RIEKER inc.

User Programmable
Current 4..20mA
Digital RS485
Dual & Single Axis
Up to 360º

2016

Flex™ Series User Guide

Sensor Installation, Wiring, Flexware App Instructions

Flex Series User Guide

For Current & Digital Output Sensors

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FORM NUMBER: H60009_12/14 UPDATED: 6/10/16

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Applies to the following Flex Series Inclinometer Sensors:

- H4360
- H6

Sensor Description

The H6 & H4360 Flex™ series of sensors are inclinometers that provide high accuracy, single or dual axis inclination over a range of ±180°.

This sensor incorporates a MEMS accelerometer referenced to gravity with integrated temperature compensation over the full industrial operating range of -40° to +85°C for absolute accuracy. It has both digital RS485 and analog current outputs. Both outputs are linear with respect to the input angle directly.

The digital RS485 output uses two-wire, half duplex communication, along with a Rieker specific protocol. This protocol can be used to measure the angle of both axes, as well as configure many of the parameters of the sensor.

The analog current output can output from 0mA to 24mA for each axis and is user configurable via the RS485 to match any angle range and current values.

Updates

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H6 Installation and Wiring

FIGURE 1: **H6 Dimensions, Mounting, and Axes Tilt Orientation (Inches [Mm])**

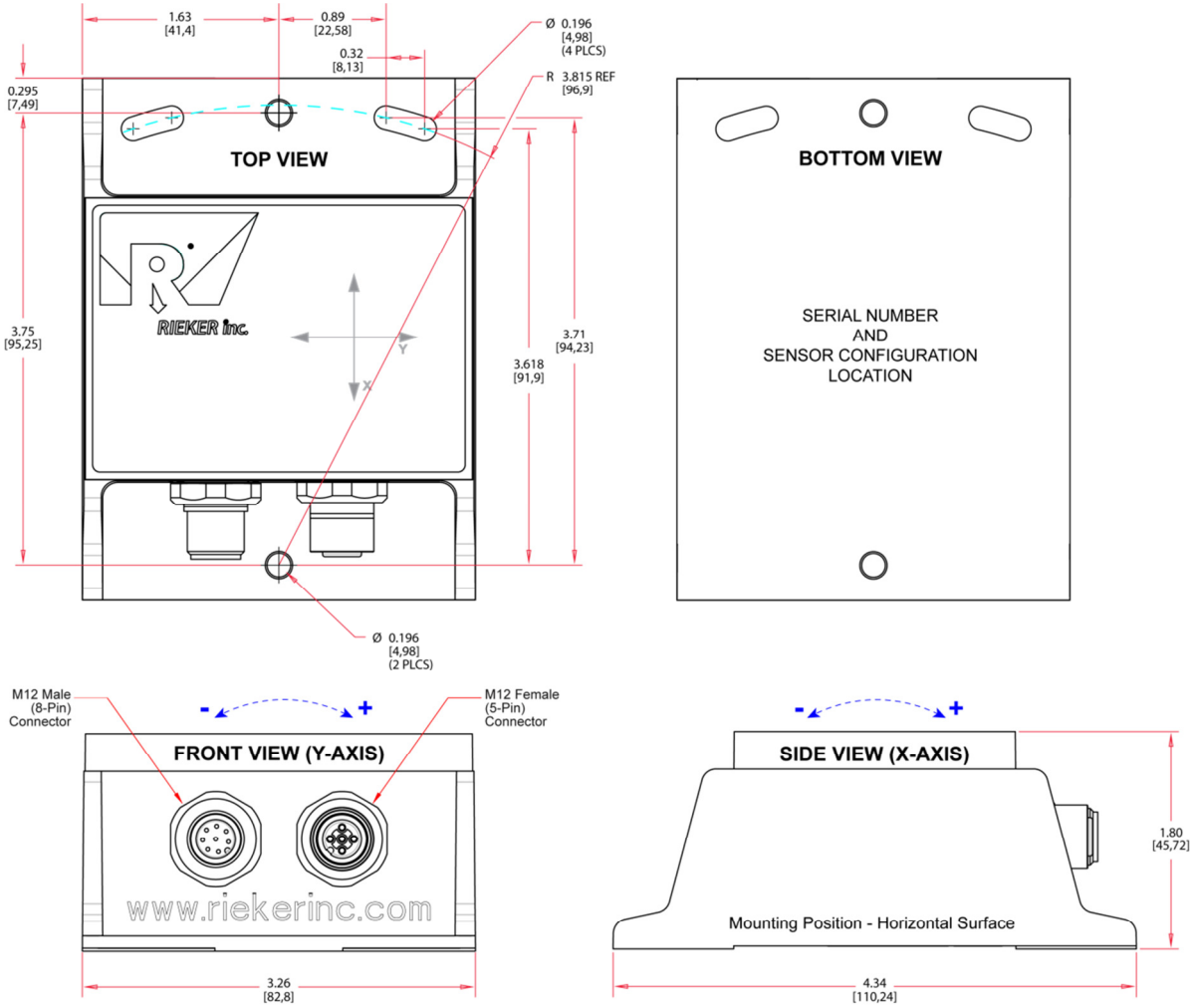
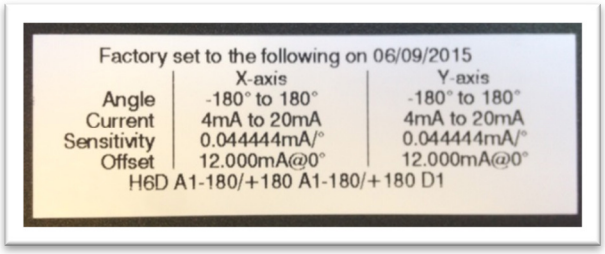


FIGURE 2: **Example of Serial Number and Factory Default Configuration Label**

NOTE: Located on the bottom of the H6 sensor, the label provides the factory configured defaults and serial number.



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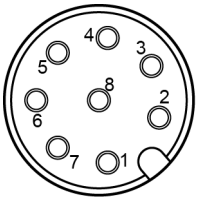
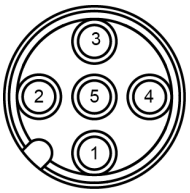
H6 Connector Wiring Tables

TABLE 1: H6 MALE 8-PIN INPUT CONNECTOR WIRING	
PIN	**FUNCTION**
1	SUPPLY VOLTAGE +11.. +36VDC
2	POWER / SIGNAL COMMON
3	RS-485 D+
4	RS-485 D-
5	NO CONNECTION
6	X AXIS 4..20MA CURRENT OUTPUT
7	Y AXIS 4..20MA CURRENT OUTPUT
8	NO CONNECTION



M12 (male 8-pin)
Pin Assignment
FRONT VIEW

TABLE 2: H6 FEMALE 5-PIN OUTPUT CONNECTOR WIRING	
PIN	**FUNCTION**
1	NO CONNECTION
2	SUPPLY VOLTAGE +11..+36VDC
3	POWER COMMON
4	RS-485 D+
5	RS-485 D-



M12 (female 5-pin)
Pin Assignment
FRONT VIEW

TABLE 3: H6 CURRENT SENSE

R_{sense} is dependent upon supply voltage and cable/wire resistance. Ensure the following equation is met:

$$R_{sense} \leq \frac{V_{supply} - 2.5}{0.020} - R_{wire}$$

QUICK REFERENCE	
SUPPLY VOLTAGE	**SENSE RESISTOR**
12V	200-350 OHMS
24V	200-1000 OHMS
28V	200-1000 OHMS

NOTE: The H6 Sensor's Chassis Ground is NOT the same as the signal ground for the current output return. The current output return must be connected to the POWER/SIGNAL COMMON (pin 2).

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H6 Bus Wiring Configurations

NOTE: When using the digital output, the H6 sensor can be connected as a single sensor or can be connected to other sensors in a bus configuration. The following figures show three possible configurations for using the H6 sensor with the digital output.

