



MR340

Fiber Optic Angle Sensor

Instruction Manual

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Revision History

Rev A	Initial Release
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Table of Contents

Revision History	2
1. Product Description	5
1.1 Position Sensor Background	5
1.2 Fiber Optic Angle Sensor.....	5
1.3 Features	7
2. Initial Preparation.....	8
2.1 Unpacking and Inspection	8
2.2 Damage in Shipment	8
2.3 Standard Contents	8
3. Installation and Operation.....	9
3.1 Mounting the Sensor Unit.....	9
3.2 Mounting the Controller Unit	10
3.3 Connecting the Controller	11
3.4 System Start-Up without PC Computer	14
3.5 Functional System Overview.....	15
3.6 SSI Interface	17
3.7 Voltage Output.....	19
3.8 Isolated Current Output (4-20mA).....	20
3.9 Low-Pass Filter Function	21
3.10 Digital Set Points	22
4. Serial Communication – MODBUS.....	23
4.1 USB-Serial Emulator	23
4.2 Serial Interface Specification	24
4.3 Physical Connection for ModBus operation	24
4.4 Serial Bus Termination Resistor.....	25
4.5 MODBUS Communications Protocol	25
5. MR340 - Error Handling and Troubleshooting.....	31
5.1 Explanation of Status and Error Handling	31
5.2 Explanation of Status and Error Indication.....	31
5.3 Reading the Error Counters	34
5.4 Warranty Information	35
6. Specifications.....	36
6.1 MR341 Sensor Specifications.....	36
6.2 MR340 Controller Specification	37

7. AngleView™ SOFTWARE	39
7.1 AngleView™ – MR340 Setup Software Installation Guide	41
8. MR340 Theory of Operation.....	45
9. Mechanical Reference Drawings	46
9.1 MR340-1 Controller	46
9.2 MR332 Sensor	46

List of Figures

Figure 1 Micronor MR340 Fiber optic Position Sensor System.....	6
Figure 2 Mounting MR340 Controller on DIN Rail.....	10
Figure 3 How to insert and remove wires from WAGO plug.	12
Figure 4 Inserting/Removing WAGO plug from MR340 unit.....	13
Figure 5 Block Diagram of MR340 System.....	15
Figure 6 SSI Interface Connector - J2 (10 pin).....	17
Figure 7 SSI Termination Resistor Switch	17
Figure 8 SSI Single Transmission Timing	18
Figure 9 Voltage output without filtering and voltage output with filtering.....	21
Figure 10 Photograph of MR232-1 RS422/RS485-to-RS232 Adapter Cable.	41
Figure 11 Block-Diagram Angle Sensor	45

List of Tables

Table 1 Table of Error Codes.....	33
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1. Product Description

1.1 Position Sensor Background

Position sensors are typically used to provide an absolute position from a mechanical moving device to a controller unit. The position information is either used to measure a position or to close the servo loop for an automatic positioning system. The key characteristics of an absolute position sensor are:

- Accuracy
- Resolution
- Time response of the actual position

1.2 Fiber Optic Angle Sensor

The MR340 series fiber optic Angle Sensor (Goniometric sensor) is an innovative all-optical design immune to any electro-magnetic interference such as magnetic fields, lightning, radiation, high voltage and other harsh environmental conditions. The fiber optic aspect of the sensor also makes it perfectly suited for long distance position sensing over thousands of meters without being affected by ground loop problems. This innovative product measures absolute angular position from 0° to 45° with a resolution of 0.1° .

This Angular sensor system has been optimized to sense the angle within a limited range while unaffected by changes in the quality of the fiber optic line. Applications range from medical (MRI) to Oil & Gas industry where the position of valves need to be monitored all the way to applications for the aerospace industry monitoring flaps, ailerons and the like on aircraft.

The sensor modulates the optical signal spectrum based on the position of the sensor shaft. This modulated optical signal is analyzed within the controller and translated into the position signal. Because the sensor is electrically passive it can be deployed in EMI/RFI intense environment without being disturbed by such interference. The sensitivity of the sensor is such that it is possible to accurately sense the position **in excess of 10km fiber length!**

The position signal is measured and updated at a rate of 1 kHz. The controller provides a host of interface capabilities such as scalable analog voltage and current outputs, digital SSI (Serial Synchronous Interface) output and a MODBUS compatible serial interface.

Figure 1 shows the position sensor connected to the controller unit. There are two optical fiber strands within the black cable. One fiber is to transmit light to the unit and the second fiber is to receive the modulated light from the sensor unit.



Figure 1 Micronor MR340 Fiber optic Position Sensor System

1.3 Features

- Absolute Angular Position with 0.1° Resolution
- Immune to Electrical Interference
- Non metallic design immune to MRI environment.
- Non metallic design is immune to corrosion and is ideal for off-shore applications.
- Zero Emitted Electrical Radiation
- Long Distance Transmission without Interference, exceeding 10km.
- Utilizes standard 62.5/125µm communications fiber
- Multiple interfaces built-in into one unit!
 - SSI Interface
 - MODBUS RTU via RS422/RS485 serial interface.
 - USB Interface
 - Two Scalable Analog Position Outputs ($\pm 10V$ and 4-20mA)
 - Two Programmable Digital Set-Points
- User settable Zero Position
- External Zero Position input.
- Zero Position Indicator LED for easy installation
- Powers from +12V DC to +30VDC
- AngleView™ Setup Software

2. Initial Preparation

2.1 Unpacking and Inspection

The unit was carefully inspected mechanically and electrically before shipment. When received, the shipping carton should contain the following items listed below. Account for and inspect each item before the carton is discarded. In the event of a damaged instrument, write or call your nearest MICRONOR office in the U.S. A. Please retain the shipping container in case reshipment is required for any reason.

2.2 Damage in Shipment

If you receive a damaged instrument you should:

- 1) Report the damage to your shipper immediately.
- 2) Inform MICRONOR
- 3) Save all shipping cartons.

Failure to follow this procedure may affect your claim for compensation.

2.3 Standard Contents

MR341 Sensor:

- MR341 Sensor Unit with fiber cable length as ordered and terminated with Duplex LC connector.
- Test Protocol Sheet
- Instruction Manual (this document, one soft copy supplied with each shipment)

MR340-1 SSI Controller Module:

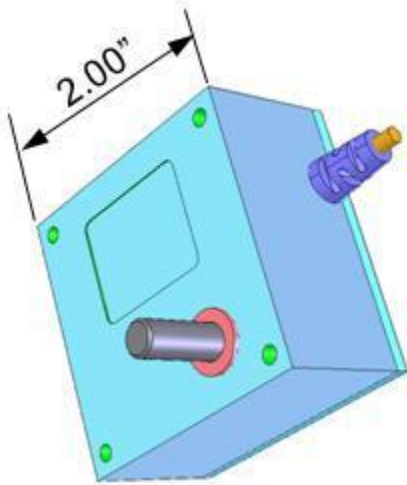
- MR340-1 Controller Module
- WAGO type connector inserted as part of the unit.
- WAGO connector wiring tool.
- WAGO strain relief, quantity 3
- MR340 Short Instruction Manual (Paper Copy)
- MR340 Full Instruction Manual (supplied as PDF on CDROM)
- AngleView™ Setup Software (on CDROM)

Available accessories (must be ordered separately):

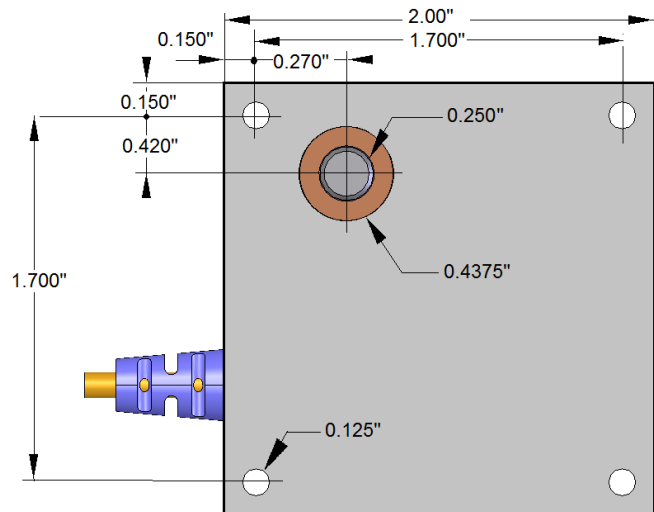
- MR320-D06CXX cable assemblies (for extended links)
- MR320C Duplex LC mating adapter (for connecting cable segments)

3. Installation and Operation

3.1 Mounting the Sensor Unit



The sensor is 2" x 2" in size and has a 0.25" shaft diameter.



Use the 4 0.125" holes to mount the sensor as required. Make sure that the shaft is mechanically properly coupled. For optimal precision and durability a flex-coupling or lever arm may be required.

Make sure that the mechanical device actuating the shaft of the MR341 does not over torque the sensor at either limit position. The MR341 sensor travels only 45°. It is advisable to make use of the mechanical range that is slightly less than the 45° available. Start with 3° to 5° and stop at 42°. This assures that the sensor shaft will not be pushed past its mechanical limit.

Once the unit is mechanically installed, then calibrate the unit as follows:

- 1.) set the mechanical system to the desired 0 position
- 2.) connect the fiber optic link to the controller. Make sure the PWR LED is steady. i.e no errors.
- 3.) push the ZERO button on the MR340 Controller Unit.
- 4.) the ZERO LED should no light up while the sensor is at the zero position.
- 5.) test unit and move the sensor. The MOVE LED should light up as the sensor is in motion.

The system is now ready and functional. Please consult this instruction manual for further setup instructions, such as output scaling.



3.2 Mounting the Controller Unit

The controller unit may be best mounted on DIN rails. There are two clamps on the bottom of the unit. Slide the unit onto the DIN rail starting from top and hook the bottom onto the rail.

