

WS-MBS Application

WS-MBS Digital Wall Sensor

The WS-MBS Wall Sensor is a Modbus based digital display wall sensor that integrates to the ASIC/2 and ASIC/3 controllers using Modbus communications controlled by the ASIC/3 Modbus Master Object.

This Application Bulletin demonstrates methods of integration with the ASIC/2 controller.

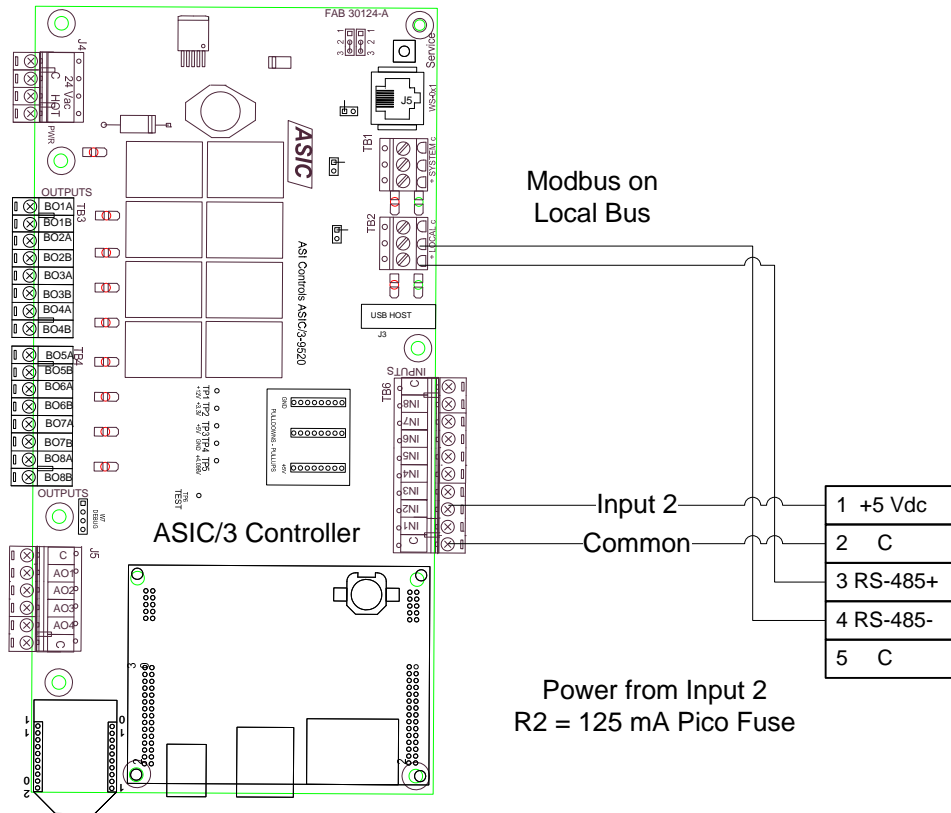
The WS-MBS bus sensor has 4 buttons; Override, Mode, Up and Down. It has a built-in temperature sensor which displays the current temperature. . The temperature display is in either Celsius or Fahrenheit in 0.1 degree increments. Pressing the Mode button allows the user to change the temperature setpoint between a high and low limit in 0.5 degree increments.



Wiring

The sensor is powered with 5 Vdc, which can be borrowed from an Input by replacing the pull-up resistor with a 125 mA picofuse. An external 5 Vdc supply may be used. In operation the WS-MBS draws about 10 mA at 5 Vdc.

1. + 5 Vdc
2. Common (Ground)
3. RS-485 +
4. RS-485 -
5. Common (Ground)



Modbus

The data in the WS-MBS wall sensor is kept in Modbus registers.

