WATTROUTER M - USER MANUAL

FOR MODELS:
WATTROUTER MSSR (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 regulator 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 offers the following functionalities:

- Three-phase indirect current measurement.
- Automatic detection of voltage necessary to determine the power direction.
- 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 regulator (up to 10 s)
- Optional CombiWATT program 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 (night/low tariff) 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 MS Windows XP and higher, provides comfortable regulator configuration and monitoring via USB interface and Ethernet.
- Integrated web interface allows comfortable regulator configuration and monitoring using regular Internet browser.
- Real-time module backed with a lithium battery for advanced management of outputs and CombiWATT function.
- Day, week, month and year statistics.
- Firmware updates (for registered customers)
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 for triac and relay outputs. SSR outputs switch on in similar way as triac outputs.

- Triac/SSR outputs are switched on almost immediately after surplus energy is detected and the regulator is gradually (synchronous control) 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 (tr./SSR)" function.

When load with 1st priority is switched on (for triac 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 triac / SSR output with higher priority is switched on, and the available surplus energy is reduced, the triac / SSR 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 regulator 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). Active power is measured with sufficient precision in order to maintain all control functions.*
### PACKAGING CONTENTS

Contents of packaging:

1. WATTrouter M regulator
2. WATTrouter M current sensing module
3. 1 USB cable
4. 1 CD with this manual, USB interface driver, WATTconfig M software for operating system Windows XP or newer.
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 certificate and qualifications. 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 below. Do not place the regulator or system electronic components near flammable objects!

When triac outputs are activated, it is absolutely necessary to fit the regulator in an open space (for example, on a wall using screws) or in a distribution box fitted with adequate heat dissipation system (with ventilation grid or vents)!

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

Only connect outputs of the regulator 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 electrical distribution box (if triac outputs are activated, sufficient heat dissipation system must be available - see chapter Safety warning). Regulator may be mounted on 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 electrical distribution box onto a 35 mm DIN rail.

Current sensing module supplied with the WATTrouter M SSR regulator is fully compatible with current sensing module supplied with the WATTrouter CWx regulator or with the WATTrouter CWx SSR regulator and vice versa. Current sensing module fitted together with the WATTrouter CWx (SSR) regulator may therefore be used with WATTrouter M SSR regulator (and vice versa). This also applies to current sensing modules supplied for WATTrouter M MAX and WATTrouter CWx MAX regulators.

Measuring inputs of the current sensing module may be connected as single, double, or triple-phase connections, but input L1 and I_L1 has always to be connected.

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.

To interconnect the current sensing module and regulator use 4 wires with minimum cross-section of 0.2 mm². For example, if these wires are placed in a cable tray together with other power cables/wires, we recommend using a shielded cable and connect the shielding of the cable to a protective PE wire.

To connect power supply to the regulator (L1 and N) use wires with a minimum cross-section of 0.5 mm², for example CY 1.5.

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

If you plan to use triac outputs, do not fit the regulator in spaces where fan noise may be annoying.

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

Regulator terminals - description:

- L1 – regulator power supply and voltage detection L1, 230VAC/50Hz (must always be connected)
- N – neutral wire (must always be connected)
- 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
- 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
- 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)
- 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)
- 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)
- Unmarked terminal is not connected (NC)
- USB – USB interface connector (USB B)
- LAN – Ethernet interface connector (RJ45, 10/100 Mbit/s)
- Micro SD – slot reserved for future use

LED description:
- PWR – regulator power on light (green)
- COM – 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 LED – carrier frequency, right LED - connection speed)

- Figure 2: WATTRouter M current sensing module terminals - description of terminals (top view) for versions SSR and MAX.

Current sensing module terminal description (terminals are described directly on the current sensing module motherboard for MAX model):
- I_L1 – current measuring output L1 (must be always connected)
- I_L2 – current measuring output L2
- I_L3 – current measuring output L3
- GND – common wire (must always be connected)

Regulator may be connected only to 230VAC, 50 Hz electric distribution 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!
We strongly advise you to protect your loads connected to the triac outputs with fuses suitable for protection of semiconductors, rather than regular circuit breakers. Please note that triac outputs damaged by overcurrent or short-circuit cannot be claimed under warranty. Similar rules also apply to solid state relays connected to external outputs. Make sure that solid state relays are correctly connected, as required by the user manual.

For correct operation of the regulator it is absolutely necessary to ensure that the phase cable connected to terminal L1 corresponds with a cable passing through the measuring coil in the current sensing module, which belongs to the I_L1 input! Current inputs I_L2 and I_L3 may be connected at random. Phase sequence can be set later in the control software or the regulator sets them automatically.

Connect the regulator according to sample connection diagrams shown on figure 3 through 8. 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.

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.

![Diagram](image)

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 RIJA. 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.

Figure 9: Experimental connection of external devices where their power output can be controlled with a voltage of 0-5 VDC. Corresponding output must be set to PWM mode. In this example the 20 kHz PWM signal is present on the S1- terminal (for output S2 it is the S2- terminal, respectively). The filter element (R2 and C1 in this example) produces DC voltage with typical residual ripple about 300 mV. If you need inverted signal then connect the filter element between the S1- and GND terminals. The resistor R1 must always be connected between the S+ and Sx- terminals because the Sx- terminals have only open collector drive with a very weak internal pull-up resistor. The connected device must have a corresponding control input with sufficiently high input impedance (which should not be below 200 kΩ), otherwise active filter could be necessary. Active filter must be always used, when the external device awaits another voltage (e.g. 0-10 VDC) or current loop (4-20 mA).
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 terminals I_L1, I_L2, I_L3, GND, S_+, S1_-, S2_-, LT, FB1, FB2 and FB3 - that means all terminals located at the lower section of the regulator. NO power grid voltage or voltage outside of tolerances specified in the chapter Technical specifications may be connected to these terminals! NO other than resistive (heating) loads may be connected to triac/SSR outputs! Regular relays CANNOT be connected to SSR outputs! NO loads may be connected to reserved NC terminals. It is prohibited to connect loads with higher than the maximum allowed nominal power! If you fail to observe this rule it is almost guaranteed that you will damage the regulator and lose your warranty!

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!

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!

It is allowed to connect only pure resistive loads to triac/SSR outputs. 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:** Triac/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 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 2.3 kW may be connected to relay outputs directly, without using external contactor.

Up to 3 pulse outputs from external energy meters may be connected to FB1, FB2 and FB3 outputs. You may also use energy meters whose pulse outputs are fitted with optically isolated switch or an optocoupler with open collector. These energy meters may measure any power outputs. Measured values are displayed in the control software and also through the integrated web interface. For example, these inputs may be used to connect energy meters which measure the actual net production of PV-plant. This net production cannot generally be determined by the current sensing module.

Carefully examine connection of the regulator and then turn off all circuit breakers and deactivate fuse switches for triac/SSR outputs. 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 regulator is fitted and ready for configuration.
DEVICE CONFIGURATION

You will need a notebook or regular PC (placed closely enough to the regulator) with a CD drive and USB interface (hereinafter referred to as a computer only). The regulator is configured using the WATTconfig M control software. The installation package for this software is on the attached CD. Before installing the WATTconfig M control software, you need to install the driver for the 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 regulator 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 (Windows 7).