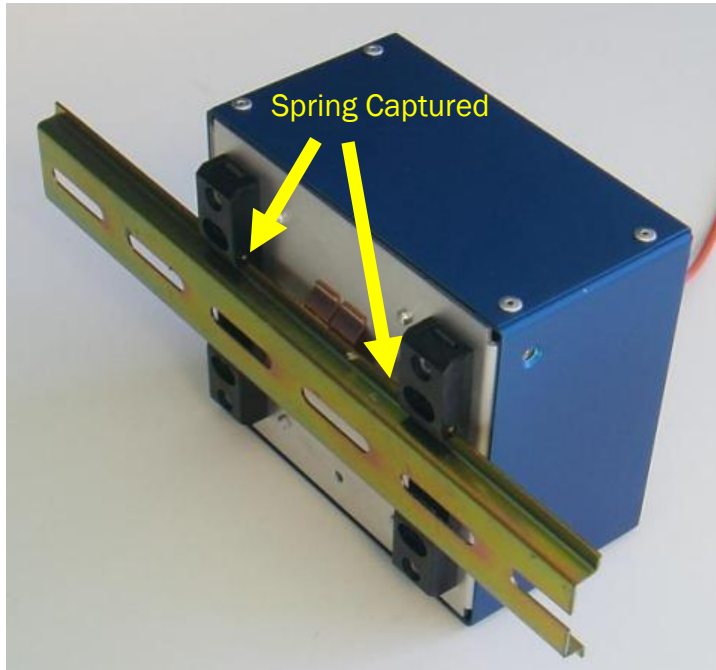
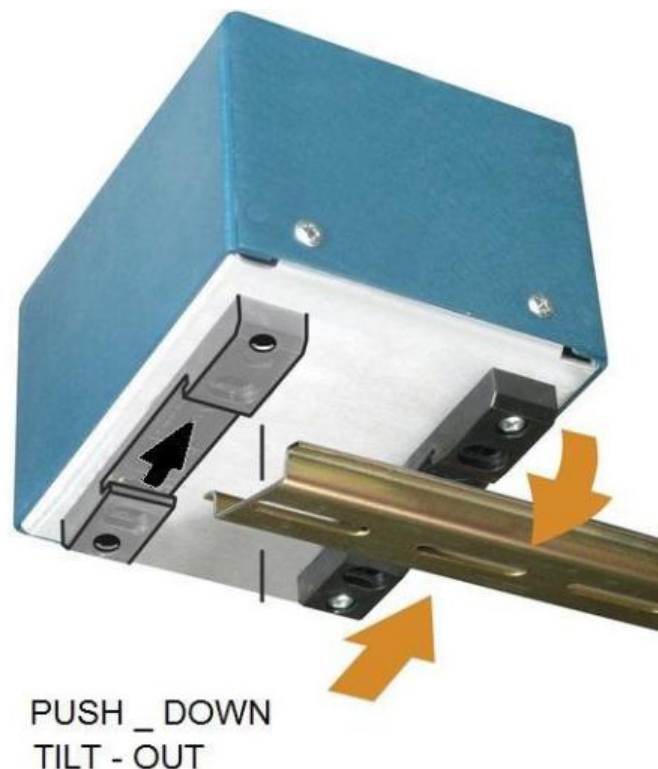


Figure 2 Mounting MR340 Controller on DIN Rail

To remove the unit from the rail press the unit firmly down and lift the bottom away from the DIN rail.

To remove the controller, push down from top of the controller and tilt out away from the DIN Rail.

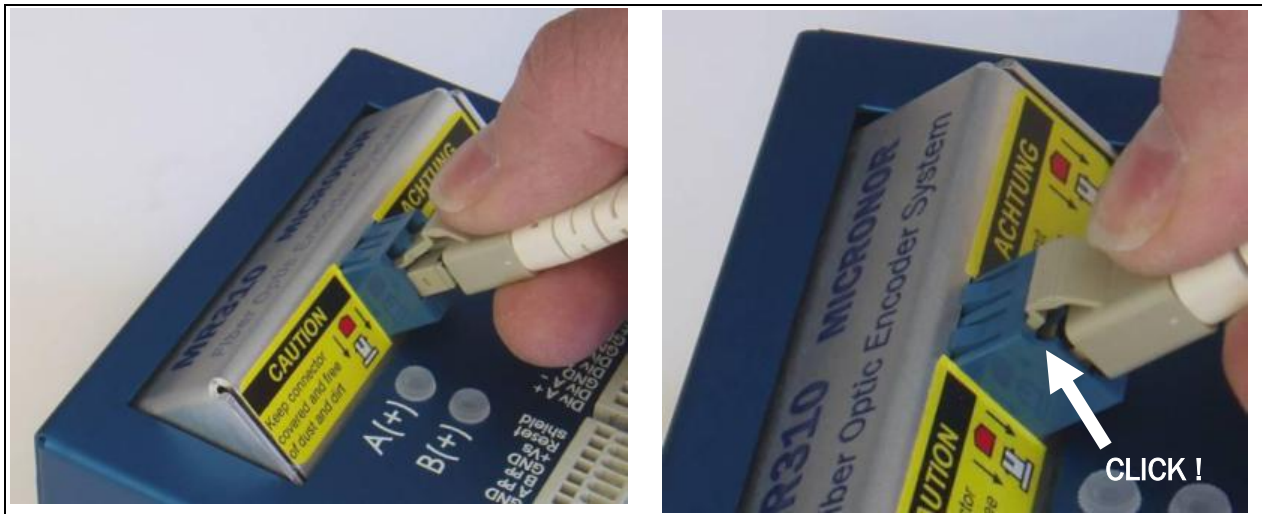


3.3 Connecting the Controller

A duplex fiber optic cable is used to interconnect the sensor and controller. The sensor incorporates an optical pigtail of length as specified by customer. If a longer connection to the controller is required then an extension fiber cable having duplex LC connector may be used.

Remove the dust cap from both the connector on the cable and the receptacle on the controller. Insert the LC connector as shown. There should be a positive click when the connector is engaged properly.

Connections to the MR340 Controller Module



Electrical Connections MR340 Controller

J1 Connections and Power Supply	
1	ZERO OUT
2	GND
3	Set Point 1
4	GND
5	Set Point 2
6	GND
7	BAT+
8	24V
9	GND (power)
10	+Vs (power) (15V to +30V)
11	ZERO IN
12	Shield

J2 Connections Data SSI and Analog Output	
1	±10V position output
2	GND
3	SSI Clock +
4	SSI Clock -
5	SSI Data +
6	SSI Data -
7	+24V IN
8	GND
9	4-20mA out +
10	4-20mA out -

J3 Connections RS422/485 Serial I/O	
1	GND
2	+5V Out (10mA max, power for MR232-1 RS232 Adapter)
3	TX+ →
4	TX- →
5	RCV+ ←
6	RCV- ←

All three Terminal Connectors are WAGO type Mini Multi Connection System with 2.5mm spacing. One each of these connectors are included.

WAGO Connector Part Numbers for Terminal Connectors		
Location	MICRONOR PN	WAGO PN
J1	63-733-112	733-112
J2	63-733-110	733-110
J3	63-733-106	733-106
Tool	63-233-335	233-335

These terminal connectors are non-screw connections and accept wires from AWG20 through AWG 28 or 0.5mm² to 0.08mm². The WAGO terminal blocks are a convenient way to pre-wire harnesses.

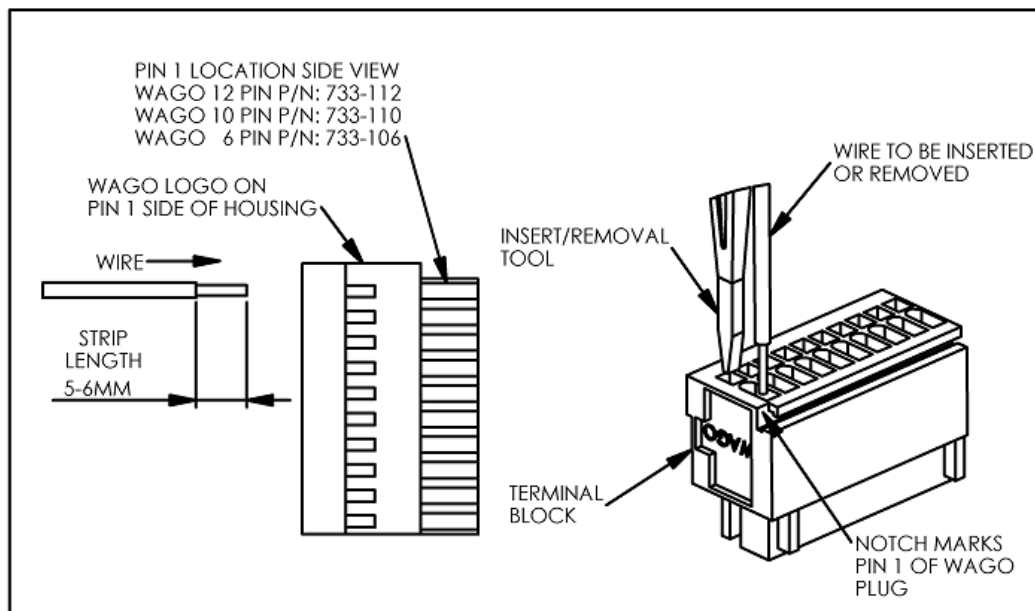


Figure 3 How to insert and remove wires from WAGO plug.

Making connections to the MR340 Controller is easy via the WAGO QuickConnect plugs:

1. Strip the wire approx. 0.22" (5mm to 6mm) length.
2. Insert the white operating tool into the square hole of the terminal.
3. Then insert the stripped wire all the way down and remove the operating tool.
4. When wiring completed, simply insert the WAGO plug to the appropriate interface connector on MR340 (J1, J2 or J3). To remove the WAGO plug, grab top and bottom of plug and pull to disconnect

Apply 24VDC electrical power to the controller unit. The current consumption is typically 70mA and should be less than 100mA at all times.

① The controller PWR LED will light up. A steady light indicates proper operation and the sensor is installed correctly. (Blinking of this LED indicates an error condition. See Section 5x.xx for error codes)

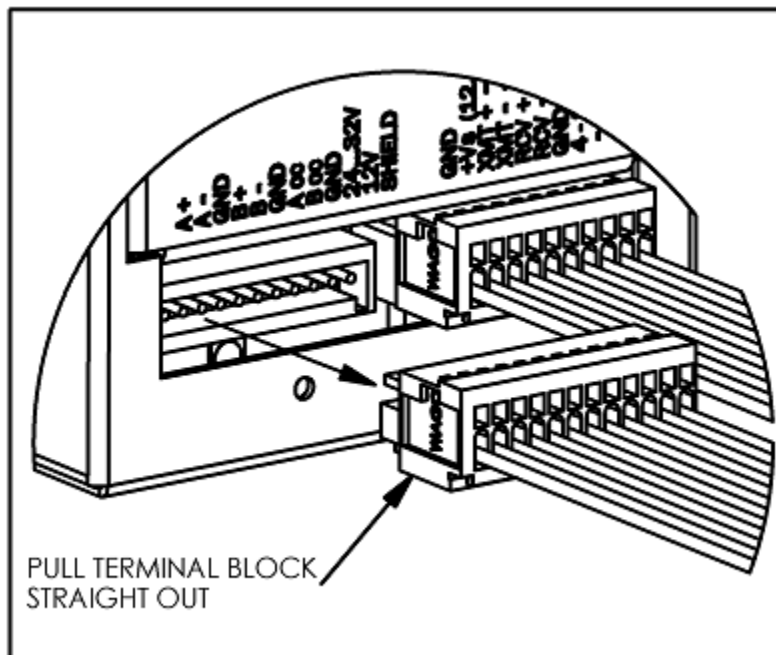
⊕ The ZERO indicator LED will be On when the position sensor is at 0 position.

➤ The RUN indicator LED will be ON whenever the sensor is in motion.

Status information is provided by a blinking PWR LED.

See Section 5 for more details regarding status and error codes.

Blinks	Code Description
Steady ON	System is ok. Shaft position within measuring range
2	External Supply Voltage is low
3	No optical signal, i.e. Fiber disconnected
4	System Problem



For streamlining wiring the WAGO connectors are removable as plugs. This is a practical arrangement when wiring harnesses be prepared without the unit present or when the a controller unit needs to be exchanged for maintenance purposes.

