current transformers easily, use flexible cables to extend the existing connections. When fitting the current sensing module do not press hard on it. You may damage the module.

Tip: *Individual phase wires may pass through the current sensing module from either direction. The direction of currents may be configured in the control software.*

To connect power supply to the regulator (L1 and N) use wires with a minimum cross-section of 0.5 mm^2, for example CYKY 1.5.

To connect loads to the relay outputs use wires with adequate cross-section corresponding with the power ratings of the connected loads.

To connect loads to the power triacs or SSRs again use wires with adequate cross-section corresponding with the power ratings of the connected loads.

To interconnect the current sensing module and regulator (inputs GND and ILx) use 4-wire cable with cross-section from 0.5 to 1.5 mm^2. If these wires are longer than 2m or are placed in a cable tray together with other power cables/wires, we recommend using a shielded cable.

To interconnect power SSR control inputs and/or PWM control signals with SSR outputs use wires with cross-section from 0.5 to 1.5 mm^2. If these wires are longer than 2m or are placed in a cable tray together with other power cables/wires, we recommend using a shielded cable.

To interconnect S0 impulse signals from external energy meters with FB inputs use 2-wire cable with cross-section from 0.5 to 1.5 mm^2, connected between GND and respective FB terminal. If these wires are longer than 2m or are placed in a cable tray together with other power cables/wires, we recommend using a shielded cable.

Connect shielding of all shielded cables to the GND terminal as close as possible to the regulator.

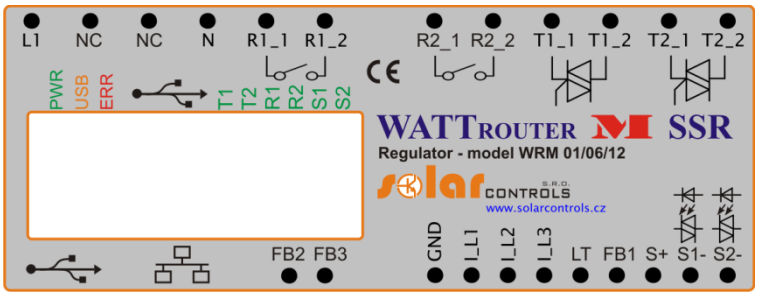


Figure 1: Connector and LED description (top view). Connection is the same for the WATTrouter M MAX device.

Regulator terminals - description:

Top left terminal block (**this only accepts voltage from public grid!**):

- L1 – regulator power supply and voltage detection L1, 230VAC/50Hz (must always be connected)
- N – neutral wire (must always be connected)
- R1_1 – relay output 1 – terminal 1
- R1_2 – relay output 1 – terminal 2
- R2_1 – relay output 2 – terminal 1
- R2_2 – relay output 2 – terminal 2
- T1_1 – triac output 1 – anode A1
- T1_2 – triac output 1 – anode A2
- T2_1 – triac output 2 – anode A1
- T2_2 – triac output 2 – anode A2

Left bottom terminal block

- FB2 – input for connection of impulse output of external energy meter (0V or +5V)
- FB3 – input for connection of impulse output of external energy meter (0V or +5V)

Right bottom terminal block

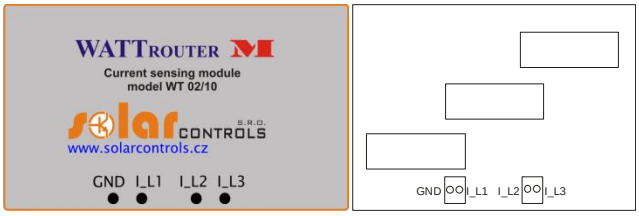
- GND – common wire coming from the current sensing module (must always be connected)
- I_L1 – electric current measuring input L1 from the current sensing module (must always be connected)
- I_L2 – electric current measuring input L2 from the current sensing module
- I_L3 – electric current measuring input L3 from the current sensing module
- LT – low tariff signal detection (0V or +5V)
- FB1 – input for connection of impulse output of external energy meter (0V or +5V)
- S+ – external SSR outputs – common positive electrode (+5V)
- S1- – external output for SSR 1 – negative electrode (open collector)
- S2- – external output for SSR 2 – negative electrode (open collector)

Left bottom communication connectors

- USB – USB interface connector (USB B)
- LAN – Ethernet interface connector (RJ45, 10/100 Mbit/s)

LED description:

- PWR – regulator power on light (green)
- USB – communication light - USB interface (yellow)
- ERR – error status light (red)
- T1 – triac output No. 1 - activity indication light
- T2 – triac output No. 2 - activity indication light
- R1– relay output No. 1 - activity indication light
- R2– relay output No. 2 - activity indication light
- S1– external output for SSR 1 - activity indication light
- S2– external output for SSR 2 - activity indication light
- RJ45 connector – Ethernet connection indication light (left green LED – carrier frequency, right green LED - connection speed)



- **Figure 2: Connection terminals of current sensing module WT 02/10 for WATTrouter M SSR and WT 03/11 for WATTrouter M MAX.**

Current sensing module terminal description (the terminals are described directly on the motherboard of the M MAX module):

- GND – common wire (must always be connected)
- I_L1 – current measuring output L1 (must be always connected)
- I_L2 – current measuring output L2
- I_L3 – current measuring output L3

Connect the controller according to sample connection diagrams shown on figures below. If you observe basic principles, connections may be combined in various ways. You may connect any number of loads to any outputs; in certain cases you may remove certain phase cable from the measuring, etc.

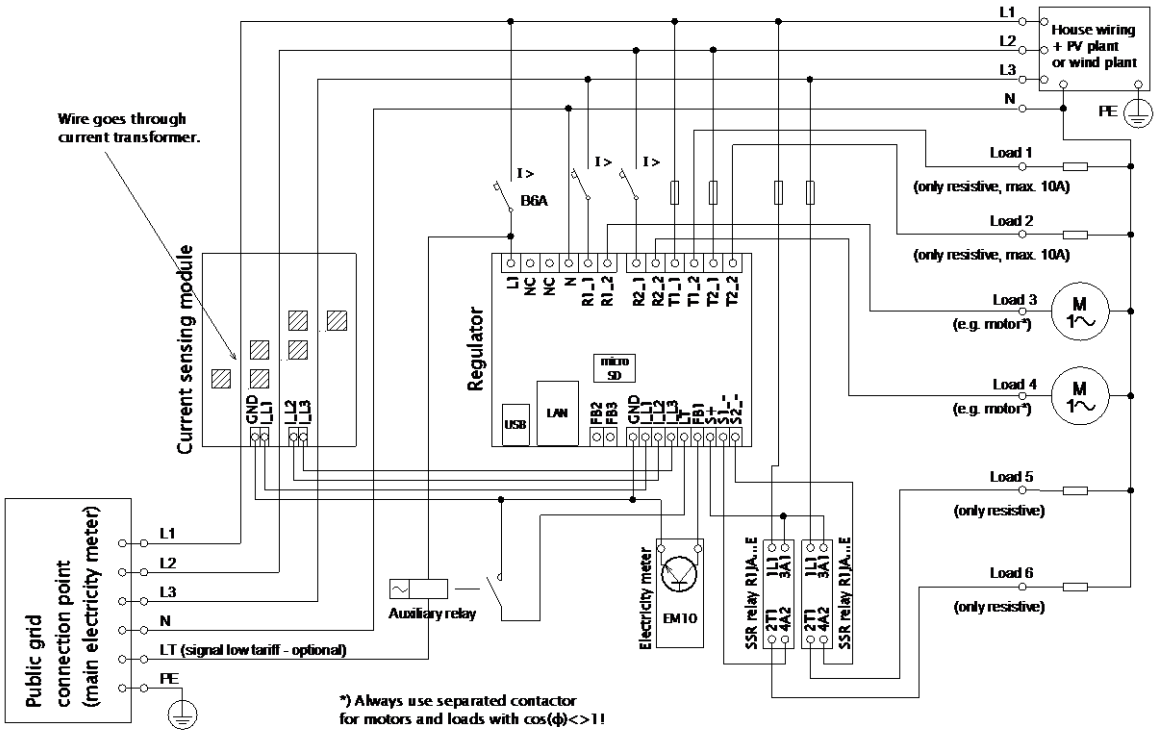


Figure 3: Three-phase connection with low tariff signal circuit for CombiWATT mode. Current sensing module is placed at the facility's supply cable coming from the distribution box where main energy meter is located. The connected loads use only real surpluses produced by PV-plant. All 6 loads are connected, 2 of them through the recommended SSR, line RJ1A - manufactured by Carlo Gavazzi. One energy meter type EM10 manufactured by Carlo Gavazzi with pulse output (open collector) is connected to input FB1. The electric meter can measure any flow of energy, for example net production of the PV-plant.

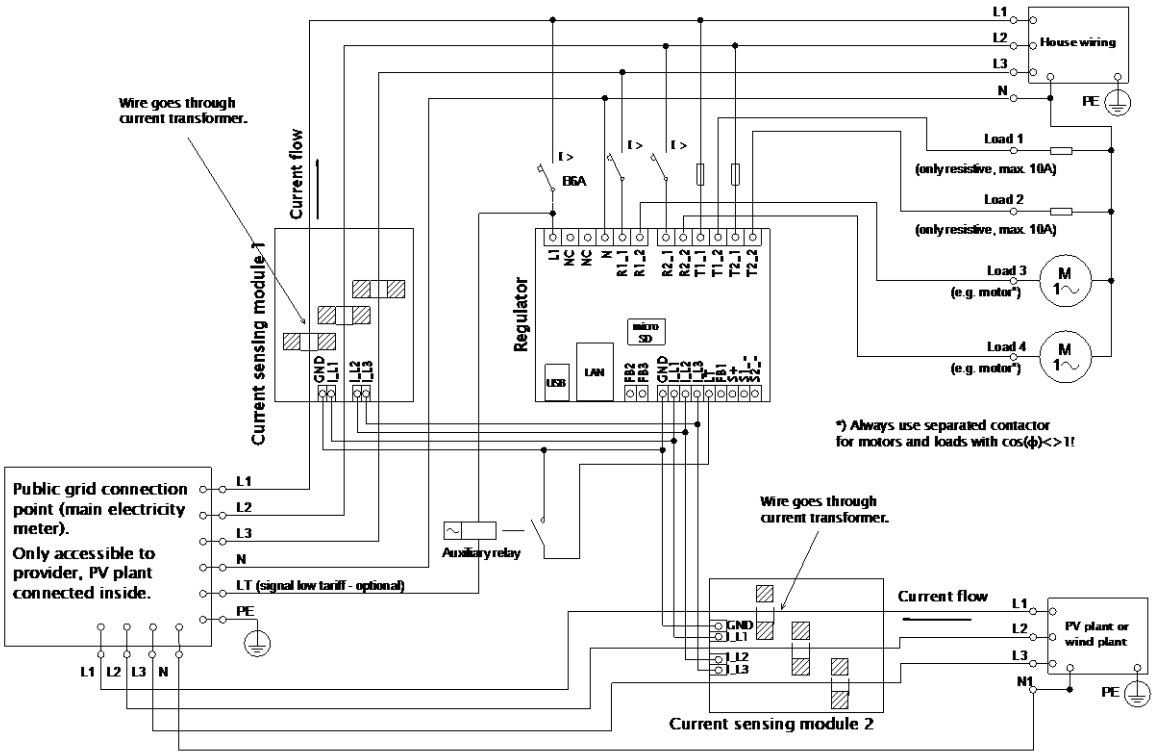


Figure 4: Three-phase connection with 2 current sensing modules and with low tariff signal circuit for CombiWATT mode. This connection is necessary if the PV-plant output is connected directly to a sealed distribution box, accessible only to the electricity provider. This may be the case for PV-plants made originally only for feed-in tariff, without self-consumption possibility. Current sensing module 1 is connected to the household wiring branch; current sensing module 2 is connected to PV-plant branch. The accuracy of measurement is reduced down to ± 10% in this connection because of the finite impedance of current transformer secondary winding. **Caution: Current flow through current sensing modules must always be subtracted in this connection (marked with arrows on the picture). The same phase sequence must be observed in the regulator and in both current sensing modules!**

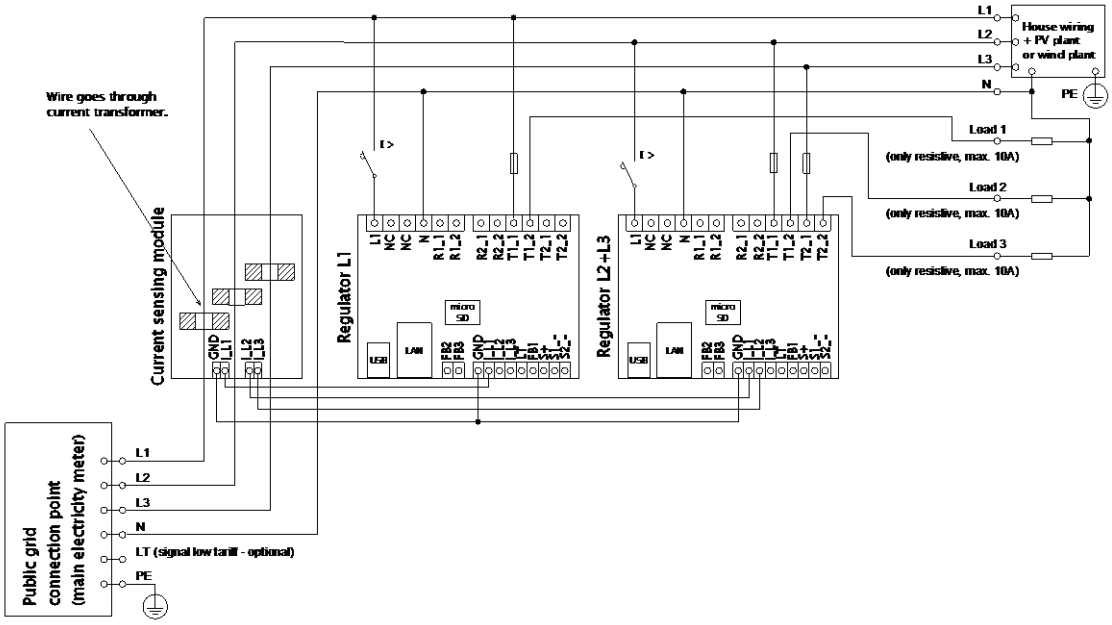


Figure 5: Three-phase connection of WATTrouter M with 2 regulators and without low tariff signal circuit (CombiWATT mode cannot be used). Connection of other models is similar. Using this connection you may extend the number of outputs up to 12. Current sensing module is placed at the facility's supply cable coming from the distribution box where main energy meter is located. Connected loads

use only the actual surpluses produced by PV-plant. To make things simple, only 3 resistive (heating) loads are connected, but you may use all 12 outputs. Similarly, you may also connect 3 regulators to 1 current sensing module. In such scenario, each regulator works on one phase and you will get 18 outputs.

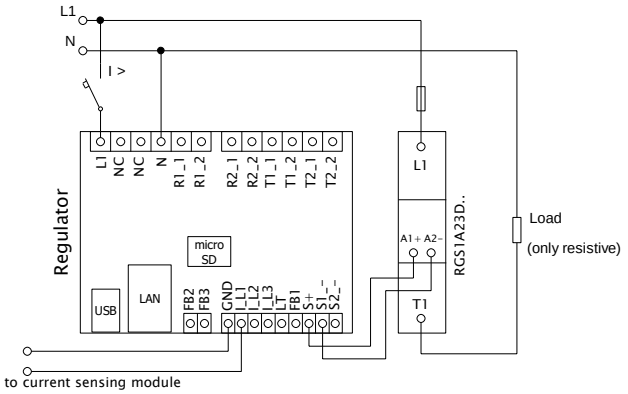


Figure 6: Solid state connection of the entire RGS1A line, manufactured by Carlo Gavazzi. Relays RGS1A are replacements for older types R1JA. You may also use other SSR with similar parameters (see chapter Technical specifications).

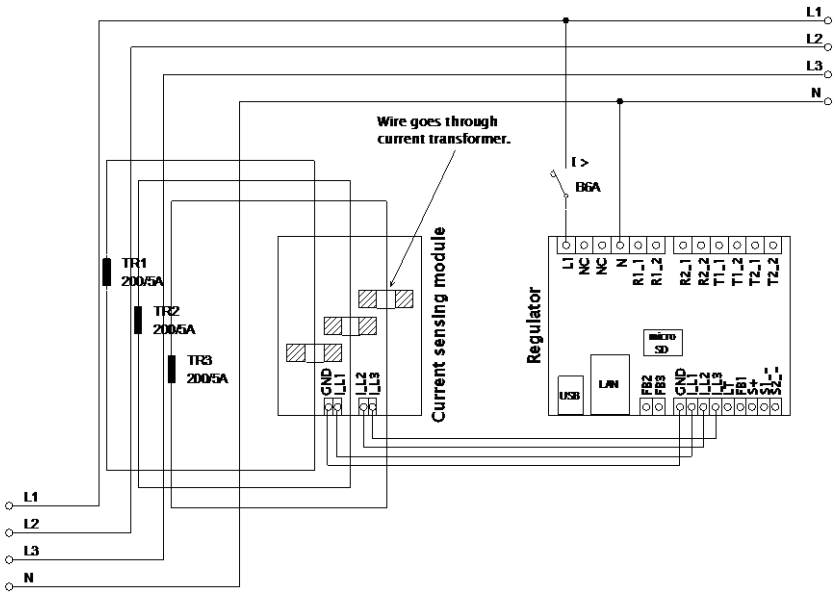


Figure 7: Increasing of current measurement range of the device for facilities where main circuit breaker is larger than 3x125A. Transformers 200/5A, or even 400/5A may be used, based on the main circuit breaker value. Secondary coil of current transformers is shorted through the current sensing module (the secondary circuit passes through measuring transformers in the current sensing module). Increasing of current measurement range may be done in both SSR and MAX models, but we recommend WATTrouter M SSR model due to higher resolution of A/D converter when current transformers with nominal secondary current of 5A are used. Additional increase of current measurement range may be done if you take the secondary circuit of the current transformer and make several turns through the measuring transformer in the current sensing module (for transformers 200/5A, the best option is to make 4 turns in order to reach optimum transfer ratio 200/20A). For this purpose we recommend using lines, which are not overrated for the nominal secondary current, just to be able to make more turns through the hole of measuring transformer. When connected through external current transformers, the conversion ratio must be set correctly in the control software - see the item Conversion ratio of external CT's in the main window of the WATTconfig M software.

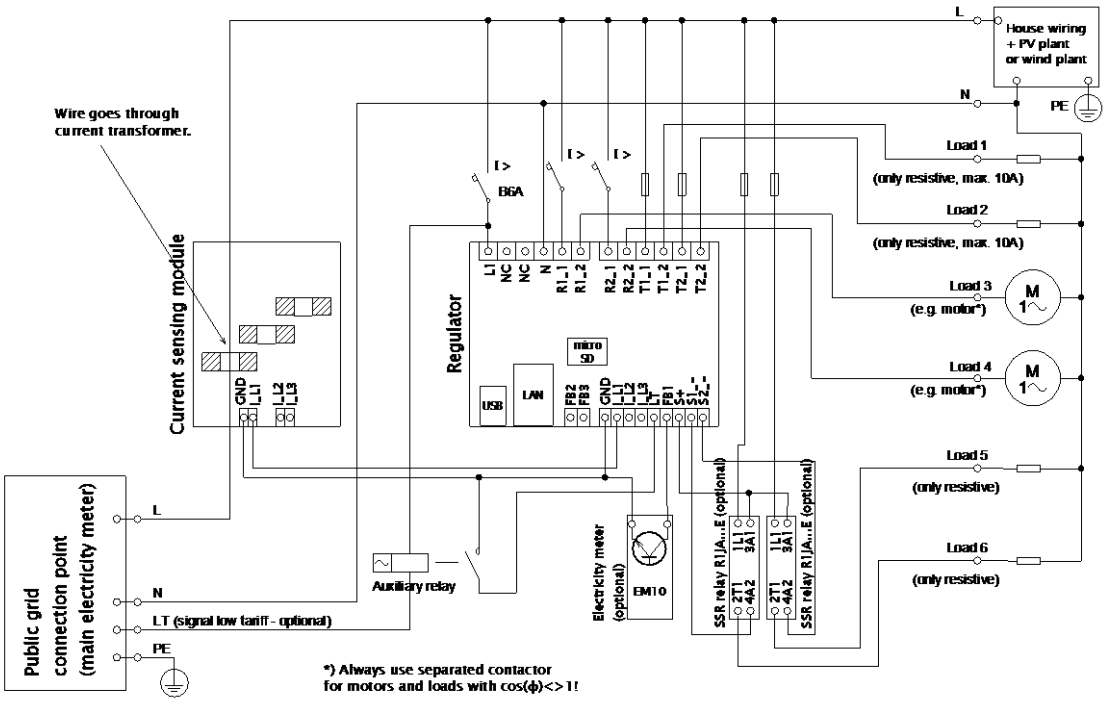


Figure 8: Single-phase connection with optional low tariff signal circuit for CombiWATT mode. Current sensing module is placed at the facility's supply cable coming from the distribution box where main energy meter is located. The connected loads use only real surpluses produced by PV-plant. All 6 loads are connected, 2 of them through the recommended SSR, line RJ1A - manufactured by Carlo Gavazzi (now superseded by RGS1A or RGC1A series). One optional energy meter type EM10 manufactured by Carlo Gavazzi with pulse output (open collector) is connected to input FB1. The electric meter can measure any flow of energy, for example net production of the PV-plant.

The controller may be connected only to 230VAC, 50 Hz public electric grids. Regulator must be protected with a circuit breaker - recommended rating is B6A - and connected loads must also be adequately protected! Installation may only be done when the facility's main circuit breaker is turned off!

Upon completion of the installation process make sure to check thoroughly the connection of the regulator and the current sensing module. Also check connection of all terminals at the bottom, where NO power grid voltage or voltage outside of tolerances specified in the chapter Technical specifications may be connected! NO other than resistive (heating) loads may be connected to built-in triacs or power SSRs! Regular relays CANNOT be connected to SSR outputs! It is prohibited to connect loads with higher than the maximum allowed nominal power! If you fail to observe these rules it is almost guaranteed that you will damage the regulator and lose your warranty!

For the correct operation of the controller, it is absolutely necessary to ensure proper phasing of the measured currents with the internal voltage detector. This can be done by selecting the appropriate phase in the Input Settings tab. It is strongly recommended to connect the controller so that the phase conductor fed to terminal L1 corresponds to the phase conductor wired through the measuring transformer corresponding to the IL1 input, which will allow the measurement to match the default settings of the controller (and

therefore the same as required for older models or older firmware versions). The IL2 and IL3 current inputs can be connected arbitrarily, the respective phases for these inputs must be set up correctly in the WATTconfig control software.

We strongly advise you to protect your loads connected to the built-in triacs or power SSRs with fuses suitable for protection of semiconductors, rather than regular circuit breakers. Please note that SSRs damaged by overcurrent or short-circuit most likely cannot be claimed under warranty. Make sure that solid state relays are correctly connected, as required by their user manual.

No electronic devices (various measuring and protective elements, such as sub-meters and residual current circuit breakers) may be installed between the SSRs and the appliance, since they may be damaged by impulse power! Always install these devices on the line between the fuse and the solid-state relay where constant power is available.

If your facility is located in an area with higher risk of overvoltage spikes due to atmospheric discharge (lightning), we strongly recommend fitting a suitable overvoltage/lightning protection between the distribution box with the main energy meter and the current sensing module!

The current sensing module supplied with the WATTrouter M SSR controller is fully compatible with the current sensing module supplied with older types, such as WATTrouter CWx, WATTrouter CWx SSR and vice versa. The current sensing module installed with these controllers can be used with the WATTrouter M controller (and vice versa)

If your computer is connected via USB cable ALWAYS USE ONLY ONE USB port on the regulator. If you fail to do so, you may damage the USB interface of the regulator.

If the regulator is constantly connected to PC via USB interface (mostly if long cable is used), we strongly recommend using an USB isolator!

Note: *It is allowed to connect only pure resistive loads to triacs and power SSRs. These loads cannot be fitted with own electronic control system nor with built-in motors (e.g. fans - see the note below). These loads may only have regular mechanically controlled thermostats and indication LEDs or neon lamps. Almost any regularly produced boilers, immersion heaters, infra radiators, heating floor pads, motor-free dryers (infra dryer), oil heaters, cartridge heaters in a solar tanks, etc. may be used.*

Note: *Each triac or SSR output is capable of providing power to heating loads with built-in fan for longer time (such as hair dryer, heat radiator). These loads are fitted with a built-in thermal protection, which, if synchronous triac or SSR control mode is used for that load, will disconnect the load for low power of triac/SSR output (in this scenario, the built-in fan's power is not sufficient to cool down the heating element of the load). Therefore, consider fitting these loads to triac/SSR outputs carefully.*

Note: *Heating loads connected via residual-current circuit breaker may be connected to triac/SSR outputs.*

Note: *Heating loads with nominal power up to 2 kW may be connected to relay outputs directly, without using external contactor.*

Carefully examine connection of the controller and then turn off all circuit breakers and deactivate fuse switches for connected loads. Then turn on the main circuit breaker and the regulator circuit breaker (L1 power supply). The LED PWR lights up (power on indication). If the light is off, or if it does not shine permanently, or if the LED ERR starts to flash (error status), proceed according to instructions specified in the Troubleshooting chapter. In default status no output is active and therefore, no load will be turned on.

