MODBUS MANUAL
For the
CLX
Online Chlorine Analyzer

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1.0 Overview

The HF Scientific CLX uses a communication protocol called Modbus. A company called Modicon, for use with their programmable controllers, developed the Modbus protocol. Since that time Modbus has evolved into common communication protocol in industry.

The communication method involves using a master-slave technique, in which there is one master and several slaves. The CLX is a slave device. Only the master can initiate queries. These queries are directed to an individual slave device and the appropriate slave responds with the requested data.

A broadcast message can be sent to all slaves. The slave devices do not answer these broadcasts.

There are two transmission modes. These modes are known as RTU (Remote Terminal Unit) and ASCII (American Standard Code for Information Interchange).

The CLX can be setup in a network of up to 255 slave devices. Each device must have a different address (1-255). The CLX can be set for either RTU or ASCII mode.

2.0 Electrical Connections

All of the electrical connections to the instrument are made at the termination area, which is located on the portion of the instrument. The connections are labeled and are self-descriptive (see Figure 1). Please follow all local and government recommendations and methods for installation of electrical connections to and between the instrument and other peripheral devices.

Plugs are inserted into cable bulkheads when shipped, to ensure a watertight seal. These plugs should be removed and discarded as required when cabling to this connection.

The bulkhead will accept cable diameters from 5.8mm (.230 in.) up to 10 mm (.395 in.). The terminals are designed to accept wires in the range of 14-28 AWG. All wires should be stripped to a length of 6 mm

It is the user's responsibility to assure that the watertight seal is maintained after the terminal box has been wired for operation. If any of the bulkheads are not tightened properly around a cable or plug, the ratings of the instrument will be jeopardized and there is a possibility of creating a shock hazard.

Note: Only qualified electricians should be allowed to perform the installation of the instrument as it involves a line voltage that could endanger life.

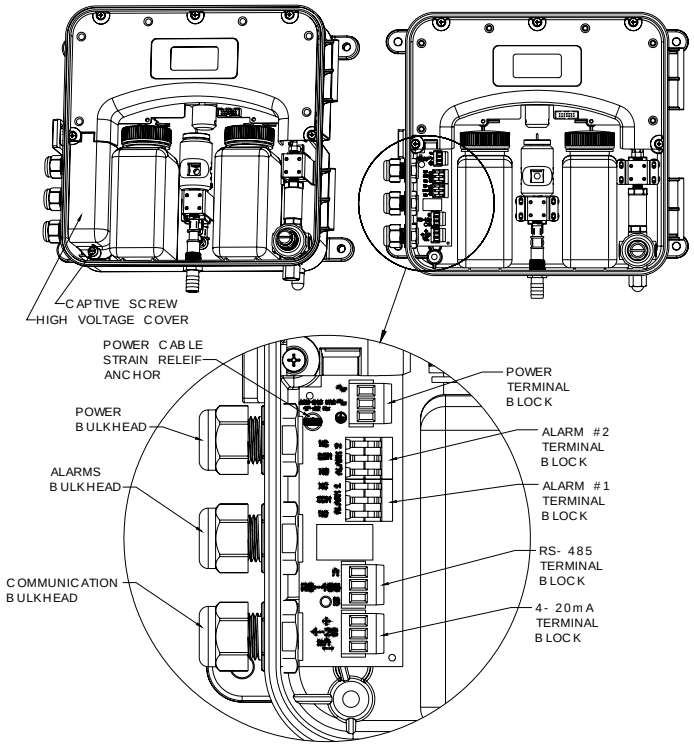


Figure 1: Electrical Connections for the Instrument

2.1 RS-485 Connection

The RS-485 half-duplex (2-wire) digital interface operates with differential levels that are not susceptible to electrical interferences. This is why cable lengths up to 3000 ft can be implemented. The last device on every bus may require a 120-ohm termination resistor to eliminate the possibilities of signal reflection on the line. Do not run RS-485 cables in the same conduit as power.

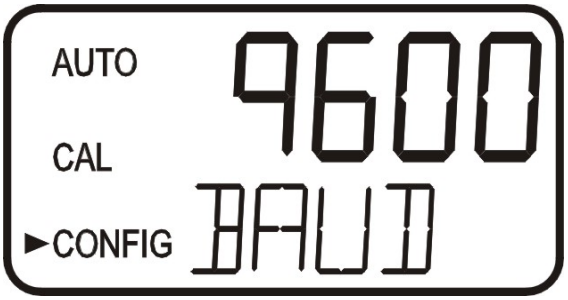
Ensure each instrument is not powered when connecting the RS-485 line. To prevent damage to the instrument, ensure that power is disconnected prior to making connections.

