STENNER PUMPS®

PERISTALTIC METERING PUMPS SINCE 1957

MODBUS RTU

COMMUNICATION PROTOCOL MANUAL

MODBUS RTU over RS-485 is compatible with Stenner S Series pumps. The model must have item number prefix S30, S40 or S50 and firmware version 3.02.02 or higher.

⚠WARNING

TO BE INSTALLED AND MAINTAINED BY PROPERLY TRAINED PROFESSIONAL INSTALLER ONLY. READ MANUAL & LABELS FOR ALL SAFETY INFORMATION & INSTRUCTIONS.

TABLE OF CONTENTS

POLICIES..... 3

SAFETY INSTRUCTIONS..... COVER, 4-6, 9, 12-13

ACCESSORIES..... 5

GENERAL INFORMATION 5

CONNECTION DIAGRAMS 6

SETUP..... 7-13

PROTOCAL CHART 14-15

PROTOCAL DIAGRAM 16-17

TROUBLESHOOTING..... 18

IMMB 120922

POLICIES

RETURNS

Stenner offers a 30-day return policy on factory direct purchases. Except as otherwise provided, no merchandise will be accepted for return after 30 days from purchase. To return merchandise at any time, call Stenner at 800.683.2378 for a Return Merchandise Authorization (RMA) number. A 15% re-stocking fee will be applied. Include a copy of your invoice or packing slip with your return.

DAMAGED OR LOST SHIPMENTS

Check your order immediately upon arrival. All damage must be noted on the delivery receipt. Call Stenner Customer Service at 800.683.2378 for all shortages and damages within seven (7) days of receipt.

DISCLAIMERS

The information in this manual is not intended for specific purposes.

The Stenner Pump Company reserves the right to make changes to prices, products, and specifications at any time without prior notice.

The Modbus communication protocol is a product of the Modbus Organization, www.modbus.org.

SAFETY INSTRUCTIONS

IMPORTANT SAFETY INSTRUCTIONS

When installing and using this electrical equipment, basic safety precautions should always be followed, including the following:

READ AND FOLLOW ALL INSTRUCTIONS

⚠ **⚠ WARNING Warns about hazards that CAN cause death, serious personal injury, or property damage if ignored.**

⚠ **⚠ WARNING ELECTRIC SHOCK HAZARD**

⚠ **⚠ WARNING RISK OF ELECTRIC SHOCK**

Connect only to a branch circuit protected by a ground-fault circuit-interrupter (GFCI). Contact a qualified electrician if you cannot verify that the receptacle is protected by a GFCI.

⚠ **⚠ AVERTISSEMENT RISQUE DE CHOC ELECTRIQUE**

Brancher seulement à un réseau électrique protégé par un DDFT. Contactez un électricien certifié si vous ne pouvez pas vérifier que la prise est protégé par un DDFT.

⚠ **⚠PELIGRO PELIGRO DE DESCARGA ELECTRICA**

Conecte a un circuito en derivación protegido por un interruptor de descarga a tierra (GFCI). Contacte a un electricista certificado si no puede verificar que su receptáculo esté protegido por dicho interruptor (GFCI).

GENERAL INFORMATION

MODBUS RTU over RS-485 is compatible with the Stenner S Series pump.

1. Pump model item number prefix must be S30, S40 or S50.
2. Pump model firmware version must be 3.02.02 or higher. To confirm, go to the Main Menu, select Configuration, then select Firmware Version to view the version code.
3. Pump mode of operation must be configured for Manual, 4-20mA, 0-10VDC or Pulse.

S Series Pump Modbus Capabilities

- Remote switching between modes of operation
- Setting the speed in Manual mode
- Starting or stopping the pump
- Reading the status of the pump

S Series Pump Modbus Specifications

- Programmable server addresses from 1 to 247
- Baud rates of 9600 or 19200 bps
- Data parities of 8 Even 1, 8 Odd 1, 8 None 1, and 8 None 2

Stenner Accessories Required for Modbus Setup (part #MOD100)

