

BMR HM2006 **power demand controller**

User and service manual



version 1.5

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1. Device description

Device is designed for regulation and monitoring of power demand. Connection to pulse outputs of electricity meter can be realized via optoelectronic unit or directly. Power demand regulation is optimized according to chosen regulation curve and set regulation or technical maximum. Device has 5 inputs, which can be connected to following signals: **active consumption, reactive consumption, reactive distribution, tariff or active distribution and measuring period**. HM2006 is doing full monitoring of power demand. There are 6 relay outputs 3 A / 250 VAC.

Device is equipped by standard communication channel RS485, which allows remote connection to PC (personal computer). From PC, it is possible to make parametrization and readings of all measured values, which are continuously being saved to the internal memory of regulator. Another features, offered by software, are on-line consumption/distribution visualization, history, data and configuration archivation in PC, etc.

Device has output of galvanic isolated power supply of 12 VDC for supplying of optoelectronic unit which separate regulator from energy meter. Regulator has its own real-time clock, which is backed up for 48 hours and can be synchronized via measuring period for energy meter. Information are shown on the LCD display and device is also equipped by four-button keyboard for control of set parameters.

2. Device function

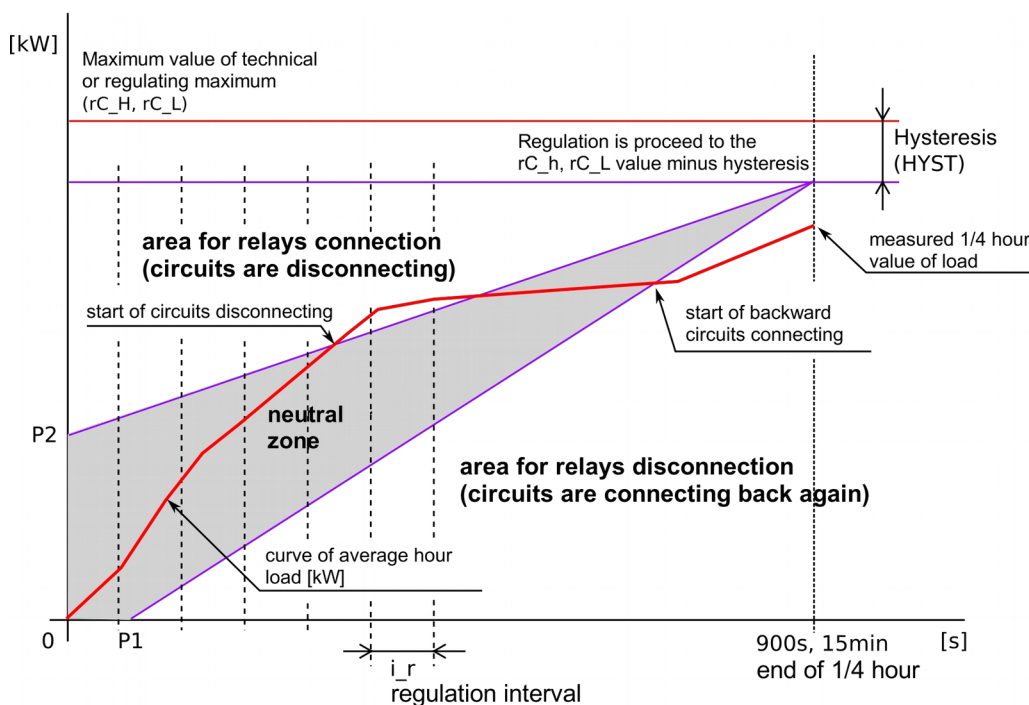
Regulator measures active power waveform on the base of number of pulses from energy meter outputs and conversion constant [Wh/pulse] which is set. These measurements are being done within the frame of measuring period, and compared with waveform defined by regulation curve, with set hysteresis included. On the base of comparison result, regulator will decide, if it is necessary to disconnect some stage, or on the contrary, that is possible to connect some. Defined parameters of particular stages have to be taken into account.

Consumed electric energy, during one measuring period, is saved into data memory and measurement starts again. It is possible to set different modes for the regulator- after measuring period ends regulator can connect again all stages, or it will continue in regulation step by step, and according to the situation it will connect progressively particular stages. If the pulse for the measuring period is not available from the main meter, it is possible to activate internal generator of pulses in the regulator itself. Afterwards it is necessary to tune real time of regulator clock with time of switching clock of main energy meter and keep regular control. There is also possibility to use one regulator input for tariff pulse, which is at some tariff rates needed for differentiation between technical and regulation maximum. If there is no possibility to connect tariff, then it is possible to use for its identification internal timer program, which is possible to be programmed in regulator. At this feature, it can happen that in the case of significant time difference between main energy meter and regulator (bigger than one period) regulator will not work correctly. This problem can never happen if the time synchronization is done by pulses. Other parameters monitored by regulator HM2006 are saved to the memory and it is possible to use them for visualization of load behaviour by PC software.

