DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

STEADYWEB™ 5

RS232 / RS485 Serial Interface
OPTION INSERT

DOC 801-2385

This document to be used
in conjunction with the
SW5 CONTROLLER
INSTRUCTION MANUAL

5 YEAR WARRANTY

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1. GENERAL DESCRIPTION

The RS232 and RS485 option cards allow communication to the SteadyWeb5 tension controller with a remote PLC (programmable logic controller), HMI (human machine interface), computer, or similar device. The communication is done using the Modbus RTU protocol or its Host Computer Interface (HCI). This includes the capability to read tension and related process data, change the setpoints and control mode, adjust settings and save and recall Setups.

Only one communication option card (RS232, RS485, or Ethernet*) can be populated at a time. When using the RS232 option card, the controller acts as a slave which can communicate with a single master using the RS232 standard. When using the RS485 option card, the controller acts as a slave which can be connected to a network with multiple other slaves and a single master using the RS485 standard. This allows multiple SW5s to be connected to a single network or to share a network with other serial communication devices. The Modbus protocol allows for the unique addressing of up to 247 devices on a single network while the HCI protocol supports up to 35 unique devices-although many RS485 implementations limit the number of connected devices to 32.

* See the SteadyWeb5 Ethernet Option Manual Insert (DOC 801-2384) for more information about the Ethernet option.

2. ELECTRICAL CONNECTIONS

Both the RS232 and RS485 option cards feature a 6 pin terminal block to allow direct connection to the board with flying leads from a communication cable. Enclosed versions of the SW5 controller are also available with a DB9 connector option. This allows connection with a standard 9-pin D-sub connector. The DB9 option includes a gender changer to allow connection to either a male or female terminated cable.

The DB9 connector option includes flying leads that tie the enclosure mounted DB9 connector to the communication option card terminal block. This allows for an adaptable connector pinout configuration, which may be desirable for RS485 implementations, as it is common for different PLC vendors to use unique Modbus DB9 pinouts. If the DB9 option is ordered with the RS485 option card, the connector pinout will be wired to the option card in accordance to the Modbus specification as described in the connection diagram below, but can be changed if needed to interface with Modbus systems that don't conform to the recommended pinout. The RS232 DB9 pinout is virtually never varied, so there should be no reason to change the factory set pinout when the DB9 option is ordered with the RS232 communication option.

2a. RS232 Connections

The RS232 communication cable should be wired directly to the option card terminal block or to the optional DB9 connector as shown in Figure 1..

In addition to the electrical connections, the STD/NULL jumpers (JP978 and JP979) must be set. When using a standard serial cables these should be left in the STD positions.(Pins 2 & 3) When using a NULL modem cable, the jumpers need to be moved to the NULL positions.(Pins 1 & 2) Both JP978 and JP979 should be set to the same position (STD or NULL).

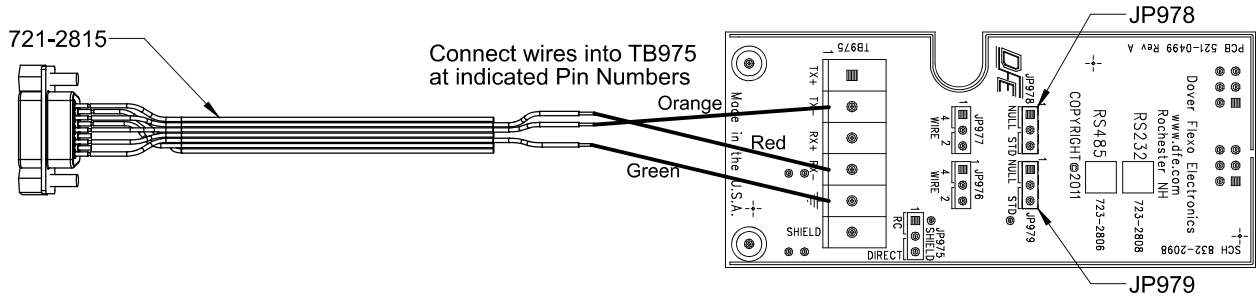

Figure 1 - RS232 Electrical Connections and Jumper Positions

2b. RS485 Connections

The RS485 Option card can be configured for 4 wire plus ground or 2 wire plus ground operation. 2 wire ground will require 2 twisted pair, and 4 wire will require 3 twisted pair. The twisted pairs should be shielded. Separate ground and shield connections are provided on the terminal block. The maximum cable length is 2000' and the maximum number of devices is 32..

For two wire RS485 communication, the cable should be wired directly to the option card terminal block or the the optional DB9 connector as shown below.

In addition to the electrical connections, the 4 wire / 2 wire jumpers (JP977 and JP976) should be set to the 2 wire positions. Both JP977 and JP976 should be set to the same position (4 wire or 2 wire).

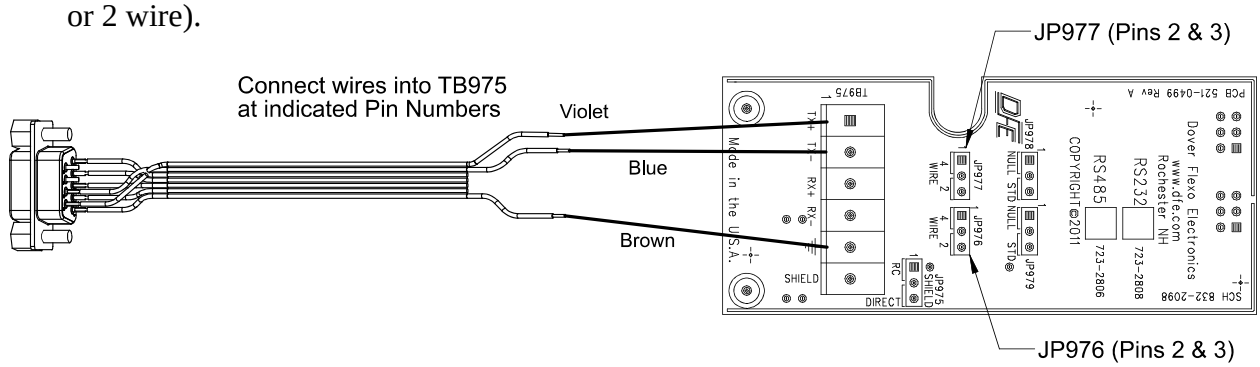

Figure 2 - RS485 2 Wire Electrical Connections and Jumper Positions

For four wire RS485 communication, the cable should be wired directly to the option card terminal block or to the optional DB9 connector as described below.

