Modbus interface LINAX PQ5000CL

Content

GMC INSTRUMENTS

Camille Bauer Metrawatt AG
Aargauerstrasse 7
CH-5610 Wohlen / Switzerland
Telephone: +41 56 618 21 11
Telefax: +41 56 618 35 35
E-Mail: info@cbmag.com
https://www.camillebauer.com

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1 Modbus communication

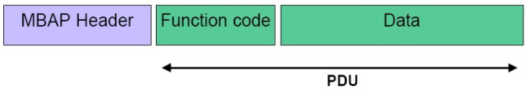
Addressing

Modbus groups different data types as references. For addressing the data, one has to know that Modbus starts the register numeration at 1, but the addressing at 0.

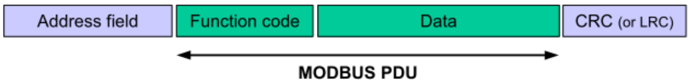
Example: Measurement U1N on register address 102

- Address declaration in value table (see chapter 4.1): (4x)102
- Real address: 102 (offset 1)
- Address used in telegram transmission: 101 (offset 0)

Telegrams



Modbus/TCP



Modbus/RTU

- The information to transmit is the same for both Modbus/TCP and Modbus/RTU, displayed in green above.
- For Modbus/TCP device addressing is done by means of the IP address. The slave address (address field) of the Modbus/RTU telegram is therefore no longer required, but I still present in the MBAP header and set to 0xFF.
  The network installation of the devices is done directly at the device or via web browser (see device handbook). As soon as all devices have a unique network address they may be accessed by means of a Modbus master client.
- The CRC check sum of the Modbus/RTU communication is dropped, because the security of the transmission is assured on TCP communication level.

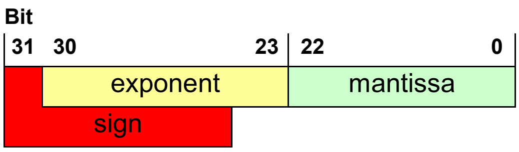
Reading float numbers (REAL): Function 0x03, Read Holding Register

There is no representation for floating point numbers in the Modbus specification. But as a matter of principle any desired data structure can be casted to a sequence of 16Bit registers.

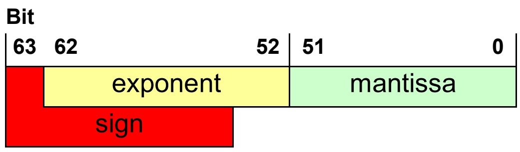
The IEEE 754 standard as the most often used standard for the representation of floating numbers is applied. 32 and 64 Bit numbers are used:

- The first register contains the bits 0 – 15
- The second register contains the bits 16 – 31
- The third register contains the bits 32 – 47
- The fourth register contains the bits 48 – 63

32-Bit Float (REAL32)



64-Bit Float (REAL64)



Example: Reading voltage U1N on register address 102 of device 17 (32-bit float)

Byte	Request		Answer	
1	Slave address	0x11 resp. 0xFF	Slave address	0x11 resp. 0xFF
2	Function code	0x03	Function code	0x03
3	Start address (102-1)	0x00	Byte Count	0x04
4		0x65	Byte 1	**0xE8**
5	Number of registers: 2	0x00	Byte 2	**0x73**
6		0x02	Byte 3	**0x43**
7	Checksum CRC16	crc_l	Byte 4	**0x6A**
8		crc_h	Checksum CRC16	crc_l
9				crc_h

for Modbus/RTU only

0x436A / 0xE873		
Sign	Exponent	Mantissa
0	1 0 0 0 0 1 1 0	1 1 0 1 0 1 0 1 1 1 0 1 0 0 0 0 1 1 1 0 0 1 1
+	Exponent: 134-127=7	Mantissa=1.11010101110100001110011b=**1,8352187871932983d**

➢ **U1N** = $+2^7$ * 1,8352187871932983 **= 234,908V**

2 Mapping

2.1 Address space

The address space may be divided in 4 address spaces in accordance with the 4 data types.

