Software manual

DULCOMETER®
Controller AEGIS II
Modbus RTU

EN

A2608

Valid only in combination with the operating instructions for the Controller AEGIS II

Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

Supplementary information

Please read the supplementary information in its entirety.

Information

This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Warning information

Warning information include detailed descriptions of the hazardous situation.

The following symbols are used to highlight instructions, links, lists, results and other elements in this document:

Tab. 1: More symbols

Symbol	Description
1.	Action, step by step.
⇨	Outcome of an action.
	Links to elements or sections of these instructions or other applicable documents.
■	List without set order.
[Button]	Display element (e.g. indicators). Operating element (e.g. button, switch).
'Display /GUI'	Screen elements (e.g. buttons, assignment of function keys).
`CODE`	Presentation of software elements and/or texts.

Table of contents

1 Description

The ProMinent Industrial Communication Driver card (COM module) provides the Aegis II controller with the possibility of communicating with an external Modbus RTU Master, via the Modbus RTU protocol, to make the data of the Aegis II available to the master. The Modbus connections of the COM module only allow values to be read. It is not possible to write or change values.

The COM module has the following functionalities:

A Modbus RTU slave interface (RS-485 serial). A second connecting option is also available on the COM module to connect a further slave to the bus via a daisy chain principle. Only a maximum of one master should always be connected to one of the two interfaces.

A Modbus RTU master interface (RS-485 serial) on which a PYXIS® fluorometer (ST-500) can be connected. A 24 V DC power supply for the PYXIS® fluorometer is provided at this place. Never connect another Modbus RTU slave to this interface other than a PYXIS® fluorometer (ST-500). The COM module can also only detect the PYXIS® fluorometer ST-500 and work with it. Never connect a device other than a PYXIS® fluorometer (ST-500) to the 24 V DC power supply to this interface. This power source is only intended and dimensions for the PYXIS® fluorometer ST-500.

Two 4 ... 20 mA outputs, which are assigned to the inputs/outputs I and J of the Aegis II.

Optionally a 2 x mA input module can be attached to the COM module. Currently no module other than a 2 x mA input module can be attached to the COM module. The two inputs are assigned to the inputs/outputs K and L of the Aegis II. The previous settings are discarded should these inputs/output be assigned differently.

2 Modbus RTU implementation

This document contains general information regarding the implementation of the controller to the serial communication protocol of the Modbus RTU.

The controller acts as slave device *[Device 1]*.

Communication between the controller *[Device 1]* and external master devices *[Device 0]* is provided, including, for example, PLC Programmable Logic Controller or PC.

The Modbus protocol is a communication protocol that enables devices to use data via a joint connection if the devices communicate with each other via the Modbus RTU RS-485 specification.

The Modbus RTU specification describes the data link layer and physical layer.

The notification structure of the function codes uses Modbus RTU standards.

The IEEE 32 bit floating point numbers and whole numbers *[Integers]* are used.

More information on Modbus can be found at *www.modbus.org* or other websites relating to the (local) Modbus organisation in your country (if available).

2.1 Modbus RTU message structure

Parameter	Value
Standard	RS-485
Coding system	8 bit
Number of data bits per character	10 / 11 bits:
	1 start bit
	8 data bits
	0 / 1 parity bits *[no, odd, even]*
	1 / 2 stop bits (requires 2 stop bits if no parity bit is used)
	predetermined value: *[8E1]*
Data rate (Baud)	9600, 19200 (specified value),115200
Error check	CRC-16
Minimum waiting time between two queries	≧ 1 second
Byte sequence of the multi-byte transmission	0x1234 transfers 0x12 followed by 0x34
[TIMEOUT] message	>= 3.5 characters (> 2 ms at a baud rate ≧ 19200)
Slave address	1 ... 247 (10 is pre-set)

2.2 Default Modbus slave interface configuration

Tab. 2: This is the default factory configuration of the ProMinent interface

Parameter	Default value
Serial format	1 stop bit
Baud rate	19200 Baud
Slave address	10
Parity	*[Even]*

The configuration can be modified in the menu of the controller at *[MENU > System > Communications]*.

2.3 Modbus RTU Link Layer *[Link Layer]*

The link layer *[Link Layer]* comprises the following features:

- Slave address identification
- Start / end identification
- CRC-16 creation / check
- Buffer overflow detection
- Unused line detection
- Sending / receiving time limit for messages
- Raster setting error detection

Errors in messages that are received by the physical layer of the slave and are recognised, are ignored. The physical layer is restarted automatically if a new message is detected on the unused line.

2.4 Serial connections

The ProMinent® interface supports the following interface standards:

RS-485 (TIA-485-A)

- half-duplex, 2-wire technology,*[twisted pair]* cable
- Differential voltage level ± 5 V.
- Cable length up to 1200 m
- Active termination.

2.5 COM module installation

The COM module can and may only be fitted in an Aegis II and then only in module slot 3 and also only works there and not in slots 1 or 2. The COM module needs to be fixed to the board of the Aegis II with three plastic screws.

A 2 x MA input module can, but does not need to be, attached to the COM module, which is fixed to the COM module using a plastic screw.