Figure 4 Inserting/Removing WAGO plug from MR340 unit

3.4 System Start-Up without PC Computer

It is recommended to use a PC (laptop) computer when bringing an MR340 Angle Sensing System on-line. Micronor provides the AngleView™ software for setting parameters and for diagnostics of the system. Checking the system after installation with AngleView™ provides assurance that the installation is complete and the system functions perfectly.

There may be instances where no PC is available. Installations that use only the analog or SSI outputs do not require specific programming on-site, especially if the MR340 controller was specially pre-configured for the customer's application at the factory - or the customer is using the default settings.

Install the sensor as described above, connect the fiber optic line and apply 24V to the MR340 controller. If the power LED comes ON steady state, that means all tests are good and the system is ready to go. If the LED indicates system OK, then all is left to set the home (zero) position. Bring the system to the desired home location and activated the recessed button as shown in figure below.

If the power LED does not turn steady state after approximately 5 seconds that indicates the unit is not fully functional. Count the number of blinks and proceed as shown in table below.



Blinks	Meaning	Remedy
3	No Optical Connection	Check the optical fiber link for high losses
2	Supply Voltage	Either internal or external supply voltages are out of range. Check the 24V power supply and the connection to the MR340 controller. Also check current draw of the unit, it should be less than 80mA.

When the MR340 controller indicates a Status, then it is advisable to use AngleView™ on a PC and connect the PC via USB or serial interface to the MR340 to troubleshoot the problem.

3.5 Functional System Overview

The MR340 system consists of an electronically passive sensor (MR341) which is connected to the MR340 Controller via a duplex 62.5/125um optical fiber link.

The MR340 Controller constantly probes the sensor by sending an optical signal to the sensor. The sensor modulates the optical spectrum of that light pulse depending on the sensor angular position.

The MR340 controller receives this modulated optical signal, evaluates the optical spectrum and calculates the angular position. The spectrum of the light used as the information carrier because it retains the information regardless of the fiber optic line quality.

Figure 5 shows the functional blocks to which the user interfaces. This block-diagram does not show the details of the sophisticated optical measurements and algorithms employed to extract the position information.

As the block diagram shows, the position signal is routed to all the various output interfaces built into the unit.

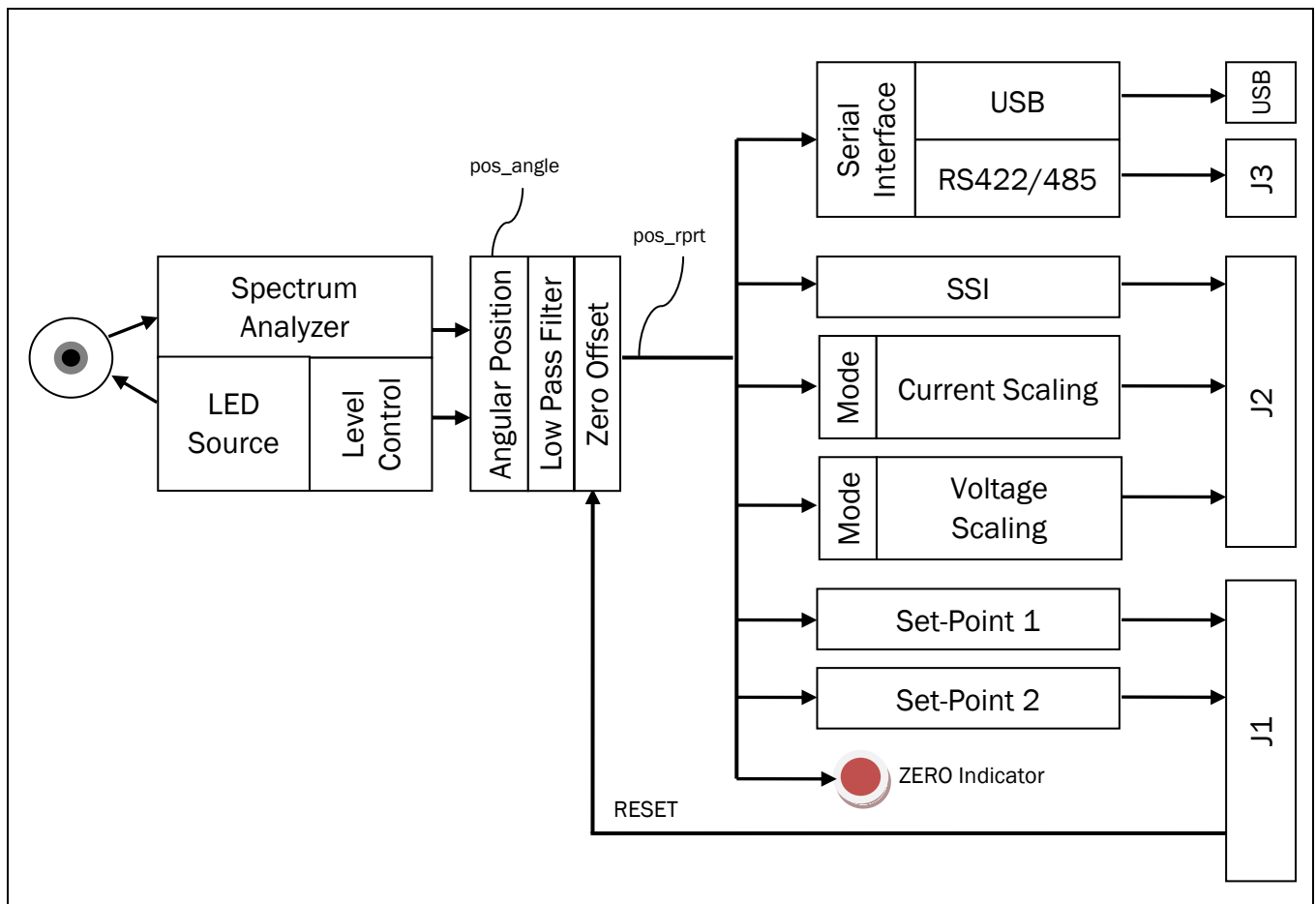


Figure 5 Block Diagram of MR340 System

The Serial Interface conforms to the MODBUS standard and is the main communications interface, specifically also for setup and configuration purposes. To make interfacing PC computers easy there is a built-in USB interface as well.

The SSI interface is often used to interface with PLC controllers and other automation equipment. This output always toggles out fixed 25bits in 0.1° increments. Typical output readings would be 0 to 450.

The Current Output is a fully isolated 4-20mA loop powered output. It has two programmable operating modes and scaling is possible via the AngleView software. Digital to analog output resolution is 13bits

The Voltage Output provides voltage from -10V to +10V and it has two programmable operating modes and it is freely scalable. Digital to analog resolution is 12 bits plus sign.

Two independent digital Set-Point outputs provide a Limit Switch like behavior. These outputs can be programmed to turn ON or OFF at a specific position. These outputs can drive or sink approximately 10mA at 24V

An additional digital output is tied together with the Zero LED indicator and the output goes high when the unit is at the zero or home position.

One external input is provided to SET the programmable home position (usually zero). When this input goes high then the position is set to the user programmable home position. It is possible to pre-set the home position to another value other than zero.

Detailed usage and functionality is described within this instruction manual.

3.6 SSI Interface

The MR340 Controller communicates the position information as an SSI SLAVE to the servo controller or similar devices. The SSI master supplies the clock within the range of 25kBaud to 250kBaud clock speed and toggles out 25 bits from the MR340 Controller.

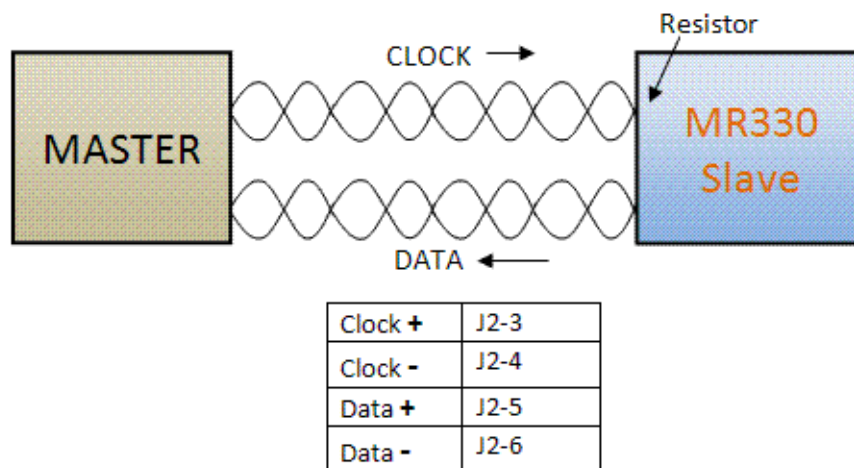


Figure 6 SSI Interface Connector - J2 (10 pin).

The SSI interface is configured as slave and the master must supply the clock. The clock maybe in the range from 25kHz to 250kHz. The user should also set the MR340 with the appropriate clock rate. This will allow the MR340 to provide correct timing for repeat read mode on the SSI bus. If not sure how to set the SSI baudrate leave it at the lowest setting of 25k baud, this setting will work fine in most applications

Termination Resistor

For long link length and high clock rate it may be necessary to terminate the Clock line at the MR340 in order to avoid reflective signal interference. There is already such a resistor available and the resistor maybe configured manually. Underneath Connector J2 you find two switches. To activate the 125 Ohm termination resistor for SSI use the switch SW2 to the left. (SW3 to the right is for terminating the MODBUS serial Interface)

Transmission signal levels are typically 0..5V and are of line driver type as required by the SSI specifications.



Figure 7 SSI Termination Resistor Switch

SSI Single Transmission

The diagram in below illustrates a single data transmission using SSI protocol:

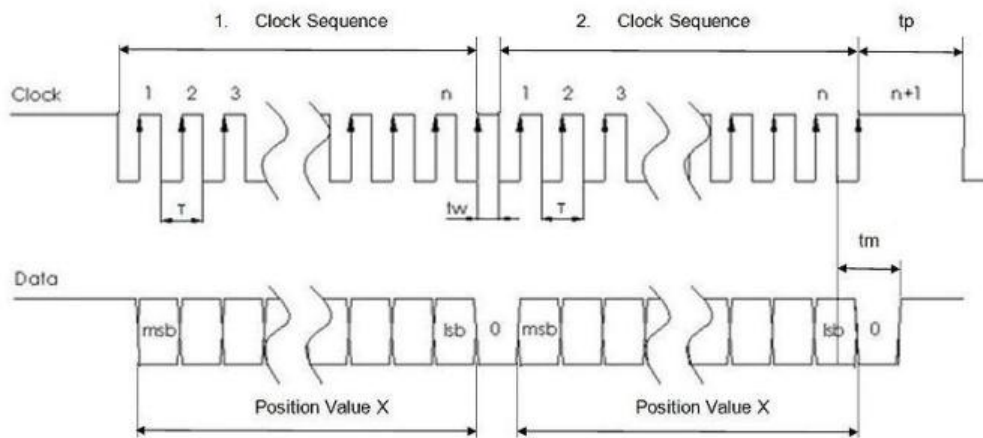


Figure 8 SSI Single Transmission Timing

The SSI is initially in the idle mode, where both the data and clock line are high. The transmission mode is evoked when the master initiates a train of clock pulses. Once, the slave receives the beginning of the clock signal (1), it automatically freezes its current data. With the first rising edge (2) of the clock sequence, the MSB of the sensor's value is transmitted and with consequent rising edges, the bits are sequentially transmitted to the output. After the transmission of complete data word (3) (i.e. LSB is transmitted), and an additional rising edge of the clock sets the clock line to go HIGH. The data line is set to low and remains there for a period of time, tm , to recognize the transfer timeout. If a clock signal (data-output request) is received within the time, tm , the same data as before will be transmitted again (multiple transmission). The slave starts updating its value and the data line is set to HIGH (idle mode), if there are no clock pulses within time, tm . This marks the end of single transmission of the data word. Once the slave receives a clock signal at a time, tp ($\geq tm$), then the updated position value is frozen and the transmission of the value begins as described earlier.

