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## Connecting Vaisala HMPX Probes to Allen-Bradley micro820 PLC via Modbus RTU

This guide is meant to be used to help you connect a Vaisala Indigo probe to the Allen-Bradley Micro820 PLC

In this guide we show you how to wire an HMP7 probe to the serial port on an Allen-Bradley Micro820, communicate between the HMP7 and the Micro820 via Modbus RTU and convert the holding registers into human readable floating-point values. We use the Allen-Bradley Micro820 as a Modbus master to read the relative humidity and temperature readings from the HMP7 as the Modbus slave. Some tables and diagrams are provided to use as a guide, but it is highly recommended to reference your own instruments' manual. It is assumed that you have at least some basic experience with ladder logic, the Connected Components Workbench software and connecting the Allen-Bradley Micro820 to a PC.

### 1 Wiring

In this section we connect a single HMP7 probe to the serial port on the micro820.

1. If you are using a cable from Vaisala, the following wire colors signify the function:
  - Brown: Power supply
  - White: RS-485 -
  - Blue: Power GND and RS-485 common
  - Black: RS-485 +
2. If not, reference the diagram below.

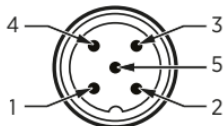


Figure 4 MI2 5-pin A-coded male connector pinout

Pin #	Function	Notes	Wire colors in Vaisala cables
1	Power supply	Operating voltage: • HMP7: 18 ... 30 V DC • Other models: 15 ... 30 V DC Current consumption: 10 mA typical, 500 mA max.	Brown
2	RS-485 -		White
3	Power GND and RS-485 common		Blue
4	RS-485 +		Black
5	Not connected		Gray

(HMPx Modbus wiring: HMP Series User Guide p.22)

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3. See the diagram below for the wiring.

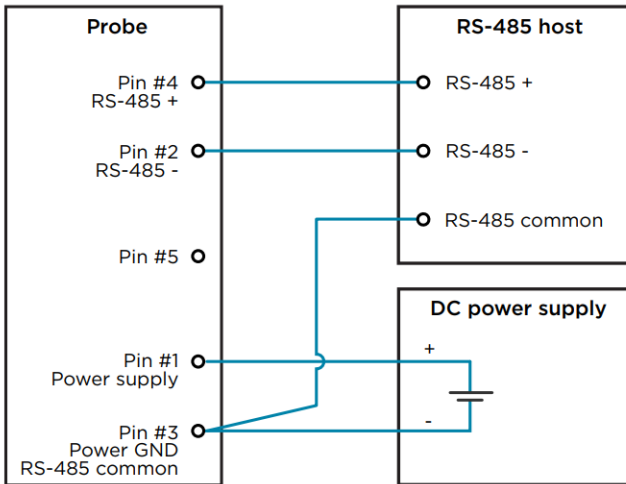


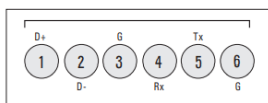
Figure 5 RS-485 wiring

**i** Recommended maximum length of the RS-485 line is 30 m (98 ft).

(HMPx Modbus wiring: HMP Series User Guide p.23)

The serial port pin configuration on the Allen-Bradley Micro820.

*Serial Port Terminal Block*



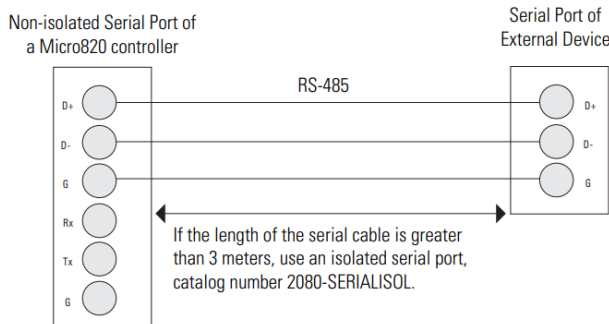
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(View into terminal block)

- Pin 1 RS485 Data +
- Pin 2 RS485 Data -
- Pin 3 RS485 Ground<sup>(1)</sup>
- Pin 4 RS232 Receive
- Pin 5 RS232 Transmit
- Pin 6 RS232 Ground<sup>(1)</sup>

(1) Non-isolated.