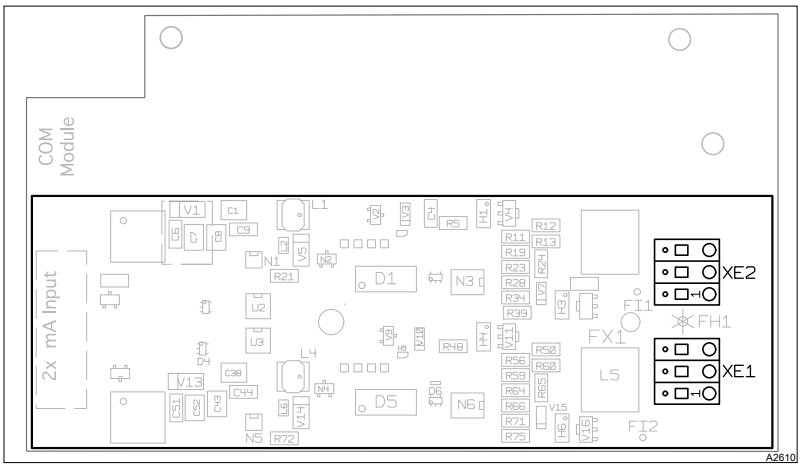


Fig. 1: Plug-on 2x mA input module and its interfaces XE1 and XE2

Never fit or remove a driver card on the COM module or the COM module itself if the Aegis II is energised. Moreover, only allow appropriately trained skilled personnel to modify the hardware of the Aegis II.

Please refer to the instructions for the Aegis II for information relating to installation, configuration and maintenance of a 2 x mA input module on the COM module. Please refer to the instructions for the Aegis II for more information relating to the configuration and maintenance of the two mA outputs of the COM module.

2.6 The Pyxis® fluorometer ST-500 and the Aegis II COM module

The Pyxis® fluorometer ST-500 can be mapped on the characteristic value *'M'* and used for control and diagnostics function purposes. It can also be calibrated directly via the HMI on the Aegis II or via a network connection using Ethernet or Wi-Fi. More information is available in the manuals for the Aegis II and Pyxis® sensor ST-500. The process of connecting the Pyxis® sensor to the COM module is described in ↳ *Chapter 2.7 'Connectors' on page 8*.

Never fit or remove a Pyxis® fluorometer on the COM module if the Aegis II is energised. Moreover, only allow appropriately trained skilled personnel to modify the hardware of the Aegis II.

