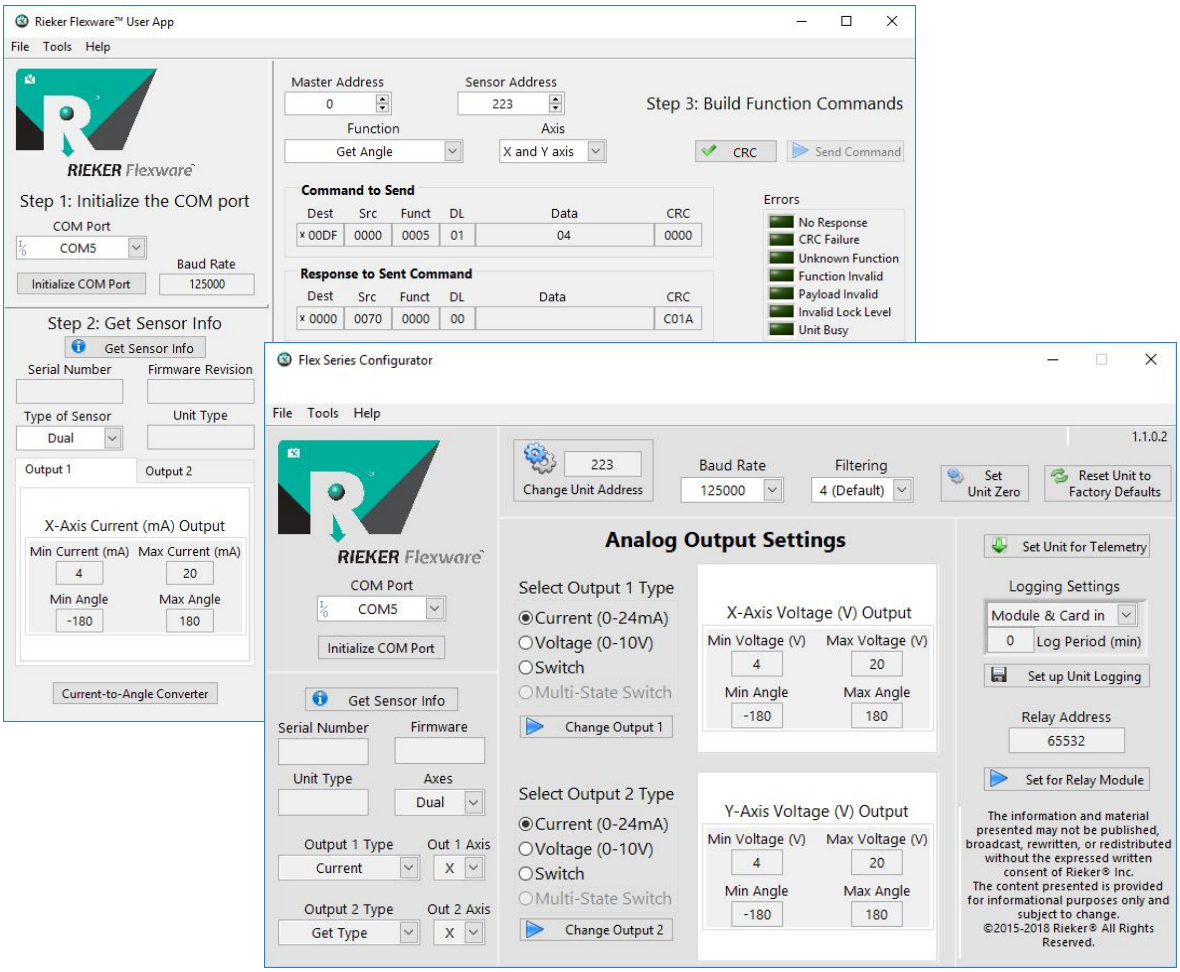
RIEKER inc.

2018

Flexware™ Software User Guide



Flexware Software Instructions

Flexware™ Software User Guide

RIEKER inc.

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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 highly accurate, dual or single axis inclination over a range of ±180°. These sensors incorporate MEMS accelerometers referenced to gravity with integrated temperature compensation over the full industrial operating range of -40° to +85°C for absolute accuracy. They have both digital RS485 and analog 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.

H6 Dual Analog Outputs

The H6 provides two continuous, fully configurable, analog outputs. These outputs can be individually set to current, voltage or open collector switch modes. Each analog output can be mapped to either axis.

The voltage output can be set to any value between 0V and 10V and to any angle range between ±180°. The current output can be set to any value between 0mA and 24mA and to any angle range between ±180°. The open collector switch output connects to signal common and can be set to trip above, below, between, or outside any angle threshold or window range.

H4360 Single Current Output

The H4360 provides one continuous, fully configurable, current output. The current output can be set to any value between 0mA and 24mA and to any angle range between ±180°.

Communications

The H6 and H4360 inclinometers communicate over a RS485 half-duplex communication bus using a Rieker-specific packet format which is described in at the end of this document. This communication can be used to read inclination angles from the sensor, as well as configure the various sensor settings. See *Digital RS485 Communications* for more information.

Updates & Revision History

The information in this guide may be subject to change. Please visit www.riekerinc.com for latest version of this document.

