

# Power Analyser UMG 801 and modules

Formulary  
to the modbus-address list

From UMG 801 firmware 1.6.2



Example illustration!

# Content

Modbus	4
Modbus functions (master)	4
Modbus Functions (Slave)	4
Transfer parameters	5
Byte sequence	5
Update rate	5
Measured values	5
Number formats	5
Symbols and definitions	5
Explanations of the measured values	6
Modbus-address list	12
Notes	13

## Copyright

This handbook is subject to the legal regulations of the copyright laws and may not be fully or partially photocopied, reprinted or reproduced mechanically or electronically and may not be copied or published in any other way without the legal, written permission of

Janitza electronics GmbH  
Vor dem Polstück 6  
D35633 Lahnau  
Germany

## Protected trademarks

All trademarks and the resulting rights belong to the respective owners of these rights.

## Subject to technical changes

The contents of this manual have been compiled with the utmost care and correspond to our current state of information. Nevertheless, we would like to point out that the updating of this manual cannot always be carried out at the same time as the technical further development of our products. Information and specifications can be changed at any time! Please check for the latest version at [www.janitza.com](http://www.janitza.com).

## Disclaimer

Janitza electronics GmbH does not accept any responsibility for errors or faults within this handbook and does not accept any obligation to keep the contents of this handbook updated.

## Comments on the handbook

We welcome your comments. If anything appears to be unclear in this handbook, please let us know and send us an E-MAIL to: [info@janitza.com](mailto:info@janitza.com).

# Modbus

## Modbus functions (master)

As a master, the UMG 801 supports the following modbus functions;

### 01 Read Coil Status

Reads the ON/OFF status of discrete outputs (0X references, coils) in the slave. Broadcast is not supported.

### 02 Read Input Status

Reads the ON/OFF status of discrete inputs (0X references) in the slave. Broadcast is not supported.

### 03 Read Holding Registers

Reads the binary contents of holding registers (4X references) in the slave.

### 04 Read Input Registers

Reads the binary contents of input registers (3X references) in the slave.

### 05 Force Single Coil

Forces a single coil (0X references) to either ON or OFF. When broadcast, the function forces the same coil reference in all attached slaves.

### 06 Preset Single Register

Presets a value into a single holding register (4X reference). When broadcast, the function presets the same register reference in all attached slaves.

### 15 (0F Hex) Force Multiple Coils

Forces each coil (0X references) in a sequence of coils to either ON or OFF. When broadcast, the function forces the same coil reference in all attached slaves.

### 16 (10Hex) Preset Multiple Registers

Presets values into a sequence of holding registers (4X references). When broadcast, the function presets the same register references in all attached slaves.

### 23 (17Hex) Read/Write 4X Registers

Performs a combination of one read and one write operation in a single Modbus transaction. The function can write new contents to a group of 4XXXX registers, and then return the contents of another group of 4XXXX registers. Broadcast is not supported.

## Modbus Functions (Slave)

As a slave, the UMG 801 supports the following modbus functions:

### 03 Read Holding Registers

Reads the binary contents of holding registers (4X references) in the slave.

### 04 Read Input Registers

Reads the binary contents of input registers (3X references) in the slave.

### 06 Preset Single Register

Presets a value into a single holding register (4X reference). When broadcast, the function presets the same register reference in all attached slaves.

### 16 (10Hex) Preset Multiple Registers

Presets values into a sequence of holding registers (4X references). When broadcast, the function presets the same register references in all attached slaves.

### 23 (17Hex) Read/Write 4X Registers

Performs a combination of one read and one write operation in a single Modbus transaction. The function can write new contents to a group of 4XXXX registers, and then return the contents of another group of 4XXXX registers. Broadcast is not supported.

## Transfer parameters

The UMG 801 supports the following transfer parameters:

Baudrate	: 9600, 19200, 38400, 57600 and 115200 baud
Data bits	: 8
Parity	: none
Stop bits (UMG 801)	: 2
Stop bits external	: 1 or 2

## Byte sequence

The data in the Modbus address list can be retrieved in big-endian format (high byte before low byte).

The addresses described in this address list return the data in big-endian format.

## Update rate

The modbus register addresses are updated every 200ms.

## Measured values

- Measured values in the **short** format do not take into account the set transformer ratio, i.e. these measured values have to be multiplied by the corresponding transformer factor!
- Measured values in **float or integer format** take into account the corresponding transformer factors!