1. Insert the attached USB cable to the USB connector of the regulator and then to the computer.
2. Turn on the PC and insert CD into the CD drive of the computer.
3. Turn on the regulator. The green LED PWR must light up (power on indication). Also, the yellow LED COM light will or should flash briefly (communication process indication) as the USB device will start to register in your computer.
4. After a moment, following window must appear confirming that a new device was found:
5. Select: No, not this time. In the following window select: Install from a list or specific location (Advanced).

6. Select the path to the driver file:

7. The driver has been installed successfully, if this window appears:
8. 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)

9. You may perform the same installation process for the device USB serial port as well but you are not required to do so because the control software does not use this interface.

**WATTCONFIG M CONTROL SOFTWARE INSTALLATION**

1. Turn on the PC and insert CD into the computer CD drive.
2. Run WATTconfig_M_Setup.exe. The software is identical for all WATTrouter device M models.
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 regulator 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. Click the "Connect" button. The regulator 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.
5. After establishing successful communication, you should be able to see the current measured values (power outputs on individual phases, regulator temperature, etc.). No outputs should be active ("unused" priority). Also no time schedules should be used.
6. 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:** It is recommended to use the default automatic settings. 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. Refresh the configuration display by pressing the Read button. Now, in the Phase order settings field you should see "L1, L2, L3" or "L1, L3, L2" option, based on the actual status recognized by the regulator. If the output values measured on individual phases differ too much from the reality, check whether the phase connected to input L1 corresponds with the measured input I_L1. If everything is ok, select a reverse phase sequence configuration - other than the one recognized by the regulator (that is, if the sequence "L1, L2, L3" was recognized select "L1, L3, L2" sequence and vice versa). Press the Write button. The configuration will be saved in the regulator.

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 opposite and press the Write button. The configuration will be saved in the regulator. 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 standby 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 "Current wave 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 \( \cos(\phi) = 1 \)! 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 sinusoidal or their power factor varies from one.
Figure 10: 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 11: 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 switch wires connected to I_Lx inputs of the regulator.

7. 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.

8. 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 "Input settings" tab. Set this mode either to "sum of all phases" or to "each phase independently", based on the configuration of your 4-quadrant (or 6-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. Regulator will then try to maintain zero energy flow in each phase ("faze 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 regulator 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.

9. 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 triac/SSR and relay outputs. Triac/SSR 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 (tr./SSR)" function). When the load is switched on (for triac/SSR
output it means 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 regulator will not operate correctly, and the load will be repeatedly turned on and off. For triac/SSR 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 regulator. Now the main function of the regulator should be configured.

10. Test the main function of the regulator, 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 regulator (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:

\[ E[kWh] = \frac{c_V \times V[I] \times \Delta T[K]}{3600000} \]

If you enter it into the formula you will get: \[ E[kWh] = 0.0464 \times V[I] \]. For a 180liter 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 regulator 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).

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 regulator.

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 \(\leq\) (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 "Assumed 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 information field "low tariff (night 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 "Assumed supplied energy" reached the "CombiWATT [kWh]" value for the relevant output.

b. 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 "Assumed supplied energy")

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

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

c. At production start. Counters are reset to zero when production begins (possibly in the morning).

More information about counter reset processing is available in the chapter WATTconfig M control software description.

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).

### SETTINGUP 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 (field "Assumed supplied energy").

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 regulator has 3 impulse inputs (FB1, FB2 and FB3), which can be used to connect external energy meters or other devices with impulse outputs which comply with FB input parameters specified in the chapter Technical specifications. The output signal of those devices must always provide information about measured electric energy.

FB inputs are not required to be used. They play an auxiliary role and provide additional information to the regulator because they allow displaying of measured energies / powers in the WATTconfig M software, through web interface or possibly in another external application.

Values obtained from FB inputs only provide information for the user and are not used to control WATTrouter device outputs.

Configuration of impulse inputs is done on the "Input settings" tab. For more information about the settings see the chapter Description of WATTconfig M items, Input settings tab.

**FINISHING THE CONFIGURATION**

After setting up the main function or the CombiWATT function, time schedules and FB inputs, the regulator 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 regulator 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 (for example Silex 3000GB). 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 regulator web interface, where the items have identical names and meanings.

MAIN WINDOW

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

![Main window of WATTconfig M software.](image)

Figure 12: 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.
- Regulator temperature - temperature inside of the regulator. It is used for thermal protection of the regulator.

Output statuses:

- Assumed load power - the assumed power drawn by the load connected to the relevant output. It refers to an estimated power based on the output settings and may not correspond with the actual power output of the load, as the power drawn by the connected load is not measured.
- Assumed supplied energy - daily energy counters measuring power already supplied to the relevant output. It refers to an estimated energy supplied to the load, which is based on the output settings and may not correspond with the actual amount of the power supplied to the load, as the power drawn by the connected load is not measured. 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. 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 4 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.

FB input status:

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

Where:

  - P – final power (this field)
  - \( t_p \) – period of impulses
  - \( \text{Imp}_{kWh} \) – 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 an output of 0.24 kW). If the measured power is lower, zero is displayed.

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

\[ E_{[kWh]} = E_p[kWh] + \frac{\text{Imp}}{\text{Imp}_{kWh}} \]

Where:

- \( E \) – final energy (this field)
- \( E_p \) – initial energy at the input (see FB input settings)
- \( \text{Imp} \) – number of impulses registered by FB input since the moment the impulses were connected to this FB input. These counter values are not displayed.
- \( \text{Imp}_{kWh} \) – number of impulses per kWh (see FB input settings)

Impulses are counted only if the regulator is operating. It is only an auxiliary and informative feature of the regulator. 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 starting offset at input FBx" to match the value of the energy meter, check the "zeroize"-field and press the Write button.

**Other statuses:**

- 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.

- Fan power – displays the current fan power output in %.

- Sunrise today – it displays time of sunrise for today. This time is calculated directly in the regulator 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 summertime" and "Time zone" settings. The official sunrise zenith, 90° 50' is used. Sunrise time is used to reset energy counters ("Assumed supplied energy"-fields) in the main window, provided that the applicable mode in the field "CombiWATT – Energy counter reset" is selected.

- 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).

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

- Voltage L1 missing – no voltage was detected on phase L1 - this is a hardware error of the regulator and the regulator must be replaced or repaired.
- Temperature sensor failed - this is a hardware error of the regulator and the regulator must be repaired or replaced.

- 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.

- Low tariff (night tariff) – if the low tariff signal is detected the red light comes on, otherwise is grayed.

- 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.

- 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.

**INPUT SETTINGS TAB**

In this tab you may set measuring inputs, FB inputs and control mode.

**Measuring output and control mode:**

- Control settings - it is used to set the control mode:
  a. Sum of all phases - the regulator will control all outputs according to the sum of measured active powers from all three phases. In this mode is not necessary to set phases for individual outputs as this does not matter.
  b. Each phase independently - the regulator 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 wire where the corresponding load is connected to.