TABLE 1: REVISION HISTORY		
REV	**DATE**	**DESCRIPTION**
A	3/14/2018	Initial Release

RIEKER Flexware™

The *Rieker Flexware™ Toolkit* can be found on the included flash drive. This toolkit includes software useful for testing, configuring, and evaluating the H6 and H4360 Flex™ Series sensors. It includes five applications:

- Configurator
- Angle Display
- User App
- Set Zero Offset
- Multi-unit Angle Display

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.

NOTES:

- 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.
- If the error message continues it could be an administrator privilege issue.
    - "Right-click" on the *Rieker Flexware™ Toolkit* install package and select "Run as Administrator".

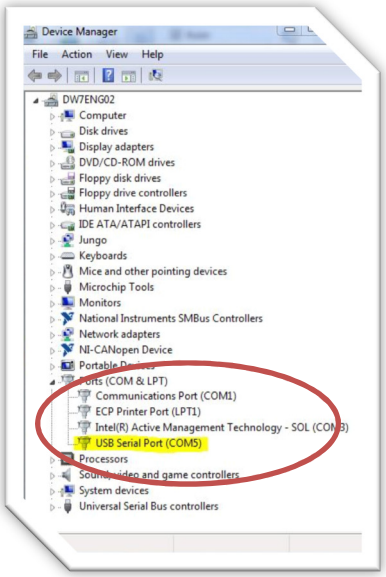
Connection to Flex Sensors

NOTE: In general, multiple sensors can be connected to the various development apps at the same time, but **each sensor must have a different address**. If there are multiple sensors with the same address on the RS485 bus, they will all respond to commands, cause unexpected responses and possible errors.

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 to the computer 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).

FIGURE 1: **Device Manager**



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. In order to determine the COM port that the USB-RS485 is connected to, open device manager and look in the "Ports (COM & LPT)" section for the USB Serial Port. Note the COM # (Figure *1*). NOTE: Figure is representative only. COM Port may be different on your computer.
6. Use this COM port when initializing any of the Flexware™ Apps

Flexware™ Toolkit Getting Started

The Rieker Flexware Toolkit is the launcher program for the various other Flexware programs. It can also be used to initialize the RS485 communication before running one of the other programs.

1. In the COM Port dropdown (or Initialization->COM Port menu (*Figure 2*)), select the COM port determined earlier in this guide (or Auto to let the toolkit search) and click "Initialize COM Port". The launcher will attempt to initialize the COM port, determine the baud rate, and test the communication.
2. Hover over the App button to get a quick description of each program. Click on the button to start the corresponding program.

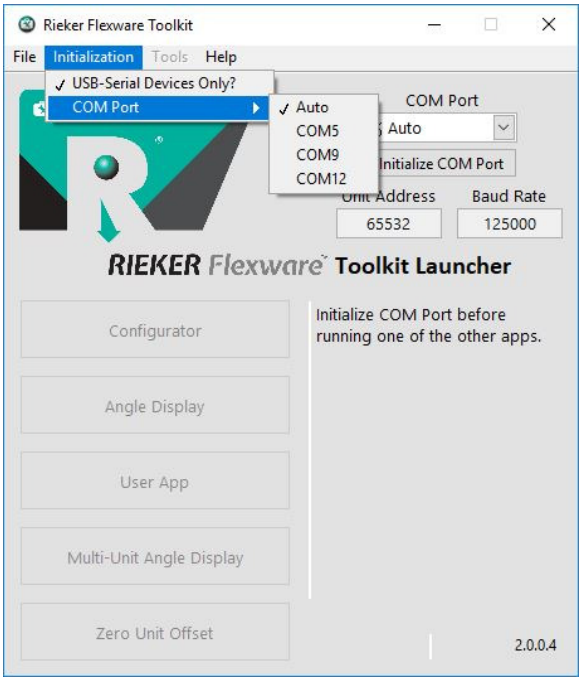


FIGURE 2: **Flexware Toolkit Initialization**

Rieker Flexware™ User App

The Rieker Flexware™ User App is designed to get the sensor and application up and running as quickly as possible. It 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 3*).