## Number formats

Type	Size	Minimum	Maximum
char	8 bit	0	255
byte	8 bit	-128	127
short	16 bit	$-2^{15}$	$2^{15} - 1$
int	32 bit	$-2^{31}$	$2^{31} - 1$
uint	32 bit	0	$2^{32} - 1$
long64	64 bit	$-2^{63}$	$2^{63} - 1$
float	32 bit	IEEE 754	IEEE 754
double	64 bit	IEEE 754	IEEE 754

## Symbols and definitions

N	Total number of sample points per period (For example, in a period of 20 ms)
k	Sample value or number of samples per period ( $0 \leq k < N$ )
p	Number or identification of the phase conductor ( $p = 1, 2$ oder $3$ )
ipk	Sample value k of the current of the phase conductor p
upNk	Sample value k of the neutral voltage of the phase conductor p
Pp	Active power of the phase conductor p

## Explanations of the measured values

### Measured value

- A measured value (in the UMG) is a effective value which is formed over a period (measuring window) of 200ms.
- A measuring window is 10 periods in the 50Hz network and 12 periods in the 60Hz network.
- A measuring window has a start time and an end time.
- The resolution between the start time and end time is approximately 2ns.
- The accuracy of the start time and end time depends on the accuracy of the internal clock.
- In order to improve the accuracy of the internal clock, it is recommended that the clock in the device is compared with a time service and reset.

### Mean value of measured value

- For each measured value, a sliding mean value is calculated over the selected averaging time.
- The mean value is calculated every 200ms.
- You can take the possible averaging times from the table.

n	Mean time / seconds
0	5
1	10
2	15
3	30
4	60
5	300
6	480
7	600
8	900

### Maximum value of measured value

- The *max. value of the measured value* is the largest measured value which has occurred since the last deletion.

### Minimum value of measured value

- The *min. value of the measured value* is the lowest measured value which has occurred since the last deletion.

### Maximum value of mean value

- The *max. value of the mean value* is the largest mean value which has occurred since the last deletion.

### Nominal current, voltage, frequency

- The limit values for events and transients are set by the nominal value in percentage.

### Nominal current $I_{\text{rated}}$

- The  $I_{\text{rated}}$  is the nominal current of the transformers and is required for calculation of the K-factor.

### Peak value negative

- Highest negative sampling value from the last 200ms measuring window..

### Peak value positive

- Highest positive sampling value from the last 200ms measuring window.

### Crest factor

- The crest factor describes the relation between the peak value and effective value of a periodic quantity. It serves as a characteristic value for general description of the curve form of a periodic quantity. The distortion factor is another example of a quantity for characterization of the difference from the pure sinusoidal form.

- Example

*A sinusoidal change voltage with an effective value of 230 V has a peak value of approx. 325 V. The crest factor is then  $325 \text{ V} / 230 \text{ V} = 1.414$ .*

Effective value of the current for phase conductor p

$$I_p = \sqrt{\frac{1}{N} \cdot \sum_{k=0}^{N-1} i_{p_k}^2}$$

Effective value of neutral conductor current

$$I_N = \sqrt{\frac{1}{N} \cdot \sum_{k=0}^{N-1} (i_{1_k} + i_{2_k} + i_{3_k})^2}$$

Effective voltage L-N

$$U_{pN} = \sqrt{\frac{1}{N} \cdot \sum_{k=0}^{N-1} u_{pN_k}^2}$$

Effective voltage L-L

$$U_{pg} = \sqrt{\frac{1}{N} \cdot \sum_{k=0}^{N-1} (u_{gN_k} - u_{pN_k})^2}$$

Star connection voltage (vectorial)

$$U_{\text{Star connection voltage}} = U_{1_{rms}} + U_{2_{rms}} + U_{3_{rms}}$$

Active power for phase conductor

$$P_p = \frac{1}{N} \cdot \sum_{k=0}^{N-1} (u_{pN_k} \times i_{p_k})$$

Apparent power for phase conductor

- Unsigned

$$S_p = U_{pN} \cdot I_p$$

Total apparent power (arithmetic)  $S_A$

- Unsigned

$$S_A = S_1 + S_2 + S_3$$

## Order number of harmonics

xxx[0] = mains frequency (50 Hz/60 Hz)  
 xxx[1] = 2nd harmonic (100 Hz/120 Hz)  
 xxx[2] = 3rd harmonic (150 Hz/180 Hz)  
 etc.