1 Stenner Modbus RTU manual

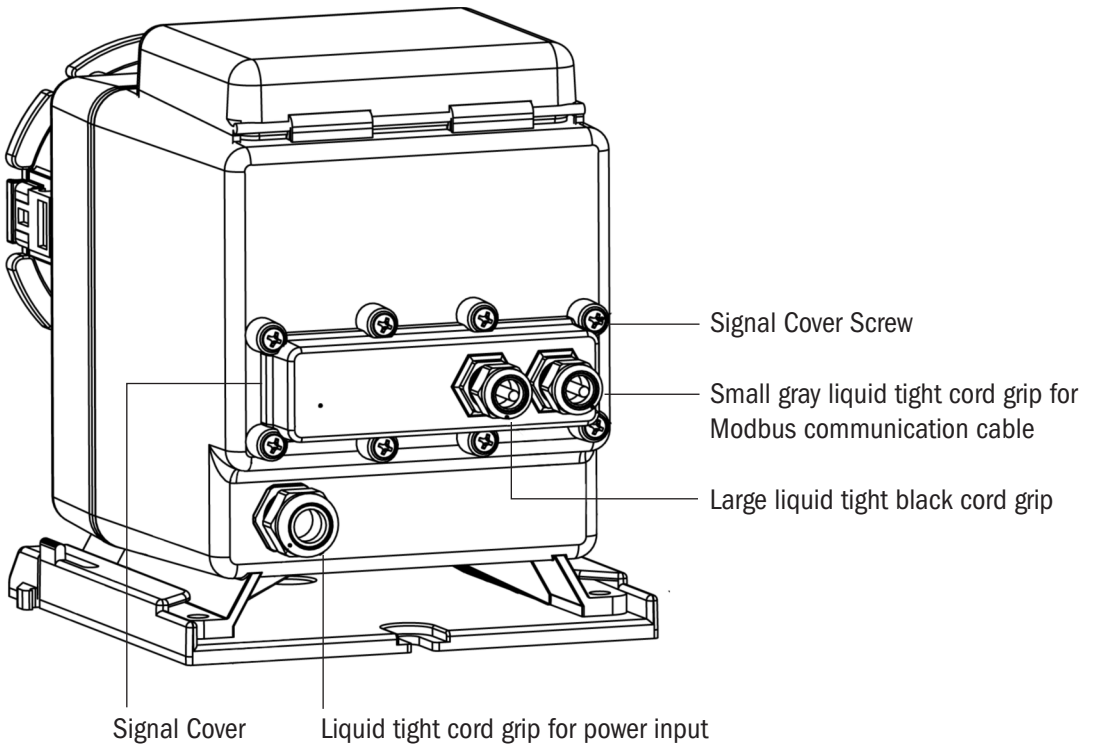
1 Modbus RS-485 communication cable

1 Three terminal junction, liquid tight

⚠ **⚠ CAUTION** Modbus communication cable entering pump must be UL, cUL AWM Style 2464 approved, shielded, with two 22 AWG conductors. Jacket diameter for small liquid tight must be 0.157" to 0.210".

CONNECTIONS DIAGRAM

S Series Pump Rear View

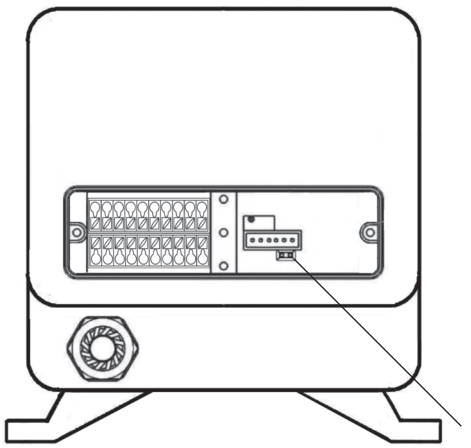


⚠ **CAUTION** Modbus communication cable entering pump must be UL, cUL AWM Style 2464 approved, shielded, with two 22 AWG conductors. Jacket diameter for small liquid tight must be 0.157" to 0.210".

⚠ **CAUTION** To reduce risk of electric shock, unplug the pump before service.

SETUP

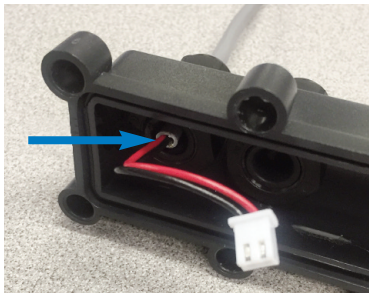
1. CONNECT MODBUS COMMINICATION CABLE page 1 of 3



The communication header pins are located at the rear of the pump.

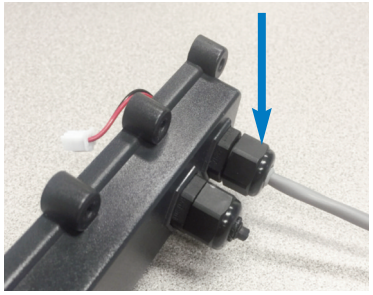
To access the pins, remove Philips head screws on the signal cover.

Communication Header Pins



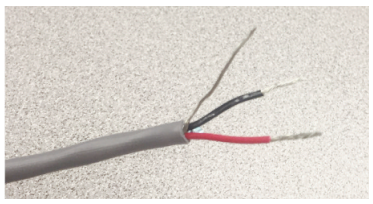
On the small gray cord grip, loosen the outer nut and remove the rubber plug.

From the inside of the signal cover, insert the stripped end of the Modbus cable through the small cord grip.



The cable outer jacket must be clearly visible from inside the signal cover.

Fully tighten the cord grip nut with the cord grip body.



On the bare end of the cable, remove 3/4" of the outer jacket and foil shielding.

Strip the wires back approximately 3/8".