FIGURE 3: **Single Sensor**

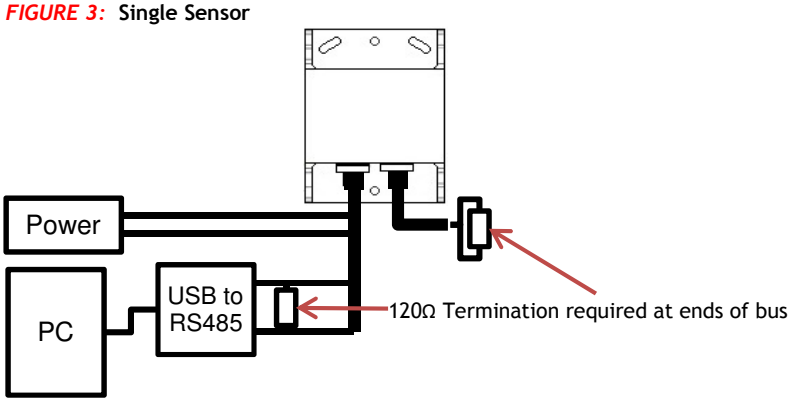

FIGURE 4: **Multiple Daisy-Chain Sensors**

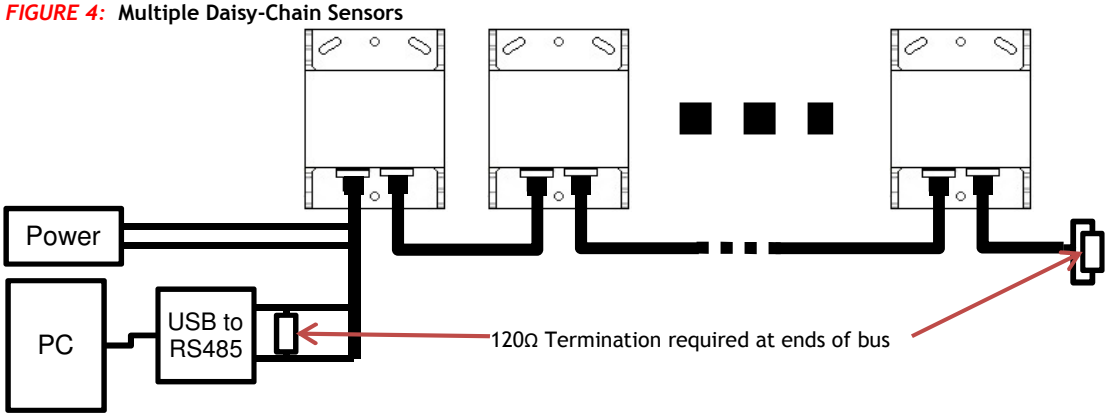

FIGURE 5: **Multiple Multi-Drop Sensors**

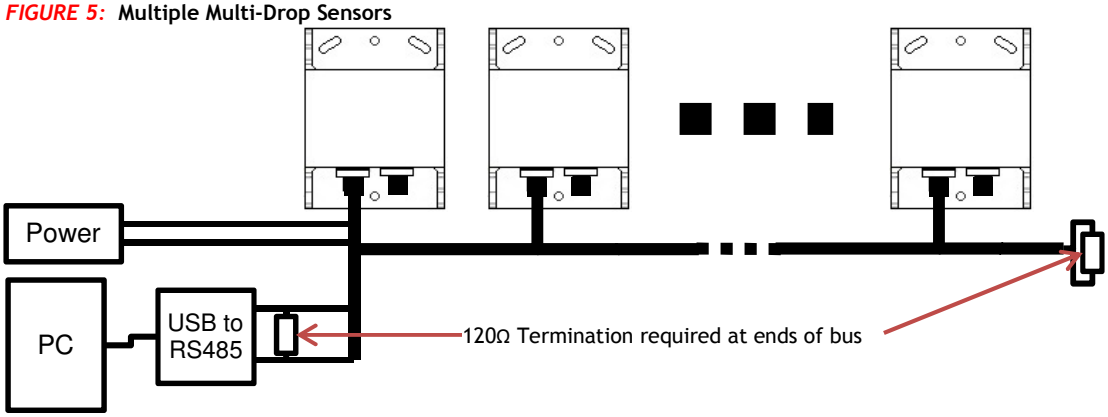

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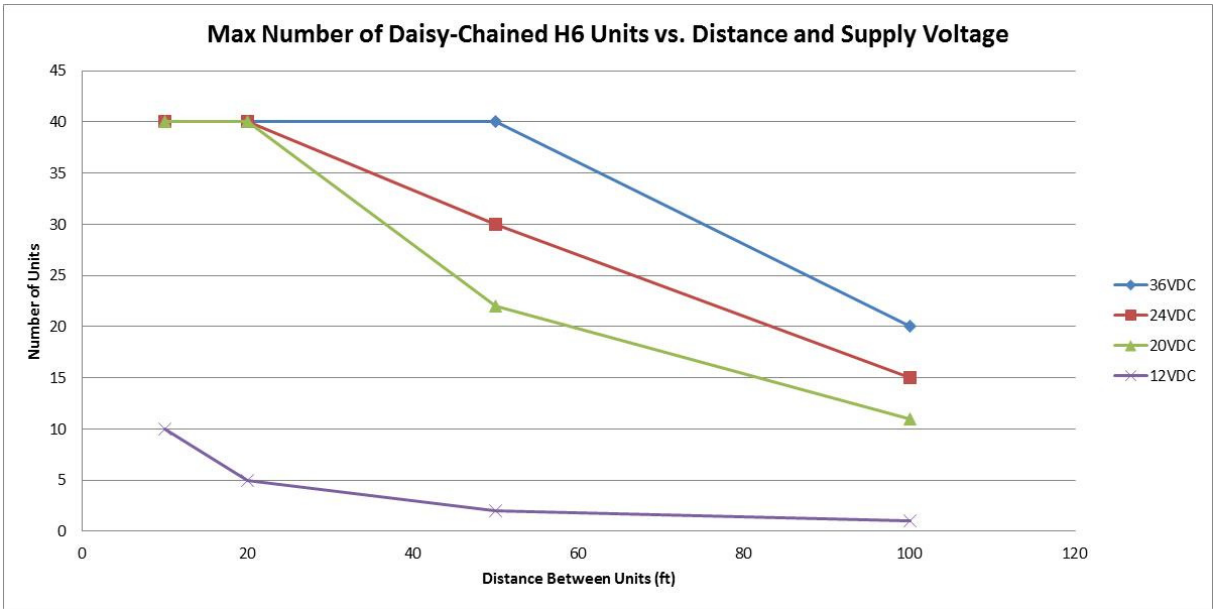
FIGURE 6: **H6 Daisy Chain Graph**



NOTE: This graph is based on 22AWG wire as the daisy-chain between sensors. Also note that by using a multi-drop configuration, additional sensors may be added, up to a maximum of 60 units due to bus loading.

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H4360 Installation and Wiring