## THD

- THD (Total Harmonic Distortion) is the distortion factor and provides the relation of the harmonic parts of an oscillation to the mains frequency.

### Distortion factor THD (U) for the voltage

- M = 40 (UMG 604, UMG 508, UMG 96RM)
- M = 50 (UMG 605, UMG 509, UMG 511, UMG 512, UMG801)
- fund corresponds to n=1

$$THD_U = \frac{1}{|U_{fund}|} \sqrt{\sum_{n=2}^M |U_{n.Harm}|^2}$$

### Distortion factor THD (I) for the current

- M = 40 (UMG 604, UMG 508, UMG 96RM)
- M = 50 (UMG 605, UMG 509, UMG 511, UMG 512, UMG801)
- fund corresponds to n=1

$$THD_I = \frac{1}{|I_{fund}|} \sqrt{\sum_{n=2}^M |I_{n.Harm}|^2}$$

## ZHD

- THD for the interharmonics.
- Is calculated in the product series and UMG 511, UMG 512, UMG 605.

## Interharmonics

- Sinusoidal oscillations, which frequencies are not a multiple integer of the main frequency.
- Are calculated in the product series and UMG 511, UMG 512, UMG 605.
- Calculation and measurement methods in accordance with the IEC 61000-4-30.
- The order number of interharmonics corresponds to the order number of the next smaller harmonic. For example, between the 3rd and 4th harmonic of the 3rd inter harmonics.

## TDD (I)

- TDD Total demand distortion, harmonic current distortion in % of maximum demand load current
- IL = IL= Maximum demand load current
- M = 40 (UMG 604, UMG 508, UMG 509, UMG 96RM)
- M = 50 (UMG 605, UMG 511, UMG 512)

$$TDD = \frac{1}{I_L} \sqrt{\sum_{n=2}^M I_n^2} \times 100\%$$

## Ripple control signal U (EN61000-4-30)

The ripple control signal U is a voltage (200 ms measured value) which is measured at a carrier frequency specified by the user. Only frequencies beneath 3 kHz are observed.

## Ripple control signal I

The ripple control signal I is a current (200 ms measured value) which is measured at a carrier frequency specified by the user. Only frequencies beneath 3 kHz are observed.

## Positive sequence-negative sequence-zero sequence

- The extent of a voltage or current imbalance in a three-phase system is identified using the positive sequence, negative sequence and zero sequence components.
- The balance of the rotation current system strived for in normal operation is disturbed by the unsymmetrical loads, errors and equipment.
- A three-phase system is called symmetric, when the three phase conductor voltages and currents are the same size and are displaced against each other by 120°. If one or both conditions are not fulfilled, the system is described as unsymmetrical. By calculating the symmetrical components consisting of the positive sequence, negative sequence and zero sequence, the simplified analysis of an imbalanced error is possible in a rotary current system..
- Imbalance is a feature of the network quality for the limits specified in international norms (EN 50160 for example).

### Positive sequence

$$U_{pos} = \frac{1}{3} \left| U_{L1,fund} + U_{L2,fund} \cdot e^{j\frac{2\pi}{3}} + U_{L3,fund} \cdot e^{j\frac{4\pi}{3}} \right|$$

### Negative sequence

$$U_{neg} = \frac{1}{3} \left| U_{L1,fund} + U_{L2,fund} \cdot e^{-j\frac{2\pi}{3}} + U_{L3,fund} \cdot e^{-j\frac{4\pi}{3}} \right|$$

### Zero sequence

$$U_{zero} = \frac{1}{3} \left| U_{L1,fund} + U_{L2,fund} + U_{L3,fund} \right|$$

A zero component can only occur if a sum current can flow back through the main conductor.

### Voltage imbalance

$$\text{Voltage imbalance} = \frac{U_{Geg}}{U_{Mit}}$$

### Under difference U (EN 61000-4-30)

$$U_{under} = \frac{U_{din} - \sqrt{\frac{\sum_{i=1}^n U_{rms-under,i}^2}{n}}}{U_{din}} [\%]$$

### Under difference I

$$I_{under} = \frac{I_{Nominal\ current} - \sqrt{\frac{\sum_{i=1}^n I_{rms-under,i}^2}{n}}}{I_{Nominal\ current}}$$

## K-factor

- The K-factor describes the increase of the eddy current losses when loaded with harmonics. For a sinusoidal load on the transformer, the K-factor = 1. The larger the K-factor, the heavier a transformer can be loaded with harmonics without overheating.