Modbus Holding Registers

Holding Register	Register Address	Parameter	Definition	Default	Static Dyn	Engr. Mode
1	0	Override Status (O/R)	0: OFF, 1: ON	0	S	
2	1	Clock Icon	0: No-clock, 1: Clock	0	D	
3	2	Temperature Setpoint	C:10.0..40.0, F: 50.0..104.0	C: 23.0 F: 75.0	S	
4	3	Temperature Display	0.1 deg		D	
5	4	Fan Mode	0:OFF, 1:ON, 2:ON Lo, 3:ON Med, 4:ON Hi	0	D	
6	5	Control State	0: Unoccupied, 1: Occupied, 2: Night Setback	1	D	
7	6	Control Mode	0:OFF, 1:Cooling , 2:Heating	0	D	
8	7	Other Icons 0: No Display 1: Display	bit0: NA; bit 1: AUTO; bit2: Outdoor; bit3:Sleep bit4:%RH; bit5: NA bit6: Enable °C/°F; bit7: OVRD, bit 8: INTLK	0x60	D	
9	8	Operation Mode	0: Unlock; 1: Lock Engineer 2: Lock User Adjust 3: Lock User and Engineer	0	D	
10	9	Temperature Units	0: °C, 1: °F	1	S	E01
11	10	Temperature Deadband	C: 0 .. 5.0 (0.5 deg) F: 0 ..10.0	C: 4.0 F: 8:0	S	E02
12	11	Setpoint Low Limit	C :10.0 .. 40.0, F : 50.0 .. 104.0	C:18.0, F: 64.0	S	E03
13	12	Setpoint High Limit	C :10.0 .. 40.0, F : 50.0 .. 104.0	C:30.0, F: 90.0	S	E04
14	13	Sensor Offset	-9.9 .. 9.9	0	S	E05
15	14	Modbus Device Address	1 .. 247	1	S	E06
16	15	Remote Sensor Enable	0: disable, 1: enable	0	S	E07
			Self-Diagnostic		S	E08
17	16	Baud Rate	0: 9600bps, 1: 19200bps	1	S	E09
18	17	Data Format (Parity,Data,Stop)	0: N-8-2; 1: O-8-1; 2: E-8-1	0	S	E10
			Exit Engineering Mode			E11

Temperature Setpoints, Temperature Display, Temperature Deadband, Setpoint High and Low Temperature Limits, and Sensor Offset are in 0.1 degree increments.

Note: the Holding Registers are zero-based. Holding Register 1 is Register Address 0.

Some registers are dynamic meaning they are reset to default values on reset of power. Dynamic registers include the Temperature Display, the Clock Icon, the Fan Icon, the control State (Unoccupied, Occupied, Night Setback), Control Mode (Off, Cooling, Heating), Other Icons and Operation Mode. The data displayed can be changed by writing to these registers using Modbus from the host ASIC/2 controller

Other registers are static, meaning that they preserve their value through reset of power. Their values change only by changing them with the Engineering Mode, or by writing to them using Modbus from the host ASIC/3 controller. Static registers include: Temperature Setpoints, , Temperature Deadband, Setpoint High and Low

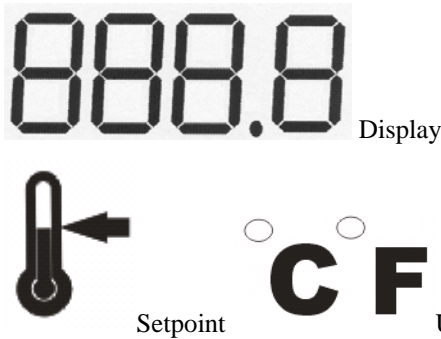
Temperature Limits, and Sensor Offset, Modbus Device Address, Remote Sensor Enable, Baud rate and Data Format.

Data from the wall sensor is read using Modbus Function 03, Read Multiple Holding Registers. The ASI Modbus Master Object can read up to 8 adjacent registers in a single read message.

The Write Single Register function 06 is supported. An error code is returned if the write message is invalid or out of limits.

Temperature Operation

The WS-MBS displays the Temperature read by its sensor in either Celsius or Fahrenheit depending on the Temperature Units, Register 10. The Temperature Display value can be read from Register 4 in 0.1 degrees. The temperature sensor can be calibrated by adjusting the Temperature Offset, Register 14.



