Technologie in Qualität

Technical note

TQ Energy Manager

Modbus Master.0011

2018-01-17

	Date:	Name:	Description:	Technical note	
Created:	2017-11-23	Valeri Budjko	Project:	TQ Energy Manager	
Checked:	2017-11-23	Sebastian Kanitz	Document-No.:	Modbus Master.0011	
Company			Release status:	approved	
			Customer	TQ BU AUT	Page 1 of 18
File	TQ Energy Manager Modbus Master.0011.docx				template revision: 020

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Illustration directory

Update index:

Rev.	Date	Pos.	Name	Modification
0001	2014-04-14	-	M. Heimpold	Document created
0002	2014-04-16	-	M. Heimpold	Included feedback from review by M. Zenker (TQ AUT)
0003	2014-06-03	-	M. Heimpold	Fixed register addresses for instantaneous values, added examples
0004	2014-06-24	-	M. Heimpold	Various spelling corrections, table 1 fixed off-by-one error
0005	2014-09-15	-	M. Heimpold	Fixed signedness of power factor
0006	2014-10-29	-	J. Schneider	Changed the term “Home-Box “ to “TQ Energy Manager”, added 4.3 Sensor registers
0007	2014-11-10	-	M. Heimpold	Rebased to new document template
0008	2014-11-18	4.1, 4.3	M. Heimpold	Fixed unit for power factors: the value remains the same but power factor is unitless by definition
0009	2016-01-14	4.1, 4.2	C. Rößler	Fixed unit for apparent power and reactive power
0010	2016-01-21	4.3	J. Schneider	change from UUID to serial number + sensor index
0010	2016-05-27	-	V. Budjko	Review and Approval
0011	2017-10-26	4.4	C. Krutz	Add group registers
0011	2017-11-23	4.4, 4.5	V. Budjko	Changed chapter order, added sensor labels to register map
0011	2017-11-23	All	S. Kanitz	Review

1. Introduction

This document describes how the TQ Energy Manager can be used as a smart sensor, by serving its measurement values via Modbus protocol to upstream instances (e.g. building automation systems).

It is assumed that the TQ Energy Manager has at least an Ethernet interface, while the RS-485 interface is optional. The reason for this assumption is that the RS-485 interface typically needs further configuration in the consumer setup. The expectation is that this configuration is done via the embedded web frontend of the TQ Energy Manager.

The Modbus interface only delivers metering data. It cannot be used to publish configuration data of the meter or for other purposes. For this, other Ethernet protocols are required.

Figure 1 - Block diagram for RS-485 usage

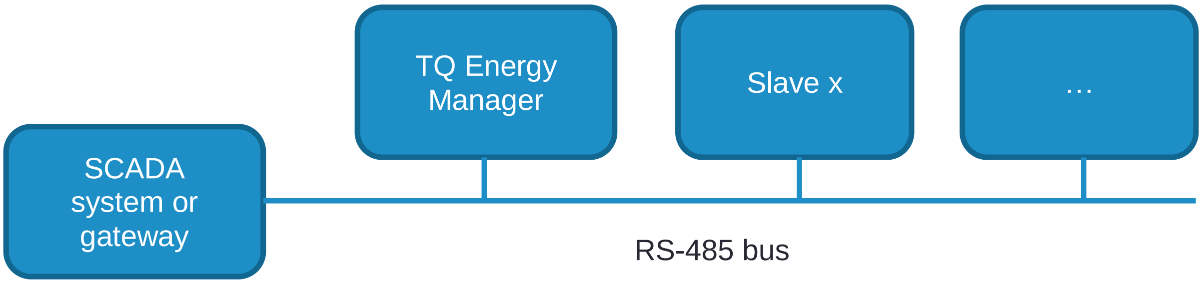
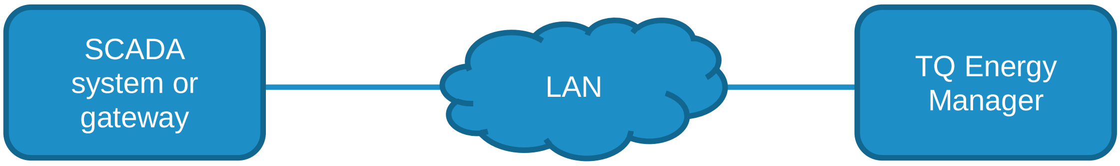


