Modbus Communication Protocol Manual

BlueEye™ Ex-D Modbus Communication

The BlueEye™ Ex-D features Modbus communication, allowing the user to read measurement values, as well as configure the device according to individual preferences.

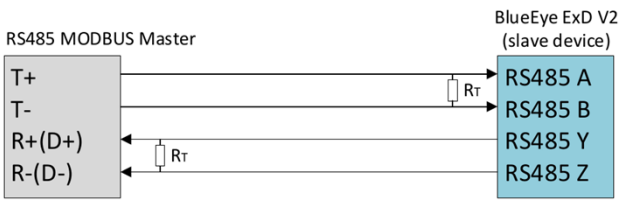
BlueEye™ Ex-D Modbus Communication – Wiring

Connect the BlueEye™ Ex-D to Modbus using either the full-duplex or the half-duplex configuration, as described in the wiring schematics below.
The device is configured for Modbus communication with 9600 baud rate.
Once connected, the device can be accessed via its default Modbus address: 0x12.

BlueEye™ Ex-D Wiring

Wire ID	Description	
1, Black	Power supply	+12 / +24 VDC
2, Black	Power supply	-12 / -24 VDC
3, Black	4-20 mA Current Loop	+
4, Black	4-20 mA Current Loop	-
5, Black	T+	RS485_A
6, Black	T-	RS485_B
7, Black	R+ (D+)	RS485_Y
8, Black	R- (D-)	RS485_Z
9, Yellow/Green	GND	Ground

BlueEye™ Ex-D Modbus Wiring Schematics



BlueEye™ Ex-D Modbus Communication – Holding register

The device can be configured by modifying the holding register.

Changes to the holding register will only take effect if the configuration passcode in register 40'050 is set to 27521. This passcode protection is used to avoid accidental modifications to the holding register, and it is recommended to keep an "incorrect" passcode in this register during normal operation.

The holding register is described in the table below.

BlueEye™ Ex-D Modbus Holding Register

Address (+40'000)	Type	Content	Options
0	Int16	Unit settings	1: Metric1, 2: Metric2, 3: Imperial1, 4: Imperial2 See Unit Options table below
1	Int16	Reference conditions	1: 0°C/0°C, 2: 15°C/0°C, 3: 25°C/0°C, 4: 15°C/15°C, 5: 20°C/20°C, 6: 25°C/20°C at 1013.25 mbara or 60°F at14.696 psi
2	Int16	Moving average on/off	0: Off, 1: On, 2: Hourly average*
3	Int16	Moving average: Number of points	Max. 10000
4	Int16	Moving average on/off (mA loop)	0: Off, 1: On, 2: Hourly average*
5	Int16	Moving average: Number of points (mA loop)	Max. 10000.
6	Int16	Analog Output	1: Wobbe Index, 2: HHV, 3: LHV
7	Int16	Minimum Analog Value	Override default value
8	Int16	Maximum Analog Value	Override default value
…			
10	Int16	Year	YYYY
11	Int16	Month	MM
12	Int16	Day	DD
13	Int16	Hour	hh
14	Int16	Minute	mm
15	Int16	Second	ss
16	Int16	Boosting	Write a '1' to initiate boosting (~5 minutes)
17	Int16	Self-test	0: Off, normal operation, 1: On, check reg. Status2
18	Int16	Composition range mode	0: Standard, 1: Custom1, 2: Custom2, 3: Custom3, 4: Custom4, 5: Custom5
…			
30	Int16	Current loop DAC min	Set DAC value corresponding to 4mA
31	Int16	Current loop DAC max	Set DAC value corresponding to 20mA
32	Int16	Override DAC output enable	0: Normal current loop operation, 1: Override DAC output of the current loop
33	Int16	DAC code	Set DAC output (0-4096)
…			
49	Int16	Modbus address (1-255)	Set Modbus address. Default is 0x12. Restart device for change to take effect.
50	Int16	Configuration passcode [27521]	Enter passcode for changes to take effect.
* Hourly average --> 1 data point per hour (ex: at 11h08 it shows average value for 10h00 to 11h00)			

Unit Options Table

Unit Options	Energy	Pressure	Density	Temperature
Metric1	MJ/m³	Pa	kg/m³	°C
Metric2	KWh/m³	Pa	kg/m³	°C
Imperial1	Btu(IT)/ft³	Psi	lb/scf	°F
Imperial2	therm(U.S)/ft³	Psi	lb/scf	°F

BlueEye™ Ex-D Modbus Communication – Input register

The measurement output can be read from the input register. The user has read-only access to the input register. The output is updated every second.

Float32 data in the input register span 2 registers, as each register is 16bits wide. Consequently, a Float32 value has to be calculated based on its two registers.

Here is an example of the procedure to calculate the WI (Float32) based on register 0 and 1:

a. Read input register addr. 0 (lower addr.) → return 0x7e5d
b. Read input register addr. 1 (upper addr.) → return 0x4248
c. Concatenate the two values: 0x42487e5d
d. When interpreting this 32bits value as a Float32 (IEEE754) = 50.1234

The input register is described in the below table.