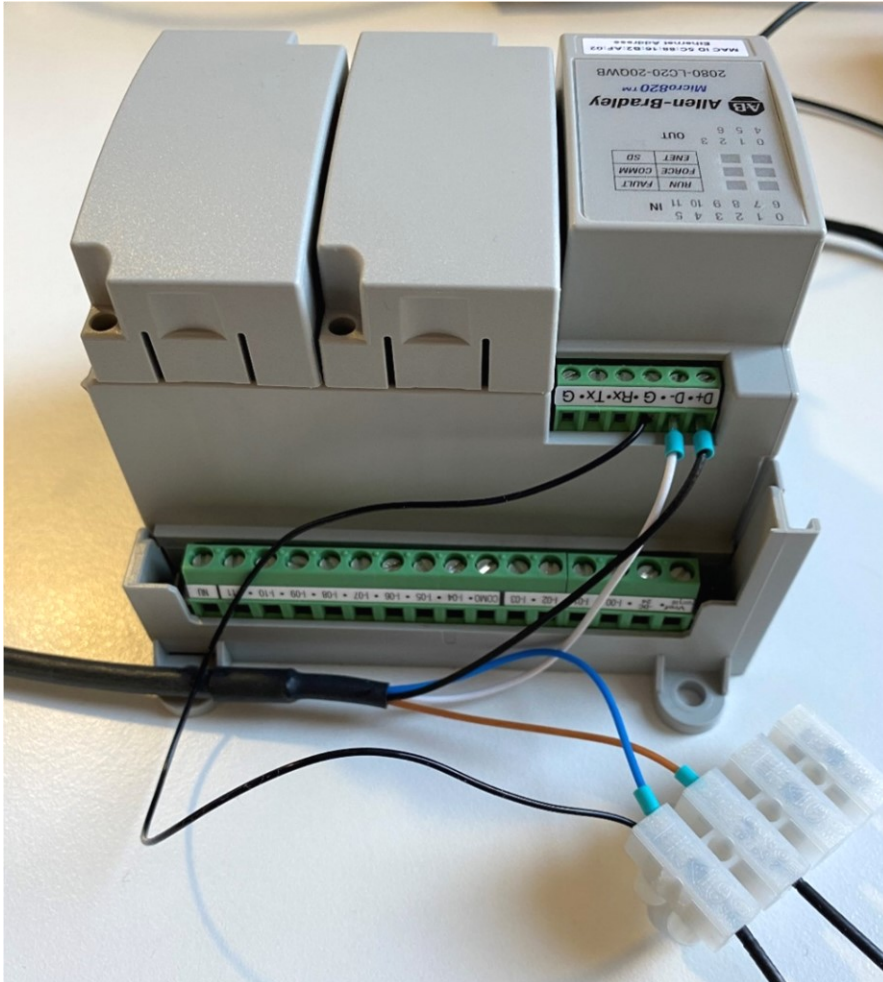
**Serial Port Wiring**



(Micro820 Serial Port Wiring: Micro820 Programmable Controllers User Manual p.48)

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4. Connect the black cable (pin 4) to D+(pin 1), the white cable (pin 2) to D-(pin 2), the Brown cable (pin 1) to DC power +, and the blue cable (pin 3) to G (pin 3) and DC power -.



## 2 Configuring the Serial Port Settings in Allen-Bradley micro820

In this section we will configure the Modbus RTU settings on the micro820 plc with Connected Components Workbench. At this point we assume you have Connected Components Workbench installed on your PC, your PLC is connected to a PC and you have a new project opened with the correct PLC selected.

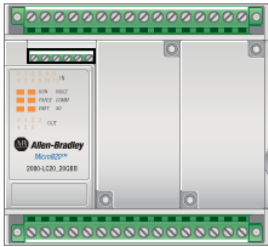
1. Select Serial Port under Micro820 Controller.
2. If the Remote LCD is configured to overwrite the serial port parameters, you will have to change the Remote LCD configuration.

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Micro820

Run  
Remote Run  Program  
Program

Download Upload Diagnose Secure



- Controller
  - General
  - Memory
  - Startup/Faults
  - Serial Port**
  - Ethernet
  - Interrupts
  - Modbus Mapping
  - Real Time Clock
  - Embedded I/O
  - Memory Card
  - Remote LCD
  - Data Log
  - Recipe
- Plug-in Modules
  - < Empty >
  - < Empty >

### Controller - Serial Port

**Common Settings**

Driver: CIP Serial

Baud Rate: 38400

Parity: None

Station Address: 1

**Remote LCD is configured to overwrite the serial port parameters.**

3. Select Remote LCD and uncheck the Configure Serial Port for Remote LCD box.

- Controller
  - General
  - Memory
  - Startup/Faults
  - Serial Port
  - Ethernet
  - Interrupts
  - Modbus Mapping
  - Real Time Clock
  - Embedded I/O
  - Memory Card
  - Remote LCD**
  - Data Log
  - Recipe
- Plug-in Modules
  - < Empty >
  - < Empty >