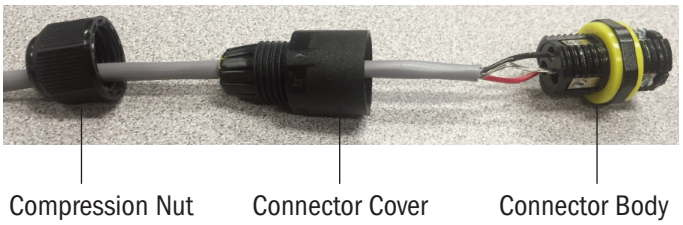
1. CONNECT MODBUS COMMINICATION CABLE page 2 of 3

Disassemble the liquid tight three terminal junction.

Slide a compression nut and a connector cover onto the communication cable.

Install and secure the wires into the three terminals on one side of the connector body. Loosen the screws, twist and insert the wires, then tighten the screws.

Repeat steps for the other side of the connector.



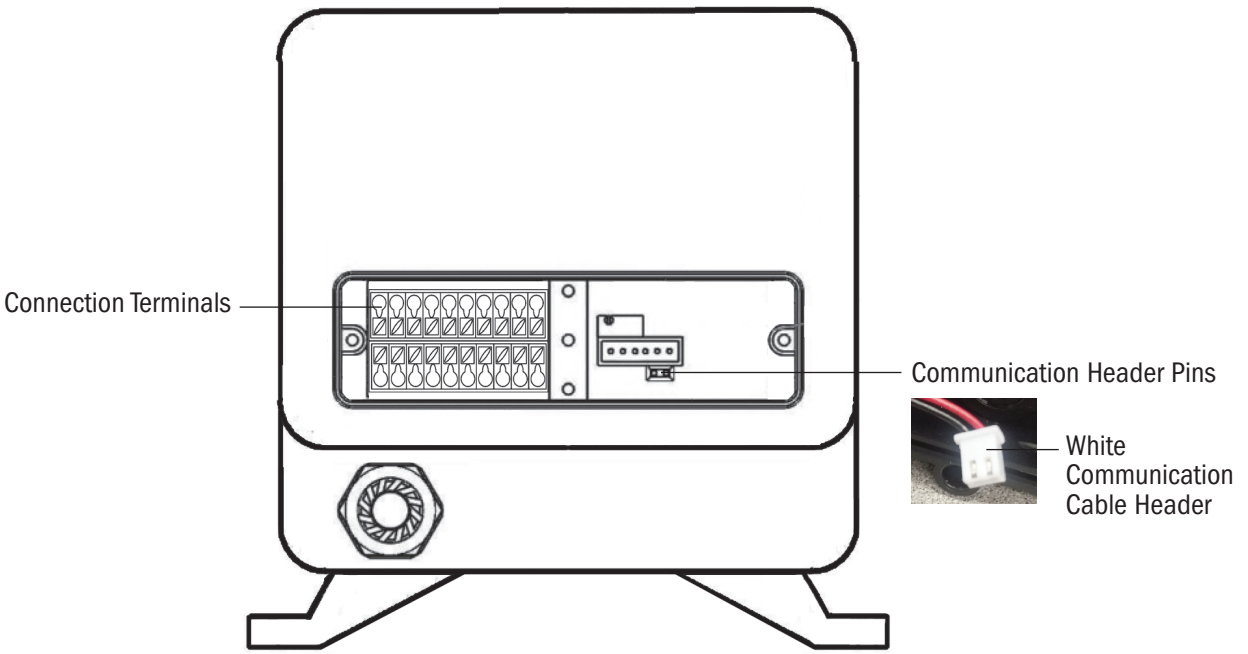
Black wire RS-485 T/R -
Red wire RS-485 T/R +

Finger tighten the connector covers onto the connector body.

Tighten the compression nuts onto the connector covers. Tighten the compression nuts until they are flush with the connector body.

1. CONNECT MODBUS COMMUNICATION CABLE page 3 of 3

Remove the black header covering the two pins. Plug the white header on the end of the communication cable, into the two pins, with the red wire positioned closest to the connection terminals. Refer to figures below.



Replace the signal cover, ensure the wires are not pinched between the signal cover and the pump body.

Replace the signal cover screws, use care to find existing threads and tighten until the signal cover is evenly and fully tightened and is flush with the housing.

⚠ **⚠ WARNING** Failure to properly tighten or secure the cord grip or signal cover may allow water to enter the pump enclosure, which can cause pump failure, property damage, or personal injury.