In addition to the electrical connections, the 4 wire / 2 wire jumpers (JP977 and JP976) should be set to the 4 wire positions. Both JP977 and JP976 should be set to the same position (4 wire or 2 wire).

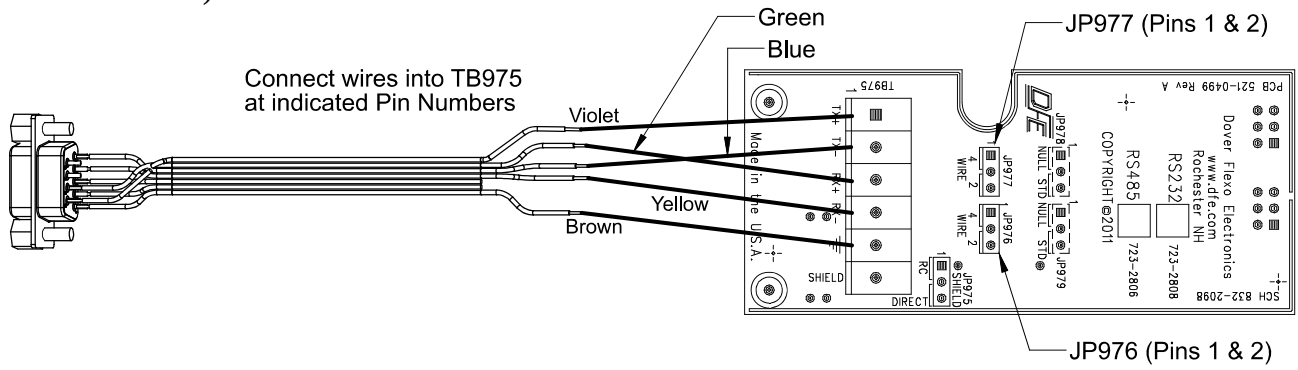

Figure 3 - RS485 4 Wire Electrical Connections and Jumper Positions

2b. RS485 Connections continued…

Depending on cable length, RS485 networks may be terminated with resistors at the two ends of the network. If the SW5 is connected into the middle of an existing network, termination resistors are not required. If it is the only device on the network (other than the master device) or if it is at the end of a network, termination resistors can be installed into the terminal block as shown below. 2 Wire communication only requires one termination resistor. 4 Wire communication requires two resistors. Typical termination resistors are 120 Ohm

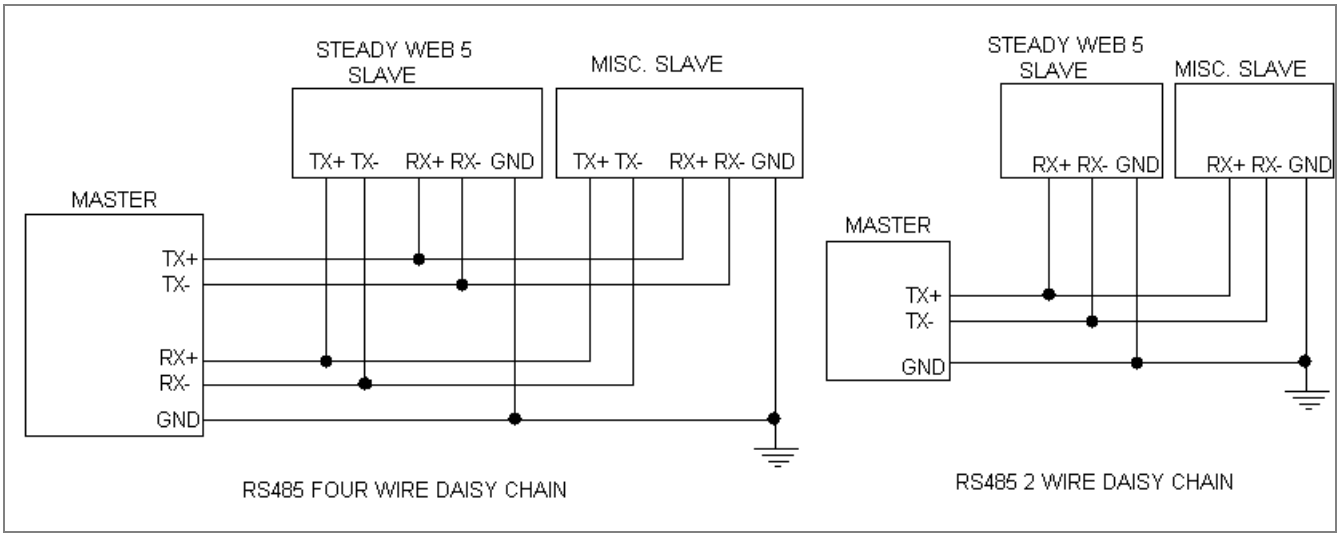

Figure 4 - RS485 Four and Two Wire Daisy Chain Set-Up

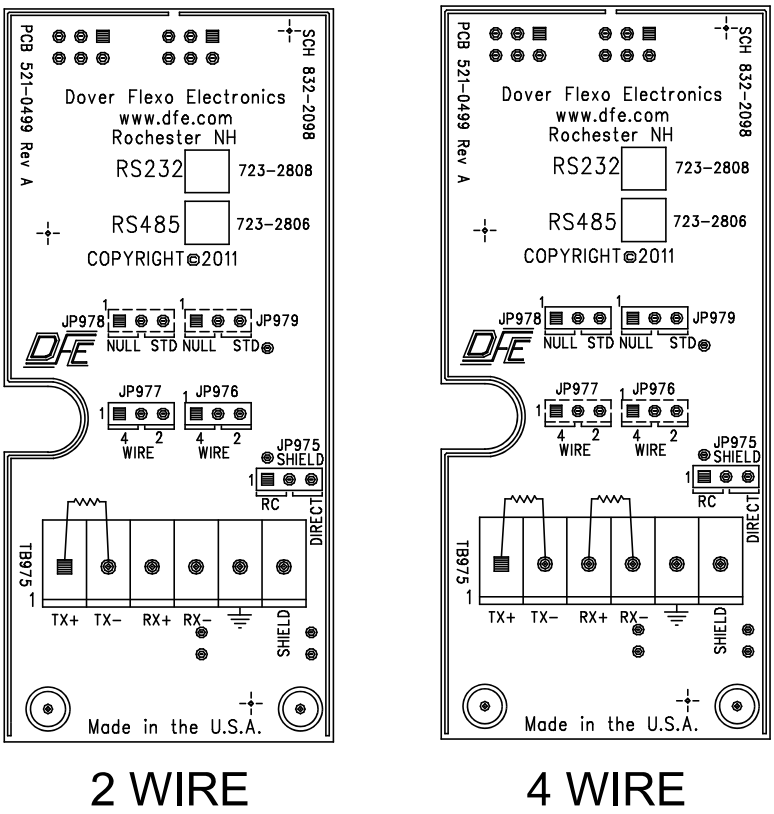

Figure 5 - RS485 2 Wire and 4 Wire Termination

3. HOST COMPUTER INTERFACE

Within the *Communications Menu,* the **Communications Option** setting should be programmed to **HCI**. The HCI communication parameters are not adjustable and are set to the following values,

Baud Rate = 9600 bits/s

Parity = None

Stop Bits = 1

Data Bits = 8

These parameters should match the communication parameters of the master computer or PLC otherwise errors will occur.