3. Working principle of consumption regulation

Regulator has 6 relay outputs (R1 – R6). In programming mode, it is possible to set maximum value of average hour consumption, in kW. This value is in periodic intervals compared to consumption during 1/4 hour and in case of fast consumption rise regulator disconnects one of six possible connected circuits. If consumption rising drops down so much that reserve of power appears, then regulator disconnects one of closed relays (according to its priority) and move relevant circuit back to be part of network. According to the actual consumption, device is showing during 1/4 hour calculation of average hour consumption value in kW. After quarter hour pulse comes, displayed value is reset and all relays are disconnected and regulation process will be repeated. During measurement, following information will be recorded: maximum reached value of quarter maximum, date and time when it happened, for each tariff individually. Those maximum values are possible to be seen in absolute value displaying mode. All values are possible to be seen and at the same time also to be reset. Load curve is recorded each quarter of hour into the device memory for period of 40 days. After exceeding of 40 days period, device memory is started to be re-written by data from first day (FIFO). After connection to the PC, it is possible to make analyzes of load for last 40 days, read actual measured values, check device configuration and also to change it.

Regulation principle is shown on the picture below:



Picture 1. Regulation principle of power demand control

Constants for regulation characteristic setting:

- **rC_H, rC_L** – regulation constant for high respective low tariff (kW). Maximum set value is 0 – 9999 kW.
- **HYST** – zone of protection (reserve) against maximum regulation value overrun. Maximum set value is 5 – 20% (from regulation constant).
- **P1** – threshold value of limit curve for **relay disconnecting (load circuit connection back to network)**. Maximum set value is 0 – 80% (from 15 minutes).
- **P2** – threshold value of limit curve for **relay connection (load circuit disconnection from network)**. Maximum set value is 0 – 80% (from regulation constant).
- **i_r** – set of regulation "speed". From 1 to 99 seconds. Defines how often situations in measurement are evaluated.

All variables are possible to be set in programming mode.

4. Working mode description

4.1. Actual value displaying mode

It is basic mode, in which device is situated after connection of supply voltage. In this mode, it is possible to select displaying of one from four values:

1. actual measured consumption value calculated on average hour power
2. current time (hour:minute) with automatic changing of summer time and back
3. current date (day:month)
4. instantaneous power

Selection of displayed value is provided by repeated pressing of button ▲. It is the symbol of the parameter, which will be displayed first every time. If the button is not pressed again in two seconds, current value will appear on display. In this mode, arrow with indication of actual tariff (▲ - high tariff, ▼ - low tariff) will light on the left side of the display.

4.2. Absolute value displaying mode

In this mode, it is possible to do the following:

1. display value of absolute maximum of quarter hour for last period, date and time when the maximum was reached

(progressively for high and low tariff separately)

2. erase values of absolute maximum and start new monitored period

Getting into this mode is done by pressing of button with symbol ►. The mode is indicated by light of all 7 lines at the upper display part. Repeated press of the same button will show following information:

- absolute maximum for high tariff (in kW)
- date when the maximum was reached
- time when the maximum was reached
- absolute maximum for low tariff
- date when the maximum was reached
- time when the maximum was reached

Another pressing of the same button will switch back to the basic mode. At the moment of displayed value of absolute maximum for any tariff, this value is possible to erase by pressing of button **SET**.

4.3. Programming mode

In this mode, it is possible to set working parameters of the regulator. Pressing of button **SET** for 5 seconds switches regulator to the manual control mode. Presence of this mode is indicated by displaying word "Prog" and symbols of both arrows including minus sign. Symbol of parameter, which is possible to be changed, will also appear on the display. For moving to another parameter in the mode, buttons ▲ and ► should be used. Buttons have autorepeat function. It means that if one of the buttons keeps being pressed, change to another parameter will be automatic. If any parameter, from the menu, has sub-menu, by pressing of the button **SET** this sub-menu will be entered. Parameter selection in the sub-menu is the same as in the main menu. For checking or changing of selected parameter value, press button **SET**. Displayed value is possible to be changed by button ▲ for increment and by button ▼ for decrement. Confirmation of changed value, or possible escape from checking can be done by pressing button **SET**. The same parameter symbol appears on the display again. It is possible to move to another parameter, or by pressing the button **SET** to escape to the basic mode. If there is no action at the keyboard for 1 minutes, device automatically returns back to the basic mode. Parameter description and their settings are explained in chapter No. 5.