FIGURE 7: **H4360 Dimensions, Mounting, And Axis Tilt Rotation (Inches [Mm])**

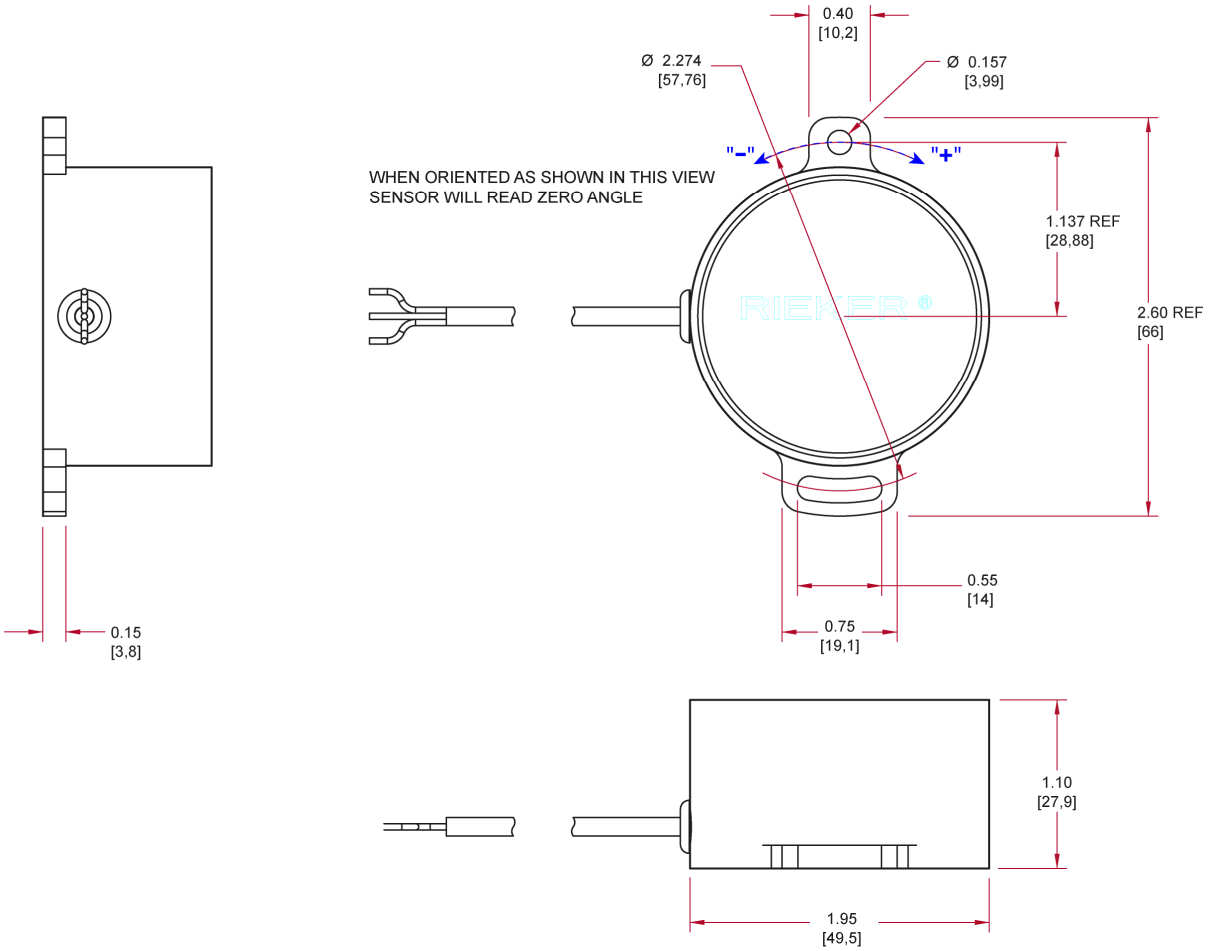
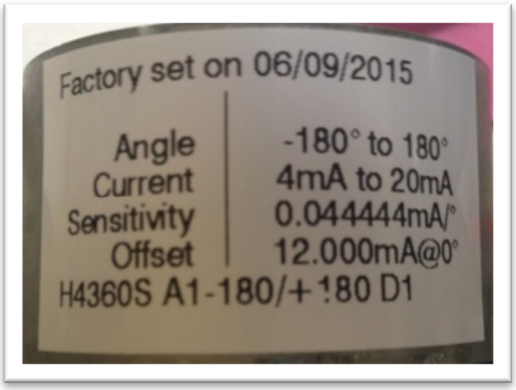


FIGURE 8: **Example Factory Default Label**

NOTE: Located on the side of the H4360 housing, the label provides factory configured defaults and serial number.



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H4360 Connector Wiring Tables

TABLE 4: H4360 OUTPUT CONNECTOR WIRING		
PIN	**FUNCTION**	**COLOR**
1	SUPPLY VOLTAGE +11 TO +36VDC	RED
2	POWER/SIGNAL COMMON	BLACK
3	4..20MA OUTPUT	WHITE
4	RS485-A	ORANGE
5	RS485-B	GREEN
6	NO CONNECTION	BLUE

TABLE 5: H4360 CURRENT SENSE

R_{sense} is dependent upon supply voltage and cable/wire resistance. Ensure the following equation is met:

$$R_{sense} \leq \frac{V_{supply} - 2.5}{0.020} - R_{wire}$$

QUICK REFERENCE	
SUPPLY VOLTAGE	**SENSE RESISTOR**
12V	200-350 OHMS
24V	200-1000 OHMS
28V	200-1000 OHMS

NOTE: The Unit's Chassis Ground is NOT the same as the signal ground for the current output return. The current output return must be connected to the POWER/SIGNAL COMMON (pin 2).

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H4360 Bus Wiring Configurations

NOTES:

- When using the digital output, the H4360 can be connected as a single sensor (*Figure 9*) or can be connected to other sensors in a bus configuration *(Figure 10)*.
- Every sensor in the chain must have a voltage above 11VDC.
- Maximum of 120 units may be connected.

FIGURE 9: **Single Sensor**

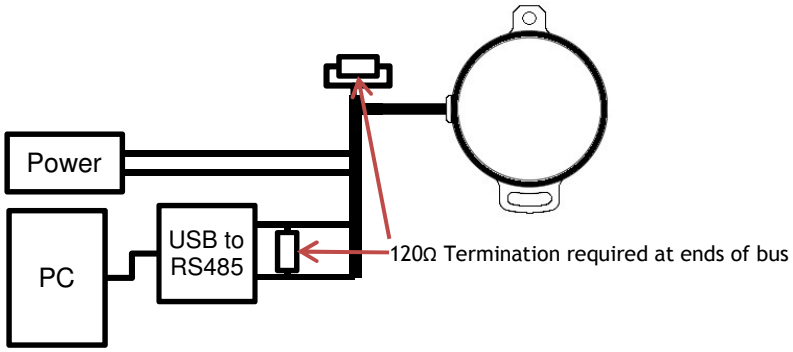
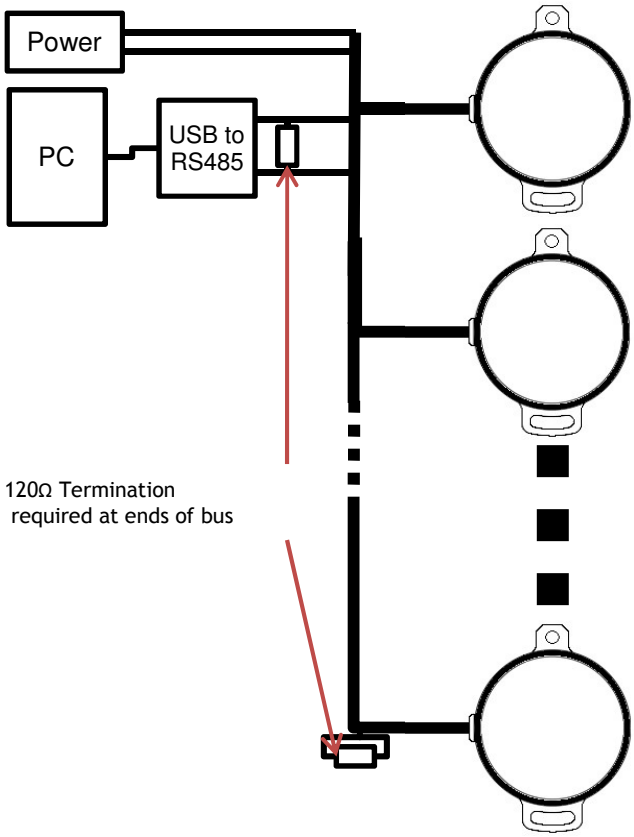


FIGURE 10: **Multiple Multi-Drop Sensors**



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RIEKER Flexware™

The *Rieker Flexware™ Toolkit* can be found on the included flash drive. This toolkit includes software useful for testing and evaluating the Flex™ Series of sensors.

Flexware™ Toolkit Installation

1. Plug the USB flash drive into the USB port on the PC computer.
2. Double-click *Rieker Flexware™ Toolkit* and follow the instructions to install the software.

NOTE: Due to varying security settings on every computer, an error message may occur during install. This is normal and the installation can be safely continued.

Getting Started with the *Flexware™ User App*

There are two main applications that are included in the Toolkit: the User App and Angle Display.

NOTE: Only one application can be used at a time (unless they are using different COM ports). If both applications try to access the same COM port, the second application will say that the COM port failed to initialize.