BlueEye™ Ex-D Modbus Input Register

Address (+30'000)	Type	Content	Details
0	Float32	WI	Unit and moving average settings: See holding register
1			
2	Float32	HHV	Unit and moving average settings: See holding register
3			
4	Float32	LHV	Unit and moving average settings: See holding register
5			
6	Float32	Density	Unit settings: See holding register
7			
8	Float32	Relative density	Unit settings: See holding register
9			
10	Float32	Temperature	Unit settings: See holding register
11			
12	Float32	Absolute pressure	Unit settings: See holding register
13			
...			
20	Int16	Unit settings (1-4)	Unit settings: See holding register
21	Int16	Reference condition T1	°C, ex: '15'
22	Int16	Reference condition T2	°C, ex: '0'
23	Int16	Moving average on/off	0: Off, 1: On, 2: Hourly average

24	Int16	Moving average, number of points	
25	Int16	Moving average on/off (mA loop)	0: Off, 1: On, 2: Hourly average
26	Int16	Moving average, number of points (mA loop)	
…			
30	Float32	Compressibility	
31			
32	Float32	AFR	
33			
34	Float32	SAFR	
35			
36	Float32	MN	
37			
38	Int16	Viscosity sensor ID	
39	Int16	-	
40	Int16	Thermal Conductivity sensor ID1 (byte 0-1)	
41	Int16	Thermal Conductivity sensor ID2 (byte 2-3)	
42	Int16	Thermal Conductivity sensor ID3 (byte 4-5)	
43	Int16	Thermal Conductivity sensor ID4 (byte 6-7)	
44	Int16	Thermal Conductivity sensor ID5 (byte 8-9)	
45	Int16	Thermal Conductivity sensor ID6 (byte 10-11)	
46	Int16	Status 1	See "Status1 register " table
47	Int16	Status 2	See "Status2 register " table
48	Int16	Year	Current time of the system
49	Int16	Month	Current time of the system
50	Int16	Day	Current time of the system
51	Int16	Hour	Current time of the system
52	Int16	Minute	Current time of the system
53	Int16	Second	Current time of the system
…			
60	Float32	Analog Maximum value	Value currently effective
61			
62	Float32	Analog Minimum value	Value currently effective
63			
64	Int16	DAC min (correspond to the min of the current loop)	Value currently effective
65	Int16	DAC max (correspond to the max of the current loop)	Value currently effective
66	Int16	Analog output	Value currently effective

BlueEye™ Ex-D Modbus Communication – Status registers

The status registers provide the user with information concerning the overall device status. When the device is working correctly the registers should display nominal values.

See below tables for a detailed overview of the status registers.

BlueEye™ Ex-D Modbus Status1 Register

Address (30'046)	Description	Details*
bit 0	Wobbe Index	0 = nominal / 1 = faulty
bit 1	HHV	0 = nominal / 1 = faulty
bit 2	LHV	0 = nominal / 1 = faulty
bit 3	Density	0 = nominal / 1 = faulty
bit 4	Relative Density	0 = nominal / 1 = faulty
bit 5	Temperature	0 = nominal / 1 = faulty
bit 6	Absolute Pressure	0 = nominal / 1 = faulty
bit 7	Viscosity	0 = nominal / 1 = faulty
bit 8	Thermal Conductivity	0 = nominal / 1 = faulty
bit 9	Compressibility	0 = nominal / 1 = faulty
bit 10	AFR	0 = nominal / 1 = faulty
bit 11	SAFR	0 = nominal / 1 = faulty
bit 12	MN	0 = nominal / 1 = faulty
bit 13	Raw viscosity	0 = nominal / 1 = faulty
bit 14	Time & Date have been set ?	0 = nominal / 1 = faulty
bit 15	Boosting	0 = nominal / 1 = sensor is boosting
*All 0 → Normal operation		

BlueEye™ Ex-D Modbus Status2 Register

Address (30'047)	Description	Details*
bit 0	SD card detected and usable	0 = nominal / 1 = faulty
bit 1	SensorID & alpha table ID identical?	0 = nominal / 1 = faulty
bit 2	SHT sensor ID & alpha table have identical Ids?	0 = nominal / 1 = faulty
bit 3	TC sensor ID & TC alpha poly Ids identical?	0 = nominal / 1 = faulty
bit 4	Analog DAC code overridden	0 = nominal / 1 = faulty
bit 5	-	0 = nominal / 1 = faulty
bit 6	TC sensor	0 = nominal / 1 = faulty
bit 7	-	0 = nominal / 1 = faulty
bit 8	-	0 = nominal / 1 = faulty
bit 9	-	0 = nominal / 1 = faulty
bit 10	-	0 = nominal / 1 = faulty
bit 11	-	0 = nominal / 1 = faulty
bit 12	Self test TimeConstant	0 = nominal / 1 = faulty
bit 13	Self test Viscosity	0 = nominal / 1 = faulty
bit 14	Self test Thermal Conductivity	0 = nominal / 1 = faulty
bit 15	Self test GasQuality	0 = nominal / 1 = faulty
*All 0 (except four last flags) → Normal operation		