Now the controller is fitted and ready for configuration.

DEVICE CONFIGURATION

You will need notebook or regular PC (placed closely enough to the regulator) with USB interface (hereinafter referred to as a computer only). The controller is configured using the WATTconfig M control software. The installation package for this software is available on manufacturer's web pages. Before installing the WATTconfig M control software you need to install the driver for USB interface.

In order to connect to the USB interface using the USB port accessible from the top of the device, turn off the regulator circuit breaker and remove the semi-transparent regulator cover. If you want to connect using the USB port accessible from the bottom side, it is necessary - due to safety reasons - to turn off the entire distribution box before manipulation.

Tip: *After you configure Ethernet network connection you may perform all settings including firmware update over the Ethernet interface. You do not need to use the USB interface at all, provided that the parameters of the connected LAN are the same as the default controller parameters (see below), and if there is no conflict between IP addresses or conflict between physical MAC addresses.*

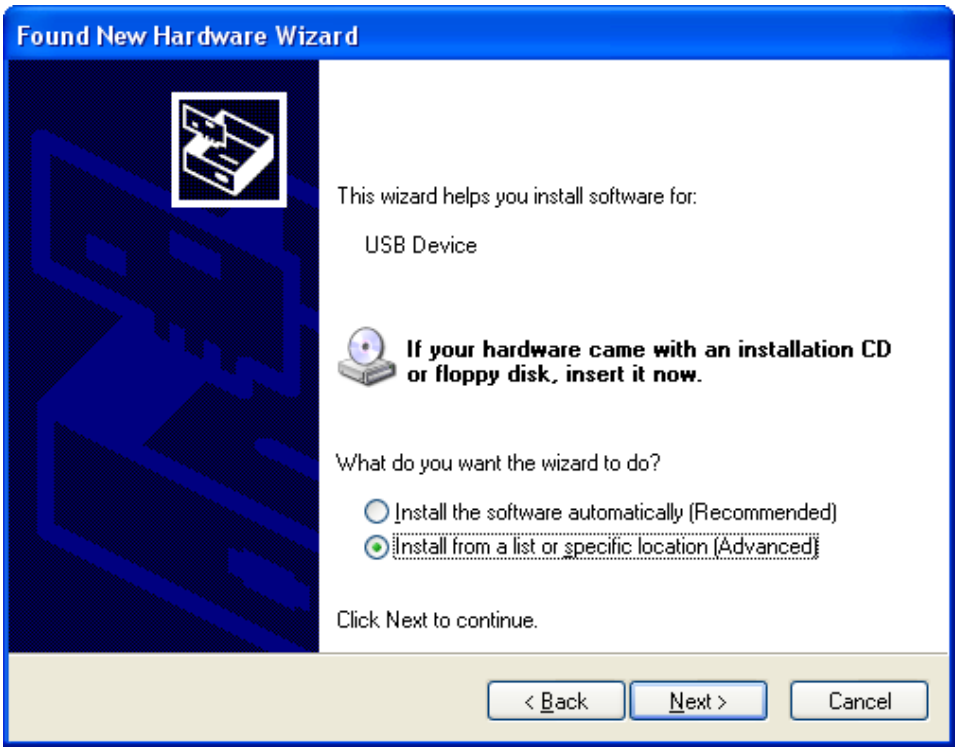
If you cannot continue with the settings (due to any reasons), proceed according to instructions specified in the Troubleshooting chapter.

USB DRIVER INSTALLATION

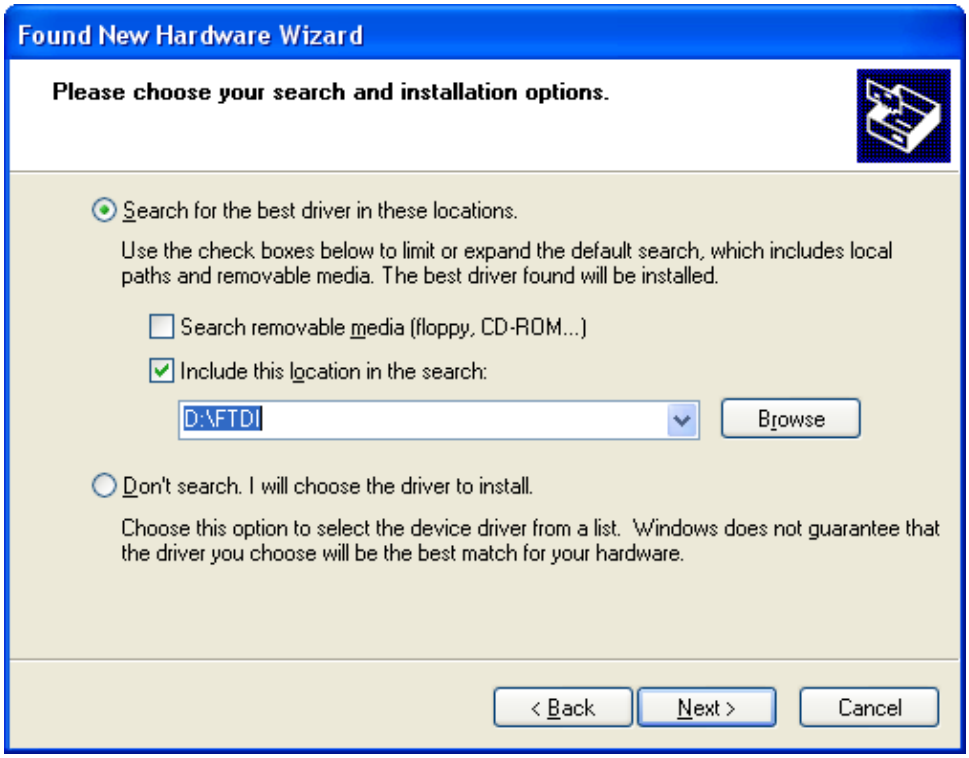
The installation procedure is described for Windows XP, English locale. The procedure is similar for newer systems, or it is much simpler. Newer operating systems (Windows, Linux, MAC OS) usually have these drivers pre-installed, hence you can skip following sections.

1. Insert the attached USB cable to the USB connector of the regulator and then to the computer.
2. Turn on the controller. The green LED PWR must light up (power on indication). Also the yellow LED USB light will or should flash briefly (communication process indication) as the USB device will start to register in your computer.
3. After a moment, following window must appear confirming that a new device was found:

4. Select: No, not this time. In the following window select: Install from a list or specific location (Advanced).



5. Select the path to the driver file:



6. The driver has been installed successfully, if this window appears:

7. During the installation there might appear a warning about an invalid digital driver signature. Just ignore it. The device is registered in your system device manager as USB serial converter (menu Universal Serial Bus Controllers)

8. You must perform the same installation process for the second USB serial port device.

WATTCONFIG M CONTROL SOFTWARE INSTALLATION

1. Turn on the PC.
2. Run WATTconfig_M_Setup_x86_64.exe.
3. Follow the on-screen instructions.

SETTING UP MAIN FUNCTION

1. Click on START button in your PC and run the WATTconfig M control software. The system will display the main software window.
2. Make sure that the controller is turned on and connected to your computer. Make sure that USB interface driver is correctly installed.
3. Select USB interface connection mode (field next to the "Connect" button).
4. Select correct port for connection. This can be done in the dropdown menu Port in USB/COM driver configuration window, which will show up by clicking on button Configure connection.

Note: *Unlike WATTrouter CWx devices or older firmware versions the WATTrouter M uses a serial port connection (COMx). This port is always virtual port because the controller is connected via USB. Once more ports are displayed, it is necessary to check in Windows device manager, which port is assigned to USB Serial Port.*

5. Click the "Connect" button. The controller should be now connected and the connection indicator (a stripe) should be displayed in green. If it is not, and the system displays an error message, wait until the USB driver is ready for use in your PC, or inspect the settings in the USB driver configuration window. You may display the window by pressing the Configure button.
6. After establishing successful communication, you should be able to see the current measured values (power outputs on individual phases, etc.). No outputs should be active ("unused" priority). Also no time schedules should be used.
7. Now you can configure measuring inputs. This can be done on the "Input settings" tab. First, you set the phase sequence and then the direction of current flows through the current sensing module.
    a. **Setting up phase sequence:** Turn off the PV-plant and turn on a resistive load on each phase which will be involved in the measuring process. The system will display measured active power on each individual phase. For now, you may ignore the signs of the measured power values. Now, in the Phase field select corresponding phase, based on the actual status recognized by the controller, and press Write button. The configuration will be saved in the controller. If the output values measured on individual phases differ too much from the reality, change the phase for given input and again press the Write button. Repeat these steps for all 3 inputs IL1, IL2 and IL3 until all measured powers are displayed correctly.
    b. **Setting up the direction of current flows through the current sensing module:** As specified in the previous steps, leave loads on measured phases switched on. When the PV-plant is turned off, **all measured power output values must be smaller than 0 or equal to 0.** If any of the measured power outputs is positive it means that the phase wire is passing through the current sensing module in a reverse direction. Use the Current orientation field for the relevant phase, select the reversed option and press the Write button. The configuration will be saved in the controller. Now, all measured power outputs must be <= 0. Turn the PV-plant on and turn off all loads. **Now, measured outputs must be positive (>=0).** If they are not, or if the measured values do not correspond with nominal power ratings of the connected loads, or if they do not correspond with the power output of the PV-plant, you have either still connected another loads (which you don‘t know about, such as various loads in stand-by

mode, etc.), or the phase sequence in voltage or in current inputs does not match, or you may have a defect in household wiring. **In any case, make sure to inspect the entire electric wiring.**

c. You can verify the correctness of measurement input configuration by using the chart "**Input checking oscilloscope**". This chart shows measured current waveforms in selected phase, values are given in units of the built-in A/D-converter (digits), these are not normalized to amps due to performance. This feature should only aid the fitter when configuring the measuring inputs. **Always verify with a resistive (heat) load only, so that the phase shift between voltage and current is zero ($cos(\varphi) = 1$)! Moreover, in order to verify the measuring inputs the amplitude of current half-wave should always be greater than 1000 digits** (to be sure about the correctness of the settings)**.**
***Note**: During normal operation there may be shown even "exotic" waveforms. Be sure this is the real current flowing through the phase wire, a superposition of currents flowing through the connected appliances which are not always sinusoidal or their power factor varies from one.*

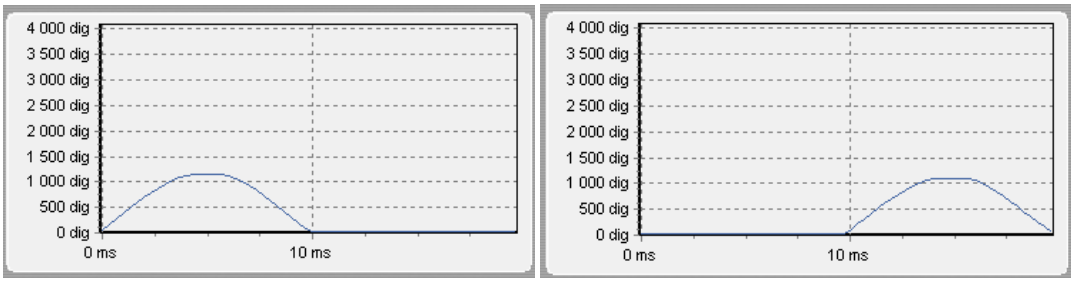


Figure9: Input is fitted correctly - sine wave of the current flowing through a resistive (heat) load is in phase with the voltage. WATTconfig shows negative values on selected phase (consumption). Left image appears when there is normal (default) current flow direction, right image appears for opposite direction. Note: The PV-inverter throughput appears exactly as the opposite, because the current is anti-phased with the voltage. If the inverter performs power factor compensation you can observe corresponding phase shifts.

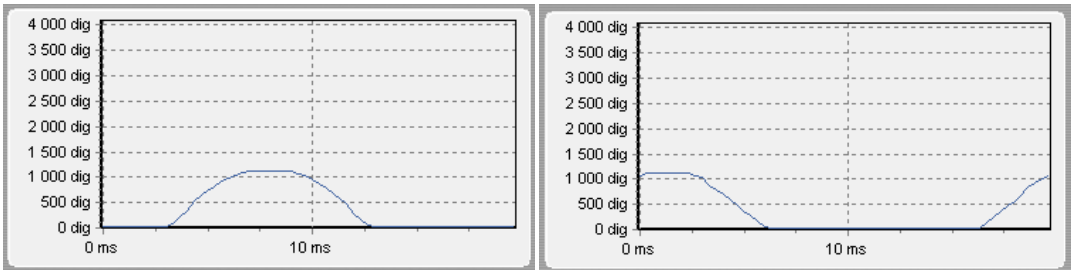


Figure 10: Input is fitted incorrectly - sine wave of the current flowing through a resistive (heat) load is not in phase with the voltage and either precedes (image left) or lags behind (image right) the voltage by 1/3 of mains half-wave. Measuring inputs are fitted incorrectly and you need to select correct option in the Phase field for respective input.

8. After a successful setup of measuring inputs you may begin to test outputs. This can be done on the "Output settings" tab. Each connected load must be tested separately. Turn on circuit breaker or activate fuse switch for the first output, and press the TEST button for the corresponding output. The load should switch on. When you switch on triac output, the built-in fan in the regulator is automatically turned on. Further, when the load is switched on, the active power drawn by connected load must be detected by the current sensing module on the relevant phase.

9. After you have successfully tested all outputs, you may begin to configure the control mode in the Control settings field. This can be done on the "Other settings" tab. Set this mode either to "sum of all phases" or to "each phase independently", based on the configuration of your 4-quadrant energy meter. If you are not sure how your energy meter is configured, please contact your electricity

provider or use the "each phase independently"-mode, which works for any configuration of the energy meter.

In order to use the "each phase independently"-mode, it is necessary to select correct phase for each output, i.e. phase where the corresponding load is really connected. Controller will then try to maintain zero energy flow in each phase ("phase zero"). You may check correct phase assignment again through the TEST button. Within a short time after pressing the button the active power drawn by connected load must be detected by the current sensing module on relevant phase.

As far as your energy meter is configured to evaluate sum of powers in all phases, you may use the mode "sum of all phases". Here the controller will try to maintain virtual zero energy flow. This means that for output switching it takes the sum of measured powers from all 3 phases ("virtual zero"). Here you may try experimenting with both methods, but it is recommended to use "sum of all phases"-mode, because it is more effective for the user.

10. After a correct setup of the control mode, you may start to assign priorities and power ratings for individual outputs. This can be done on the "Output settings" tab. Select priorities of individual loads. The switching process based on priorities may be described as follows:

    By default (during night), all loads are turned off. If PV-plant production (available surplus energy) is determined in the morning, the output with the first (highest) priority is switched on. The switching time is different for proportional outputs (their function equals to proportional or PWM) and relay outputs. Proportional outputs are switched on almost immediately (this is the proportional switching), but relay outputs are switched on only if the available surplus energy exceeds the value specified in the Connected power field (there is also a different solution available – see the "Prepend before triacs/SSRs" function). When the load is switched on (for proportional output it means the load is switched to the value specified in the Maximum power field), the system waits until the power output of PV-plant increases again (sunrise). If additional available surplus energy is determined when the load with first priority is switched on, then load with second priority is switched on in the same mode. The same applies to all outputs. If the available surplus energy decreases, or if another load in the household is switched on, active outputs are disconnected according to preset priorities but in reverse order (first, the load with the lowest priority gets disconnected).

    The value in the "Connected power" field should be equal to the power rating of the connected load. For relay output it must be higher or equal to the power rating of the load, otherwise the controller will not operate correctly, and the load will be repeatedly turned on and off. For proportional output this value only configures the control dynamics, but it should be also equal to the actual power rating of the load.

    The fields On-delay time and Off-delay time for relay outputs specify the time delay to switch the relay on or off after a condition has been detected to do so. This feature is necessary for loads which cannot be switched on frequently.

    Set outputs according to the connected loads and based on your priorities and then press the Write button. The configuration will be saved in the controller. Now the main function of the controller should be configured.

11. Test the main function of the controller, or possibly, modify priorities for outputs and power settings of connected loads.

SETTING UP COMBIWATT MODE

After you have successfully tested the main function, you may start to configure CombiWATT mode, provided a low tariff signal is connected to the controller (it may be used even if single tariff rate is present – see notes

below). This can be done on the "Output settings" tab. CombiWATT mode provides constant daily energy supply to the connected loads. This mode is indispensable if you need to heat up water but also e. g. if you use a swimming pool filtering system during cloudy days or when your PV-plant is temporarily out of order. In CombiWATT mode, energy is taken both from PV-plant and from public grid.

Determine the optimal value of energy in kWh for the connected load (for example for a boiler or immersion heater), which you plan to supply the load with every day. For example, for a boiler it is suitable to determine the value of electric energy based on the average consumption of hot water. Usually, electric energy necessary to increase the temperature of hot water by 40°C equals to: $E[kWh] = \frac{c_V * V[l] * \Delta T[K]}{3600000}$. If you enter it into the formula you will get: $E[kWh] = 0.0464 * V[l]$. For a 180 liter boiler it will be 8.36 kWh. We recommend to increase this value by the daily heat loss of the boiler and also to modify (reduce) the value based on the actual average consumption of hot water.

Note: *If you are heating water for example, the controller does not "know" how hot the water in the boiler is and therefore, the assumed values of the supplied electric energy may be higher than the actual delivered energy (the boiler thermostat may shut it off at any time). If you want to count only real supplied energy to the boiler then connect additional measurement for it according to Figure 8.*

Mark the CombiWATT field for the relevant output (output must be activated, which means that the output must be assigned with the relevant priority), enter the established value of the daily electric energy in kWh and press the Write button. The configuration will be saved in the controller.

The CombiWATT mode is activated only if ALL the following conditions are met:

a. The output is activated (priority has been assigned to the output - that means the output is not in the "not used" status).

b. PV-plant does not produce electric power (active powers at all measured phases are <= (less or equal to the) CombiWATT production limit field).

c. During the day, PV-plant did not supply the load with the required amount of energy, that is, the field "Supplied energy" is lower than the value specified in the "CombiWATT [kWh]" field for the relevant output.

d. Low tariff signal has been detected (the info LED "low tariff" is red). Energy from public grid is always consumed in CombiWATT only if low tariff is present. See note below to learn how to configure this mode if you don't have double tariff rate.

e. The "Time to activate CombiWATT"-field shows zero.

The CombiWATT mode is deactivated if some of the following conditions will apply:

a. The value in the field "Supplied energy" reached the "CombiWATT [kWh]" value for the relevant output.

b. PV production has been detected at some of the measured phases (active power at some measured phase is > (greater than the) CombiWATT production limit field).

c. The low tariff signal is turned off.

Reset of energy counters (that is reset of values in the fields "Supplied energy")

a. At sunrise. Counters are reset to zero at sunrise time, which is automatically calculated by the controller.

b. At fixed time. Counters are reset to zero at a preset time.

More information about counter reset processing is available in the chapter Description of WATTconfig M items.

Note: *For boilers/immersion heaters or any other hot water tanks the CombiWATT mode "does not care" during what time of the day the water is heated and used. The CombiWATT function only supplies the preset minimum daily power to the boiler and thus making sure that there is enough hot water when the recommended configuration is used. In cases when even under the recommended configuration hot water is not available in required amount, we recommend to gradually increase the daily energy limit ("CombiWATT [kWh]") for example, by 1 kWh, in order to make sure that hot water is available and at the same time that not too much energy is consumed from public grid. This is recommended mostly for households where consumption of hot water is high at the evening. Here it may come to the situation where water is sufficiently heated during the present day by the PV-plant, but the next day the plant is not capable of providing the necessary amount of energy (cloudy weather). The CombiWATT mode may also be aided by enforcing the relevant output with a time schedule. Based on user preferences, time schedules may even completely replace the CombiWATT mode. For more information see chapter Setting up time schedules.*

If you do not have low tariff signal available (either you don't have double tariff rate or the signal cannot be utilized) but you still want to use the CombiWATT mode, connect the GND terminal to the LT terminal. In such scenario, the low tariff signal will be active at all times and the CombiWATT mode will be activated after production of PV-plant comes to an end (after sundown).

SETTING UP TIME SCHEDULES

Up to 4 independent time intervals may be set for each individual output. During these time intervals the relevant output may be forced to be switched on, or the switching process may be prohibited (restricted). The enforcing/restricting process may be further conditioned by the presence of the low tariff signal and / or by the status of daily energy counters for the relevant output ("Supplied energy"-fields).

The actual configuration of time schedules is done on the "Time schedules" tab. For more set up information, see the chapter Description of WATTconfig M items, Time schedules tab.

FB INPUT CONFIGURATION

The controller has 3 FB inputs to connect external meters with impulse output S0, which meet the parameters specified in the technical specification and their output signal provides information about the measured electrical energy.

FB inputs are not required to be used. They play an auxiliary role and provide additional information to the controller. For more information, see chapter Description of WATTconfig M items, Input settings tab.

S-CONNECT PROTOCOL SETTINGS

The device supports the S-Connect device sharing protocol since firmware version 4.0. The following paragraphs describe the basic principles of the protocol. For more detailed information on setting up this communication, see chapter S-Connect tab.

Note: *The S-Connect protocol is not public, so only the principles of the protocol are described, not the protocol itself.*

DESCRIPTION OF THE S-CONNECT PROTOCOL

The S-Connect protocol allows you to share devices via any physical communication layer. The SOLAR controls s.r.o. controllers currently support device sharing via 2 physical layers (if available):

a) Over the existing network architecture, ie Ethernet or WIFI. This is only possible if the device is connected to an Ethernet network. Therefore, it cannot be used for WATTrouter ECO.
b) Over the wireless architecture. This is only possible if a SC-Gateway or SC-Router module is inserted in the device. Therefore, it cannot be used for WATTrouter M and Heating Control.

Attention: *In the case of ad a) communication is provided by UDP and TCP protocols. Regarding the requirements for the UDP protocol, see chapter Pairing of stations to the access point. Port 50160 is used for TCP communication. For communication to work, this port must not be blocked on the network. In order for the communication to work without problems, the local network must not be excessively overloaded with other communication, eg by downloading large files, videos, etc.*

Attention: *Communication in case of ad a) is not secured. It may take place only in the local network or in a network that is sufficiently secured against unauthorized access!*

Attention: *Communication in case of ad b) only transmits information about the status of the outputs, due to limited data throughput. Therefore, the states of the inputs (binary inputs, temperatures, powers) and the states of the memory cells are not transmitted!*

The term device means hardware device that a controller supports and that holds certain status information, or measure certain physical quantities.

In the current version, the S-Connect protocol allows you to transfer information from the following devices:

a) Binary input. Status information 0 (off) or 1 (on).
b) Temperature. The temperature data is transmitted with a resolution of 0.1 ° C.
c) Performance. The instantaneous active power data with a resolution of 1W is transmitted. In addition, some auxiliary data is transmitted, such as the daily and total energy measured by the respective device.
d) Output. The output excitation data in the range of 0 to 1000 is transmitted, where 0 means the output is switched off and 1000 means the output is fully switched on. In addition, some auxiliary data is transmitted, such as the output hardware type, the assigned output function, or the possible output restriction.
e) Memory. The memory cell status is transferred. The memory cell can hold any status information described in the previous points.

The S-Connect protocol works based on the access point's communication with remote stations, similar to how computers connect to a WIFI access point. The access point is always 1 device that the user chooses.

The access point controls the communication with remote stations and their pairing. There cannot be 2 access points in one S-Connect network, but there can be several S-Connect networks, ie several access points, within a local Ethernet network.

Example 1: *A typical example of an access point is the Wattrouter Mx controller, which provides power measurement on phases L1 to L3 and also switches the connected appliances (loads) according to the photovoltaic excess energy. Another Wattrouter Mx controller is then connected to it as a remote station, which only serves as an output expansion module. The S-Connect protocol is transmitted via the Ethernet network.*

Example 2: *Another example of an access point is the Heating Control controller, which controls the building heating. The Wattrouter Mx controller then connects to it as a remote station and shares information about the low tariff, temperature data, or excitation of the output needed to optimize the operation of a heat pump according to the photovoltaics excess energy (heat pump that is connected to Heating Control). The S-Connect protocol is transmitted via the Ethernet network.*

Example 3: *Another example of an access point is again the Wattrouter Mx controller, which provides power measurement on phases L1-L3 and switches the connected appliances and at the same time it has the SC-*

Gateway module installed. A wireless socket is then connected to it as a remote station. The S-Connect protocol is transmitted over the wireless network and replaces the older protocol used in previous firmware versions for this wireless communication.