The Temperature Setpoint, Register 3, also in 0.1 degrees, can be changed from the Wall Sensor by pressing the Mode Button. Pressing the Up or Down buttons increments or decrements the Temperature Setpoint by 0.5 degrees between the Setpoint Low Limit, Register 10, and Setpoint High Limit, Register 11.

The Temperature Deadband, Register 8, can be read from the wall sensor and used by the control sequence in the host ASIC/2 controller.

If Remote Sensor Enable, Register 14, is enabled, then the Temperature display value must be written to Holding Register 4, by the host ASIC/2 controller.

Override Button

Pressing the Override Button, O/R, on the display sets the Override Status, Register Address 0. This register can only be cleared by writing to the WS-MBS from the control sequence in the host ASIC/2 controller.

Clock Icon



Clock Icon, Register Address 1, controls the display of the Clock Icon. For instance, if the controller has gone into afterhours operation, the Clock Icon can be displayed. The host ASIC/2 controller would write a 1 to Register 2 to turn on the icon, and a 0 to turn it off.

Fan Mode



The Fan Mode, Register Address 4, controls the display of the Fan icon, and the multiple speeds. The host ASIC/2 controller would write to Register 5: 0 to turn it off., 1 On; 2 On-Low, 3 On-Medium, 4- On-High

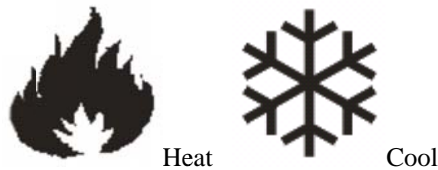
Control State



The Control State, Register Address 5, controls the displays of the Day and Night icons.

The host ASIC/2 controller would write to Register Address 5: 0 for Unoccupied, 1 for Occupied, Day icon; or 2 for Night Setback, Night icon.

Control Mode



The Control Mode, Register Address 6, controls the display of the Cool and Heat icons.

The host ASIC/2 controller would write to Register 7: 0 for Off or Deadband, 1 for Cooling, Cool icon; or 2 for Heating, Heat Icon

Other Icons

A series of icons can be individually shown or hidden based on the bit values in Register Address 7

- bit-0 " Not Used";
- bit-1 = "AUTO"
- bit 2="Outdoor",
- bit 4 ="%RH";
- bit 5="Not Used";
- bit 6 = Enable °C/°F;
- bit 7 = OVRD
- bit 8 = INTLK

Operating Mode

By writing to the Operating Mode Register Address 8 it is possible to lock out the Engineering Mode, to lock out the User Mode, or both. When the User Mode is locked out WS-MBS continues to display the Temperature value, but the display does not respond to key presses. Operating Mode is dynamic and is cleared on reset of power.

Engineering Mode

The sensor has an Engineering Mode which is used to set-up the static parameters and options. The Engineering Mode should only be used by a qualified technician.

Pressing both the Up and Down buttons together for 3 seconds, puts the sensor in Engineering mode. E01 will show in the display. You may use the UP or DOWN buttons through the range E01 to E11. Engineering Modes are shown in the Register table. See above.

Pressing the Mode button shows the present value of the parameter. Use the UP or Down button to adjust the value. Press the Mode button again to save the current value return to the Engineering Mode.

To test the display go to E08, and press Mode. To Exit go to E11 and press Mode.

Other parameters can be set including: Units (C/F), Deadband, Low and High Setpoint Limits, Offset, Modbus Device Address, Remote Sensor enable, Baud rate, data format, and a self-diagnostic test.

Note: Pressing and holding Mode, Up, and Down at the same time resets all static parameters to default values.

Modbus Parameters

The Modbus configuration parameters are typically set using the Engineering Mode.

Each Modbus device on the ASIC/3 Local Bus must have a unique **Modbus Device Address**, Register Address 14, E06, in the range from 1 to 247.