Space	Access	Function code	
Coil / 0x	readable / writable	0x01 0x05 0x0F	Read Coil Status [1)] Force Single Coil [1)] Force Multiple Coils [1)]
Discrete input / 1x	read only	0x02	Read Input Status [1)]
Input register / 3x	read only	0x04	Read Input Register [1)]
Holding register / 4x	readable / writable	0x03 0x06 0x10	Read Holding Register Force Single Register [1)] Preset Multiple Register[1)]

1) not implemented

To reduce the number of commands the device image has been mapped using „Holding register" if possible. Quantities normally addressed as a single bit information are implemented as „Coil" or „Discrete input".

Used addresses

4x addresses	# Reg.	Description	Access
100 – 121	22	Instantaneous values general	R
200 – 209	10	Instantaneous values of imbalance analysis acc. Fortescue	R
400 – 425	26	Instantaneous values PQ analysis	R
1000 – 1051	52	Instantaneous values Current Module 1	R
1060 – 1075	16	Energy meters Current Module 1	R
1100 – 1151	52	Instantaneous values Current Module 2	R
1160 – 1175	16	Energy meters Current Module 2	R
1200 – 1251	52	Instantaneous values Current Module 3	R
1260 – 1275	16	Energy meters Current Module 3	R
1300 – 1351	52	Instantaneous values Current Module 4	R
1360 – 1375	16	Energy meters Current Module 4	R
1400 – 1451	52	Instantaneous values Current Module 5	R
1460 – 1475	16	Energy meters Current Module 5	R
1500 – 1551	52	Instantaneous values Current Module 6	R
1560 – 1575	16	Energy meters Current Module 6	R
1600 – 1651	52	Instantaneous values Current Module 7	R
1660 – 1675	16	Energy meters Current Module 7	R
1700 – 1751	52	Instantaneous values Current Module 8	R
1760 – 1775	16	Energy meters Current Module 8	R
1800 – 1851	52	Instantaneous values Current Module 9	R
1860 – 1875	16	Energy meters Current Module 9	R
1900 – 1951	52	Instantaneous values Current Module 10	R
1960 – 1975	16	Energy meters Current Module 10	R
2000 – 2011	12	Instantaneous values THD	R
2030 – 2641	612	Instantaneous values harmonic analysis	R
3360 – 3363	4	Last recorded event: Timestamp and event type	R

Access: R = readable, W = writable

2.2 Used Syntax

Address 4x		Start address of described data block (Register)
Value		4x register address of a measured value, typically for minimum / maximum values
Name		Unique name of a variable or structure
Type		**Data type of variable** REAL32 (32-bit float) TIME: seconds since 1970/1/1 (UINT32)
Description		Description of the quantity
3U	4U	Availability of the measured quantities, depending on the connected system **3U** = 3-wire unbalanced load **4U** = 4-wire unbalanced load

3 Device information

3.1 Device identification

The type of the connected device may be identified using the function ***Report Slave ID*** (0x11).

Device address	Function	CRC	
ADDR	0x11	Low-Byte	High-Byte

Device answer:

Device address	Function	#Bytes	Device ID	Data1	Data2	CRC	
ADDR	0x11	3	<sid>			Low-Byte	High-Byte

0x01	0x00	VR660	Temperature controller
0x02	0x00	A200R	Display unit temperature controller
0x03	0x01	CAM	Measurement unit power quantities
0x04	0xFF	APLUS	Multifunctional display unit
0x05	0x00	V604s	Universal transmitter
0x05	0x01	VB604s	Universal transmitter
0x05	0x02	VC604s	Universal transmitter
0x05	0x03	VQ604s	Universal transmitter
0x07	0x00	VS30	Temperature transmitter
0x08	0x00	DM5S	Multi-transducer DM5S
0x08	0x01	DM5F	Multi-transducer DM5F
0x0A	0xFF	HW730	Angular transmitter
0x0B	0xFF	AM1000	Multifunctional display unit
0x0C	0xFF	AM2000	Multifunctional display unit
0x0D	0xFF	AM3000	Multifunctional display unit
0x0E	0xFF	PQ3000	Power quality display unit
0x0F	0xFF	PQ5000	Power quality measurement unit
0x10	0xFF	DM5000	Measurement unit power quantities
0x11	0xFF	CU3000	Multif. display unit with CODESYS
0x12	0xFF	CU5000	Multif. measurement unit with CODESYS
0x13	0xFF	PQ1000	Power quality display unit
0x1F	0xFF	PQ5000-MOBILE	Mobile power system analysis unit
0x25	0xFF	PQ5000R	Power quality measurement unit
0x26	0xFF	PQ1000	Power quality measurement unit
0x27	0xFF	PQ5000CL	Power quality measurement unit

The value for Data2 is reserved for future extensions.