1. Initialization
2. Sensor Info
3. Communication

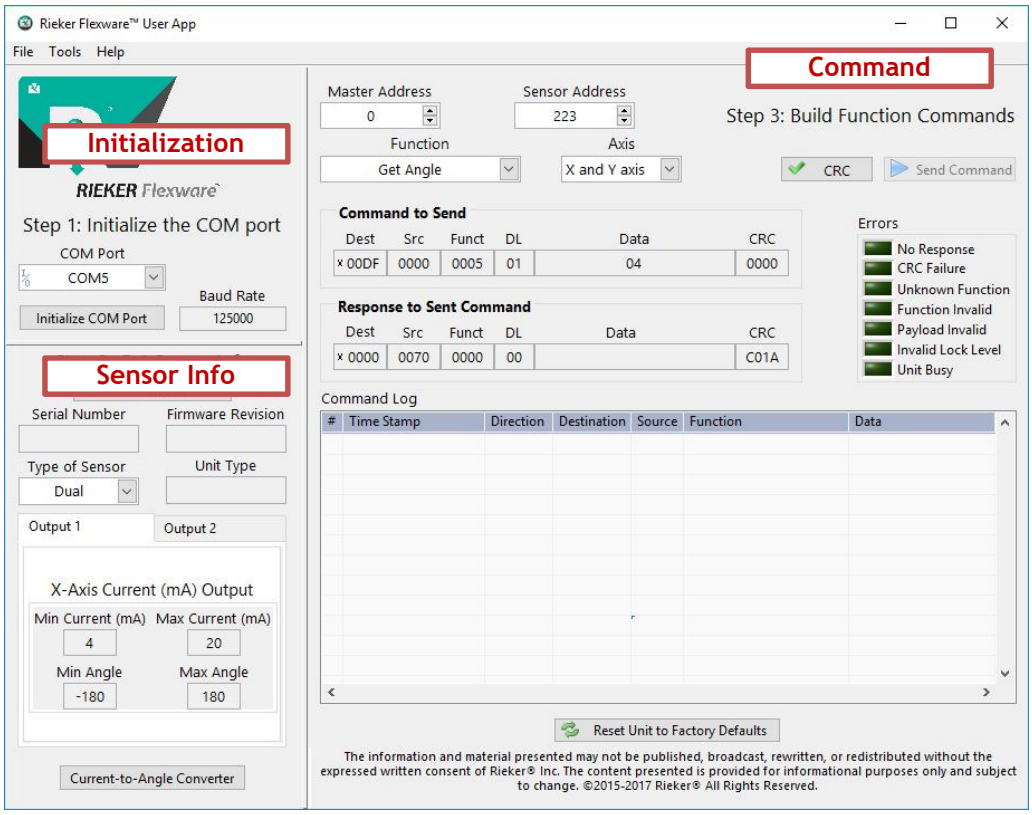


FIGURE 3: **User App Main Screen**

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.

Getting Started with Rieker Flexware™ User App

The INITIALIZATION section is where communication with the sensor is set up. Initialization is very simple:

3. If not already initialized, select the COM port determined earlier in this guide. Click the "Initialize COM Port" button to save the current settings and test the communication.
4. 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. The connected sensor's current baud rate will be displayed.

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.

Sensor Info Section

The SENSOR INFO SECTION displays pertinent information about the connected sensor. Click the "Get Sensor Info" button to display the sensor info dialog box (*Figure* 4) and update the Sensor Info window information.

- Sensor Address
- Serial Number
- Firmware Revision
- Model Number and Sensor Type
- Analog Output parameters

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

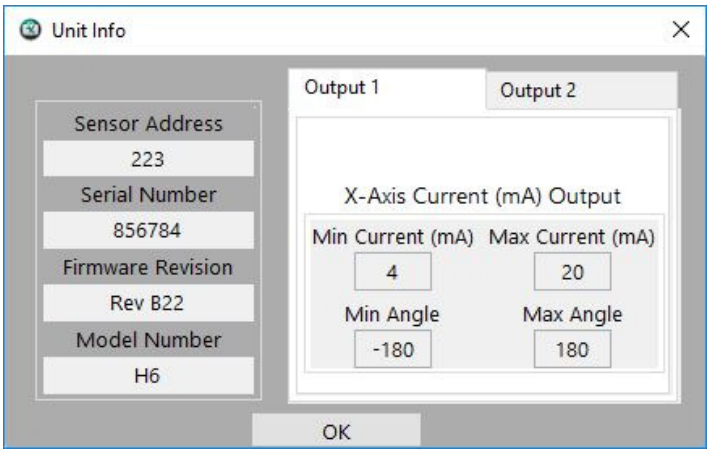


FIGURE 4: **User App Sensor Info Dialog Box**

NOTES:

- **CAUTION:** The Sensor Info window will not work correctly if more than one sensor is connected to the bus.
- The Get Sensor Info button will set the lock level of the connected sensor to 1 (Unlock).
- Use the *Rieker Flexware™ Series Configurator* to quickly and easily change a sensor's analog output parameters. Refer to the Configurator section for more information.

Command Section

The COMMAND section is used to 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. (Optional) 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" button).

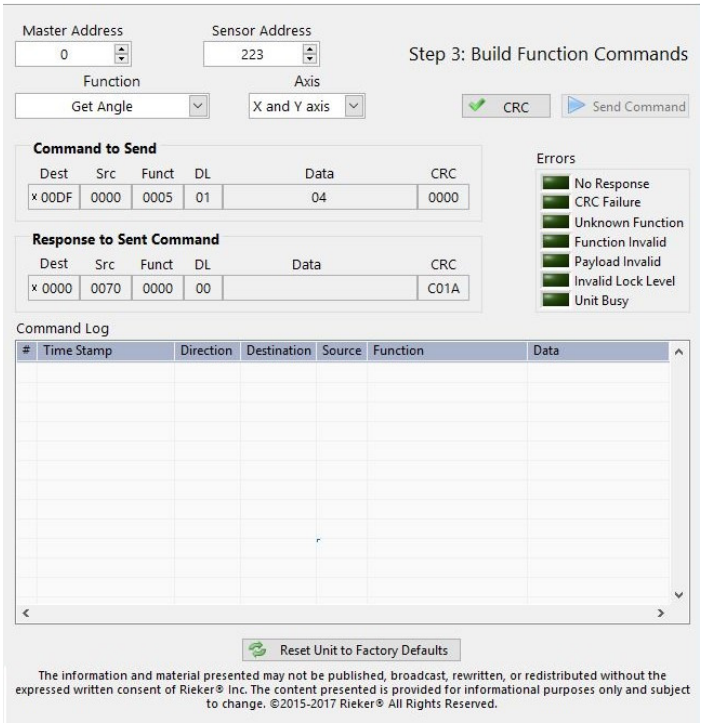


FIGURE 5: **User App Command Window**

3. Select the function to send. (See Function Descriptions for specifics on each command.)
4. Select the argument(s) for the function (if any). (See Function Descriptions for specifics on each command.)
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.
6. Click the "Send Command" button. The "Send Command" button will be grayed out until the "CRC" button is pressed.