2.7 Connectors

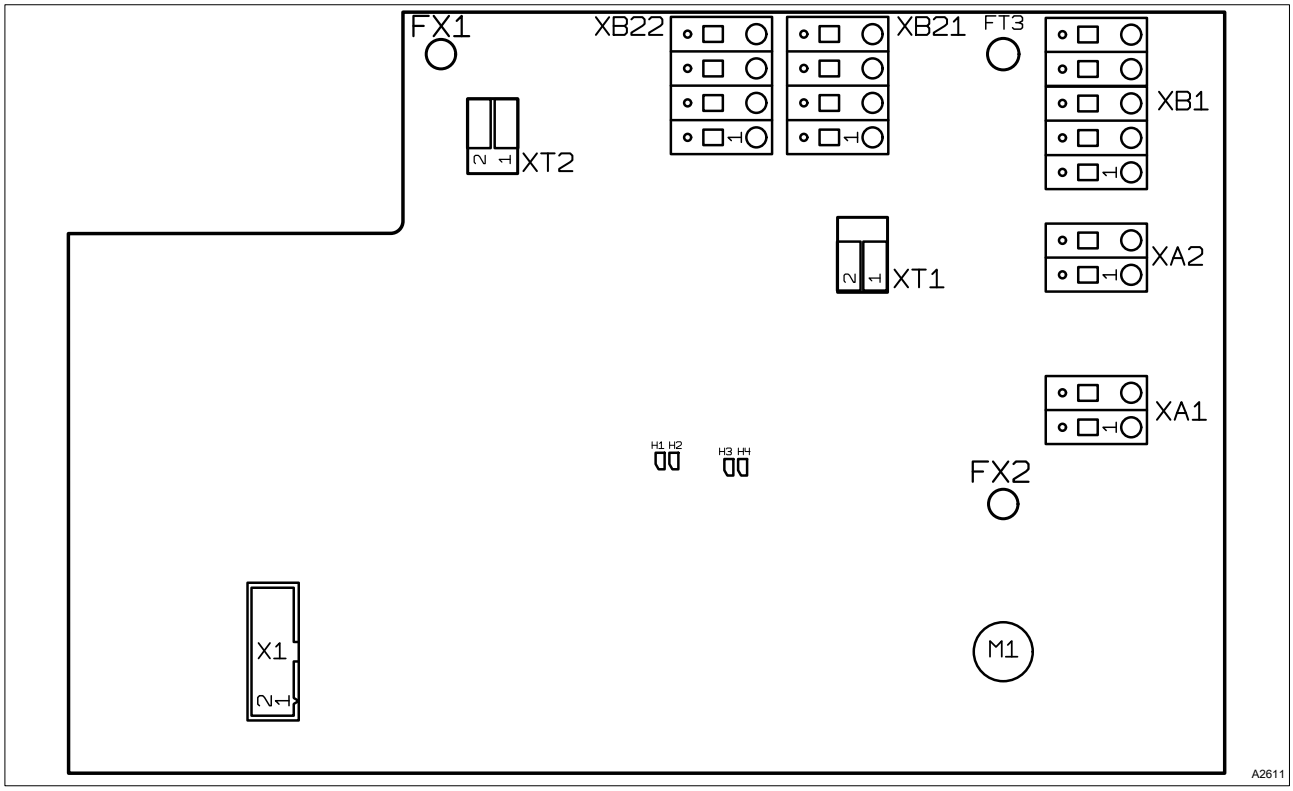


Fig. 2: COM module upper side,

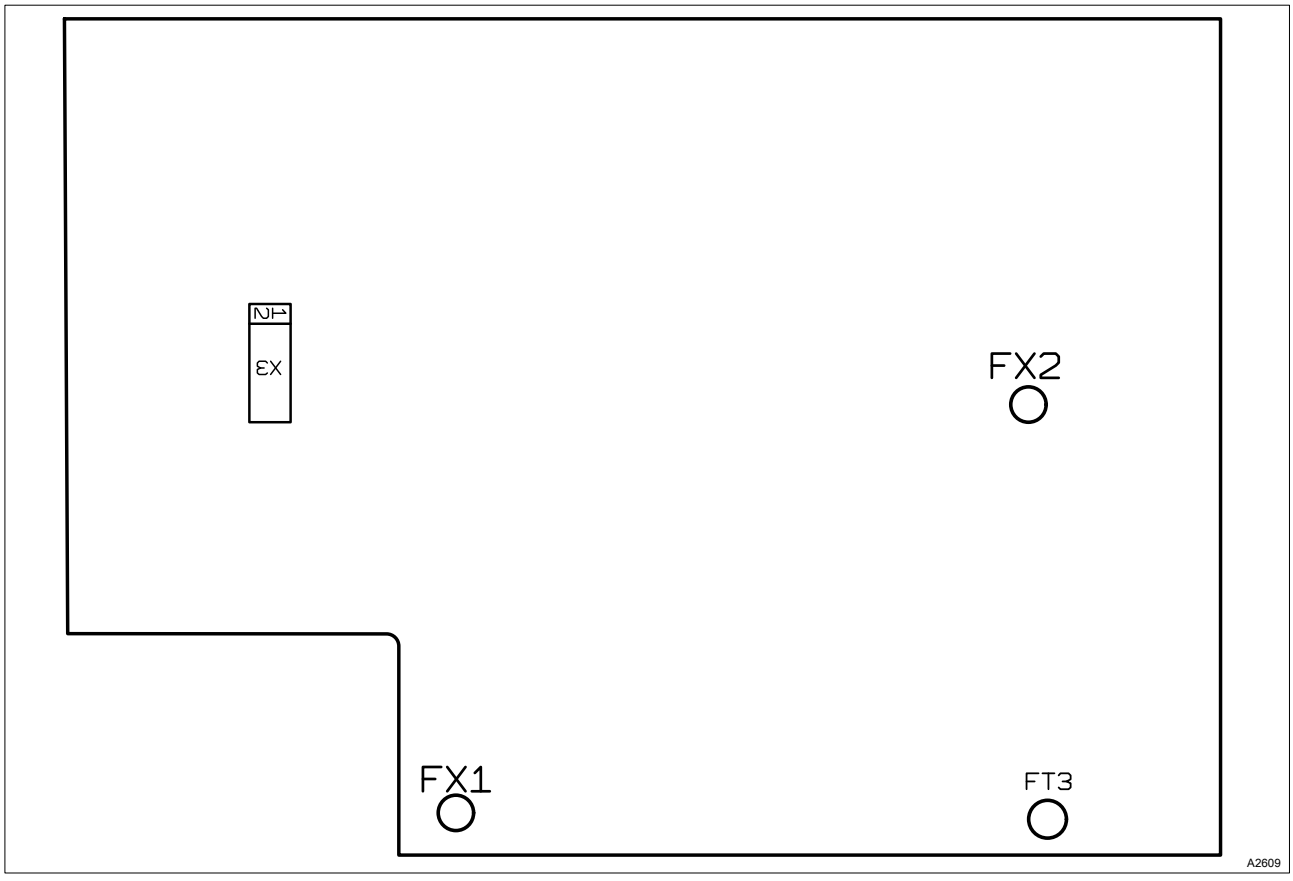
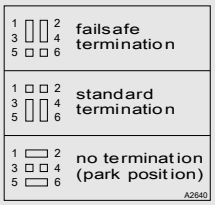


Fig. 3: COM module lower side,

Name	Range	Operation	Description
X1	Add-on module	Interface(only 2 x mA input module)	Optional driver card
X3	Aegis II	Interface	Only in module slot 3
XT1	Modbus RTU master to external slave	Termination resistor - pin strip (default: fail-safe termination)	
XT2	Modbus RTU slave to external master	Termination resistor - pin strip (default: default termination)	
XA1	mA outputs	Interface - channel 1	Pin 1 = (-) Pin 2 = (+)
XA2		Interface - channel 2	Pin 1 = (-) Pin 2 = (+)
XB1	Modbus RTU master to external slave	Interface (Pyxis® ST-500 only)	Pin 1 = (A) … blue line, Pin 2 = (B) … yellow line, Pin 3 = (GND) … black line
			Pin 4 = (shield) … shield Pin 5 = (+24 V DC) … red line
XB21 and XB22	Modbus RTU slave to external master	2 connections but only a maximum of 1 Modbus RTU master and the other for other slave based on the daisy chain principle.	Pin 1 = (A / +) Pin 2 = (B / -) Pin 3 = (GND) Pin 4 = (screen)
H1	Modbus RTU slave to external master	Message sent / received	LED – yellow
H2		Error	LED – red
H3	Modbus RTU master to external slave	Error	LED – red
H4		Message sent / received	LED – yellow
FX1+FX2+FT3	Aegis II	Fixing of the COM module on the Aegis II	Holes for plastic bolts
M1	Add-on module	Fixing of a driver card (only 2 x mA input modules) on the COM module	Bolts with a female thread for fixing an optional driver card with a plastic screw