- Phase order settings - it is used to set the phase sequence (order) based on the fact how wires are actually passing through the current sensing module. Phase sequence is set only for I_L2 and I_L3 inputs (phase current measured at the I_L1 input must always match the phase connected to L1):
  a. Automatically – this option enables automatic phase sequence recognition algorithm (see chapter Setting up main function). This algorithm however, may not always identify the correct phase sequence.
  b. L1, L2, L3 – manual phase sequence setting.
  c. L1, L3, L2 – manual phase sequence setting.

- 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. It is possible to adjust the measuring accuracy of the current sensing module by means of this ratio. External current transformers can extend the measuring range of the regulator 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 0.75 kW per phase) are below the resolution capacity of the measuring inputs and therefore, these power values will not be measured and equal to zero.

- **Current orientation Lx** - it is used to change the sign of measured powers, if the current sensing module is fitted in reverse position, or in cases for example, when it is desirable to pass the wire through the module in reverse direction.

**FB Input configuration**

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

- **Energy starting offset at input FBx** - 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 “zeroize”.

- **Zeroize** - used to reset impulse counters to zero.

- **Number of impulses per one kWh – FBx input** – 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 FBx power fields.

- **Data source FBx** – use this to setup the energy data source for the FBx input. In current firmware revision this assignment is used only to generate statistics about production. Following options are available:
  a. **Other** – input counts e.g. energy flowing to a load or another appliance.
  b. **Prod. L1** – input counts energy measured on L1, value will be added to daily production stats on L1.
  c. **Prod. L2** – input counts energy measured on L2, value will be added to daily production stats on L2.
  d. **Prod. L3** – input counts energy measured on L3, value will be added to daily production stats on L3.
  e. **Prod. L1+L2** – input counts energy measured on L1+L2, value will be equally divided to daily production stats on L1 and L2.
  f. **Prod. L2+L3** – input counts energy measured on L2+L3, value will be equally divided to daily production stats on L2 and L3.
g. Prod. L1+L3 – input counts energy measured on L1+L3, value will be equally divided to daily production stats on L1 and L3.

h. Prod. L1+L2+L3 – input counts energy measured on all phases, value will be equally divided to daily production stats on L1, L2 and L3 (i.e. counted value will be divided by 3).

Note: In case production on more phases is measured by one FBx input and the inverter does not divide produced energy equally to each phase it is necessary to use separate measurement and FB input for each phase.

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

  Caution: The purpose of this experimental 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 for external solid state relays, for which these outputs were originally constructed!

- 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 regulator.

- 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.

- 3f mode – if 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. 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 minimum surplus energy from all 3 phases
b. Prům (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 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 mentioned 3-phase heating element).

- 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 triac/SSR outputs, and must be higher or equal for relay outputs.

- Maximum power – this value applies only for triac/SSR 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 regulator cooling possibility or due to saving the surplus energy for additional outputs, you may decrease this value. The value in the “Assumed 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. The reason is that triac/SSR outputs do not switch on fully proportionally but only "quasi-proportionally", which means, only in certain switching levels.

- Prepend (tr./SSR) – this option replaces functions Instant relay switchover and Priority count from Other settings tab in older software versions, and extends them so that they can be setup individually for each output. Fill in 1 if you want a relay with lower priority to switch on when assumed load power on nearest higher priority proportional output (triac/SSR or more specifically, an output with preset proportional switching function) reaches the relay’s Connected power value. Fill in 2 if you want this relay to be switched on when sum of assumed 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 spiral connected to triac No. 1, 1st priority, connected power 2 kW, maximum power 2 kW
- 2nd spiral connected to relay No. 1, 2nd priority, connected power 2 kW, prepend value = 1
- 3rd spiral connected to relay No.2, 3rd priority, connected power 2 kW, prepend value = 1

If the triac 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 triac No. 1 will automatically reduce its power. If the surplus energy increases by additional 2 kW so that the triac No. 1 is fully switched again, the relay No. 2 will be switched and triac 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 spirals must be active (heated) at the same time or inactive (disconnected by the thermostat). The algorithm will not work correctly if spiral No. 1 is disconnected by the thermostat and the other two spirals will continue producing heat. In this scenario, the relay will be continuously connected and disconnected because the regulator is trying to keep "virtual zero" or "phase zero", depending on control mode, and is not able to determine from phase wire measurements that spiral No. 1 is disconnected. The relay will switch on only if the measured power on the respective phase is stable and does not fluctuate. Otherwise the relay switching might be counterproductive.

**Note:** In order to ensure correct function of the algorithm it is necessary that the triac / SSR - to which spiral No. 1 is connected, is assigned with the higher priority than the relay No.1 with the 2nd spiral. If spiral No. 1 connected to triac/SSR has lower power rating than the other two remaining spirals, relays will connect only after the overall power (power drawn by the first spiral + 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.

**Example 2:** A boiler and 2 other heating elements:
- boiler connected to triac No. 1, 1st priority, connected power 2 kW, maximum power 2 kW,
- 1st spiral connected to triac No. 2, 2nd priority, connected power 2 kW, maximum power 2 kW,
- 2nd spiral connected to relay No. 1, 3rd priority, connected power 2 kW,
  a) Prepend value set to 0: In this case the 2nd spiral will never be prepended and after 4kW surplus is reached and consumed by boiler and 1st spiral the controller will wait until the available surplus is 6kW. Then it connects 2nd spiral. In the meantime surplus flows to public grid.
  b) Prepend value set to 1: In order to prioritize the 2nd spiral, we will take into account only the assumed load power of the 1st spiral, which means that the boiler will always have first priority. So after surplus reaches 4 kW the 2nd spiral will be connected (prepended) before the 1st spiral.
  c) Prepend value set to 2 and higher: In order to prioritize the 2nd spiral, we will take into account the sum of assumed load powers of the boiler and 1st spiral. So after surplus reaches 2 kW the 2nd spiral will be connected (prepended) before boiler and 1st spiral.

- Minimum power – for SSR 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.

- PWM-I – for SSR outputs when PWM function is used then this value is equal to the I-component value of the 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 will enable to switch 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 softstarts 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!
- **Delay** - for SSR outputs when PWM function 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.

- **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. After the 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 mode.

- **Switch-off delay** - this value applies only 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. For example, for heating pumps we recommend increasing this value significantly. This time delay is not active in CombiWATT mode. Here it is assumed that the low tariff activity time is always sufficiently long in case of double tariff rates.

- **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 triac/SSR in CombiWATT at full power, regardless of the Maximum power setting ("Maximum power"-field). In this way you may eliminate the occurrence of disturbing "flicker effect" produced by light bulbs or fluorescent tubes. If you don’t check this field the specified maximum power for the load is used in CombiWATT mode.

- **Inverted** – this option replaces the Inverted output option from Other settings tab in earlier software versions and makes this setting individually possible for every relay output. If checked, the selected output will be switched on in inactive status and switched off in active status. The output will not be switched on if any defect/failure is detected, or the output was not assigned with any priority, or the output was not assigned with relay function. In these cases, the output inversion condition does not apply. For example, this feature may apply if there is necessary to "unlock" some device according to available surplus energy.