PAIRING OF STATIONS TO THE ACCESS POINT

If the station is not connected to an access point, it sends a pairing request. This request is implemented differently depending on the physical layer used:

a) Ethernet connection: The station sends a request periodically every 10 s. The station sends a UDP broadcast, which the access point receives if it is connected to the same local network. This UDP broadcast uses IP 255.255.255.255 and port 50161. For the request to arrive, this port must not be blocked on the network and the UDP broadcast function must not be blocked either.

b) Wireless connection: The station registers in the wireless network managed by the SC-Gateway module and the request is then sent from the SC-Gateway module to the unit to which the module is connected and which always acts as an access point. The wireless device must be within range of the SC-Gateway for the request to arrive. If the request does not arrive and even after a longer period of time (1 minute or more) and the information below is not displayed, then the station is probably out of range. Then proceed according to chapter Troubleshooting. The request arrives only once, to show the request again station restart is needed (switch it off and on again).

The station pairing request is then displayed to the user in the access point control interface, and the user must decide whether or not to allow the station to pair with the access point.

The pairing request then looks like this:

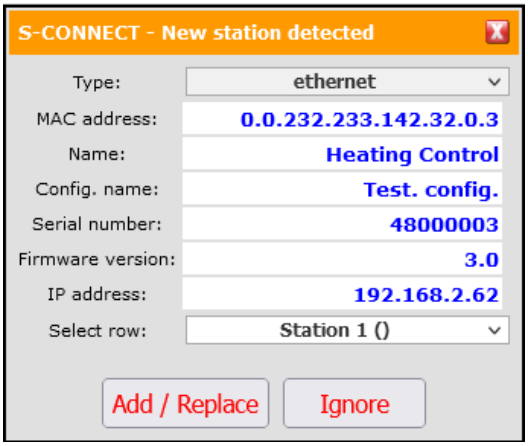


Figure 11: A dialog box showing the new station pairing request.

The user can then acknowledge the request and add the station to the specified row of the station table or reject the request, then add the station to the internal list of ignored stations so that the next time the access point ignores its repeated request.

To confirm the pairing or reject the station, it is necessary to write the configuration to the controller.

As soon as a station is added to the station table of the access point, the access point starts communicating with that station immediately.

This is also reflected in the station control interface, where the given access point appears in the first row of the station table.

This completes the pairing.

Note: *In the case of ad a), if the connection between the station and the access point is interrupted, the station will start transmitting pairing requests again periodically. This is because the connection may have been lost due to a change in the station's IP address if, for example, the station uses DHCP for IP assignment. The pairing request is therefore also used to communicate the current valid IP address of the station to the access point.*

Note: *In case of ad a), if there are more access points in one local network, ie more independent S-Connect networks, the pairing request will be displayed in all access points. The user can try to pair the station with multiple access points, but communication can only take place with only one access point at a time, depending on where the first pairing took place. If a station has a specific access point assigned to it, it will refuse to communicate with another access point. Pairings with other access points will be invalid. If a pairing request is displayed at an access point where you do not want to pair the station, the request must be rejected, and the access point will continue to ignore that station.*

CANCEL STATION PAIRING

If the pairing needs to be canceled, this is done in the control interface of the access point and possibly the station.

For an access point, the appropriate command (Clear entry button) removes the stations from the access point station table. This will also delete the station from the access point, end the communication and delete all mapped devices from the device mapping table.

The access point remains assigned in the station control interface. It can either be deleted in the same way or left in case we want to re-pair this station with the same access point later.

DEVICE PAIRING

After pairing the station with the access point, in order to share the device, it is necessary to assign the source (physical) devices of the remote unit to the destination (logic) device of the local unit. This assignment is called mapping and can be done both in the user interface of the access point and at the station.

Source devices can be selected from the device map, which is transmitted by the respective remote unit. The destination devices can be selected from the available logic devices of the local unit.

The mapping is performed in a device mapping table, where each row of the table maps one source device to one destination device. The principle of mapping is best illustrated by the following figure:

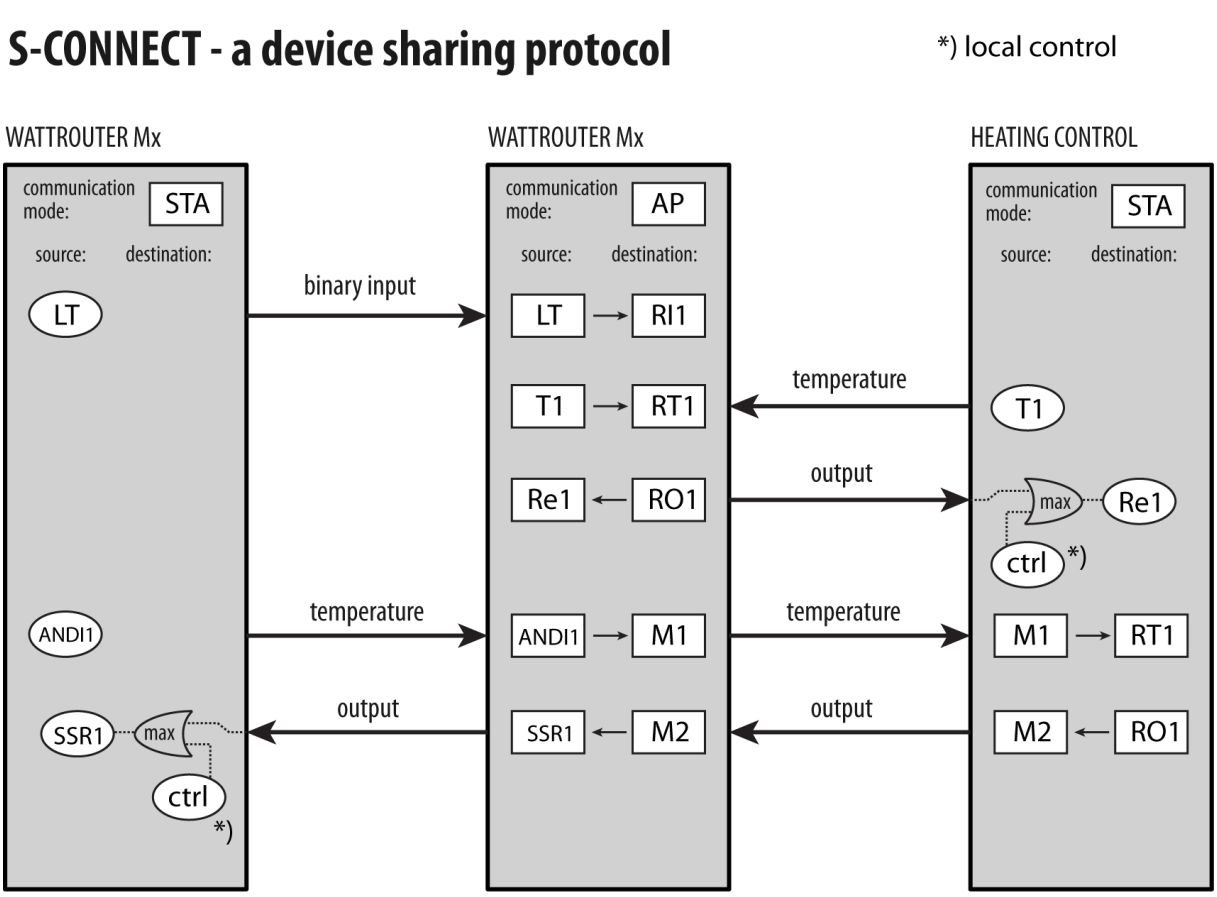


Figure 12: Device sharing in the S-Connect protocol. The communication mode of the given device is marked in the upper part, the relevant mappings of source devices to destination devices are marked in the rectangular fields below. The oval fields indicate the source physical devices available in the device. To excite (switch) the physical outputs, the maximum excitation of the local control of the given device and the excitation received from the remote station are always used. The figure also shows the sharing of devices between individual stations using the memory cells of the access point.

Only after the mapping is completed, logic (remote) devices can be used in the local unit. These can be selected in various places in the control interface of the local unit as well as their physical devices.

PROTOCOL LIMITATIONS IN THE WATTROUTER M

The S-Connect protocol has the following limitations in the device:

- The Ethernet version of the protocol only works in station mode, it is not possible to create an access point.
- The Ethernet version of the protocol also works only in passive mode, it is not possible to create device mappings.
- The wireless version of the protocol is not available because the SC-Gateway module cannot be inserted in the controller.

FINISHING THE CONFIGURATION

After setting up the controller according to previous chapters the controller is fully configured. You may save the preset configuration by pressing the Save button or you may load it at any time by pressing the Open button. This way you may create several different configurations and monitor them for some time and determine which one provides better utilization of energy self-consumption in your facility or household.

After you have completed the settings using the top USB port turn off the regulator using the circuit breaker, remove the USB cable and put on the semi-transparent regulator cover.

After you have completed the settings using the side USB port then in case of manipulating within the distribution box turn off entire distribution box, remove the USB cable and turn on the distribution box again.

Tip: *In order to maintain continuous monitoring the controller can be kept connected either via USB or Ethernet. If you want to use permanent USB connection, then it is recommended using a suitable USB isolator or USB connection extender via Ethernet. To use permanent Ethernet connection you may connect the network cable directly to your network router or switch.*

DESCRIPTION OF WATTCONFIG M ITEMS

This chapter contains a list of all items available in the WATTconfig M control software and explains their meaning. Or you may use the controller web interface, where the items have identical names and meanings.

MAIN WINDOW

The main window displays all basic measured values and statuses. The controller can be configured using configuration tabs.

Figure 13: Main window of WATTconfig M software.

MEASURED PARAMETERS AND STATUSES

Measured values:

- Power on ph. Lx - the actual value of the active power measured on the relevant phase wire. Positive value means production (PV-plant supplies power to the grid); negative value means that power is being drawn from the grid.
- Power sum L1+L2+L3 – sum of active power outputs in all three phases.
- Controller temperature - temperature inside of the regulator. It is used for thermal protection of the regulator.

Error and info status (gray in inactive status, red in active status):

- Missing voltage L1 – failure of the synchronization circuit that detects the voltage at L1 terminal. This is a hardware failure of the regulator and it must be replaced or repaired. This fault blocks the power measurement and the active functions of the controller (output switching).
- Temperature sensor(s) – this is a hardware error of the regulator and the regulator must be repaired or replaced. This fault blocks the active functions of the controller (output switching).
- Max. temperature exceeded – the maximum allowed regulator temperature was exceeded. Improve cooling conditions, decrease the Maximum power for active triac outputs, or increase the value in the field "Max. controller temperature" on the "Other settings" tab. This fault blocks the active functions of the controller (output switching).
- DC source overload - Voltage level of the internal DC source drops below +6,5V relative to GND. This malfunction can occur when the internal DC voltage source is heavily loaded. The firmware since version 3.0 checks this and eventually signals this failure. This malfunction lasts for the duration of the cause and for a further 60s afterwards. Typically, this failure occurs when all 6 internal outputs are used or there is overload on the S+ terminal (there can be for example a malfunction of SSR control circuit). Please check that the S+ terminal is not overloaded. This fault blocks the active functions of the controller (output switching).
- Low tariff – if the low tariff signal is detected the red light comes on, otherwise it is grayed.
- Summer time - informs the user that the summer time mode is active. Summer time starts at 2:00 CET, on the last Sunday in March and ends at 3:00 CEST, on the last Sunday in October. If the option "Use summer time" is not marked on the "Other settings" tab, the indicator remains inactive.
- CombiWATT is active – informs the user that CombiWATT mode is active. This indicator is active if the condition necessary to run CombiWATT is valid, if the low tariff is active and if the CombiWATT function has been configured for some output.
- Output test is active – informs the user about a status when some of the outputs have been activated by the TEST button. Output tests done via LAN interface are protected from unauthorized access or intervention.

In case of an error that blocks active functions of the controller, all outputs turn off and any control functions are stalled.

Output statuses:

- Load power - the power drawn by the load connected to the relevant output. It is either:
    - Estimated power based on the output settings and may not correspond with the actual power output of the load, or:

- Measured power using an external power meter connected to the corresponding FB input. If the output is switched on by the controller, but the assigned FB input does not measure any power (for example, the appliance is disconnected by its internal thermostat), the item flashes.

- Supplied energy - daily energy counters counting energy already supplied to the relevant output. It is either:
  - Estimated energy supplied to the load, which is based on the output settings and may not correspond with the actual amount of the energy supplied to the load, or:
  - Measured energy using an external power meter connected to the corresponding FB input.

  These energy counters inform CombiWATT mode or the corresponding time schedule about the energy already delivered to the load and at the same time, they also inform the user about the amount of delivered energy. Counters are reset to zero based on the configuration of "CombiWATT - Energy counter reset"-field in the Other settings tab.

  Note: *In case ad a) the WATTrouter device does not "know" the status of the load and therefore, counters may also show much higher energy values than those actually delivered to the load (for example, if the boiler is heated up during the day and turned off by the thermostat).*

- Status output indicators - inform the user about the reason for switching, or possibly about the reason for output restriction. There are following indicators:

  a) Blue - it is displayed only if the output is switched on due to basic control process according to the available surplus energy from PV-plant. This indicator also signals possible off-delay time for the relay output (after being enforced by time schedule or CombiWATT mode).
  b) Violet - it is displayed only if the output is switched on by the CombiWATT mode.
  c) Green - it is displayed only if switching is enforced by time schedule.
  d) Red - it is displayed if the output is restricted by time schedule, or by a remote device via the S-Connect protocol.
  e) Green - (since firmware version 4.0) is displayed when the output is forced to be switched on by a remote device via the S-Connect protocol, or when the output is forced to be switched on during duplication from another relay output.

FB input status:

- Power- displays electric power which is registered by the relevant impulse input. The value is calculated using the following formula: $P[kW] = \frac{3600}{t_p[s].Imp_{kWh}}$

  Where:

  P – final power (this field)

  t_p – period of impulses

  Imp_{kWh} – number of impulses per kWh (see FB input settings)

  The measurement dynamics depends on the impulse frequency. It may be very small for small measured powers. The maximum measurable period of impulses is set to 15 seconds (at 1000 impulses per kWh it corresponds to a power value of 0.24 kW). If the measured power is lower, zero is displayed.

- Energy – displays electric energy counted by the relevant impulse input. The value is calculated using the following formula:

$$E[kWh] = E_p[kWh] + \frac{Imp}{Imp_{kWh}}$$

Where:

E – final energy (this field)

E_p – initial energy at the input (see FB input settings)

Imp – number of impulses registered by FB input since the moment the impulses were connected to this FB input. These counter values are not displayed.

Imp_{kWh} – number of impulses per kWh (see FB input settings)

Impulses are counted only if the controller is operating. It is only an auxiliary and informative feature of the controller. Counted impulses are saved in the internal EEPROM memory every hour. In case of a short time power supply failure these values should not be very different from the actual reality. More frequent impulse saving is not possible due to technical reasons. If these values do not correspond with the value shown on the display of the connected energy meter, modify the field "Energy offset" to match the value of the energy meter, check the "Reset energy"-field and press the Write button.

Other statuses:

- Configuration/object name - it is used to set label to the facility or the current configuration. Text may contain maximum of 16 characters in ASCII encoding.
- Sunrise today – it displays time of sunrise for today. This time is calculated directly in the controller based on the actual calendar date and the actual geographic location of the facility/building (see "Geographic location" on the "Other settings" tab). The calculated time is converted to the current local time based on configuration of the "Use summer time" and "Time zone" settings. The official sunrise zenith is considered, i.e. 90° 50'. Sunrise time is used to reset energy counters ("Supplied energy"-fields) in the main window, provided that the applicable mode in the field "CombiWATT – Energy counter reset" is selected, and also since firmware version 4.1 to start or end the time schedule.
- Sunset today – (since firmware version 4.1) it displays time of sunset for today. This time is calculated directly in the controller based on the current calendar date and the current location of the facility/building (see "Geographic location" on the "Other settings" tab). The calculated time is converted to the current local time based on configuration of the "Use summer time" and "Time zone" settings. The official sunset zenith is considered, i.e. 90°50'. The sunset time is used to start or end the time schedule.
- Day of week – shows the current day of week, which is obtained from the controller date.
- Fan power– displays the current fan power output in %.
- Firmware version – displays actual regulator firmware version.
- Date (regulator) – it indicates the real time running inside the regulator (date part).
- Time (regulator) – it indicates the real time running inside the regulator (time part).

Note: *Regulator real time is backed up with a built-in lithium battery, so it runs even if the regulator power supply is turned off.*

- Date (client) – it displays the real-time running on the PC (date part).

- Time (client) – it displays the real-time running on the PC (time part).

INPUT SETTINGS TAB

In this tab you may set ILx measuring inputs and FB inputs.

Common settings for ILx measurement inputs and FB inputs:

- Label – used to assign a label for the relevant input. Label may contain a maximum of 8 characters in ASCII encoding. For ILx inputs it cannot be modified.

Measurement input settings (ILx):

- Current orientation - it is used to change the sign of measured powers, if the current sensing module is fitted in inverted position, or in cases for example, when it is desirable to pass the wire through the module in inverted direction.
- Phase - it is used to set the physical phase to given input. Assign the phase so that the measured currents are in phase with voltage. Check the assignment using the input checking oscilloscope and a purely resistive (thermal) load on the given phase.

  Note: *The Phase parameter replaces the "Phase Order Setting" menu from older WATTrouter models and allows you to set any phasing for all inputs with the power measurement function.*

- Ratio for external CTs - set this ratio only if you use additional external current transformers (CTs), whose secondary coils are shorted with a wire passing through measuring coils of the current sensing module, as specified on figure 7. If you use standard connection for WATTrouter device that is, the facility or household supply wire is passing directly through measuring coils as specified on figure 3, then this ratio should be 1:1 (however, this ratio can also be used to calibrate current measurement even in the case of standard wiring without external measuring transformers). External current transformers can extend the measuring range of the controller up to any value, depending on the conversion rate of the external current transformer.

  Example: Let us say you want to use WATTrouter M SSR in a facility where the main circuit breaker is rated up to 3x400A. In this case you have to buy external current transformers with ratio 400A:5A. Connect/short-cut their secondary terminals using a wire, and at the same time, pass it through measuring coils of the current sensing module (see figure 7). Now set the conversion rate to 400:5.

  However, in order to use the full range of the built-in A/D converter, it is recommended to make 4 turns around the measuring coils to get optimum conversion rate of 400A:20A. Then, set the conversion rate to 400:20.

  Caution: Use only external CTs for large facilities and large PV-plant power outputs. If you are using a high conversion rate of external CTs, you have to take into account that (relatively) small power outputs (in the example describing the optimized conversion rate 400A:20A, the limit represents approximately 100 W per phase) are below the resolution capacity of the measuring inputs and therefore, these power values will not be measured and equal to zero.

  Note: *The setting is only possible for the IL1 input, other ILx inputs share the same configuration.*

FB input settings:

- Energy offset - this field can be used to set initial values of measured energies. If the values of measured energies do not match the display on the connected energy meter (for example), put the value of the energy shown on the display into this column and reset impulse counters to zero by marking the option "Reset energy".

- Reset energy - used to reset energy counters to zero.
- Number of impulses per one kWh – this column is used to set the number of impulses per one kWh. Set the value according to the label or manual of the connected energy meter, inverter or according to another compatible measuring instrument. It is recommended to use highest possible amount of impulses per kWh to get better resolution for the power fields in the "FB input status" group.
- Measurement source – as of firmware version 4.0, this item is replaced by the more general items Measured by input (see chapter Output settings tab) and Input settings for statistics (see chapter Other settings tab), which better correspond to the advanced options when using the S-Connect protocol.

Input checking oscilloscope:

This graph is primarily used to check the correctness of ILx metering inputs settings but can be used to check FB inputs settings as well. From the drop-down menu, select the input you want to check and follow the chart.

The oscilloscope will always display the events at the analog inputs of the WATTrouter microprocessor, which will vary according to the assigned input function:

a. Power measurement (ILx inputs) - one whole period of measured current is displayed, the value for zero measured power should be around 0 digits. For more information about this view, see chapter Setting up main function.
b. S0 pulse counter (FB inputs) - logic 1 (about 4000 digits) will be displayed for pulse delay or logic 0 (about 10 digits) for the active pulse from the meter.

OUTPUT SETTINGS TAB

On this tab you may set basic parameters for outputs and setup the CombiWATT mode for outputs.

- Function - used to set the functionality of the corresponding output:

  a. Relay - the output will operate in On/Off mode (as a relay).

  b. Proportional - (only for triac and SSR outputs) the output will operate in proportional control mode, by modulating connected load's power according to the available surplus energy.

This mode is only for controlling the output of resistive (thermal) appliances and in case of SSR outputs it requires the connection of external power semiconductor relays (SSRs)! This mode can further increase the flicker (fast changes in mains voltage or fast flashing of light bulbs and fluorescent lamps). Before connecting the appliance to this mode, read the flicker recommendations in the Frequently Asked Questions section of the manufacturer's website.

  c. PWM – (only for SSR outputs) the output will operate in proportional control mode, by modulating connected load's power according to the available surplus energy, but the output signal will be sent as PWM, see technical specification for PWM parameters.

Caution: The purpose of this mode is only to control the instantaneous power of external devices which allow this and have corresponding input (such as some battery chargers and heating pumps). This mode cannot be used if external solid state relays (SSRs) are connected to the SSR outputs!

Note: *If the Function field is disabled then either there is only one function possible (function that is shown) or (since firmware version 4.0) the function is set remotely by S-Connect protocol.*

- Label – used to assign a label for the relevant output. Label may contain a maximum of 8 characters in ASCII encoding.

- Priority – it is used to set priority for the relevant output. First priority is the highest; the 6th priority is the lowest. "Not used" means that the output is not activated. Output with higher priority will switch on "sooner" and will switch off "later" (see the chapter "Setting up main function"). If you are using the "Sum of all phases" control mode, you cannot select the same priority for two or more outputs (except for the "not used" status). In the "Each phase independently" control mode this settings must be applied to each phase. From the first (the highest) priority all the way down to the lowest priority. No gaps are allowed in the priority settings, that is, you cannot set only the 1st priority and the 3rd priority, without setting the 2nd priority as well. WATTconfig M inspects priority and phase settings before writing them into the controller.
- Phase – if using the "Each phase independently" control mode you have to set the phase wire for each output where the relevant load is connected to. The setting must correspond with the reality. Use the TEST button to verify that.

  Note: *The output phases may not correspond to the physical phase settings for the ILx inputs. The reason is that for the inputs physical phase is assigned according to the actual connection of the current sensing module and for the outputs logical phase in relation to the inputs ILx.*
- 3f mode –when using the "Each phase independently" control mode you can set special method of surplus energy calculation to switch on or off this output. These special methods can be used only for symmetrical three-phase loads (such as 3-phase heating elements, 3-phase heat pumps and others), which have to be connected on 3-phase line. Connect those loads only via external 3-phase contactor or 3-phase power SSR or, if you have 3-phase inverter heat pump, use corresponding control module which can directly control the power of this heat pump.

  The phase entry for the output in 3f mode indicates a *reference phase*, which is used only for assigning the output to the priority chain for that phase.

  Note that for triac outputs in proportional mode this option has no meaning as no 3-phase load can be connected to triac output directly in this mode.

  Put one third of nominal input power of the load to the Connected Power field and set phase and priority according to your preferences (the Phase field only serves here as reference parameter to include this output into correct priority chain). Following special methods of energy surplus calculation are available:

  a. Min (L1, L2, L3) – output will be switched on behalf on a minimum surplus energy from all 3 phases

  b. Avg (L1, L2, L3) – output will be switched on behalf on average surplus energy from all 3 phases

  c. Max (L1, L2, L3 – output will be switched on behalf on a maximum surplus energy from all 3 phases

  Within the assignment of one phase there can be combined single-phase and three-phase loads at different outputs. Use this function with extreme caution and only if it is not actually possible to split given three-phase load to 3 single-phase loads (e.g. as the aforementioned 3-phase heating element).

  Since firmware version 3.0, this mode has changed:

  - The output in 3f mode no longer blocks the switching of the lower priority outputs on the reference phase if there is enough surplus energy at that phase to switch them.
  - Also, if there is enough surplus energy on the reference phase and there are lower priorities switched on at that phase, and the available surplus energy on other phases decreases, it does not

remain permanently (incorrectly) switched on, but adjusts (regulates) its excitation according to the requirement from all 3 phases.

- Connected power - it specifies the active power rating of connected load. If power rating is specified in VA and the power factor cos (Φ) is specified, you may determine the active power rating using $P[W] = S[VA].\cos(\Phi).$ formula. The connected power value should be equal to the power rating of connected load for proportional or PWM function, and must be higher or equal for relay function.

- Maximum power – this value applies only for proportional outputs. It determines the maximum allowed power applicable for the connected load. In many cases this value is equal to the connected power value, but for example, due to limited triac/SSR cooling possibility or due to saving the surplus energy for additional outputs, you may decrease this value. The value in the "Load power"-field may be slightly lower than the selected maximum power value, even if the output is fully excited and maximum power is reached (if this power is assumed and not measured by an FB input). The reason is that outputs with proportional function do not switch on fully proportionally but only "quasi-proportionally", which means, only in certain switching levels.

Always keep the value equal to the Connected power value in cases where the output is set to the proportional function, causing an increased flicker (fast changes in mains voltage or rapid flashing of light bulbs and fluorescent lamps). The output will always be permanently switched on when fully excited. See the flicker recommendation in the Frequently Asked Questions section of the manufacturer's website.