2.8 IEEE 32 bit floating point register

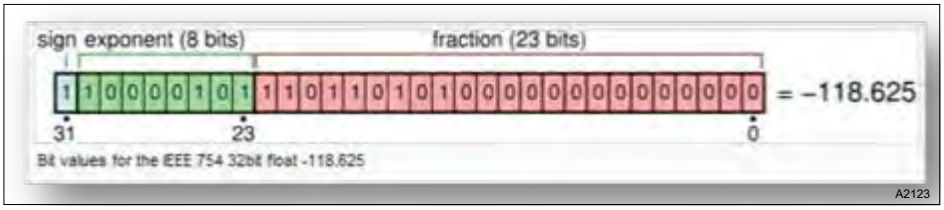


Fig. 4: Example of an IEEE 32 bit floating point register

The ProMinent interface uses the IEEE 754 format for 32 bit floating point values (with single precision).

2.9 Supported Modbus commands

All the registers are solely *[Read holding registers]*. None of the values can be or may be modified/written. Should an external Modbus RTU master try to read other values than are specified in this document, a Modbus response with an exception code is returned, in the same way as when an external master tries to modify values.

Tab. 3: The ProMinent interface supports the following commands:

Command	Function code	Maximum register number in a transaction
Read-holding register	0x03 (3)	125

Maximum call-up frequency of messages

Please do not ask for values more often than once per second.

≧ 1/second.

- Long integer parameters [Unsigned integer 32] are 4 bytes long and are mapped in two subsequent Modbus registers.
- Floating point parameters [Float 32] are 4 bytes long and are mapped in two subsequent Modbus registers. Floating points are mapped with simple precision IEEE format (1 sign bit, 8 bit exponent and 23 bit fraction).
- With registers between 501 and 723 that are 4 bytes long, it is essential that the first register contains bits 15 to 0 and the following register contains bits 31 to 16.
- With registers between 901 and 1123 that are 4 bytes long, it is essential that the first register contains bits 31 to 16 and the following register contains bits 15 to 0.
- Bytes are defined as *[Big Endian]* with MSB.

2.10 Register address numbering

Maximum PDU size

The maximum PDU size is 253 bytes.

Register address numbering differs from Modbus RTU PDU numbering.

The Modbus PDU register address is register address 1.

The ProMinent register 100 is called up from a PDU address 99.

2.11 Overview of registers

This table contains the ProMinent register overview.

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info
PDU address	Register	PDU address	Register				
500	501	900	901	A	*[- seriel sensor 1 -> value]*	FLOAT32	
502	503	902	903	B	*[- seriel sensor 2 -> value]*	FLOAT32	
504	505	904	905	C	*[- module slot 1 -> value 1]*	FLOAT32	
506	507	906	907	D	*[- module slot 1 -> value 2]*	FLOAT32	
508	509	908	909	E	*[- module slot 2 -> value 1]*	FLOAT32	
510	511	910	911	F	*[- module slot 2 -> value 2]*	FLOAT32	
512	513	912	913	G	*[- 4... 20mA input value]*	FLOAT32	
514	515	914	915	H	*[- 10 mV/C temperature sensor input value]*	FLOAT32	
516	517	916	917	I	*[- module slot 3 -> value 1]*	FLOAT32	
518	519	918	919	J	*[- module slot 3 -> value 2]*	FLOAT32	
520	521	920	921	K	*[- phantom sensor value - module slot 3 -> COM module -> pluggable module -> value 1]*	FLOAT32	Depending on the Aegis II configuration
522	523	922	923	L	*[- phantom sensor value - module slot 3 -> COM module -> pluggable module -> value 2]*	FLOAT32	Depending on the Aegis II configuration
524	525	924	925	M	*[- phantom sensor value - module slot 3 -> COM module -> connectable "Pyxis ST-500" probe -> value]*	FLOAT32	Depending on the Aegis II configuration

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info	
PDU address	Register	PDU address	Register					
526	527	926	927	N	*[- phantom sensor value]*	FLOAT32		
528	529	928	929	O	- *[volume meter (daily counter) - contact set input (digital input)]*	FLOAT32	Volume meter: Value = volume today in user units. (If your counter is in L or G or m^3, then the counter automatically resets at midnight). Contact set input: Value = 1.0 when closed & 0.0 when open (Client app looks after the time in status, Time ON/OFF today.)	
530	531	930	931	P	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
532	533	932	933	Q	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
534	535	934	935	R	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
536	537	936	937	S	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
538	539	938	939	T	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
540	541	940	941	U	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
542	543	942	943	V	*[- volume meter (daily counter) - contact set input (digital input)]*	FLOAT32		
544	545	944	945	W	*[- Phantom volume meter - contact set inputs]*	FLOAT32		Wert = 1,0 bei ON & 0,0 bei OFF
546	547	946	947	X	*[- Phantom volume meter - contact set inputs]*	FLOAT32		
548	549	948	949	Y	*[- Phantom volume meter - contact set inputs]*	FLOAT32		