3.0 Operation

3.1 Configuring the RS–485 Port

The CLX is equipped with an RS-485 port which operates in one of three ways (see the operator's manual for more information).

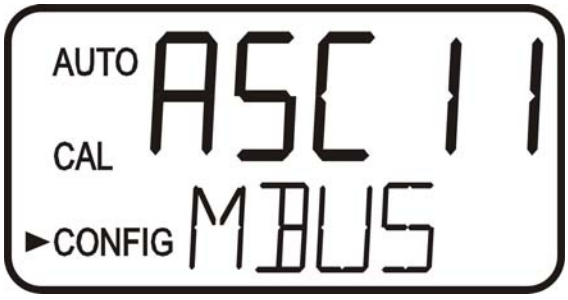
Select the correct baud rate (1200, 2400, 4800, 9600, or 19200) for operation of the I/O port by pressing the ▲ or ▼ buttons to change the displayed baud rate.

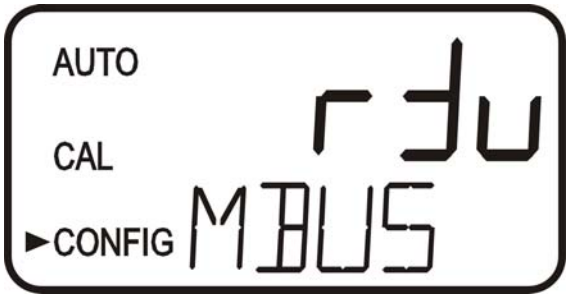


Press the ↵ button to continue on and select the desired instrument address (1-255) using the ▲ or ▼ buttons. Once the selection is satisfactory, press the ↵ button.



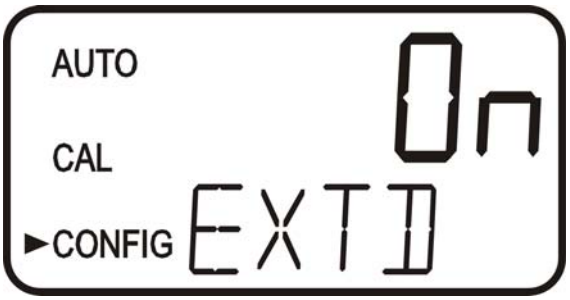
Select the operating mode either ASCII or RTU using the ▲ or ▼ buttons. Press the **MODE** key to complete the Modbus setup.



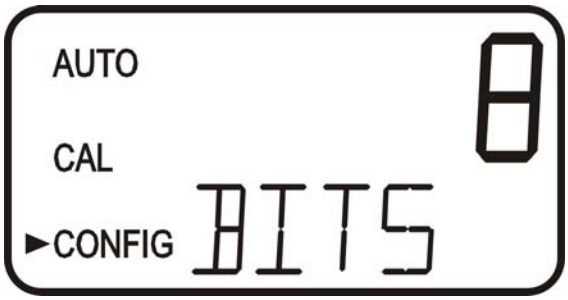


3.1 Configuring the RS–485 Port (continued)
For Modbus some applications, especially involving the ASCII operation mode, it may be necessary to set a different protocol than the default setting (8 bits, 1 stop bit, no parity). Menus are available for this in the Extended Settings portion of the configuration **CONFIG** mode**.**

While in the **CONFIG** mode, press the ↵ button, several times until the Extended Settings is as shown below. Select **On** using the ▲ or ▼ buttons.



Press the ↵ button a few times until the menus appear for **BITS, PRTY** (Parity) and **STOP** (Stop Bits). Set each one to the desired setting using the ▲ and ▼ buttons.







4.0 The Modbus RS-485 Output & Commands Implemented

The default communication parameters are 8 bits, no parity and 1 stop bit. Please note that all Modbus communication is via RS-485. The instruments can support a two wire multidrop network of 255 units. If the connection is to the master on USB, an RS-485 to USB converter is required.

4.1 Coils

These single-bit values are readable and changeable from the master. The data will be returned with the lowest addressed coil in the LSB of the data. Unused bits in the data will be set to 0. True is a 1 and False is 0.

4.1.1 Valid Command(s)

Code	Name	Broadcast
0x01	Read Coil Status	No
0X05	Force Single Coil	Yes

4.1.2 Format

16-bit word format

MSB															LSB
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

4.1.3 Valid Addresses

00001 – 00XXX

4.1.4 Definitions

Address	Function	Default
00001	Access code enabled	False
00002	RS-485 enabled	True
00003	4-20 mA enabled	False

4.2 Input Status

These single-bit values are readable from the master. The data will be returned with the lowest addressed input status in the LSB of the data. Unused bits in the data will be set to 0.