All Modbus devices on the ASIC/2 Local Bus must have the same Data Format and Baud Rate. It will communicate at a **Baud Rate**, Register Address 16, E09, of 9600 or 19200 baud.

The **Data Format**, Register Address 17, E10, specifies 1-Start bit, plus Parity, Data Bits, and Stop bits. The default is

Parity-None, 8 Data Bits, and 2-Stop bits (N-8-2).

Depending on other Modbus devices present the Data Format could be

Parity-Odd, 8 Data Bits, and 1-Stop Bit (O-8-1) or

Parity-Even, 8 Data Bits, and 1-Stop Bit (E-8-1)

ASIC/3 Applications

Reading Registers

The ASIC/2 or ASIC/3 communicates on local bus to the WS-MBS digital display using the Modbus RTU protocol function 03, Read Holding Registers. A single instance of ModBus Master can return up to 8 registers, in this case Registers 1- 8, 8 Registers with Start Address 0. Registers 9-16 are returned with Start Address 8. The Slave Address is the device address for the specific WS-MBS.

The screenshot shows the ModBus Master configuration window. At the top, there is a 'Send' button and fields for 'Address: 8582', 'Firmware: 854a v2.2', and 'Description: ASIC/2-8540 WS-MOD (-062)'. Below this is the 'ModBus Master' section with the following settings:

- Instance Name:** MBM-00 01-08
- Index Enable:** Yes
- Modbus Function:** 3 (Read Holding Registers)
- Slave Address:** 2
- Start Address:** 0
- Number of Registers:** 8
- Gate Enable:** No
- Gate Handle:** NONE 00-00-00-00
- Gate Handle Name:** NONE
- Read Interval (s):** 10
- Read Timer:** 6

On the right side, the 'System Object' section shows:

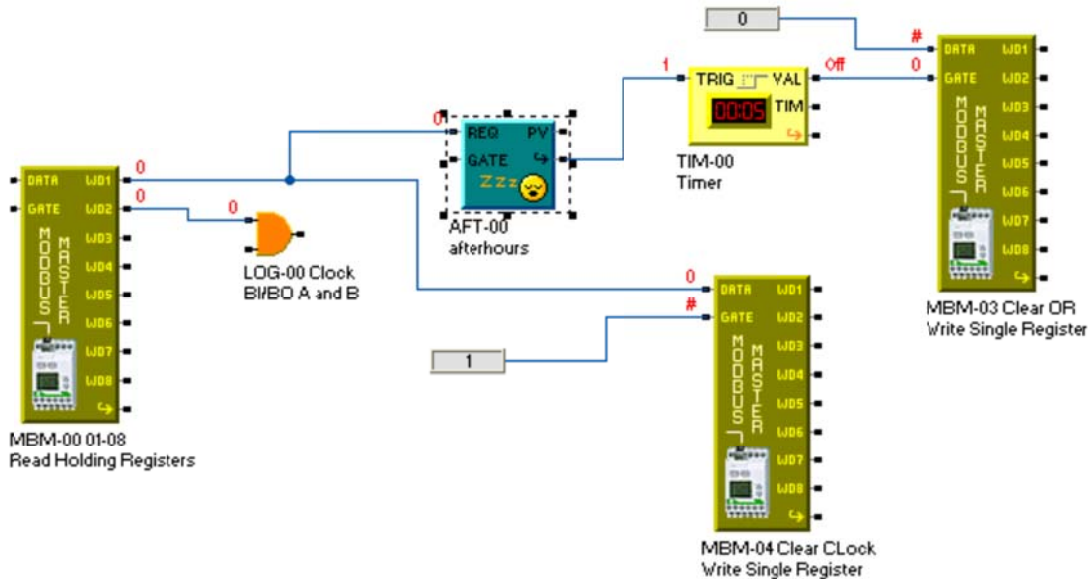
- Modbus Enable:** Yes
- Modbus IS Enabled!!**
- Byte Swap:** No
- Data1:** 0
- Data2:** 0
- Data3:** 220
- Data4:** 253
- Data5:** 0
- Data6:** 2
- Data7:** 2
- Data8:** 0
- Index Enable Status:** Yes
- Gate Status:** Yes
- Invalid Msg:** No
- On-Line Status:** Yes

In this case the data is returned with a Read Interval of 10 seconds. Do not ask for data too frequently, or some of the indexes may not get their turn on the COM bus.