### Controller - Remote LCD

**Configure Serial Port for Remote LCD**

Status: Disconnected

**Hardware Settings**

Enable Push Button Key Read

Backlight Mode: Interval

Time Value: 30 sec

Contrast: 0% 100%

**Startup Message**

Display Time: 3 sec

Font Size: Large (8x16 pixel)

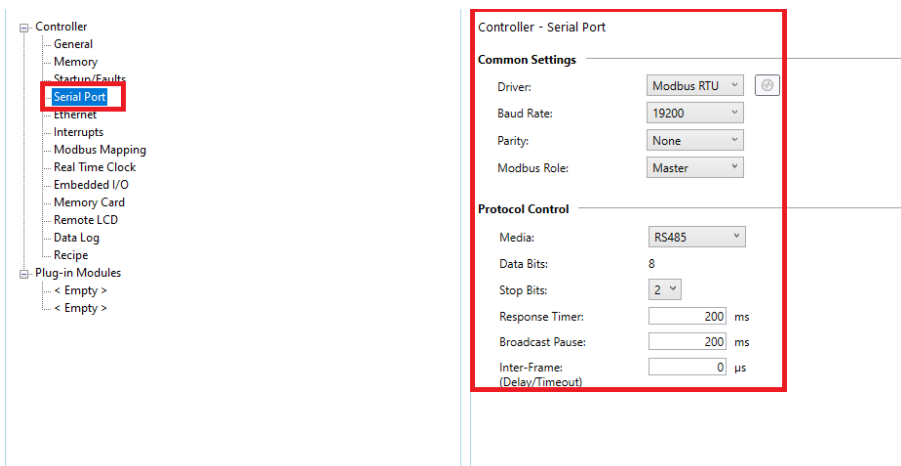
Max Size: 96 Characters (24 columns x 4 rows)

Message: 2080-REMLCD

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4. Select Serial Port again and configure to the following settings.

- Driver: Modbus RTU
- Baud Rate: 19200
- Parity: None
- Modbus Role: Master
- Media: RS485
- Data Bits: 8
- Stop Bits: 2



Reference the user manual for your own specific probe. Below is a reference to the HMP series probe.

## Appendix A. Modbus reference

### A.1 Default communication settings

Table 72 Default Modbus serial communication settings

Property	Description/Value
Serial bit rate	19200
Parity	None
Number of data bits	8
Number of stop bits	2
Flow control	None
Modbus device address	240

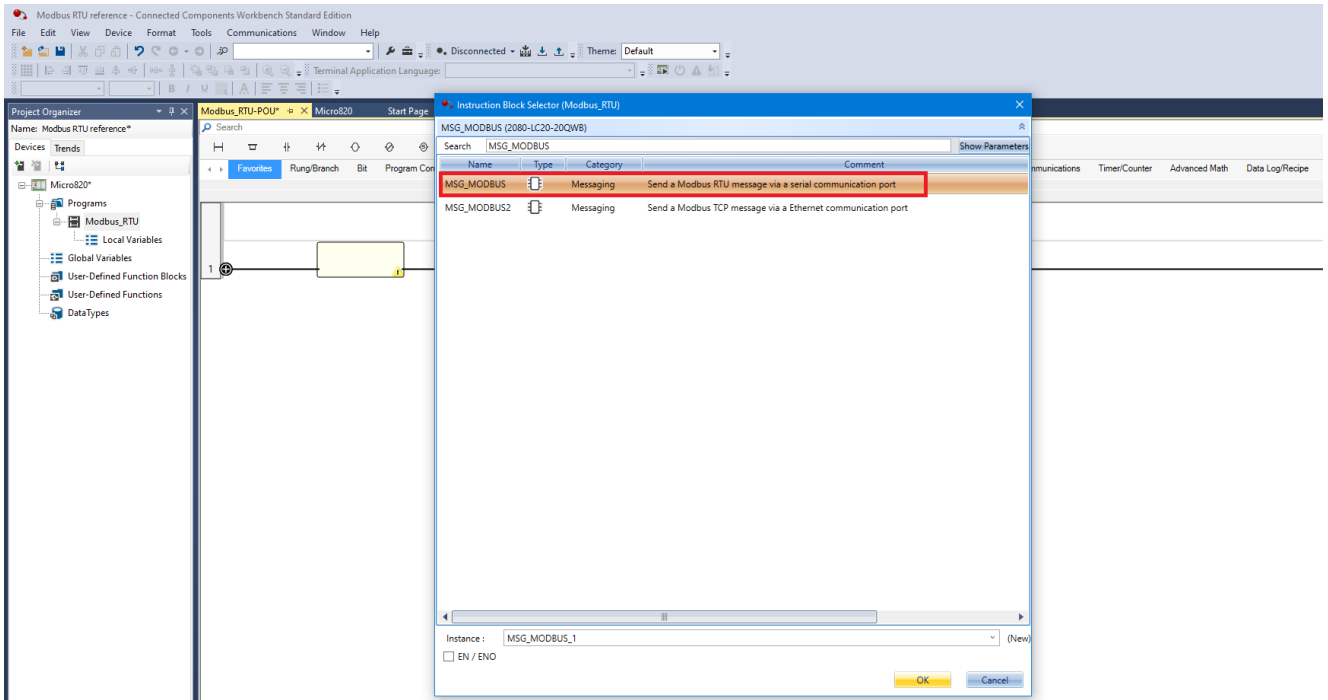
You can use up to ten probes on the same RS-485 line. You must configure each probe on the line to have a different Modbus address.