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.

- **TEST** – it is used to test the relevant output and load. If you press any of the TEST buttons, all other control functions regarding the outputs are blocked.

**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 presence of the low tariff signal and/or by the status of daily energy counters for the relevant output (field "Assumed 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
- **To** – time when time schedule ends
- **Power** – this field can be configured in firmware version 2.5 and later. It can be configured on proportional outputs (in the function proportional and PWM) for the Enforced mode. This field can be used here to enforce the output power as a percentage of the connected power. Thus, the output can be switched proportionally even when switched by the time schedule. If the power is set lower than 100% then such enforcement does not deactivate the basic mode of regulation according to surplus energy. For example, if the output is enforced to 50%, and the surplus is available for the switching on 75%, the output will be switched to 75% power. For the Restricted mode, this value is not used.
- **LT** – if you mark this field, the time schedule additionally requires the existence of the low tariff signal to become active. This function differs based on the time schedule mode, and it is primarily based on the fact that electric power in low tariff is cheaper than electric power in regular (peak) tariff:
  
  a) **Restricted mode** – the output is restricted only if low tariff is not active.
  
  b) **Enforced mode** – the output is enforced only if low tariff is active.

- **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 "Assumed supplied energy" field). Again the function differs based on the time plan 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:** 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 triac/SSR 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 set LAN parameters and other advanced device settings.

**Network configuration:**

- Controller address (IPv4) – IP address saved/stored in the regulator. The regulator uses this address to “listen” to all UDP and TCP/IP (HTTP) incoming requests. You must always assign a static address. Dynamic address assignment (DHCP Dynamic Host Configuration Protocol) is not supported.

- Controller mask (IPv4) – a network mask to which the regulator is connected.

- Default router (IPv4) – default gateway IP address. We recommend using IP address of your router.

- Controller MAC address – physical (MAC) address of the regulator. Change this address only if there is a conflict between physical addresses in your local network.

- UDP port – port used by the regulator to "listen" to UDP requests.

- HTTP port – port used by the regulator to "listen" to HTTP requests.

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

**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).

**Expert settings:**
• 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 regulator 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 triacs or SSR switch only small amount of power to the load. Transitional statuses are usually identified by 4-quadrant energy meters as "movement 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.

• 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 regulator), which consume entire surplus energy of the PV-plant for long time. In this case, the regulator cannot recognize that PV-plant production is not yet over.

• 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 regulator 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 production falls below 0.05 kilowatt in each phase.

• 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.

• CombiWATT – Energy counter reset – this field is used to reset energy counters, which represent the reset of the "Assumed supplied energy"-fields in the main window. You have three 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".
  c) At production start: counters are reset at the moment when production begins. This setting is not recommended. It originated from the basic WATTrouter CWx product line. The beginning of production is a moment when the CombiWATT mode is terminated, which means, the production in some phase exceeded the value specified in the "CombiWATT production limit" field. If you want to use this setting, then it is recommended to set the "CombiWATT delay time" field to 1-2 hours, in order to prevent false counter resets during the day.
• Fixed time of energy reset – it specifies a fixed time for energy counter reset mode according to fixed time (the previous paragraph, mode b).

Other settings:

• Synchronize date and time with the client - check this field if you want to synchronize the regulator date and time with the actual time running in your PC.

• Use summer time - check this field if you want the regulator 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.

• 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.

• 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.

WATTconfig settings:

• Language - select the language which you want the WATTconfig M 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 regulator after each configuration was written. Regulator reset is necessary to change the network settings and also to delete daily energy counters, etc.

• Default tab - Set the tab in the WATTconfig you wish to appear when you launch the program. If you are using WATTconfig M software then this setting is stored on PC hard drive, the same settings in the web interface is stored directly in the regulator.

Firmware update:

• Update firmware button - allows you to update firmware of this product. If you are our registered customer and purchased this product, you are allowed to access the Download section available at our webpage. 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.

![Warning]

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 regulator 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!

STATISTICS TAB
This tab displays daily, weekly, monthly and yearly statistics on production, consumption and surplus (excess) energy. Statistics can be exported to *.csv files by using the WATTconfig M software.

**Caution:** Through current sensing module you can obtain only the consumption and surplus (excess) energy. To display data on production and self-consumption, it is necessary to connect a pulse output to some FB input from an external meter, which measures the power of the inverter. Alternatively, connect inverter directly to the FB input when the inverter is equipped with a compatible pulse output. It is also necessary to configure the FB input in the "Data Source" field on the Settings tab, in order to let the regulator process the counted value properly.

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

**Caution:** 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 regulator you may cause irreversible deletion of stored history!

**Daily statistics:**

- Phase Lx – displays information about the surplus (excess) energy, normal and low price energy tariff as well as (optionally) 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 settings" field on the Input 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 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 do not correspond with the values in the fields "Assumed 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. If the FB input is configured to measure production then a short label "counts prod." appears above the measured value.
- Show for day – select the date for which to view daily statistics. You can display them for current date and last 7 days.
- Erase – use this button to delete all statistics. 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 the relationship: 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 the 5 main summary data (production, surplus energy, self-consumption, consumption in normal and low tariff) in bars for the last 7 days. Double click on the bar to view the day in the daily statistics.
- Export – exports the weekly statistics to a *.csv file that can be opened e.g. in MS-Excel.

**Monthly statistics:**

- Production chart - displays summary data on production (production + surplus energy) in the last 31 days.
- Consumption Chart - displays summary data on consumption (self-consumption, consumption in normal and low tariff) in the last 31 days.
- Export - exports monthly statistics to a *.csv file that can be opened e.g. in MS-Excel.

**Note:** The monthly statistics can't show detail of a day as in the case of weekly statistics, details are stored only for the last 7 days.

**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 yearly statistics to a *.csv file that can be opened e.g. in MS-Excel. Exports data for last 24 months.

**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.

**OPTIONS AND BUTTONS**
**Main window buttons:**
- Connect through – this option allows you to connect via USB or LAN.
- Connect – connects your computer to the regulator and loads configuration from the regulator just after successful connection has been established.
- Disconnect - disconnects your computer from the regulator.
- Configure connection - the software displays a window where you may configure active connection.
- Open - loads configuration from PC.
- Save - saves configuration to PC.
- Reset to defaults – loads default configuration settings.
- Read – reads configuration from the regulator.
- Write – writes (downloads) configuration to the regulator and optionally resets the regulator. Configuration download via LAN interface is protected from unauthorized access or intervention.
- Exit - exits WATTconfig M software.
- 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.
USB DRIVER CONFIGURATION WINDOW

In this dialog box you may specify USB interface parameters. USB interface in the regulator uses a chip made by FTDIchip (http://www.ftdichip.com/). On this page latest USB drivers (D2XX version) can be found.