- Prepend before triacs/SSRs – allows prepending the relay output before specified number of proportional outputs. Fill in 1 if you want a relay with lower priority to switch on when load power on nearest higher priority proportional output reaches the relay's Connected power value. Fill in 2 if you want this relay to be switched on when sum of load powers on nearest 2 higher priority proportional outputs reaches the relay's Connected power value. The function works similar for higher values. This function will violate the preset order of priorities. However, it allows using almost all available surplus energy even if heating elements are connected to relay outputs. For example, if you are using a three-phase heating element.

  Example 1: heating element 3x2 kW connected and configured in the following way:

  - 1st heating coil connected to SSR No. 1, 1st priority, connected power 2 kW, maximum power 2 kW

  - 2nd heating coil connected to relay No. 1, 2nd priority, connected power 2 kW, prepend value = 1

  - 3rd heating coil connected to relay No. 2, 3rd priority, connected power 2 kW, prepend value = 1

  If the SSR No. 1 is fully switched and consumes 2 kW of surplus energy and the amount of surplus energy further increases, then the relay No. 1 will switch on and SSR No. 1 will automatically reduce its power. If the surplus energy increases by additional 2 kW so that the SSR No. 1 is fully switched again, then the relay No. 2 will be switched and SSR No. 1 will again automatically reduce the power output. If the power output continues increasing, additional outputs with lower priorities will be connected. Similarly, outputs will disconnect when the PV-plant power generation will decrease.

  Note: *To make sure that the function works correctly, all 3 heating coils must be active (heated) at the same time or inactive (disconnected by the thermostat). The algorithm will not work correctly if heating coil No. 1 is disconnected by the thermostat and the other two heating coils will continue producing heat. In this scenario, the relay will be continuously connected and disconnected because the controller is trying to keep "virtual zero" or "phase zero", depending on control mode, and is not able to determine from phase wire measurements that heating coil No. 1 is disconnected.*

Note: *In order to ensure correct function of the algorithm it is necessary that the SSR output - to which the heating coil No. 1 is connected, is assigned with the higher priority than the relay No.1 with the 2nd heating coil. If the coil No. 1 connected to a SSR output has lower power rating than the other two remaining heating coils, then the relays will connect only after the overall power (power drawn by the first coil + surplus energy) exceeds the value of "Connected power" field set for relay No. 1. In this case, the part of surplus energy will be still delivered to public grid as in the case of the default function of WATTrouter controller, without prepend mode.*

Example 2: A boiler and 2 other heating elements:
- the boiler connected to SSR No. 1, 1st priority, connected power 2 kW, maximum power 2 kW,
- 1st heating coil connected to SSR No. 2, 2nd priority, connected power 2 kW, maximum power 2 kW,
- 2nd heating coil connected to relay No. 1, 3rd priority, connected power 2 kW,

a) Prepend value set to **0**: In this case the 2nd coil will never be prepended and after 4kW surplus is reached and consumed by boiler and 1st coil the controller will wait until the available surplus is 6kW. Then it connects 2nd coil. In the meantime surplus flows to public grid.

b) Prepend value set to **1**: In order to prioritize the 2nd coil, we will take into account only the load power of the 1st coil, which means that the boiler will always have first priority. So after PV-surplus reaches 4 kW the 2nd coil will be connected (prepended) before the 1st coil.

c) Prepend value set to **2 and higher**: In order to prioritize the 2nd coil, we will take into account the sum of load powers of the boiler and 1st coil. So after surplus reaches 2 kW the 2nd coil will be connected (prepended) before boiler and 1st coil.

Note: *The Prepend function does not affect relay output priorities. For example, if the relay 2 is set to the nearest lower priority than the relay 1 but has a higher Prepend value than the relay 1, the relay 2 will not be prepended before the relay 1. Therefore, in this case, higher Prepend value for relay 2 than for relay 1 is not meaningful, so don't set it.*

- Minimum power – for proportional outputs when PWM function is used this value gives the minimum power for the connected load. The output will not be activated unless available surplus energy exceeds this threshold. Nonzero value can be useful e.g. for proportional control of inverter air conditioner or heating pump. These devices usually don't run with less than 1/3 of nominal power. For more information about controlling air conditioners or heating pumps proportionally see manufacturer's web site.

- @ – (since firmware version 4.1) for proportional outputs when PWM function is used, it allows you to enter the output excitation level corresponding to the item Minimum power. The excitation level is entered as a percentage of the full cycle of the PWM signal or full voltage range 0-10V. Up to and including firmware version 4.0, the level was fixed at 10%/1V.

  Example: Let's have a heat pump, controlled by the external 0-10V signal, connected to the SSR output with the PWM function set. The smallest pump power is 1kW, which corresponds to a voltage of 3V. The highest pump power is 3kW, which corresponds to a voltage of 10V. The pump switches off at a voltage of <0.5V. Then we set Connected power=3kW, Minimum power=1kW and item @=30%. PWM-range remains full 0-100%. The controller will then switch this pump in the range of 1kW to 3kW, which corresponds to 3V to 10V. If it needs to be turned off, the controller will set it to 0V.

- PWM-I – for proportional outputs when PWM function is used then this value is equal to the I-component value of the PID-regulator assigned to this output. The value can be selected between 1 and 1000. Select value according to the dynamics of the connected system (battery charger, heating pump etc.). Start with a small value (1 to 10) and gradually increase the value if the system dynamics is slow. For values less than 100 the dynamics is rather slow so that the system allows switching outputs

with lower priorities, to cover available surplus energy. If the Minimum power field is nonzero the control will start after 3 minutes. In the meantime minimum power is held – aimed for softstart of air conditioners or heating pumps.

Caution: In case of a too big PWM-I value the system may become unstable and this status may damage the connected device, when there is no built-in protection in the device!

- PWM range – (since firmware version 3.0) these values can be used to limit physical PWM or 0-10V output to given subrange. For example, if we need a signal that is 1-10V (1V corresponds to zero power, 10V corresponds to full power) then we set 10-100%. Similarly if we need a signal that is 2-5V (2V corresponds to zero power, 5V corresponds to full power) then we set 20-50%. The output within this range is linear and even for the smallest possible subrange (10% of the full range, so eg. 10-20% ie. 1-2V) is fine enough and has minimum resolution of 100 levels (for smallest subrange of 1V it means the resolution is 10mV).
- On-delay time – this value applies only for relay outputs. This delay time runs from the moment a condition has been detected to switch the relay output on. By this condition we mean that the corresponding energy surplus exceeds the limit set by the ”Connected power” field, which is further increased by internal fixed hysteresis of 0.1 kW. After the on-delay time elapses the relay is really switched on. It is recommended to use the default value, or to slightly increase it if the relevant load cannot be switched on frequently. The value may be decreased down to 2s. However, such small delay time may sometimes cause false load switching. Therefore, we recommend decreasing the value only in certain cases and after proper testing. This time delay is not active in CombiWATT and TEST mode.
- Off delay time - this value applies only for relay or PWM outputs. For relay outputs this delay time runs from the moment a condition has been detected to switch the relay output off. After the time elapses the relay is really switched off. This feature is necessary for loads which cannot be switched on frequently. The value may be reduced down to 2s. This time delay is not active in CombiWATT and TEST mode. Here it is assumed that the low tariff activity time is always sufficiently long in case of double tariff rates.

  For proportional outputs when PWM function and nonzero minimum power is used this value gives the switch off delay for case air conditioner or heating pump is connected to this output and controlled by PWM mode. If there is not enough surplus energy to run the device anymore the device will continue to run at minimum power for specified amount of time. The delay in this case cannot be set to less than 3 minutes.
- Duplicate to - (since firmware version 4.0) allows you to duplicate the relay output switching to another relay output that is selected in this field.

  Example: Consider a three-phase pool heater operated in the control mode of each phase separately. Here we need to ensure the operation of the pool water circulation pump when switching on the pool heating in any phase. We will use 3 relay outputs in the first priority on each phase, where the circulation pump is connected to the relay output on phase L1. We will also use 3 proportional outputs (triacs or SSR) in the second priority on each phase, which proportionally switch the individual heating coils of the pool heating. Duplication ensures switching of the relay output on L1 even in case there is no PV surplus on L1, but it is on L2 or L3.

  Note: *When you select an output that has no relay function set, duplication does not apply.*
- Measured by input - (since firmware version 4.0) assigns the respective output for measuring the power of the connected appliance. Any FB input can be set.

- CombiWATT – activates the CombiWATT mode for the relevant output (output must be activated, i.e. to have assigned valid priority). Enter the required amount of energy power, which must be supplied to the corresponding load every day.
- Full power – mark this field if you want to switch the proportional output in CombiWATT or TEST mode at full power, regardless of the Maximum power setting ("Maximum power"-field). In this way you may eliminate the occurrence of disturbing flicker effect (fast changes in mains voltage or rapid flashing of light bulbs and fluorescent lamps) when CombiWATT or TEST is active. If you don't check this field the specified Maximum power for the load is used in CombiWATT or TEST mode.
- Inverted – this checkbox applies only for relay or PWM outputs. When checked, the selected output will be switched on in inactive status and switched off in active status. Since firmware version 1.6 this inversion is active in all cases (independent from priority assignment or even the TEST status). There is only one exception when a failure is detected. In this case the inverted relay output will remain physically turned off.

  In case of a relay output, this function can be useful when you want to avoid delivering surplus energy to public grid. Here, typically, one relay output is set as inverted and assigned to last priority. And it is used to block the inverter. If there is inconsumable surplus energy (typically in hot summer) this relay output disconnects the inverter for some time (given by Off-Delay time). After this time the inverter starts again. To block the inverter it is recommended to use analog inputs of the inverter (for inverters which support power reduction). In this configuration the inverter will be disconnected from grid on each WATTrouter failure or when WATTrouter itself gets disconnected from grid.

  In case of the output with PWM function, the output duty cycle of the PWM signal is inverted.

  Attention: *As of firmware version 4.0, the output can also be switched on by an external station when the S-Connect protocol is activated. In this case, the inversion does not apply! If you want the output to be inverse and you also want to switch it externally, you must also set the inversion of the corresponding remote output on the external station (however, not all stations support this).*
- TEST – it is used to test the relevant output and load. If you press any of the TEST buttons then the corresponding output is forced to switch on, independent from its current configuration. If the output is inverted then since firmware version 3.0 the test mode is also inverted, i.e. it switches off. The behavior of all other control functions depends on the “Output test blocks control” option state as described in chapter Other settings tab.

TIME SCHEDULES TAB

On this tab you may set time schedules for individual outputs.

Up to 4 independent time intervals may be set for each individual output. During these time intervals the relevant output may be forced to be switched on, or the switching process may be restricted. Enforcing or restricting may be further conditioned by the binary input status and / or by the status of daily energy counter for the relevant output (field "Supplied energy").

You may use time schedules to create more complex configurations for outputs, based on user preferences. You may also use time schedules to add or possibly replace the built-in CombiWATT mode.

Time schedules operate independently of the basic regulation mode. If used inappropriately, time schedules may worsen the energy efficiency of your facility. Setting up time schedules depends entirely on your creativity and provides a wide range of different combinations. Only advanced users should use time schedules and

only after they have been thoroughly familiarized with the applicable functionalities of this device!

Description of a time schedule option:

- Time schedule mode:
  a) Not used – time schedule is not active.
  b) Restricted – the output will be restricted during the interval specified in the "From - To" field. If the "From" time is larger than the "To" time, the restrictions or limitations are valid from the "From" time to midnight and on the next following day from midnight to the "To" time. **Restriction applies to all activities of this output and has the highest priority.** During the time interval neither basic regulation - based on the surplus energy - nor the CombiWATT mode will work. Neither any other time schedule set to enforced mode will work. Output restriction does not prevent outputs with lower priorities from working regularly.
  c) Enforced - the output will be enforced/switched-on during the time specified in the "From – To" interval. If the "From" time is larger than the "To" time, the enforcement is valid from the "From" time to midnight and on the next following day from midnight to the "To" time. **Enforcement has the second highest priority** and it may be disabled only with another time schedule set to the restricted mode at the same time. During the preset time interval the output enforcement deactivates the basic regulation mode based on surplus energy (only if the Power field is set to 100%). However, it does not affect conditions for the activation of CombiWATT mode, which then can run simultaneously with the enforcement mode. Output enforcement does not prevent outputs with lower priorities from working regularly.
- From – time when time schedule begins. Since firmware version 4.1, the following times can be set:
  a) Time – the entered time is used
  b) SR – sunrise time is used
  c) SS – sunset time is used
- To – time when time schedule ends. Since firmware version 4.1, the following times can be set:
  a) Time – the entered time is used
  b) SR – sunrise time is used
  c) SS – sunset time is used
- Power – this field can be configured in firmware version 2.5 and later. It can be configured on proportional outputs (if the function is proportional or PWM). This field can be used here to enforce or restrict the output power as a percentage of the connected power. Thus, the output can be switched proportionally even when switched by the time schedule.
  Since firmware version 4.1, the Power item behaves differently depending on the time schedule mode and the Minimum power value for the PWM function. Conversion tables of the Power item to resulting PWM signal, or voltage 0-10V, follow. These conversion tables apply in the case of full PWM range (PWM Range item) and no output inversion:
  a) Enforced mode:

Power [%]	Smallest PWM duty cycle [%]	Lowest voltage [V]
0	Cannot configure	Cannot configure
1	1	0,1
10	10	1
20	20	2
…		
90	90	9
100 (fully enforced)	100	10

Important: *If the PWM output function is selected, a non-zero Minimum power is set, and the Power item is lower than what would correspond to the percentage excitation in the @ field, the*

output will not be forced. This serves as protection against powering the connected appliance outside the specified operating range.

***Note:** If in the Enforced mode the output power is set to be lower than 100%, then such enforcement does not deactivate the basic regulation mode according to excess energy. So if the output is forced to e.g. 50% and there is a surplus energy available to switch it to 75%, the output will switch to 75% power.*

b) Restricted mode:

Power [%]	Biggest PWM duty cycle [%]	Highest voltage [V]
0 (fully restricted)	0	0
1	1	0,1
10	10	1
20	20	2
…		
90	90	9
100	Cannot configure	Cannot configure

***Important:** If the PWM output function is selected, a non-zero Minimum power is set, and the Power item is lower than what would correspond to the percentage excitation in the @ field, the output will be fully restricted. This serves as protection against powering the connected appliance outside the specified operating range.*

***Note:** If in the Restricted mode the output power is set to be higher than 0%, then such restriction does neither deactivate the basic regulation mode according to excess energy nor the enforced time schedule. So if the output is restricted to e.g. 50% and there is a surplus energy available to switch it to 25%, the output will switch to 25% power.*

In the Enforced mode, always keep the value equal to 100% in cases where the output is set to the proportional function, causing an increased flicker (fast changes in mains voltage or rapid flashing of light bulbs and fluorescent lamps). The output will always be permanently switched on when fully excited. A similar recommendation also applies to the Restricted mode, where the Power value should always be equal to 0%. See the flicker recommendation in the Frequently Asked Questions section of the manufacturer's website.

- M to S – shortcuts for weekdays. The time schedule will be active only on checked days.
- LT – this checkbox is not available since firmware version 4.1. It has been replaced by the more general Binary Input condition.
- Binary input – (since firmware version 4.1) if you mark this field, the time schedule activity additionally depends on the state of the binary input. The function is different depending on the time schedule mode:
  a) Restricted mode – the output will be restricted only if a binary input is selected and it is switched off when the ON condition is set or switched on when the OFF condition is set.
  b) Enforced mode – the output will be enforced only if a binary input is selected and it is switched on when the ON condition is set or switched off when the OFF condition is set.
- Energy – if you mark this field, the time schedule activity additionally depends on the status of the daily energy counter of the relevant output (the "Supplied energy" fields). Again the function differs based on the time schedule mode:
  a) Restricted mode – the output will be restricted only if the daily energy counter exceeds the value specified in the Limit field.
  b) Enforced mode– the output will be enforced only if the daily energy counter did not yet reach the value specified in the Limit field.

Tip: *Time schedules may also be set for an output which does not have any assigned priority. These outputs may be used for example, as time switch clock etc. Labels and "Connected power" field may be configured for these outputs using the Output settings tab. "Connected power" field of such output is then used to update the daily energy counter.*

Note: *The conditions described above combine with logic AND within one time schedule. If you need to create a logic OR combination, you need to add a second time schedule with the same time range and another condition.*

Note: *Impact-free transition to the basic regulation mode: If the condition necessary for the enforcement of a relay output no longer exists, a basic 10s delay is set for this output. This delay is used to ensure impact-free transition to the basic regulation mode. Similar method is also used for proportional outputs. User-defined off-delay time is not used here.*

For more practical samples demonstrating configuration of time schedules, see the chapter Configuration examples.

OTHER SETTINGS TAB

On this tab you may configure general control settings and other advanced device settings.

Control settings:

- Control mode - it is used to set the basic control mode:
  a. Each phase independently - the controller will control outputs according to measured active power on each phase wire separately. In this mode it is necessary to correctly set phases for all active outputs. They must correspond with the phase wire where the load is connected to.
  b. Sum of all phases - the controller will control all outputs according to the sum of measured active powers from all three phases. In this mode it is not necessary to set phases for individual outputs as this does not matter.
- Power offset – this field specifies the difference between the actual sum of measured powers in 3 phases L1+L2+L3 and the value used for the control purposes. For example, if the actual sum of measured powers L1+L2+L3 equals to +500W and the power offset equals to -100W, the controller will use the value of 400W to determine the conditions for output switching. Above terms apply for the "sum of all phases" control mode. For the "each phase independently" control mode this power offset value applies for each phase independently. The lower (more negative) the power offset is, the more power consumption from grid is avoided in transitional statuses as well as in stable statuses where the proportional outputs pass only small amount of power to the load. Transitional statuses are usually identified by 4-quadrant energy meters as "fluctuation around zero", where production and consumption indicators change irregularly and fast. Negative power offset avoid showing up the consumption indicator, but during normal and stable control statuses some surplus energy flows unused into public grid. If you use standard connection and configuration, then it is not recommended to use positive offset.
- PWM frequency - (since firmware version 3.0) set the desired frequency for outputs with PWM function. This frequency is always the same for all outputs (and cannot be set differently by hardware).
- Internal DC source - (since firmware version 3.0) informs about the voltage value of the internal DC source of the controller. This value is used to check for eventual overloading of the internal power supply, which may lead to the "DC source overload" fault. See chapter Measured parameters and statuses for details.

- Output test blocks control - (since firmware version 3.0) this function is used to set the output behavior in TEST mode. If this option is checked, the test mode behaves as in all older firmware versions and thus activating any output to the TEST mode completely stops the control. If this option is unchecked, the TEST mode does not block the control of other outputs that are not in the TEST mode.
- Output test timeout - (since firmware version 3.0) this item is used to limit the duration of the TEST mode activity. If the entry is zero, the TEST mode is unlimited and behaves as in all older firmware versions. If the item is non-zero, the TEST mode will be limited to the specified time. The value is the same for all outputs. This new function can be used, for example, to temporarily switch an output in manual mode, if it is necessary to quickly force a certain output to switch on for a limited period of time.

Network configuration:

- Controller IP address – IP address saved/stored in the controller. The controller uses this address to "listen" to all UDP and TCP/IP (HTTP) incoming requests.
- Subnet mask – a network mask to which the controller is connected.
- Default router IP address – we recommend using IP address of your router. Requests outside of the local network, except the DNS server, are directed to this address.
- DNS server IP address - (since firmware version 3.0) enter the IP address of your preferred DNS server.
- Controller MAC address – physical (MAC) address of the controller. Change this address only if there is a conflict between physical addresses in your local network.
- UDP port – port used by the controller to listen to UDP requests.
- HTTP port – port used by the controller to listen to HTTP requests.
- DHCP mode - (since firmware version 3.0) selects the mode of automatic configuration of network connection via DHCP:
    a) none – DHCP is inactive, entire network settings have to be input manually as in case of all older firmware versions.
    b) DNS – DHCP is only used to obtain the IP address of the DNS server (the device will use only the DHCP inform request or the DHCP discover request).
    c) all – DHCP is used for complete network setup. Note that in this mode the IP address of the controller can be changed at any time, which may lead to loss of its accessibility e.g. from the Internet (NAT routing stops working). Recommended only for experienced users!

The network configuration will become effective after you reset the controller (see option "Reset unit on config. write").

Date and time settings:

- Synchronize date and time with the client - check this field if you want to synchronize the controller date and time with the actual time running in your PC. The date and time will be synchronized when the configuration is subsequently written.
- Synchronize date and time with time server - (since firmware version 3.0) check this box if you want the controller to synchronize the date and time once a week with the time server on the Internet. In order for synchronization to work, the controller must be connected to the Internet, a valid time

server IP address must be set and the default gateway IP address must also be set correctly. The moment of synchronization is calculated from the serial number of the controller and is different for each controller.

In order for the time server synchronization function to work, the controller must be connected to the Internet, the time server IP address or its domain name must be valid and the default gateway IP address must be set correctly!

- Time server (hostname) - (since firmware version 3.0) time Server domain name. The time server name is stored directly in the controller and its IP is obtained automatically using the newly implemented DNS protocol. Then, the IP address of the time server is ignored. The default and recommended name is pool.ntp.org, which is a service that automatically assigns the IP address of a particular time server, based on the load of individual time servers and other criteria. You can use the "Test time server and get it's IP" button to verify the functionality of the server.
- Time server IP address - (since firmware version 3.0) time server IP address stored in the controller. The IP address of the time server does not need to be set and detected, just use a valid time server domain name. However, in case the IP of a time server cannot be found from its name, an attempt will be made to contact the time server specified by this IP. Therefore, it is possible to use this field as a backup solution to the specified domain name.
- Use summer time - check this field if you want the controller to perform automatic switching between summer and winter time. Based on EU recommendations only summertime is supported, which starts at 2:00 CET on the last Sunday in March and ends at 3:00 CEST on the last Sunday in October. The summertime information is used to automatically modify the current time as well as the calculated sunrise time.
- Time zone - specify the time zone based on your country. The default value uses Central European time. This value is only used to modify the calculated sunrise time. Time zones outside of multiples of full hours are not supported.
- Test time server and get it's IP - (since firmware version 3.0) press to test the time server and determine its IP address. The IP address is written to the controller when the configuration is next written. Since firmware version 1.5 there is no need to use this feature, IP is detected primarily from the specified domain name.
- Synchronize time now! - (since firmware version 3.0) press this button to instantly synchronize the time in the controller (without requiring configuration writing). If the Synchronize date and time with the client check box is checked, the time is set equal to PC time, otherwise the time server synchronization is performed (if properly configured, otherwise nothing will be done).

CombiWATT settings:

- CombiWATT delay time – specifies the time delay from the moment where PV-plant production is not detected anymore (after sunset) until CombiWATT can become active. It is recommended to increase the setting if you are frequently using electrical loads (other loads than those connected to the controller), which consume entire surplus energy of the PV-plant for long time. In this case, the controller cannot recognize that PV-plant production is not yet over.
- Time to activate CombiWATT – it displays the remaining time before activation of the CombiWATT mode. The value is equal to the "CombiWATT delay time" parameter, provided that some surplus energy is still detected. If the value equals to zero and low tariff signal is detected at the same time, the system activates the CombiWATT mode for corresponding outputs.

- CombiWATT production limit – small amount of active production or surplus energy (single units or tens of Watts) may be detected for facilities with significant capacity loads (blocking capacitors, UPS stations, large number of switching sources, etc.), even though the inverter does not work. The cause may be even the inverter itself. In this case, the controller displays small amounts of positive active power in either phase wire. Reason for this is significant reactive power, which is drawn by those devices and measured by WATTrouter near the "recognition line" between production and consumption. Also watt meters produced by different manufacturers behave in similar way. This item partially tries to resolve this issue by setting additional offset valid for each phase wire.

  For example, if the production limit equals to 0.05 kW, CombiWATT mode will already be initiated (provided that also other requirements for the initiation of this mode are met), even if the surplus falls below 0.05 kilowatt in each phase.

- CombiWATT – Energy counter reset – this field is used to reset energy counters, i.e. the "Supplied energy" fields in the main window. You have two options:

  a) At sunrise: counters are reset if the time equals the sunrise time valid for this day.
  b) At fixed time: counters are reset if the time is the same as the time set in the field called "Fixed time for energy reset".

- Fixed time of energy reset – it specifies a fixed time for energy counter reset mode according to fixed time (the previous paragraph, mode b).

Cooling:

- Cool in standby mode - check this field if you want the fan to be switched on even when triac outputs are not switched on. You may use this mode to circulate air in the distribution box or to cool down other components.
- Fan trigger temp. in standby - in standby mode the fan is switched on only if the temperature inside the regulator exceeds this value.
- Max. controller temperature - if this temperature is exceeded the system announces "Max. temperature exceeded" error.

Geographic location:

- Latitude - enter the latitude (in degrees) here. The value is used to calculate the sunrise time and therefore, values specified in degrees are precise enough.
- Longitude - enter the longitude (in degrees) here. The value is used to calculate the sunrise time and therefore, values specified in degrees are precise enough.