4.4. Manual control mode

This mode is used for manual control of power demand, without automatic influence. To enter this mode press button **MAN** for h seconds. Manual control mode indication is realized by blinking symbol of fan, on the upper left corner of the display. Name of relay will also appear on the display. This name can be currently manually controlled. Selection of another relay is done by button ▲ or ►. Available relays are only those which have feature USE (in usage) set on 1 (possible to be set in programming mode). If the relay is selected, after pressing of button **SET** the status ON/OFF will appear on display. This status can be changed by pressing of buttons ▲ and ►. If the status the change is confirmed by button **SET**, relevant relay will immediately be switched on or switched off, according the requested setting. Next pressing of button **SET** moves regulator to the status where regulator stays in manual regime. Measured quarter-hour (calculated to the hour average) will be shown on the display. Pressing of any button will switch again to the relay selection. Manual mode is possible to be closed, at the moment when actual measured value is on the display, by pressing the button **MAN** for 5 seconds. Device will automatically move to the basic mode and start again automatic regulation, according to the set working parameters.

5. Adjustable parameters

Menu	Sub menu	Description	Setting range	Factory setting
rC_h		Regulation constant for high tariff, in kW.	0 ... 9999	0
rC_L		Regulation constant for low tariff, in kW.	0 ... 9999	0
P_C		Transition constant for individual inputs from energy meter outputs (Wh / pulse)	0 ... 9999	0
	P_C1	Input EL1 (kWh+ active consumption)		0
	P_C2	Input EL2 (kVARh+ reactive consumption)		0
	P_C3	Input EL3 (kVARh- reactive consumption)		0
	P_C4	Input EL4 (kWh- active distribution, if SEL4=0 is set)		0

rELE	r_1 to r_6	Parameter setting of individual output relays R1-R6		
	uSE	Setting of relay usage 1 (yes - used), 0 (no - unused)	0 / 1	1
	Prio	Setting of relay priority – value from 1 to 6. Higher priority means that relay connects later and disconnects earlier. Appropriate circuit is connected and disconnected less commonly.	1 ... 6	1-6
	t_i	Minimum time of relay connection [min].	0 ... 15	1
	t_o	Minimum time of relay disconnection before it can be switch on again [min].	0 ... 15	1
	nSEP	Flag of „not connected relay“. Used in the case when some of controlled circuits is impossible to be disconnected, because of technological or other reasons, even during exceeding of set maximum regulation value. Values: 0 - relay is connecting according to regulation procedure; 1 - relay is disabled and not used for regulation.	0 / 1	0
	ESEP	Flag that it is possible to switch relay on even in case that time of minimum disconnection has not expired yet. This flag is applied only at moment, when actual consumption (during 1/4 hour) gets over the requested maximum regulation level (minus hysteresis). Values: 1 - relay is possible to connect before time; 0 - relay is waiting for expiration of minimum disconnection time period.	0 / 1	1
	t_m	Maximum time of stage disconnection [min]	0 ... 15	0
r_C		Regulation constants for regulation curve (see graph of regulation principle)		
	P1	Threshold value of limitation curve for relay disconnecting	0 ... 80%	0
	P2	Threshold value of limitation curve for relay connection	0 ... 80%	10
	HYS	Hysteresis – zone of protection against maximum regulated value overrun	5 ... 20%	10
YEAr		Actual year setting.		2002
dAt		Actual date setting. Set parameter is blinking.		01.01
CAS		Actual time setting. At the first hour is set and then after pressing of button SET , minutes are set too.		00:00
SEL4		Function setting of input No. 4. Value: 0 - input counts pulses from energy meter 1 - low tariff change is made by positive level of input No. 4 2 - low tariff change is made by negative level of input No. 4	0 / 1 / 2	0
SYnC		Real time synchronization by quarter hour pulse. Value: 1 – time is synchronized 0 – time is not synchronized	0 / 1	1
u1_4		Setting of active level of quarter hour pulse. Value: 0 – negative quarter hour pulse 1 – positive quarter hour pulse 2 – internal quarter hour pulse	0 / 1 / 2	1
P1_4		Moving forward to the new quarter hour. Value: 1 – all circuit switch on again (relays disconnect) 0 – circuits switch on according to the regulation conditions	0 / 1 / 2	1
dEL		Erasing and creating of the new measuring profile (last 40 days measuring saved into the memory will be erased). It is necessary to confirm this command by simultaneous pressing of buttons ► + <SET>+<MAN>		
i_r		Regulation interval [sec]. Defines regulation speed.	1 ... 99	10
ACPr		Time program activation for tariff changing regulation according to technical or regulating maximum.		0
Cpr	HT_1 ... HT_8 LT_1 ... LT_8	Time program for tariff changing for regulation according the technical or regulation maximum. It is possible to define 8 intervals during 1 day.		
	ht_1	Time for changing to the high tariff (regulation maximum) hour:min	in steps of 15 min	--:--
	Lt_1	Time for changing to the low tariff (technical maximum) hour:min	in steps of 15 min	--:--
LEt		Date of time change to the summer time in the actual year. When new year starts date is automatically changed. Do not change this if there is not any official modification in the rule of time change!		31.3
SEC		Date of changeover to the central European time in actual year. Rest is the same as at LEt parameter setting.		27.10
rES		Reset of parameters of operating conditions and setting of default factory values. Erasing of last measurement profile and creation of the new one. It is necessary to confirm this command by simultaneous pressing of buttons ► + <SET>+<MAN>		
r6_A		0 – output No. is subject of normal regulation 1 – output No. is withdrawn from regulation and connects only if measured value of active power gets over technical maximum value	0 / 1	0

6. Comment to parameter setting

After the first start of device, default values of all parameters are being set in the memory. Value of active load, equal to 0, should appear on the display. Immediately after setting of input constants **PC_1** to **PC_2**, technical maximum **rC_L** value and regulation maximum **rC_h** value, regulator will start to register pulses.