Port settings:

- Choose a device – if the USB driver from FTDI is correctly installed on the system and the regulator is connected to PC then active FTDI device must be shown, e.g. FTDI USB1 (FT232R USB UART, SN:...). If several devices using FTDI USB interface are connected to your computer, you have to select the correct device.
- Remaining items can be used to set communication parameters. Valid values are: Data bits =8, Stop bits=1, Baud rate =38400 Bd, Parity – none. Check echo while transmitting is not used.

Timeouts:

- Default read timeout – maximum time necessary to receive response from the regulator. Modify the value (increase) only if you experience communication problems.
- Default inter-byte timeout - time necessary to accept individual bytes from regulator. Modify the value only if you experience communication problems.

Buttons:

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

LAN/UDP INTERFACE 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 regulator WATTconfig M software. You may specify the regulator address in your local network, or if you use suitable NAT settings for your router you may also specify the global Internet address. Before you change the IP address, you have to change the IP address settings directly in the regulator - see the "Other settings" tab.
- UDP port – UDP port used to access the regulator via WATTconfig M software. The default value is 50000.

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

Timeouts:

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

**LED STATUSES**
The following table shows possible regulator statuses indicated by built-in LEDs.

<table>
<thead>
<tr>
<th>LED</th>
<th>Status</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED PWR (green)</td>
<td>On</td>
<td>The regulator is switched on and no output is active.</td>
</tr>
<tr>
<td></td>
<td>Flashes</td>
<td>The regulator is switched on and some outputs are active.</td>
</tr>
<tr>
<td></td>
<td>Flashes quickly</td>
<td>The regulator is switched on and boot mode is active.</td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>The regulator is without power supply or there is a failure.</td>
</tr>
<tr>
<td>LED COM (yellow)</td>
<td>Off</td>
<td>Communication with computer via USB was not established.</td>
</tr>
<tr>
<td></td>
<td>Stays on or flashes quickly</td>
<td>Communication with computer via USB was established.</td>
</tr>
<tr>
<td>LED ERR (red)</td>
<td>Off</td>
<td>No error status detected.</td>
</tr>
<tr>
<td></td>
<td>Flashes regularly in the following way: short- short- short</td>
<td>L1 voltage is missing. Proceed according to instructions specified in the chapter Description of WATTconfig M items.</td>
</tr>
<tr>
<td></td>
<td>Flashes regularly in the following way: long-long-short</td>
<td>Temperature sensor error, proceed according to instructions specified in the chapter Description of WATTconfig M items.</td>
</tr>
<tr>
<td></td>
<td>Flashes regularly in three long bursts (long-long-long)</td>
<td>Maximum temperature exceeded, proceed according to instructions specified in the chapter Description of WATTconfig M items.</td>
</tr>
<tr>
<td>LED OUT</td>
<td>Off</td>
<td>The relevant output is not active.</td>
</tr>
<tr>
<td></td>
<td>On or flashes quickly</td>
<td>The output is active (switched on)</td>
</tr>
<tr>
<td>LED on LAN connector - right LED</td>
<td>Off</td>
<td>No Ethernet signal detected.</td>
</tr>
<tr>
<td></td>
<td>On</td>
<td>Ethernet signal detected.</td>
</tr>
<tr>
<td></td>
<td>Flashes</td>
<td>Data transfer active</td>
</tr>
<tr>
<td>LED on LAN connector - left LED</td>
<td>Off</td>
<td>Data rate is 10 Mbit/s.</td>
</tr>
<tr>
<td></td>
<td>On</td>
<td>Data rate is 100 Mbit/s.</td>
</tr>
</tbody>
</table>
CONFIGURATION EXAMPLES

These examples only demonstrate the potential use of the device - in most cases however, settings must be modified. 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 effectivity of the system.

EXAMPLE NO. 1 – ONE LOAD ONLY

Boiler with nominal power rating of 2 kW, 200 l 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:

\[ E = \frac{c_v \cdot V[l] \cdot \Delta T[K]}{3600000} = \frac{4180 \cdot 200 \cdot 38}{3600000} = 8.82 \text{ kWh} \]

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 spiral 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 spiral with 2nd priority (SSR 2).

Unfortunately, in this "one-regulator" configuration setup, the 3rd heating spiral 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 device M allows monitoring and configuration via Ethernet. In order to establish communication you must correctly configure network connection.

![Warning]

Always entrust the configuration of the network and Internet access to the regulator 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 technical support policy and cannot be claimed.

It is recommended to perform regulator 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 regulator allows you to set only static IP address. The regulator does not support dynamic IP address assignment. Because most users connect to the regulator from Internet through a network router or the NAT function, static regulator IP address is required.

LOCAL NETWORK CONNECTION SETTINGS

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

![Warning]

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

- **IP address**: enter the IP address where regulator 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 regulator 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.
- **Regulator MAC address**: enter the physical/MAC address of your regulator. 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 regulator will listen to incoming UDP request e.g. from WATTconfig M software. Change this value only if there are several UDP servers in your local network.
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 regulator it is also necessary to change the UDP port settings in the LAN/UDP device driver configuration of WATTrouter M software.

- **HTTP port**: enter the HTTP port value where your regulator 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 setting section. Dynamic IP address may also be used, but depending on your Internet connection provider, this address may be changed more or less frequently. If your regulator is not accessible from the Internet, always check the WAN configuration in your router first.

Regulator 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 into local network IP addresses.

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.

<table>
<thead>
<tr>
<th>NO.</th>
<th>Private IP</th>
<th>Type</th>
<th>Port Range</th>
<th>Comment</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>192.168.2.200</td>
<td>TCP</td>
<td>80</td>
<td>WATTrouter HTTP</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>192.168.2.200</td>
<td>UDP</td>
<td>50000</td>
<td>WATTrouter UDP</td>
<td></td>
</tr>
</tbody>
</table>

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 regulator 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 regulator from the Internet via WATTconfig M, 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 the different HTTP port in the regulator, for example widely used alternate port No. 8080, instead of the standard port No. 80. To access the regulator just enter the following address into your internet browser:

**http://80.200.50.6:8080/**
WATTrouter M devices can be monitored and configured using regular Internet browsers and therefore, you may use other platforms than Microsoft Windows. Web interface may be used only if the regulator is connected via Ethernet.

Figure 13: Device web interface.

Using the web interface you may monitor and configure all regulator parameters as if you would use the WATTconfig M control software, except for network settings, statistic exports and firmware upgrades.