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.

Rieker Flexware™ Series Configurator

The Rieker Flex™ Series Configurator gives the user a simple program to quickly configure both the analog and digital parameters of the H6 and H4360 Flex™ series sensors. Unavailable settings and functions (due to incompatible models or older revisions) are grayed-out and disabled to protect a sensor from being set up improperly.

CAUTION: The H6 and H4360 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.

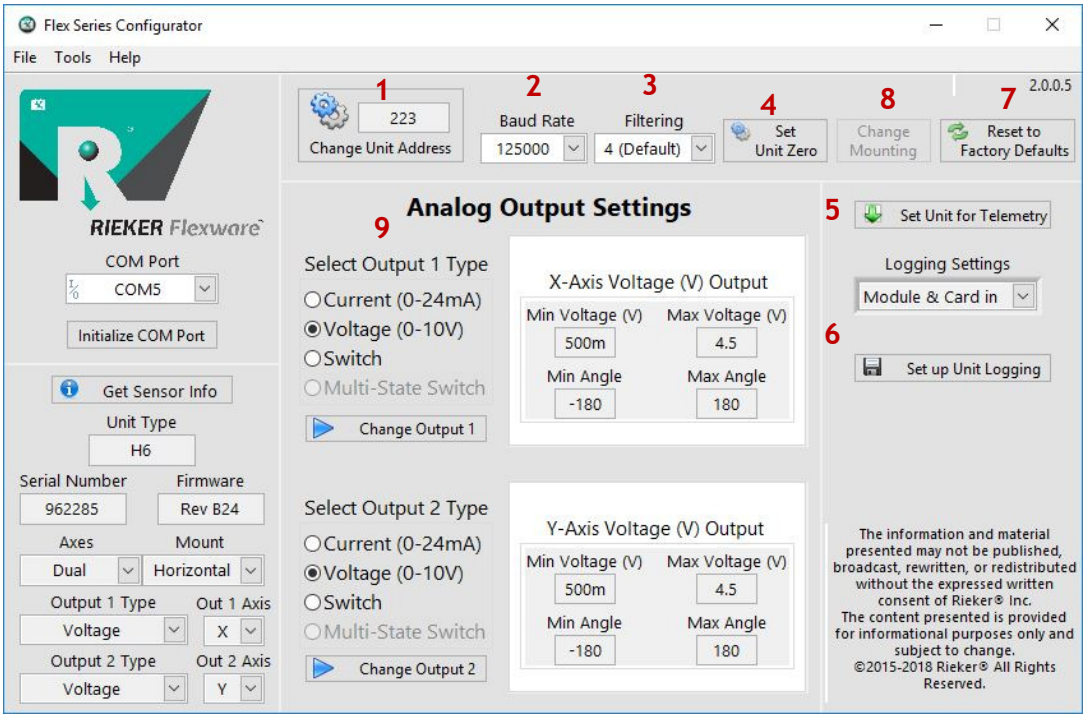


FIGURE 6: **Configurator Main Screen**

Getting Started with Rieker Flexware™ Configurator

1. If not already initialized, select the COM port determined earlier in this guide (or leave blank to have the program attempt to automatically find the correct port). Click the "Initialize COM Port" button to open the COM port.
2. Click "Get Sensor Info" to retrieve all the current sensor information.
3. Use the selectors and buttons to configure the connected sensor.

1. Change Unit Address

This button is used to change the unit address of the connected sensor.

2. Baud Rate

This dropdown is used to change the baud rate of the connected sensor.

3. Filtering

This dropdown is used to change the filter setting of the connected sensor. 1 is the quickest response rate, but the noisiest. 6 is the slowest response rate, but the quietest.

4. Set Unit Zero

This button is used to set the customer zero offset of the connected sensor. There are two options available for setting the zero:

- Explicitly – Manually enter the value required for each axis. This value will be subtracted out from every subsequent angle measurement.
- Current Angle – Sets the current orientation to zero degrees.

5. Set Unit for Telemetry

This button is used to setup the connected sensor properly in order to communicate with the Rieker Flex™ Gateway.

6. Set Up Unit Logging (*H6 Only*)

This button is used to setup the connected sensor for logging to an external micro SD card. Logging can be set at one minute intervals (from once a minute to once a month).

7. Reset Unit to Factory Defaults

This button is used to reconfigure the connected sensor back to the following factory defaults. This is useful if the sensor settings are unknown and communication is not working. Reset to default also removes all applied customer zero offsets.

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

8. Change Mount Orientation (*Specialty H6s Only*)

This button is used to reconfigure the connected sensor to either Horizontal (desktop) mounting or Vertical (wall) mounting.