J2 Connections Data SSI and Analog Output	
1	±10V position output
2	GND
3	SSI Clock +
4	SSI Clock -
5	SSI Data +
6	SSI Data -
7	+24V IN
8	GND
9	4-20mA out +
10	4-20mA out -

In AngleView™ select page: ‘SSI Interface’

MODBUS commands:

Address	Register	Description
0x138	0x139	Baudrate SSI

3.7 Voltage Output

The analog output voltage is derived from the position signal and maybe freely scaled by the user. There are four distinct modes:

- Mode 0: OFF, voltage is always 0
 Mode 1: Scalable output -10V to +10V

MODE 1 Unit is freely scalable and the output follows the formula below:

$$\text{Output [V]} = \frac{10\text{V} * \text{Angle [1/10}^\circ\text{]}}{\text{User Scale}}$$

$$\text{User Scale} = \frac{10\text{V} * \text{Angle [1/10}^\circ\text{]}}{\text{Output [V]}}$$

Example: Set the output so that at 45.0° an output of 4.5V

$$\text{Scale} = \frac{10\text{V} * 450}{4.5\text{V}} = 1000$$

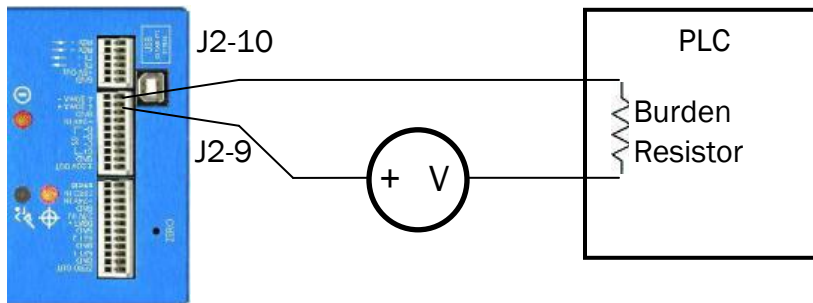
In AngleView™ select page: “**Voltage Output**” and enter the value 1000 for the new scale.

MODBUS commands:

Address	Register	Description
0x200	0x201	Voltage Mode
0x201	0x202	Voltage Scale

3.8 Isolated Current Output (4-20mA)

The isolated current output is derived from the position signal and may be freely scaled by the user. Since the output is isolated from the rest of the circuitry, it must be loop powered:



There are three selectable output modes:

- Mode 0: OFF, current is less than 300uA
- Mode 1: Scalable 4mA to 20mA

MODE 1 The user programmable scale defines the position where 20mA output current is reached.

$$\text{Output [mA]} = \frac{16\text{mA} * \text{Angle [1/10}^\circ]}{\text{User Scale}} + 4[\text{mA}]$$

$$\text{User Scale} = \frac{16\text{mA} * \text{Angle [1/10}^\circ]}{\text{Output [mA]} - 4[\text{mA}]}$$

Example: User desires to obtain 20mA (full scale) current when the sensor reaches 30.0°

$$\text{User Scale} = \frac{16\text{mA} * 300}{20\text{mA} - 4\text{mA}} = 300$$

In AngleView™ select page: “**Current Output**” and enter the value 300

MODBUS commands:

Address	Register	Description
0x202	0x205	Current Mode
0x203	0x206	Current Scale

3.9 Low-Pass Filter Function

There is a Low-Pass Filter Function built into the unit. The time constant is user programmable via the modbus interface. Through AngleView the time constant can be changed as desired by the application.

Select the appropriate filter number based on table below:

Filter Number	Time Constant [ms]
0	0.36
1	2.5
2	5
3	10
4	20
5	40
6	80
7	160

In AngleView™ select page “System Information”

MODBUS command:

Address	Register	Description
0x204	0x205	Filter Number 0..7



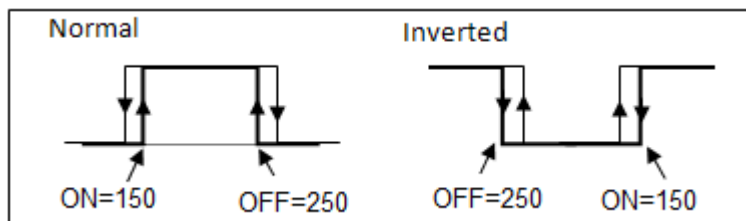
Figure 9 Voltage output without filtering and voltage output with filtering

3.10 Digital Set Points

There are two independent user programmable digital set points. These set points, once programmed, may be used as limit switches. Each output can drive a load of 10mA with 24V output

There are two independent user programmable digital set points. These set points, once programmed, may be used as limit switches. Each output can drive a load of 10mA with 24V output.

The switching point has a fixed defined hysteresis of 3 counts (0.3°). This hysteresis prevents undesired chatter on the output.



To program, simply define the point in position counts ($1/10^\circ$) where the output should turn ON (Set_Point_ON) and then define the point where the output should turn OFF again.

The example above shows defines the output to be ON at 15° (setpoint-ON set at 150counts) and turn OFF at 25° (setpoint-OFF set at 250 counts).

Should the output be inverted, reverse the position points of the two entries and the output will switch at the same position but with reversed sign.

In AngleView™ select page “Set Points”

MODBUS commands:

Address	Register	Description
0x230	0x231	Set Point 1 On
0x232	0x233	Set Point 1 Off
0x234	0x235	Set Point 2 On
0x236	0x237	Set Point 2 Off

4. Serial Communication – MODBUS

Integration with a PLC or other host computer within an automation system is via the ModBus compatible serial interface. The main purpose is to query the MR340 controller for angular position information which is accomplished by reading Register 0x001. In most cases, it is recommended to also include the status information registers 0x000 with the position register 0x001 for the same read request. (Read from register 0 and read 2 registers, a total of 4 bytes)

In addition to the position register the MR340 provides a host of auxiliary functions and parameter settings that the user may choose to utilize. All the functions and parameter settings maybe programmed by the PLC during system initialization. An alternate way is to pre-configure the MR340 using the MICRONOR provided AngleView™ software and permanently store all the parameters in the EEPROM. Specifically, an individual configuration of the MR340 controller is required when a specific ModBus address need to be preset before connecting the controller to the ModBus.

To access these functions and to familiarize yourself with the functionality of the MR340 controller we recommend to use AngleView™ software, which is supplied with the unit. To run AngleView™ you must have a Personal Computer available with a USB interface. If a USB interface is not available then a serial interface plus the MICRONOR RS232 to RS422/RS485 converter cable model RS232-1 (must be purchased separately) maybe used.

4.1 USB-Serial Emulator

The MR340, ModBus compatible, must communicate via a serial interface, thus the USB interface utilizes the Future Technology Devices International (FTDI) interface chip www.ftdichip.com. This chip communicates via USB, but within the PC emulates a serial COM port. When AngleView is installed the appropriate FTDI driver is installed on the PC. The conversion from USB to Serial is essential to keeping the communications protocol ModBus compatible. Even when communicating via USB the MR340 controller uses the actual baudrate and bus address settings. The baudrate of the PC's COMx port must therefore be set to match the baudrate of the MR340 controller.



The default bus address of the MR340 controller is **235**. This address is always available and no other device on the bus should use this address. The user may change the address of the MR340, however the unit will also respond to address 235.

The factory set and recommended baudrate is 57,600 baud.

4.2 Serial Interface Specification

- RS-422/RS485 Duplex addressable bus interface
- Baudrate programmable: 9,600 / 19,200 / 38,400 / 57,200 or 11,5200 baud
- 1 Start Bit
- 8 Data Bits
- 1 Stop Bit
- no parity

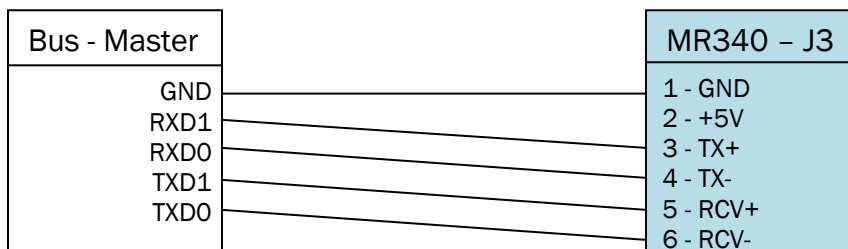
Factory Standard ModBus Address is set to 235 (Hexadecimal 0xEB).

When not using a USB interface, the optional MR232-1 Interface cable may be connected directly to a PC Computer via standard RS232 and DB9 connector. In that case the maximum baudrate is 57,600. The MR232-1 Interface cable converts the RS232 signals to the RS485 compatible signals of the MR340.

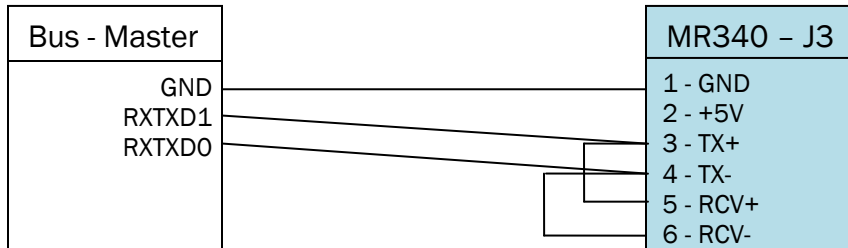
4.3 Physical Connection for ModBus operation

BUS Master	Wire	Slave		MR340 Connector -J3
TXD0	→	RXD0	A	RCV- (6)
TXD1	→	RXD1	B	RCV+ (5)
RXD1	←	TXD0	A	TX- (4)
RXD0	←	TXD1	B	TX+ (3)
GND		GND		GND (1)

Four Wire Configuration:



Two Wire Configuration:



4.4 Serial Bus Termination Resistor

The MR340 does have a user configurable internal 125 ohm bus termination resistor. If the MR340 is the last device on the bus and distance exceeds 5m then using the built-in termination resistor is advisable.



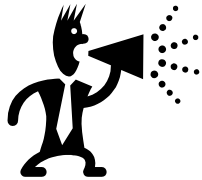
Lift J2 and the right hand switch is for bus termination of the serial bus signal.

The 125 ohm termination resistor is inserted when the switch is shifted to the left.