Figure 2 - Block diagram for Ethernet usage



2. Introducing Modbus protocol

The Modbus protocol is a master-slave protocol. This means that only one master is connected to the bus and one or several (up to 247) slave nodes are connected to the same serial bus. A Modbus communication is always initiated by the master and there is only one transaction at the same time.

There are two request modes:

- unicast mode: The master addresses an individual slave. After receiving and processing the request, the slave returns a message (a “reply”) to the master.
- broadcast mode: The master sends a request to all slaves. No response is returned.

The Modbus protocol can be used over several physical layers, most commonly used are RS-485 and Ethernet.

This document describes the behavior of the TQ Energy Manager in case it is configured as Modbus RTU master / Modbus TCP client. In this mode, the TQ Energy Manager is actively providing its metering data in a configurable time interval to the device which is configured as the TQ Energy Manager’s RTU slave / TCP Server.

3. Physical interfaces

3.1 RS-485

3.1.1 Termination

A RS-485 bus should be terminated properly with 120 Ohm terminators on each side of the cable. This is required for highly reliable applications to reduce reflections in the transmission line.

The TQ Energy Manager itself does not provide such termination capability, so the consumer must install external terminators when required.

3.1.2 Protocol layer

When using Modbus via RS-485, each slave device is required to have a unique address (in the range from 1 to 247). The address 0 is used to identify broadcast messages and addresses from 248 to 255 are reserved.

Therefore, a configuration of the Modbus ID is required before the TQ Energy Manager can be attached to the RS-485 bus. A consumer can configure this Modbus ID via Web Frontend. The default setting of the Modbus ID is 247.

The Modbus specification describes two different transmission modes: RTU mode and ASCII mode. The TQ Energy Manager does only support RTU mode.

The default communication settings of the RS-485 port are:

Setting	Factory Default
Baudrate	19200
Data bits	8
Parity	Even
Stop Bits	1

Table 1: default serial communication parameters

Note: These factory defaults ensure Plug & Play in the TQ's metering eco system, e.g. sub-metering sensors/actors.

However, it is possible to change these default settings via the TQ Energy Manager's web frontend.

Additionally, different factory default settings can be defined in the TQ Energy Manager firmware per (OEM) customer upon request to ease plug and play installation in a customer's eco system.

3.2 Ethernet

To use Modbus in an IP based local area network (Ethernet) the TQ Energy Manager has to be configured with a hostname or an IP address of a Modbus TCP server which listens to incoming TCP connections. The server is expected to use the industry standard port number 502 for this purpose, but the customer can configure an alternative destination TCP port for the server via the TQ Energy Manager’s web frontend.

The TQ Energy Manager connects automatically to this Modbus/TCP server and sends its data in a configurable interval.

To be able to send its measurement data, the TQ Energy Manager has to be properly integrated into the consumer’s network. The TQ Energy Manager’s web frontend allows configuring static/dynamic IP addressing and other network related settings.

4. Modbus register description

For a detailed description of the Modbus protocol, please refer to the Modbus specification. It describes the frames used in RTU mode, the data encoding and model and the addressing model. Modbus/TCP is described in IEC 61158.

The TQ Energy Manager communicates with the Modbus RTU slaves / Modbus TCP servers using register addresses according to the following specification.

The mapping of register addresses to data points (OBIS codes) and function codes which have to be supported by the RTU slaves / TCP servers can also be found in the following table.

As most registers consists of multiple Modbus 16-bit registers, the RTU slaves / TCP servers can expect the TQ Energy Manager to combine the writing of all parts of a data point in a single write request. Thus only function code 0x10 (WRITE_MULTIPLE_REGISTERS) is used.