Override

Register 1 holds the Override parameter which is set if the O/R Button is pressed and only cleared by a Write Single Register message. This can be used to trigger a change of state, for instance by triggering the Afterhours Object, as shown below.

At the end of the Afterhours period a timer is triggered to send a message to clear the Override. Register 2 holds the Clock icon status. A Write Single Message is configured to periodically send the Override Status to the Clock icon so that when override is requested, the clock icon is displayed.



Send Address: 8582 Firmware: 854a v2.2

ModBus Master

Instance Name: **MBM-03 Clear OR**

Index Enable: Yes

Modbus Function: **6** Write Single Register

Slave Address: **2**

Register Address: **0**

Data Handle: **# 0**

Data Handle Name: **SPECIAL**

Data Constant: **0**

Gate Enable: Yes

Gate Handle: **TIM-00-00-LB_ONLY**

Gate Handle Name: **TIM-00**

Transmit Interval (s): **30**

Transmitt Timer: **2**

Send Address: 8582 Firmware: 854a v2.2

ModBus Master

Instance Name: **MBM-04 Clear Clock**

Index Enable: Yes

Modbus Function: **6** Write Single Register

Slave Address: **2**

Register Address: **1**

Data Handle: **MBM-00-00-WD_VAL**

Data Handle Name: **MBM-00 01-08**

Gate Enable: No

Gate Handle: **# 1**

Gate Handle Name: **SPECIAL**

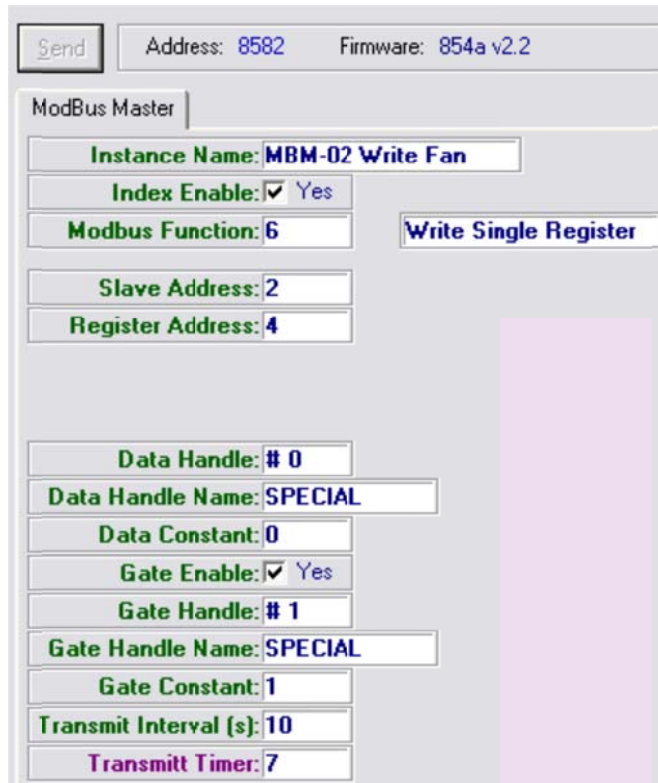
Gate Constant: **1**

Transmit Interval (s): **15**

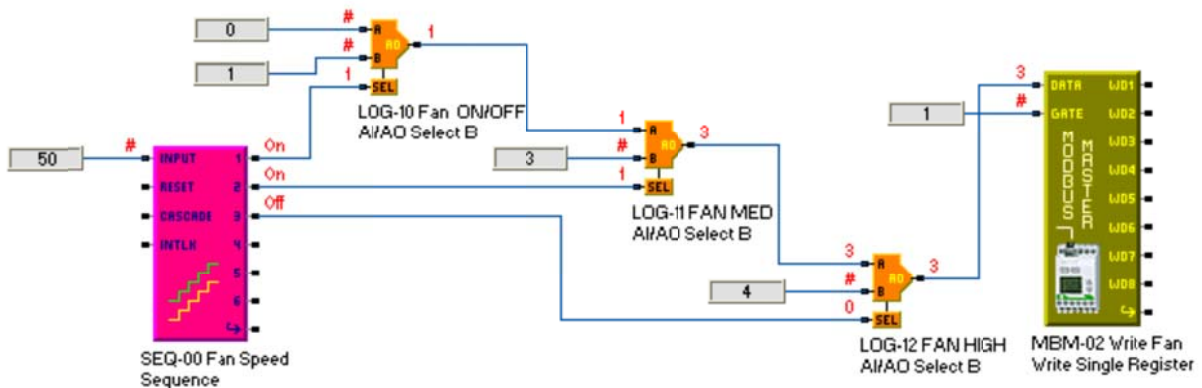
Transmitt Timer: **10**

Fan Mode

Register 5 controls the display of the Fan and Multiple Speed Icons The host ASIC/2 controller would write to Register 5: 0 to turn it off., 1 On; 2 On-Low, 3 On-Medium, 4- On-High



The logic which controls the multi-speed fan outputs, can also switch the correct value into the Data Handle, so that the correct icon is displayed.

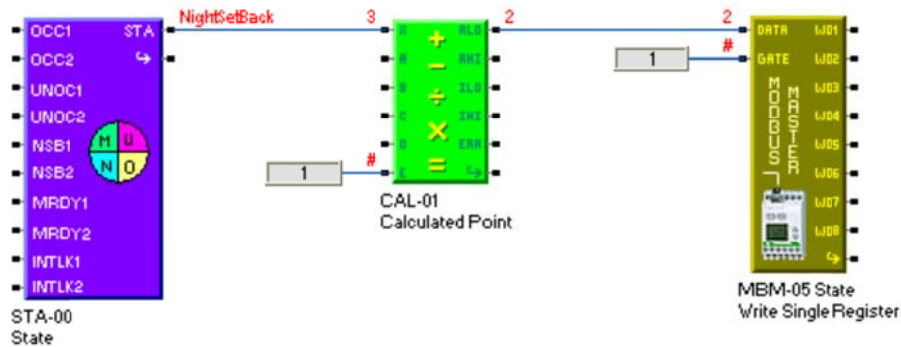


Control State

The Control State, Register 6, controls the displays of the Day and Night icons.

The host ASIC/2 controller would write to Register 6: 0 for Unoccupied , 1 for Occupied, Day icon; or 2 for Night Setback, Night .

The ASIC/2 state object has a present value 1=UNO, 2= OCC, 3= NSB, 4= MRDY, so that a Calculated point is needed to subtract 1 from the value, and limit the maximum value to 3. Write Single Register is used to update the display icons based on the present value of state. This can also be done with simple logic.