(HMP Modbus reference: HMP Series User Guide p.99)

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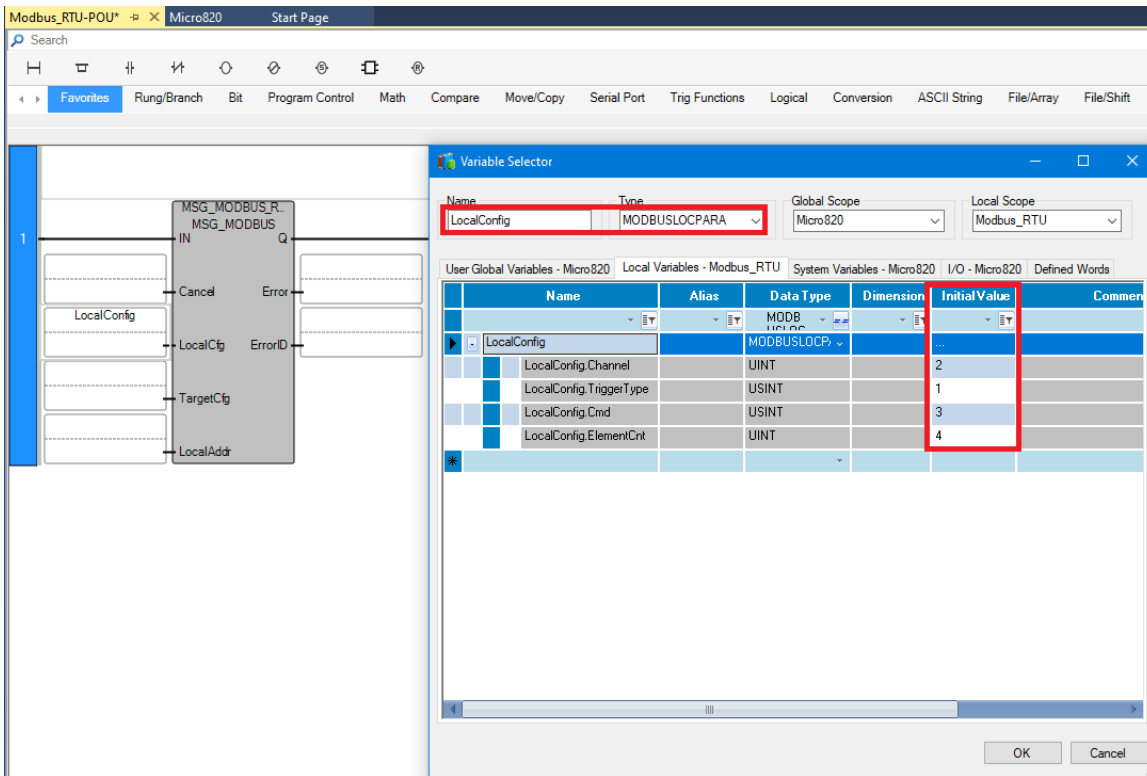
### 3 Reading Modbus registers

On Connected Components Workbench we will create a new program to read the registers of your Indigo probe. We will use the ready-made function MSG\_MODBUS to read the Modbus RTU registers.



1. Create a new Instruction Block and select MSG\_MODBUS: Send a Modbus RTU message via serial communication port.

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2. Create a new MODBUSLOCPARA variable for the LocalCf.
3. Fill in the following values into the InitialValues:
  - LocalCf.Channel: 2
  - LocalCf.TriggerType: 1
  - LocalCf.Cmd: 3
  - LocalCf.ElementCnt: 4

Or reference the table below.