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info
PDU address	Register	PDU address	Register				
550	551	950	951	Z	*[- Phantom volume meter - contact set inputs]*	FLOAT32	
552	553	952	953	R 1	*[- Line powered control relay state]*	FLOAT32	
554	555	954	955	R 2	*[- Line powered control relay state]*	FLOAT32	
556	557	956	957	R 3	*[- Dry or line powered control relay state]*	FLOAT32	
558	559	958	959	R 4	*[- Dry or line powered control relay state]*	FLOAT32	
560	561	960	961	R 5	*[- Dry or line powered control relay state]*	FLOAT32	
562	563	962	963	P 6	*[- Pulse - ON/OFF control]*	FLOAT32	If configured as a pulse control: Value = Metering 0 ... 100% (0.0% = OFF). If the client application adds up, the client application can cumulatively have the metered volume per control circuit.
564	565	964	965	P 7	*[- Pulse - ON/OFF control]*	FLOAT32	
566	567	966	967	P 8	*[- Pulse - ON/OFF control]*	FLOAT32	
568	569	968	969	P 9	*[- Pulse - ON/OFF control]*	FLOAT32	
570	571	970	971		*[A - high alarm level]*	FLOAT32	If an alarm is disabled for A - N, e.g. for C, the corresponding alarm level (for C) is automatically set to 0.
572	573	972	973		*[A - low alarm level]*	FLOAT32	
574	575	974	975		*[B - high alarm level]*	FLOAT32	
576	577	976	977		*[B - low alarm level]*	FLOAT32	
578	579	978	979		*[C - high alarm level]*	FLOAT32	

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info
PDU address	Register	PDU address	Reg-ister				
580	581	980	981		*[C - low alarm level]*	FLOAT32	
582	583	982	983		*[D - high alarm level]*	FLOAT32	
584	585	984	985		*[D - low alarm level]*	FLOAT32	
586	587	986	987		*[E - high alarm level]*	FLOAT32	
588	589	988	989		*[E - low alarm level]*	FLOAT32	
590	591	990	991		*[F - high alarm level]*	FLOAT32	
592	593	992	993		*[F - low alarm level]*	FLOAT32	
594	595	994	995		*[G - high alarm level]*	FLOAT32	
596	597	996	997		*[G - low alarm level]*	FLOAT32	
598	599	998	999		*[H - high alarm level]*	FLOAT32	
600	601	1000	1001		*[H - low alarm level]*	FLOAT32	
602	603	1002	1003		*[I - high alarm level]*	FLOAT32	
604	605	1004	1005		*[I - low alarm level]*	FLOAT32	
606	607	1006	1007		*[J - high alarm level]*	FLOAT32	
608	609	1008	1009		*[J - low alarm level]*	FLOAT32	
610	611	1010	1011		*[K - high alarm level]*	FLOAT32	
612	613	1012	1013		*[K - low alarm level]*	FLOAT32	
614	615	1014	1015		*[L - high alarm level]*	FLOAT32	
616	617	1016	1017		*[L - low alarm level]*	FLOAT32	
618	619	1018	1019		*[M - high alarm level]*	FLOAT32	
620	621	1020	1021		*[M - low alarm level]*	FLOAT32	

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info
PDU address	Register	PDU address	Reg-ister				
622	623	1022	1023		*[N - high alarm level]*	FLOAT32	
624	625	1024	1025		*[N - low alarm level]*	FLOAT32	
626	627	1026	1027		*[O - total counter]*	FLOAT32	If disabled & set to contact inputs, then set to 0.
628	629	1028	1029		*[P - total counter]*	FLOAT32	
630	631	1030	1031		*[Q - total counter]*	FLOAT32	
632	633	1032	1033		*[R - total counter]*	FLOAT32	
634	635	1034	1035		*[S - total counter]*	FLOAT32	
636	637	1036	1037		*[T - total counter]*	FLOAT32	
638	639	1038	1039		*[U - total counter]*	FLOAT32	
640	641	1040	1041		*[V - total counter]*	FLOAT32	
642	643	1042	1043		*[R 1 - Turn On setpoint]*	FLOAT32	If a parameter (R1 - P9) is locked, the corresponding setpoint is automatically set to 0.
644	645	1044	1045		*[R 1 - Turn Off setpoint]*	FLOAT32	
646	647	1046	1047		*[R 2 - Turn On setpoint]*	FLOAT32	
648	649	1048	1049		*[R 2 - Turn Off setpoint]*	FLOAT32	
650	651	1050	1051		*[R 3 - Turn On setpoint]*	FLOAT32	
652	653	1052	1053		*[R 3 - Turn Off setpoint]*	FLOAT32	
654	655	1054	1055		*[R 4 - Turn On setpoint]*	FLOAT32	
656	657	1056	1057		*[R 4 - Turn Off setpoint]*	FLOAT32	
658	659	1058	1059		*[R 5 - Turn On setpoint]*	FLOAT32	
660	661	1060	1061		*[R 5 - Turn Off setpoint]*	FLOAT32	
662	663	1062	1063		*[P 6 - Turn On setpoint]*	FLOAT32	