2. CONFIGURE THE PUMP PARAMETERS

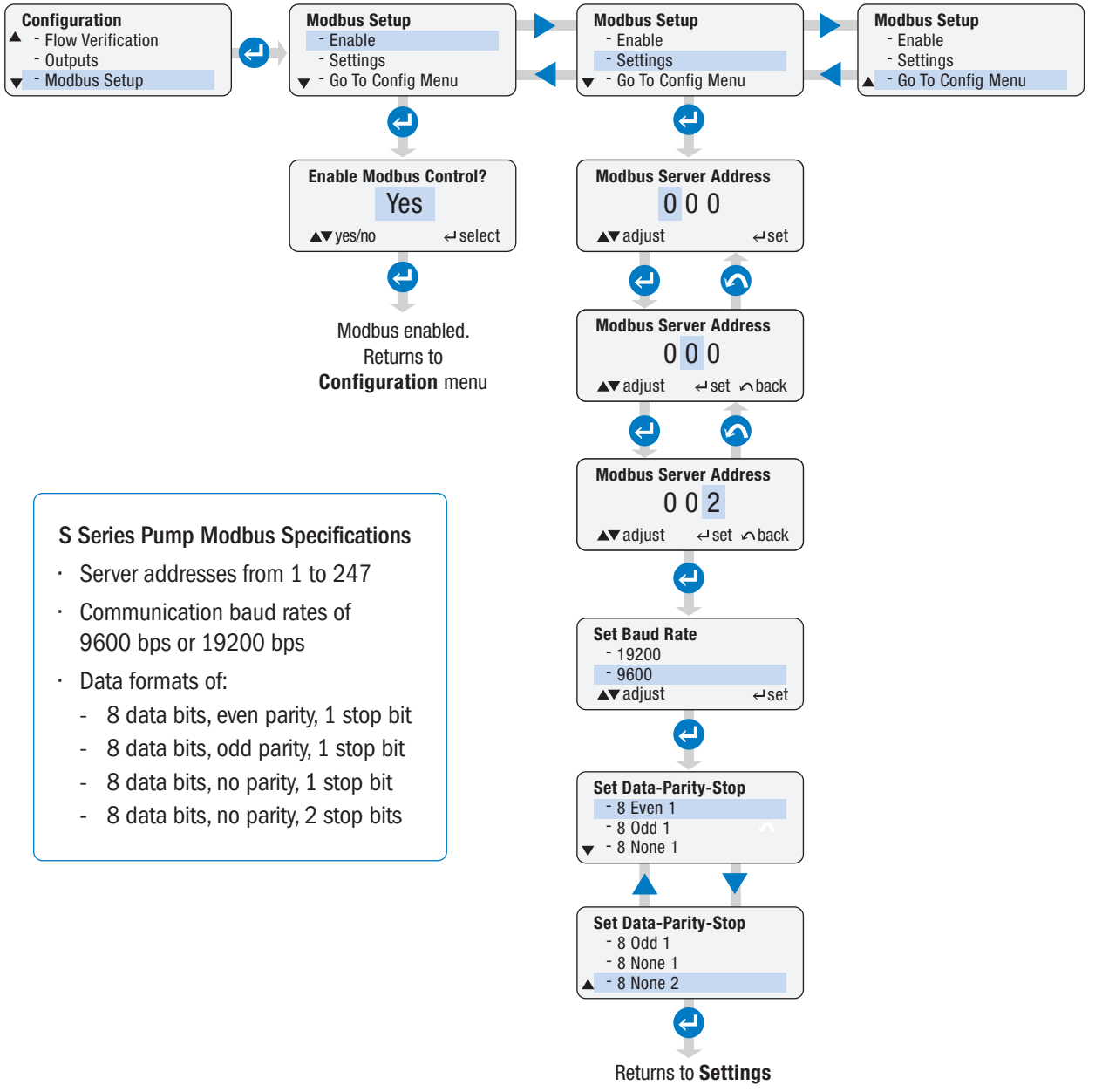
The S Series pump parameters should be configured at the initial setup.

Display Brightness	Reset Totalizer
Units	Leak Detect
Clock	Outputs
Calibration	Modbus Setup
Password	Firmware Version
Tube Timer	Reset Pump

The Modbus parameters are also configured from the Configuration menu illustrated on the next page.

3. CONFIGURE THE MODBUS PARAMETERS

From the Main Menu, select Configuration and Modbus Setup. Follow the menu to enable Modbus and set the server address, baud rate, and data formats. Modbus is also disabled from the Modbus Setup menu.



S Series Pump Modbus Specifications

- Server addresses from 1 to 247
- Communication baud rates of 9600 bps or 19200 bps
- Data formats of:
  - 8 data bits, even parity, 1 stop bit
  - 8 data bits, odd parity, 1 stop bit
  - 8 data bits, no parity, 1 stop bit
  - 8 data bits, no parity, 2 stop bits

NAVIGATION

▲ Moves up in a menu, toggles between options, or increase a value

▼ Moves down in a menu, toggles between options, or decreases a value

↶ Moves one step back in a menu, when permitted

↵ Sets a value in a menu

Holding the ▲ or ▼ button causes the numbers to change rapidly.

4. SET PUMP MODE OF OPERATION

From Main menu, go to Control Mode to configure pump's appropriate mode of operation.

5. PLACE PUMP UNDER REMOTE OR LOCAL CONTROL illustrated on the next page

Run the pump under Remote Control for Manual, 4-20mA, 0-10VDC or Pulse mode.

Run the pump under Local Control for the Manual mode only.