We connected our HMP7 probe to the embedded serial port, so we must then select 2 for the Channel. In this example we chose 1 for the TriggerType for the continuous triggering, if you wish you can select 0 and create a timer which arbitrarily triggers at a certain interval. We chose 03 for Cmd to read the holding registers. We chose 4 for the ElementCnt because each value takes two registers and, in this example, we only want to read the relative humidity and temperature.

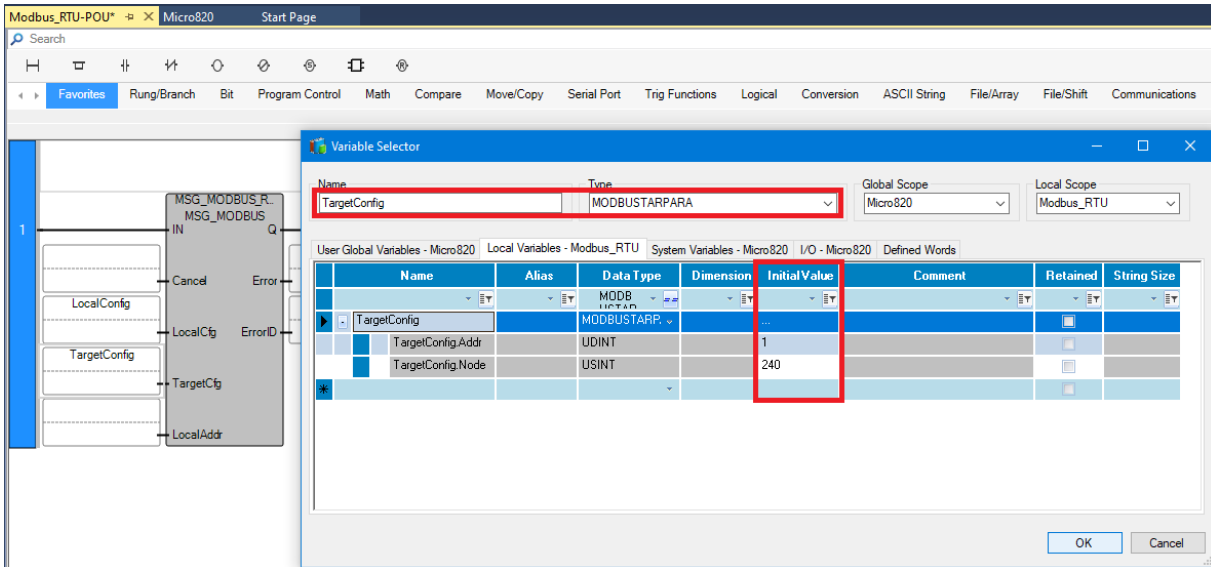
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Parameter	Data type	Description
Channel	UINT	<p>Micro800 PLC serial port number:</p> <ul style="list-style-type: none"> <li>• 2 for the embedded serial port, or</li> <li>• 5-9 for serial port plug-ins installed in slots 1 through</li> <li>• 5 for slot 1</li> <li>• 6 for slot 2</li> <li>• 7 for slot 3</li> <li>• 8 for slot 4</li> <li>• 9 for slot 5</li> </ul>
TriggerType	USINT	<p>Represents one of the following:</p> <ul style="list-style-type: none"> <li>• 0: Msg Triggered Once (when IN goes from False to True)</li> <li>• 1: Msg triggered continuously when IN is True</li> <li>• Other value: Reserved</li> </ul>
Cmd	USINT	<p>Represents one of the following:</p> <ul style="list-style-type: none"> <li>• 01: Read Coil Status (0xxxx)</li> <li>• 02: Read Input Status (1xxxx)</li> <li>• 03: Read Holding Registers (4xxxx)</li> <li>• 04: Read Input Registers (3xxxx)</li> <li>• 05: Write Single Coil (0xxxx)</li> <li>• 06: Write Single Register (4xxxx)</li> <li>• 15: Write Multiple Coils (0xxxx)</li> <li>• 16: Write Multiple Registers (4xxxx)</li> <li>• Others: Custom command support.</li> </ul> <p>MODBUSLOCPARA custom command support:            Custom Commands in the range of 0-255 that are not already assigned to a Modbus command are also supported. If a custom command is used then the LocalCfg:ElementCnt contains the number of bytes received.            The response is received into the Local Address Data and overwrites the request data.</p> <ul style="list-style-type: none"> <li>• Example for CMD=0x2B</li> <li>• Local Address Data 1:0x0E, READ_DEVICE_ID_MEI</li> <li>• Local Address Data 2:0x01, READ_DEV_ID_BASIC</li> <li>• Local Address Data 3:0x00, Read Vendor Object</li> </ul>
ElementCnt	UINT	<p>Limits</p> <ul style="list-style-type: none"> <li>• For Read Coil/Discrete inputs: 2000 bits</li> <li>• For Read Register: 125 words</li> <li>• For Write Coil: 1968 bits</li> <li>• For Write Register: 123 words</li> </ul>