9. Analog Output Settings

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

Current Output

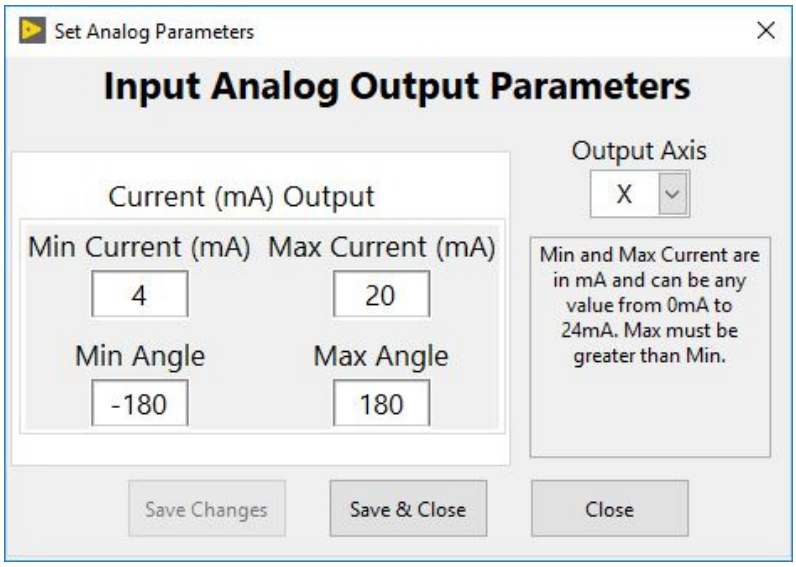


FIGURE 7: **Configurator Input Current Output Parameters**

Notes:

- **Min Current (mA)** – the desired minimum current output in milliamps (0 to 24 mA)
- **Max Current (mA)** – the desired maximum current output in milliamps (0 to 24 mA). Max Current must be greater than Min Current
- **Min Angle** – the desired angle corresponding to the minimum current (±180°)
- **Max Angle** – the desired angle corresponding to the maximum current (±180°)
- **Output Axis** (*H6 Only*) – the desired axis associated with the given current output (X or Y). In general, Output 1 is associated with the X-axis and Output 2 is associated with the Y-axis.

Voltage Output (H6 only)

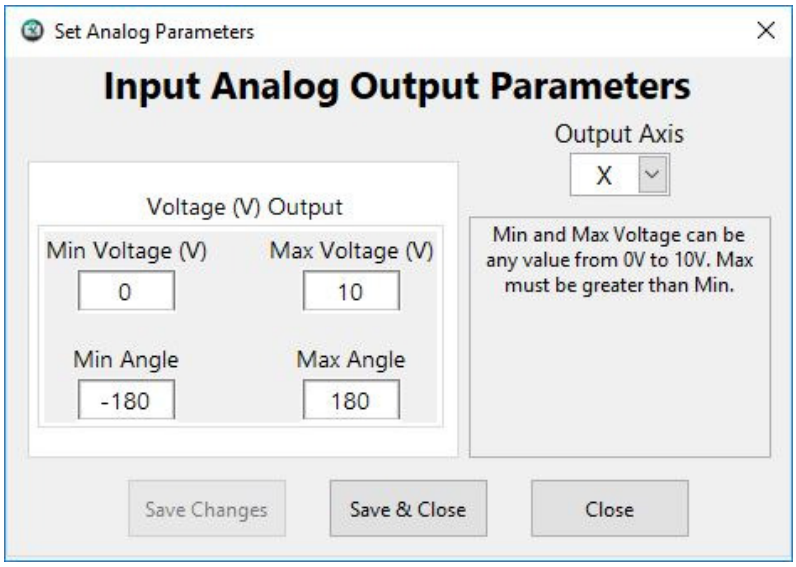


FIGURE 8: **Configurator Input Voltage Output Parameters**

Notes:

- **Min Voltage (V)** – the desired minimum voltage output (0 to 10 V)
- **Max Voltage (V)** – the desired maximum voltage output (0 to 10 V). Max Voltage must be greater than Min Voltage
- **Min Angle** – the desired angle corresponding to the minimum voltage (±180°)
- **Max Angle** – the desired angle corresponding to the maximum voltage (±180°)
- **Output Axis** – the desired axis associated with the given voltage output (X or Y). In general, Output 1 is associated with the X-axis and Output 2 is associated with the Y-axis.

Switch Output (H6 only)