The **HCI Slave Address** setting should be programmed to a value from 1 through 9 or A through Z. For RS485 applications, this address should be unique to any other devices sharing the network. The factory default is "1".

All host commands include a unit address for those applications which have multiple units on a single RS485 serial communications link. In the following command descriptions, "#" indicates the SteadyWeb5's one-byte ASCII address which can be set from 1 through 9 or A through Z. This provides 35 possible addresses for multiple unit installations.

Whenever the SteadyWeb5 receives a command which requires a specific response to that command , it responds with a "%" character common to all responses, a prefix specific to that command, its address, and then the requested information. In this way the host has confirmation that the SteadyWeb5 processed the command correctly and that the data is valid. If the SteadyWeb5 receives a command but does not recognize it, or for any reason cannot process the command the SteadyWeb5 will acknowledge the receipt of these undefined or inappropriate command arguments with the NAK(negative acknowledge) response, "%#?".

The host computer may transmit commands to other devices on the same network as the SteadyWeb5. If the command prefix is not a "$" character the SteadyWeb5 will ignore it completely and no NAK response will be generated. In similar fashion, a SteadyWeb5 with a given address will ignore a command sent to a SteadyWeb5 with a different address.

In multiple unit installations it may be desirable to broadcast the same command to all SteadyWeb5's. An example of this would be to turn all SteadyWeb5's tension "ON" at the same time, or to simultaneously update all of them with a new setpoint. For this purpose, the address "0" is reserved as a broadcast address. However, to eliminate garbled data from multiple controllers responding with the ACK response, the SteadyWeb5 does not respond when a broadcast command is issued(this is the only circumstance that the SteadyWeb5 does not respond to command when it is processed correctly). Be aware that other manufacturers products may respond in different ways, making this usage have unpredictable results.

The user must constrain command arguments, including numeric ranges, to be valid entries, otherwise unpredictable results may occur.

Note All Steadyweb5's responses are terminated with the ASCII code for "Carriage Return"(0x0D). The user must ensure that all host commands are also terminated with a Carriage Return.

Host Commands & SteadyWeb5 Responses

Command	Description
$#a(+4)	**Set Auto Setpoint:** Host sets automatic setpoint to be equal to the value contained in the following four bytes, where the data format is: "X.XX" when the tension range is <10 "XX.X" when the tension range is <100 "XXX." when the tension range is <1000 "XXXX" when the tension range is <10000 **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#A	**Go to Auto Mode:** Host instructs the SteadyWeb5 to go to automatic control mode. **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#C	**Inquire Controller Mode:** Host inquires the controller mode (Auto/Manual) **SteadyWeb5 Response:** %#C(+1) Controller mode is contained in the next byte, where ASCII "0" (0x30h) = Manual Mode, and ASCII "1" (0x31h) = Auto Mode
$#d(+5)	**Inquire Roll Diameter:** Host inquires what the present roll diameter is. **SteadyWeb5 Response:** %#d(+5) Roll diameter value is contained in the following five bytes, where the data format is: "_ _ X.X" when maximum diameter is between 0 and 9.99 "_ XX.X" when maximum diameter is between 10 and 99.9 "XXX.X" when maximum diameter is between 100 and 999.9 "XXXX." when maximum diameter is between 1000 and 9999
$#F	**Turn Tension Off:** Host instructs SteadyWeb5 to deactivate output. **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#G(+5)	**Set Gain Coefficient:** Host sets gain(proportional of the PID) to be equal to the value contained in the following five bytes, where the data format is "XX.XX"(ex. 09.50 represents 9.50 inches, centimeters, or other units of distance) **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.

Host Commands & SteadyWeb5 Responses *continued...*

Command **Description**

$#I **Status Inquiry:** Host inquires what the present controller status is.

SteadyWeb5 Response:

%#I(+2) Controller status is contained in the first 10 bits of the 16 bit word(2 bytes)

0000 00XX XXXX XXXn: n=0: Estop Inactive n=1 Estop Active
0000 00XX XXXX XXnX: n=0: TLS LOW Inactive n=1 TLS LOW Active
0000 00XX XXXX XnXX: n=0: TLS HIGH Inactive n=1 TLS HIGH Active
0000 00XX XXXX nXXX: n=0: Tension Off n=1 Tension On
0000 00XX XXXn XXXX: n=0: Manual n=1 Auto
0000 00XX XXnX XXXX: n=0: Soft Start Inactive n=1 Soft Start Active
0000 00XX XnXX XXXX: n=0: Hold Inactive n=1 Hold Active
0000 00XX nXXX XXXX: n=0: Ratio Inactive n=1 Ratio Active
0000 00Xn XXXX XXXX: n=0: Lockout Inactive n=1 Lockout Act
0000 00nX XXXX XXXX: n=0: Taper Inactive n=1 Taper Active

$#K(+2)(+14) **Store Setup Name:** The controller is capable of storing up to 31 Setups, in addition to the ACTIVE setup. Setups are stored in memory slots. Slot 1 always holds the ACTIVE Setup. The ACTIVE setup may be copied and saved into slots 2-32 as selected by (+2). Setups 2-32 may have unique names up to 14 characters long as entered in (+14). Only the following characters can be used in a name:

_0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ

Saving a setup name will copy the ACTIVE configuration into the selected slot.(Ex. $1K05FINAL_SETUP will copy the ACTIVE configuration into slot 5 and name it "FINAL_SETUP")

SteadyWeb5 Response:

%#A Command acknowledged, processed correctly.

Note: Due to the time required for the storage operation, it may take up to 2 seconds for the SteadyWeb5 to deliver the ACK response. If the SteadyWeb5 returns the NAK response %#?, this is because the slot number is out of range, or the name contains invalid characters

$#m(+3) **Set Manual Setpoint:** Host sets manual setpoint to be equal to the value contained in the following three bytes, where the data format is "XXX" (Ex. 075 represents 75% output)

SteadyWeb5 Response:

%#A Command acknowledged, processed correctly.