In contrast, due to the limited maximum length of a Modbus packet and the many sparse registers, the writes are divided into multiple transactions. This means, that multiple write requests are issued to deliver a full dataset of all available registers.

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	Description
0	145	0x0000	0x0091	146	see 4.1 Internal instantaneous registers
512	791	0x0200	0x0317	280	see 4.2 Internal Energy registers (counters)
59392	61311	0xE800	0xEF7F	1920	see 4.3 Group registers
61440	65279	0xF000	0xFEFF	3840	see 4.4 Sensor registers

Table 2: Register overview

This register mapping is carefully chosen for best compatibility and interoperability and part of a system concept. However, this is beyond the scope of this document; see Table 11: Additional applicable documents for further references.

The register mapping is documented in the following sub-chapters.

4.1 Internal instantaneous registers

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
0	1	0x0000	0x0001	2	RW	0x10	uint32	0.1 W	1-0:1.4.0*255	Active power+
2	3	0x0002	0x0003	2	RW	0x10	uint32	0.1 W	1-0:2.4.0*255	Active power-
4	5	0x0004	0x0005	2	RW	0x10	uint32	0.1 var	1-0:3.4.0*255	Reactive power+
6	7	0x0006	0x0007	2	RW	0x10	uint32	0.1 var	1-0:4.4.0*255	Reactive power-
8	9	0x0008	0x0009	2	RW	0x10				(reserved)
10	11	0x000A	0x000B	2	RW	0x10				(reserved)
12	13	0x000C	0x000D	2	RW	0x10				(reserved)
14	15	0x000E	0x000F	2	RW	0x10				(reserved)
16	17	0x0010	0x0011	2	RW	0x10	uint32	0.1 VA	1-0:9.4.0*255	Apparent power+
18	19	0x0012	0x0013	2	RW	0x10	uint32	0.1 VA	1-0:10.4.0*255	Apparent power-
20	21	0x0014	0x0015	2	RW	0x10				(reserved)
22	23	0x0016	0x0017	2	RW	0x10				(reserved)
24	25	0x0018	0x0019	2	RW	0x10	int32	0.001 (unitless)	1-0:13.4.0*255	Power factor
26	27	0x001A	0x001B	2	RW	0x10	uint32	0.001 Hz	1-0:14.4.0*255	Supply frequency
28	29	0x001C	0x001D	2	RW	0x10				(reserved)
30	31	0x001E	0x001F	2	RW	0x10				(reserved)
32	33	0x0020	0x0021	2	RW	0x10				(reserved)
34	35	0x0022	0x0023	2	RW	0x10				(reserved)
36	37	0x0024	0x0025	2	RW	0x10				(reserved)
38	39	0x0026	0x0027	2	RW	0x10				(reserved)
40	41	0x0028	0x0029	2	RW	0x10	uint32	0.1 W	1-0:21.4.0*255	Active power+ (L1)
42	43	0x002A	0x002B	2	RW	0x10	uint32	0.1 W	1-0:22.4.0*255	Active power- (L1)
44	45	0x002C	0x002D	2	RW	0x10	uint32	0.1 var	1-0:23.4.0*255	Reactive power+ (L1)
46	47	0x002E	0x002F	2	RW	0x10	uint32	0.1 var	1-0:24.4.0*255	Reactive power- (L1)
48	49	0x0030	0x0031	2	RW	0x10				(reserved)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
50	51	0x0032	0x0033	2	RW	0x10				(reserved)
52	53	0x0034	0x0035	2	RW	0x10				(reserved)
54	55	0x0036	0x0037	2	RW	0x10				(reserved)
56	57	0x0038	0x0039	2	RW	0x10	uint32	0.1 VA	1-0:29.4.0*255	Apparent power+ (L1)