RUN REMOTE Place Pump Under Remote Control

1. From Main menu, select Configuration, select Modbus Setup and enable Modbus.
2. From Main menu, select Control Mode, set Manual, 4-20mA, 0-10VDC or Pulse mode.
3. From Main menu, select Run Pump, set Yes for Remote, press Enter.

The pump is now under Remote Control and will only run when instructed via Modbus. The screen will display "rmt Stop".

RUN LOCAL Place Pump Under Local Control

1. From Main menu, select Configuration, select Modbus Setup and enable.
2. From Main menu, select Control Mode and set Manual.
3. From Main menu, select Run Pump, set Yes for Local and press Enter.

The pump is now under Local Control and will run in manual mode. A remote operator or system can monitor pump status via Modbus.

- If the pump was taken out of remote
- If the pump is running or has stopped
- If the pump is in an alarm condition or faults
- The speed the pump is running

Remove Pump From Remote Modbus Control

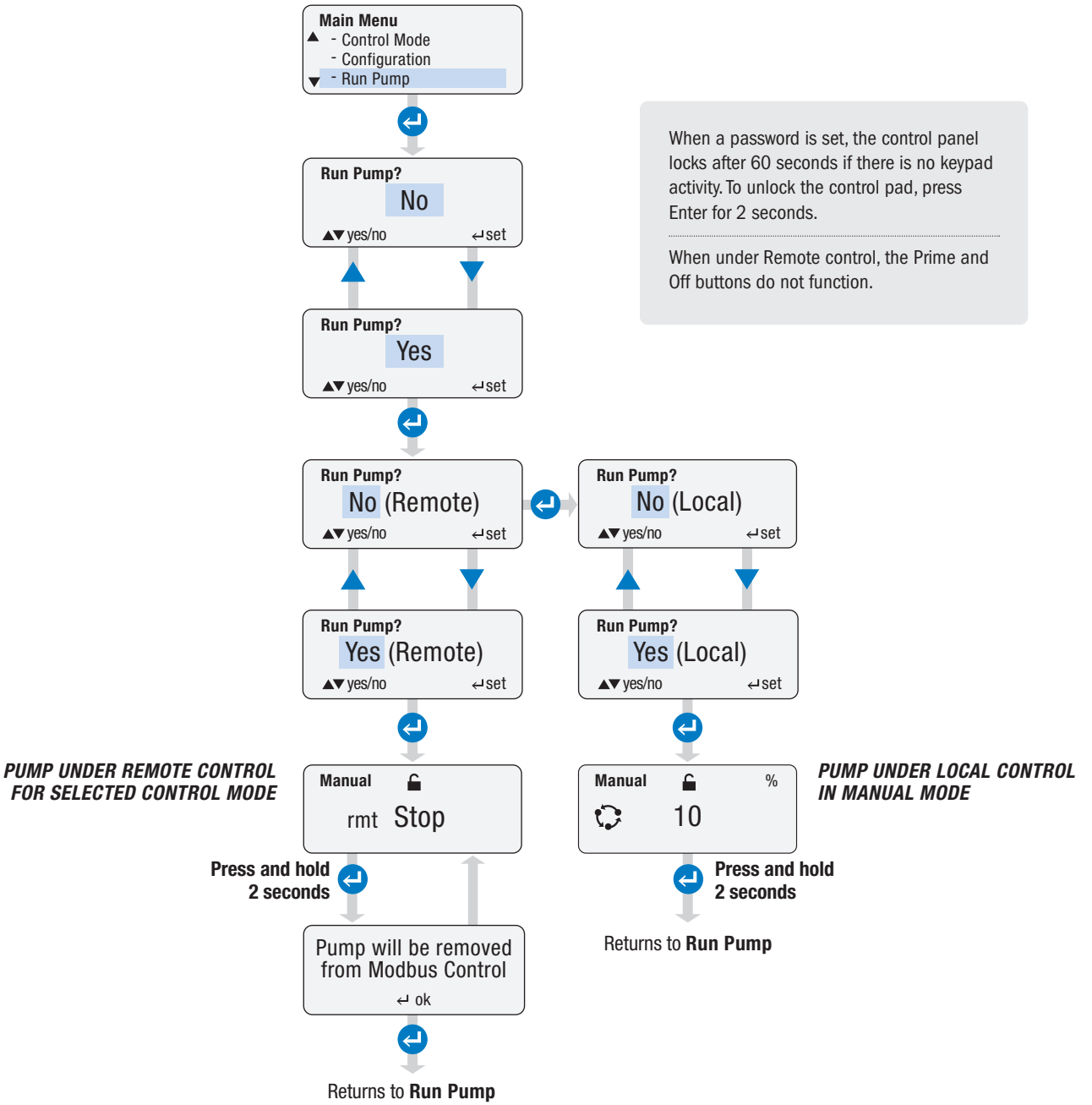
1. On the control panel, press and hold the Enter button for 2 seconds.
2. The pump will not run, the screen will display "Pump will be removed from Modbus control". Press Enter to accept or if applicable, enter your password. The screen will go to the top of the main menu.