The H6 and H4360 sensors come with an RS485 output that can be used to measure the angle, as well as set and modify many of the output settings. Use the included development cable to connect the H6 or H4360 sensor to a computer and to a power outlet. Refer to Appendix A. Creating a Development Cable for instructions on connecting the H6 or H4360 sensor without using the development cable.

1. Connect the USB-RS485 adaptor to the computer via the USB adaptor. Verify that the red and green LEDs flashed. Also note that the device drivers may take a while to install depending on your system and that the app will not correctly initialize until the device drivers are installed.
2. Connect the development cable to power either via the Wall DC power supply (included) to a power outlet or using your own DC power source (11-36 VDC not included).
3. (If using the H4360) Connect the H4360 adaptor cable to the end of the development cable.
4. Connect the H6 or H4360 unit to the end of the development cable.
5. Click on the Windows Start menu on the computer. Then click PROGRAMS > Rieker > Rieker Flexware™ User App. You should see the User App screen appear *(Figure 17)*.

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FIGURE 11: **User App Start**

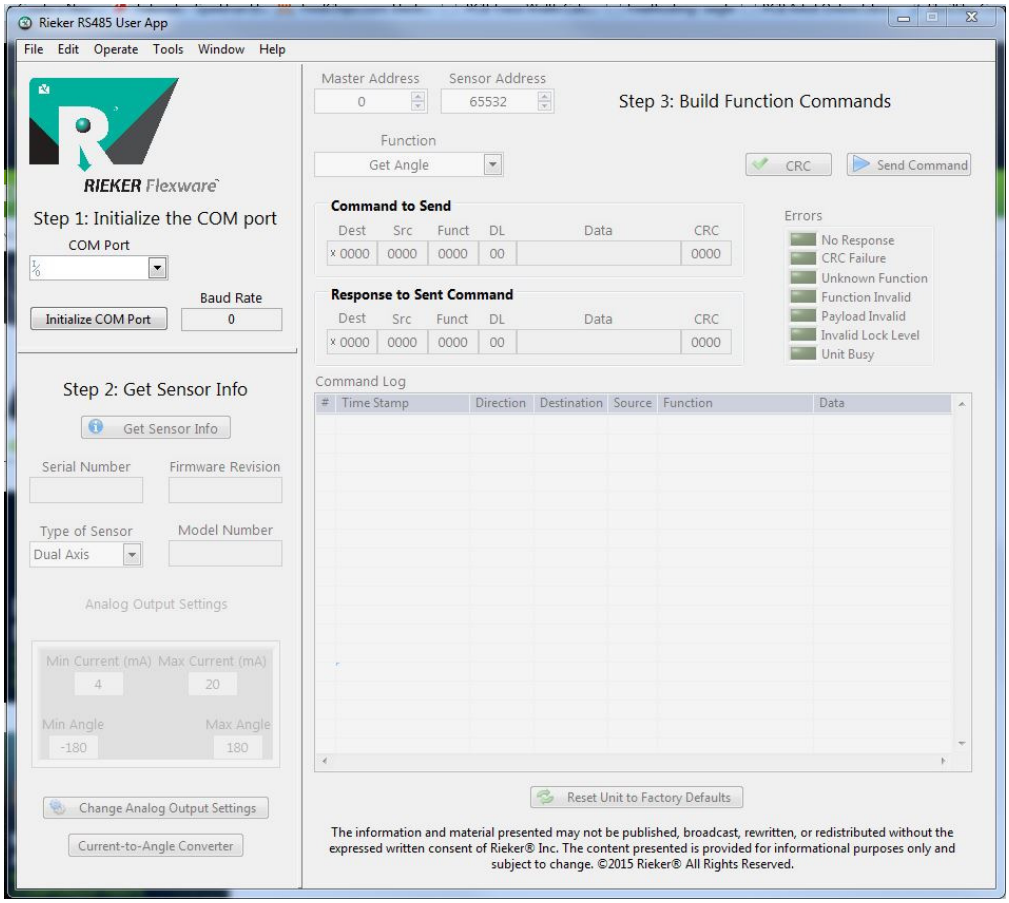
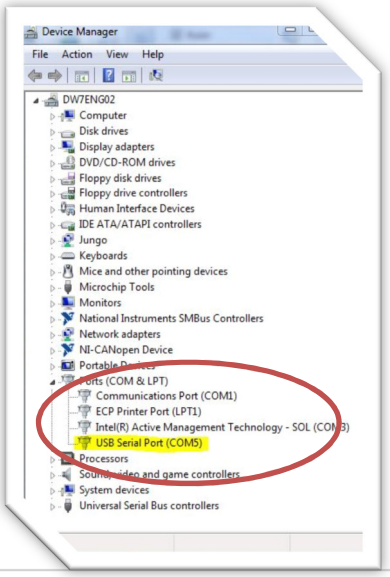


FIGURE 12: **Device Manager**



6. In the program, select the COM port that the USB-RS485 is connected to. This can be found by opening the device manager and looking in the “Ports (COM & LPT)” section for the USB Serial Port and noting the COM # (

7.

8. Figure *12*). NOTE: Figure is representative only. COM Port may be different on your computer.

9. Click the “Initialize COM Port” button to open the COM port. This also queries for any sensor and displays “COM Port Successfully Initialized” if there is a response (meaning the baud rate and COM port are correct). If the “COM Port Failed to Initialize. Check settings and wiring” dialog box pops up, verify all connections and/or try another COM port.

10. Click OK. You can now communicate with the sensor.

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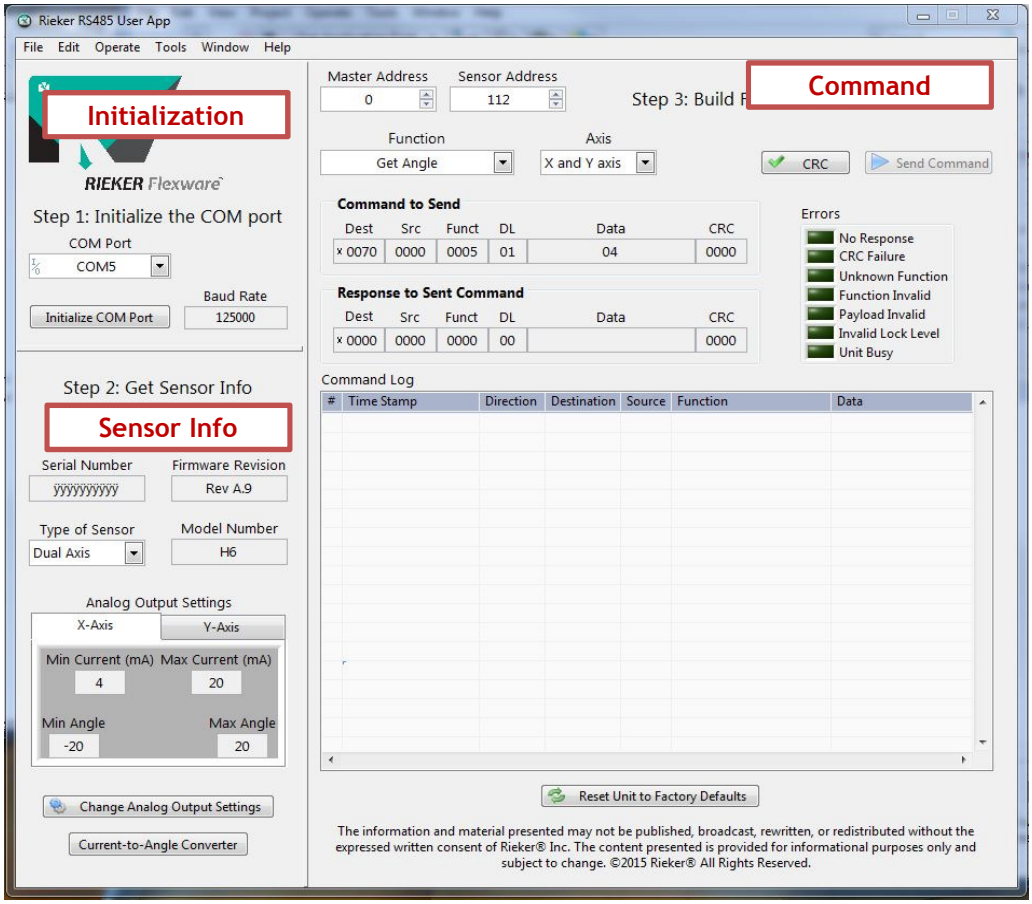
Overview of the Rieker Flexware™ User App

The Rieker Flexware™ User App is designed to get the sensor and application up and running as quickly as possible. The App can be used for gathering sensor info and troubleshooting sensor issues, as well as having tools to design a customer specific application.