4 Measurements

4.1 Instantaneous values base unit

Address 4x	Name	3U	4U	Type	Description
100	F	●	●	REAL32	System frequency [Hz]
102	U1N	-	●	REAL32	Voltage phase L1 to N [V]
104	U2N	-	●		Voltage phase L2 to N [V]
106	U3N	-	●		Voltage phase L3 to N [V]
108	U12	●	●		Voltage phase L1 to L2 [V]
110	U23	●	●		Voltage phase L2 to L3 [V]
112	U31	●	●		Voltage phase L3 to L1 [V]
114	UNE	-	●		Zero displacement voltage in 4-wire systems [V]
116	UF12	●	●	REAL32	Phase angle voltage U1-U2 [°]
118	UF23	●	●		Phase angle voltage U2-U3 [°]
120	UF31	●	●		Phase angle voltage U3-U1 [°]

4.2 System analysis base unit

4.2.1 Instantaneous values of harmonic analysis

Address 4x	Name	3U	4U	Type	Description
2000	THD_U1N	-	●	REAL32	Total Harmonic Distortion Voltage U1N [%]
2002	THD_U2N	-	●		Total Harmonic Distortion Voltage U2N [%]
2004	THD_U3N	-	●		Total Harmonic Distortion Voltage U3N [%]
2006	THD_U12	●	-	REAL32	Total Harmonic Distortion Voltage U12 [%]
2008	THD_U23	●	-		Total Harmonic Distortion Voltage U23 [%]
2010	THD_U31	●	-		Total Harmonic Distortion Voltage U31 [%]

► THD_U: Harmonic content related to the fundamental of the RMS value of the voltage

Address 4x	Name	3U	4U	Type	Description
2034 2130	H2_U1N . . . . . H50_U1N	-	●	REAL32	Voltage U1N: Content 2nd harmonic [%] . . . . . Voltage U1N: Content 50th harmonic [%]
2136 2232	H2_U2N . . . . . H50_U2N	-	●	REAL32	Voltage U2N: Content 2nd harmonic [%] . . . . . Voltage U2N: Content 50th harmonic [%]
2238 2334	H2_U3N . . . . . H50_U3N	-	●	REAL32	Voltage U3N: Content 2nd harmonic [%] . . . . . Voltage U3N: Content 50th harmonic [%]
2340 2436	H2_U12 . . . . . H50_U12	●	-	REAL32	Voltage U12: Content 2nd harmonic [%] . . . . . Voltage U12: Content 50th harmonic [%]
2442 2538	H2_U23 . . . . . H50_U23	●	-	REAL32	Voltage U23: Content 2nd harmonic [%] . . . . . Voltage U23: Content 50th harmonic [%]
2544 2640	H2_U31 . . . . . H50_U31	●	-	REAL32	Voltage U31: Content 2nd harmonic [%] . . . . . Voltage U31: Content 50th harmonic [%]

► Hi_Uxy: Harmonic content of the voltage related to the fundamental 100 %

4.2.2 Instantaneous values of imbalance analysis acc. Fortescue

Address 4x	Name	3U	4U	Type	Description
200	UR1	●	●	REAL32	Voltage [V]: Positive sequence
202	UR2	●	●		Voltage [V]: Negative sequence
204	U0	-	●		Voltage [V]: Zero sequence
206	UNB_UR2_UR1	●	●	REAL32	Imbalance factor voltage: UR2/UR1 [%]
208	UNB_U0_UR1	-	●	REAL32	Imbalance factor voltage: U0/UR1 [%]