⚠ **⚠ WARNING** To prevent injuries during tube replacement or other maintenance, always take pump out of Modbus by either running it under Local control or disabling Modbus in the Modbus Setup menu in the Configuration menu. Removing the pump from Modbus control prevents the pump from remotely starting.

5. PLACE PUMP UNDER REMOTE OR LOCAL CONTROL

Continued from previous page

From the main menu, select Run Pump and and set pump for Remote or Local control.



When a password is set, the control panel locks after 60 seconds if there is no keypad activity. To unlock the control pad, press Enter for 2 seconds.

When under Remote control, the Prime and Off buttons do not function.

⚠ **⚠ WARNING** To prevent injuries during tube replacement or other maintenance, always take pump out of Modbus by either running it under Local control or disabling Modbus in the Modbus Setup menu in the Configuration menu. Removing the pump from Modbus control prevents the pump from remotely starting.

MODBUS PROTOCOL CHART

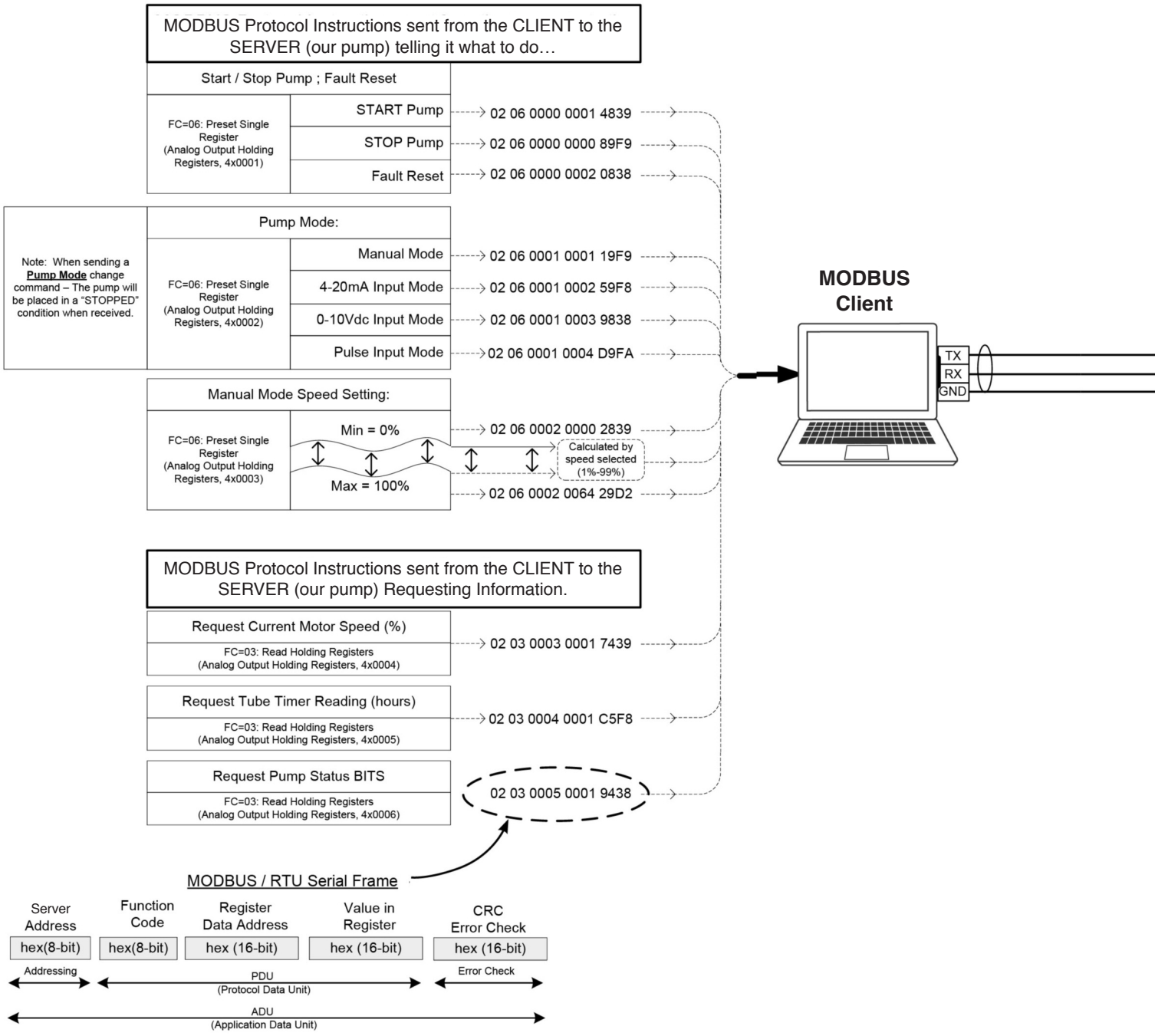
The chart and diagram on the next four pages represent a typical Modbus protocol.