4.5 MODBUS Communications Protocol

The communications protocol follows the **Modbus RTU (binary) protocol**. A number of commands allow for configuring the operational parameters of the MR340 while other commands are specifically meant for diagnostics used during setup, maintenance and troubleshooting. The status and position readout registers are intentionally arranged in sequence for a quick readout while system is in operation mode. The format for the commands and responses in general follow the MODBUS RTU specification, with the exception that not all registers maybe combined within one readout sequence. See table below for allowable register combination.

→ MODBUS information can be obtained at: www.modbus.com



What Is AngleView™ Setup Software?

MICRONOR provides AngleView™ a user friendly setup program free of charge along with the purchase of the MR340 system. AngleView runs on Windows XP, Vista, Windows 7 and requires .net Framework4.0 to be on the machine. Please refer to section x.xx for detailed information.

- Unless you plan to connect the MR340 to your own PLC or computer equipment for real-time data retrieval you do not need to become familiar with the Communications protocol described herein.

Framing

Message frames are separated by a silent interval of at least 3.5 character times. If a silent interval of more than 1.5 character times occurs between two characters of the message frame, the message frame is considered incomplete and is discarded. A 16bit LRC/CRC Frame Check follows the message.

Device Address Selection:

The MR340 comes pre-configured with Device address 235

The MR340 always listens to address 235 (Broadcast Address). To re-program the device address, send desired new address via command FC10 to register 0x104 via the broadcast address (235) and then send the appropriate “STORE EEPROM” command via FC52 register

Upon that procedure the unit will listen to the newly assigned Device Address and the Broadcast address 235.

- In AngleView™, select tab page “System Info” and enter the desired new bus address and hit <enter> key. When the red “Save to EEPROM” button pops up push this button and the new address is stored in the MR340 controller.

→ REGISTER NUMBERS VS. METER ADDRESSES

In this instruction manual all register are referred to by their address i.e. starting at 0. Some Master devices (e.g., Modicon) require that the desired Register Number and not the Register Address be entered. The Register Number is 1 higher than the Register Address. For entry to these devices, add 1 to the Register Address shown in the tables below. The Register Address shown will then be output from these devices.

FUNCTION FC03 – Read Holding Registers

FUNCTION FC10 – Write Holding Registers

Holding registers FC03 are used for reading the position and all other parameters
 These Registers can be written using Function FC10 using identical address offset

Register Address	Register Number	Name	# regs	Range	Description
0x000	0x001	System Status	1 2 3	n/a	Returns the system status. num register = 1 : reads status only num register = 2 : reads status & angle num register = 3 : reads status & angle & power
0x001	0x002	Get Angle in 1/10°	1	n/a	Returns position angle in 1/10 of degrees (0..450) plus offset
0x002	0x003	Get Optical Power	1	n/a	Returns the optical power level from 0 to 1023. With 1023 being the most power.
0x040	0x041	Get Error Counts	16	n/a	Returns 16 registers with the total number of errors for each error class.
0x100	0x101	Set New Position	1	-450 to +450	The value is used as the new position readout. The MR340 automatically calculates a position offset. Range is ±45 degrees
0x101	0x102	Get Position Offset	1	n/a	Position offset that is used to adjust for desired angular position readout.
0x104	0x105	Device Address	1	1 - 254	Sets the MR340 serial address for commands. Note that the address 4 cannot be used. A FC06 command to save EEPROM must be issued following this command. Address 235 is used as a general address.
0x105	0x106	Operating Mode	1	0..2	Used to setting MR340 in calibration, or troubleshooting mode. Normal Operating mode is 0. Calibration mode is 1. Trouble shooting mode is 2. Do not put unit in any of these modes without first consulting the user manual. Be familiar with what these functions do before using.
0x132	0x133	Voltage Offset	1	-128 - 127	Factory use only – do NOT write to it. Hardware calibration value for voltage output
0x133	0x134	Voltage Gain Pos	1	-128 - 127	Factory use only – do NOT write to it. Hardware calibration value for voltage output
0x134	0x135	Voltage Gain Neg	1	--128 - 127	Factory use only – do NOT write to it. Hardware calibration value for voltage output
0x135	0x136	Current Gain	1	-128 - 127	Factory use only – do NOT write to it. Hardware calibration value for current output
0x138	0x139	Baudrate SSI	1	25 - 250	Defines the SSI Baudrate. This value should be set by the user and it should match the clock frequency of the SSI master reading the position output.
0x139	0x13A	Baudrate Serial Communications	1	0 - 3	Sets the Baudrate for Serial Communications on the MODBUS. 0 = 9,600 1 = 19,200 2 = 38,400 3 = 57,600 4 = 115,200
0x13A	0x13B	Power Supply Input Voltage	1	n/a	Gets the voltage reading of the voltage applied to the controller.
0x13B	0x13C	Returns the status during calibration process	1	n/a	Returns the currently executing calibration step. Read Only, only active during calibration process only.
0x13C	0x13D	Reserved			

0x13D	0x13E	Reserved			
0x13E	0x13F	Reserved			
0x200	0x201	Voltage Mode	1	0 - 1	Defines the output mode for the voltage output. 0 = OFF no Position Output 1 = Angle Output -10V to 10V
0x201	0x202	Voltage Scale	1	0 - 10,000	Establishes the scale used for the voltage output. Regardless of Voltage Mode setting 10V refers to the scale value. Applied to Position output in 1/10 degree. When the angle reaches the scale value the output is 10V.
0x202	0x205	Current Mode	1	0 - 1	Defines the output mode for the current output. 0 = OFF current is < 300uA. 1 = Angle 4 to 20mA
0x203	0x206	Current Scale	2	0 - 10,000	Establishes the scale used for the isolated current output. Regardless of current Mode setting 16mA refers to the scale value. When position count reaches the scale value then the output is 16mA plus 4mA bias for a total of 20mA.
0x204	0x205	Filter	1	0 - 7	This is a low pass filter which applies for all outputs including digital. Value = 0 Filter is OFF Value 1 to 7 is the filter strength with 7 being a low-pass with a time constant of 1 seconds
0x205	0x206	Reset Mode	1	0 - 1	Defines how the hardware input resets the internal counter. 0 = Edge Triggered, resets the counter at the first rising edge 1 = Debounced Trigger when state changes from 0 to 1 after 60ms debounce time. (used for switch or relay input)
0x206	0x207	Preset Value	2	-450 to +450	Counter will be preset to this value when the Zero push button is pressed or when hardware input is activated. (See Reset Mode)
0x207	0x208	Turn Direction	1	0 - 1	Defines output results based on turning direction of the sensor 0 = when CW outputs are positive reading. 1 = when CCW then outputs are positive reading. It may be necessary to calibrate the zero position after changing the turn direction.
0x230	0x231	Set Point 1 On	2	-450 to +450	Lower threshold for digital limit switch output 1
0x232	0x233	Set Point 1 Off	2	-450 to +450	Upper threshold for digital limit switch output 1
0x234	0x235	Set Point 2 On	2	-450 to +450	Lower threshold for digital limit switch output 2
0x236	0x237	Set Point 2 Off	2	-450 to +450	Upper threshold for digital limit switch output 2
0x300	0x301	Ratio A	1	n/a	Relative Power Level of Internal Photodetector A. The sum of Detector A plus B is ~ 950
0x301	0x302	Ratio B	1	n/a	Relative Power Level of Internal Photodetector B The sum of Detector A plus B is ~ 950
0x302	0x303	LED Drive Current	1	n/a	Internal current driving the LED for the sensor. The higher this level the higher the loss in the optical link
0x303	0x304	24V Power Supply	1	n/a	External applied Voltage 24V. Unit will function from 12V DC to 30V DC
0x330	0x331	DAC 1, Chan 1	1		Internal Digital to Analog Converter Value Positive Voltage Output
0x331	0x332	DAC 1, Chan 2	1		Internal Digital to Analog Converter Value

					Negative Voltage Output
0x332	0x333	DAC 1, Chan 3	1		Internal Digital to Analog Converter Value n/a
0x333	0x334	DAC 1, Chan 4	1		Internal Digital to Analog Converter Value n/a
0x334	0x335	Reserved			
0x800	0x801	Device Name	4	n/a	Returns the ASCII string equivalent as device name (MR340)
0x804	0x805	Version	4	n/a	Returns the ASCII string equivalent of the software version form MM.mm.bb
0x808	0x809	Serial Number	2	n/a	Returns the serial number of the device.

FUNCTION FC05 – Write Single Coil

Single Coil commands are used to trigger an action.

Register Address	Register Number	Name	Description
0x001	0x002	Device Reset	Same as a Power OFF and Power ON cycle.
0x002	0x003	Save to EEPROM	Save current parameters to EEPROM. A time delay of approximately 20ms should be allowed before sending ny other command.
0x003	0x003	Restore From EEPROM	Restore all configuration parameters from EEPROM. Same as a Power Up.
0x004	0x004	Restore Factory Default	Restores Factory Defaults. The MR340 stores a factory default for each user parameter. These values maybe restored using this command. Factory calibration values and pairing data are not affected.
0x004	0x005	Clear Status	Clears the status register. If another error is pending then the status register will reflect that new value in queue.
0x005	0x006	Clear Error Count Table	Resets error table counters to 0. Same as in power up.

MODBUS Message Format

The following is a brief overview of the detailed byte by byte messaging of the ModBus protocol. Please consult the Modbus standards for detailed information.

DA	= Device Address	DD	= Data to read	CRCL	= CRC Byte low
FC	= Function Code	WW	= Data to write	CRCH	= CRC byte high
RA	= Register Address	SF	= Sub Function		
NR	= Number to Read	EC	= Error Code		
NB	= Number of bytes				

FC	Action	Sync 3.5b	Byte Number										
			1	2	3	4	5	6	7	8	9	10	11
01	request	pause	DA	FC	RA								
01	response		DA	FC	NR								
03	request	pause	DA	FC	RA	RA	NR	NR	CRL	CRH			
03	response		DA	FC	NB	DD*	DD*	CRL	CRH				
04	request	pause	DA	FC	RA								
04	response		DA	FC	NR								
05	request	pause	DA	FC	RA								
05	response		DA	FC	RA								
08	request	pause	DA	FC	SF								
08	response		DA	FC	SF								
23	request	pause	DA	FC	RA	RA							
23	response		DA	FC	NR								
			DA	FC									
			DA	FC									

DD* = number of bytes requested or being sent

5. MR340 - Error Handling and Troubleshooting

5.1 Explanation of Status and Error Handling

The MR340 incorporates a sophisticated integrity monitoring, error and failure reporting system. There are four Error Groups:

1. EEPROM

At start-up the EEPROM checksum and EEPROM data integrity are checked.

2. Power Supply Voltages

At start-up the applied power supply voltage (24V) and internal voltages are checked. If they fall outside the required value, errors are logged and reported. These voltages are evaluated once at system power-up. Subsequent voltage changes will not be evaluated.

3. Sensor Read Error

- Low optical power

The system relies on the wavelength of the light and not the optical amplitude to determine the angular position. Therefore as long as the controller receives sufficient optical power the sensor readout is accurate.