4.2.1 Valid Command(s)

Code	Name	Broadcast
0x02	Read Input Status	No

4.2.2 Format

16-bit word format

MSB															LSB
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

4.2.3.Valid Addresses

10001 – 10XXX

4.2.4 Definitions

Address	Function	Default
10001	Instrument error	False
10002	Instrument error with alarm (levels 1,2and 3)	False
10003	Alarm 1 active	False
10004	Alarm 2 active	False

4.3 Holding Registers

These 16-bit values are readable and changeable from the master. The data is stored and transmitted with the MSB first and then the LSB.

4.3.1 Valid Command(s)

Code	Name	Broadcast
0x03	Read Holding Registers	No
0x06	Preset Single Register	Yes
0X16	Preset Multiple Registers	Yes

4.3.2 Format

Float – stored in two consecutive addresses, with the first address containing the least significant word (lower part of mantissa) and the second address containing the most significant word (sign, exponent, and upper part of mantissa).

4.3.3 Valid Addresses

40001 – 40XXX

4.3.4 Definitions

Address	Type	Register	Min	Default	Max	Function
40001	Int	Decimal places	0	2	3	0 – XXXXX 1 – XXXX.X 2 – XXX.XX 3 – XX.XXX
40002	Int	Units (scaling)	0	0	1	0 – PPM 1 – MG/L
40003	Int	Response speed	1	10	60	Time constant (minutes)
40004	Int	LCD backlight	1	8	10	Higher is brighter
40005, 40006	Float	4-20 mA minimum value	0.0	0.00	10.0	Scaling value
40007, 40008	Float	4-20 mA maximum value	0.0	6.00	10.0	Scaling value
40009	Int	4-20 mA error alarm output	0	2	3	0 – Off 1 – 0 mA 2 – 2 mA 3 – 4 mA
40010	Int	RS-485 baud	0	3	4	0 – 1,200 1 – 2,400 2 – 4,800 3 – 9,600 4 – 19,200
40011	Int	RS-485 data bits	0	1	1	0 – 7 bits 1 – 8 bits
40012	Int	RS-485 parity	0	0	2	0 – None 1 – Even 2 -- Odd

Address	Type	Register	Min	Default	Max	Function
40013	Int	RS-485 stop bits	0	0	1	0 – One 1 -- Two
40014	Int	Instrument address	1	1	255	
40015	Int	Modbus serial mode	0	0	1	0 – RTU 1 – ASCII
40016	Int	Alarm 1 type	0	0	2	0 – Off 1 – Low alarm 2 – High alarm 3 – Error alarm
40017, 40018	Float	Alarm 1 set point	0.0	1.0	10.0	
40019	Int	Alarm 2 type	0	0	2	0 – Off 1 – Low alarm 2 – High alarm 3 – Error alarm
40020, 40021	Float	Alarm 2 set point	0.0	1.0	10.0	
40022, 40023						Unused
40024	Int	Measurement period	90	150	600	Seconds between measurements
40025	Int	Response speed	0	10	30	Response time constant, in minutes
40026						Unused

4.4 Input Registers

These 16-bit values are readable by the master. The data is stored with the MSB first and then the LSB.

4.4.1 Valid Command(s)

Code	Name	Broadcast
0x04	Read Input Registers	No

4.4.2 Format

Float – stored in two consecutive addresses, with the first address containing the least significant word (lower part of mantissa) and the second address containing the most significant word (sign, exponent, and upper part of mantissa).

4.4.3 Valid Addresses

30001 – 30XXX

4.4.4 Definitions

Address	Type	Register	Value	Function
30001, 30002	Float	Sensor reading	--	The meter reading
30003, 30004	Float	Sensor reading raw	--	Sensor reading to six significant places
30005	Int	Version major	--	Software version major number
30006	Int	Version minor	--	Software version minor number
30007	Int	Version revision	--	Software version revision number
30008	Int	Model number	--	Product number
30009	Int	Model suffix number	--	Options – model dependent
30010	Int	Reading status	0	unknown
			1	normal
			2	Over range
			3	Under range
			4	need standard
			5	need sample
			6	reading problem (*Err*)
30011	Int	Days since last prime	--	No.of days since the last prime was performed
30012	Int	PCB Revision	0	Revision 1
			1	Revision 2
30013	Int	Instrument error summary (bit-mapped)	0x0000	normal
			0x0001	Error
			0x0002	Alarm 1 is active
			0x0004	Alarm 2 is active
			0x0008	Calibration error
30014, 30015	Long	Level 4 Errors (bit-mapped), least severe	0x00000	Normal
			0x00001	Alarm 1 active (*ALM1*)
			0x00002	Alarm 2 active (*ALM2*)
			0x00004	Data over-range (*OVER*)
			0x00008	Reading error (*Err*)

