

Modbus Communication Protocol MANUAL



BlueEye™ Ex-D Modbus Communication

The BlueEye™ Ex-D features RS485 Modbus communication, allowing the user to read measurement values, and configure the device according to individual preferences.

BlueEye™ Ex-D Modbus Communication - RS485 settings

Serial type	RS485
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

BlueEye™ Ex-D Modbus Communication – Wiring

Connect to the BlueEye™ Ex-D using either the full-duplex or the half-duplex RS485 Modbus configuration, as described in the wiring schematics below.

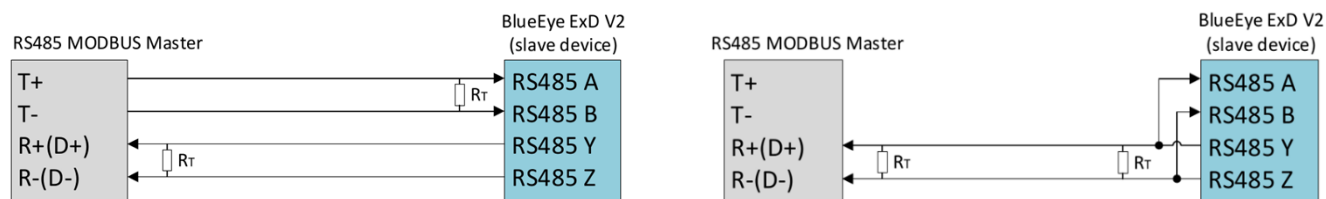
Once connected, the device can be accessed via its default Modbus address:

18 (0x12 in hexadecimal format).

BlueEye™ Ex-D Wiring

Wire ID	Description	
1, Black	Power supply	+24 VDC
2, Black	Power supply	-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 set this register value to zero during normal operation.

The holding register is described in the table below.

BlueEye™ Ex-D Modbus Holding Register

Address (+40'001)	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. 7: 60°F at 14.696 psia, 8: 60°F at 14.65 psia, 9: 60°F at 14.73 psia, 10: 60°F at 15.025 psia.
2	Int16	Modbus moving average on/off	0: Off, 1: On, 2: Hourly average*
3	Int16	Modbus moving average count	Max. 10000
4	Int16	4-20 mA moving average	0: Off, 1: On, 2: Hourly average*
5	Int16	4-20 mA moving average count	Max. 10000.
...			
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	Correlative model	0: Standard, 6: Hydrogen
...			
30	Int16	Current loop DAC min	DAC value corresponding to 4mA
31	Int16	Current loop DAC max	DAC value corresponding to 20mA
32	Int16	Override DAC output	0: Normal current loop operation, 1: Override DAC output of the current loop
33	Int16	DAC value	DAC output (0-4096)
34	Int16	4-20 mA output parameter	1: Wl _s , 2: H _s , 3: H _i , 4: Rho, 5: Rho rel., 6: Z, 7: AFR, 8: s-AFR, 9: MN, 10: Wl _i , 11: CO ₂ , 12: H ₂ , 13: Temperature,

			14: Absolute pressure
35	Float32	4 mA equivalent	Override default value
36			
37	Float32	20 mA equivalent	Override default value
38			
...			
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)/scf	Psi	lb/scf	°F
Imperial2	therm(U.S)/scf	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 must be calculated based on its two registers.

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

- Read input register addr. 0 (lower addr.) → return 0x7e5d
- Read input register addr. 1 (upper addr.) → return 0x4248
- Concatenate the two values: 0x42487e5d
- 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 (+30'001)	Type	Content	Details
0	Float32	W _s	Unit and moving average settings: See holding register
1			
2	Float32	H _s	Unit and moving average settings: See holding register
3			
4	Float32	H _i	Unit and moving average settings: See holding register
5			
6	Float32	Rho	Unit settings: See holding register
7			
8	Float32	Rho relative	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			
14	Float32	CO ₂ content	% mol
15			
16	Float32	H ₂ content	% mol
17			
18	Float32	W _i	Unit and moving average settings: See holding register
19			
20	Int16	Unit settings (1-4)	Unit settings: See holding register
21	Float32	Reference condition t ₁	°C / °F, example: '15' or '60'
22			
23	Float32	Reference condition t ₂	°C / psia, example: '0' or '14.696'
24			
25	Int16	Modbus moving average	0: Off, 1: On, 2: Hourly average
26	Int16	Modbus moving average count	Moving average over n measurements
27	Int16	4-20 mA moving average	0: Off, 1: On, 2: Hourly average
28	Int16	4-20 mA moving average count	Moving average over n measurements
...			
30	Float32	Z	
31			
32	Float32	AFR	
33			
34	Float32	s-AFR	
35			
36	Float32	MN	
37			
38	Int16	Viscosity sensor ID	
...			
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	Status1	See "Status1 register" table
47	Int16	Status2	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	20 mA equivalent	Currently used value

61			
62	Float32	4 mA equivalent	Currently used value
63			
64	Int16	4 mA calibration counter	Currently used value
65	Int16	20 mA calibration counter	Currently used value
66	Int16	4-20 mA output parameter	1: W _l s, 2: H _s , 3: H _i , 4: Rho, 5: Rho rel., 6: Z, 7: AFR, 8: s-AFR, 9: MN, 10: W _l i, 11: CO ₂ , 12: H ₂ , 13: Temperature, 14: Absolute pressure
67	Int16	Correlative model	0: Standard, 6: Hydrogen
68	Int16	Firmware version	Example: 107 -> Version 1.0.7

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 (30'047)	Description	Details*
bit 0	W _l s and W _l i	0 = nominal / 1 = faulty
bit 1	H _s	0 = nominal / 1 = faulty
bit 2	H _i	0 = nominal / 1 = faulty
bit 3	Rho	0 = nominal / 1 = faulty
bit 4	Rho relative	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	Z	0 = nominal / 1 = faulty
bit 10	AFR	0 = nominal / 1 = faulty
bit 11	s-AFR	0 = nominal / 1 = faulty
bit 12	MN	0 = nominal / 1 = faulty
bit 13	Raw viscosity	0 = nominal / 1 = faulty
bit 14	Time and 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 (30'048)	Description	Details*
bit 0	SD card detected and functional	0 = nominal / 1 = faulty
bit 1	Viscosity sensor ID & alpha table ID match	0 = nominal / 1 = faulty
bit 2	SHT serial ID & alpha table serial ID match	0 = nominal / 1 = faulty
bit 3	TCD sensor ID & TC alpha poly ID match	0 = nominal / 1 = faulty
bit 4	4-20 mA calibration overridden	0 = nominal / 1 = faulty
bit 5	-	0 = nominal / 1 = faulty
bit 6	TC sensor	0 = nominal / 1 = faulty

bit 7	CO ₂ sensor	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		