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

Monitoring the regulator 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 cookies, but instead of it the login data is embedded into each configuration write request. This mechanism simplifies the implementation on the superior control system where using cookies could create problems.
In order to monitor and configure your regulator you may use following HTTP/XML requirements. 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 regulator (actual measured powers in individual phases and assumed values on connected loads). Structure of returned data:

```
<--Response headers
<--one empty line
<meas

<PL1>-2.20</PL1>-- measured power on phase L1 in kW
<PL2>-1.50</PL2>-- measured power on phase L2 in kW
<PL3>-1.10</PL3>-- measured power on phase L3 in kW
<PPS>-1.80</PPS>-- sum of measured powers L1+L2+L3 in kW
<Te>25.0°C</Te>-- controller temperature in °C
<PA1>1.00</PA1>-- assumed load power at output No. 1 in kW
<PA2>0.50</PA2>-- assumed load power at output No. 2 in kW
...<HNI1>1</HNI1>-- basic control mode at output No. 1: 0=inactive, 1=active
...<CWT1>1</CWT1>-- CombiWATT at output No. 1: 0=inactive, 1=active
...<CWT2>1</CWT2>-- output No. 1 enforced by time schedule: 0=inactive, 1=active
...<HRL1>0</HRL1>-- output No. 1 restricted by time schedule: 0=inactive, 1=active
<TS1>0</TS1>-- output test: 0=inactive, 1=active
<PAO2>0.50</PAO2>-- assumed load power at output No. 2 in kW
...<PAO1>0.50</PAO1>-- power registered at input FBl
...<FEI1>1.60</FEI1>-- energy registered at input FBI
...<PAO2>0.00</PAO2>-- power registered at input FB2
...<PAO1>0.00</PAO1>-- power registered at input FB3
...<TIR1>0:00:00</TIR1>-- time (controller)
...<CT1>7200</CT1>-- time to activate CombiWATT
...<FP>7200</FP>-- fan power
...<FW>0.00</FW>-- firmware type (first letter and version (2 digits)
...<EL1>0</EL1>-- no fault, L1 voltage missing
...<ETS>0</ETS>-- no fault, temperature sensor error
...<EL2>0</EL2>-- no fault, maximum temperature exceeded
...<ELT>0</ELT>-- not present, low tariff active
...<ICW>0</ICW>-- not present, CombiWATT active
...<ITS>0</ITS>-- not present, output test active
...<IDST>0</IDST>-- 0=not present, 1=summer time
...<SRT>6:00</SRT>-- sunrise time
</meas>
```

2. GET /conf.xml

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

```
<--Response headers
<--one empty line
<conf

<DE>My configuration</DE>-- configuration/object name
<RM>0</RM>-- control mode (0=each phase independently, 1=sum of all phases)
<PSe0<PSe5>-- phase sequence (0=automatically, 1=L1,L2,L3, 2=L1,L3,L2)
<CD1<CD1>-- L1 current orientation (0=normal, 1=opposite)
<CD2<CD2>-- L2 current orientation (0=normal, 1=opposite)
<CD3<CD3>-- L3 current orientation (0=normal, 1=opposite)
<NAI>BOILER</NAI>-- output label
<Ty1>Ty1>-- output function (0=relay, 1=proportional)
<Pr1>Pr1>-- output priority (0=unused to 6=sixth)
<Ph1>Ph1>-- output phase (0=L1 through 2-L3)
<PC>PC>-- connected power in kW
<PM1>0.01</PM1>-- maximum power in kW
<PI1>10</PI1>-- PWM-I value
<TDI>TDI>-- on-delay time in s
<TPI>TPI>-- off-delay time in s
<CE1>0.50</CE1>-- energy limit for CombiWATT in kWh
<CF1>CF1>-- full power for CombiWATT (0=no, 1=yes)
<PR1>PR1>-- prepend (0=inactive to 5=max. number of outputs)
<IN1>IN1>-- inverted output (0=normal, 1=inverted)
```
3. POST /conf.xml

By sending this HTTP request you will save the configuration in the regulator. 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:

```
<conf>
<DaC>1.1.2012</DaC>
<TiC>0:00:00</TiC>
<UN>admin</UN>
<UP>1234</UP>
<UNn>home</UNn>
<UPn>abcd</UPn>
</conf>
```

The regulator will reply with the following:

```
<conf>
<accept>0</accept>
</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:

```
<conf>
<accept>0</accept>
</conf>
```
POST /test.xml

<-- one empty line>
<test>
<TST1>1</TST1><-- activate test mode for output 1>
<TST2>0</TST2><-- deactivate test mode for output 2>
<-- 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 regulator will reply with the following:

<-- Response headers>
<-- one empty line>
<test>
<accept>0</accept><-- error code: 0-ok, 2=incorrect login (access) data>
</test>

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

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

<-- Response headers>
<-- one empty line>
<stat_day>
<SDD0>2013-07-20</SDD0><-- date today>
<SDD1>2013-07-17</SDD1><-- 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 2 to 6>
<SDI1>0.00</SDI1><-- daily energy for FB1 input>
<-- similarly for remaining inputs FB2 and FB3>
</stat_day>

6. GET /stat_week.xml

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

<-- Response headers>
<-- one empty line>
<stat_week>
<SWD>2013-07-20</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>

7. GET /stat_month.xml

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

<-- Response headers>
<-- one empty line>
<stat_month>
<SMD>2013-07-20</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>
8. GET /stat_year.xml

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