02	06	0000	0001	4839
Server Address	**Function Code**	**Register Address**	**Register Value**	**CRC**

REGISTER NUMBER	REGISTER ADDRESS (2 BYTES)	DESCRIPTION	READ/WRITE	REGISTER VALUE RANGE (2 BYTES)	DATA SIZE	FUNCTION CODE (1 BYTE)
4x0001	0x0000	Start Pump, Stop Pump, Reset Faults	Write Only	0x0000 to 0x0002	16 bits	6
4x0002	0x0001	Change Pump Mode	Write Only	0x0001 to 0x0004	16 bits	6
4x0003	0x0002	Set Manual Mode Speed	Write Only	0x0000 to 0x0064	16 bits	6
4x0004	0x0003	Request Pump Speed	Read Only	0x0000 to 0x0064	16 bits	3
4x0005	0x0004	Request Tube Time	Read Only	0x0000 to 0x270F	16 bits	3
4x0006	0x0005	Request Pump Status	Read Only	0x0000 to 0xFFFF	16 bits	3

	COMMENTS		
	Write 0x0000 to **STOP** pump. Write 0x0001 to **START** pump Write 0x0002 to **RESET** faults (tube timer, leak detect, flow verification) Note: **Drive Fault** error requires cycling of pump power to reset.		
	Write 0x0001 to put pump in **MANUAL** mode Write 0x0003 to put pump in **0-10VDC** mode	Write 0x0002 to put pump in **4-20mA** mode Write 0x0004 to put pump in **Pulse** mode	
	0x0000 to 0x0064 maps to 0 to 100% speed in one percent increments For example: Writing 0x0000 sets speed at 0%	Writing 0x0032 sets speed at 50%	Writing 0x0064 sets speed at 100%
	Returns a value from 0x000 to 0x0064 that maps to 0 to 100%		
	Returns a value from 0x000 to 0x270F that maps to 0 to 9999 hours		
	Returns a value that corresponds to the following status bits:		
	Bit 0:	REMOTE	A value of 1 indicates that the pump is in **REMOTE** control via Modbus. A value of 0 indicates that the pump is in **LOCAL** control.
	Bit 1:	RUN	**Remote:** A value of 1 indicates that the pump has been sent a START command. Speed must be checked to determine if the pump is running. For example, the pump could be in 4-20mA mode while receiving a signal of 4mA. It has been sent the START command, but the pump will not actually be running if 4mA = 0% speed. **Local:** A value of 1 indicates that the pump is running. A value of 0 indicates that the pump is not running.
	Bit 2:	STANDBY	A value of 1 indicates that **STANDBY** is activated.
	Bit 3:	DRIVE FAULT	A value of 1 indicates that the pump is in **Drive Fault.** This must be reset by cycling power to the pump.
	Bit 4:	TUBE TIMER	A value of 1 indicates that **Tube Timer** has expired. This fault can be reset remotely; however, the fault will return if the condition has not been cleared at the pump. In this case, the tube should be changed, and the tube timer should be reset.
	Bit 5:	FLOW DETECT	A value of 1 indicates that **Flow Verifiation** has detected a loss of flow. This fault can be reset remotely; however, the pump should be physically checked first to ensure that any issues that could cause the loss of flow have been addressed, such as a clogged discharge, empty solution tank, disconnected discharge tube, etc.
	Bit 6:	LOW SIGNAL	A value of 1 indicates a **LOW SIGNAL** fault in the 4-20mA or 0-10VDC mode. This fault will self-reset when the signal returns to a value above the low signal setpoint.
	Bit 7:	HIGH SIGNAL	A value of 1 indicates a **HIGH SIGNAL** fault in the 4-20mA or 0-10VDC mode. This fault will self-reset when the signal returns to a value above the low signal setpoint.
	Bit 8:	RESERVED	Reserved for future use.
	Bit 9:	RESERVED	Reserved for future use.
	Bit 10:	SIGNAL OVERRUN	A value of 1 indicates an **OVERRUN** fault in the PULSE mode. This fault will self-reset when there is no longer a pulse signal present during a run.
	Bit 11:	TRANSFER	A value of 1 indicates that a **LEAK DETECT, FLOW VERIFICATION,** or **DRIVE FAULT** error has occurred. If a relay has been programmed for **TRANSFER,** the relay will be activated.
	Bit 12:	TUBE LEAK	A value of 1 indicates that a **TUBE LEAK** has been detected. This fault can be reset remotely; however, the pump should be physically checked first to ensure that the cause of the leak detect fault has ben addressed (tube has been changed).
	Bit 13:	RESERVED	Reserved for future use.
	Bit 14:	RESERVED	Reserved for future use.
	Bit 15:	RESERVED	Reserved for future use.

MODBUS PROTOCOL DIAGRAM



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SUBJECT TO CHANGE WITHOUT NOTICE

The Modbus communication protocol is a product of the Modbus Organization, www.modbus.org.