58	59	0x003A	0x003B	2	RW	0x10	uint32	0.1 VA	1-0:30.4.0*255	Apparent power- (L1)
60	61	0x003C	0x003D	2	RW	0x10	uint32	0.001 A	1-0:31.4.0*255	Current (L1)
62	63	0x003E	0x003F	2	RW	0x10	uint32	0.001 V	1-0:32.4.0*255	Voltage (L1)
64	65	0x0040	0x0041	2	RW	0x10	int32	0.001 (unitless)	1-0:33.4.0*255	Power factor (L1)
66	67	0x0042	0x0043	2	RW	0x10				(reserved)
68	69	0x0044	0x0045	2	RW	0x10				(reserved)
70	71	0x0046	0x0047	2	RW	0x10				(reserved)
72	73	0x0048	0x0049	2	RW	0x10				(reserved)
74	75	0x004A	0x004B	2	RW	0x10				(reserved)
76	77	0x004C	0x004D	2	RW	0x10				(reserved)
78	79	0x004E	0x004F	2	RW	0x10				(reserved)
80	81	0x0050	0x0051	2	RW	0x10	uint32	0.1 W	1-0:41.4.0*255	Active power+ (L2)
82	83	0x0052	0x0053	2	RW	0x10	uint32	0.1 W	1-0:42.4.0*255	Active power- (L2)
84	85	0x0054	0x0055	2	RW	0x10	uint32	0.1 var	1-0:43.4.0*255	Reactive power+ (L2)
86	87	0x0056	0x0057	2	RW	0x10	uint32	0.1 var	1-0:44.4.0*255	Reactive power- (L2)
88	89	0x0058	0x0059	2	RW	0x10				(reserved)
90	91	0x005A	0x005B	2	RW	0x10				(reserved)
92	93	0x005C	0x005D	2	RW	0x10				(reserved)
94	95	0x005E	0x005F	2	RW	0x10				(reserved)
96	97	0x0060	0x0061	2	RW	0x10	uint32	0.1 VA	1-0:49.4.0*255	Apparent power+ (L2)
98	99	0x0062	0x0063	2	RW	0x10	uint32	0.1 VA	1-0:50.4.0*255	Apparent power- (L2)
100	101	0x0064	0x0065	2	RW	0x10	uint32	0.001 A	1-0:51.4.0*255	Current (L2)
102	103	0x0066	0x0067	2	RW	0x10	uint32	0.001 V	1-0:52.4.0*255	Voltage (L2)
104	105	0x0068	0x0069	2	RW	0x10	int32	0.001 (unitless)	1-0:53.4.0*255	Power factor (L2)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
106	107	0x006A	0x006B	2	RW	0x10				(reserved)
108	109	0x006C	0x006D	2	RW	0x10				(reserved)
110	111	0x006E	0x006F	2	RW	0x10				(reserved)
112	113	0x0070	0x0071	2	RW	0x10				(reserved)
114	115	0x0072	0x0073	2	RW	0x10				(reserved)
116	117	0x0074	0x0075	2	RW	0x10				(reserved)
118	119	0x0076	0x0077	2	RW	0x10				(reserved)
120	121	0x0078	0x0079	2	RW	0x10	uint32	0.1 W	1-0:61.4.0*255	Active power+ (L3)
122	123	0x007A	0x007B	2	RW	0x10	uint32	0.1 W	1-0:62.4.0*255	Active power- (L3)
124	125	0x007C	0x007D	2	RW	0x10	uint32	0.1 var	1-0:63.4.0*255	Reactive power+ (L3)
126	127	0x007E	0x007F	2	RW	0x10	uint32	0.1 var	1-0:64.4.0*255	Reactive power- (L3)
128	129	0x0080	0x0081	2	RW	0x10				(reserved)
130	131	0x0082	0x0083	2	RW	0x10				(reserved)
132	133	0x0084	0x0085	2	RW	0x10				(reserved)
134	135	0x0086	0x0087	2	RW	0x10				(reserved)
136	137	0x0088	0x0089	2	RW	0x10	uint32	0.1 VA	1-0:69.4.0*255	Apparent power+ (L3)
138	139	0x008A	0x008B	2	RW	0x10	uint32	0.1 VA	1-0:70.4.0*255	Apparent power- (L3)
140	141	0x008C	0x008D	2	RW	0x10	uint32	0.001 A	1-0:71.4.0*255	Current (L3)
142	143	0x008E	0x008F	2	RW	0x10	uint32	0.001 V	1-0:72.4.0*255	Voltage (L3)
144	145	0x0090	0x0091	2	RW	0x10	int32	0.001 (unitless)	1-0:73.4.0*255	Power factor (L3)