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info	
PDU address	Register	PDU address	Register					
664	665	1064	1065		*[P 6 - Turn Off setpoint]*	FLOAT32		
666	667	1066	1067		*[P 7 - Turn On setpoint]*	FLOAT32		
668	669	1068	1069		*[P 7 - Turn Off setpoint]*	FLOAT32		
670	671	1070	1071		*[P 8 - Turn On setpoint]*	FLOAT32		
672	673	1072	1073		*[P 8 - Turn Off setpoint]*	FLOAT32		
674	675	1074	1075		*[P 9 - Turn On setpoint]*	FLOAT32		
676	677	1076	1077		*[P 9 - Turn Off setpoint]*	FLOAT32		
678	679	1078	1079		*[A - state]*	UINT16	If a parameter (A - Z) is disabled, the corresponding status is automatically set to 0.	Bit coded
679	680	1079	1080		*[B - state]*	UINT16		
680	681	1080	1081		*[C - state]*	UINT16		
681	682	1081	1082		*[D - state]*	UINT16		
682	683	1082	1083		*[E - state]*	UINT16		
683	684	1083	1084		*[F - state]*	UINT16		
684	685	1084	1085		*[G - state]*	UINT16		
685	686	1085	1086		*[H - state]*	UINT16		
686	687	1086	1087		*[I - state]*	UINT16		
687	688	1087	1088		*[J - state]*	UINT16		
688	689	1088	1089		*[K - state]*	UINT16		
689	690	1089	1090		*[L - state]*	UINT16		
690	691	1090	1091		*[M - state]*	UINT16		
691	692	1091	1092		*[N - state]*	UINT16		
692	693	1092	1093		*[O - state]*	UINT16		
693	694	1093	1094		*[P - state]*	UINT16		
694	695	1094	1095		*[Q - state]*	UINT16		
695	696	1095	1096		*[R - state]*	UINT16		
696	697	1096	1097		*[S - state]*	UINT16		
697	698	1097	1098		*[T - state]*	UINT16		
698	699	1098	1099		*[U - state]*	UINT16		
699	700	1099	1100		*[V - state]*	UINT16		
700	701	1100	1101		*[W - state]*	UINT16		

Modbus RTU reg. (BA.DC) (decimal)		Modbus RTU reg. (DC.BA) (decimal)		Aegis II parameter	Parameter name	Format [bit]	Info	
PDU address	Register	PDU address	Register					
701	702	1101	1102		*[X - state]*	UINT16		
702	703	1102	1103		*[Y - state]*	UINT16		
703	704	1103	1104		*[Z - state]*	UINT16		
704	705	1104	1105		*[R 1 - cstate]*	UINT32	If a parameter (R1 - P9) is disabled, the corresponding status is automatically set to 0.	Bit coded
706	707	1106	1107		*[R 2 - cstate]*	UINT32		
708	709	1108	1109		*[R 3 - cstate]*	UINT32		
710	711	1110	1111		*[R 4 - cstate]*	UINT32		
712	713	1112	1113		*[R 5 - cstate]*	UINT32		
714	715	1114	1115		*[P 6 - cstate]*	UINT32		
710	717	1110	1117		*[P 7 - cstate]*	UINT32		
718	719	1118	1119		*[P 8 - cstate]*	UINT32		
720	721	1120	1121		*[P 9 - cstate]*	UINT32		
722	723	1122	1123		*[system state]*	UINT32	Bit coded	

3 Bit field values

The bit field values are described here.

3.1 Status of the channel

[State for A-Z called 'state']		
15	-	-
14	-	-
13	-	-
12	-	-
11	*[linked]*	*[Set when HTTP user calibrating, used to end seqeunce-state when user closes page]*
10	*[cal]*	*[Captured sample control in calibrate mode, supports early exit from measure on calibrate selected by user]*
9	-	-
8	-	-
7	-	-
6	-	-
5	-	-
4	-	-
3	*[arelay]*	*[trip alarm relay on alarm]*
2	-	-
1	*[alarmed]*	*[execute alarm action bit(s)]*
0	*[enabled]*	*[Parameter is enabled]*

[Control State for R1-P9 called 'cstate']		
31	-	-
30	-	-
29	-	-
28	-	-
27	-	-
26	-	-
25	-	-
24	-	-
23	*[latched]*	*[Contact Set controls, retains state during deadtime]*
22	*[ilockedit]*	*[Sets Alarm when a phantom contact set auto-removed. If OFF on alarm, control is off]*
21	*[eventsp]*	*[Set when Oxidant Event Setpoints override control setpoints]*
20	*[ontrip]*	*[Set when ON setpoint exceeded, stays On until OFF setpoint exceeded]*
19	*[prime]*	*[Bypasses all controls but interlocks, blocks & STOP, expires on]*
18	*[test]*	*[ON while user presses key]*
17	*[prebleed]*	*[ON becasue prebleed active on time or uS]*
16	*[drvfault]*	*[Driver card communication timeout, implies no card, card fault, auto resets set on Modbus driver when controlling sensor blocked]*
15	*[delayed]*	*[User set delay on flowswitch, uses alarm delay]*
14	*[oxidant]*	*[one of assist | pH lockout | alt. control events is active]*
13	*[blocking]*	*[Output R1-P9 is blocking another relay]*
12	-	-
11	*[owed]*	*[time owed, count down if not blocked]*
10	*[forcedon]*	*[prebleed has turned relay ON, bypass setpoint ON/OFF]*
9	*[sequence]*	*[2nd phase of an Q:P sequential volume control; ON for 'P']*
8	*[special]*	*[control by special control]*
7	-	-
6	*[rlocked]*	*[interlocked by another relay]*
5	*[offonalarm]*	*[turn OFF on alarm, (default)]*
4	*[do]*	*[Frequency output is DO. AO,FE, SS & RP special controls run as Digital Outputs on both relays & frequencies]*
3	*[vary]*	*[varying cycle controls, adjusts setpoints]*
2	*[tlocked]*	*[lockout on time]*
1	*[ilocked]*	*[interlocked on contact set U..Z]*
0	*[on]*	*[current state of Relay ON|OFF or Pulse Drive, reset at start of each control loop update]*