There are three sections in the Flexware™ User app: (*Figure 13*).

1. Initialization
2. Sensor Info
3. Communication

***FIGURE 13*: User App Screen**



NOTES:

- By default, a context help window is displayed in the upper left corner of the desktop. This window will display more information about any control that is moused over.
- Most functions of the Flexware™ User app will only work with one connected sensor at a time.

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1. Initialization Section

The INITIALIZATION section is where communication with the sensor is set up. There are two parts to setting up communication: COM port and Baud Rate.

- **COM Port**
  - Name of the computer port that the USB-RS485 adaptor is connected to
- **Baud Rate**
  - Data rate of the currently connected sensor

Click the "Initialize COM Port" button to save the current settings and test the communication. A successful setting will display a "COM Port Successfully Initialized" dialog box, while an unsuccessful setting will display a "COM Port Failed to Initialize. Check settings and wiring" dialog box.

NOTE: the COM Port will also fail to initialize if another application is currently using the selected COM port. Please exit the other applications before trying to reinitialize the port.

2. Sensor Info Section

This window displays pertinent information about the connected sensor. Click the "Get Sensor Info" button to display the sensor info dialog box (*Figure* 14) and update the Sensor Info window information.

- Sensor Address
- Serial Number
- Firmware Revision
- Model Number and Sensor Type
- Analog Output parameters
  - Min/max current in milliamps, as well as the min/ max measurement angle range corresponding to the min/max currents.
  - For dual axis sensors the analog parameters will be shown for each axis on individual tabs.

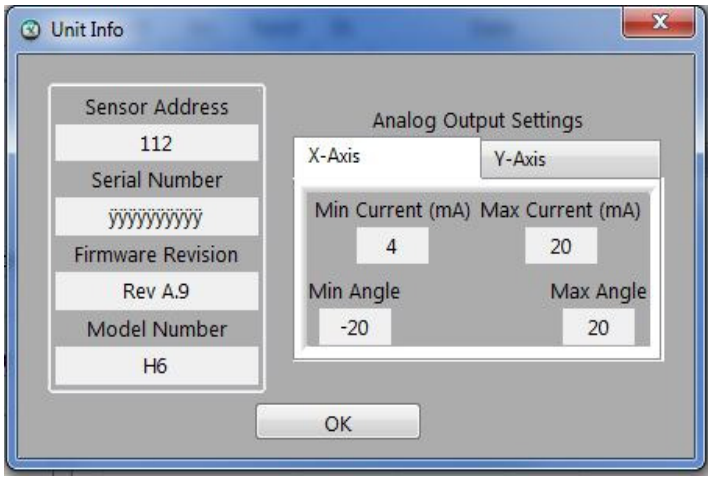

FIGURE 14: **Sensor Info Dialog Box**

Click "OK" to get back to the main window.

NOTES:

- **CAUTION:** This window will not work correctly if more than one sensor is connected to the bus.
- The "Change Analog Output Settings" button is used to change a sensor's analog output parameters. Refer to Changing the Analog Output Settings section for more information.

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3. Command Section

Overview

The COMMAND section is where you build, send, and receive commands from the sensor. It is meant to quickly and simply allow the user to get up and running with the commands required to communicate with the Rieker Flex™ Series of sensors.

To send a command to the sensor:

1. Select the master address in decimal. This is the address you want the sensor to respond to, range is 0-65,500. (Default is 0.) **CAUTION: Do not set the master address to the same address as any connected sensor. Doing so could cause the communications to fail.**
2. Select the sensor address in decimal. This is the address of the connected sensor (this can be found by using the "Get Sensor Info" window).
3. Select the function to send. The list of functions and their description is in the RS485 Command Functions Section.
4. Select the argument(s) for the function (if any). The list of arguments for each function is also in the RS485 Command Functions Section.
5. Click the "CRC" button. This will calculate and add the CRC Checksum to the command string and generate the complete packet to be sent.

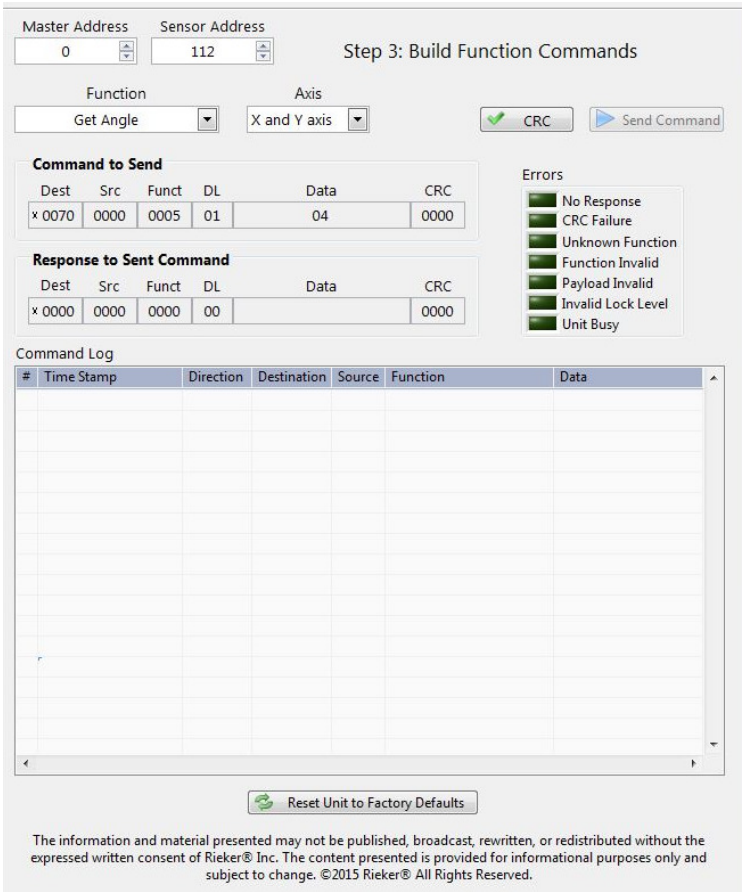

FIGURE 15: **Command Window**

6. Click the "Send Command" button. The "Send Command" button will be grayed out until the "CRC" button is pressed.

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The "Command to Send" window shows the exact data byte string (in hexadecimal) sent to the sensor. This can be used as a reference when developing the user specific application to poll the sensor.

The "Response to Sent Command" window shows the exact data byte string (in hexadecimal) received from the sensor.

The "Command Log" window shows a log of all sent and received commands:

- Time stamp of the command
- Direction of data (sent or received)
- Address of the destination device (commanded sensor if sent, master if received)
- Address of the source device (master if sent, commanded sensor if received)
- Function name
- Data (if any)

The error window will indicate various errors to aid in debugging your code.

NOTES:

- You can connect multiple sensors to the development app at the same time, but you must first insure that **no sensors have the same address**, as this will cause more than one sensor to respond at the same time.
- Also, with multiple sensors connected to the bus, the "Get Sensor Info" window *cannot* be used as it will cause errors.

Reset Unit to Factory Defaults

The "Reset Unit to Factory Defaults" button will configure the connected sensor to the following factory defaults. This is useful if the sensor settings are unknown and communication does not seem to be working. Reset to default also removes all applied zero offsets.

Sensor Address	223
Baud Rate	125kbps
Analog Output Parameters	Customer Specific

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Analog Output

Overview

The H6 sensor comes with dual 0-24mA DAC outputs used for dual axis angle measurements, while the H430 comes with a single 0-24mA DAC outputs used for single axis angle measurements. The factory default output parameters can be reconfigured at time of order, and/or can be reconfigured to angle and current range by the end user via the Rieker Flexware App. For dual axis sensors, each axis analog output can be configured separately. The current outputs are directly related to the input angle and will match the angle for any configured range.