Host Commands & SteadyWeb5 Responses *continued...*

Command	Description
$#M	**Go to Manual Mode:** Host instructs SteadyWeb5 to go to Manual Mode. **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#N	**Turn Tension On:** Host instructs SteadyWeb5 to activate output. **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#O	**Inquire Tension Mode:** Host inquires tension mode(Tension ON/OFF) **SteadyWeb5 Response:** %#O(+1) Tension mode is contained in the next byte, where ASCII "0" (0x30h) = Tension On, and ASCII "1" (0x31h) = Tension Off.
$#P(+2)	**Retrieve Stored Setup:** Activate one of the stored setups(2 through 32) and make it the active setup(Ex. $1P05 will take the setup in slot number 5 and make it the active setup) **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly *Note: Due to the time required for the storage operation, it may take up to 2 seconds for the SteadyWeb5 to deliver the ACK response. If the SteadyWeb5 returns the NAK response %#?, this is because a stored setup doesn't exist or the slot number is out of range.*
$#r(+5)	**Set Tension Trim:** Host sets tension trim setting to be equal to the value contained in the following five bytes,where the data format is "XXX.X" (Ex. 075.5 represents a value of 75.5%) **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.
$#R(+6)	**Set Response:** Host sets response(derivative of the PID) to be equal to the value contained in the following three bytes, where the data format is "XX.XXX"(Ex. 09.532 represents a value of 9.532) **SteadyWeb5 Response:** %#A Command acknowledged, processed correctly.

Host Commands & SteadyWeb5 Responses *continued...*

Command	Description
$#s	**Inquire Line Speed:** Host inquires what the present line speed is.

SteadyWeb5 Response:

%#s(+5) Line speed value is contained in the following five bytes, where the data format is:

_ _ X.X	when maximum line speed is <10
_ XX.X	when maximum line speed is <100
XXX.X	when maximum line speed is <1000
XXXX.	when maximum line speed is <10000
XXXXX	when maximum line speed is >10000

$#S(+6) **Set Stability:** Host sets stability(integral of the PID) to be equal to the value contained in the following six bytes, where the data format is "XX.XXX"(Ex. 09.532 represents a value of 9.532)

SteadyWeb5 Response:

%#A Command acknowledged, processed correctly.

$#t **Inquire Tension Value:** Host inquires what the present tension value is.

SteadyWeb5 Response:

%#t(+5) Tension value is contained in the following five bytes where the data format is,

"_ X.XX"	when tension range is between 1 and 9.99
"_ XX.X"	when tension range is between 10.0 and 99.9
"_ XXX."	when tension range is between 100 and 999.9
"_XXXX"	when tension range is between 1000 and 9999

Note: The left most space is reserved for the negative sign if tension is negative.

$#T **Read Tension Trim:** Host inquires the current tension trim setting.

SteadyWeb5 Response:

%#T(+5) Tension trim value is contained in the following 5 bytes where the data format is "XXX.X" (Ex. _ _ 9.5 represents 9.5%)

Host Commands & SteadyWeb5 Responses *continued...*

Command	Description
$#V	**Inquire Manual Setpoint:** Host inquires what the present manual setpoint is.
	SteadyWeb5 Response:
	%#V(+3) Manual setpoint value is contained in the following 3 bytes where the data format is "XXX" (Ex. _15 represents 15%)
$#W	**Read Auto Setpoint:** Host inquires the current auto setpoint.
	SteadyWeb5 Response:
	%#W(+4) Automatic setpoint value is contained in the following 4 bytes where the data format is,
	"X.XX" when tension range is between1 and 9.99
	"XX.X" when tension range is between 10 and 99.9
	"XXX." when tension range is between 100 and 999
	"XXXX" when tension range is between 1000 and 9999
$#X	**Read Gain:** Host inquires the current PID gain setting from the controller.
	SteadyWeb5 Response:
	%#X(+5) Gain value is contained in the following 5 bytes where the data format is "XX.XX" (Ex. _ 8.25 represents 8.25)
$#Y	**Read Stability:** Host inquires the current PID stability setting from the controller.
	SteadyWeb5 Response:
	%#Y(+6) Stability value is contained in the following 6 bytes where the data format is "XX.XXX" (Ex. _ 8.123 represents 8.123)
$#Z	**Read Response:** Host inquires the current PID response setting from the controller.
	SteadyWeb5 Response:
	%#Z(+6) Response value is contained in the following 6 bytes where the data format is "XX.XXX" (Ex. _ 8.123 represents 8.123
%#?	**SteadyWeb5 Negative Acknowledge(NAK) response:**
	Command interpreted and acknowledged, but not processed. Typically this is because the argument is out of range, or because the formatting is incorrect.

4. MODBUS RTU PROTOCOL

The communication option cards are configured through the SW5's user interface. The settings are accessible through the display's Menu mode in the *Setup Menu* > *Communications Menu* (refer to the SW5 manual for informations on how to access and navigate the controller's menu system).

Within the *Communications Menu*, the **Communications Option** setting should be programmed to **Modbus**.

The **Modbus Slave Address** setting should be programmed to a value from 1 to 247. For RS485 applications, this address should be unique to any other devices sharing the network.

The **Modbus Baud Rate** setting should be set to the communication rate used by the master. Options are **4800**, **9600**, **14400**, and **19200** baud.

The **Modbus Parity** setting should be set to **Even** or **Odd** to match the parity used by the master.

The **Modbus Stop Bits** setting should be set to 1 or 2 to match the number of stop bits used by the master.

Communication packets always contain 8 data bits, and this is not adjustable.

4a. Modbus Protocol

Communication for both the RS232 and RS485 option cards use the Modbus RTU protocol.

The Modbus Protocol Specification is described in the document:
MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b
This may be downloaded from: http://www.Modbus-IDA.org

Modbus is a Master-Slaves protocol. Only one master is connected to the bus, and up to 247 slaves may be connected to the same serial bus. Modbus communications is always initiated by the Master node. Serial transmission uses the RTU mode.

A Modbus command consists of the following fields:

Address Field	Function Code	Data	CRC Error Check

Where the Address is the slave device address and the CRC (cyclic redundancy check) is used to identify any errors or corruption in the data packet.