Send Address: 8582 Firmware: 854a v2.2

ModBus Master

Instance Name: MBM-05 State

Index Enable: Yes

Modbus Function: 6 Write Single Register

Slave Address: 2

Register Address: 5

Data Handle: CAL-01-00-WD_VAL

Data Handle Name: CAL-01

Gate Enable: Yes

Gate Handle: # 1

Gate Handle Name: SPECIAL

Gate Constant: 1

Transmit Interval (s): 4

Transmitt Timer: 3

Control Mode



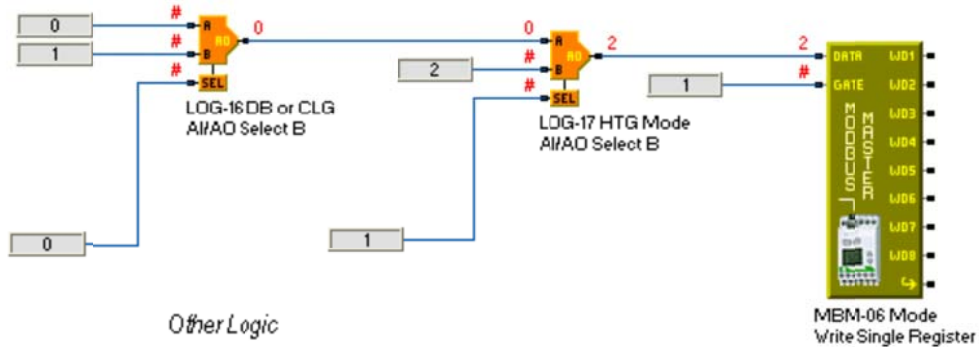
Heat



Cool

The Control Mode, Register 7, controls the display of the Cool and Heat icons.

The host ASIC/2 controller would write to Register 7: 0 for Off or Deadband, 1 for Cooling, Cool icon; or 2 for Heating, Heat Icon



Send Address: 8582 Firmware: 854a v2.2 Description: ASIC/2-8540 WS-MOD (-062)

ModBus Master

Instance Name: MBM-06 Mode

Index Enable: Yes

Modbus Function: 6 **Write Single Register**

Slave Address: 2

Register Address: 6

Data Handle: LOG-17-00-2_BYTE

Data Handle Name: LOG-17 HTG Mode

Gate Enable: Yes

Gate Handle: # 1

Gate Handle Name: SPECIAL

Gate Constant: 1

Transmit Interval (s): 4

Transmitt Timer: 4

System Object

Modbus Enable: Yes

Modbus IS Enabled!!