Tip: *By changing the longitude you may modify the sunrise time in order to reset energy counters according to your preferences, for example, based on how large area is covered by shadow, etc. If you are not sure, do not modify these values. The default geographic location is set to Central Europe (CZ).*

Other settings:

- Language - select the language which you want the WATTconfig software to use after restart. The Custom item may be used for any other, still not supported language. If you want to use this option, you have to manually translate strings in the *custom.xml* file into the language you want to use.
- Reset unit on config. write - check this field if you want to restart the controller after each configuration was written. Controller reset is necessary to change the network settings.

- Default tab - set the tab you wish to appear when you launch the WATTconfig program or web interface. For WATTconfig software this setting is stored on PC hard drive, the same settings in the web interface is stored directly in the controller.
- Default statistics tab - (since firmware version 1.6) set the subtab on Statistics tab you wish to appear when you launch the WATTconfig program or web interface. For WATTconfig software this setting is stored on PC hard drive, the same settings in the web interface is stored directly in the controller.

Authorization settings:

- Require better HTTP security – check this to disallow passing plain text username and password in HTTP/XML requests (see chapter Description of web interface and XML communication). If checked the authorization will be made using a hash (XML node <sig> replaces here the nodes <UN> and <UP>) and username/ password cannot be changed using web interface anymore (nodes <UNn> and <UNp> cannot be used). If you use a superior system to modify the device configuration this option must be left unchecked because you will not be able to generate the hash there.
- New username - write a new username to authorize writing data to the controller via Ethernet interface.
- New password - write a new password to authorize writing data to the controller via Ethernet interface.

Note: *New login data is written to the controller and can only be used after the configuration is written to the controller. WATTconfig will automatically change the previously saved login so you do not have to re-enter it later.*

Input settings for statistics:

As of firmware version 4.0, the source inputs for calculating data on the Statistics tab can be set more precisely. In older firmware versions, it was only possible to select FB inputs for measuring or capturing photovoltaic production, in the Measurement source field corresponding to the FB input. In newer versions, it is already possible to select inputs both for determining the production of photovoltaics and for determining (measuring) consumption and surpluses, for all 3 phases.

Note: *Due to the limited configuration memory size of the WATTrouter M, it is not possible to actually change the configuration of the Consumption and Surplus fields. The IL1-3 inputs are fixed here.*

For any phase and any category (consumption, surplus, production of PV) it is now possible to select any input that measures or captures information about the instantaneous active power.

- Consumption - the power measured by the assigned input is registered in the Cons. NT or Cons. LT fields of the relevant phase, according to the validity of the low tariff. If the assigned input is the same as the input in the Surplus column for the given phase, then only negative values are registered.
- Surplus - the power measured by the assigned input is registered in the Surplus field of the respective phase. If the assigned input is the same as the input in the Consumption column for the given phase, then only positive values are registered.
- Production - the power measured by the assigned input is registered in the Production field of the relevant phase.

If the same input is assigned to several phases in a given category, then the measured power is divided evenly by the number of these phases.

It is also possible to create a sum of up to 3 source inputs for each category and phase.

Example*: If the FB1 input is assigned to the Production field on all phases, then this means that the power of the three-phase PV-inverter is determined by this input, and this power is evenly divided into three phases.*

By default, the IL1-3 inputs are set to detect consumption and surpluses, as was the case in older firmware versions, and the production inputs are unoccupied.

Note: *When upgrading the firmware from an older version, the controller will try to convert the original FB input settings (Measurement source settings) to the Production items.*

Firmware update:

- Update firmware button - allows you to update firmware of this product. You can find firmware updates in the Download section at the manufacturer's website. If there is an update available you may download it and install it. The progress of the update process is indicated on screen and it takes (based on your connection type and speed) between 20 to 60 seconds. Firmware update via LAN interface is protected from unauthorized access or intervention.

Update of original firmware is completely safe. The system fully and thoroughly inspects the integrity of the update file, as well as the integrity of data after downloading. In case of a power failure during the update, you may download the firmware again at any time after your power is restored. If possible, download your firmware via USB or ONLY from your local network (should an error occur during the download, the controller remembers the original network setting only for about 2 minutes). Should you experience an unsuccessful firmware update repeatedly, you may file a claim pursuant to valid trade terms and conditions. It is strictly prohibited to modify the downloaded file in any way. If you modify the downloaded file and even if the system inspected the integrity, you may still damage your product and lose your warranty!

S-CONNECT TAB

As of firmware version 4.0, the S-Connect protocol can be configured on this tab.

For more information on the S-Connect protocol itself, see chapter S-Connect protocol settings.

- Communication mode - selects the protocol mode for this unit:
  a) Turned off - the protocol is not used. If the protocol is switched off from the previous active state, its entire configuration (station table and device mapping) is deleted and the data exchange with the unit is terminated.
  b) Access Point (AP) - the unit acts as an access point that controls the operation of remote stations and their pairing. This mode is not supported in WATTrouter M.
  c) Station (STA) - the unit acts as a station that responds to access point messages.

Note: *If the S-Connect protocol is activated (ie AP or STA modes), then the configuration options of logic devices are displayed in the control interface of the device.*

- Delete ignored stations – (AP only) when checked, this will clear all stations that were previously rejected by the user, ie the request to pair them was rejected (Ignore button). This option will allow you to re-pair previously rejected stations. The option is only enabled if some previously rejected stations are stored in the controller. For this option to be effective, the configuration must be written to the controller.

Remote station table:

This table shows the essential data of the paired stations. The number of table rows varies depending on the communication mode. In the case of an access point, the table has 6 rows, so a maximum of 6 remote stations can be added. In the case of a station, the table has only 1 row, which is reserved for access point information.

- Type – indicates the type of station, which can be:
  a) Not used – the table row is not used

b) Ethernet – (AP only) the station communicates via a computer network (Ethernet or WIFI)
c) Wireless – (AP only, devices with SC-Gateway module only) the station communicates wirelessly via the embedded SC-Gateway
d) Access point – (STA only) this is the access point

- MAC address – the MAC address of the station is displayed in this field. For stations communicating via Ethernet this is the Ethernet MAC address (last 6 bytes, the first 2 bytes are zero), for stations communicating via the SC-Gateway wireless interface this is the wireless MAC address (8 bytes).
- Name – this field displays the name of the station, which is pre-filled with the station identification data.
- Configuration name – this field displays the name of the station's configuration, if this information is supported by the station and has been filled in.
- Serial Number – this field displays the station's serial number, if supported by the station.
- IP Address – (Ethernet only) this field displays the IP address that is currently assigned to the station.
- LQI – this field displays information about the signal quality of the station's connection. For stations communicating via Ethernet, 100% is always displayed because this physical layer does not communicate the relevant data. For stations communicating via the wireless interface, the signal quality between the station and the nearest access point is displayed (this is either the SC-Gateway or the nearest signal repeater).
- Message counter – this field shows the number of messages that have been sent to the respective station. If the number of messages exceeds 2^{32}, the messages are counted again from zero.
- Ping – this field displays the station response in milliseconds. The term response refers to the actual response of the station from the moment a message is sent to the station to the receipt of the response, increased by a pause in the communication which is inserted by the access point. Communication pauses are necessary to maintain communication stability and to optimize the use (non-overloading) of the controller's network interface.

Note: *The access point operates all stations of the same type cyclically. The response thus increases in proportion to the increasing number of stations of the same type in the station table. For example, if all 6 stations are occupied and all are of the same type (eg Ethernet), then the response will usually be 6 times longer than the response of one station (if we consider a similar response for all stations). If a station is unavailable, then the station response increases by a preset response timeout.*

- Station status indicator – is displayed in green when the station is connected.
- Clear entry button – removes the station, ie cancels the pairing. For the change to take effect, it is necessary to write the configuration to the controller.

Device mapping table:

In this table, the source devices of the station are assigned to the destination (logic) device of the controller. Each line defines one usable device. New mapping can be added by pressing the Add entry button.

WATTrouter M cannot map devices due to limited configuration memory, so detailed mapping information is not provided.

STATISTICS TAB

This tab displays daily, weekly, monthly and annual statistics on production, consumption and surplus (excess) energy. Statistics can be exported to *.csv files if desirable.

Through the current sensing module it is only possible to measure consumption and surplus data using IL1-3 signals. In order to display data on production and self-consumption, it is necessary to add photovoltaic power measurements. As of firmware version 4.0, this means setting the

appropriate input carrying active power information in the Production field in the Input settings for statistics on the Other settings tab. It is possible to use any FB input. It is necessary to connect pulse output from an external electricity meter, which measures the power and energy from the inverter, to the appropriate FB input. Alternatively, connect inverter directly to the respective input when the inverter is equipped with a compatible impulse output.

Values are approximate! The device does not know the exact values from utility/billing meters!

Daily statistics are reset every time just after midnight, i.e. at 0:00 A.M. At the same time, daily values from the just finished day are moved into history. When you change the date in the controller you may cause irreversible deletion of stored history!

Real time chart (since firmware version 3.0):

Up to 7 rows can be selected in this line chart, which can display power or temperature curves. You can select a time base of acquiring values from 1 second to 10 minutes. The maximum number of points on the time axis of the chart is 144 (when selecting a ten-minute period it corresponds to 1 day). The chart data are not stored in a non-volatile EEPROM, and therefore after a reset, or if there is a power failure, the data is deleted. The data will also be erased each time you reconfigure this chart.

- Time base - configure the period of reading values into the chart.
- Series 1-7 - dropdown menus configure the input or output to be loaded into the corresponding chart series.
- Export - exports chart data to a * .csv file that can be opened e.g. in MS-Excel.

Daily statistics:

- Show for day –select the date for which to view daily statistics. You can display them for current date and last 7 days.
- Phase Lx–displays information about the surplus (excess) energy, normal and low price energy tariff as well as (optionally) PV-production, when counted with a FB input, in the current or selected day.
- Total L1+L2+L3 – displays summary data from all three phases. The calculation of these data depends on the selected control mode -the "Control mode" field on the Other settings tab:
    a. Each phase independently – summary data are simply the sum of the fields from all 3 phases
    b. Sum of all phases – summary data are updated continuously from immediate results. **In this control mode summary data are not the simple sum of the displayed values in each phase** (in one phase the surplus energy may cover consumption in different phase, etc.).
- Daily output status- displays the assumed or really measured amount of energy supplied to each load in the current or selected day. **Since the statistics are reset every time just after midnight, these values will not correspond with the values in the fields "Supplied energy"**(reset of those fields is generally done at different time).
- Daily FB input status – displays the measured energy at corresponding FB input in the current or selected day.
- Erase internal stats – use this button to delete all statistics stored in the built-in EEPROM memory. Confirmation dialog will be shown first.
- Charts – they show a graphical interpretation of the daily statistics on production and consumption. Charts in each phase indicate the part of corresponding summary data (pie slice or part of the bar). The self-consumption value is calculated from this formula: **self-consumption = production – surplus energy**. Self-consumption values are not available unless the displayed production value is bigger than measured surplus energy value.

***Note**: For very small energy values (typically immediately after resetting statistics after midnight) internal rounding to 0.01kWh is significant for displaying the charts .In these cases, pie charts may not be displayed absolutely correctly.*

Weekly statistics:

- Chart -shows the5 main summary data (production, surplus energy, self-consumption, consumption in normal and low tariff) in bars for the last 7days. Double click on the bar to view the day in the daily statistics.

Monthly statistics:

- Production chart - displays summary data on production (production +surplus energy) in the last 31 days. Double click on the bar to view the day in the daily statistics.
- Consumption Chart - displays summary data on consumption (self-consumption, consumption in normal and low tariff) in the last 31 days. Double click on the bar to view the day in the daily statistics.
- Export- exports monthly statistics to a *.csv file that can be opened e.g. in MS-Excel.
- Import - imports monthly statistics from the *.csv file. The file must contain monthly statistics stored in WATTconfig Mx, M, or ECO. This feature can transfer statistics from another device. The daily input and output states are not imported.

Annual (yearly) statistics:

- Production chart – displays summary data on production (production +surplus energy) in the last 12 months.
- Consumption Chart – displays summary data on consumption (self-consumption, consumption in normal and low tariff) in the last 12 months.
- Export- exports annual statistics to a *.csv file that can be opened e.g. in MS-Excel. Exports data for last 24 months.
- Import - imports annual statistics from the *.csv file. The file must contain annual statistics stored in WATTconfig Mx, M, or ECO. This feature can transfer statistics from another device. The daily input and output states are not imported.

***Note:** Actual day will take effect in the annual history (current month) after moving into history (after midnight).*

LOG TAB

This tab displays error and warning log. For example, the system displays detected communication errors. Since firmware version 3.0, there is also a listing of up to 20 error messages stored in the controller from the latest to the oldest. This error list is not stored in the nonvolatile memory (EEPROM) so in case of a power failure it will be deleted.

- Clear error list - press this button to clear the error list in the controller.
- Save error list - press this button to save the error list to a CSV file on your PC hard drive.
- Clear log – use this button to clear log contents.
- Save log – use this button to save the log as text file on your PC hard drive.
- Write detailed communication info - check this option to see more detailed information about communicating with the controller, for example for diagnostics. Additional information may help the technical support to detect possible problems in connection configuration etc.

OPTIONS AND BUTTONS

Main window buttons:

- Connect through – this option allows you to connect via USB or LAN.

- Connect – connects your computer to the controller and loads configuration from the controller just after successful connection has been established.
- Disconnect - disconnects your computer from the controller.
- Configure connection - the software displays a window where you may configure active connection.
- Read – reads configuration from the controller.
- Write – writes (downloads) configuration to the controller and optionally resets the controller. Configuration download via LAN interface is protected from unauthorized access or intervention.
- Open - loads configuration from PC hard drive.
- Save - saves configuration to PC hard drive.
- Reset to defaults – loads default configuration settings in WATTconfig (you have to write it then to the controller).
- Exit - exits WATTconfig software.

USB/COM DRIVER CONFIGURATION WINDOW

In this dialog box you may specify connection parameters for the USB interface.

Port settings:

- Port – if the driver is properly installed and the controller is connected to the computer, the appropriate COMx port can be found in the pop-up menu. If multiple or none ports are shown, make sure that the USB serial port driver installation in Device Manager is correct. Here, you can also find out which port is used for communication. The communication parameters are fixed: 38400 Bd, 8N1.

Timeouts:

- Default read timeout – maximum time necessary to receive response from the controller. Modify the value (increase) only if you experience communication problems.

Buttons:

- Default – sets default communication parameters.
- OK, Cancel – standard confirmation and cancellation of the dialog box.

LAN/UDP DRIVER CONFIGURATION WINDOW

In this dialog box you may specify Ethernet interface parameters and UDP protocol settings.

UDP protocol settings:

- Select profile - it is used to select connection profile. Connection profiles are used to quickly configure connection settings. They are useful e. g. for connections from local and public networks where you must switch between two IP addresses. New profile may be created by pressing the "New" button. The new profile stores the current IP address and UDP port settings. Created profiles may be deleted by the Delete button.
- IP address (IPv4) – IP address used to access the controller. You may specify the controller IP address in your local network, or if you use suitable NAT settings for your router you may also specify the global Internet address of your router. Before you changing the IP address, you have to change the IP address settings directly in the controller - see the "Other settings" tab.
- UDP port – UDP port used to access the controller. The default value is 50000.

Note: *If you cannot establish communication via Ethernet, connect via USB and check the current LAN settings in the controller.*

Timeouts:

- Default read timeout – maximum time necessary to receive response from the controller. Modify the value (increase) only if you experience communication problems.
- Communication delay after reset – if you are connected via LAN the "reestablishment" of the connection after the controller reset may take longer than if you are connected via USB. Modify the value (increase) only if you experience communication problems after controller reset (typically, after you loaded new firmware to your controller).

LED STATUSES

The following table shows possible controller statuses indicated by built-in LEDs.

LED	Status	Note

LED PWR (green)	On	The controller is switched on and no output is active.
	Flashes	The controller is switched on and some outputs are active.
	Flashes quickly	The controller is switched on and boot mode is active.
	Off	The controller is without power supply or there is a failure.
LED COM (yellow)	Off	Communication with computer via USB was not established.
	Stays on or flashes quickly	Communication with computer via USB was established.
LED ERR (red)	Off	No error status detected.
	Flashes regularly in the following way: short- short- short	Missing voltage L1 error. Proceed according to instructions specified in the chapter Measured parameters and statuses.
	Flashes regularly in the following way: short- short- long	Temperature sensor(s) error. Proceed according to instructions specified in the chapter Measured parameters and statuses.
	Flashes regularly in the following way: long-long- long	Maximum temperature exceeded. Proceed according to instructions specified in the chapter Measured parameters and statuses.
	Flashes regularly in the following way: long- long- short	DC source overload. Proceed according to instructions specified in the chapter Measured parameters and statuses.
LED OUT	Off	The relevant output is not active.
	On or flashes quickly	The output is active (switched on)
LED on LAN connector - right LED	Off	No Ethernet signal detected.
	On	Ethernet signal detected.
	Flashes	Data transfer active
LED on LAN connector - left LED	Off	Data rate is 10 Mbit/s.
	On	Data rate is 100 Mbit/s.

CONFIGURATION EXAMPLES

The examples below only illustrate the possible use of the device, in most cases it may be necessary to adjust the settings.

The examples were created in version 1.0/1.1 of the software. In newer versions there may be other advanced options to further increase the efficiency of the system.

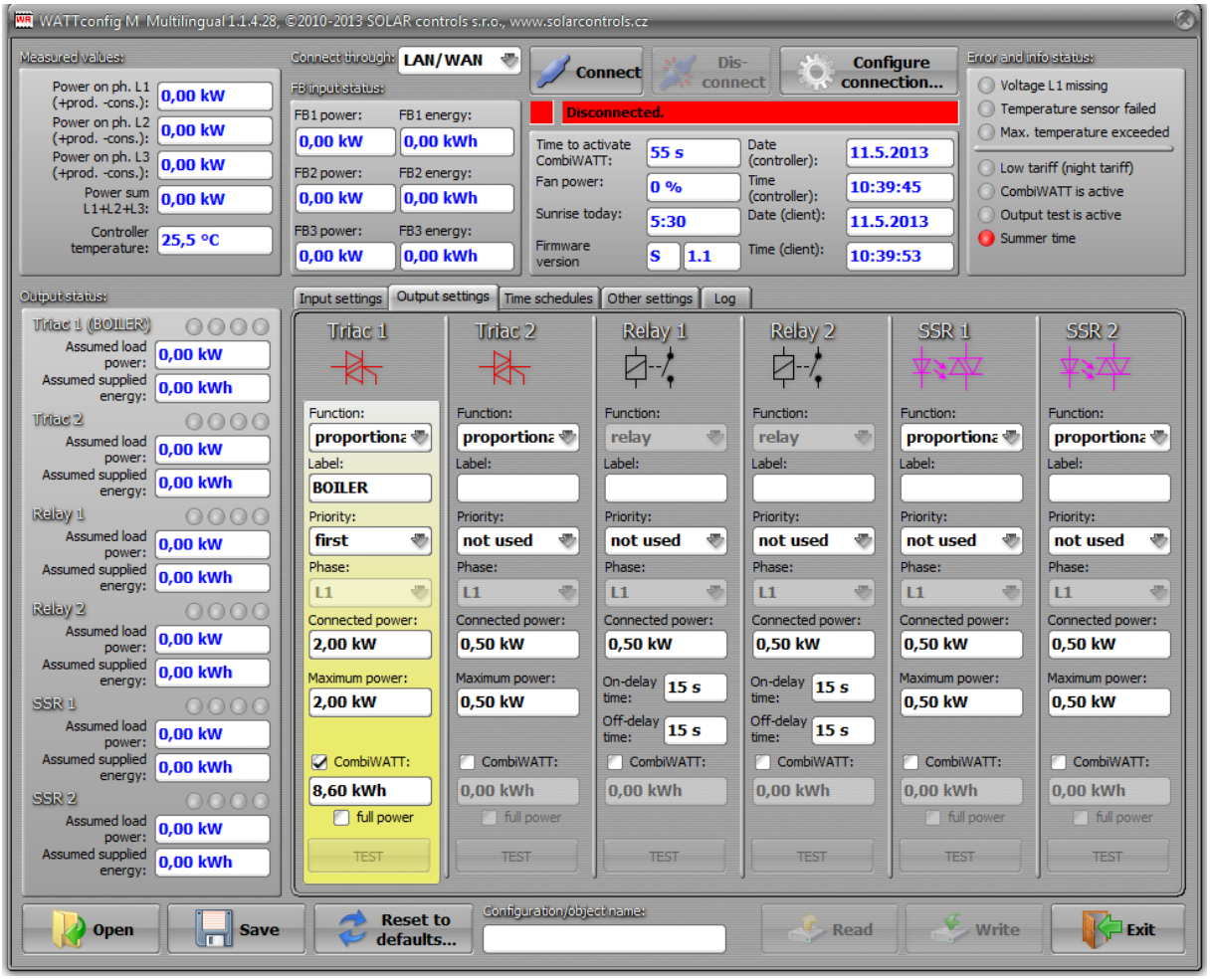
EXAMPLE NO. 1 – ONE LOAD ONLY

Boiler with nominal power rating of 2 kW, 200l of water, average cold water temperature at the input is 12 °C, hot water target temperature 50 °C, average daily water consumption is 160 l. The daily amount of electric power necessary to heat up the entire boiler (without taking into account heat losses) is:

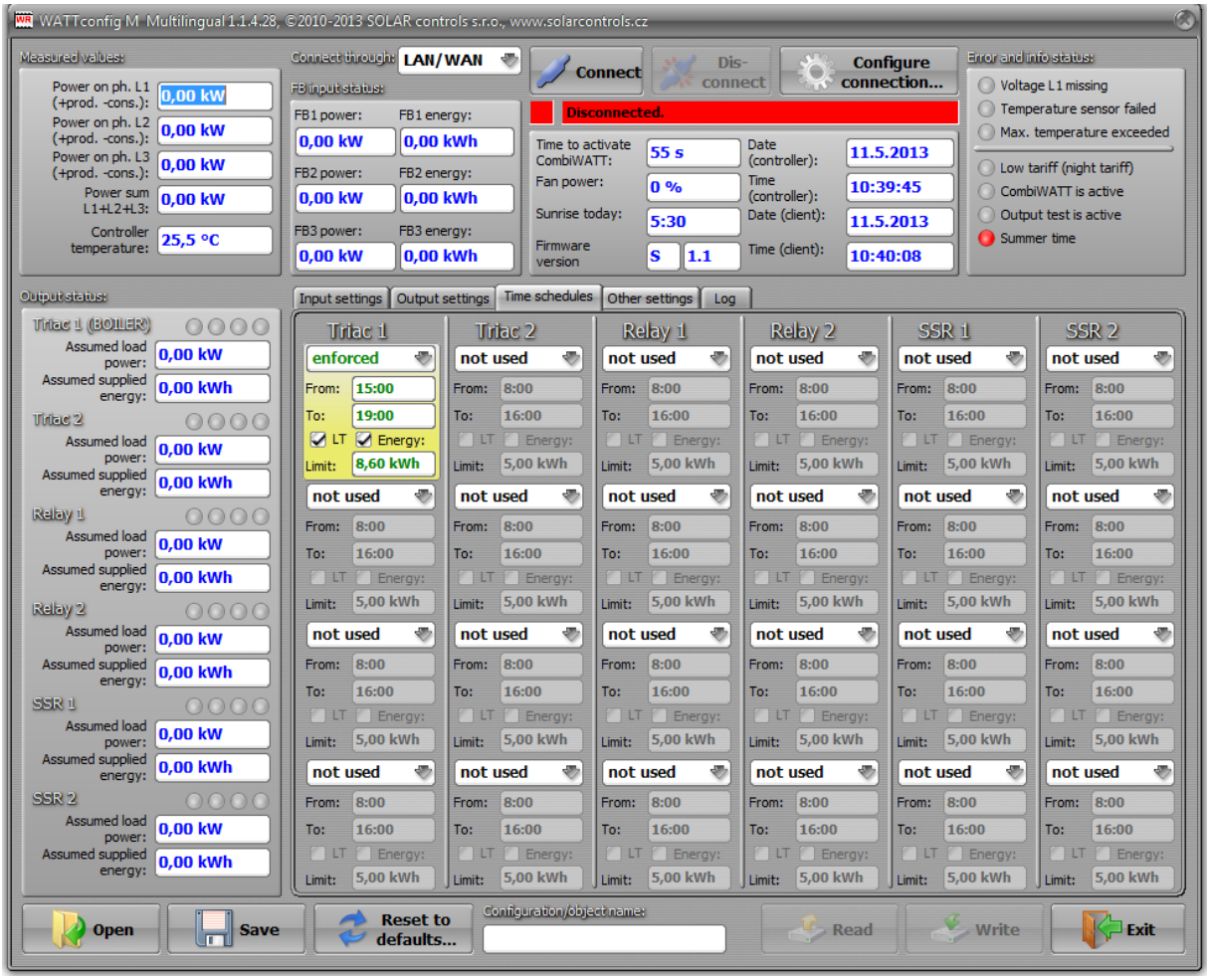
$$E = \frac{c_V * V[l] * \Delta T[K]}{3600000} = \frac{4180 * 200 * 38}{3600000} = 8.82\ kWh$$

Average daily losses of boilers with these parameters represent approximately 1.5 kWh. If you use 160 l of hot water and you take into account heat losses, the daily supply of electric power is approximately 8.6 kWh.