[Common state for AegisII called 'system state']		
31	-	-
30	*[MFGOVR]*	*[MFG Override: Ignore 'no mikroSD card' & 'Fan' alarms, Set on init if Bluetooth X1.1(3V3) shorted to X1.8(RE7)]*
29	*[NOFAN]*	*[Powered down A-J & DI driver, All outputs OFF, Local HMI stops fault message, AV, exits-enters on global]*
28	-	-
27	*[NOUSD]*	*[File System faults, no mikroSD, on SPI, faulted SPI]*
26	*[DICS]*	*[Set true after SYS_MFG set & all 8 DI re-conifgured to CS:contact sets. Set false when MFG resert & Di restored to prev. usage]*
25	-	-
24	-	-
23	*[MFG]*	*[Set when MFG mode selected, blocks all normal controller functions, allows MFG test-set-verify]*
22	*[IOCFG]*	*[Loading new I/O Config: Turns OFF all outputs then blocks control updates, sets IOs to 4mA, Blocks all I updating]*
21	*[RUNNING]*	*[Set when Poweron timer expires, enables Modbus alarms, CD & EF driver removal, controls & alarms]*
20	-	-
19	-	-
18	-	-
17	*[FSYS]*	*[mikroSD File sytem UP, OK to open-append-write-read activity & log files]*
16	*[NOWIFI]*	*[Most Recent power ON could not get a wify SPI response. Set this bit & SWR then sets of interface to 1, not 2.]*
15	*[RTCRESET]*	*[Set when Real Time Clock error]*
14	*[LOCKED]*	*[Lockout limit password fails, reset @ 7:00AM]*
13	-	-
12	-	-
11	-	-
10	*[USB]*	*[USB host port active, file uploading, Pumps OFF, A/D blocked]*
9	*[RESTART]*	*[Software restart = Power OFF/ON]*
8	-	-
7	*[NEWYEAR]*	*[A new year has just ocurred or has ocurred while the power was OFF]*
6	*[MIDNIGHT]*	*[Midnight has just occured or has occurred while the power was off]*
5	-	-
4	-	-
3	-	-
2	*[IORESET]*	*[I/O reset to factory]*
1	*[SWR]*	*[Restart due the SoftWare Reset, Could by Wdog, Ethernet, User Restart or Reset I/Os]*
0	-	-