(MODBUSLOCPARA data type: Reference Manual Micro800 Programmable Controllers General Instructions p. 196)



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4. Create a new MODBUSTARPARA variable for the TargetCfg and fill in the following values into the InitialValue:
  - TargetCfg.Addr: 1
  - TargetCfg.Node: 240

In this guide we are reading Relative humidity and Temperature, for other values reference your Vaisala probe's user guide. Vaisala probe's default Modbus device address is 240, it can be changed on Vaisala's insight software.

**MODBUSTARPARA data type** The following table describes the MODBUSTARPARA data type.

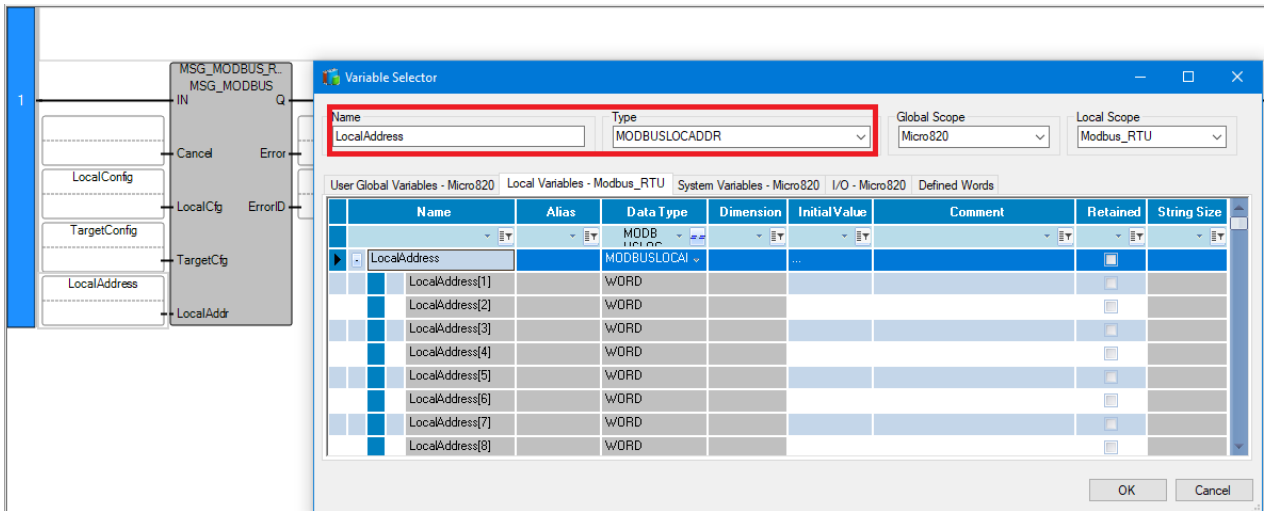
Parameter	Data type	Description
Addr	UDINT	Target data address (1 - 65536). Decreases by one when sending.
Node	USINT	The default slave node address is 1. The range is 1- 247. Zero is the Modbus broadcast address and is only valid for Modbus write commands (for example, 5, 6, 15 and 16).

(MODBUSTARA data type: Reference Manual Micro800 Programmable Controllers General Instructions p. 199)