Table 3: Instantaneous values

4.2 Internal Energy registers (counters)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
512	515	0x0200	0x0203	4	RW	0x10	uint64	0.1 Wh	1-0:1.8.0*255	Active energy+
516	519	0x0204	0x0207	4	RW	0x10	uint64	0.1 Wh	1-0:2.8.0*255	Active energy-
520	523	0x0208	0x020B	4	RW	0x10	uint64	0.1 varh	1-0:3.8.0*255	Reactive energy+
524	527	0x020C	0x020F	4	RW	0x10	uint64	0.1 varh	1-0:4.8.0*255	Reactive energy-
528	531	0x0210	0x0213	4	RW	0x10				(reserved)
532	535	0x0214	0x0217	4	RW	0x10				(reserved)
536	539	0x0218	0x021B	4	RW	0x10				(reserved)
540	543	0x021C	0x021F	4	RW	0x10				(reserved)
544	547	0x0220	0x0223	4	RW	0x10	uint64	0.1 VAh	1-0:9.8.0*255	Apparent energy+
548	551	0x0224	0x0227	4	RW	0x10	uint64	0.1 VAh	1-0:10.8.0*255	Apparent energy-
552	555	0x0228	0x022B	4	RW	0x10				(reserved)
556	559	0x022C	0x022F	4	RW	0x10				(reserved)
560	563	0x0230	0x0233	4	RW	0x10				(reserved)
564	567	0x0234	0x0237	4	RW	0x10				(reserved)
568	571	0x0238	0x023B	4	RW	0x10				(reserved)
572	575	0x023C	0x023F	4	RW	0x10				(reserved)
576	579	0x0240	0x0243	4	RW	0x10				(reserved)
580	583	0x0244	0x0247	4	RW	0x10				(reserved)
584	587	0x0248	0x024B	4	RW	0x10				(reserved)
588	591	0x024C	0x024F	4	RW	0x10				(reserved)
592	595	0x0250	0x0253	4	RW	0x10	uint64	0.1 Wh	1-0:21.8.0*255	Active energy+ (L1)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
596	599	0x0254	0x0257	4	RW	0x10	uint64	0.1 Wh	1-0:22.8.0*255	Active energy- (L1)
600	603	0x0258	0x025B	4	RW	0x10	uint64	0.1 varh	1-0:23.8.0*255	Reactive energy+ (L1)
604	607	0x025C	0x025F	4	RW	0x10	uint64	0.1 varh	1-0:24.8.0*255	Reactive energy- (L1)
608	611	0x0260	0x0263	4	RW	0x10				(reserved)
612	615	0x0264	0x0267	4	RW	0x10				(reserved)
616	619	0x0268	0x026B	4	RW	0x10				(reserved)
620	623	0x026C	0x026F	4	RW	0x10				(reserved)
624	627	0x0270	0x0273	4	RW	0x10	uint64	0.1 VAh	1-0:29.8.0*255	Apparent energy+ (L1)
628	631	0x0274	0x0277	4	RW	0x10	uint64	0.1 VAh	1-0:30.8.0*255	Apparent energy- (L1)
632	635	0x0278	0x027B	4	RW	0x10				(reserved)
636	639	0x027C	0x027F	4	RW	0x10				(reserved)
640	643	0x0280	0x0283	4	RW	0x10				(reserved)
644	647	0x0284	0x0287	4	RW	0x10				(reserved)
648	651	0x0288	0x028B	4	RW	0x10				(reserved)
652	655	0x028C	0x028F	4	RW	0x10				(reserved)
656	659	0x0290	0x0293	4	RW	0x10				(reserved)
660	663	0x0294	0x0297	4	RW	0x10				(reserved)
664	667	0x0298	0x029B	4	RW	0x10				(reserved)
668	671	0x029C	0x029F	4	RW	0x10				(reserved)
672	675	0x02A0	0x02A3	4	RW	0x10	uint64	0.1 Wh	1-0:41.8.0*255	Active energy+ (L2)
676	679	0x02A4	0x02A7	4	RW	0x10	uint64	0.1 Wh	1-0:42.8.0*255	Active energy- (L2)
680	683	0x02A8	0x02AB	4	RW	0x10	uint64	0.1 varh	1-0:43.8.0*255	Reactive energy+ (L2)
684	687	0x02AC	0x02AF	4	RW	0x10	uint64	0.1 varh	1-0:44.8.0*255	Reactive energy- (L2)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
688	691	0x02B0	0x02B3	4	RW	0x10				(reserved)
692	695	0x02B4	0x02B7	4	RW	0x10				(reserved)
696	699	0x02B8	0x02BB	4	RW	0x10				(reserved)
700	703	0x02BC	0x02BF	4	RW	0x10				(reserved)
704	707	0x02C0	0x02C3	4	RW	0x10	uint64	0.1 VAh	1-0:49.8.0*255	Apparent energy+ (L2)
708	711	0x02C4	0x02C7	4	RW	0x10	uint64	0.1 VAh	1-0:50.8.0*255	Apparent energy- (L2)
712	715	0x02C8	0x02CB	4	RW	0x10				(reserved)
716	719	0x02CC	0x02CF	4	RW	0x10				(reserved)
720	723	0x02D0	0x02D3	4	RW	0x10				(reserved)
724	727	0x02D4	0x02D7	4	RW	0x10				(reserved)
728	731	0x02D8	0x02DB	4	RW	0x10				(reserved)
732	735	0x02DC	0x02DF	4	RW	0x10				(reserved)
736	739	0x02E0	0x02E3	4	RW	0x10				(reserved)
740	743	0x02E4	0x02E7	4	RW	0x10				(reserved)
744	747	0x02E8	0x02EB	4	RW	0x10				(reserved)
748	751	0x02EC	0x02EF	4	RW	0x10				(reserved)
752	755	0x02F0	0x02F3	4	RW	0x10	uint64	0.1 Wh	1-0:61.8.0*255	Active energy+ (L3)
756	759	0x02F4	0x02F7	4	RW	0x10	uint64	0.1 Wh	1-0:62.8.0*255	Active energy- (L3)
760	763	0x02F8	0x02FB	4	RW	0x10	uint64	0.1 varh	1-0:63.8.0*255	Reactive energy+ (L3)
764	767	0x02FC	0x02FF	4	RW	0x10	uint64	0.1 varh	1-0:64.8.0*255	Reactive energy- (L3)
768	771	0x0300	0x0303	4	RW	0x10				(reserved)
772	775	0x0304	0x0307	4	RW	0x10				(reserved)
776	779	0x0308	0x030B	4	RW	0x10				(reserved)