Examples for ILLEGAL Function Code (01)

ILLEGAL or INVALID Command From CLIENT to SERVER	Exception Reply from SERVER to CLIENT
02 01 0005 0001 EDF8	02 81 01 7190
02 05 0003 0011 FDF5	02 85 01 7350
02 0F 0003 0011 65F4	02 8F 01 75F0
02 10 0005 0011 1037	02 90 01 7DC0

MBFD 061520

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The Pump will only respond to MODBUS commands if the "Modbus Control Enable" option is set to "YES" in the configuration menu.

Pumps responds to the MODBUS request sent from the Client for the FC=06 Function Codes:

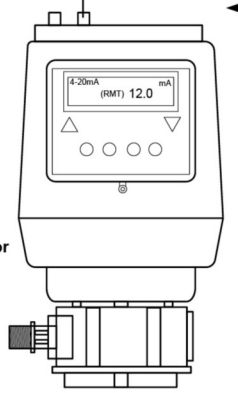
Start / Stop Pump ; Fault Reset		
02 06 0000 0001 4839	START Pump	The Pump will acknowledge it received the instruction by returning (echoing) the same data that it received.
02 06 0000 0000 89F9	STOP Pump	
02 06 0000 0002 0838	Fault Reset	

Mode Pump Mode:		
02 06 0001 0001 19F9	Manual Mode	The Pump will acknowledge it received the instruction by returning (echoing) the same data that it received.
02 06 0001 0002 59F8	4-20mA Input Mode	
02 06 0001 0003 9838	0-10Vdc Input Mode	
02 06 0001 0004 D9FA	Pulse Input Mode	

NOTE: CRC's in this example are calculated with the pump set at server address 2.

(RS485A) CN402-1
(RS485B) CN402-2

RS-485 2-wire Connection



MODBUS Server
(address set as 002 for this example)

Pumps responds to the MODBUS request sent from the Client for the FC=03 Function Codes:

Request Current Motor Speed (%)		
02 03 02 0000 FC44	Min = 0%	The Pump will return the current speed % (as a hex value) in the MODBUS data structure. (see details)
Calculated by actual speed (1%-99%)		
02 03 02 0064 FDAF	Max = 100%	

Request Tube Timer Reading (hours)		
02 03 02 0000 FC44	0	The Pump will return the current Run Time hour (as a hex value) in the MODBUS data structure. (see details)
Calculated by actual tube time (1-9998)		
02 03 02 270F A7B0	9999	

MODBUS / RTU Serial Frame (for Valid Replies)

Server Address	Function Code	Number of Data bytes to follow	Value in Register	CRC Error Check
hex(8-bit)	hex(8-bit)	hex(8-bit)	hex (16-bit)	hex (16-bit)
Addressing	PDU (Protocol Data Unit)			Error Check
ADU (Application Data Unit)				

02 03 02 xxxx xxxx — Calculated CRC value

BIN to HEX

000x xxxx xxxx xxxx

Request Pump Status BITS		
Remote	Bit 0	The Pump will return a 16-BIT word (in hex) that represents the status of various signals. (see details)
Run	Bit 1	
Standby	Bit 2	
Drive Fault	Bit 3	
Tube Timer	Bit 4	
Flow Detect	Bit 5	
Low Signal	Bit 6	
High Signal	Bit 7	
Low Flow	Bit 8	
High Flow	Bit 9	
Signal Overrun	Bit10	
Transfer	Bit11	
Tube Leak	Bit12	
Reserved	Bit13	
Reserved	Bit14	
Reserved	Bit15	

MODBUS / RTU Serial Frame (for Exception Replies)

Server Address	Exception Response	Exception Code	CRC Error Check
hex(8-bit)	hex(8-bit)	hex(8-bit)	hex (16-bit)

01 = ILLEGAL FUNCTION CODE
02 = ILLEGAL DATA ADDRESS

Exception Response = Function Code Received + 80(hex)

Pumps responds to the MODBUS request sent from the Client that are not recognized. These are referred to as Exceptional Reponses:

Exception Response for ILLEGAL DATA ADDRESS (02)

02 83 02 30F1 — The data address received in the query is not an allowable address for the server. This code will be returned if the data field is not valid for the Function Code. (0000,0001, or 0002)

Exception Code for an ILLEGAL Function Code (01)

The Functioon Code received in the query is not an allowable Function for the server. This code will be returned to the client if the Function Code is anything but 03 or 06.

02 xx 01 xxxx — Calculated CRC value

Exception response returned to MASTER. This is calculated by adding 80(hex) to the received Function Code.

Exception Response for ILLEGAL DATA ADDRESS (02)

02 86 02 33A1 — The data address received in the query is not an allowable address for the server. This code will be returned if the data field is not valid for the Function Code. (0003,0004, or 0005)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump does not respond to Modbus	Incorrect cable connection	Confirm all cable connections are in the correct orientation
	Pump is not under Remote control	Program the pump for the desired mode and select Run Remote
	Incorrect communication settings	Check server address, baud rate, and data settings

NOTES

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