4.2.3 Instantaneous values of PQ analysis

Address 4x	Name	3U	4U	Type	Description
400	F_10S	●	●	REAL32	System frequency 10 s average [Hz]
402	PST_U1N	-	●		Short time flicker Pst U1N
404	PST_U2N	-	●		Short time flicker Pst U2N
406	PST_U3N	-	●	REAL32	Short time flicker Pst U3N
408	PST_U12	●	-		Short time flicker Pst U12
410	PST_U23	●	-		Short time flicker Pst U23
412	PST_U31	●	-		Short time flicker Pst U31
414	PINST_U1N	-	●		Instantaneous flicker Pinst U1N
416	PINST_U2N	-	●		Instantaneous flicker Pinst U2N
418	PINST_U3N	-	●	REAL32	Instantaneous flicker Pinst U3N
420	PINST_U12	●	-		Instantaneous flicker Pinst U12
422	PINST_U23	●	-		Instantaneous flicker Pinst U23
424	PINST_U31	●	-		Instantaneous flicker Pinst U31

4.3 Measured values Current Module 3P / 3PN

4.3.1 Instantaneous values

The below table contains the available measurements of the first Current Module 3P / 3PN.

Address 4x	Name	3U	4U	Type	Description
1000	P	●	●	REAL32	Active power system [W]
1002	Q	●	●	REAL32	Reactive power system [var]
1004	S	●	●	REAL32	Apparent power system [VA]
1006	PF	●	●	REAL32	PF = P / S, Power factor system
1008	I1	●	●	REAL32	Current in phase L1 [A]
1010	I2	●	●		Current in phase L2 [A]
1012	I3	●	●		Current in phase L3 [A]
1014	IN	-	●		Neutral current [A]
1016	IPE	●	●		Fault current [A]
1018	ANGLE_I1	●	●	REAL32	Phase angle current L1 [°]
1020	ANGLE _I2	●	●		Phase angle current L2 [°]
1022	ANGLE _I3	●	●		Phase angle current L3 [°]
1024	(res)	-	-		Reserved for future applications
1026	(res)	-	-		Reserved for future applications
1028	P1	-	●	REAL32	Active power phase 1 (L1 – N) [W]
1030	P2	-	●		Active power phase 2 (L2 – N) [W]
1032	P3	-	●		Active power phase 3 (L3 – N) [W]
1034	Q1	-	●	REAL32	Reactive power phase 1 (L1 – N) [var]
1036	Q2	-	●		Reactive power phase 2 (L2 – N) [var]
1038	Q3	-	●		Reactive power phase 3 (L3 – N) [var]
1040	S1	-	●	REAL32	Apparent power system [VA]
1042	S2	-	●		Apparent power phase 1 (L1 – N) [VA]
1044	S3	-	●		Apparent power phase 2 (L2 – N) [VA]
1046	PF1	-	●	REAL32	Power factor phase 1 (L1 – N)
1048	PF2	-	●		Power factor phase 2 (L2 – N)
1050	PF3	-	●		Power factor phase 3 (L3 – N)

4.3.2 Energy meters

The below table contains the available energy meters of the first Current Module 3P / 3PN.

Address 4x	Name	3U	4U	Type	Description
1060	P_I_IV	●	●	REAL64	Active energy QI+IV [Wh]
1064	P_II_III	●	●		Active energy QII+III, [Wh]
1068	Q_I_II	●	●		Reactive energy QI+II, [varh]
1072	Q_III_IV	●	●		Reactive energy QIII+IV [varh]

The access to data of further modules is done with an offset of +100. Therefore, e.g. active power P for module 2 may be requested via address 1100 or the active energy QI+IV of module 3 via address 1260.

The measurements are related to the current or power demand of the monitored feeder. The term system therefore describes the total of all values, which can be determined by means of a Current Module.

4.4 Last recorded event

Time [TIME]	**Value** [UINT32]	**Name**	**Description**
3360	3362	LAST_EVENT	Last recorded event with timestamp **Value** 0: undefined trigger 1: Voltage swell 2: Voltage dip 3: Voltage interruption 4: Rapid voltage change (RVC) 5: Over-current 7: Mains signalling voltage 8: Current swell 9: Current dip 10: Snapshot by user 15: Frequency event 18: Voltage imbalance If **time** is "0" no event was recorded since device start. ⚠ The registers for time and event type cannot be read with one request, two telegrams are required.