The Data is determined by the Function Code. The following Modbus Function Codes are supported:

Function Code	Function
00	Broadcast Message
03	Read Holding Registers
04	Read Input Registers
05	Write Single Coil
06	Write Single Register
16	Write Multiple Registers

4b. Configuration Settings

The remaining settings are used to configure the SteadyWeb5. Configuration settings are read using the Read Holding Registers command **(03)**, and are written using the Write Single Register Command **(06)**. The address and range of each configuration setting is given below. Settings that have been left blank should not be accessed.

Register	Setting	Range	Read/Write
1	**Control Software Version**	0 = 0.00 → 1000 = 10.00 Example: A value of 150 represents Version 1.50	Read Only
2	**Tension Zone**	0 → 2, where 0 → 2 represents: 0 = Unwind 1 = Intermediate 2 = Rewind	Read/Write
3	**Control Feedback Mode**	0 → 2, where 0 → 2 represents: 0 = Closed Loop 1 = Line Follow Tension Trim 2 = Diameter Compensated Line Follow Tension Trim	Read/Write
5	**Tension Source**	0 → 2, where 0 → 2 represents: 0 = Transducer 1 = RTA 1 2 = RTA 2	Read/Write
6	**Excitation Voltage**	0 → 2, where 0 → 2 represents: 0 = Auto 1 = 5V Set 2 = 10V Set	Read/Write
7	**Tension Trim**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents 50.00% trim	Read/Write

Register	Setting	**Range**	
8	**Tension Off by ESTOP**	0 → 1, where 0 → 1 represents: 0 = Yes 1 = No	Read/Write
9	**Power On Control Mode**	0 → 1, where 0 → 1 represents: 0 = Manual 1 = Auto	Read/Write
10	**Power On Tension Mode**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
11	**Core Diameter**	10 = 1.0 → 10000 = 1000.0 Example: A value of 5000 represents a diameter of 500.0 The diameter units (in. or cm) is specified by the **Diameter Units** setting.	Read/Write
12	**Max Full Roll Diameter**	10 = 1.0 → 10000 = 1000.0 Example: A value of 5000 represents a maximum diameter value of 500.0 The diameter units (in. or cm) is specified by the **Diameter Units** setting.	Read/Write
13	**Diameter Input Type**	0 → 1, where 0 → 1 represents: 0 = Direct 1 = Tachometer Ratio Calculate	Read/Write
14	**Diameter Filter Time**	0 → 8, where 0 → 8 represents: 0 = 0.00 sec 1 = 0.10 sec 5 = 2.00 sec 2 = 0.25 sec 6 = 3.00 sec 3 = 0.50 sec 7 = 4.00 sec 4 = 1.00 sec 8 = 5.00 sec	Read/Write
15	**Diameter Units**	0 → 1, where 0 → 1 represents: 0 = in. 1 = cm	Read/Write
19	**Max Line Speed**	0 → 10000 The line speed units (ft/min, m/min, etc.) is specified by the **Line Speed Units** setting.	Read/Write

Register	Setting	Range	Read/Write
20	**Line Speed Units**	0 → 7, where 0 → 7 represents: 0 = in/sec 1 = in/min 2 = ft/sec 3 = ft/min 4 = cm/sec 5 = cm/min 6 = m/min 7 = Y/min	Read/Write
21	**Speed Soft Start**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
22	**Tension Soft Start**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
23	**Switched Soft Start**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
24	**Soft Start Speed Trip Point**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a trim point of 50.00% the max line speed, which is specified by the **Max Line Speed** setting.	Read/Write
25	**Soft Start Delay ms**	1000 = 1.000 sec → 5000 = 5.000 sec Example: A value of 1500 represents a 1.500 second Soft Start delay.	Read/Write
26	**Soft Start Output Level**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a Soft Start output level of 50% max output, or 5V.	Read/Write
27	**Ratio Multiplier**	1 = 0.1x → 100 = 10.0x Example: A value of 50 represents a Ratio Multiplier of 5.0x.	Read/Write
28	**Ratio Delay ms**	1000 = 1.000 sec → 15000 = 15.00 sec Example: A value of 5000 represents a Ratio Delay of 5.000 seconds.	Read/Write
29	**Ratio Target**	0 → 2, where 0 → 2 represents: 0 = Output 1 = Setpoint 2 = Line Speed	Read/Write

Register	Setting	Range	Read/Write
30	**TLS Low Mode**	0 → 2, where 0 → 2 represents: 0 = Off 1 = Momentary 2 = Latched	Read/Write
31	**TLS High Mode**	0 → 2, where 0 → 2 represents: 0 = Off 1 = Momentary 2 = Latched	Read/Write
32	**TLS Delay**	0 = 0.000 sec → 10000 = 10.000 sec Example: A value of 5000 represents a TLS Delay of 5.000 seconds.	Read/Write
33	**Tension Off by TLS Low**	0 → 1, where 0 → 1 represents: 0 = Yes 1 = No	Read/Write
34	**Tension Off by TLS High**	0 → 1, where 0 → 1 represents: 0 = Yes 1 = No	Read/Write
35	**Manual Setpoint Source**	0 → 2, where 0 → 2 represents: 0 = Front Panel 1 = Potentiometer 2 = 0 – 10V Input	Read/Write
36	**Auto Setpoint Source**	0 → 2, where 0 → 2 represents: 0 = Front Panel 1 = Potentiometer 2 = 0 – 10V Input	Read/Write
37	**External Tension Toggle**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
38	**External Auto Manual Toggle**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
40	**Positive Output Limit**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a maximum output value of 50.00% of 10V, which is 5V.	Read/Write
41	**Negative Output Limit**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a minimum output value of 50.00% of -10V, which is -5V.	Read/Write

Register	Setting	Range	Read/Write
42	**Control Output**	0 → 1, where 0 → 1 represents: 0 = Standard 1 = Reverse	Read/Write
43	**Relay Function**	0 → 3, where 0 → 3 represents: 0 = None 1 = Tension On 2 = TLS On 3 = TLS Off	Read/Write
48	**(P) Gain**	1 = 0.01 → 2500 = 25.00 Example: A value of 150 represents an error gain of 1.50x.	Read/Write
49	**(I) Stability**	10 = 0.010 sec → 30000 = 30.000 sec Example: A value of 2500 represents an Integral time constant of 2.500 seconds.	Read/Write
50	**(D) Response**	0 = 0.000 sec → 30000 = 30.000 sec Example: A value of 500 represents a Derivative time constant of 0.500 seconds.	Read/Write
51	**Acceleration Percentage**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents an Acceleration Percentage of 50.00%.	Read/Write
52	**Acceleration Limit**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents an Acceleration Limit of 50.00%.	Read/Write
53	**Acceleration P Multiplier**	1 = 0.1 → 100 = 10.0 Example: A value of 50 represents an Acceleration Proportional Multiplier of 5.0x.	Read/Write
54	**Accel I Multiplier**	1 = 0.1 → 100 = 10.0 Example: A value of 50 represents an Acceleration Integral Multiplier of 5.0x.	Read/Write
55	**Accel D Multiplier**	1 = 0.1 → 100 = 10.0 Example: A value of 50 represents an Acceleration Derivative Multiplier of 5.0x.	Read/Write