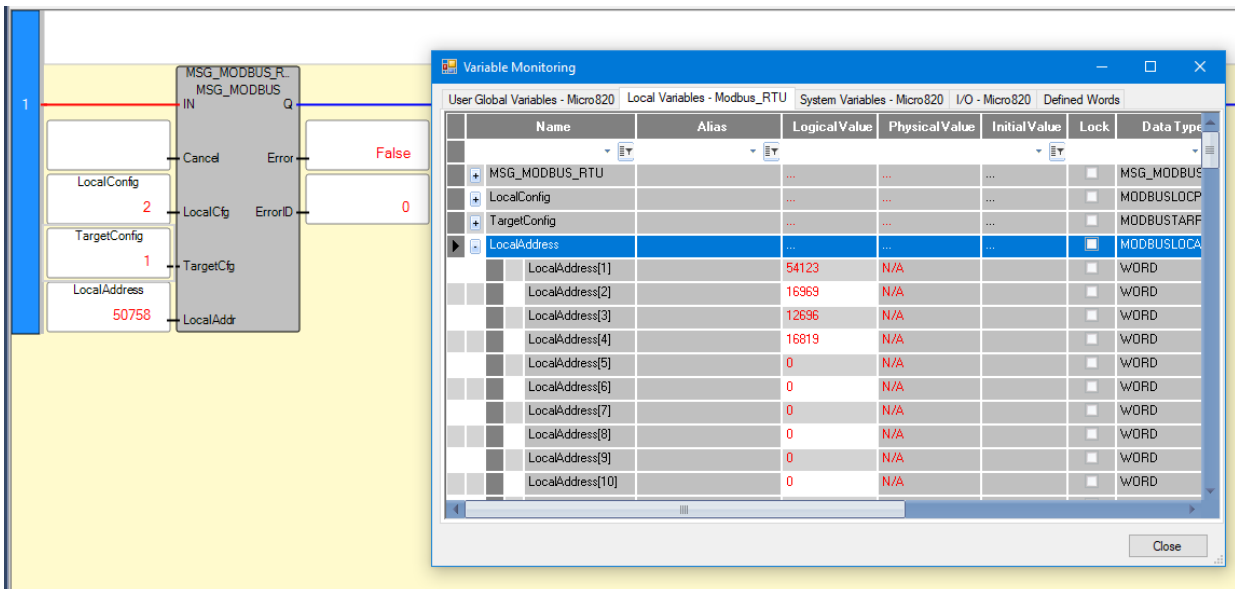
Register number	Address	Register description	Data format	Unit
1	0000 <sub>hex</sub>	Relative humidity	32-bit float	%RH
	0001 <sub>hex</sub>			
3	0002 <sub>hex</sub>	Temperature	32-bit float	°C
	0003 <sub>hex</sub>			

(Modbus registers: User Guide Vaisala Indigo compatible humidity and temperature probes **HMP Series with MMP8 and TMP1** p. 101)

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5. Create a new MODBUSLOCADDR variable for the LocalAddr, you do not need fill in any InitialValues.
6. Download the project to the Micro820 PLC then switch to run mode.
7. Your LocalAddr variable should looks something like this. Now it is time to combine the word addresses to 32-bit floating point values.



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## 4 Converting word addresses to human readable 32-bit floating point values

Vaisala probes send the 32-bit data in two 16-bit registers in Little-Endian format via Modbus RTU, Allen-Bradley Micro820 on the other hand is expecting the data to be in Big-Endian format. There is no option in settings to change this so we will have to create a user defined function to convert the data from Little-Endian to Big-Endian.

```

1  i := 1;
2  WHILE i < 4 DO
3      SwappedEndianArray[i] := EndianArray[i + 1];
4      SwappedEndianArray[i + 1] := EndianArray[i];
5      i := i + 2;
6  END_WHILE;

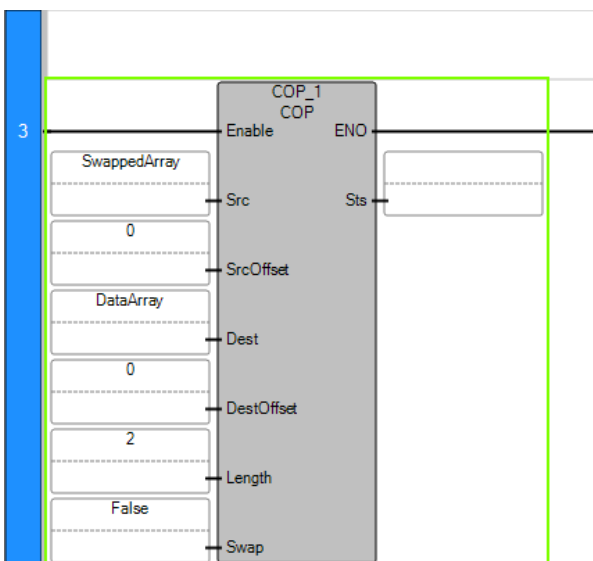
```

Here is an example function which copies the values from one array to another while swapping the values of the pair.

Name	Alias	Data Type	Direction	Dimension	Initial Value	Comment	String Size
EndianArray		WORD	VarInput	[1..125]	...		
SwappedEndianArray		WORD	VarOutput	[1..4]	...		
i		DINT	Var				
*							

It takes the WORD array with length 125, the same as the LocalAddr, and returns a WORD array with length 4. We chose a length of four in this example because we are only taking the first two values: relative humidity and temperature.