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description
780	783	0x030C	0x030F	4	RW	0x10				(reserved)
784	787	0x0310	0x0313	4	RW	0x10	uint64	0.1 VAh	1-0:69.8.0*255	Apparent energy+ (L3)
788	791	0x0314	0x0317	4	RW	0x10	uint64	0.1 VAh	1-0:70.8.0*255	Apparent energy- (L3)

Table 4: Energy registers (counters)

Examples:

To obtain the instantaneous active power (which is consumed”), use the (integer) values of the holding registers 0 and 1:

<u>Active power imported</u> [W] = (*{Register 0}* $\cdot 2^{16}$ + *{Register 1}*) $\cdot$ 0.1 [W]

To obtain the total active energy (which was imported), that means the cumulated energy over all phases, use (integer) registers 512 to 515:

<u>Active energy imported</u> [Wh] = (*{Register 512}* $\cdot 2^{48}$ + *{Register 513}* $\cdot 2^{32}$ + *{Register 514}* $\cdot 2^{16}$ + *{Register 515}*) $\cdot$ 0.1 [Wh]

4.3 Group registers

This register set contains group specific information. In total, there are 48 group register sets. Each register set has a size of 40 registers, which models one group connected to the TQ Energy Manager. The group registers are only available, if the base product has sensor support enabled and the groups are configured. The groups provide sum calculations of power, energy and current for the configured sensors, according to the following tables.