30016, 30017	Long	Level 3 Errors (bit-mapped)	0x00000	Normal
			0x00001	Break in the 4-20 mA current loop (*MA*)
			0x00002	Calibration error (*ZCAL*)
			0x00004	No intake water (*WATR*)
			0x00008	Intake water fill fast (*FAST)*
			0x00010	Intake water fill slow (S*LOW*)
			0x00020	Purge is slow (*PURG*)
			0x00040	Purge clogged (*NPRG*)
			0x00080	Cannot determine intake water level (*H2O*)
			0x00100	Intake solenoid stuck open (*ISOL*)
			0x00200	Purge solenoid stuck closed (*PSOL*)
			0x00400	Problem with reagent (*RGNT*)
			0x00800	Sample chamber glass too dark (*GLAS*)
			0x01000	Water calibration invalid (*WCAL*)
			0x02000	Reagent is old and needs to be replaced (*REPL*)
			0x04000	Adjust calibration error *(ACAL)*
30018, 30019	Long	Level 2 Errors (bit-mapped)	0x00000	Normal
			0x00001	POST error (*POST*)
			0x00002	Visible lamp blown (*GRN0*)
			0x00004	Visible lamp stuck on (*GRN1*)
			0x00008	Visible lamp optimization problem (*GRN2*)
			0x00010	IR lamp blown (*WTR0*)
			0x00020	IR lamp stuck on (*WTR1*)
			0x00040	IR lamp optimization problem (*WTR2*)
			0x00080	Solenoid power supply (*SOL0*)
			0x00100	Intake solenoid (*SOL1*)
			0x00200	Purge solenoid (*SOL2*)
			0x00400	Reagent solenoid (*SOL3*)
30020, 30021	Long	Level 1 Errors (bit-mapped), most severe	0x00000	Normal
			0x00001	MSP oscillator
			0x00002	MSP A/D
			0x00004	MSP flash data read
			0x00008	MSP flash data write
			0x00010	A/D problem
			0x00020	S/W MiCOS queue overflow
			0x00040	S/W stack overflow
			0x00080	S/W invalid PWM port
			0x00100	S/W options missing
			0x00200	S/W sensor type option

Note: Error messages shown in Prentiss and in (*Italics)*

4.5 Exception Responses Implemented

Code	Name	Meaning
00	--	No error
01	ILLEGAL FUNCTION	The function code is not allowed in the device.
02	ILLEGAL DATA ADDRESS	The data address is not allowed in the device
03	ILLEGAL DATA VALUE	A value contained in the query field is wrong for the device

5.0 Warranty

HF scientific, inc., as vendor, warrants to the original purchaser of this instrument that it will be free of defects in material and workmanship, in normal use and service, for a period of one year from date of delivery to the original purchaser. HF scientific, inc.'s, obligation under this warranty is limited to replacing, at its factory, the instrument or any part thereof. Parts, which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically reagent, desiccant, sensors, electrodes and fuses are excluded. Also excluded are accessories and supply type items.

Original purchaser is responsible for return of the instruments, or parts thereof, to HF scientific, inc.'s factory. This includes all freight charges incurred in shipping to and from HF scientific, inc.'s factory.

HF scientific, inc. is not responsible for damage to the instrument, or parts thereof, resulting from misuse, environmental corrosion, negligence or accident, or defects resulting from repairs, alterations or installation made by any person or company not authorized by HF scientific, inc.

HF scientific, inc. assumes no liability for consequential damage of any kind, and the original purchaser, by placement of any order for the instrument, or parts thereof, shall be deemed liable for any and all damages incurred by the use or misuse of the instruments, or parts thereof, by the purchaser, its employees, or others, following receipt thereof.

Carefully inspect this product for shipping damage, if damaged, immediately notify the shipping company and arrange an on-site inspection. HF scientific, inc. cannot be responsible for damage in shipment and cannot assist with claims without an on-site inspection of the damage.

This warranty is given expressly and in lieu of all other warranties, expressed or implied. Purchaser agrees that there is no warranty on merchantability and that there are no other warranties, expressed or implied. No agent is authorized to assume for HF scientific, inc. any liability except as set forth above.

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