Register	Setting	Range	Read/Write
56	**Diameter Comp. Enable**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
57	**Full Roll (P) Gain**	1 = 0.01 → 2500 = 25.00 Example: A value of 150 represents a Full Roll error gain of 1.50x.	Read/Write
58	**Full Roll (I) Stability**	10 = 0.010 sec → 30000 = 30.000 sec Example: A value of 2500 represents a Full Roll Integral time constant of 2.500 seconds.	Read/Write
59	**Full Roll (D) Response**	0 = 0.000 sec → 30000 = 30.000 sec Example: A value of 500 represents a Full Roll Derivative time constant of 0.500 seconds.	Read/Write
60	**Tension Filter Time**	0 → 8, where 0 → 8 represents: 0 = 0.000 sec 1 = 0.008 sec 2 = 0.016 sec 3 = 0.032 sec 4 = 0.064 sec 5 = 0.125 sec 6 = 0.250 sec 7 = 0.500 sec 8 = 1.000 sec	Read/Write
62	**Display Mode**	0 → 2, where 0 → 2 represents: 0 = Bar Graph 1 = Analog Meter 2 = Line Graph	Read/Write
63	**Tension Update Time**	0 → 4, where 0 → 4 represents: 0 = 0.2 sec 1 = 0.5 sec 2 = 1.0 sec 3 = 2.0 sec 4 = 5.0 sec	Read/Write
65	**Line Speed Display**	0 → 2, where 0 → 2 represents: 0 = Auto 1 = On 2 = Off	Read/Write
66	**Diameter Display**	0 → 2, where 0 → 2 represents: 0 = Auto 1 = On 2 = Off	Read/Write

Register	Setting	Range	Read/Write
67	**Manual Setpoint**	0 = 0.00% → 1000 0 = 100.00% Example: A value of 5000 represents a maximum output value of 50.00% of 10V, which is 5V.	Read/Write
68	**Taper Enable**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
69	**Taper Percentage**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a Taper Percentage of 50.00%.	Read/Write
71	**Tension Units**	0 → 4, where 0 → 4 represents: 0 = lb. 1 = oz. 2 = g 3 = kg 4 = N	Read/Write
72	**Advanced Menu Mode**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
74	**Tension Range**	0 → 27, where 0 → 27 represents: 0 = 1 14 = 200 1 = 3 15 = 250 2 = 5 16 = 300 3 = 7 17 = 400 4 = 10 18 = 500 5 = 15 19 = 750 6 = 20 20 = 1000 7 = 25 21 = 1250 8 = 35 22 = 1500 9 = 50 23 = 2000 10 = 75 24 = 2500 11 = 100 25 = 3000 12 = 125 26 = 4000 13 = 150 27 = 5000	Read/Write
78	**Tension Trip Point**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents a Tension Trip Point percentage of 50.00% the full range tension.	Read/Write
79	**TLS Low Setpoint**	0 = 0.00% → 10000 = 100.00% Example: A value of 2000 represents a TLS Low Setpoint of 20.00% the full range tension.	Read/Write

Register	Setting	Range	Read/Write
80	**TLS High Setpoint**	0 = 0.00% → 10000 = 100.00% Example: A value of 8000 represents a TLS High Setpoint of 80.00% the full range tension.	Read/Write
81	**Auto Setpoint**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents an Auto Setpoint of 50.00% the full range tension.	Read/Write
82	**Line Graph Update Time**	0 → 5, where 0 → 5 represents: 0 = 30 sec 1 = 60 sec 2 = 2 min 3 = 5 min 4 = 10 min 5 = 30 min	Read/Write
85	**Trim Percentage Target**	0 → 1, where 0 → 1 represents: 0 = Output 1 = Line Speed	Read/Write
86	**Acceleration Compensation Enable**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read/Write
87	**Tension Display Damping**	0 → 5, where 0 → 5 represents: 0 = 0.0 sec 1 = 0.2 sec 2 = 0.4 sec 3 = 0.8 sec 4 = 1.6 sec 5 = 3.2 sec	Read/Write
88	**Line/Roll Filter Time**	0 → 4, where 0 → 4 represents: 0 = 0.00 sec 1 = 0.10 sec 2 = 0.25 sec 3 = 0.50 sec 4 = 1.00 sec	Read/Write

4c. Store Setup Names

The controller is capable of storing up to 30 Setups, including the ACTIVE Setup.

Setups are stored in EEPROM "slots". Slot 1 always holds the ACTIVE Setup. The ACTIVE Setup may be copied and saved into Setup slots 2 to 30. Setups 2 to 30 may have unique names up to 14 characters each. Only the following characters may be used in a name:

_0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ

Saving a Setup name will copy the ACTIVE configuration into the selected slot. For instance, writing a name into locations 524 → 531 will copy the active configuration into configuration 4, and store the name of configuration 4.

Eight 16-bit registers are required to hold a configuration name, although only the first seven registers are valid. The last character of a name must be followed by the hexadecimal character 0x00. Register 8 should be 0x0000. Each register holds two characters, and the maximum name length is 14 characters. Attempting to write a longer name will result in a Write Rules Error (code 63). Configuration names are read using the Read Holding Registers command **(03)**, and are written using the Write Multiple Registers Command **(16)**. The ACTIVE configuration Name is Read Only. The address range of each name is given below:

500 → 507 ACTIVE	628 → 635 Name 17
508 → 515 Name 2	636 → 643 Name 18
516 → 523 Name 3	644 → 651 Name 19
524 → 531 Name 4	652 → 659 Name 20
532 → 539 Name 5	660 → 667 Name 21
540 → 547 Name 6	668 → 675 Name 22
548 → 555 Name 7	676 → 683 Name 23
556 → 563 Name 8	684 → 691 Name 24
564 → 571 Name 9	692 → 699 Name 25
572 → 579 Name 10	700 → 707 Name 26
580 → 587 Name 11	708 → 715 Name 27
588 → 595 Name 12	716 → 723 Name 28
596 → 603 Name 13	724 → 731 Name 29
604 → 611 Name 14	732 → 739 Name 30
612 → 619 Name 15	
620 → 627 Name 16	

Recall Setup

Recall Setup will copy the Stored Setup into the Active Setup. In order to Recall a Setup, using Write Single Register Command **(06)**, write the Setup Number 2 – 30 into Register 800.