The base offset of each sensor register block can be calculated by:

offset = 0xE800 + (<*group number*> - 1) · 0x0028

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	Description
59392	59431	0xE800	0xE827	40	Group 1
59432	59571	0xE828	0xE8B3	40	Group 2
…	…	…	…	…	…
61272	61311	0xEF58	0xEF7F	40	Group 48

Table 5: Group registers overview

The register set for each group is equal for all groups. That means the following table only describes the register set of group 1, all other channels only vary in their offset address.

The group OBIS codes do not contain a phase information because the user can combine sensors from different phases in a group.

Each sensor in the TQ Energy Manager's environment can be identified by its group index.
Note: first group index starts at 0.

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description	Source type
59392	59395	0xE800	0xE803	4	RO	0x10	uint64	unitless	0-x:96.1.0*255	Group label (first 8 characters)	Configured
59396	59399	0xE804	0xE807	4	RO	0x10				(reserved)	
59400	59400	0xE808	0xE808	1	RO	0x10				(reserved)	
59401	59404	0xE809	0xE80C	4	RO	0x10	uint64	1 Wh	1-x:81.8.0*255	Active energy+ (group sum)	Calculated
59405	59408	0xE80D	0xE810	4	RO	0x10				(reserved)	
59409	59412	0xE811	0xE814	4	RO	0x10	uint64	1 VAh	1-x:89.8.0*255	Apparent energy+ (group sum)	Calculated
59413	59416	0xE815	0xE818	4	RO	0x10				(reserved)	
59417	59418	0xE819	0xE81A	2	RO	0x10	uint32	0.001 W	1-x:81.4.0*255	Active power+ (group sum)	Calculated
59419	59420	0xE81B	0xE81C	2	RO	0x10				(reserved)	
59421	59422	0xE81D	0xE81E	2	RO	0x10	uint32	0.001 VA	1-x:89.4.0*255	Apparent power+ (group sum)	Calculated
59423	59424	0xE81F	0xE820	2	RO	0x10				(reserved)	
59425	59426	0xE821	0xE822	2	RO	0x10	uint32	0.001 A	1-x:91.4.0*255	Current (group sum)	Sensors
59427	59428	0xE823	0xE824	2	RO	0x10				(reserved)	
59429	59430	0xE825	0xE826	2	RO	0x10				(reserved)	
59431	59431	0xE827	0xE827	1	RO	0x10				(reserved)	

Table 6: Group register set

4.4 Sensor registers

This register set contains sensor specific information according to the following table. In total, there are 96 sensor register sets. Each register set has a size of 40 registers, which models one sensor connected to the TQ Energy Manager. The sensor registers are only available, if the base product has sensor support enabled.

The base offset of each sensor register block can be calculated by:

offset = 0xF000 + (<*sensor number*> - 1) · 0x0028

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	Description
61440	61479	0xF000	0xF027	40	Sensor 1
61480	61519	0xF028	0xF04F	40	Sensor 2
…	…	…	…	…	…
65240	65279	0xFED8	0xFEFF	40	Sensor 96

Table 7: Sensor registers overview

The register set for each sensor is equal for all sensors. That means the following table only describes the register set of sensor 1, all other channels only vary in their offset address.

The OBIS codes are for illustration only as the real OBIS code depends upon the configured phase of the sensor and the channel. All sensors are mapped to a unique channel respectively. Sensor 1 is mapped to channel 1, Sensor 2 is mapped to channel 2 and so on.