Switching to the low or high tariff will get active after device overran to the new 1/4 hour.

If the tariff is not used and you are not sure with connection and setting of input No. 4 (parameter SEL4), set the same value of technical maximum in parameter **rC_L** and parameter **rC_h**.

Technical maximum change will get active after device overran to the new 1/4 hour.

7. Installation

Regulator HM2006 is designed in plastic box with size of 6 modules for DIN rail mounting. Connection to the separation optoelectronic unit is shown on the connection diagrams below (chapter 9).

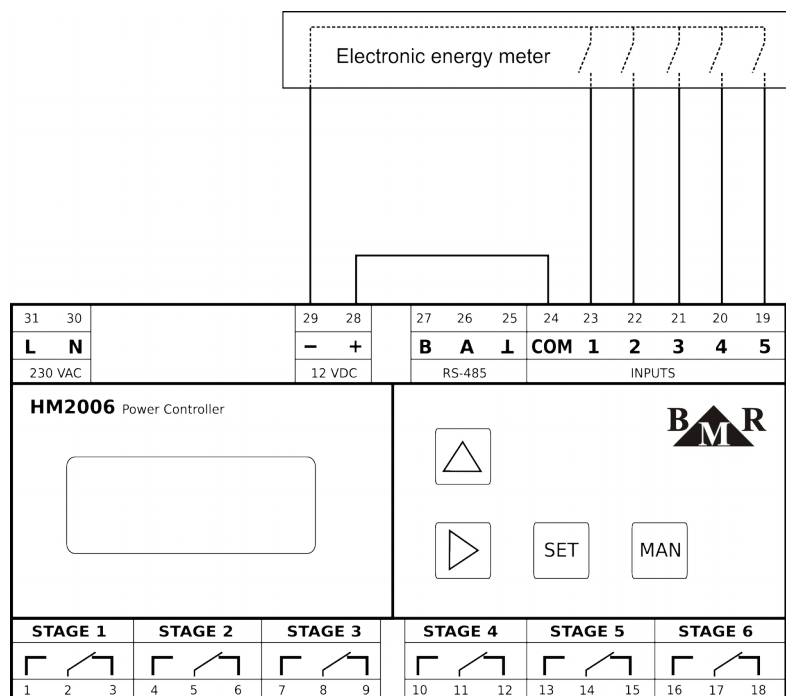
Minimum needed setting:

1. **Transition constant for pulse inputs** – this value can be found on the energy meter. For example 1 pulse = 0,1 kWh it means that 1 pulse has weight of 100 Wh. Value "100" set into parameter (**P_C->P_C1**[Wh/imp]) in the device menu and adequately for other inputs **P_C2**, **P_C3**, **P_C4**, if they are used.
2. **Regulating and technical maximum** – according to the contracted limits agreed with electricity supplier, set regulating maximum (high tariff) to the parameter (**rC_h** [kW]), technical maximum (low tariff) to the parameter (**rC_L** [kW]). If there is not available technical maximum (not agreed low tariff) set to the parameter (**rC_L** [kW]) the same value as for **rC_h**.
3. **Way of time synchronization with electricity meter** – synchronization is made by negative or positive pulse. Information which pulse is used, obtain from electricity supplier or determinate from quarter hour pulse signalization on optoelectronic unit (for BMR OP105 it is LED Tm). Device uses synchronization 1x per day at midnight or always in consequently 1/4 hour after the manual time setting. Electricity meter sends synchronization pulses every quarter hour with duration of 5-8 seconds. If the signalization LED on optoelectronic unit is on all the time and only during quarter hour change it turns off, it is negative pulse. Set value "0" in the parameter (**u1_4**). If the signalization LED on optoelectronic unit is off all the time and turns on only during quarter hour change, it is positive pulse. Set value "1" in the parameter (**u1_4**). Deice can work also without synchronization. Nevertheless this working mode is suitable only for testing purposes or temporary operation.
4. **Time and date** – primary time setting is very important. Device makes time synchronization about midnight. After the first installation, manually set time is running. Device, after the manual time setting, is synchronizing always according to consequently received synchronization pulse to the whole quarter hour. Set the initial time with an accuracy of the minute or trace up time and the moment of consequently quarter hour start on the electricity meter. In the service menu set parameter (**CAS**), confirm hour, set actual value of minute by arrows and press button SET. At the moment of change of energy meter to the new quarter hour time synchronization will be activated. Date setting is essential for summer time changes. Set also parameters (**DAT** and **YEA**r).