Changing the Analog Output Settings

Changing the analog output settings is very easy when using the Flexware™ User App. On the Sensor Info Window, click the "Change Analog Output Settings" button to display a dialog box to change the analog output parameters.

- Min Current: The minimum output current (in milliamps).
- Max Current: The maximum output current (in milliamps).
- Min Angle: The angle (in degrees) corresponding to the minimum output current.
- Max Angle: The angle (in degrees) corresponding to the maximum output current.

The "Save" or "Save & Close" buttons send the current parameters to the sensor. Note that the analog parameters are changed for each axis individually.

Example: for the sensor configured in *Figure 16*, at -20° the x-axis current output would measure 4mA and at +20° the x-axis current output would measure 20mA (and at 0° it would measure 12mA).

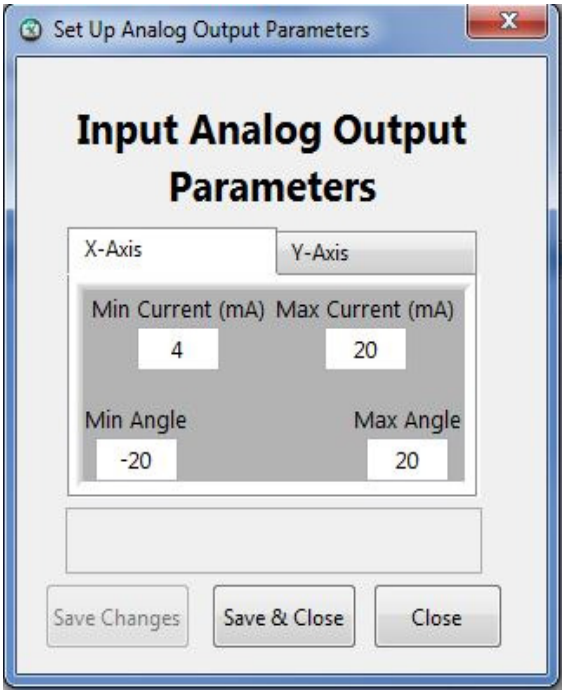

FIGURE 16: **Change Analog Output**

Unit Ranges

Each analog output (for both the H6 and H4360) can be set to:

- any current between 0-24mA
- any angle between ±180°.

CAUTION: The Flex™ series of sensors are manufactured to allow end user adjustments to certain output parameters. Purchaser assumes the responsibility of ensuring that the settings are appropriate for their specific application. IN NO EVENT WILL RIEKER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND.

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Default Axis Orientations

H6 Dual Axis

As shown in ***Error! Reference source not found.***, the 0° orientation for the H6 is a desktop level position.

- For the X-axis, looking at the unit from the side with the connector facing to the right, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.
- For the Y-axis, looking at the unit from the front with the connector facing towards you, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.

H4360 Single Axis

As shown in *Figure 7*, the 0° orientation for the H4360 is a vertical mount with the slot at the bottom. A clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.

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Rieker Flexware™ Angle Display App

Description

The Rieker Flexware™ Angle Display can be used to measure and display the angle outputs of the Flex™ series of sensors, in both a graph and number format. Additionally, the output data may be saved to a text file.

Getting Started with Rieker Flexware™ Angle Display

Use the included development cable to connect the sensor to a computer and to a power outlet. Refer to Appendix A. Creating a Development Cable for instructions on connecting the sensor without using the development cable.

1. Connect the USB-RS485 adaptor to the computer.
2. Connect the development cable to power either via the Wall DC power supply to a power outlet or using your own DC power source (11-36 VDC).
3. Connect the sensor to the other end of the development cable.
4. Click on the Windows START menu on the computer. Then click PROGRAMS > Rieker > GET ANGLE APP. You should see the following screen appear (*Figure 17*).

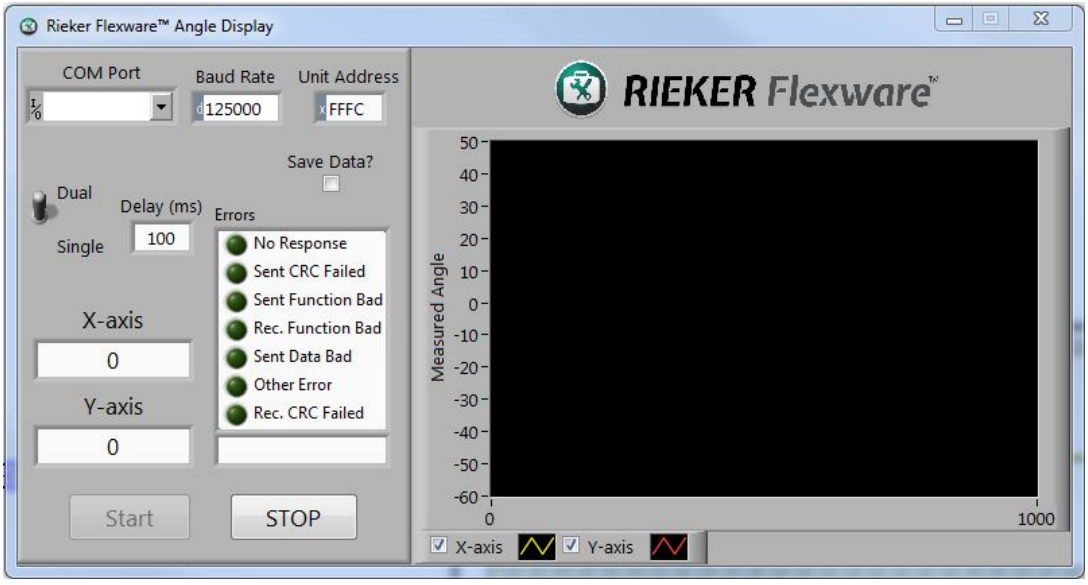

FIGURE 17: **Angle Display Start**

5. In the program, select the COM port that the USB-RS485 is connected to.
6. (Optional) Change the baud rate if the connected sensor is at a different baud rate than the default (default is 125,000bps).

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1. Select the address of the desired sensor to measure, or use 0xFFFC if only one sensor is connected.
2. Select whether the connected sensor is single or dual axis.
3. (Optional) Select the delay (in ms) between measurements.
4. Click the "Start" button to open the COM port and begin measuring data. If the "COM Port Failed to Initialize. Check settings and wiring" dialog box pops up, verify all connections and/or try another COM port.
5. If everything worked correctly, the sensor's angle output should begin displaying on the graph and in the numeric boxes. (*Figure 18*)

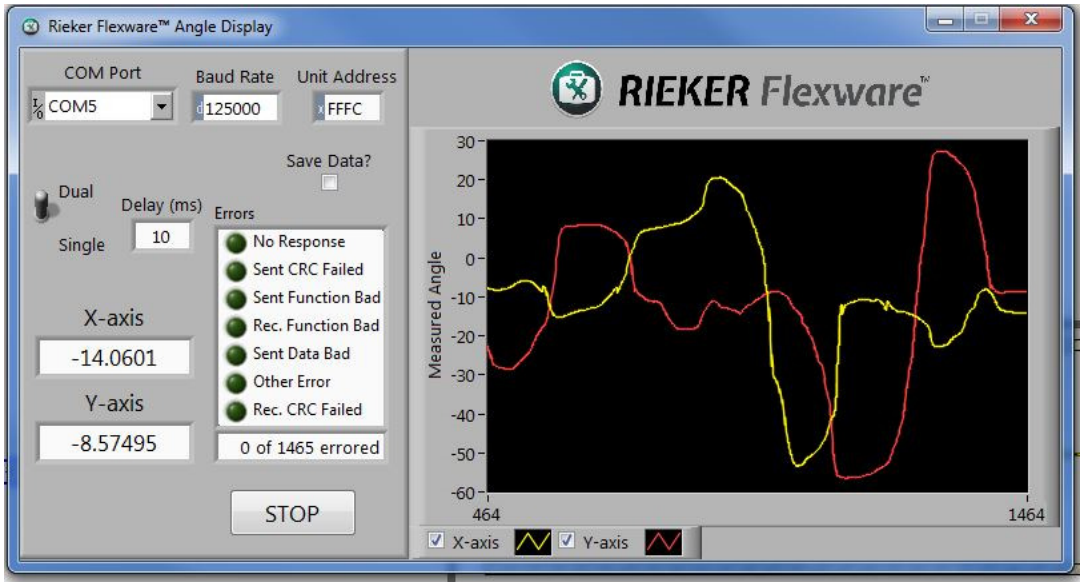

FIGURE 18: **Angle Display Running**

6. (Optional) Before closing the app, check the "Save Data?" box to save the angle output data to a text file.