## Power Factor (vectorial) - Lambda

- The power factor is unsigned.

$$PF_x = \frac{|P_x|}{S_x}$$

$$x = L1, L2, L3, L4$$

## Cos(φ) - Fundamental Power Factor

- Only the mains frequency part is used for calculation of the Cos(φ).
- Cos(φ) sign:
  - = for the supply of real power
  - + = for obtaining real power

$$PF_1 = \cos(\varphi) = \frac{P_1}{S_1}$$

## Cos(φ) total

- Cos(φ) sign:
  - = for the supply of real power
  - + = for obtaining real power

$$\cos(\varphi)_{Sum_3} = \frac{P_{1\_fund} + P_{2\_fund} + P_{3\_fund}}{\sqrt{(P_{1\_fund} + P_{2\_fund} + P_{3\_fund})^2 + (Q_{1\_fund} + Q_{2\_fund} + Q_{3\_fund})^2}}$$

$$\cos(\varphi)_{Sum_4} = \frac{P_{1\_fund} + P_{2\_fund} + P_{3\_fund} + P_{4\_fund}}{\sqrt{(P_{1\_fund} + P_{2\_fund} + P_{3\_fund} + P_{4\_fund})^2 + (Q_{1\_fund} + Q_{2\_fund} + Q_{3\_fund} + Q_{4\_fund})^2}}$$

## Phase Angle φ

- The phase angle between current and voltage of the external conductor p is calculated according to DIN EN 61557-12 and displayed.
- The sign of the phase angle corresponding to the sign of the reactive power.

## Mains frequency reactive power

The mains frequency reactive power is the power factor of the mains frequency and is calculated using the fourier analysis (FFT). Voltage and current do not have to be sinusoidal. All in the device calculated reactive power are resulting of fundamental reactive power.

### Reactive power sign

- Sign  $Q = +1$  for  $\varphi$  in the range  $0^\circ \dots 180^\circ$  (inductive)
- Sign  $Q = -1$  for  $\varphi$  in the range  $180^\circ \dots 360^\circ$  (capacitive)

$$\text{Sign } Q(\varphi_p) = +1 \text{ if } \varphi_p \in [0^\circ - 180^\circ]$$

$$\text{Sign } Q(\varphi_p) = -1 \text{ if } \varphi_p \in [180^\circ - 360^\circ]$$

### Reactive power for phase conductor p

- Reactive power of the mains frequency.

$$Q_{fund p} = \text{Sign } Q(\varphi_p) \cdot \sqrt{S_{fund p}^2 - P_{fund p}^2}$$

### Total reactive power

- Reactive power of the mains frequency.

$$Q_V = Q_1 + Q_2 + Q_3$$

### Distortion power factor

- The distortion power factor is the power factor of all mains frequencies and is calculated using the fourier analysis (FFT).
- The apparent power „S” contains all fundamental harmonics and all harmonic rates up to the M-th harmonic.
- The effective power „P” contains all fundamental harmonics and all harmonic rates up to the M-th harmonic.

$$D = \sqrt{S^2 - P^2 - Q_{fund}^2}$$

### Reactive energy per phase

$$E_{r_{L1}} = \int Q_{L1}(t) \cdot \Delta t$$

### Reactive energy per phase, inductive

$$E_{r(ind)_{L1}} = \int Q_{L1}(t) \cdot \Delta t \quad \text{for } Q_{L1}(t) > 0$$

### Reactive energy per phase, capacitive

$$E_{r(cap)_{L1}} = \int Q_{L1}(t) \cdot \Delta t \quad \text{for } Q_{L1}(t) < 0$$

### Reactive energy, sum L1-L3

$$E_{r_{L1,L2,L3}} = \int (Q_{L1}(t) + Q_{L2}(t) + Q_{L3}(t)) \cdot \Delta t$$

### Reactive energy, sum L1-L3, inductive

$$E_{r(ind)_{L1,L2,L3}} = \int (Q_{L1}(t) + Q_{L2}(t) + Q_{L3}(t)) \cdot \Delta t$$

for  $(Q_{L1}(t) + Q_{L2}(t) + Q_{L3}(t)) > 0$

### Reactive energy, sum L1-L3, capacitive

$$E_{r(cap)_{L1,L2,L3}} = \int (Q_{L1}(t) + Q_{L2}(t) + Q_{L3}(t)) \cdot \Delta t$$

for  $(Q_{L1}(t) + Q_{L2}(t) + Q_{L3}(t)) < 0$

## Modbus-address list

The Modbus address list in XLSX file format can be found at [www.janitza.com](http://www.janitza.com) in the download area. Within the document, you can filter by measurement group using the header.