Boiler is connected to triac output No. 1, WATTrouter device uses low tariff signal and the boiler operates under CombiWATT mode.



The time schedule is configured for the boiler between 15:00 and 19:00.It becomes active only if the low tariff is available and, moreover, until the assumed supplied energy did not exceed the energy specified in the limit field. This allows you to heat up water for evening use, provided that during morning and afternoon hours the boiler was not sufficiently heated up by power supplied by the PV-plant. If low tariff is not active from 15:00 to 19:00, the basic control mode according to available surplus energy continues even during this time period.



EXAMPLE NO. 2 – ALL 6 LOADS, CONTROL MODE = SUM OF ALL PHASES

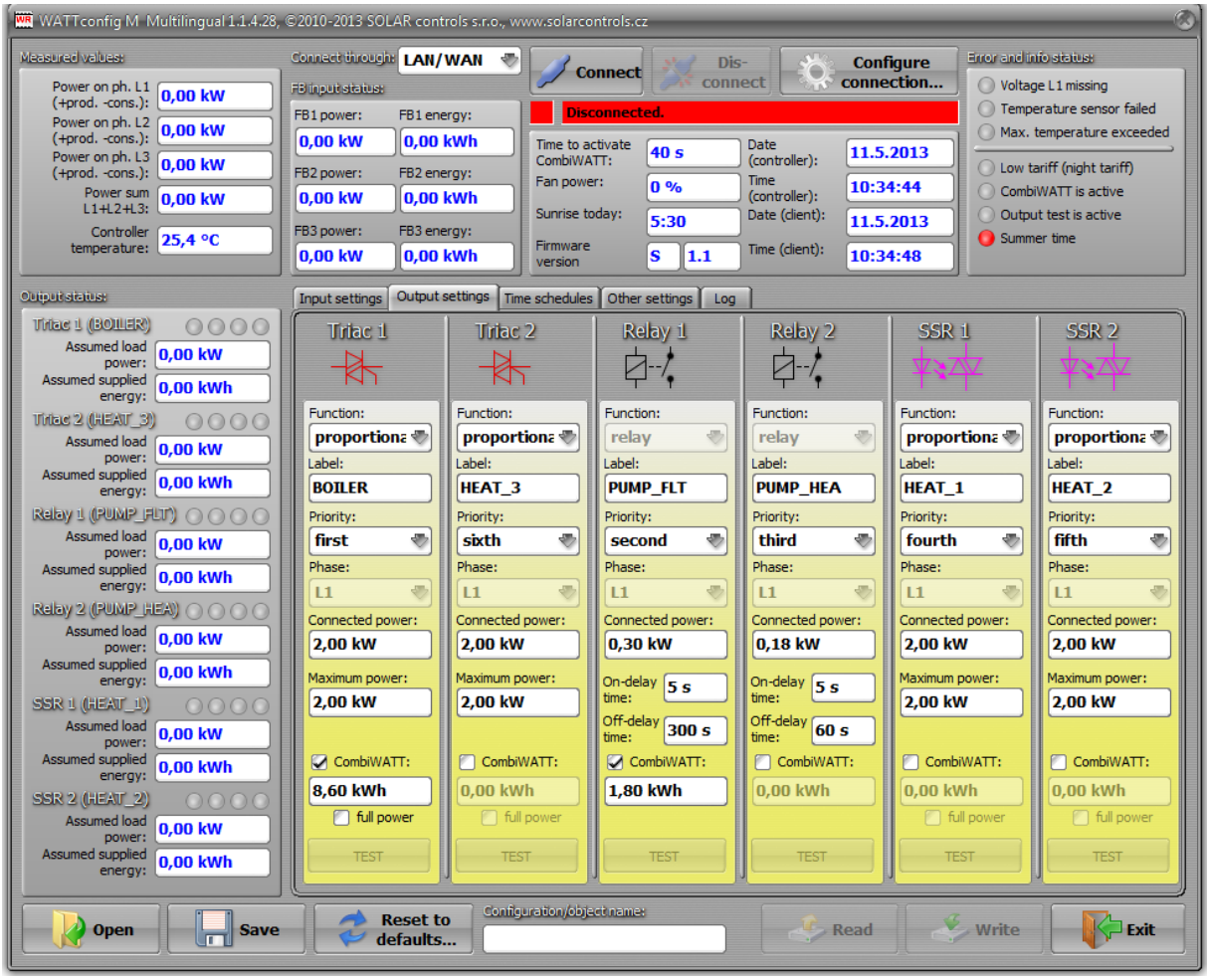
The same boiler as specified in example No. 1, swimming pool filtering pump and 6 kW instantaneous water heating for the swimming pool (pump and three-phase heating element). Recommended peak power output of the PV-plant is more than 8 kWp. It also depends on the amount of water in the pool.

Boiler heating process has 1st priority (triac No. 1).Requirements are the same as in example No. 1.

Filtering pump has 2nd priority (relay No. 1), nominal motor rating 0.3 kW (value in VA is usually not specified here), and it must run exactly for 6 hours per day and the minimum switching time is 5 minutes. The daily amount of required power for this motor is 1.8 kWh. If there is not sufficient amount of sunshine available, the system will switch back to the low tariff. The motor should not be running at night between 23:00 and 5:00 - not to disturb people during night (this also depends on the local low tariff time schedule so that the motor can get a chance to run).

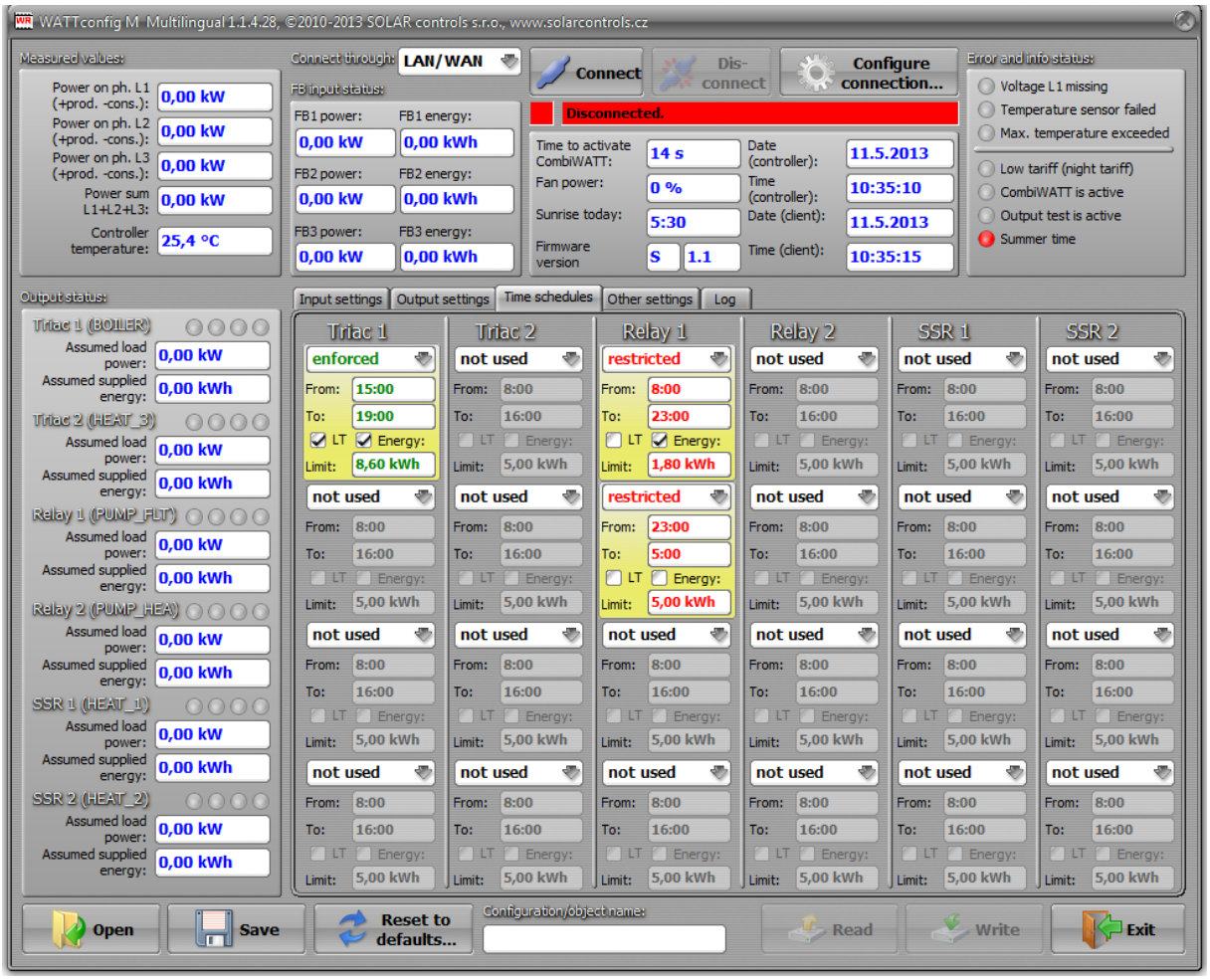
Heating pump has 3rd priority (relay No. 2), power output 0.16 kW and it must run always if the heating element of the pool heating is on. The typical off delay time for the pump is 1 minute. We only want to turn the swimming pool heating when there is surplus energy available. Make sure swimming pool heating is fitted with a thermal protection! Heating elements are connected to the remaining outputs with lower priorities (triac No. 2 and both SSR outputs).

We recommend using separate contactors for motors, but due to their low power consumption rate it is not really necessary. WATTrouter device uses low tariff signal and the boiler and swimming pool filtration motors operate under CombiWATT mode.



Time schedule for boiler is set the same as in example No. 1.

Two time schedules are assigned for pool filtering pump. The first of them describes restriction of the output during "daytime" between 8:00 and 23:00. This restriction ensures the motor runs approximately 6 hours and therefore, it applies only if the daily energy counter exceeds 1.6 kWh. The second time schedule restricts operation of the motor between 23:00 and 5:00 without any special requirements or conditions. The necessary prerequisite for correct application of these two time schedules is correct configuration of daily energy counter reset. As reset mode there must be selected "at sunrise" or "at fixed time". The fixed time for second case should be selected in the morning before 8:00.



EXAMPLE NO. 3 – ALL 6 LOADS, CONTROL MODE = EACH PHASE INDEPENDENTLY

Loads specified in example No. 2 but more complex connection. Control mode is set for each phase independently.

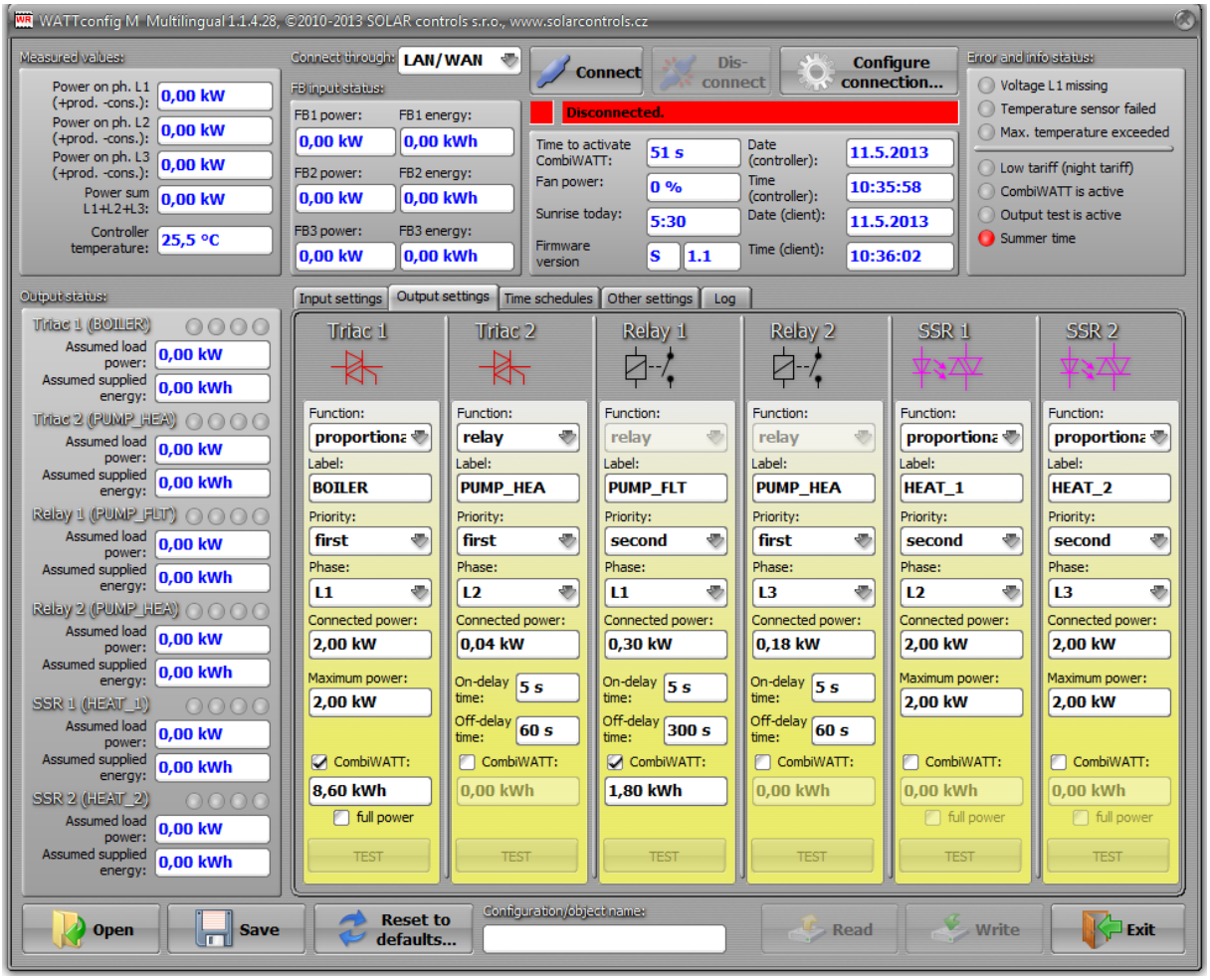
Connect the following to L1 phase:
- boiler has 1st priority (triac No. 1).Requirements are the same as in example No. 1.
- pool filtering pump has 2nd priority (relay No. 1).Requirements are the same as in example No. 2.

Connect the following to L2 phase:
- heating pump has 1st priority (relay No. 2).Requirements are the same as in example No. 2.
- 1st heating coil with 2nd priority (SSR 1).

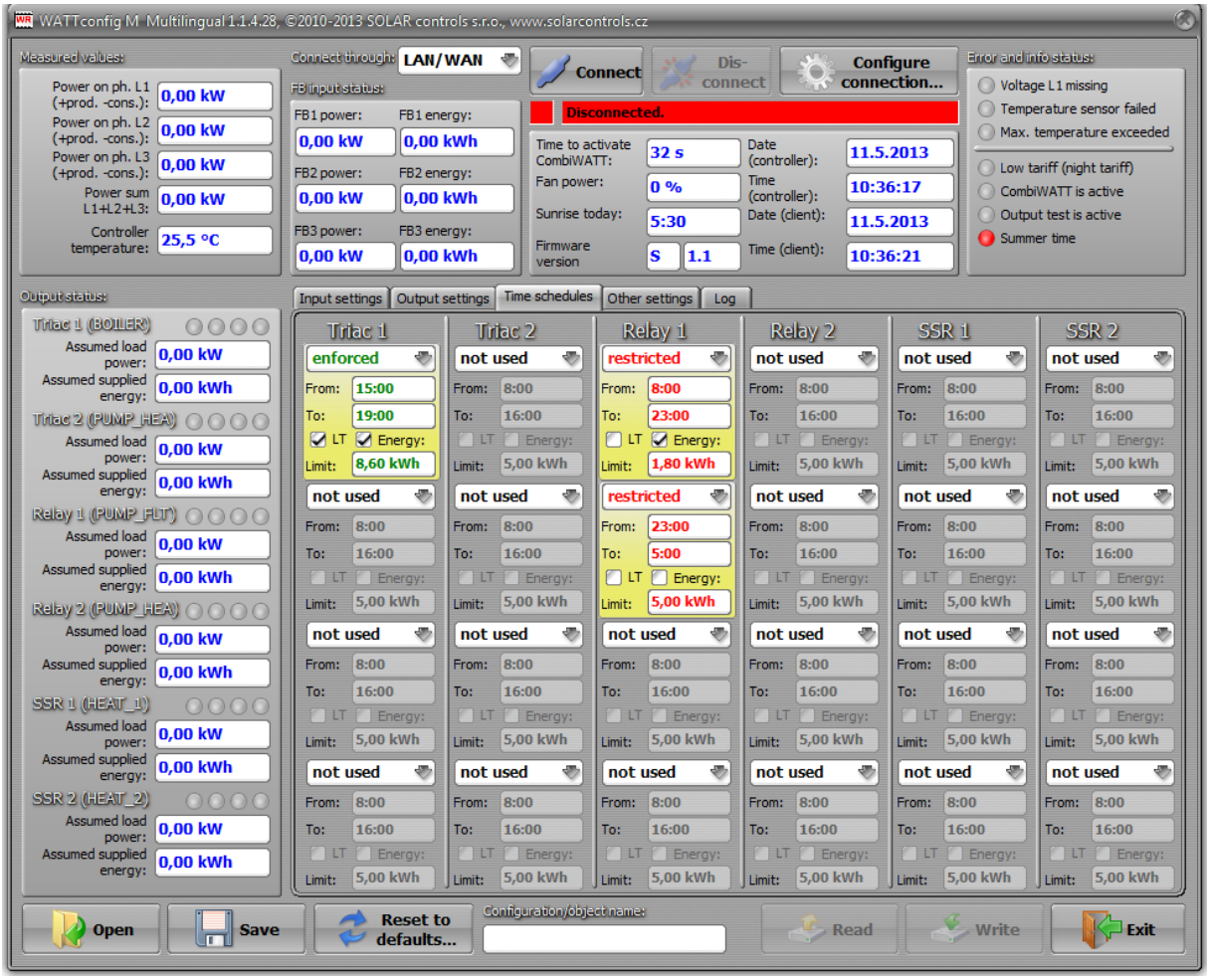
Connect the following to L3 phase:
- auxiliary contact with 1st priority (triac No. 2 operating as a relay), will also turn on the heating pump connected actually to phase L2 (here, a small amount of power may be drawn from the public grid at phase L2, but in order to prevent it we would have to use two circulation pumps).

- 2nd heating coil with 2nd priority (SSR 2).

Unfortunately, in this "one-regulator" configuration setup, the 3rd heating coil cannot be connected. We would have to make sure that the circulation heating pump will be turned on by one output only - using a time schedule, or completely separately - outside of WATTrouter.



Time schedules are the same as in example No. 2.



EXAMPLE NO. 4 – 5 LOADS, CONTROL MODE = EACH PHASE INDEPENDENTLY

Boiler and pool filtering system specified in example No. 2 plus 2 resistive electric heaters and a heating pump used to heat the swimming pool. Everything in more complex connection plus control mode set for each phase separately.

Each electric heater draws 2 kW and should be supplied only with the surplus energy, independently of the house hold primary heating system. These heaters must be deactivated at summer time - either through built in thermostats, by deactivating fuse switches for respective outputs or by deactivating them in the software.

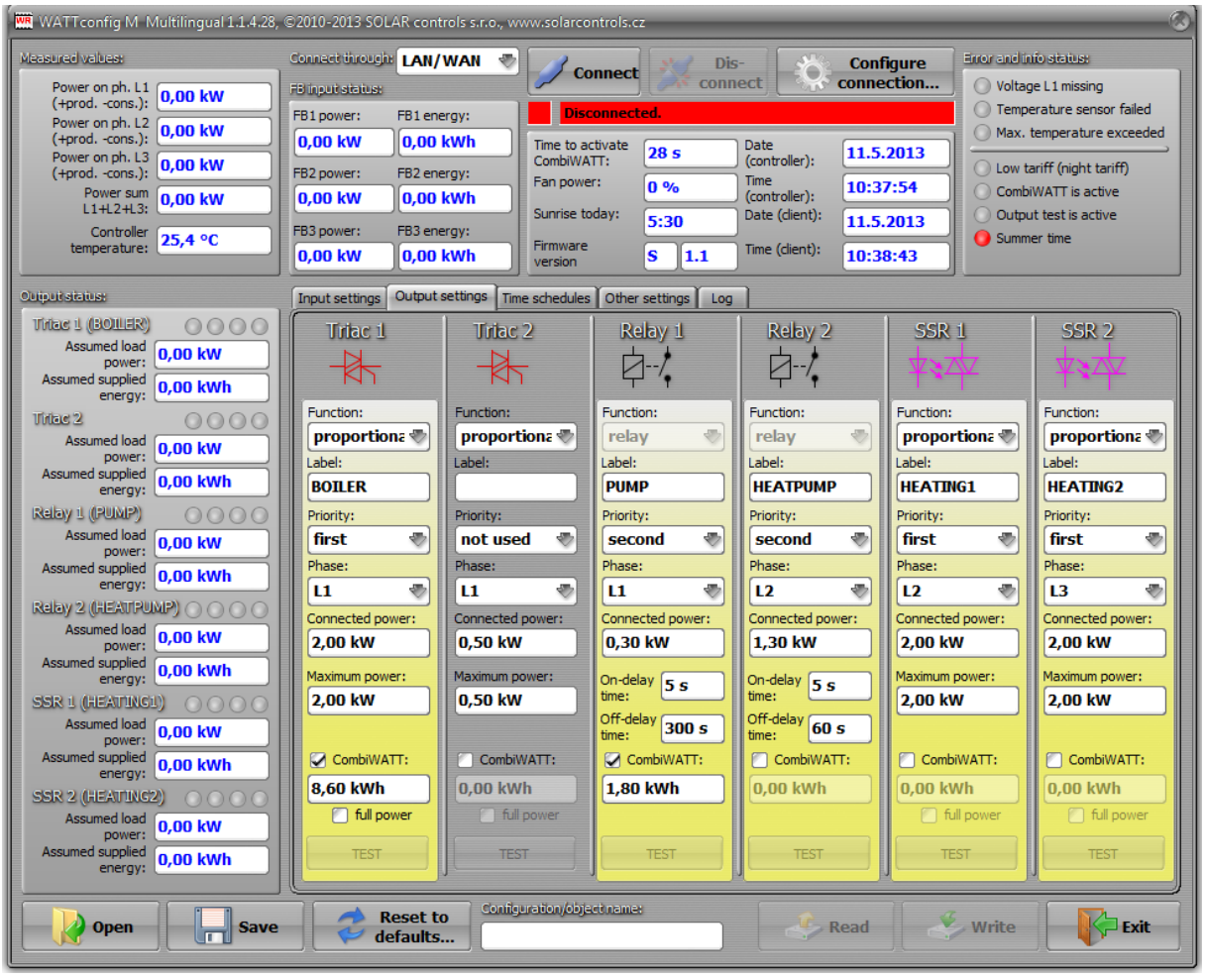
The heating pump draws power of 1.3 kW and it is supplied only with the surplus energy, or manually, outside of the WATTrouter device.

Connect the following to L1 phase:
- boiler has 1st priority (triac No. 1).Requirements are the same as in example No. 1.
- pool filtering pump has 2nd priority (relay No. 1).Requirements are the same as in example No. 2.