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Communications

The H6 and H4360 inclinometers communicate over a RS485 half-duplex communication bus using a Rieker-specific packet format which is described in this section. This communication can be used to read inclination angles from the device, as well as configure the various device settings.

The sensors are initially configured for RS485 communications at a baud rate of 125,000bps. The protocol is fixed at 8 data bits, No parity, 1 Stop bit, and No Flow Control. Each device has an address, and only responds to commands sent to that address, or to the BROADCAST address (0xFFFC). The BROADCAST address is used to send a single command to every sensor on the bus. The sensor address is initially set to 223 (0xDF), but can be configured to any number from 1-65000. Every sensor on the same RS485 bus must have a unique address.

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RS485 Protocol

The protocol is set up in a Master/Slave configuration, where the sensors will not respond unless they are commanded to by a master device. The packets sent by the master are called commands. Sensors will respond to all commands that are specifically addressed to that sensor.

Packet Format

Commands and responses are sent in the following form: [DEST][SRC][FUNCT][DL][DATA][CRC]
where:

[DEST]	2 byte destination address. The address of the device to be communicated with.
[SRC]	2 byte source address. The address of the device sending the command.
[FUNCT]	2 byte command function ID. Refer to RS485 Command Functions for a list of functions.
[DL]	1 byte number of DATA bytes.
[DATA]	Data of length [DL] bytes.
[CRC]	16 bit checksum outputted in bytes.

Commands in this guide, unless otherwise stated, are displayed as a series of hexadecimal bytes.

CRC16

The sensor uses a 16-bit cyclic redundancy check in order to be sure a command was sent correctly and did not lose information on the way to the sensor. The polynomial and initial value for the CRC used are as follows:

Polynomial: $x^{16} + x^{15} + x^2 + 1$
Initial Value: 0x0000

- *Example CRC values for given input values:*

Input (hex)	Output (hex)
00	0000
FF	4040
ABCD	A5BE
123456	FB36
9876543210	E86E

For more information on the CRC and for a calculator visit:
http://www.lammertbies.nl/comm/info/crc-calculation.html

Packet Timing

Bytes in a packet must be less than 125 microseconds apart. Packets originating from the master must be separated by at least 1 millisecond. Sensors will respond to the master as fast as possible.

Protection Levels (lock)

The sensor has two lock levels (0 and 1) to protect against unwanted modifications to the sensor. Some functions work at all lock levels, while others will only work if the sensor is put into lock level 1 (Unlocked). Functions that modify sensor settings require lock level 1, while functions that are only reading data will work at either lock level 0 or 1.

When plugged in or reset, the sensor will always be at lock level 0 (Locked). The sensor will stay at a given lock level until the Change Lock command is sent or the sensor is reset or unplugged.

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RS485 Command Functions

Table 6 shows a list of all the user functions for the H6 & H4360 inclinometer, including the function ID, name, description of the function, and the lock level required to use that function.

The following pages give more details on each function, its format, expected response, and its use.

IDs not shown here are reserved for factory use only.

TABLE 6: FUNCTION LIST

ID	*Name*	*Description*	*Lock Required*
0	ACK	Acknowledge	0
1	NAK	No acknowledge	0
2	Set Address	Set sensor address	1
3	Get Address	Returns the sensor address	0
4	Check Address	Check for sensor at address	0
5	Get Angle	Returns the angle	0
10	Change Lock	Change lock level to 0 or 1	0
16	Restart Sensor	Restarts the sensor	0
24	Set Analog Output Parameters	Set analog output parameter to value	1
25	Set Zero To Value	Set zero offset to float value sent	1
26	Set Zero To Angle	Set zero offset to current angle	1
28	Get Firmware Revision	Returns the firmware revision	0
30	Get Lock Level	Returns the lock level	0
37	Get Serial #	Returns the serial number	0
38	Set Baud Rate	Set the baud rate	1
41	Set Filter Response	Sets the response and filtering	1

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Function Descriptions

0	ACK	ACKNOWLEDGE

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Not a query, no response
Info: Sent from sensor to master in acknowledgement of a completed command.

1	NAK	NO ACKNOWLEDGE

Length: 1 byte
Data: Error Code (Unsigned 8-bit Integer)
Lock Level Required: 0 or 1
Immediate Response: Not a query, no response
Info: Sent from sensor to master when the sent command cannot be executed due to an error, given by Error Code.

Error code	Error description
0	CRC failure
1	Unknown function
2	Function not valid for this sensor or mode of operation
3	Data invalid for given function
4	Invalid lock level to execute command
5	Sensor Busy. Wait and try again

2	SET ADDRESS	SET SENSOR ADDRESS

Length: 2 bytes
Data: Address (Unsigned 16-bit Integer)
Lock Level Required: 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to change the sensor address. After sending this command, wait 50 milliseconds before issuing further commands.

Example Command Send/Receive:

Sent Command:

00DF	0000	0002	02	0065	4F2D
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Set address of sensor at address 223 (0x00DF) to 101 (0x0065)

Received Command:

0000	00DF	0000	00		D43B
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

ACK

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3	GET ADDRESS	GET SENSOR'S ADDRESS

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: Packet with the sensor's address in 2 data bytes, as an Unsigned 16-bit Integer.
Info: This function is useful when a sensor address is unknown and it is the only sensor on the bus. By issuing 'Get Address' to a broadcast address (0xFFFC), the sensor will respond with its address in the data field. CAUTION: Do not issue broadcast commands with multiple sensors on a bus. Their packets will collide, which can usually be detected by a failed CRC check (but not always).

Example Command Send/Receive:

Sent Command:

FFFC	0000	0003	00		C31B
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Get address of sensor (broadcast command)

Received Command:

0000	0065	0003	02	0065	5A68
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Sensor address is 101 (0x0065)

4	CHECK ADDRESS	CHECK FOR SENSOR PRESENT AT AN ADDRESS

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: ACK from sensor at address DEST
Info: A sensor with the targeted destination address will respond with an ACK. If no sensor has that address, there will be no response. CAUTION: If multiple sensors have that address, there may or not be a CRC error.

Example Command Send/Receive:

Sent Command:

0065	0000	0004	00		350B
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Set address of sensor at address 223 (0x00DF) to 101 (0x0065)

Received Command:

0000	0065	0000	00		CC1E
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

ACK

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5	GET ANGLE	GET THE ANGLE OF A SENSOR

Length: 1 byte
Data: Type Code (Unsigned 8-bit Integer)
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: Packet with the sensor's measured angle(s) in 4 (or 8) bytes, as an IEEE-754 single precision floating point number, based on the sent type code.
NOTE: A change in angle will not display instantly due to filtering and smoothing in the sensor.

Type Code	Description
1	Single axis angle
2	Dual X-axis angle
3	Dual Y-axis angle
4	Dual X and Y axis angles

Example Command Send/Receive:

Sent Command:

```
  0065    0000   0005     01    04       5425
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

Get X and Y axis angles from sensor at address 101 (0x0065)

Received Command:

```
  0000    0065   0005     08    BF4B 1C00 4193 8D00    71C8
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]                 [CRC]
```

X-axis = (0x BF4B1C00) -0.79339599609375°; Y-axis = (0x41938D00) 18.44384765625°

10	CHANGE LOCK	CHANGE LOCK LEVEL

Length: 5 bytes
Data: Lock Level (Unsigned 8-bit Integer), Password, 12345678 (Unsigned 32-bit Integer)
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to change the lock level of the sensor. Can be changed to 0 (locked) or 1 (unlocked). Lock level 1 allows various sensor settings to be changed, while lock level 0 prevents changes to the sensor settings.

Example Command Send/Receive:

Sent Command:

```
  0065    0000   000A     05    0100BC614E     E414
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]        [CRC]
```

Change lock level to 1

Received Command:

```
  0000    0065   0000     00    00       CC1E
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

ACK

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16	RESTART	RESTARTS THE SENSOR

Length: 0 bytes
Data: None
Lock Level Required: 1
Immediate Response: Yes
Expected Response from sensor: ACK before resetting
Info: Stops and restarts the sensor. Similar to unplugging and plugging in the sensor.