8. Technical features

Parameter	Value
Supply voltage	230 V _{AC} 50 Hz (+10%,-15%)
Frequency	50/60 Hz
Power consumption	4 VA
Number of signal inputs	5
Internal power supply for signal inputs	12 V _{DC}
Number of output channels	6
Load capability of relay contacts	250 V _{AC} / 3 A
Communication	RS485
Communication speed	9600 baud
Communication line distance	1200 m
Working temperature	-25°C ... +70°C
Dimension	DIN 6M (106 x 90 x 58 mm)
Weight	750 g

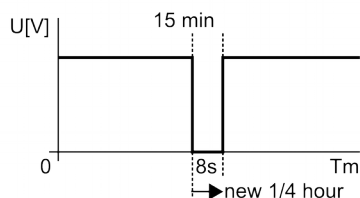
9. Connection diagrams



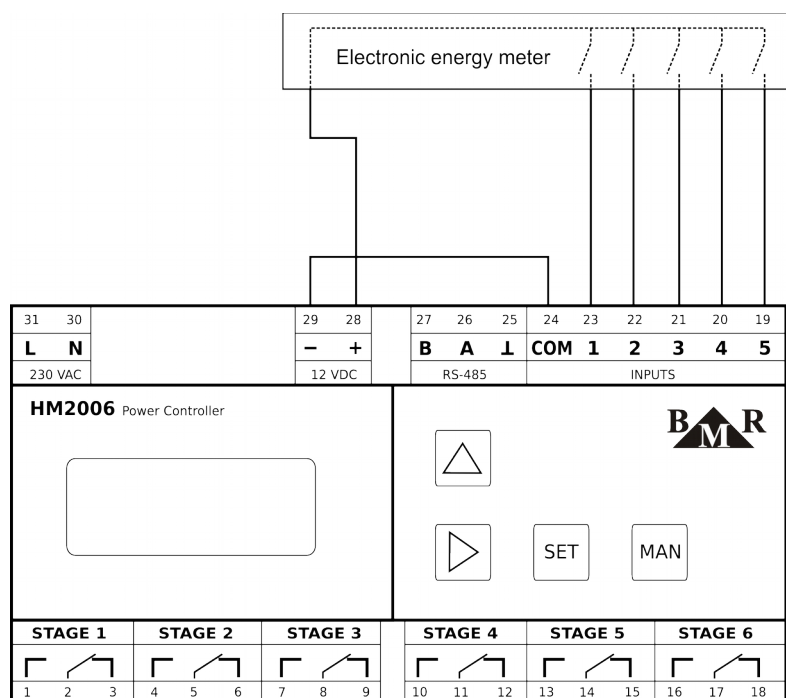
HM2006 input terminals

- 1 (23) kWh+ (active power consumption)
- 2 (22) kVARh+ (reactive power consumption)
- 3 (21) kVARh- (reactive power supply)
- 4 (20) kWh-tarif (active power supply or tariff)
- 5 (19) regulation period 1/4 hour Tm

Synchronization of 1/4 hour. by negative pulse



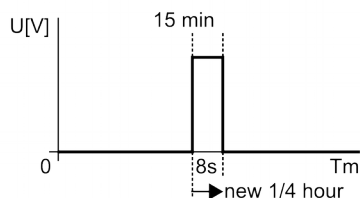
Picture 2. Connection diagram of HM2006 inputs controlled by negative pulse



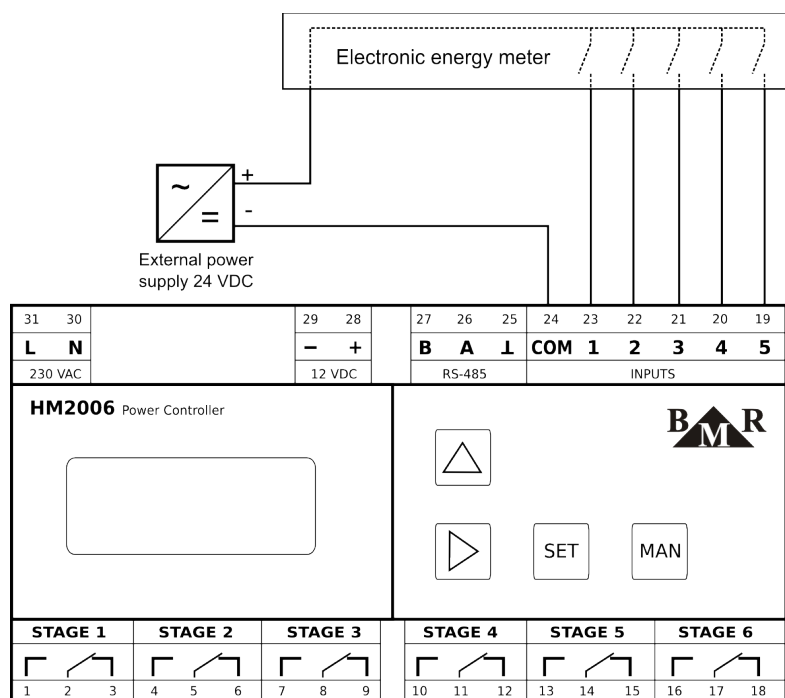
HM2006 input terminals

- 1 (23) kWh+ (active power consumption)
- 2 (22) kVARh+ (reactive power consumption)
- 3 (21) kVARh- (reactive power supply)
- 4 (20) kWh-tarif (active power supply or tariff)
- 5 (19) regulation period 1/4 hour Tm