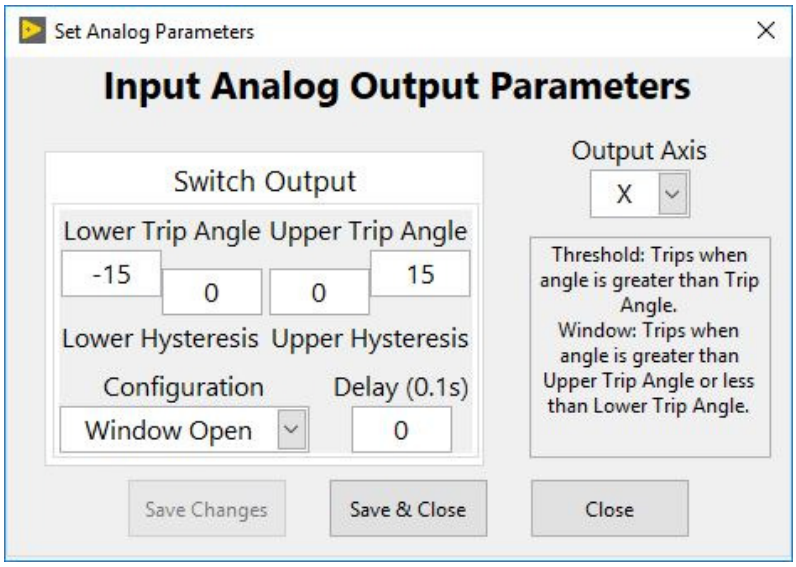


FIGURE 9: **Configurator Input Switch Output Parameters**

Notes:

- **Configuration** - the desired switch output functionality. Choose from one of four options:
  - **Window Open:** The output state is set to off/high between the adjustable Upper and Lower Trip Angles and opposite (on/low) outside the window. (External relay will activate outside of window)
  - **Window Closed:** The output state is set to on/low between the adjustable Upper and Lower Trip Angles and opposite (off/high) outside the window. (External relay will activate inside of window)
  - **Threshold Open:** The output state is set to off/high below the adjustable Trip Angle and opposite (on/low) above or equal to the Trip Angle. (External relay will activate above the Trip Angle)
  - **Threshold Closed:** The output state is set to on/low below the adjustable Trip Angle and opposite (off/high) above or equal to the Trip Angle. (External relay will activate below the Trip Angle)
- **Lower Trip Angle** - the desired Lower Trip Angle (unused for Threshold configurations) (±180°)
- **Upper Trip Angle** - the desired Upper Trip Angle (or just Trip Angle for Threshold configurations) (±180°). Upper Trip Angle must be greater than Lower Trip Angle.
- **Lower Hysteresis** - the desired additional angle change needed for a switch output to return to the untripped state from the Lower tripped state (unused for Threshold configurations). This value is subtracted from the Lower Trip Angle to create the untripped angle (in most cases, this value will be negative). *E.g.* Lower Trip Angle = -10, Lower Hysteresis = -5: Unit will trip at -10 and untrip at -5.
- **Upper Hysteresis** - the desired additional angle change needed for a switch output to return to the untripped state from the Upper tripped state (or just Trip Angle for Threshold configurations). This value is subtracted from the Upper Trip Angle to create the untripped angle (in most cases, this value will be positive). *E.g.* Upper Trip Angle = 10, Upper Hysteresis = 5: Unit will trip at 10 and untrip at 5.
- **Delay (s)** - the desired delay time (in tenths of seconds) that a trip condition must be met before the switch output is actually set/unset to the new condition. *E.g.* Enter 20 for a 2 second delay.
- **Output Axis** - the desired axis associated with the given switch output (X or Y). In general, Output 1 is associated with the X-axis and Output 2 is associated with the Y-axis.

Rieker Flexware™ Angle Display App

The Rieker Flexware™ Angle Display can be used to measure and display the angle outputs of the H6 and H4360 Flex™ series of sensors, in both a graph and number format. Additionally, the output data may be saved to a text file.

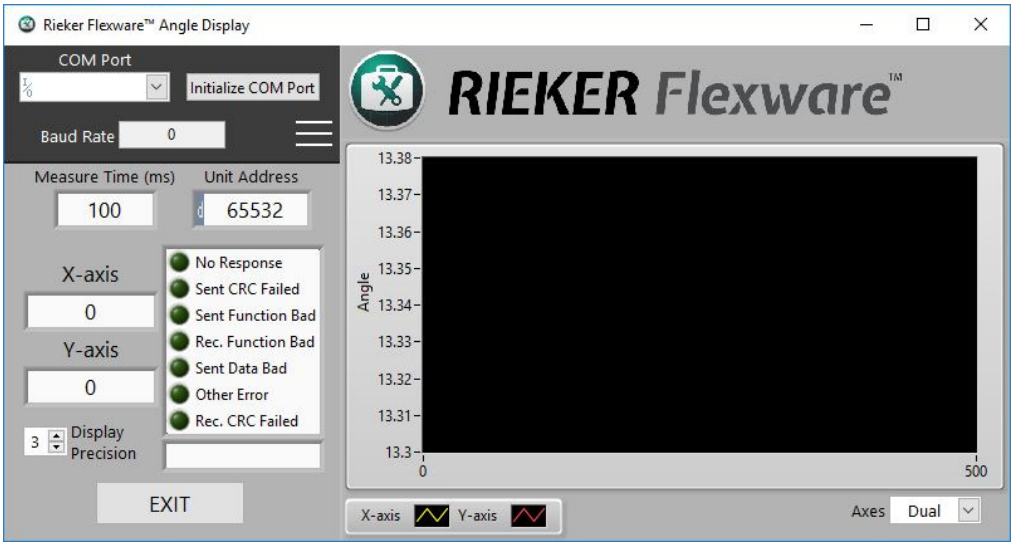


FIGURE 10: **Angle Display Start**

Getting Started with Rieker Flexware™ Angle Display

1. If not already initialized, select the COM port determined earlier in this guide. Click the "Initialize COM Port" button to open the COM port.
2. Select the address of the desired sensor to measure, or use 0xFFFC if only one sensor is connected.
3. (Optional) Select the delay (in ms) between measurements.
4. Click "Start" to begin measuring data from the sensor. The sensor's angle output should begin displaying on the graph and in the numeric boxes. (*Figure 11*)
5. (Optional) Click "Start Logging" to begin logging the angle data. A dialog box will open to select a save location.