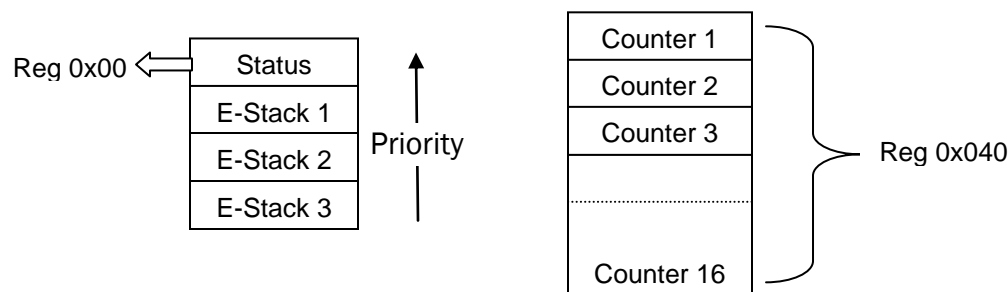
4. Communication Errors

Communication errors are flagged by the underlying Modbus drivers. However, Modbus standard does not specify a data integrity test. This is where the MR340 allows the user to query the Status byte after each transmission to verify if the provided data was within the appropriate range etc.

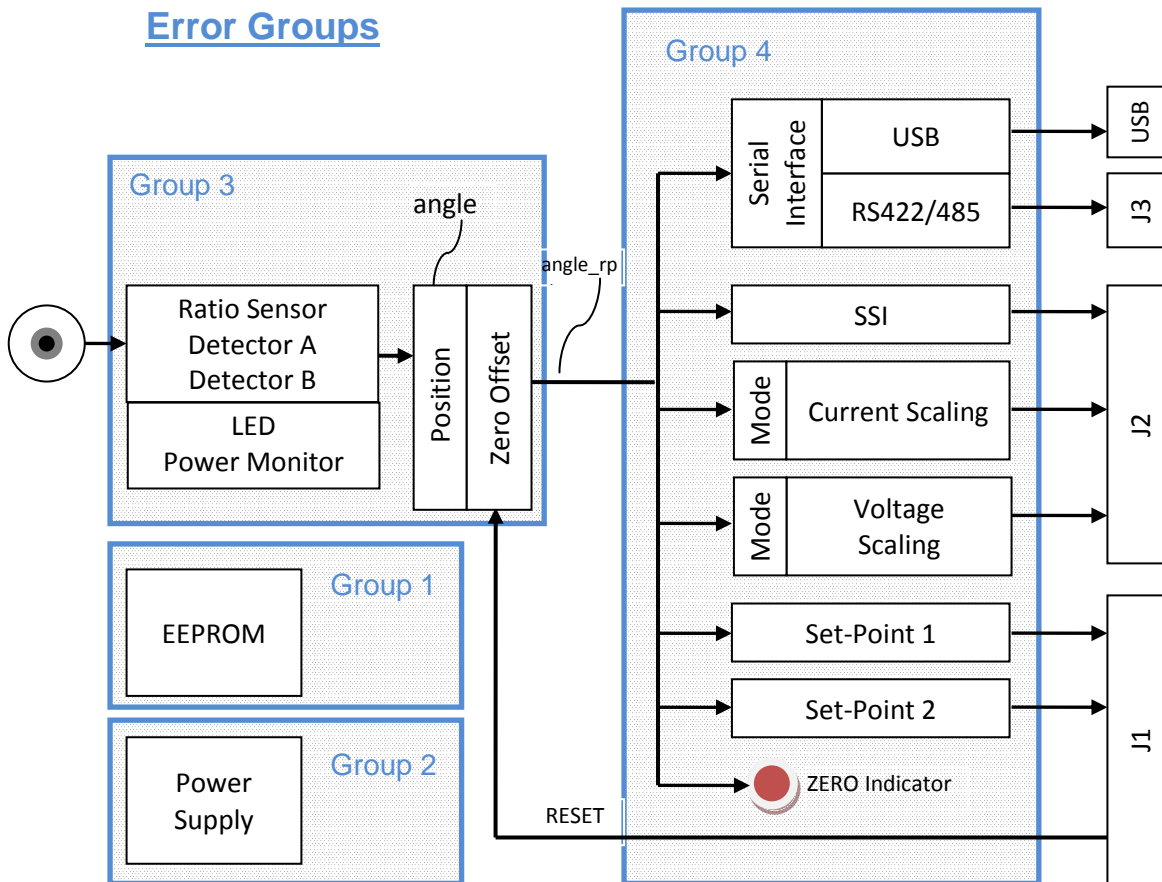
5.2 Explanation of Status and Error Indication

When an error occurs the System Status Word is set with the associated Error Code (Register 0x00). When more than one error at the time occurs then the error code is stacked up in order of its priority.

Each Error has an associated error counter. The user may request all error registers for examination through a request to Register 0x040. MODBUS Function Register 0x40, Reads all 16 Error Registers Sequentially



Error Groups



All errors get logged but may not necessarily provide visual indication. The user should take necessary action based on the severity level of the reported status/error.

- 3** = System will no longer work without a remedy.
- 2** = Important, problem should be fixed but system may still be partially operational
- 1** = Benign, system keeps on working fine

After examination the user may clear the Error Indication by issuing the Function Call FC5 to coil number 5. This will clear the indicated error in the Status byte. If there are more errors stacked up then the next highest priority will be displayed.

While there is an error indication The Zero push button will also clear a pending error indication. The user must be careful to only push the button once and wait and check if the error indication. Once the error is cleared the button will assume its normal function as a Zero Point switch.

Some errors are cleared as soon as normal operation is reestablished. For instance when the sensor is disconnected or a high loss in the optical connection occurs then an error is

reported and the PWR LED will blink. However, when the optical connection is re-established then the error will clear itself without user interaction.

Some errors are not sufficient cause of a problem and therefore they are logged and indicated by a short blink on the PWR LED and then will clear themselves. For instance, if the 24V power supply deviates by more, than $\pm 10\%$ such an error is indicated but since the MR340 works flawlessly in the range of 12V to 30V there is no cause for further error indication.

Table 1 Table of Error Codes

Hardware Related Status Indication					
EEPROM					
#	Description	S	Remedy	How Cleared	Announced
257	EEPROM INIT EEPROM is not initialized not initialized. This occurs only on first factory power up of new system or when a badly corrupt EEPROM is detected	3	Firmware automatically re-initializes the EEPROM. User must remove Power and apply power again Restore factory values. All parameters are lost.	Recycle Power	Blink 5x + code
258	EEPROM Checksum checksum failure both banks	3	Both data banks indicate a bad checksum. User should read all parameters and verify proper settings and then save parameters again using Miconor Zappy software.	software or recycle Power	Blink 5x + code
259	EEPROM Checksum Low Bank checksum failure low bank	1	One set of data in EEPROM shows a bad checksum. Firmware automatically corrects the error.	n/a	n/a
260	EEPROM Checksum High Bank checksum failure low bank	1	One set of data in EEPROM shows a bad checksum. Firmware automatically corrects the error.	n/a	n/a
261	EEPROM Bad Value One or more parameter values are out of range in both data banks.	3	User should use Zappy to read and examine the data and restore the corrupted value.	Timed Clear	Blink 5x + code
Voltages					
#	Description	S	Remedy	How Cleared	Announced
513	Bad Hardware No Clock Signal from CPLD Bad I2C Bus on internal components	3	Recycle Power If persist repair	next startup	blink 5x
514	BAD Firmware Firmware is corrupted	3	Recycle Power If persist repair	next startup	blink 5x
515	Voltage Reference Internal reference voltage is out of tolerance	3	Recycle Power If persist repair	next startup	Blink 4x + Code
519	Voltage 24V too Low User applied 24V input less than 12V	2	Apply proper voltage.		Blink 2x + code

Position Sensor Failures					
#	Description	S	Remedy	How Cleared	Announced
770	Sensor Disconnect Detect low optical power	3	Check Fiber Optic connection to the sensor.	self clear when restored.	Blink 3x + code

Communication Failures					
#	Description	S	Remedy	How Cleared	Announced
1025	CMD Unknown Function A non valid or non implemented ModBus function was sent to the controller	1	Check your software for correct function calls.	self clear after one blink	Blink 1x once
1026	CMD Unknown Register A non implemented register address was addressed	1	Check your software for correct register addressing. See user manual with address table.	self clear after one blink	Blink 1x once
1027	CMD Wrong Register Count The register count in your command did not match the length of requested register.	1	Check your software for correct register addressing. See user manual with address table. Note: This controller does not allow to read across multiple registers, except when starting at address 0	self clear after one blink	Blink 1x once
1028	CMD Wrong Device Addr. The device address sent was not matching the address of this unit.	1	The MR340 controller has one fixed address at 235. If you are not sure what the address is talk to the unit at 235 and reset your desired bus address.	self clear after one blink	Blink 1x once
1029	CMD Wrong Value The data value was outside the permissible range for this parameter.	1	Consult the user instruction for the permissible parameter values allowed in each register.	self clear after one blink	Blink 1x once
1030	CMD Checksum ModBus Packet Checksum was invalid.	1	Resend the packet.	self clear after one blink	Blink 1x once

5.3 Reading the Error Counters

The entire packet of all 16 error counters may be read by issuing a Modbus command to Register 0x040 with a register count of 16. The sequence of registers is according to the error number in Table 1 in ascending order.

According to ModBus standard definition, each register is a 16-bit word. If the most significant bit is set to a logical one, this indicates that there is an active error residing in the Status stack.

The remaining 15 bits indicate the number of errors that occurred since power was applied to the unit.

The user may clear all error counters by issuing Function Call FC5 (coil #6).

5.4 Warranty Information

Warranty

MICRONOR INC. warrants this product to be free from defects in material and workmanship for a period of 1 (one) year from date of shipment. During the warranty period we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local MICRONOR INC. representative, or contact MICRONOR INC. headquarters. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitations of Warranty

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to Fiber Optic Connector interfaces, fuses or AC line cords. This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability of fitness for a particular use. MICRONOR INC. shall not be liable for any indirect, special or consequent damages.