Group	Address	Format	RD/WR	Unit	Note
basic device	5010	Float	RD	V	Average Value L3-L1 Voltage L-L (RMS)
Basic device measuring group 01	5012	Float	RD	A	Average Value L1 Current (RMS)
Basic device measuring group 01	5014	Float	RD	A	Average Value L2 Current (RMS)
Basic device measuring group 01	5016	Float	RD	A	Average Value L3 Current (RMS)
Basic device measuring group 01	5018	Float	RD	A	Average Value L4 Current (RMS)
Basic device measuring group 01	5020	Float	RD	A	Average Value Sum L1..L4 Current (RMS)
Basic device measuring group 01	5022	Float	RD	W	Average Value L1 Active Power
Basic device measuring group 01	5024	Float	RD	W	Average Value L2 Active Power
Basic device measuring group 01	5026	Float	RD	W	Average Value L3 Active Power
Basic device measuring group 01	5028	Float	RD	W	Average Value L4 Active Power
Basic device measuring group 01	5030	Float	RD	W	Average Value Sum L1..L4 Active Power
Basic device measuring group 01	5032	Float	RD	var	Average Value L1 Reactive Power
Basic device measuring group 01	5034	Float	RD	var	Average Value L2 Reactive Power
Basic device measuring group 01	5036	Float	RD	var	Average Value L3 Reactive Power
Basic device measuring group 01	5038	Float	RD	var	Average Value L4 Reactive Power
Basic device measuring group 01	5040	Float	RD	var	Average Value Sum L1..L4 Reactive Power
Basic device measuring group 01	5042	Float	RD	VA	Average Value L1 Apparent Power
Basic device measuring group 01	5044	Float	RD	VA	Average Value L2 Apparent Power
Basic device measuring group 01	5046	Float	RD	VA	Average Value L3 Apparent Power

Fig. Microsoft Excel - Extract from the Modbus address list.

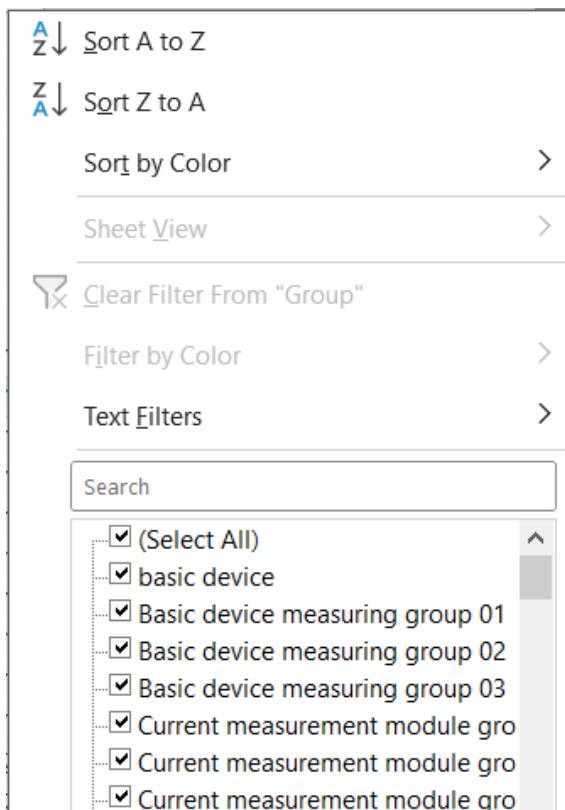


Fig. Microsoft Excel - Measurement group filter

### **i** INFORMATION

The Modbus address list contains addresses that the UMG 801 can output with the various modules. The actual addresses depend on your measurement device and module topology. An exact list can be found on the measurement device homepage.



# ***Janitza***<sup>®</sup>

Janitza electronics GmbH  
Vor dem Polstück 6 | 35633 Lahnau  
Germany

Tel. +49 6441 9642-0  
info@janitza.com | www.janitza.com