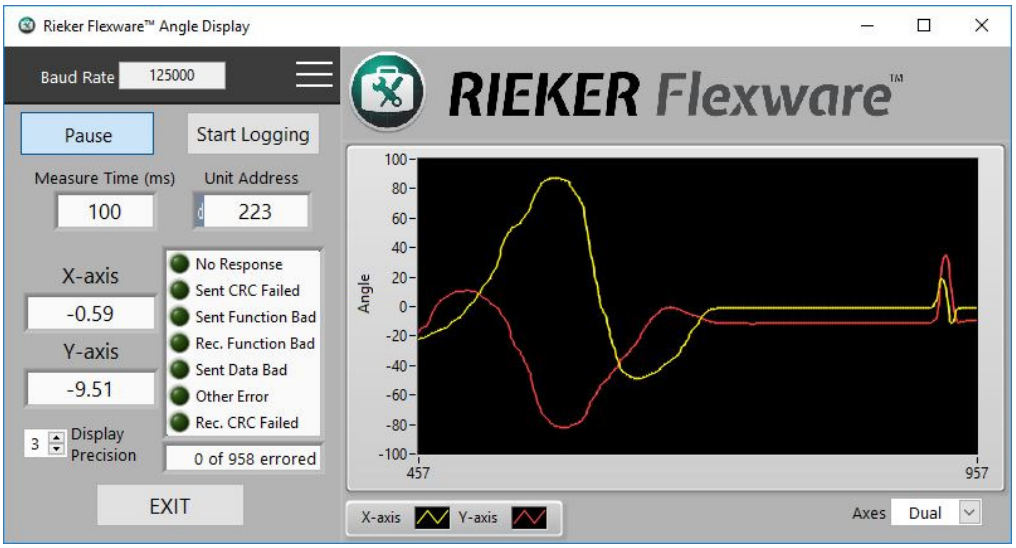


FIGURE 11: **Angle Display Running**

Rieker Flexware™ Multi-Unit Angle Display App

The Rieker Flexware™ Multi-Unit Angle Display can be used to measure and display the angle outputs of many connected sensors simultaneously.

Getting Started with Rieker Flexware™ Multi-Unit Angle Display

1. If not already initialized, select the COM port determined earlier in this guide. (*Figure 12*)
2. Click “Add Sensor” then type in the address of the desired sensor to measure.
   NOTE: The broadcast address (0xFFFC) can **NOT** be used in this app.
3. (Optional) Select the read interval (in seconds).
4. The sensor address, serial number, and angle output will be displayed, in addition to an LED indicating whether the sensor is responding or not. (*Figure 13*)
5. (Optional) Continue adding additional sensors through the “Add Sensor” button.