Delete Setup

Only a named setup can be deleted. In order to Delete a Setup, using Write Single Register Command **(06)**, write the Setup Number 2 – 30 into Register 900.

4d. Run Time Data

Run Time Data may be accessed using the Read Input Registers command **(04)**. Run time data is Read Only. The following registers hold run time data:

Register	Setting	Range	Read/Write
0	**RTA 2 ADC In**	0 → 4095	Read Only
1	**RTA 1 ADC In**	0 → 4095	Read Only
2	**Remote Auto Setpoint ADC In**	0 → 4095	Read Only
Register	**Setting**	**Range**	**Read/Write**
3	**Remote Manual Setpoint ADC In**	0 → 4095	Read Only
4	**Line Speed ADC In**	0 → 4095	Read Only
5	**Roll ADC In**	0 → 4095	Read Only
6	**Diameter ADC In**	0 → 4095	Read Only
7	**+10 / 15 V Rail ADC In**	0 → 4095	Read Only
8	**RTA 1 Signal**	0 = 0.00V → 10000 = 10.00V	Read Only
9	**RTA 2 Signal**	0 = 0.00V → 10000 = 10.00V	Read Only
10	**Line Speed Signal**	0 = 0.00V → 10000 = 10.00V	Read Only
11	**Auto Signal Percent**	0 = 0.00V → 10000 = 10.00V	Read Only
12	**Manual Signal**	0 = 0.00V → 10000 = 10.00V	Read Only
13	**+10 / 15 V Sense**	0 = 0.00V → 10000 = 10.00V	Read Only
14	**Diameter**	0 = 0.00% → 10000 = 100.00%	Read Only
15	**Acceleration**	0 = 0.00% → 10000 = 100.00%	Read Only
16	**Excitation Voltage ADC In**	0 – 1024	Read Only
17	**Excitation Current A ADC In**	0 – 1024	Read Only
18	**Excitation Current B ADC In**	0 – 1024	Read Only
19	**E-STOP Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
20	**Tension Off Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
21	**Tension On Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
22	**Auto Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only

Register	Setting	Range	Read/Write
23	**Manual Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
24	**Ratio Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
25	**Hold Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
26	**Soft Start Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
27	**Spare Input**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
32	**Output**	0 = 0.00% → 10000 = 100.00% Example: A value of 5000 represents an output of 50%.	Read Only
33	**Output Sign**	0 → 1, where 0 → 1 represents: 0 = Positive 1 = Negative	Read Only
34	**Tension ADC In**	0 → 65535	Read Only
35	**Transducer Tension Percent**	0 = 0.00% → 10000 = 100.00% A value of 1500 represents a 15.00% tension input if the Tension Sign = 0. If the Tension Sign = 1, then 1500 represents -15.00%	Read Only
36	**Tension Sign**	0 → 1, where 0 → 1 represents: 0 = Positive 1 = Negative	Read Only
48	**Tension On / Off**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read Only
49	**Auto / Manual**	0 → 1, where 0 → 1 represents: 0 = Manual 1 = Auto	Read Only
50	**Ratio State**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
51	**Soft Start State**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only
52	**Hold State**	0 → 1, where 0 → 1 represents: 0 = Inactive 1 = Active	Read Only

Register	Setting	Range	Read/Write
53	**TLS Low State**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read Only
54	**TLS High State**	0 → 1, where 0 → 0 = Off 1 = On	Read Only
55	**Lockout I/O Pin**	0 → 1, where 0 → 0 = Active 1 = Inactive	Read Only
62	**Excitation Error**	0 → 12, where 0 → 12 represents: 0 = No excitation error 10 = Excitation short or low impedance 11 = Excitation Open 12 = Unknown transducer	Read Only
63	**Tension Error**	0 → 22, where 0 → 22 represents: 0 = No Error 20 = Tension ADC Comm Error 21 = Signals ADC Error 22 = Internal ADC Error	Read Only
65	**Reset TLS Button State**	0 → 1, where 0 → 1 represents: 0 = Off 1 = On	Read Only

4e. Standard Data

Command (04) may also be used to read a packet of 16 registers of data starting with register 256. This is a special case that may reduce the number of commands required to obtain standard data. The data is packed as follows:

If Tension Source = Transducer
Register 0 = Transducer Tension Percent
Register 1 = Tension Sign

If Tension Source = RTA1
Register 0 = RTA1 Signal Percent
Register 1 = 0

If Tension Source = RTA2
Register 0 = RTA2 Signal Percent
Register 1 = 0
Register 2 = Output Percent
Register 3 = Output Sign
Register 4 = Line Speed Signal Percent
Register 5 = Diameter Percent

4e. Standard Data continued...

Register 6 = Auto Setpoint Percentage

Register 7 = Manual Setpoint Percent

Register 8 = Status Alarm Bits with the following additional bits:

Bit 10 = Taper Enable Bit 11 = Excitation Error

Bit 12 = Transducer ADC Error Bit 13 = Cal Not Complete (If using transducer)

Register 9 = Tension Units

Register 10 = Max Line Speed

Register 11 = Line Speed Units

Register 12 = Max Full Roll Diameter

Register 13 = Core Diameter

Register 14 = Diameter Units

Register 15 = Tension Range

4f. Remote Push Buttons

Remote Push Buttons are Write Only. Remote push buttons may be activated using the Write Single Coil command **(05)**. The following buttons may be remotely controlled:

Register	**Setting**	**Range**	**Read/Write**
0	**Toggle Tension**	0 → 1	Write Only
1	**Toggle Auto Manual**	0 → 1	Write Only
2	**Decrement Auto Setpoint 1%**	0 → 1	Write Only
3	**Increment Auto Setpoint 1%**	0 → 1	Write Only
4	**Decrement Manual Setpoint 1%**	0 → 1	Write Only
Register	**Setting**	**Range**	**Read/Write**
5	**Increment Manual Setpoint 1%**	0 → 1	Write Only
6	**Decrement Auto Setpoint 10%**	0 → 1	Write Only
7	**Increment Auto Setpoint 10%**	0 → 1	Write Only
8	**Decrement Manual Setpoint 10%**	0 → 1	Write Only
9	**Increment Manual Setpoint 10%**	0 → 1	Write Only
10	**Tension On / Off**	0 → 1 0 = Tension Off 1 = Tension On	Write Only
11	**Auto / Manual**	0 → 1 0 = Manual 1 = Auto	Write Only