Byte Swap: No

Data1: 2

Data2: 0

Data3: 0

Data4: 0

Data5: 0

Data6: 0

Data7: 0

Data8: 0

Index Enable Status: Yes

Gate Status: Yes

Invalid Msg: No

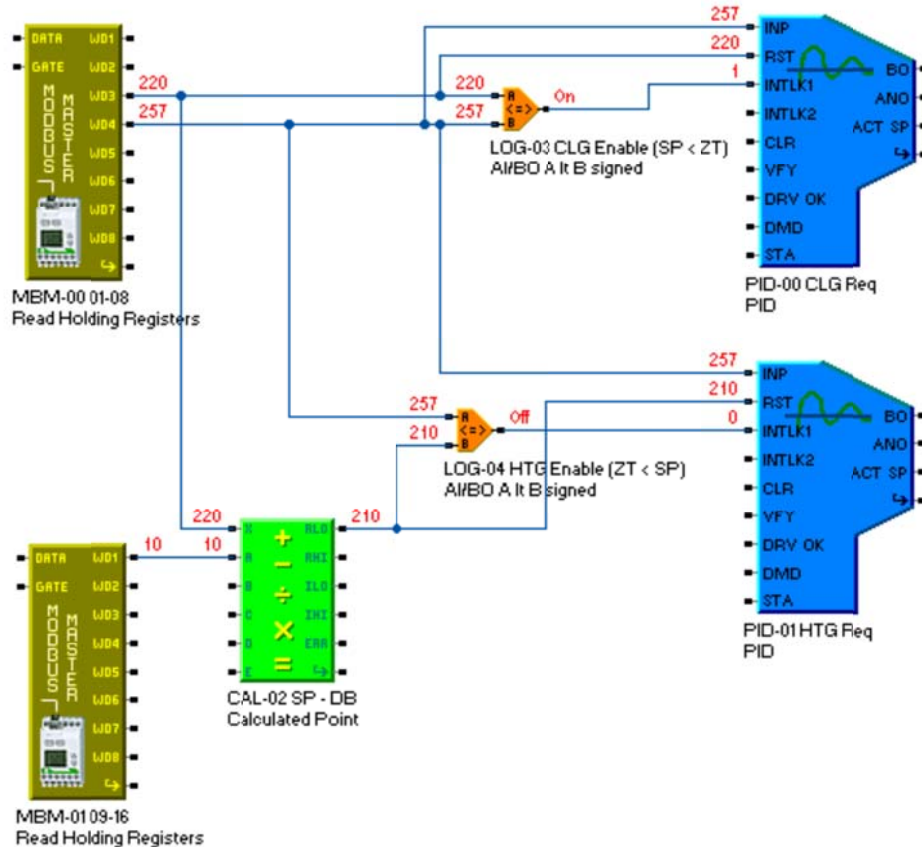
On-Line Status: Yes

Temperature Control

The WS-MBS Digital Display can be used for temperature control, reading the Temperature SP(Register 3), Zone Temperature (Register 4), and Temperature Deadband (Register 9) from the wall sensor using Modbus. All temperatures are used in 0.1 degrees. 220 represents 22.0 degrees Celsius.

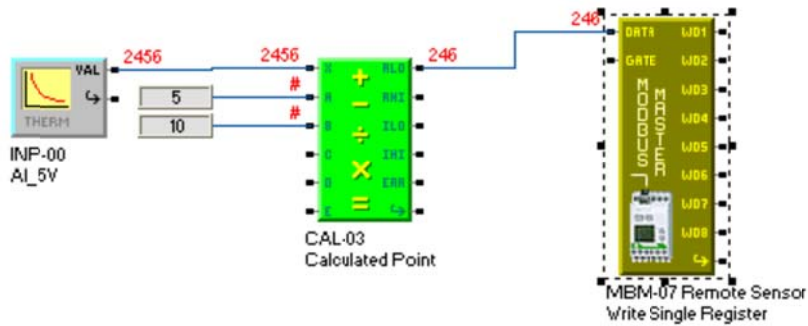
PID-00 CLG Requirement reads the Zone Temperature as an Input and the Temperature Setpoint as a Reset Signal. LOG-03 is used to Enable the PID loop for Cooling if the Temperature Setpoint is Less than the Zone Temperature.

PID-01 HTG Requirement reads the Zone Temperature as an Input, and uses CAL-02 to subtract the Deadband(Register 9) from the Temperature Setpoint (Register 3) to be used as the Reset Signal. LOG-04 is used to enable PID-01 for Heating.



Remote Sensor

If Remote Sensor Enable is set in the WS-MBS, then the Temperature Display (Register 4) value, must be written from the ASIC/2 controller. The internal temperature sensor is not read.



ASIC/2 INP-00 reads a value in 0.01 deg C. CAL-03 rounds, and divides by 10. The Write Single Register sends the value to the WS-MBS for display.

Remote Sensor Enable must be set manually in the WS-MBS by using Engineering Mode E07. It can also be enabled or disabled by writing to Register 14.

Send Address: 8582 Firmware: 854a v2.2

ModBus Master

Instance Name: MBM-07 Remote Sensor

Index Enable: Yes

Modbus Function: 6 Write Single Register

Slave Address: 2

Register Address: 3

Data Handle: CAL-03-00-WD_VAL

Data Handle Name: CAL-03

Gate Enable: No

Gate Handle: NONE 00-00-00-00

Gate Handle Name: NONE

Transmit Interval (s): 7

Transmitt Timer: 3

About this Document

This manual was produced using *Doc-To-Help*[®], by Component One, LCC. This manual, WS-MBS Digital Display, DOC-1762 and Windows[™] help system was last revised on 2014-12-11. ASI Controls is always working to improve our products. Should you have any questions, or suggestions that would help our products better meet your needs, or that would help us serve you better, please call, write, or e-mail to:

ASI Controls
2202 Camino Ramon
San Ramon, CA 94583
Phone: (925) 866-8808
FAX: (925) 866-1369

Customer Support: sales@asicontrols.com
Technical Support: techsupport@asicontrols.com
Visit our Web site at <http://www.asicontrols.com>

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