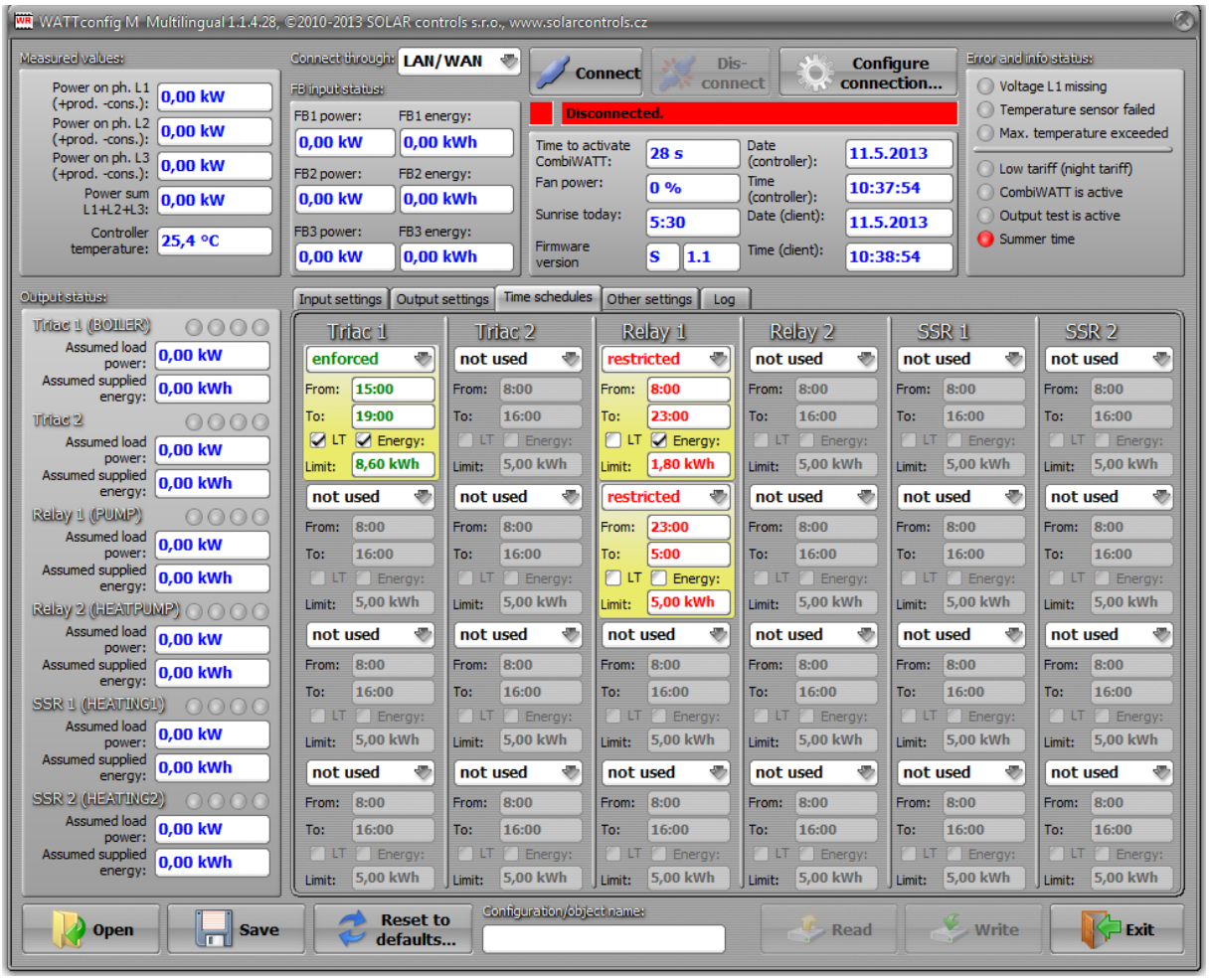
Connect the following to L2 phase:
- 1st electric heater with 1st priority (SSR 1).
- heating pump with 2nd priority (relay No. 2).

Connect the following to L3 phase:
- 2nd electric heater with 1st priority (SSR 2).

You may activate the Prepend function for relay outputs in newer software revisions, in order to better use the surplus energy at L2, when the heating pump and electric heater operate at the same time.



Time schedules are the same as in example No. 2.



ETHERNET NETWORK CONFIGURATION

WATTrouter M allows monitoring and configuration via Ethernet socket. In order to establish the communication you must correctly configure network connection.

Always entrust the configuration of the network and Internet access to the controller to a person with the necessary technical skills. Problems associated with network settings, except for demonstrable malfunctions of the regulator network interface, are not included in the manufacturer's technical support policy and cannot be claimed.

It is recommended to perform controller network settings via USB interface (when you connect via Ethernet and change network parameters you will probably always loose connection).

In order to successfully set network parameters you must know parameters of your local network. It is necessary to know the following parameters:

- IP address of your router or another access point to your local network (if it is installed),
- Free range of IP addresses, which means that you need to know what addresses do not belong to the range of dynamically assigned addresses, provided that your DHCP server is on and also what addresses are not static addresses of other devices in your local network.
- Local network mask used by all devices connected to your local network.

THE LOCAL NETWORK CONNECTION SETTINGS

Network connection is configured in the "Other settings" tab, group "Network settings".

Network configuration changes will become effective only after you reset the controller (see option "Reset unit on config. write").

- **IP address**: enter the IP address where controller will be accessible. Make sure that the address does not collide with other devices in your local network. For example, if the IP address of your router is **192.168.2.1**, set it to **192.168.2.10**, provided that this address is not already used by other device in your local network and also provided that this address does not belong to the range of dynamically assigned DHCP server addresses in your local network (DHCP server is usually active in your router).
- **Mask**: enter the mask of your local network. In majority of cases the value is **255.255.255.0**.
- **Default gateway:** set IP address of network device where the controller will try to send requests outside of your local network. In majority of cases it is the IP address of your router. In this case the address is **192.168.2.1.** If you do not have such device, enter another IP address not used in your local network. In this case, requests directed outside of your local network will not be acknowledged.
- **Controller MAC address:** enter the physical/MAC address of your controller. Change this value only if there is another device with the same MAC address in your local network.
  Note: *WATTrouter M devices do not have their own IP address range registered within the IEEE, because network communication is only additional feature and not the main function of the device.* ***If you change MAC address you must respect specific requirements applicable to these addresses!***
- **UDP port**: enter the value of the UDP port where the controller will listen to incoming UDP requests from WATTconfig M software. Change this value only if there are several UDP servers in your local network sharing the same UDP port, or if you want to increase protection against unauthorized access to your network. If you change UDP port in the controller it is also necessary to change the UDP port settings in the LAN/UDP driver configuration dialog.

- **HTTP port**: enter the HTTP port value where your controller will listen to incoming HTTP requests - that is requests from web browser. Change this value only if there are several web servers in your local network (which will be accessible from the Internet), or if you want to increase protection against unauthorized access to your network.

SETTING UP INTERNET ACCESS

In order to connect to the Internet we recommend you to have an active global static IP address. If you have only dynamically assigned IP address, you may see its value in your router info page. Dynamic IP address may also be used, but depending on your Internet connection provider, this address may vary more or less frequently. If your controller is not accessible from the Internet, always check the WAN configuration in your router first.

The controller may be accessed from the Internet only through routers or other access points which support the NAT (Native Address Translation) function or other similar function, which is used to translate global IP addresses and ports into local network IP addresses/ports.

The following text describes a sample Internet connection configuration, using a regular broadband router Edimax BR-6204Wg-M. See the below:

- On the **NAT Settings** tab check the field ***Enable NAT module function***, and press ***Apply*** and then ***Continue***.
- On the **Port forwarding** tab check ***Enable Port Forwarding***, fill out the NAT table for as seen on the picture and check ***Apply*** and then again ***Apply***, which will save the settings in the router and your router will restart.

NO.	Private IP	Type	Port Range	Comment	Select
1	192.168.2.200	TCP	80	WATTrouter HTTP	☐
2	192.168.2.200	UDP	50000	WATTrouter UDP	☐

NAT configuration is similar for other routers.

If your global address (static or the currently used dynamic address) is **80.200.50.6**, then in order to access your controller from the Internet via HTTP protocol, enter the following address into your web browser (we recommend creating a bookmark in your browser):

http://80.200.50.6/

In order to access your controller from the Internet via WATTconfig, enter the same IP address into the LAN/UDP driver configuration window, here **80.200.50.6.**

If you experience conflict between HTTP ports, provided you have several web servers in your local network which you want to be accessible from the Internet, it is necessary to select different HTTP port in the controller, for example widely used alternate port No. 8080, instead of the standard port No. 80. To access the controller then just enter the following address into your internet browser:

http://80.200.50.6:8080/

DESCRIPTION OF WEB INTERFACE AND XML COMMUNICATION

WATTrouter M devices can be monitored and configured using regular Internet browsers. Web interface can be used only if the controller is connected via Ethernet.

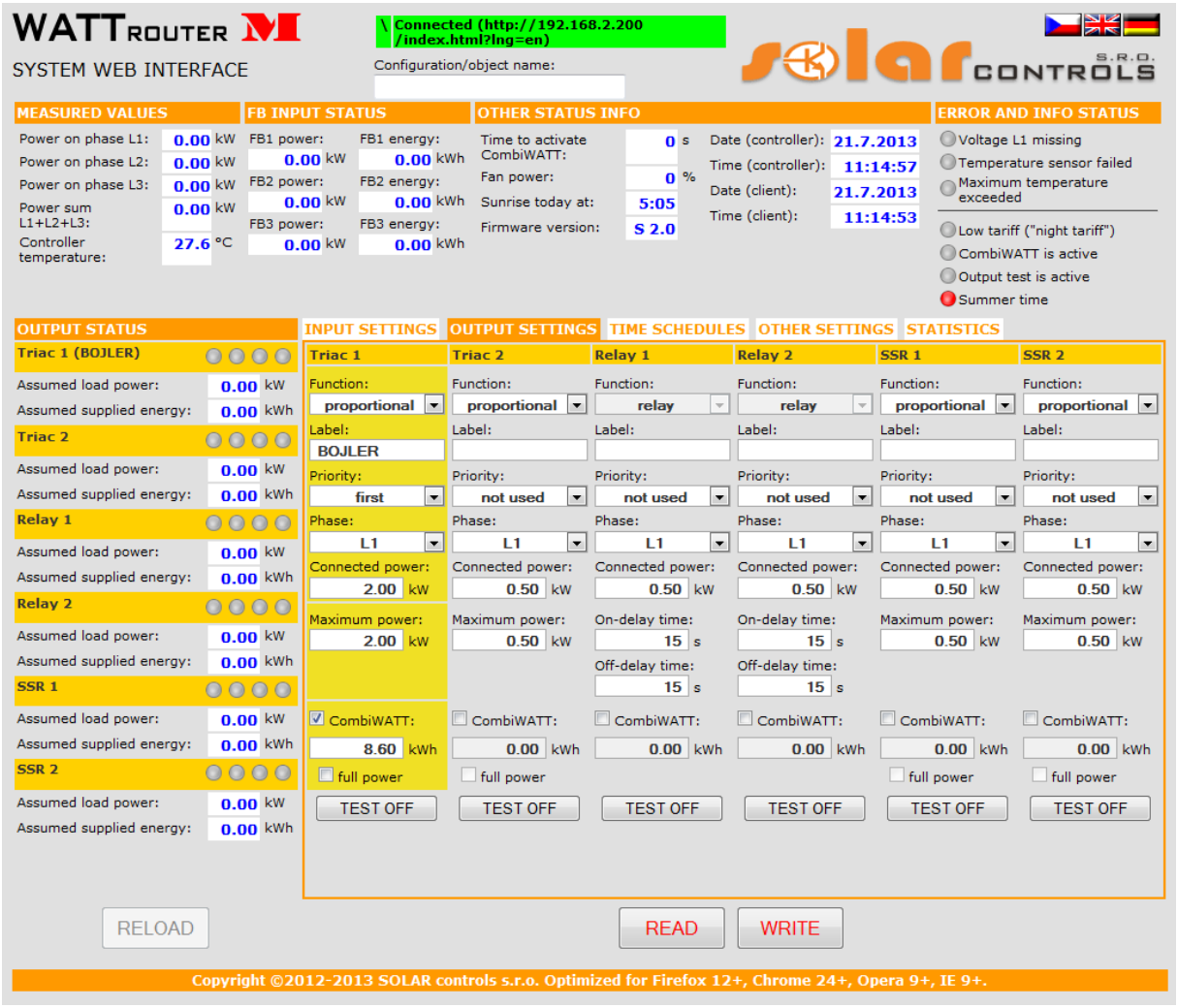


Figure14: Device web interface.

Using the web interface you may monitor and configure all controller parameters as if you would do using the WATTconfig software, except for input checking oscilloscope, time server testing, statistic export/import and firmware upgrade.

Web interface is implemented in your Internet browser by using AJAX/XML technology and therefore, you have to allow JavaScript.

Monitoring the controller activity and configuring it may also be implemented into any superior control system capable to send or parse XML data. However, the implementation requires certain knowledge of HTTP protocols and XML files.

Authorization to write a new configuration was not designed using common HTTP authentication, but instead of it the login data is embedded into each configuration write request. This mechanism simplifies the implementation on the superior control system side where using HTTP authentication could be problematic.

In order to monitor and configure your controller you may use following HTTP/XML requests. Description of individual XML data are listed as HTML/XML comments directly embedded in the XML data listings:

1. GET /meas.xml

By sending this HTTP request you will obtain the current measured/status data from the controller (actual measured powers in individual phases and power/energy values for connected loads). Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<meas>
<I1>
  <P>-2.20</P><!-- measured power by IL1 in kW-->
</I1>
<I2>
  <P>1.50</P><!-- measured power by IL2 in kW-->
</I2>
<I3>
  <P>-1.10</P><!-- measured power by IL3 in kW-->
</I3>
<I4><!-- FB1 input status-->
  <P>0.50</P><!-- measured power in kW-->
  <E>1.60</E><!-- energy counted in kWh-->
</I4>
<!-- similarly for remaining inputs FB2(I5) to FB3(I6)-->
<O1><!-- triac 1 output status-->
  <A>0</A><!-- assigned FB input (0=none, 4=FB1, 5=FB2, etc.)-->
  <P>1.00</P><!-- load power in kW-->
  <E>3.00</E><!-- supplied energy to connected load in kWh-->
  <HN>1</HN><!-- basic control mode: 0=inactive, 1=active-->
  <HC>0</HC><!-- CombiWATT mode: 0=inactive, 1=active -->
  <HE>0</HE><!-- output enforced by time schedule: 0=inactive, 1=active-->
  <HR>0</HR><!-- output restricted by time schedule: 0=inactive, 1=active--
>
  <HX>0</HX><!-- output switched externally: 0=inactive, 1=active-->
  <TOT>0</TOT><!-- timer status of the relay on-delay timer -->
  <TFT>0</TFT><!-- timer status of the relay off-delay timer -->
  <T>0</T><!-- output test: 0=inactive, 1=active-->
  <EX>0</EX><!-- private auxiliary item-->
</O1>
<!-- similarly for remaining outputs triac 2(O2) to SSR 2(O6)-->
<PPS>-1.80</PPS><!-- sum of measured powers L1+L2+L3 in kW-->
<DaR>1.1.2017</DaR><!-- date (controller)-->
<TiR>0:00:00</TiR><!-- time (controller)-->
<CW>7200</CW><!-- time to activate CombiWATT-->
<DC>12.0</DC><!--internal DC source-->
<FW>1.0</FW><!-- firmware version-->
<EL1>0</EL1><!-- 0=no fault, 1=L1 voltage missing error-->
<ETS>0</ETS><!-- 0=no fault, 1=temperature sensor(s) error-->
<EDC>0</EDC><!-- 0=no fault, 1=DC source overload-->
<ELV>0</ELV><!-- 0=no fault, 1=max. temperature exceeded -->
<ILT>0</ILT><!-- 0=not present, 1=low tariff active-->
<ICW>0</ICW><!-- 0=not present, 1=CombiWATT active-->
<ITS>0</ITS><!-- 0=not present, 1=output test active-->
<IDST>0</IDST><!-- 0=not present, 1=summer time-->
<SRT>6:00</SRT><!-- sunrise time-->
<SST>18:00</SST><!-- sunset time-->
<DW>1</DW><!-- day of week (0=Monday to 6=Sunday)-->
<DIP>...</DIP><!-- controller IP address (currently configured)-->
<DMS>...</DMS><!-- subnet mask (currently configured)-->
<DDR>...</DDR><!-- default gateway IP address (currently configured)-->
<DDN>...</DDN><!-- DNS server IP address (currently configured)-->
```

```
<WV>6</WV><!-- internal version of the corresponding WATTconfig software-->
</meas>
```

2. GET /conf.xml

   By sending this HTTP request you will obtain the current configuration stored in the controller (input and output settings, etc.). Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<conf>
<DE>My configuration</DE><!-- configuration/object name-->
<I1><!-- IL1 input configuration-->
  <N>IL1</N><!-- input label, for ILx inputs cannot be changed-->
  <F>0</F><!-- input function (0=power meas. to 1=impulse input), cannot be
changed -->
  <Ph>0</Ph><!-- input phase (0=L1 to 2=L3)-->
  <CD>0</CD><!-- current orientation (0=normal, 1=reversed)-->
  <M>1</M><!-- conversion ratio of external CTs - multiplier-->
  <D>1</D><!-- conversion ratio of external CTs - divider-->
  <V>0</V><!-- voltage for calculation (0=measured at L1, 1=fixed)-->
..<O>0.00</O><!-- energy offset v kWh, only for FB inputs-->
..<Pu>1000</Pu><!-- number of impulses per kWh, only for FB inputs-->
</I1>
<!-- similarly for remaining inputs IL2(I2) to FB3(I6)-->
<O1><!-- SSR1 output configuration-->
  <N>BOILER</N><!-- output label-->
  <F>1</F><!-- output function (0=relay, 1=proportional, 2=PWM)-->
  <Pr>1</Pr><!-- output priority (0=unused to 6=sixth)-->
  <Ph>0</Ph><!-- output phase (0=L1 to 2=L3)-->
  <M>0</M><!-- 3f mode (0=none to 3=max(L1,L2,L3))-->
  <Po>2.00</Po><!-- connected output power in kW-->
  <PM>2.00</PM><!-- maximum output power in kW-->
  <PN>0.00</PN><!-- minimum output power in kW, only for PWM function-->
  <PI>500</PI><!-- PWM-I value, only for PWM function-->
  <PRB>0</PRB><!-- PWM range, minimum in %-->
  <PRE>100</PRE><!-- PWM range, maximum in %-->
  <TO>15</TO><!-- on-delay time in s, only for relay function-->
  <TF>15</TF><!-- off-delay time in s, only for relay function-->
  <Du>0</Du><!-- duplicate to (0=not used, 1=triac 1, etc.)-->
  <Q>0</Q><!—measured by input (0=not used, 1=FB1, etc.)-->
  <CE>0.50</CE><!-- energy limit for CombiWATT in kWh-->
  <CF>0</CF><!-- full power for CombiWATT (0=no, 1=yes)-->
  <PR>0</PR><!-- prepend before SSR (0=inactive to 5=max. output count)-->
  <In>0</In><!-- inverted output (0=normal, 1=inverted)-->
  <TS>0</TS><!-- number of displayed time schedules (0=none to 4=all)-->
</O1>
<!-- similarly for remaining outputs triac 2(O2) to SSR 2(O6)-->
<TS11><!-- 1st time schedule for 1st output (triac 1)-->
  <M>2</M><!-- mode (0=unused, 1=restricted, 2=enforced) + binary input,
energy flags, day of week flags, details upon request-->
  <N>15:00</N><!-- time From-->
  <F>19:00</F><!-- time To-->
  <P>100</P><!-- power in percent, only for proportional outputs-->
..<Li>8.60</Li><!-- energy limit-->
  <B>0</B><!-- assigned Binary input (0=none, 1=LT)-->
</TS11>
<!-- similarly for remaining outputs and time schedules (a total of 24 time
schedules)-->
```

```
<RM>1</RM><!-- control mode (0=each phase independently, 1=sum of all
phases)-->
<PO>-0.10</PO><!-- power offset in kW-->
<PWM>0</PWM><!-- PWM frequency (0=10kHz to 5=200Hz-->
<TB>1</TB><!-- output test blocks control (0=no, 1=yes)-->
<TTL>0</TTL><!-- output test timeout (0=none)-->
<SCO>0</SCO><-- standby cooling (0=inactive, 1=active)>
<TF>30.0</TF><-- fan trigger temperature in standby in °C>
<TM>50.0</TM><-- maximum controller temperature in °C>
<IP>...</IP><!-- controller IP address-->
<MSK>...</MSK><!-- controller subnet mask-->
<DR>...</DR><!-- default gateway IP address-->
<DNS>...</DNS><!-- DNS server IP address-->
<MAC>...</MAC><!-- controller MAC address-->
<HTTP>80</HTTP><!-- HTTP port-->
<UDP>80</UDP><!-- UDP port-->
<DHCP>1</DHCP><!-- DHCP mode (0=none to 2=all)-->
<CWD>7200.0</CWD><!-- CombiWATT delay in s-->
<CWL>0.02</CWL><!-- CombiWATT production limit in kW-->
<CWR>0</CWR><!-- energy counter reset (0=at sunrise to 1=fixed time)-->
<CWT>6:00</CWT><!-- fixed time for energy counter reset-->
<LA>50</LA><!-- latitude in °-->
<LO>15</LO><!-- longitude in °-->
<STC>0</STC><!-- synchronize date and time with the client (0=inactive,
1=active)-->
<STS>0</STS><!-- synchronize date and time with time server (0=inactive,
1=active)-->
<DST>1</DST><!-- use summer time (0=inactive, 1=active)-->
<TZ>13</TZ><!-- time zone (0=GMT-12 through 25=GMT+14)-->
<TSH>pool.ntp.org</TSH><!-- time server hostname-->
<TSIP>...</TSIP><!-- time server IP address-->
<DT>0</DT><!-- digital sensor type (0=DS18S20, 1=DS18B20)-->
<LTI>0</LTI><!-- low tariff input (0=none, 1=LT, etc.)-->
<DFT>1</DFT><!-- default tab (0=Input settings to 5=Statistics)-->
<DFS>1</DFS><!-- default statistics tab (0=Real time chart to 5=All time)--
>
<SC><!-- Configuration of statistics and real time chart -->
  <C1>0</C1><!-- input consumption phase L1 (0=not used, 1=IL1, etc.)-->
  <S1>0</S1><!-- input surplus energy phase L1 (0=not used, 1=IL1, etc.)-->
  <P1>0</P1><!-- input production phase L1 (0=not used, 1=IL1, etc.)-->
  <!-- similarly for remaining phases L2 to L3 -->
  <P>5</P><!-- time base (0=1s to 8=600s)-->
  <L1>1</L1><!-- assignment for series 1 (0=unassigned, 1=IL1, etc.)-->
  <!-- similarly for remaining series-->
</SC>
</conf>
```

3. POST /conf.xml

By sending this HTTP request you will save the configuration in the controller. This configuration has the same format as the GET /conf.xml command, but you must (can) also send additional data. Append the configuration to the POST /conf.xml command and skip 1 empty line, so the request will look like this:

```
POST /conf.xml
<!--Request headers-->
<!--one empty line-->
<conf>
<!--the following shows configuration data structure as in the GET
/conf.xml request-->
<DaC>1.1.2012</DaC><!-- date (client)-->
```

```
<TiC>0:00:00</TiC><!-- time (client)-->
<UN>admin</UN><!-- username for authorization, mandatory item-->
<UP>1234</UP><!-- password for authorization, mandatory item-->
<UNn>home</UNn><!-- new username, only when change is required-->
<UPn>abcd</UPn><!-- new password, only when change is required-->
<RST>1</RST><!-- reset controller, only if required-->
</conf>
```

The controller will reply with the following:

```
<!--Response headers-->
<!--one empty line-->
<conf>
<accept>0</accept><!-- error code: 0-ok, 1-incorrect configuration, 2-
incorrect login (access) data, 3-incorrect new login data, 4-wrong XML file
format-->
</conf>
```

4. POST /test.xml

By sending this HTTP request you activate or deactivate test mode for given output(s). Append the data to the POST /test.xml command and skip 1 empty line, so the request will look like this:

```
POST /test.xml
<!--Request headers-->
<!--one empty line-->
<test>
<TST1>1</TST1><!-- activate test mode for triac 1 output (1=activate,
0=deactivate)-->
<!-- similarly for remaining outputs when test mode change is required for
them-->
<UN>admin</UN><!-- username for authorization, mandatory item-->
<UP>1234</UP><!-- password for authorization, mandatory item-->
</test>
```

The controller will reply with the following:

```
<!--Response headers-->
<!--one empty line-->
<test>
<accept>0</accept><!-- error code: 0-ok, 2-incorrect login (access) data,
4-wrong XML file format-->
</test>
```

5. POST /learn.xml

By sending this HTTP request you activate the search request for any digital temperature sensors connected to the DQ data bus. Append the data to the POST /learn.xml command and skip 1 empty line, so the request will look like this:

```
POST /learn.xml
<!--Request headers-->
<!--one empty line-->
<learn>
<LRN>1</LRN><!-- search for temperature sensors-->
<UN>admin</UN><!-- username for authorization, mandatory item-->
<UP>1234</UP><!-- password for authorization, mandatory item-->
</learn>
```

The controller will reply with the following:

```
<!--Response headers-->
<!--one empty line-->
<learn>
<accept>0</accept><!-- error code: 0-ok, 2-incorrect login (access) data,
4-wrong XML file format-->
</learn>
```

6. GET /stat_chart.xml

   By sending this HTTP request you will obtain the real time chart data from the controller. Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<stat_chart>
<DaR>2020-01-01</DaR><!-- date when last acquired-->
<TiR>08:00:00</TiR><!-- time when last acquired-->
<P1>0.50,0.40,...</P1><!-- sequence of values for series 1 - power-->
<!-- similarly for remaining series-->
</stat_chart>
```

7. GET /stat_day.xml?day={index}

   By sending this HTTP request you will obtain the daily statistics from the controller. The "index" parameter specifies the selected day (0=today, 1=yesterday to 7=last saved day). Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<stat_day>
<SDD0>2017-07-20</SDD0><!-- date today-->
<SDD{index}>2017-07-17</SDD{index}><!-- date selected day-->
<SDS1>0.00</SDS1><!-- surplus energy phase L1 in kWh-->
<SDH1>0.00</SDH1><!-- consumption normal tariff phase L1 in kWh-->
<SDL1>0.00</SDL1><!-- consumption low tariff phase L1 in kWh-->
<SDP1>0.00</SDP1><!-- production phase L1 in kWh-->
<!-- similarly for remaining phases L2 and L3-->
<SDS4>0.00</SDS4><!-- surplus energy all phases in kWh-->
<SDH4>0.00</SDH4><!-- consumption normal tariff all phases in kWh-->
<SDL4>0.00</SDL4><!-- consumption low tariff all phases in kWh-->
<SDP4>0.00</SDP4><!-- production all phases in kWh-->
<SDO1>0.00</SDO1><!-- daily energy for output 1 in kWh-->
<!-- similarly for remaining outputs triac 2(SDO2) to SSR 2(SDO6)-->
<SDI1>0.00</SDI1><!-- daily energy for FB1 input in kWh-->
<!-- similarly for remaining inputs FB2(SDI2) to FB3(SDI3)-->
</stat_day>
```

8. GET /stat_week.xml

   By sending this HTTP request you will obtain the weekly statistics from the controller. Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<stat_week>
<SWD>2017-07-20</SWD><!-- date today-->
<SWS1>0.00</SWS1><!-- surplus energy all phases in kWh, yesterday-->
<SWH1>0.00</SWH1><!-- consumption normal tariff all phases v kWh,
yesterday-->
<SWL1>0.00</SWL1><!-- consumption low tariff all phases in kWh, yesterday--
>
<SWP1>0.00</SWP1><!-- production all phases in kWh, yesterday-->
```

```
<!-- similarly for the 2th to 7th last day-->
</stat_week>
```

9. GET /stat_month.xml

   By sending this HTTP request you will obtain the monthly statistics from the controller. Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<stat_month>
<SMD>2017-07-20</SMD><!-- date today-->
<SMS1>0.00</SMS1><!-- surplus energy all phases in kWh, yesterday-->
<SMH1>0.00</SMH1><!-- consumption normal tariff all phases v kWh,
yesterday-->
<SML1>0.00</SML1><!-- consumption low tariff all phases in kWh, yesterday--
>
<SMP1>0.00</SMP1><!-- production all phases in kWh, yesterday-->
<!-- similarly for the 2th to 31th last day-->
</stat_month>
```

10. GET /stat_year.xml

    By sending this HTTP request you will obtain the annual statistics from the controller. Structure of returned data:

```
<!--Response headers-->
<!--one empty line-->
<stat_year>
<SYD>2017-07-20</SYD><!-- date today-->
<SYS1>0.00</SYS1><!-- surplus energy all phases in kWh, this month-->
<SYH1>0.00</SYH1><!-- consumption normal tariff all phases v kWh, this
month-->
<SYL1>0.00</SYL1><!-- consumption low tariff all phases in kWh, this month-
->
<SYP1>0.00</SYP1><!-- production all phases in kWh, this month-->
<!-- similarly for the 2th to 12th last month-->
</stat_year>
```

In addition to these commands, there are other non-public HTTP requests for S-Connect configuration and monitoring since firmware version 4.0.