Example Command Send/Receive:

Sent Command:

0065	0000	0010	00		3504
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Received Command:

0000	0065	0000	00	00	CC1E
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

ACK

24	SET ANALOG OUTPUT SETTINGS	ANALOG OUTPUT PARAMETERS SENT TO SENSOR

Length: 6 bytes
Data: Parameter Code (Unsigned 16-bit Integer), Value (4 byte Float)
Lock Level Required: 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to manually set the various analog output parameters. The Parameter Code determines which parameter to set. For more information on the different parameters, see the section “Changing the Analog Output Settings”.

Parameter Code	Description for Dual Axis Units	Description for Single Axis Units
0x10	X-Axis Current MIN	Current MIN
0x11	X-Axis Current MAX	Current MAX
0x12	X-Axis Angle MIN	Angle MIN
0x13	X-Axis Angle MAX	Angle MAX
0x15	Y-Axis Current MIN	Not Used
0x16	Y-Axis Current MAX	Not Used
0x17	Y-Axis Angle MIN	Not Used
0x18	Y-Axis Angle MAX	Not Used

Sent Command:

0065	0000	0018	06	10 3B83126E	E9C7
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Set the X-axis current min of sensor 101 to 4mA.

Received Command:

0000	0065	0000	00	00	CC1E
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

ACK

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25	SET ZERO TO VALUE	SET ZERO OFFSET TO SENT VALUE (FLOAT)

Length: 5 bytes
Data: Axis Code (Unsigned 8-bit Integer), Offset (4 byte Float)
Lock Level: 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to manually change the zero offset. The offset value is subtracted from every angle for the axis given by Axis Code (causing Offset to become the new zero value).
This lasts until a new offset is set or the sensor is reset to factory defaults.
NOTE: This can be used to remove any previous offsets by setting the value to 0.
NOTE: This function can be used to mount the sensor upside down by setting both values to 180.

Axis Code	Description
1	X-axis (or Single Axis)
2	Y-axis

Example Command Send/Receive:

Sent Command:

```
 0065    0000   0019     05    0100000000    995A
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]         [CRC]
```

Set the X-axis zero of sensor 101 to 0°.

Received Command:

```
 0000    0065   0000     00    00       CC1E
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

26	SET ZERO TO CURRENT ANGLE	SET ZERO OFFSET BASED ON MEASURED ANGLE VALUES

Length: 1 byte
Data: Type Code (Unsigned 8-bit Integer)
Lock Level: 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to set the zero offset to the sensor's measured angle. Takes both axis angle measurements and subtracts the values from all subsequent angle readings (causing the current angle to become the new zero value).
If the Type Code is set to temporary, this offset only lasts until the sensor is powered off or reset. If the Type Code is set to permanent, this offset lasts until a new offset is set or the sensor is reset to factory defaults.
This can be used to account for any installation errors (including mounting the sensor upside down) by mounting the sensor in the zero setting and sending the permanent command.

Type Code	Description
0	Temporary
1	Permanent

Example Command Send/Receive:

Sent Command:

```
 0065    0000   001A     01    01       91D4
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

Permanently set the zero of sensor 101 to the measured angles.

Received Command:

```
 0000    0065   0000     00    00       CC1E
[DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

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28	GET FIRMWARE REV	GET THE FIRMWARE REVISION

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: Packet with the sensor's firmware revision in 7 bytes, as an ASCII string.

Example Command Send/Receive:

Sent Command:

```
 0065   0000  001C    00          3501
[DEST] [SRC] [FUNCT] [DL] [DATA]  [CRC]
```

Received Command:

```
 0000   0065  001C    07   52657620412E38  CC1E
[DEST] [SRC] [FUNCT] [DL] [DATA]          [CRC]
```

Sensor 101's firmware revision is "Rev A.8"

30	GET LOCK LEVEL	GET THE CURRENT LOCK LEVEL SETTING

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: Packet with the sensor's current lock level (0 or 1), as one unsigned byte.

Example Command Send/Receive:

Sent Command:

```
0065  0000 001E  00     5500
[DEST] [SRC] [FUNCT] [DL] [DATA]  [CRC]
```

Received Command:

```
 0000   0065  001E    01   01      5EEC
[DEST] [SRC] [FUNCT] [DL] [DATA]  [CRC]
```

Sensor 101 is at lock level 1.

37	GET SERIAL NUMBER	GET THE SENSOR'S SERIAL NUMBER

Length: 0 bytes
Data: None
Lock Level Required: 0 or 1
Immediate Response: Yes
Expected Response from sensor: Packet with the sensor's 10 digit serial number, as a 10-byte ASCII string.

Example Command Send/Receive:

Sent Command:

```
 0065   0000  0025    00          6513
[DEST] [SRC] [FUNCT] [DL] [DATA]  [CRC]
```

Received Command:

```
 0000   0065  0025    0A   3834 3938 3734 2020   F6F3
[DEST] [SRC] [FUNCT] [DL] [DATA]               [CRC]
```

Sensor 101's serial number is "849874".

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38	SET BAUD	SET THE RS485 COMMUNICATION BAUDRATE

Length: 1 byte
Data: Type Code (Unsigned 8-bit Integer)
Lock Level Required: 1
Immediate Response: Yes
Expected Response from sensor: ACK in current baud rate.
Info: This function is used to change the sensor's communication baud rate, based on Type Code. Requires a reset (or power off and on) to switch to the new baud rate.
Default is 3 (125,000 bps).

Type Code	Baud Rate
0	9600
1	38400
2	115200
3	125000
4	128000
5	250000

Example Command Send/Receive:

Sent Command:

0065	0000	0026	01	01	9D14
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Set the baud rate of sensor 101 to 38,400.

Received Command:

0000	0065	0000	00	00	CC1E
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

41	SET FILTER RESPONSE	SET THE RESPONSE AND FILTERING

Length: 1 byte
Data: Unsigned 8-bit Integer Type Code
Lock Level Required: 1
Immediate Response: Yes
Expected Response from sensor: ACK
Info: This function is used to change the filter response of the sensor, based on Type Code. This affects the instantaneous response of the sensor. "Low" filter level is useful for measuring small rapid changes in angle. As filter level is increased, the instantaneous response is averaged out.
Default is 4 (highest)

Type Code	Filtering
1	Low
2	Medium
3	High
4	Highest

Example Command Send/Receive:

Sent Command:

0065	0000	0029	01	02	9F64
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

Set the filter response of sensor 101 to Medium.

Received Command:

0000	0065	0000	00	00	CC1E
[DEST]	[SRC]	[FUNCT]	[DL]	[DATA]	[CRC]

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Appendix A. Creating a Development Cable

H6 Development Cable

1. Connect D+ (pin 3) and D- (pin 4) to the D+ and D- pins on the RS485 device, respectively.
2. Connect the USB-RS485 adaptor to the computer via USB cable.
3. In order to measure the current output, connect the X-axis output (pin 6) or Y-axis output (pin 7) and the sensor ground (pin 2) to the measurement device. NOTE: the current outputs will not work using chassis ground.
4. Connect the power (pin 1) to 11-36VDC supply voltage and the ground (pin 2) to the power supply ground. Apply power.

H4360 Development Cable

1. Connect D+ (pin 4) and D- (pin 5) to the D+ and D- pins on the RS485 device, respectively.
2. Connect the USB-RS485 adaptor to the computer via USB cable.
3. In order to measure the current output, connect the current output (pin 3) and the unit ground (pin 2) to the measurement device. NOTE: the current output will not work using chassis ground.
4. Connect the power (pin 1) to 11-36VDC supply voltage and the ground (pin 2) to the power supply ground. Apply power.

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