To combine the two words into a single 32-bit floating point value, we will use the COP function.



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The COP function copies the binary data from the source array to the destination array. In our case it copies the bits from the two words and concatenates them to create a 32-bit element which it reads as float.

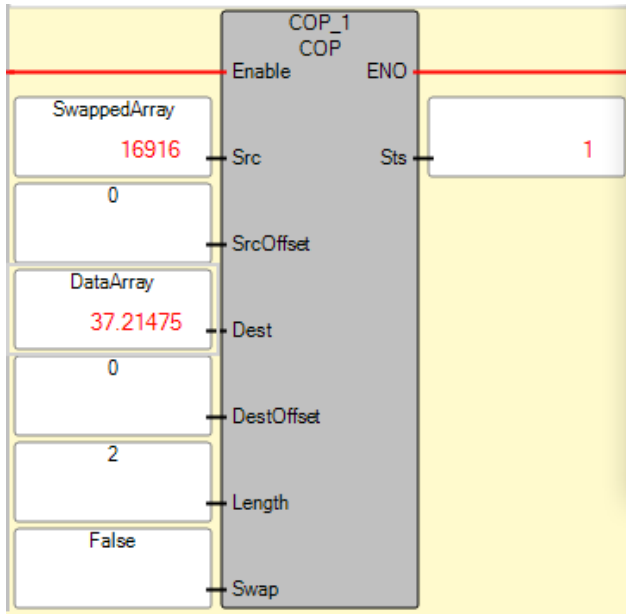
The source element is the Big-Endian word array of length 4 which we created with the previous user function. The destination element is a REAL array of length 2. We are not offsetting any of the arrays in this example, so the values inputted are 0. The length set as 2 as we are only inputting two values into our destination array.

**Chapter 13 Data manipulation instructions**

Src	Input	BOOL SINT USINT BYTE INT UINT WORD DINT UDINT	DWORD REAL TIME DATE STRING LWORD ULINT LINT LREAL	Initial element to copy. If the source is a STRING data type the destination must be either a STRING data type or a USINT (UCHAR and BYTE) data type. If it is not, a data type mismatch is reported.
SrcOffset	Input	UINT		The source element offset is used with array data types to identify the position in the source array to copy the data from. Set the offset to 0 if: <ul style="list-style-type: none"> <li>• If it is not an array data type, or</li> <li>• To copy from the first element for an array data type.</li> </ul>
Dest	Input	BOOL SINT USINT BYTE INT UINT WORD DINT UDINT	DWORD REAL TIME DATE STRING LWORD ULINT LINT	Initial element to be overwritten by the source. If the destination is a STRING data type the source must be either a STRING data type or a USINT (UCHAR and BYTE) data type. If it is not, a data type mismatch is reported.
DestOffset	Input	UINT		The destination element offset is used with array data types to identify the position in the destination array to copy the data to. Set the offset to 0 if: <ul style="list-style-type: none"> <li>• If it is not an array data type, or</li> <li>• To copy from the first element for an array data type.</li> </ul>
Length	Input	UINT		Number of destination elements to copy. When the destination is a STRING data type, it indicates the number of strings to be copied.
Swap	Input	BOOL		Used to exchange the data from the source and destination elements, so that the destination data replaces the source data and the source data replaces the destination data. TRUE - Swap bytes according to the data type. A swap operation does not occur if: <ul style="list-style-type: none"> <li>• The source data type or the destination data type is a STRING, or</li> <li>• If both the source and the destination are 1-byte length data.</li> </ul>
Sts	Output	UINT		Status of the copy operation. The definitions for the Sts parameter are defined in COP status codes.
ENO	Output	BOOL		Enables output. Applies only to Ladder Diagram programs.

The data array should now contain two values, the first being the relative humidity and the second one being temperature.

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...	...	...	...	...	...	...	...
▶	DataArray					<input type="checkbox"/>	REAL [1..2]
	DataArray[1]		37.21476	N/A		<input type="checkbox"/>	REAL
	DataArray[2]		22.25081	N/A		<input type="checkbox"/>	REAL

(COP function parameters: Reference Manual Micro800 Programmable Controllers General Instructions p. 284)

References:

- User Guide Vaisala Indigo compatible humidity and temperature probes HMP Series with MMP8 and TMP1 (M212022EN-F)
- User Manual Allen-Bradley Micro820 programmable Controllers (2080-um005\_-en-e)
- Reference Manual Micro800 Programmable Controllers General Instructions (2080-RM001J-EN-E)