4 CRC-16 calculation

```
extern void calculate_CRC(unsigned char *message,
int length, unsigned char *CRC)

unsigned char CRCHi, CRCLo, TempHi, TempLo;

static const unsigned char table[512] = {

0x00, 0x00, 0xC0, 0xC1, 0xC1, 0x81, 0x01, 0x40, 0xC3, 0x01, 0x03, 0xC0, 0x02,
0x80, 0xC2, 0x41,

0xC6, 0x01, 0x06, 0xC0, 0x07, 0x80, 0xC7, 0x41, 0x05, 0x00, 0xC5, 0xC1, 0xC4,
0x81, 0x04, 0x40,

0xCC, 0x01, 0x0C, 0xC0, 0x0D, 0x80, 0xCD, 0x41, 0x0F, 0x00, 0xCF, 0xC1, 0xCE,
0x81, 0x0E, 0x40,

0x0A, 0x00, 0xCA, 0xC1, 0xCB, 0x81, 0x0B, 0x40, 0xC9, 0x01, 0x09, 0xC0, 0x08,
0x80, 0xC8, 0x41,

0xD8, 0x01, 0x18, 0xC0, 0x19, 0x80, 0xD9, 0x41, 0x1B, 0x00, 0xDB, 0xC1, 0xDA,
0x81, 0x1A, 0x40,

0x1E, 0x00, 0xDE, 0xC1, 0xDF, 0x81, 0x1F, 0x40, 0xDD, 0x01, 0x1D, 0xC0, 0x1C,
0x80, 0xDC, 0x41,

0x14, 0x00, 0xD4, 0xC1, 0xD5, 0x81, 0x15, 0x40, 0xD7, 0x01, 0x17, 0xC0, 0x16,
0x80, 0xD6, 0x41,

0xD2, 0x01, 0x12, 0xC0, 0x13, 0x80, 0xD3, 0x41, 0x11, 0x00, 0xD1, 0xC1, 0xD0,
0x81, 0x10, 0x40,

0xF0, 0x01, 0x30, 0xC0, 0x31, 0x80, 0xF1, 0x41, 0x33, 0x00, 0xF3, 0xC1, 0xF2,
0x81, 0x32, 0x40,

0x36, 0x00, 0xF6, 0xC1, 0xF7, 0x81, 0x37, 0x40, 0xF5, 0x01, 0x35, 0xC0, 0x34,
0x80, 0xF4, 0x41,

0x3C, 0x00, 0xFC, 0xC1, 0xFD, 0x81, 0x3D, 0x40, 0xFF, 0x01, 0x3F, 0xC0, 0x3E,
0x80, 0xFE, 0x41,

0xFA, 0x01, 0x3A, 0xC0, 0x3B, 0x80, 0xFB, 0x41, 0x39, 0x00, 0xF9, 0xC1, 0xF8,
0x81, 0x38, 0x40,

0x28, 0x00, 0xE8, 0xC1, 0xE9, 0x81, 0x29, 0x40, 0xEB, 0x01, 0x2B, 0xC0, 0x2A,
0x80, 0xEA, 0x41,

0xEE, 0x01, 0x2E, 0xC0, 0x2F, 0x80, 0xEF, 0x41, 0x2D, 0x00, 0xED, 0xC1, 0xEC,
0x81, 0x2C, 0x40,

0xE4, 0x01, 0x24, 0xC0, 0x25, 0x80, 0xE5, 0x41, 0x27, 0x00, 0xE7, 0xC1, 0xE6,
0x81, 0x26, 0x40,

0x22, 0x00, 0xE2, 0xC1, 0xE3, 0x81, 0x23, 0x40, 0xE1, 0x01, 0x21, 0xC0, 0x20,
0x80, 0xE0, 0x41,

0xA0, 0x01, 0x60, 0xC0, 0x61, 0x80, 0xA1, 0x41, 0x63, 0x00, 0xA3, 0xC1, 0xA2,
0x81, 0x62, 0x40,

0x66, 0x00, 0xA6, 0xC1, 0xA7, 0x81, 0x67, 0x40, 0xA5, 0x01, 0x65, 0xC0, 0x64,
0x80, 0xA4, 0x41,

0x6C, 0x00, 0xAC, 0xC1, 0xAD, 0x81, 0x6D, 0x40, 0xAF, 0x01, 0x6F, 0xC0, 0x6E,
0x80, 0xAE, 0x41,

0xAA, 0x01, 0x6A, 0xC0, 0x6B, 0x80, 0xAB, 0x41, 0x69, 0x00, 0xA9, 0xC1, 0xA8,
0x81, 0x68, 0x40,

0x78, 0x00, 0xB8, 0xC1, 0xB9, 0x81, 0x79, 0x40, 0xBB, 0x01, 0x7B, 0xC0, 0x7A,
0x80, 0xBA, 0x41,
```

```
0xBE, 0x01, 0x7E, 0xC0, 0x7F, 0x80, 0xBF, 0x41, 0x7D, 0x00, 0xBD, 0xC1, 0xBC,
0x81, 0x7C, 0x40,

0xB4, 0x01, 0x74, 0xC0, 0x75, 0x80, 0xB5, 0x41, 0x77, 0x00, 0xB7, 0xC1, 0xB6,
0x81, 0x76, 0x40,

0x72, 0x00, 0xB2, 0xC1, 0xB3, 0x81, 0x73, 0x40, 0xB1, 0x01, 0x71, 0xC0, 0x70,
0x80, 0xB0, 0x41,

0x50, 0x00, 0x90, 0xC1, 0x91, 0x81, 0x51, 0x40, 0x93, 0x01, 0x53, 0xC0, 0x52,
0x80, 0x92, 0x41,

0x96, 0x01, 0x56, 0xC0, 0x57, 0x80, 0x97, 0x41, 0x55, 0x00, 0x95, 0xC1, 0x94,
0x81, 0x54, 0x40,

0x9C, 0x01, 0x5C, 0xC0, 0x5D, 0x80, 0x9D, 0x41, 0x5F, 0x00, 0x9F, 0xC1, 0x9E,
0x81, 0x5E, 0x40,

0x5A, 0x00, 0x9A, 0xC1, 0x9B, 0x81, 0x5B, 0x40, 0x99, 0x01, 0x59, 0xC0, 0x58,
0x80, 0x98, 0x41,

0x88, 0x01, 0x48, 0xC0, 0x49, 0x80, 0x89, 0x41, 0x4B, 0x00, 0x8B, 0xC1, 0x8A,
0x81, 0x4A, 0x40,

0x4E, 0x00, 0x8E, 0xC1, 0x8F, 0x81, 0x4F, 0x40, 0x8D, 0x01, 0x4D, 0xC0, 0x4C,
0x80, 0x8C, 0x41,

0x44, 0x00, 0x84, 0xC1, 0x85, 0x81, 0x45, 0x40, 0x87, 0x01, 0x47, 0xC0, 0x46,
0x80, 0x86, 0x41,

0x82, 0x01, 0x42, 0xC0, 0x43, 0x80, 0x83, 0x41, 0x41, 0x00, 0x81, 0xC1, 0x80,
0x81, 0x40, 0x40,
```

```
CRCHi = 0xff;

CRCLo = 0xff;

while(length)

{

TempHi = CRCHi;

TempLo = CRCLo;

CRCHi = table[2 * (*message ^ TempLo)];

CRCLo = TempHi ^ table[(2 * (*message ^ TempLo))
+ 1];

message++;

length--; };

CRC [0] = CRCLo;

CRC [1] = CRCHi;

return;

}
```

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