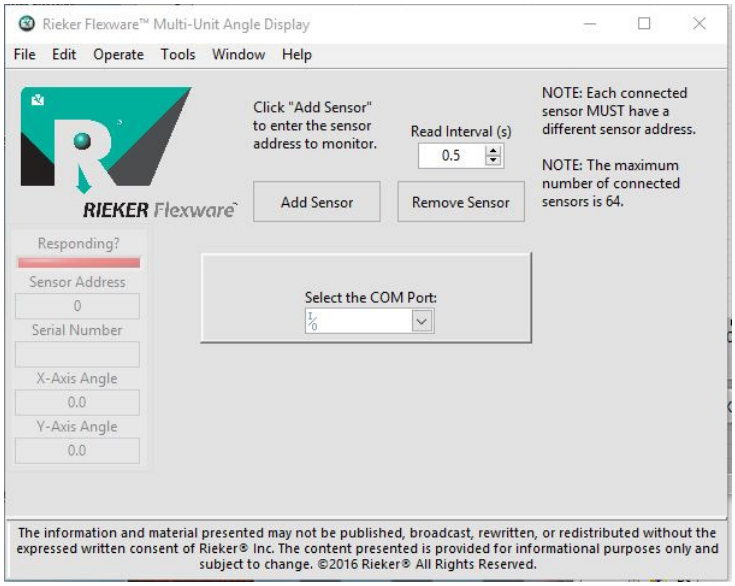


FIGURE 12: **Multi-Unit Angle Display Start**

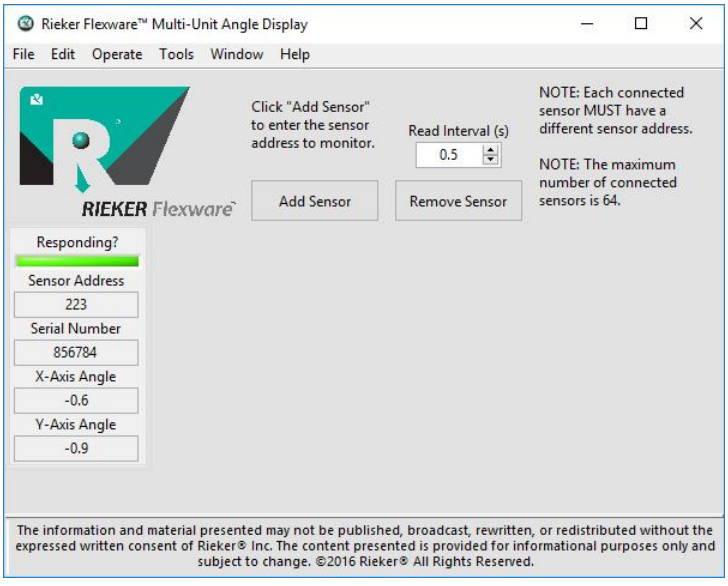


FIGURE 13: **Multi-Unit Angle Display Running**

Rieker Flexware™ Set Zero Offset App

The Rieker Flexware™ Set Zero Offset App can be used to zero the angle outputs of a connected H6 or H4360 Flex™ Series sensor (to account for the customer application).

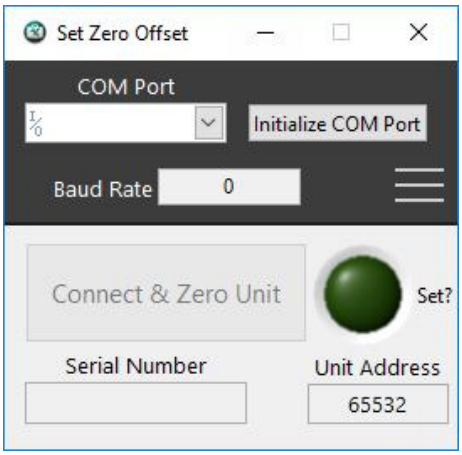


FIGURE 14: **Set Zero App Start**

Getting Started with Rieker Flexware™ Set Zero App

1. If not already initialized, select the COM port determined earlier in this guide. Click the "Initialize COM Port" button to open the COM port.
2. Mount the unit in the desired zero position and click "Connect & Zero Unit". The LED indicator will light if the zero is successful (*Figure 15*).
3. (Optional) Verify the zero by using the Flexware Angle Display App.

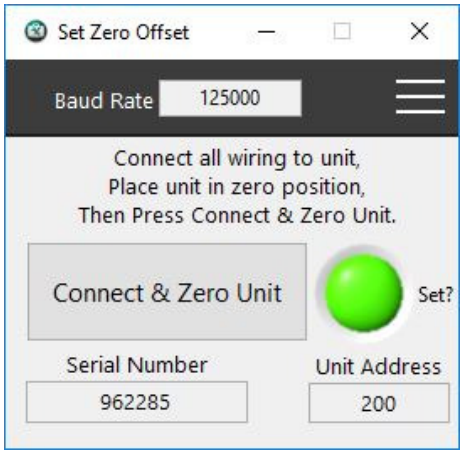


FIGURE 15: **Set Zero App Success**

Digital RS485 Communications

The Flex™ H6 & 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.

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.

RS485 Command Functions

Table 2 shows a list of all the user functions for the H6 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 2: RS485 FUNCTION LIST

ID	*Name*	*Description*	*Lock Required*
0	ACK	Acknowledge	0
1	NAK	No acknowledge	0
2	Set Address	Set sensor address	0
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
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

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:       0065   0000  0002    02   00DF   F727
                   [DEST] [SRC] [FUNCT] [DL] [DATA] [CRC]
```

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

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

ACK

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    00DF   0003     02    00DF    73F3
                   [DEST] [SRC] [FUNCT] [DL] [DATA] [CRC]
```

Sensor address is 223 (0x00DF)

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:       00DF    0000   0004     00           AF11
                   [DEST] [SRC] [FUNCT] [DL] [DATA] [CRC]
```

Check for sensor at address 223 (0x00DF).

```
Received Command:   0000    00DF   0000     00           D43B
                   [DEST] [SRC] [FUNCT] [DL] [DATA] [CRC]
```

ACK

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 (4 bytes)
2	Dual X-axis angle (4 bytes)
3	Dual Y-axis angle (4 bytes)
4	Dual X and Y axis angles (8 bytes)

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 = (0xBF4B1C00) -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

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

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]
```

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    3936 3232 3835 2020 2020    DF6D
                   [DEST] [SRC] [FUNCT] [DL] [DATA]                         [CRC]
```

Sensor 101's serial number is "962285".

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.
The restart sensor command (or power off and on) is required to switch to the new baud rate.
Default is 3 (125,000 bps).

Type Code	Baud Rate
1	9600
2	38400
3	115200
4	125000

Type Code	Baud Rate
5	128000
6	250000
7	19200
8	62500

Example Command Send/Receive:

```
Sent Command:       0065    0000   0026     01    08       50CF
                   [DEST]  [SRC]  [FUNCT]  [DL]  [DATA]   [CRC]
```

Set the baud rate of sensor 101 to 62,500.

```
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. Values range from 1 (low filtering) – 6 (high filtering).
1 has a faster response, but more noise. 6 has a slower response, but less noise. Default is 4.

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 2.

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

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 analog output, connect analog output 1 (pin 6) and/or analog output 2 (pin 7) and the sensor ground (pin 2) to the measurement device. NOTE: the analog 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.