```xml
<stat_year>
  <SYD>2013-07-20</SYD>  <!-- date today -->
  <SYS1>0.00</SYS1>  <!-- surplus energy all phases in kWh, this month -->
  <SYH1>0.00</SYH1>  <!-- consumption normal tariff all phases in 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 -->
</stat_year>
```

<-- similarly for the 2th to 12th last month -->
WATTCONFIG FOR ANDROID OS

WATTRouter M device allows monitoring and configuration through the use of regular smart phones or tablets running Android OS. To do so, you may use not only the built-in web interface, but also a special application developed for this purpose. This application is available at the manufacturer’s webpage as an installation package called wattconfig_android_x_x.apk.

The application is divided into 4 screens and offers very easy and intuitive controls. You may switch between individual screens by dragging your finger to another screen. If the screen cannot fit in the display, you may roll down the screen by dragging your finger up and down. In WATTconfig for Android the configuration cannot be saved or opened, network settings cannot be read and written and firmware update is not possible.

The application connects to the regulator only through the UDP interface via phone or tablet using wireless data communication (Wi-Fi or data transfer service provided by the mobile phone operator). The regulator must be connected to the Internet via LAN port. If you want to have access from local network, you must connect your regulator to a router which supports Wi-Fi communication.

Description of available screens:

1. Measured values and statuses - it corresponds with measured values and statuses in the main window of WATTconfig M software.
2. Input settings – the same as on the "Input settings" tab of WATTconfig M software.
3. Output setting – the same as on the "Output settings" tab of WATTconfig M software.
4. Time schedules – the same as on the "Time schedules" tab of WATTconfig M software.

You may display the menu options by pressing the Menu button on your smartphone or tablet.

The menu contains 5 options/items:

1. **Read** - reads the configuration from the regulator, if the regulator is connected (displays green status if connection is available)
2. **Write** - writes the current configuration into the regulator, if the regulator is connected (displays green status if connection is available). This command will write only available configuration options. Options which are not supported (time schedules etc.) will not be changed in the regulator.
3. **Profile x** – Change/switch the profile – switches/changes the current connection profile. This application supports only two connection profiles for which you may set the same parameters as in the WATTconfig M software (that is the IP address and UDP port).
4. **Settings** – allows you to configure connection profiles. Each profile may be named and assigned with IP address and UDP port. Default values may be set by resting your finger on the relevant item followed by pressing the Set default option to confirm your selection.
5. **About the software** - displays information about this software.

**Notes regarding the installation and usage of your software:**

The application is digitally signed by the manufacturer. Therefore, installation fully complies with Android principles.

Should you experience unusual behavior, terminate the application and restart it. If restart did not solve your problems, use the Application Manager utility in your phone or tablet and clear application data.

**Changing the language version:**

If you change the language in your phone or tablet, the application language is changed automatically. The same languages are supported as languages available in WATTconfig M software.
# TROUBLESHOOTING

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

<table>
<thead>
<tr>
<th>Problem description</th>
<th>Possible causes</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The regulator has been fitted according to the manual but after you switch on the circuit breaker no LED lights up or flashes.</td>
<td>The circuit breaker is on but the supply voltage is missing.</td>
<td>Check or measure whether there is any voltage between terminals L1 and N. Replace the regulator or take it to repair.</td>
</tr>
<tr>
<td>The regulator has been fitted according to the manual but after you turn on the circuit breaker the green LED quickly flashes, the regulator does not work and the WATTconfig M software shows all zeros.</td>
<td>Regulator failure/defect</td>
<td>Use the WATTconfig M 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 regulator access authorization.</td>
</tr>
<tr>
<td>The regulator does not communicate with computer</td>
<td>The regulator has no voltage</td>
<td>Check whether green LED PWR is on and the regulator is powered.</td>
</tr>
<tr>
<td></td>
<td>Computer is not properly connected with the regulator</td>
<td>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. It can be downloaded at: <a href="http://www.ftdichip.com/Drivers/D2XX.htm">http://www.ftdichip.com/Drivers/D2XX.htm</a></td>
</tr>
<tr>
<td></td>
<td>Computer cannot detect connected regulator.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>USB interface driver was not correctly installed in your computer</td>
<td>Make sure the USB interface driver is correctly installed and Windows device manager detects it as a USB serial converter. In case of problems always ensure the latest version of USB driver is installed: <a href="http://www.ftdichip.com/Drivers/D2XX.htm">http://www.ftdichip.com/Drivers/D2XX.htm</a></td>
</tr>
<tr>
<td>Issue</td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>USB interface driver is not configured properly</td>
<td>Use the USB interface driver configuration window in WATTconfig M and reset all parameters back to default values.</td>
<td></td>
</tr>
<tr>
<td>LAN/UDP interface driver is not configured properly</td>
<td>Use the LAN/UDP interface driver configuration window in WATTconfig M to check the validity of IP address and UDP port. Connect to the regulator using USB in order to determine the current network configuration stored in the regulator (use the Other settings tab). IP addresses and UDP ports must have the same configuration.</td>
<td></td>
</tr>
<tr>
<td>The Log window records communication errors</td>
<td>A very few communication errors is considered a common status and it depends on the actual load put on Microsoft Windows OS, the local network, or on the operating system running in the regulator. However, if they 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.</td>
<td></td>
</tr>
<tr>
<td>Overloaded Ethernet</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Regulator failure/defect</td>
<td>Replace the regulator or take it to repair.</td>
<td></td>
</tr>
<tr>
<td>Measured powers are not displayed or they are displayed incorrectly</td>
<td>The current sensing module is not connected Connect the current sensing module according to this manual.</td>
<td></td>
</tr>
<tr>
<td>Incorrect phase sequence</td>
<td>Make sure that phase connected to terminal L1 is the same as phase measured at input I_L1. Also inspect the validity of phase sequence settings (see Phase order settings field in the main window).</td>
<td></td>
</tr>
<tr>
<td>Incorrect current orientation settings</td>
<td>Set the current orientations in WATTconfig M software as specified in this manual.</td>
<td></td>
</tr>
<tr>
<td>Regulator or current sensing module defect</td>
<td>Replace the regulator and/or current sensing module or take them to repair.</td>
<td></td>
</tr>
<tr>
<td>There are suspicious waveforms shown in chart &quot;Current wave oscilloscope&quot;</td>
<td>This is normal During normal operation there may be shown even &quot;exotic&quot; waveforms. Be sure this is the real current flowing through the phase wire, a superposition of currents flowing through the connected appliances</td>
<td></td>
</tr>
<tr>
<td>Issue</td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Positive measured power value (production) differs too much from the</td>
<td>There is connected some load, which decreases this value.</td>
<td></td>
</tr>
<tr>
<td>value on the inverter display</td>
<td>No defect</td>
<td></td>
</tr>
<tr>
<td>Inverter shows approximate values, or the status is not stable</td>
<td>No defect</td>
<td></td>
</tr>
<tr>
<td>Incorrect phase sequence or incorrect current orientation settings</td>
<td>Follow the steps specified in the previous item.</td>
<td></td>
</tr>
<tr>
<td>Low tariff signal is missing</td>
<td>Low tariff signal is not connected</td>
<td></td>
</tr>
<tr>
<td>Low tariff signal is not connected</td>
<td>Connect the low tariff signal to LT terminal. You must connect the signal</td>
<td></td>
</tr>
<tr>
<td>Low tariff signal is not active</td>
<td>through an auxiliary relay as specified in this manual.</td>
<td></td>
</tr>
<tr>
<td>Regulator failure/defect</td>
<td>Replace the regulator or take it to repair.</td>
<td></td>
</tr>
<tr>
<td>FB inputs do not work</td>