Contact Information:

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URL www.micronor.ch

6. Specifications

6.1 MR341 Sensor Specifications

Specifications Sensor MR341 - No Electronic Limitations		
Range	0° to 45°	Mechanical range is typically 0° to 46°
Resolution	0.1°	
Fiber Type:	62.5µm/125µm/250µm GI 0.275 NA	The sensor is attached by 2 fibers. One input fiber one output fiber.
Accuracy	See controller	
Pigtail Length	2m to 25m	User specified at time of order. standard 3m, 5m, 10m
Fiber Optic Connector	Duplex LC	PC polish
Shaft Dimension	Ø0.250" x 0.5"L	
Moment of Inertia	TBD	
Max Shaft Loads	TBD	
Material	Acetal Homopolymer (Delrin Black)	
Weight	100g (3.3oz)	Without fiber cable.
Dimension	2" x 2" x 1.15"	See detail drawing

Environmental Specifications MR332 Sensor		
Operating Temperature	-15° to +65°C	continuous
Storage	-40° to +80°C	
Humidity	0% to 95% RH (non-condensing)	
Ingress Protection	IP63	
ATEX Rating	CE I/M1 II/1 GD Ex op is I/II 65 °C/T6 Ga Zones 0/1/2/20/21/22 Simple Mechanical Device Classification "Inherently Safe Optical Radiation"	

Specifications subject to change without notice

6.2 MR340 Controller Specification

Description	Specification	
Position Output Formats	SSI – 25bits Programmable Baudrate 25kHz – 250kHz Modbus compatible RS422/RS485 interface. USB (FTDI) (disables Modbus interface)	
Current Output	Isolated 4-20mA, 250V isolation Accuracy : $\pm 0.25\%$ Full Scale. Frequency Response 30Hz Max Burden Resistance: 500 Ω (24V supply) Position output scalable by user.	
Voltage Output	-10V to +10V non isolated Accuracy : $\pm 0.20\%$ Full Scale. Frequency Response 50Hz Max Current: 5mA (2k Ω load); Short Circuit < 5 sec Position output scalable by user.	
Position Set-Point Outputs	0V – 24V, maximum 10mA Load (Digital On-OFF)	
Resolution	0.1°	analog outputs have 0.05° resolution
Accuracy	$\pm 0.25^\circ$ $\pm 0.35^\circ$	5° to 40° over full range
Angular Speed (ω)	125 radians/sec	equivalent to 45° in 6ms
Update rate	1.0kHz (1ms)	Every 1ms a new reading is output
Reporting delay	600 μ s (max)	Time from actual position to SSI output availability.
Fiber Type	62.5/125 μ m 0.275NA Multimode Duplex	
Fiber Connector	LC-PC Duplex	
Fiber Link Length	2m to 10,000m (assuming 0.5dB/km or less)	
Operating Wavelength	1300nm (for purposes of fiber link loss calculation)	
Optical Output Power	< -17dBm (20 μ W) average, eye safe pulsed LED source	
Loss Budget	10dB loss budget includes all connector and fiber losses	
Electrical Connectors	WAGO QuickConnect Plugs: J1: 12-pin (WAGO 733-112) J2: 10-pin (WAGO 733-110) J3: 6-pin (WAGO 733-106) Accepts one AWG20 wire or two AWG26 wire per contact.	
Power Supply	+12VDC to +32VDC, 85mA (typical) 100mA max. @ 24V Note(1)	
+5V Output	10mA maximum load (Designed for powering MR232-1 or MR232-2 adapter cables)	

Note 1: During Power Up the external power supply should be capable of delivering a momentary current in excess of 100mA. Unit will operate from +10V to 32V, however analog outputs may not work properly due to insufficient operating voltage.

Description	Specification
ATEX Rating	[Ex op is I/II 45 °C/T6 Ga] Simple Mechanical Device Classification “Inherently Safe Optical Radiation” “For installation in non-hazardous location only”
Temp Range	-0° to +45°C (operating) -15°C to +65°C (storage)
Humidity	25% to 85% RH (non-condensing)
Housing Protection	IP40 (Non-Protected)
Mounting	35mm DIN Rail
Housing	102mm W x 102mm D x 68mm H
Weight	600g (22oz)

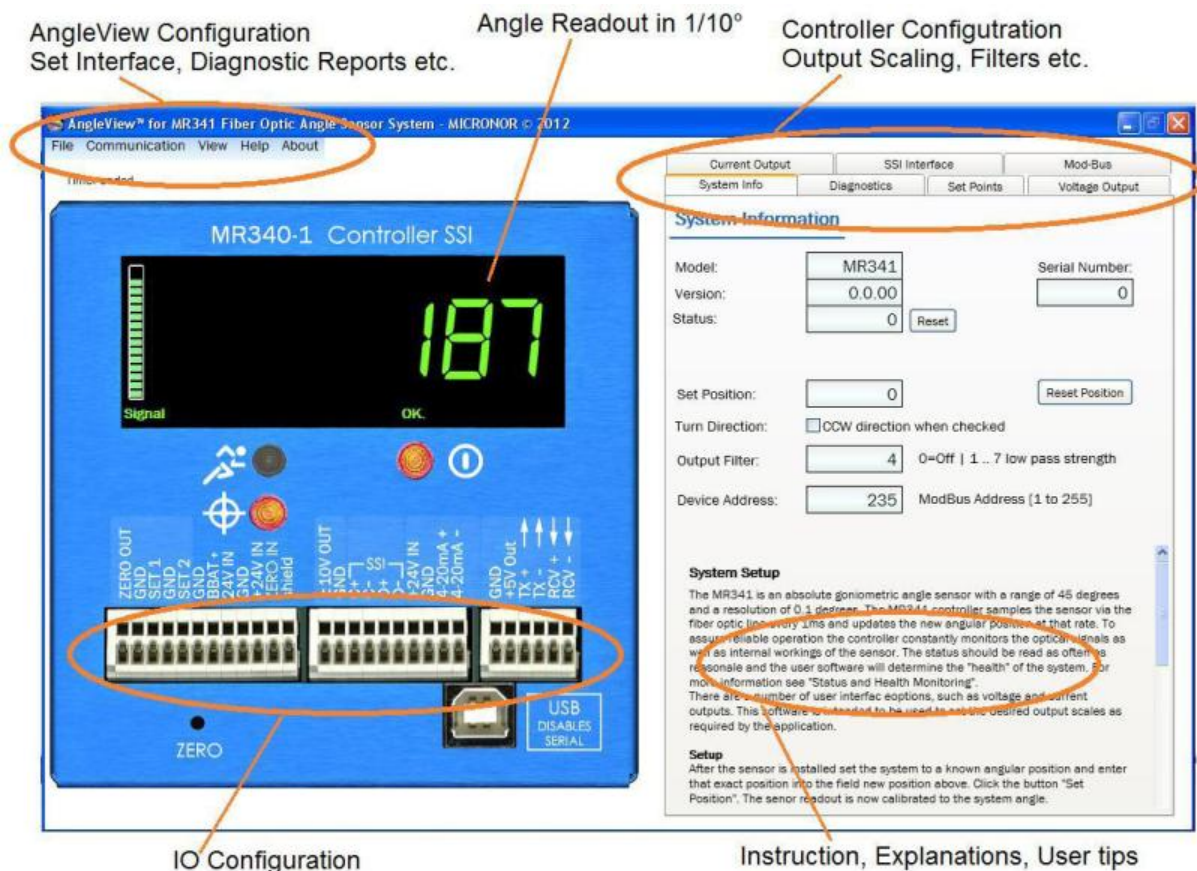
Specifications subject to change without notice

7. AngleView™ SOFTWARE

Micronor provides AngleView™ with the MR340 Controller Module. AngleView™ runs on: Windows 7, Vista, or XP with SP3 and with .net Framework 4.0 installed. AngleView™ can be used to pre-program MR340 parameters associated with the various auxiliary Functions, such as programming the scale of the analog outputs, or it can be used to verify the proper operation of the position sensor system.

The AngleView™ software is designed to provide the user with simple but powerful system configuration and monitoring functionality. Refer to Section 7.1, AngleView™ – MR340 Setup Software Installation Guide to install the software.

The software was designed with the following areas to enable the user to quickly learn and understand how to configure the system:



The AngleView™ software displays the parameters that the MR340 system is currently using for its operating configuration. The MR340 system has EEPROM storage capability so that if the power is lost the parameters that have been stored are remembered when the power is restored. When the user changes a setting, AngleView™ will remind you to save the setting if the **Enable Save Reminder** is enabled. If you don't want to save to EEPROM just Ignore.



When a setting is changed, to save in EEPROM just click on the reminder Save in EEPROM
Summary of AngleView™ Functions:

PC and AngleView™ configuration

- File Save and Load Parameters to Disk - enables quick system duplication
- Communication - Configure the address and serial port settings
- View - Enable Save Reminder, Gauge-Angle, Voltage and Current Meters (digital representation of position)
- Help - View the Instruction Manual for the product
- About - AngleView™ version and Software License Agreement

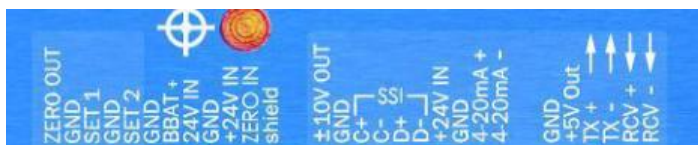
MR 340 Configuration

Each tab enables the user to View / Configure the corresponding functions of the MR340 System

Enter the value that you want the system to use, if the value is within the allowed range the parameter is sent to the MR340 controller when you press Enter or go to another field.

MR 340 I/O Configurations

By selecting/clicking on a configurable port Text AngleView™ will automatically go to the appropriate tab for viewing or configuring the respective settings.



By clicking on a connector, Information regarding the connections is displayed.

Descriptions and Information

Read the description and information on the lower section of each Tab to learn how to set the respective portion of the system.

The optional MR232-1 RS422/RS485 to RS232 Adapter Cable (shown in Figure 10) is required to connect the MR340 to the RS232 serial port on the PC running the AngleView™ software. If the PC does not have a serial port, then use a standard USB Cable on a USB port, the cable must have a type B connector at the end that plugs into the MR340 Controller.



Figure 10 Photograph of MR232-1 RS422/RS485-to-RS232 Adapter Cable.

7.1 AngleView™ – MR340 Setup Software Installation Guide

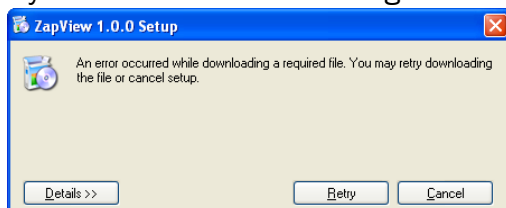
AngleView™: PC Software for configuring the Parameters of the Micronor MR340 Fiber Optic Position Sensor and for familiarization with the many features of the unit.

System Requirement: The AngleView™ Software requires the .NET FRAMEWORK 4.0 Client to be installed on the PC. If your system does not have the .NET FRAMEWORK 4.0 Client installed follow the instructions in Step 1 To install the .NET FRAMEWORK 4.0 Client.

Installation of AngleView™ is simple. The Installer will install the necessary files on your PC, follow the steps:

Step 1 Insert the AngleView™ CD into the CD drive. The program should start automatically if Autoplay is enabled on the PC. If the installation does not start automatically simply Run the Autoplay.exe program from the root directory of the AngleView™ CD, then Select the Install AngleView™ Software. A second option is to run the Setup.exe program from the root directory of the AngleView™ CD.

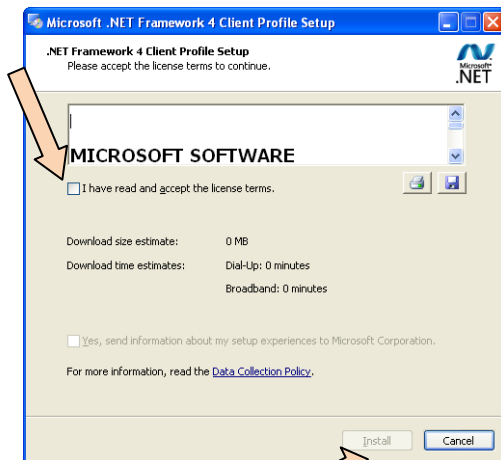
If you encounter the following error:



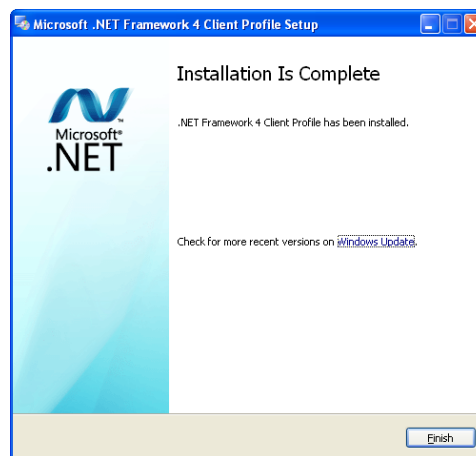
The problem may be that the required .NET FRAMEWORK 4.0 Client is not installed on the PC. Select Cancel and install the .NET FRAMEWORK 4.0 Client.