4g. Modbus RTU Command Format

(03) Read Holding Registers

The Read Holding Registers command is used to:

Read configuration parameters

Read configuration names

Read configuration independent parameters

The Request, Response, and Error codes are described below:

Request

Function Code	1 Byte	**0x03**
Starting Address	2 Bytes	**0x0000 → 0xFFFF**
Quantity of Registers	2 Bytes	**1 → 16**

Response

Function Code	1 Byte	**0x03**
Byte Code	1 Byte	**2 x N**
Input Registers	N x 2 Bytes	

Error

Error Code	1 Byte	**0x83**
Exception Code	1 Byte	

For example, if the Slave Address is 25, the following command can be used to read the Core Diameter:

Hex

19, 03, 00, 0B, 00, 01, F6, 10

If the core diameter is 6.0, then the following reply should be returned:

Hex

19, 03, 02, 00, 3C, 98, 57

(04) Read Input Registers

The Read Input Registers command is used to:

Read Run Time Variables

The Request, Response, and Error codes are described below:

Request

Function Code	1 Byte	**0x04**
Starting Address	2 Bytes	**0x0000 → 0xFFFF**
Quantity of Registers	2 Bytes	**1 → 16**

(04) Read Input Registers continued...

Response

Function Code	1 Byte	**0x04**
Byte Code	1 Byte	**2 x N**
Input Registers	N x 2 Bytes	

Error

Error Code		
Exception Code	1 Byte	

For example, if the Slave Address is 25, the following command can be used to read the Diameter Percent:

Hex

19, 04, 00, 0E, 00, 01, 53, D1

If the Diameter is 0%, then the following reply should be returned:

Hex

19, 04, 02, 00, 00, 90, 32

(05) Write Single Coil

The Write Single Coil command is used to:

Press remote push buttons

The Request, Response, and Error codes are described in the following table:

Request

Function Code	1 Byte	**0x05**
Output Address	2 Bytes	**0x0000 → 0xFFFF**
Output Value	2 Bytes	**0x0000 or 0xFF00**

Response

Function Code	1 Byte	**0x05**
Output Address	2 Bytes	**0x0000 → 0xFFFF**
Output Value	2 Bytes	**0x0000 or 0xFF00**

Error

Error Code	1 Byte	**0x85**
Exception Code	1 Byte	

For example, if the Slave Address is 25, the following command can be used to turn the Tension On:

Hex

19, 05, 00, 0A, FF, 00, AF, E0

The following reply will be returned:

Hex

19, 05, 00, 0A, FF, 00, AF, E0

(06) Write Single Register

Write Single Register is used to:

Write a configuration parameter
Write a configuration independent parameter
Recall a configuration
Delete a configuration

An exception code is returned if it is not possible to change the parameter. This will occur if a grayout rule is in effect, or a register value is out of range.

The Request, Response, and Error codes are described below. The normal response is an echo of the request:

Request

Function Code	1 Byte	**0x06**
Register Address	2 Bytes	**0x0000 → 0xFFFF**
Register Value	2 Bytes	**0x0000 → 0xFFFF**

Response

Function Code	1 Byte	**0x06**
Register Address	2 Bytes	**0x0000 → 0xFFFF**
Register Value	2 Bytes	**0x0000 → 0xFFFF**

Error

Error Code	1 Byte	**0x86**
Exception Code	1 Byte	

For example, if the Slave Address is 25, the following command can be used to set the Core Diameter to 3.5:

Hex
19, 06, 00, 0B, 00, 23, BA, 09

The following reply should be returned:

Hex
19, 06, 00, 0B, 00, 23, BA, 09

(16) Write Multiple Registers

Write Multiple Registers is used to:

Write a configuration name (requires writing to 8 registers). Writing a configuration name will copy the Active configuration into the newly named configuration.

An exception code is returned if it is not possible to change the parameter. This will occur if a grayout rule is in effect, or a register value is out of range.

The Request, Response, and Error codes are described below. The normal response is an echo of the request:

Request

Function Code	1 Byte	**0x10**
Starting Address	2 Bytes	**0x0000 → 0xFFFF**
Quantity of Registers	2 Bytes	**1 to 8**
Byte Count	1 Byte	**2 x N**
Register Value	N x 2 Bytes	**value**

Response

Function Code	1 Byte	**0x10**
Starting Address	2 Bytes	**0x0000 → 0xFFFF**
Quantity of Registers	2 Bytes	**1 to 8**

Error

Error Code	1 Byte	**0x90**

For example, if the Slave Address is 1, the following command can be used to store the Active Setup to slot 3 and name it “NW”. The hex code for “N” is 0x4E, and the hex code for “W” is 0x57. The register value byte order is reversed.

Hex

01, 10, 02, 04, 00, 08, 10, 57, 4E, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 7B, 91

The following reply should be returned:

Hex

01, 10, 02, 04, 00, 08, 81, B6

Exception Codes

Exception Codes 0x01 to 0x0B are Modbus exception codes and are listed below:

0x01 ILLEGAL FUNCTION
0x02 ILLEGAL DATA ADDRESS
0x03 ILLEGAL DATA VALUE
0x04 SLAVE DEVICE FAILURE
0x05 ACNOWLEDGE
0x06 SLAVE DEVICE BUSY
0x08 MEMORY PARITY ERROR
0x0A GATEWAY PATH UNAVAILABLE
0x0B GATEWAY TARGET DEVICE FAILED TO RESPOND

The following exception codes are unique to the SteadyWeb5:

60 Eeprom comm error
61 Corrupted data error
62 Bounds error
63 Write rules error.
80 Eeprom timeout
81 Front board timeout
82 Comm timeout

CRC Error

As documented in the Modbus Application Protocol Specification, no response is returned if a CRC error is detected.

(00) Broadcast Message

In Modbus RTU broadcast is achieved using 0 as the slave address. A broadcast message cannot expect a reply message. It is used to broadcast a command to all devices on the network by using slave address **(0)**. Function codes **(05)** and **(06)** can be broadcast. For instance, function code **(05)** can be used to turn off tension to every SW5 on the RS485 network.

Because there is no reply to a broadcast message, there is no error response, and no guarantee that the message was successfully received and implemented.

Reference:

Modbus software was tested using Modbus Test Procedure from Rogue Engineering Inc.

http: www.rogue-engr.com.