<td>Output with open collector is connected in reverse polarity</td>
<td></td>
</tr>
<tr>
<td>Signal coming from the output is an unsupported impulse signal</td>
<td>Use only device with impulse output whose signal carries information</td>
<td></td>
</tr>
<tr>
<td>Regulator failure/defect</td>
<td>about the measured energy and has a minimum impulse width of 1 ms.</td>
<td></td>
</tr>
<tr>
<td>The TEST button cannot be used to switch on some of the connected</td>
<td>The relevant load is not connected or it is connected incorrectly</td>
<td></td>
</tr>
<tr>
<td>loads</td>
<td>Check the connection of the relevant load and switch on the corresponding</td>
<td></td>
</tr>
<tr>
<td>The load is connected correctly but cannot be switched on</td>
<td>circuit breaker or fuse switch.</td>
<td></td>
</tr>
<tr>
<td>Output LED is defect or there is another regulator defect</td>
<td>Replace the regulator or take it to repair.</td>
<td></td>
</tr>
<tr>
<td>Outputs do not switch on as they should</td>
<td>Output is not activated</td>
<td></td>
</tr>
<tr>
<td>PV-plant does not provide sufficient power output</td>
<td>Activate the output by setting the relevant priority.</td>
<td></td>
</tr>
<tr>
<td>Incorrectly set priorities or connected power values</td>
<td>Check whether there is enough surplus energy available in respective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>phase wire or sum of phases L1 + L2 + L3 is positive, depending on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>configured control mode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the priority setting of your loads and connected power settings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>according to their power ratings.</td>
<td></td>
</tr>
</tbody>
</table>

For issues with measured power values that are not sinusoidal or their power factor varies from one, there is connected some load, which decreases this value. The inverter shows approximate values, or the status is not stable. Follow the steps specified in the previous item.
<table>
<thead>
<tr>
<th>Problem Description</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>You cannot load firmware, even if you try repeatedly</td>
<td>Also check the CombiWATT production limit field, which should be low.</td>
</tr>
<tr>
<td>Incorrect or corrupted *.scf file</td>
<td>Load only original regulator firmware for the WATTrouter M device.</td>
</tr>
<tr>
<td>Communication errors</td>
<td>Make sure that there are no problems with the connection of the regulator to PC, or in the PC alone (viruses etc.).</td>
</tr>
<tr>
<td>Regulator failure/defect</td>
<td>Replace the regulator or take it to repair.</td>
</tr>
<tr>
<td>The built-in fan does not work (does not spin) when triac outputs are on</td>
<td>Fan is disconnected.</td>
</tr>
<tr>
<td>oler in the WATTrouter M device.</td>
<td></td>
</tr>
<tr>
<td>Fan does not work</td>
<td>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.</td>
</tr>
<tr>
<td>The sound of the fan changes irregularly</td>
<td>This is normal.</td>
</tr>
<tr>
<td>The speed of the fan is regulated in order to provide optimal cooling.</td>
<td>This is normal.</td>
</tr>
<tr>
<td>Fan makes strange noises</td>
<td>The system detected error status</td>
</tr>
<tr>
<td>The fan is defective</td>
<td>Follow instructions in the LED statuses chapter.</td>
</tr>
<tr>
<td>Flashing red LED</td>
<td>Follow instructions in the LED statuses chapter.</td>
</tr>
<tr>
<td>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</td>
<td>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 triacs or SSRs with higher priority may be disconnected earlier than the relay outputs with lower priority.</td>
</tr>
<tr>
<td>CombiWATT software runs even if PV-plant produces power</td>
<td>This is normal.</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Solid state relay (SSR) does not switch on</td>
<td>This is normal.</td>
</tr>
<tr>
<td>SSR is not connected correctly</td>
<td>Check for proper terminal connection and observe polarity of SSR anodes.</td>
</tr>
<tr>
<td>Incompatible relay</td>
<td>Always use a SSR with zero cross switch and minimum DC control voltage of 4VDC.</td>
</tr>
<tr>
<td>Regulator failure/defect</td>
<td>Replace the regulator or take it to repair.</td>
</tr>
<tr>
<td>SSR failure/defect</td>
<td>Replace the SSR.</td>
</tr>
<tr>
<td>Data in statistics don't correspond with reality</td>
<td>This is normal.</td>
</tr>
<tr>
<td>The data are indicative only; the device does not have accurate data from</td>
<td>This is normal.</td>
</tr>
<tr>
<td>Statistics suddenly erased</td>
<td>This is normal</td>
</tr>
</tbody>
</table>
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 improbable. 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 (except for fan replacement - after your warranty period expires)! If you do so, you are putting yourself at risk of electric shock. Further, your entire warranty will be void!**
# TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value, notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td>230 V~, 50 Hz</td>
</tr>
<tr>
<td>Power consumption – stand-by mode</td>
<td>&lt;3 VA</td>
</tr>
<tr>
<td>Power consumption – 1 triac output</td>
<td>approximately 1 W/A</td>
</tr>
<tr>
<td>Power consumption – 1 relay output</td>
<td>0.4 W</td>
</tr>
<tr>
<td>Power consumption – all outputs switched on and loaded with maximum allowable currents</td>
<td>25 W</td>
</tr>
<tr>
<td>Current measuring range</td>
<td>SSR model: 0-20 A~ (±5 %), 50 Hz (±5 %)</td>
</tr>
<tr>
<td></td>
<td>MAX model: 0-100 A~ (±5 %), 50 Hz (±5 %)</td>
</tr>
<tr>
<td>Voltage range</td>
<td>230V~ (±5%), 50Hz (±5%)</td>
</tr>
<tr>
<td>Maximum steady currents allowed to flow through current sensing module</td>
<td>SSR model: 0-40 A~ (±5 %), 50 Hz (±5 %)</td>
</tr>
<tr>
<td></td>
<td>MAX model: 0-125 A~ (±5 %), 50 Hz (±5 %)</td>
</tr>
<tr>
<td>Active power measuring accuracy</td>
<td>5% ± 0,05kW</td>
</tr>
<tr>
<td><strong>Output and input parameters</strong></td>
<td></td>
</tr>
<tr>
<td>L1 input</td>
<td>230 V~, 50 Hz</td>
</tr>
<tr>
<td>I_L1, I_L2, I_L3 inputs:</td>
<td>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~.</td>
</tr>
<tr>
<td>Triac outputs</td>
<td>230 V~, 50 Hz, max. 10 A, 2300 W, only resistive load with cos(Ω) = 1 Protection: Fuse for semiconductor protection</td>
</tr>
<tr>
<td>Relay outputs</td>
<td>230 V~, 50 Hz, max. 10 A, 2300 W (it is recommended to connect load with cos(Ω) ≠ 1 via external contactor) Protection: Regular circuit breaker, type B</td>
</tr>
<tr>
<td>External outputs for connection of solid state relays SSR (S+, S1-, S2-)</td>
<td>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</td>
</tr>
<tr>
<td>External outputs - connection with PWM function (S+, S1-, S2-)</td>
<td>0 or 5 VDC, isolated from power grid supply PWM parameters: carrier frequency 200 Hz, duty cycle 0-100% in 1% steps. Protection: based on instructions specified in the manual of connected device</td>
</tr>
<tr>
<td>LT, FB1, FB2 and FB3 inputs</td>
<td>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.</td>
</tr>
<tr>
<td>USB Connection</td>
<td>USB 1.1/ USB 2.0, isolated both from power grid</td>
</tr>
<tr>
<td><strong>LAN Connection</strong></td>
<td>10/100 Mbit/s, isolated from power grid supply according to IEEE 802.3</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

**Dynamic characteristics**

<table>
<thead>
<tr>
<th><strong>Active power measuring period (effective values)</strong></th>
<th>typically 600 ms (including averaging of switched-on (active) triacs/SSR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulation dynamics (full scale) at Triac/SSR output</strong></td>
<td>typically 3 s (from 0 to 100 % of power output and vice versa)</td>
</tr>
<tr>
<td><strong>Relay output on-delay time</strong></td>
<td>Programmable (minimum of 2s)</td>
</tr>
<tr>
<td><strong>Relay output off-delay time</strong></td>
<td>Programmable (minimum of 2s)</td>
</tr>
</tbody>
</table>

**Other parameters**

<table>
<thead>
<tr>
<th><strong>Maximum diameter of wires connected to terminals</strong></th>
<th>2.5 mm</th>
</tr>
</thead>
</table>
| **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). For longer lines than 2 m it is recommended to use shielded cable and connect shielding to PE wire. |
| **Distance of the regulator and solid state relay** | <10 m. For lines longer than 1 m it is recommended to use shielded cable and connect shielding to PE wire. |
| **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. Distribution box 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,(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

**RECYCLING**

After the product life is over the product may be disassembled, recycled or disposed of at a save dumpsite.
Legal regulations regarding electronic waste treatment have to be observed in respective country.
Do not dispose in regular household waste!
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 Kryšl, Company Executive

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