Synchronization of 1/4 hour. by positive pulse



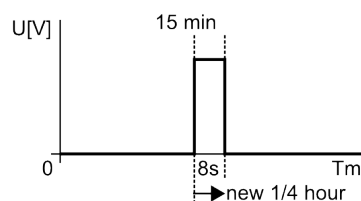
Picture 3. Connection diagram of HM2006 inputs controlled by positive pulse



HM2006 input terminals

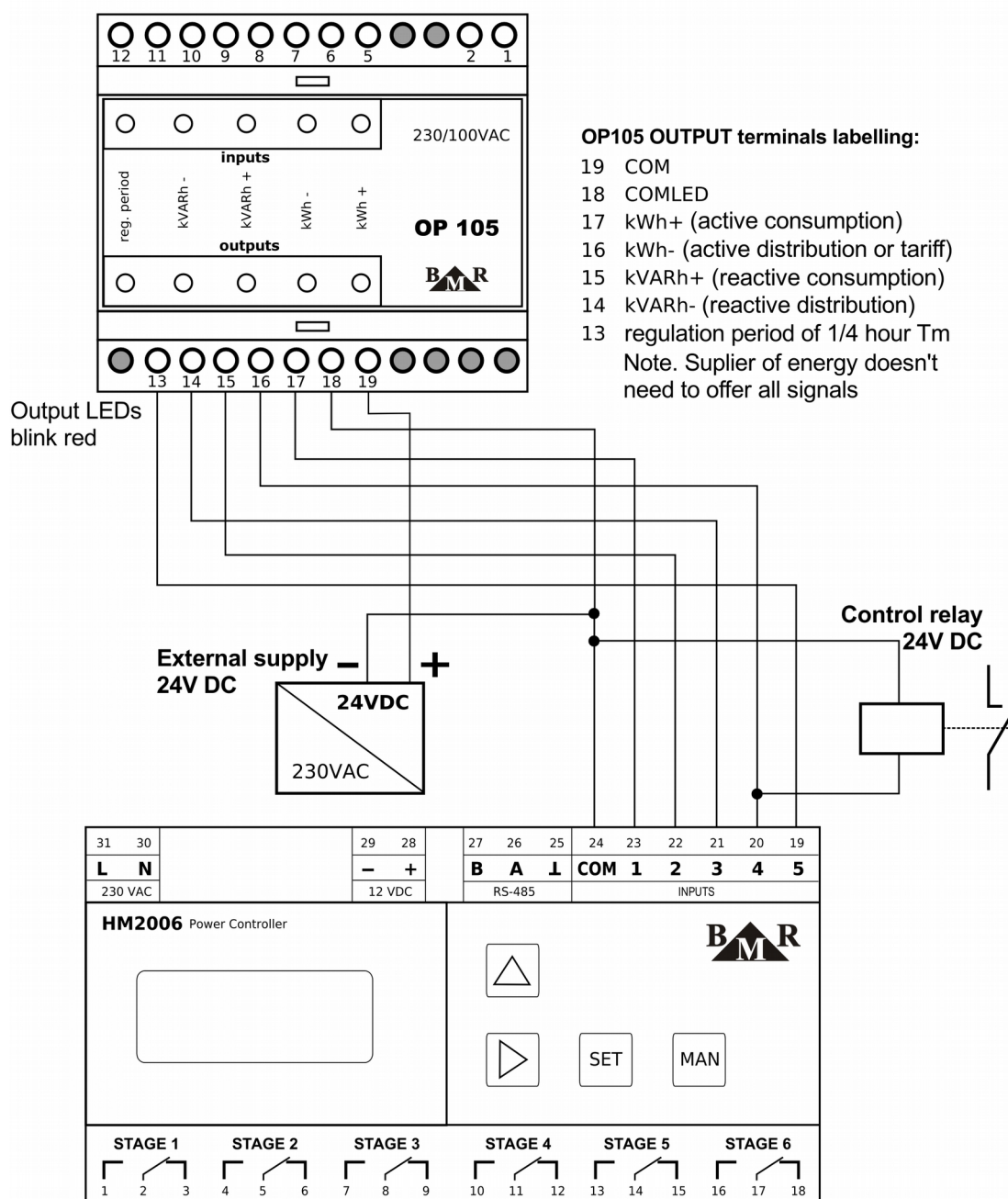
- 1 (23) kWh+ (active power consumption)
- 2 (22) kVARh+ (reactive power consumption)
- 3 (21) kVARh- (reactive power supply)
- 4 (20) kWh-|tarif (active power supply or tariff)
- 5 (19) regulation period 1/4 hour Tm