To install the .NET FRAMEWORK 4.0 Client on the PC, Run the file “dotNetFx40_Client_x86_x64.exe” found on the Root directory of the AngleView™ CD.

When the .NET FRAMEWORK 4.0 Client installation begins, select I have read and except the license agreement:



Install the software displayed.



When finished the following message will be

With the .NET FRAMEWORK 4.0 Client installed the AngleView™ Software can now be installed.

Run the Setup.exe program from the root directory of the AngleView™ CD

Step 2 The Installer will guide you through the steps to install the AngleView™ Software.

Step 3 Click on **Next>** to continue through the installation.

Step 4 You must Read and Agree with the End User License Agreement to use this Software.

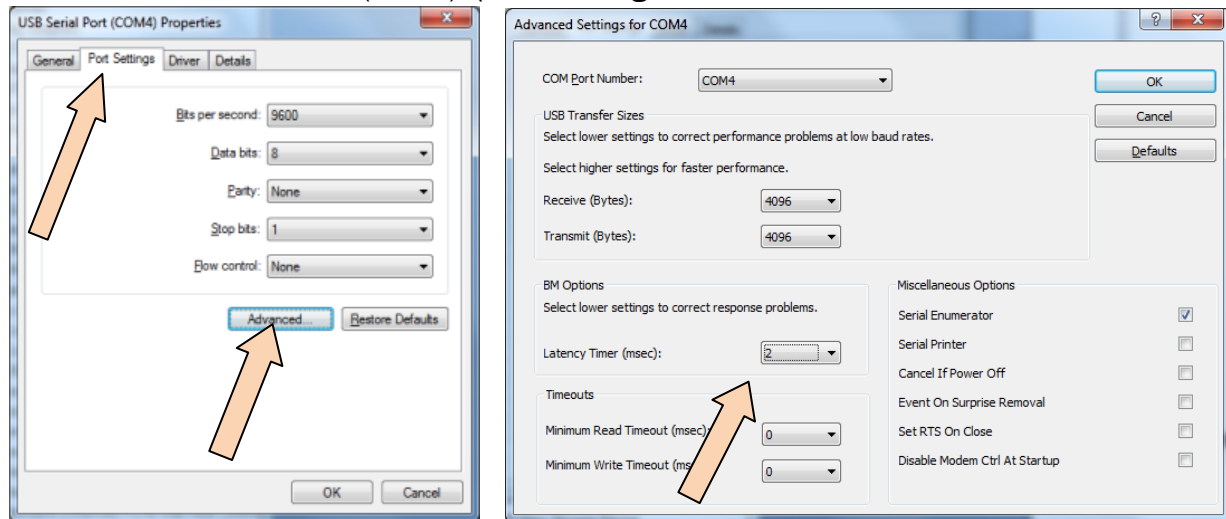
Step 5 The Installer will load the USB driver for the FTDI interface chip on the PC enabling AngleView™ to communicate with the MR340 Controller. More information on the USB driver can be viewed on the USB_Driver folder on the CD.

Step 6 When the Installation is Complete Simply **Close** the Installer.

Step 7 For better performance configure the COM port Latency to 2 mS . This is configured under Computer Management \ Device Manager \ Ports (COM & LPT)

(NOTE: the COM port needs to be connected and the MR340 Controller must be power up for the COM to be visible on the PC)

Select the USB Serial Port (COMx) \ Port Settings. Then select Advanced...



Set 2 for the Latency

Select OK when done.

AngleView™ is now ready to use.

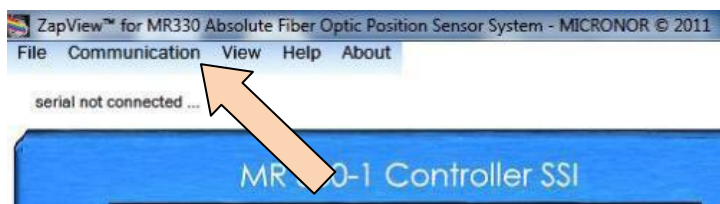
Start/Run AngleView™ by selecting the Desk Top short cut



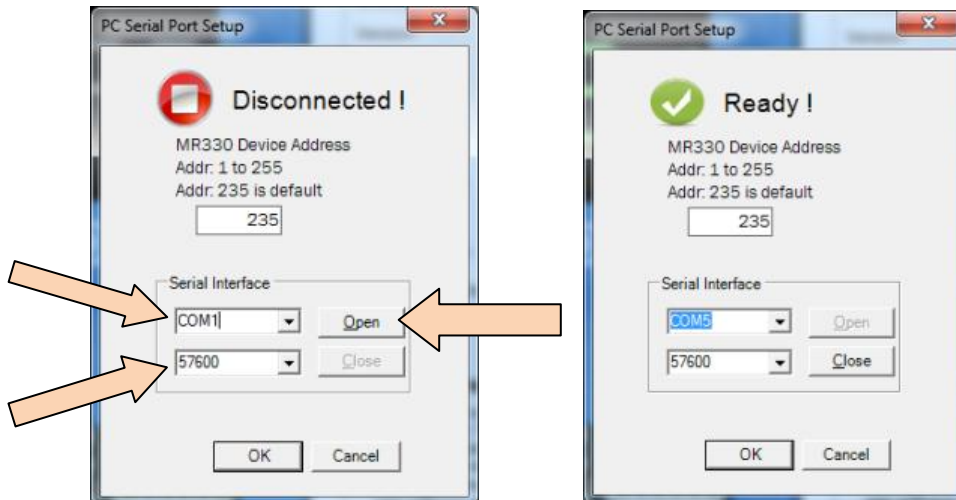
Or use the Start Menu.

AngleView™ can communicate with the MR340 Controller via a standard PC Serial port, if the PC does not have a serial port, use a USB port. The USB cable must have a type B connector at the end that plugs into the MR340 Controller, or use the optional MR232-1 RS422/RS485 to RS232 Adapter Cable.

To start AngleView™ communicating with the MR340 Controller click on Communication at the top of the AngleView™ window.



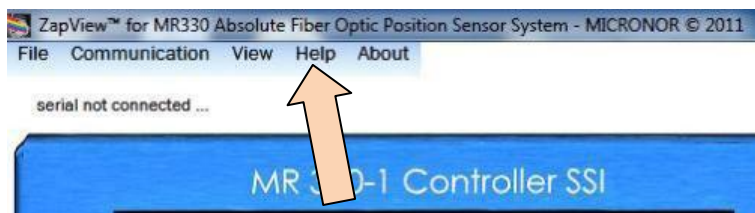
The PC Serial Port Setup window will pop –up:



Select the Serial Interface COM port on the PC that is connecting to the MR340 Controller. The baud rate is 57600 (default). After selecting the Com Port and Baud rate, select **Open**.

The PC serial Port Setup will display Ready, when communication is established with the MR340 Controller. Note: Only if the correct COM port and baud rate are selected communications will be successful.

Note: The AngleView™ instruction manual can be displayed, select Help – AngleView™



AngleView™ runs on: Windows 7, Vista, or XP with SP3 and with .net Framework 4.0 installed.

8. MR340 Theory of Operation

The functional block diagram shows the two main components. The Sensor is connected by a duplex fiber optic cable of readily available 62.5/125um multi-mode fiber. The transmit fiber guides an optical pulse from a broadband light source to the position interrogation. A second receive fiber returns the light with the spectrally embedded position (angle) information.

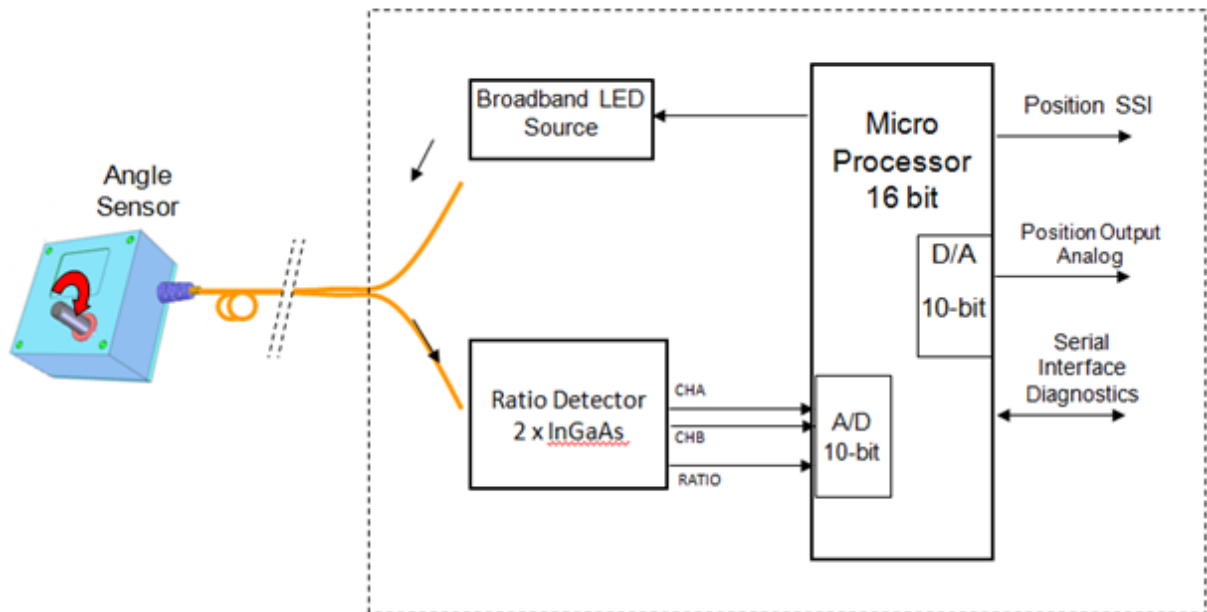


Figure 11 Block-Diagram Angle Sensor

The optical spectral line of the returned light is unique to any given position of the sensor. The light spectrum is separated into two portions within the ratio detector. The ratio of the separated optical power determines the wavelength and hence the position of the shaft within the sensor.

The analog electrical signals are converted into digital words and the firmware algorithm extracts the position information and sends out the information over the bus interface Modbus and additionally the SSI (serial synchronous interface).

Each sensor is calibrated along with the interrogator module and are typically installed as a matched pair.

9. Mechanical Reference Drawings

9.1 MR340-1 Controller

See following page for reference drawing for MR340-1 Controller.

9.2 MR332 Sensor

See following page for reference drawing for MR332 Sensor.