DESCRIPTION OF THE MODBUS PROTOCOL

As of firmware version 4.1, the device supports the MODBUS TCP on the Ethernet line.

Only the SLAVE (server) version is supported, ie the device answers requests from the parent unit, which is MASTER (client).

The protocol supports only 4 functions, namely:

- Read Holding Registers (03)
- Read Input Registers (04)
- Write Single Register (06)
- Write Multiple Registers (16)

Attention, a maximum of 32 registers can be read/written with one 03 or 04 or 16 function request!

MODBUS TCP communication parameters on the Ethernet line are: server IP = controller IP, server port = 502.

The Unit ID field in the MBAP header is ignored – it is possible to send any value and the controller will respond.

INPUT REGISTER TABLE

The registers are 16-bit. The data in the registers are stored in Big Endian format. If a 32-bit value is stored, which occupies 2 adjacent registers, then a higher word is stored in the lower register and a lower word in the higher register.

These registers may be read with the function Read Input Registers (04).

Register number	Meaning	Bit width	Unit	Notes
Measured values and states				
0-1	Power on phase L1	32s	Tens of W	
2-3	Power on phase L2	32s	Tens of W	
4-5	Power on phase L3	32s	Tens of W	
6-7	Power sum L1+L2+L3	32s	Tens of W	
8-9	Voltage at L1	32s	V	
10	Error word	16u	-	Meaning of bits: 0 – Missing voltage L1 1 – Temperature sensor(s) 2 – reserved 3 – DC source overload 4 – reserved 5 – Max. temperature exceeded 6 to 15 – reserved
11	Info word	16u	-	Meaning of bits: 0 – Low tariff 1 – CombiWATT is active 2 – Output test is active 3 – Summer time 4 to 15 - reserved
FB inputs				
12-13	Power FB1	32s	Tens of W	

14-15	Energy FB1	32s	Tens of Wh	
16-17	Power FB2	32s	Tens of W	
18-19	Energy FB2	32s	Tens of Wh	
20-21	Power FB3	32s	Tens of W	
22-23	Energy FB3	32s	Tens of Wh	
24-27	Reserved	32s	-	Always reads as zero.
Outputs				
28-29	Load power Triac1	32s	Tens of W	
30-31	Supplied energy Triac1	32s	Tens of Wh	
32-33	Load power Triac2	32s	Tens of W	
34-35	Supplied energy Triac2	32s	Tens of Wh	
36-37	Load power Relay1	32s	Tens of W	
38-39	Supplied energy Relay1	32s	Tens of Wh	
40-41	Load power Relay2	32s	Tens of W	
42-43	Supplied energy Relay2	32s	Tens of Wh	
44-45	Load power SSR1	32s	Tens of W	
46-47	Supplied energy SSR1	32s	Tens of Wh	
48-49	Load power SSR2	32s	Tens of W	
50-51	Supplied energy SSR2	32s	Tens of Wh	
52-91	Reserved	32s	-	Always reads as zero.
Statistics current day				
92-93	Cons. HT (total L1+L2+L3)	32s	Tens of Wh	
94-95	Cons. LT (total L1+L2+L3)	32s	Tens of Wh	
96-97	Surplus (total L1+L2+L3)	32s	Tens of Wh	
98-99	Production (total L1+L2+L3)	32s	Tens of Wh	
100-101	Cons. HT (L1)	32s	Tens of Wh	
102-103	Cons. LT (L1)	32s	Tens of Wh	
104-105	Surplus (L1)	32s	Tens of Wh	
106-107	Production (L1)	32s	Tens of Wh	
108-109	Cons. HT (L2)	32s	Tens of Wh	
110-111	Cons. LT (L2)	32s	Tens of Wh	
112-113	Surplus (L2)	32s	Tens of Wh	
114-115	Production (L2)	32s	Tens of Wh	
116-117	Cons. HT (L3)	32s	Tens of Wh	
118-119	Cons. LT (L3)	32s	Tens of Wh	
120-121	Surplus (L3)	32s	Tens of Wh	
122-123	Production (L3)	32s	Tens of Wh	
Device type and firmware version				
124-125	Device type	32u	-	ASCII text „WRMS“ or “WRMM”
126-127	Firmware version	32u	-	ASCII text for firmware version Character meaning: 0 – development version, default is ‘A’ for normal release 1 – bug fix version, default is ‘0’

				for normal release 2 – major version, eg. ‘4’ 3 – minor version, eg. ‘1’
128-129	Device option	32u	-	ASCII text for device option: a) text “SSR” – 20A option b) text “MAX“ – 100A option

HOLDING REGISTER TABLE

The registers are 16-bit. The data in the registers are stored in Big Endian format. If a 32-bit value is stored, which occupies 2 adjacent registers, then a higher word is stored in the lower register and a lower word in the higher register.

These registers may be read with the function Read Holding Registers (03) and written with the function Write Single Register (06) or Write Multiple Registers (16).

Register number	Meaning	Bit width	Unit	Notes
Outputs – external switching ***(does not restrict internal output switching in any way)***				
0	Switching level Triac1	16u	-	0 – turned off 1000 – fully turned on
1	Switching level Triac2	16u	-	0 – turned off 1000 – fully turned on
2	Switching level Relay1	16u	-	0 – turned off 1000 – fully turned on
3	Switching level Relay2	16u	-	0 – turned off 1000 – fully turned on
4	Switching level SSR1	16u	-	0 – turned off 1000 – fully turned on
5	Switching level SSR2	16u	-	0 – turned off 1000 – fully turned on
6-7	Reserved	16u	-	Always reads as zero. Writing any value does nothing.
Outputs – external restriction ***(restricts internal output switching, does not restrict external switching)***				
8	Restriction level Triac1	16u	-	0 – not restricted 1000 – fully restricted
9	Restriction level Triac2	16u	-	0 – not restricted 1000 – fully restricted
10	Restriction level Relay1	16u	-	0 – not restricted 1000 – fully restricted
11	Restriction level Relay2	16u	-	0 – not restricted 1000 – fully restricted
12	Restriction level SSR1	16u	-	0 – not restricted 1000 – fully restricted
13	Restriction level SSR2	16u	-	0 – not restricted 1000 – fully restricted

14-15	Reserved	16u	-	Always reads as zero. Writing any value does nothing.

Note: *For external switching/restriction of outputs, do not write values 1-999 in case of set relay function. For other functions, the selected modulation type (proportional or PWM) is used.*

Note: *Do not combine external switching on one output via both MODBUS and S-Connect protocols! This may damage the output or the connected load!*

Note: *When switched/restricted externally, the output keeps the switched/restricted state for only 30 s, then for safety reasons the output will be switched off and its restriction cancelled. If you want to switch/restrict the output in this way for a longer time, you must send message 06/16 repeatedly, with a period of eg 10 s.*

TROUBLESHOOTING

The following table shows the most frequent problems and usual solutions:

Problem description	Possible causes	Solution
The controller has been fitted according to the manual but after you switch on the circuit breaker no LED lights up or flashes.	The circuit breaker is on but the supply voltage is missing.	Check or measure whether there is any voltage between terminals L1 and N.
	Regulator failure/defect	Replace the regulator or take it to repair.
The controller has been fitted according to the manual but after you turn on the circuit breaker the green LED quickly flashes, the controller does not work and the WATTconfig software shows BOOT firmware version.	The controller runs in the boot mode without any application firmware	Use the WATTconfig software and load the newest firmware version or load the version you prefer. In this scenario, you have to load the application using USB interface, which is not blocked by the controller access authorization.
The controller does not communicate with computer	The regulator has no voltage	Check whether green LED PWR is on and the regulator is powered.
	Computer is not properly connected with the controller	Check the USB/network cable connection, try using different network cable, or try the cable with different device (printer for example). If there is problem with network connection you may have a problem with your router or with other network components. Try to restart your device or try to connect the network cable to another port. Your device may also be incorrectly configured - the same applies to local network configuration settings. Should you experience problems contact a computer or network expert. If there is problem with the USB connection then always try the newest USB driver.
	Computer cannot detect connected controller.	Check USB/network cable connection. When USB device is being registered in your PC, the yellow LED COM must flash temporarily. If your network cable is connected correctly, at least one LED on the regulator network connector must be on.
	USB interface driver was not correctly installed in your computer	Make sure the USB interface driver is correctly installed and Windows device manager detects it as a USB serial converter.
	USB interface driver is not configured properly	Use the USB/COM driver configuration window in WATTconfig and reset all parameters back to default values.

	LAN/UDP interface driver is not configured properly	Use the LAN/UDP driver configuration window in WATTconfig to check the validity of IP address and UDP port. Connect to the controller using USB in order to determine the current network configuration stored in the controller (use the Other settings tab). IP addresses and UDP ports must have the same configuration.
	The Log window records communication errors	A very few communication errors is considered a common status and it depends on the actual load put on the operating system in your computer, the local network, or on the operating system running in the controller. However, if there are many errors inspect the functionality of your PC, or it may also be a conflict at the USB interface in your PC, USB driver may be outdated or your Ethernet may be overloaded or malfunctioning. If you are connected to the Internet, large occurrence of communication errors (packet losses) is considered normal status. With S-Connect communication over Ethernet active, the frequency of these errors increases further.
	Overloaded Ethernet	Your local network or Internet connection is temporarily out of order, overloaded with other transfers, etc. Try to reconnect later or ask a network expert for advice to optimize your connection.
	Regulator failure/defect	Replace the regulator or take it to repair.
Measured powers on ILx inputs are not displayed or they are displayed incorrectly	The current sensing module is not connected	Connect the current sensing module according to this manual.
	Incorrect phase sequence	Make sure that for all ILx inputs the “Phase” field is correctly set. Perform the settings according to chapter Setting up main function and check with Input checking oscilloscope.
	Incorrect current orientation settings	Make sure that for all ILx inputs the “Current orientation” field is correctly set. Perform the settings according to chapter Setting up main function.
	Regulator or current sensing module defect	Replace the regulator and/or current sensing module or take them to repair.
There are suspicious waveforms shown in chart "Input checking oscilloscope"	This is normal	During normal operation there may be shown even "exotic" waveforms. Be sure this is the real current flowing through the phase wire, a superposition of currents flowing through the connected appliances

		which are not sinusoidal or their power factor varies from one.
Positive measured power value (production) differs too much from the value on the inverter display	There is connected some load, which decreases this value.	No defect
	Inverter shows approximate values, or the status is not stable	No defect
	Incorrect phase sequence or incorrect current orientation settings	Follow the steps specified in the previous troubleshooting item.
Low tariff signal is missing	Low tariff signal is not connected	Connect the low tariff signal to LT terminal. You must connect the signal through an auxiliary relay as specified in this manual.
	Low tariff signal is not active	Wait until the signal is active, or manually test the auxiliary relay by switching it on (some relays have this option).
	Regulator failure/defect	Replace the regulator or take it to repair.
FB inputs do not work	S0 impulse output from external meter/inverter is connected with reverse polarity	Observe polarity of the device output (energy meter, inverter).
	Signal coming from the output is an unsupported impulse signal	Use only device with S0 impulse output whose signal carries information about the measured energy and has a minimum impulse width of 1 ms. Signal parameters are described in chapter Technical specifications.
	Regulator failure/defect	Replace the regulator or take it to repair.
The TEST button cannot be used to switch on some of the connected loads	The relevant load is not connected or it is connected incorrectly	Check the connection of the relevant load and switch on the corresponding circuit breaker or fuse switch.
	The load is connected correctly but cannot be switched on	Check whether the load is fitted for example with a thermal protection system or a thermostat, which is currently off.
	Output LED is defect or there is another regulator defect	Replace the regulator or take it to repair.
Outputs do not switch on as they should	Output is not activated	Activate the output by setting the relevant priority.
	PV-plant does not provide sufficient power output	Check whether there is enough surplus energy available in respective phase wire or sum of phases L1 + L2 + L3 is positive, depending on configured control mode.
	Incorrectly set priorities or connected power values	Check the priority settings of your loads and connected power settings according to their power ratings.

	Incorrect settings of some items in the Other settings tab	Check the settings in the Power offset field. Also check the CombiWATT production limit field, which should be low.
You cannot download firmware, even if you try repeatedly	Incorrect or corrupted *.scf file	Load only original firmware for the WATTrouter M device.
	Communication errors	Make sure that there are no problems with the connection of the controller to PC, or in the PC alone (viruses etc.).
	Regulator failure/defect	Replace the regulator or take it to repair.
The built-in fan does not work (does not spin) when triac outputs are on	Fan is disconnected	Remove the regulator cover and make sure that the fan is connected.
	Fan does not work	Replace your fan with SUNON MagLEV 12VDC, 35x35x10mm ventilator, with power rating of 0.5 W or 0.75 W or contact your distributor to get spare part.
The sound of the fan changes irregularly	This is normal	The speed of the fan is regulated in order to provide optimal cooling.
Fan makes strange noises	The fan is defective	Replace your fan with SUNON MagLEV 12VDC, 35x35x10mm fan, with power rating of 0.5 W or 0.75 W or contact your distributor to get spare part.
Flashing red LED	The system detected error status	Follow instructions in the LED statuses chapter.
When the available surplus energy is decreased, the triac/SSR output with higher priority is switched off earlier than the relay output with lower priority	This is normal	Relay outputs have always longer delay when in the process of disconnecting. In order to make sure that energy from the power grid is not drawn unnecessarily, all connected proportional outputs with higher priority may be disconnected earlier than the relay outputs with lower priority.
CombiWATT function runs even if PV-plant produces power	This is normal	CombiWATT will be initiated even if during the time specified in the CombiWATT delay time field, no production is detected at any phase wire, which may occur if the PV-plant produces small amount of energy or if loads with large power consumption operate for long time and consume all available surplus energy. If you want to eliminate this behavior, increase the value in the CombiWATT delay time field.
Solid state relay (SSR) does not switch on	SSR is not connected correctly	Check for proper terminal connection and observe polarity of SSR control anodes.
	Incompatible relay	Always use a SSR with zero cross switch and minimum DC control voltage of 4VDC.
	Regulator failure/defect	Replace the regulator or take it to repair.
	SSR failure/defect	Replace the SSR.
Data in statistics don't	This is normal	The data are indicative only; the device

correspond with reality		does not have accurate data from utility/billing meters. Furthermore, the device may be configured improperly, i.e. does not evaluate the same as your utility meter does.
Statistics suddenly erased	This is normal	There was a date change in the controller or power failure during writing the history into EEPROM.
Cannot pair units via Ethernet using the S-Connect protocol	The units do not have S-Connect activated	Activate S-Connect on all units, one unit must be access point (AP) and the other units must be stations (STA).
	The units are not connected to the same local network	Connect all units to the same local network. Note: Pairing requests do not pass from one subnet to another, you must use the same subnet.
	The units have either incorrect network configuration or are disconnected	Make sure all units are accessible on local network (use PING command).

MAINTENANCE AND REPAIRS

The WATTrouter M devices have been designed as maintenance-free units, provided that they were configured and fitted according to instructions specified in this manual. We recommend inspecting the operation of the entire system at regular intervals (at least once in a month, for example, when inspecting the status of the PV-plant). Focus mainly on the load switching process and heat dissipation.

Should you discover a defect which cannot be repaired according to instructions specified in the Troubleshooting chapter, contact your distributor (applies both to warranty and post warranty repairs).

Defect on current sensing module is very unlikely to occur. In case of a defective regulator, you can send only the regulator for repair or replacement. The current sensing module may still remain fitted without the regulator. Even if electric currents flow through measuring coils, the module will not be damaged.

Never attempt to repair your device by yourself! If you do so, you are putting yourself at risk of electric shock. Further, your entire warranty will be void!

TECHNICAL SPECIFICATIONS

Parameter	Value, notes
Main parameters	
Supply voltage	230 V~, 50 Hz
Power consumption – stand-by mode	<3 VA
Power consumption – 1 triac output	approximately 1 W/A
Power consumption – 1 relay output	0.4 W
Power consumption – all outputs switched on and loaded with maximum allowable currents	25 W
Current measuring range	SSR model: 0-20 A~ (±5 %), 50 Hz (±5 %) MAX model: 0-100 A~ (±5 %), 50 Hz (±5 %)
Voltage range	230V~ (±5%), 50Hz (±5%)
Maximum steady currents allowed to flow through current sensing module	SSR model: 0-40 A~ (±5 %), 50 Hz (±5 %) MAX model: 0-125 A~ (±5 %), 50 Hz (±5 %)
Active power measuring accuracy	5% ± 0,05kW
Output and input parameters	
Power supply terminals L1 and N	230 V~, 50 Hz. L1 = phase wire, N = neutral wire
I_L1, I_L2, I_L3 inputs:	Secondary currents from measuring coils. Maximum allowed voltage against GND terminal is 5.5 V. SSR model: max. 40 mA~. MAX model: max. 125 mA~.
Triac outputs	230 V~, 50 Hz, max. 10 A, 2300 W, only resistive load with cos(Φ) = 1 Protection: Fuse for semiconductor protection
Relay outputs	230 V~, 50 Hz, max. 10 A, 2300 W (it is recommended to connect load with cos(Φ) ≠ 1 via external contactor) Protection: Regular circuit breaker, type B
External outputs for connection of solid state relays SSR (S+, S1-, S2-)	0 or 5 VDC, isolated from power grid supply SSR parameters: control DC min. 4VDC, SSR must switch at zero (zero switch). Protection: based on instructions specified in the SSR relay manual
External outputs - connection with PWM function (S+, S1-, S2-)	0 or 5 VDC, isolated from power grid supply PWM parameters: carrier frequency 200 Hz to 10 kHz, duty cycle 0-100% in 1% steps. Protection: based on instructions specified in the manual of connected device
LT, FB1, FB2 and FB3 inputs	0 or 5 VDC, isolated from power grid supply. May be switched using regular relay outputs or optocouplers with open collector, always against GND. Minimum pulse width and gaps for FB inputs is 1ms.
USB Connection	USB 1.1/ USB 2.0, isolated both from power grid

	supply and other control parts of the regulator, serial communication parameters: 38400 Bd 8N1.
LAN Connection	10/100 Mbit/s, isolated from power grid supply according to IEEE 802.3
Dynamic characteristics	
Active power measuring period (effective values)	typically 600 ms (including averaging of switched-on (active) triacs/SSR)
Regulation dynamics (full scale) at Triac/SSR output with function set to proportional control	typically 3 s (from 0 to 100 % of power output and vice versa)
Relay output on-delay time	Programmable (minimum of 2s)
Relay output off-delay time	Programmable (minimum of 2s)
Other parameters	
Maximum diameter of wires connected to terminals	2.5 mm
Maximum diameter of wires passing through measuring transformers	SSR model: 9 mm (including insulation) MAX model: 14 mm (including insulation)
Distance of the current sensing module and the regulator	<2 m (longer wires are acceptable, but they reduce the accuracy approx. by 0.2% per 2m)
Distance of the regulator and solid state relay	<10 m
Working position	Any
Mounting	Regulator: DIN 35mm or wall mounted using 2 screws with round or sink head and with diameter of up to 6mm. Switchboard must be equipped with vents to ensure sufficient heat dissipation. Current sensing module: DIN 35mm or wall mounted using 1 screw with round or sink head and with diameter of up to 6mm.
Overvoltage category	III
Electric strength	4 kV / 1 min (power supply (L1, N)-output, output - output, power supply-current input, external output, etc.(GND,I_L…,LT,FB…,S+,S1-,S2-))
Pollution degree	2
Operational temperature range	-20°C to +40°C
Storage temperature range	-40 °C to +80 °C
Protection (power supply)	B6A
IP code	Regulator and current sensing module: IP 20
Dimensions (WxHxD)	Regulator: 106x110x64mm (6 modules) Current sensing module: Model SSR: 70x110x64mm (4 modules) Model MAX: 91x90x65mm (5-6 modules)
Weight	Regulator: 350g Current sensing module: Model SSR: 100g Model MAX: 250g
Fan noise level	Max. 15 dB(A)
Battery for real time backup	CR2032 lithium, usual lifetime> 6 years
Warranty period	24 months

BATTERY FOR REAL TIME BACKUP

The regulator contains a CR2032 type battery for real-time backup. If the controller shows an incorrect date and time after a power failure, then the battery is discharged. The battery can be replaced.

The battery can be of two types (the battery type can be determined by opening the lid of the regulator with a small screwdriver):

a) Soldered battery to the regulator PCB. This battery usually has a yellow band around the perimeter and contacts for soldering. To replace this battery, it is necessary to disassemble the device and entrust the replacement to an electronics repair service.
b) Standard battery placed in a case. This battery can be replaced by yourself without having to disassemble the device. Remove the battery with a suitable tool, for example a plastic clamp, after removing the regulator lid. Insert the spare battery in the same way.

Important notice: *It is absolutely necessary to respect the polarity of the battery. If you insert the battery the other way round, the main microprocessor will be damaged! When replacing the battery, do not use metal tools that could short-circuit the battery!*

RECYCLING

After the product life is over the product may be disassembled, recycled or disposed of at a safe dumpsite.

Legal regulations regarding electronic waste treatment have to be observed in respective country.

Before product disposal, remove real time backup battery (if possible).

Do not dispose in regular household waste!

EU DECLARATION OF CONFORMITY

Company:

SOLAR controls s.r.o. (manufacturer name)
Brojova 25, Plzeň, 32600, Czech Republic (manufacturer address)
29109795 (manufacturer id)

Hereby declares that this product:

WATTrouter device M SSR, WATTrouter M MAX (product name)
WRM 01/06/12 (regulator) and WT 02/10, WT 03/11 (current sensing modules) (type/model)
Designed for to optimize self-consumption of electric power produced by photovoltaic power plant (function)

To which this declaration relates is in conformity with the following directives, standards and other normative documents, provided that it is installed, maintained and used in application for which it was made, in accordance with relevant installation standards and manufacturer's instructions:

Directives:

- LVD Directive 2006/95 EC
- EMC Directive 2004/108 EC

Standards:

- EN 61010-1:2010
- EN 61000-3-2:2006+A1:08+A2:09
- EN 61000-3-3:2008
- EN 61000-3-11:2000
- EN 61000-4-2:2009
- EN 61000-4-4:2012
- EN 61000-4-5:2006
- EN 61000-4-11:2004
- EN 61000-6-3:2007

Year of affixing the CE marking: 2012

Declaration issued:

Plzeň, July 1, 2012 — **Ing. Tomáš Krýsl, Company Executive**

(place and date) — (name, job title and signature of responsible person of the manufacturer)