Synchronization of 1/4 hour. by positive pulse



Picture 4. Connection diagram of HM2006 inputs controlled by positive pulse from external power supply

Connection diagram of optoelectronic unit OP105 and regulator HM2006 for control by POSITIVE pulse with tariff signal input and auxiliary relay

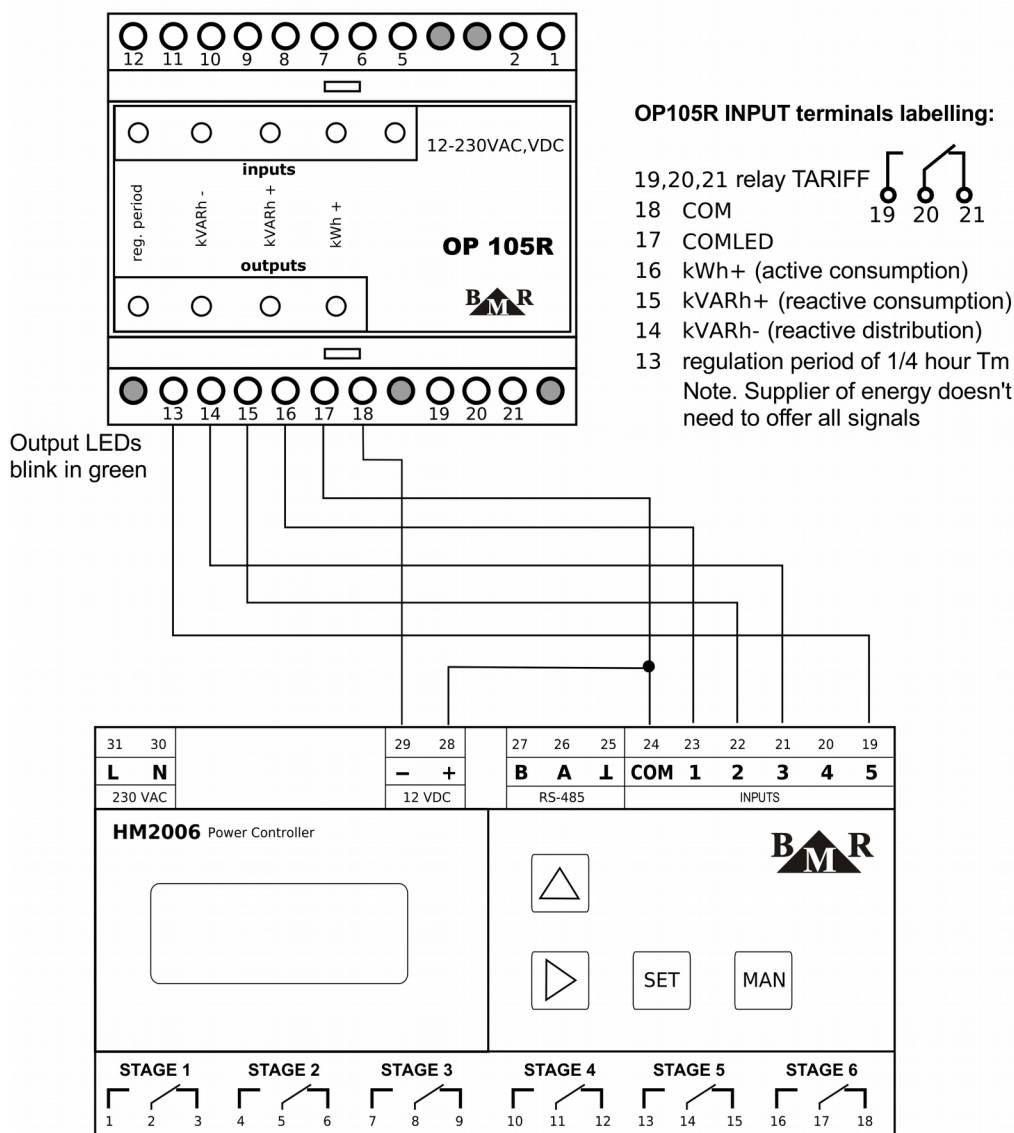


For relay switching it is not possible to use internal supply of HM2006. External supply has to have output voltage 24V DC and has to be strong enough to supply the relay.