The phase information of each sensor must be configured using the TQ Energy Managers web interface. If a sensor is not yet configured by the consumer, the corresponding registers will contain zero and only the current register will show a value. The registers contain zero because the data acquisition layer uses the phase information to obtain the voltage and power factor from the corresponding internal measurement values.

The columns “source type” indicates the origin of the provided data: “configured” means that the value is determined by configuration and/or generated by sensor management in the TQ Energy Manager; “calculated” means that the value is calculated within the sensor data acquisition layer and “internal” means that the value originates from the internal data acquisition components and thus depends upon configuration of the sensor.

Each sensor in the TQ Energy Manager’s environment can be identified by its serial number + sensor index. Note: first sensor index starts at 0.

Register	Value
61644	0xF45A
61645	0xEE84
61646	0x6F2B
61647	0x0005

Table 8 – serial + index

Example: The hexadecimal interpretation of the serial number + sensor index registers suggests that the following register set corresponds to the sixth sensor of the sensorbar with serial number F4.5A.EE.84.6F.2B.

Start address (decimal)	End address (decimal)	Start address (hexadecimal)	End address (hexadecimal)	Size	R/W	Function codes	Type	Units	OBIS-Code	Description	Source type
61440	61443	0xF000	0xF003	4	RO	0x10	uint64	unitless	0-x:96.1.0*255	Sensor label (first 8 characters)	Configured
61444	61447	0xF004	0xF007	4	RO	0x10	uint64	unitless	0-x:96.1.1*255	Serial number + sensor index	Configured
61448	61448	0xF008	0xF008	1	RO	0x10	uint16	unitless	-	Phase (1, 2, 3)	Configured
61449	61452	0xF009	0xF00C	4	RO	0x10	uint64	1 Wh	1-x:1.8.0*255	Active energy+	Calculated
61453	61456	0xF00D	0xF010	4	RO	0x10				(reserved)	
61457	61460	0xF011	0xF014	4	RO	0x10	uint64	1 VAh	1-x:9.8.0*255	Apparent energy+	Calculated
61461	61464	0xF015	0xF018	4	RO	0x10				(reserved)	
61465	61466	0xF019	0xF01A	2	RO	0x10	uint32	0.001 W	1-x:1.4.0*255	Active power+	Calculated
61467	61468	0xF01B	0xF01C	2	RO	0x10				(reserved)	
61469	61470	0xF01D	0xF01E	2	RO	0x10	uint32	0.001 VA	1-x:9.4.0*255	Apparent power+	Calculated
61471	61472	0xF01F	0xF020	2	RO	0x10				(reserved)	
61473	61474	0xF021	0xF022	2	RO	0x10	uint32	0.001 A	1-x:11.4.0*255	Current	Sensor
61475	61476	0xF023	0xF024	2	RO	0x10	uint32	0.001 V	1-x:12.4.0*255	Voltage	Internal
61477	61478	0xF025	0xF026	2	RO	0x10	int32	0.001 (unitless)	1-x:13.4.0*255	Power factor	Internal
61479	61479	0xF027	0xF027	1	RO	0x10				(reserved)	

Table 9: Sensor register set

5. Appendix

Abbreviation	Description	Remarks
Customer	Customer of TQ Group	This term is used when a customer of the TQ group is meant.
Consumer	Customer of Customer	This term refers to the end customer, who actually bought the TQ Energy Manager as a (branded) product from the customer.
OMS	Open Metering System	
OBIS	Object Identification System	

Table 10: Specific abbreviations

No	Title / File name	Version / Date	Author	Company
(1)	Modbus application protocol specification / Modbus_Application_Protocol_V1_1b.pdf	V1.1b / 2006-12-28	-	Modbus IDA
(2)	MODBUS over serial line specification and implementation guide / Modbus_over_serial_line_V1_02.pdf	V1.02 / 2006-12-20	-	Modbus IDA
(3)	Open Metering System Volume 2 Primary Communication	Issue 3.0.1 / 2011-01-29	-	OMS Group

Table 11: Additional applicable documents