HM2006 input terminals labelling:

- 1 kWh+ (active consumption)
- 2 kVARh+ (reactive consumption)
- 3 kVARh- (reactive distribution)
- 4 kWh-|tariff (active distribution or tariff)
- 5 regulation period of 1/4 hour Tm

Connection diagram of optoelectronic unit OP105 and regulator HM2006 for control by NEGATIVE pulse without tariff signal input

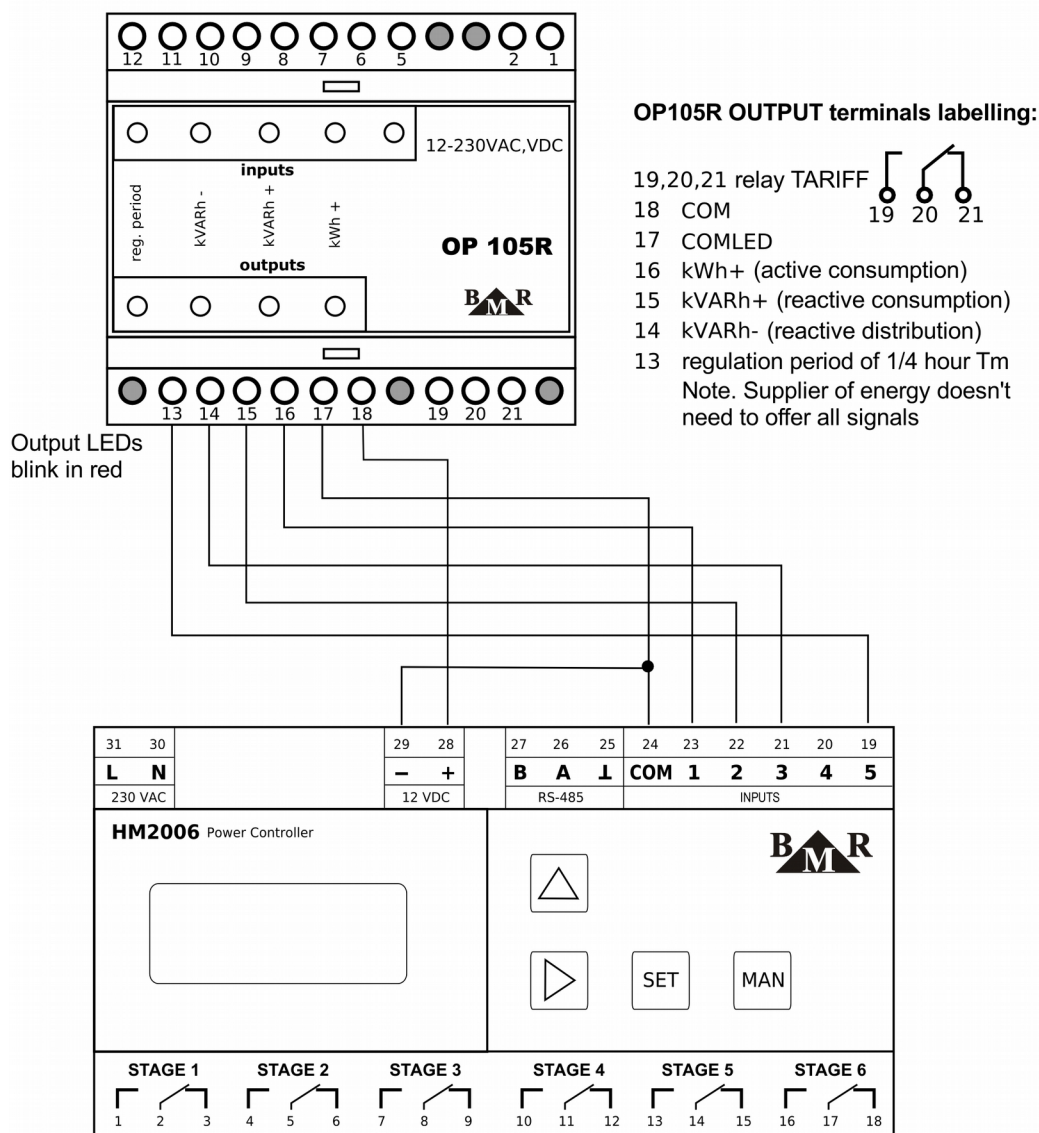


COMLED terminal is intended for lighting of OP105 output LEDs. Wire jumper between regulator and COMLED terminal doesn't have any influence over regulator operation.

HM2006 output terminals labelling:

- 1 kWh+ (active consumption)
- 2 kVARh+ (reactive consumption)
- 3 kVARh- (reactive distribution)
- 4 kWh-|tariff (active distribution or tariff)
- 5 regulation period of 1/4 hour Tm

Connection diagram of optoelectronic unit OP105R and regulator HM2006 for control by POSITIVE pulse without tariff signal input



COMLED terminal is intended for lighting of OP105 output LEDs. Wire jumper between regulator and COMLED terminal doesn't have any influence over regulator operation.

HM2006 input terminals labelling:

- 1 kWh+ (active consumption)
- 2 kVARh+ (reactive consumption)
- 3 kVARh- (reactive distribution)
- 4 kWh-|tariff (active distribution or tariff)
- 5 regulation period of 1/4 hour Tm