

## 3DM-GX3<sup>®</sup>

### Using Dataloggers with Inertial Sensors

#### Overview

Many inertial applications incorporate dataloggers. The datalogger can take many forms: hardware or software, analog or digital, simple or complex, and/or combinations of all. For our purposes, let's work through a simple-digital-software datalogger. In this case, datalogger software is installed on a computer. The inertial sensor is connected to the computer via an RS-232 communication interface. The inertial sensor is pre-programmed to automatically send data when powered. The computer receives the stream of data and the datalogger software continuously records the stream to a data file.

#### Connect and Configure the 3DM-GX3<sup>®</sup>

In our example, we are using a Lord MicroStrain<sup>®</sup> [3DM-GX3<sup>®</sup>-45](#) Miniature GPS-Aided Inertial Navigation System with RS-232 interface and its accompanying MIP Monitor software to configure the inertial sensor.

- Connect the RS-232 communication cable to the host computer as normal and power the inertial sensor.
- Launch MIP Monitor software and establish communication with the inertial sensor as normal.
- Click Settings.
- Click AHRS and the AHRS Settings screen will appear.
- Select Euler Angles and 10 Hz in the AHRS Message Format drop-down.
- Click OK and the AHRS Settings screen will disappear.
- Got to the GPS and NAV Settings screen and insure that no other data quantities are selected for output.
- Click the blue Start Streaming Data icon to begin sampling and outputting Euler Angles at 10 Hz.
- Click Settings.
- Click Save Current Settings and an information window will appear indicating that the current settings will be written to non-volatile memory.
- Click OK and the information window will disappear.
- **Note:** By clicking OK, we have configured the inertial sensor to automatically and continuously output Euler Angles at 10 Hz each time it is powered up.
- Disconnect the power and reconnect the power. Now observe the activity LED and its rapid blinking will indicate that it is now automatically and continuously outputting Euler Angles.

#### Install the Datalogger Software

In our example, we are using [Eltima RS232 Port Logger](#) software. The software is typical of datalogger software and works easily right out-of-the-box. Download and install the Eltima RS232 Port Logger software.

#### Use the Datalogger Software

- Connect the 3DM-GX3<sup>®</sup>-45 RS-232 communication cable to the host computer and power the inertial sensor.
- Launch the datalogger software.
- Click the appropriate RS-232 port from the Available Ports list to highlight it. In our example, our 3DM-GX3<sup>®</sup>-45 is connected to COM1.
- Click the ... button to select a folder for the data file. In our example, we have selected our Desktop and named the data file 'Test.txt'.
- Select 115200 in the Baudrate drop-down. This is the default baud rate of the 3DM-GX3<sup>®</sup>-45. If you have otherwise changed the baud rate of the 3DM-GX3<sup>®</sup>-45, select the appropriate setting.
- Select 8 in the Data bits drop-down.
- Select None in the Parity drop-down.
- Select 1 in the Stop bits drop-down.
- Select None in the Flow control drop-down.

- When ready to start logging, click the Start logging button and datalogging will begin.
- Note: Remember that your 3DM-GX3<sup>®</sup>-45 is already running and outputting data and the datalogger software will start recording at the point that you click its start button.
- For demonstration purposes, let the datalogger software run for ~10 seconds.
- You will note that the datalogger software continually reports statistics in the form of:
  - Bytes received from port, and
  - Total bytes in file.
- These are indicators of successful logging.
- Click the Stop logging button.
- You will note that a Test.txt data file has been created on your Desktop, containing the 'stream' of data output by the 3DM-GX3<sup>®</sup>-45.

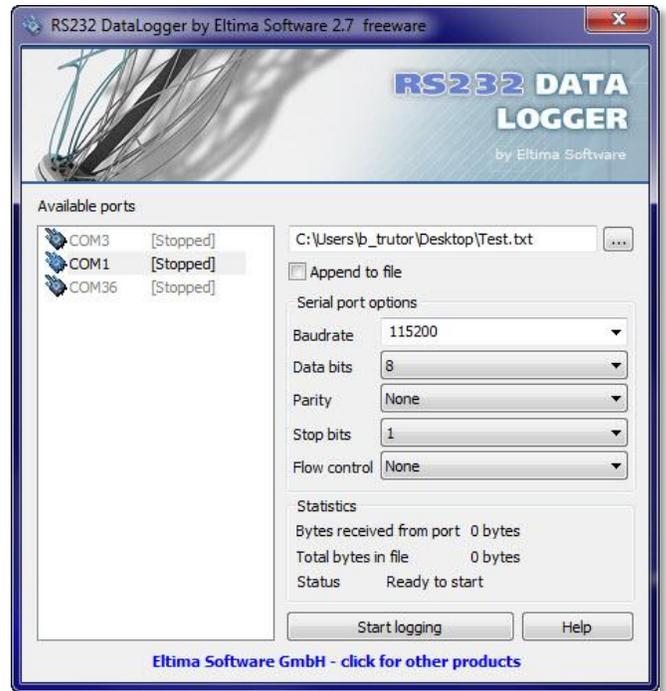


Figure 1: RS232 Data Logger Software

### Understanding the Datalogger Data File

- Double-click on Test.txt and you will be presented with a view, as shown in our example figure 2.
- We are looking at a series of [ASCII](#) characters which at first sight seem to be gibberish. However, these characters actually represent our data and with a bit of manipulation we will find our Euler Angles.

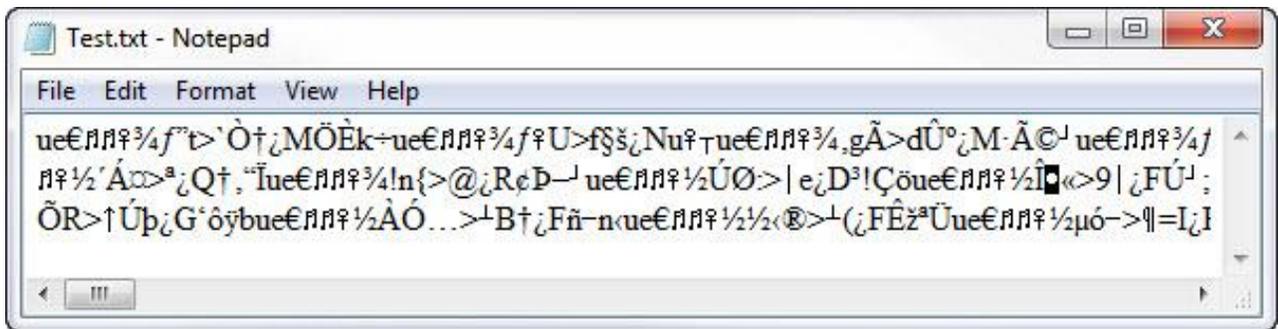


Figure 2: Datalogger file

- Let's pull out the first several characters and dissect these further by comparing them with an ASCII chart.
- Open this [ASCII chart](#) in a separate browser window to follow along.
- Our first 3 characters are: ue€
- By looking through the ASCII chart, we find the following, as shown in figure 3.

DEC	OCT	HEX	BIN	Symbol	HTML Number	HTML Name	Description
117	165	75	01110101	u	&#117;		Lowercase u
101	145	65	01100101	e	&#101;		Lowercase e
128	200	80	10000000	€	&#128;	&euro;	Euro sign

Figure 3: ASCII table

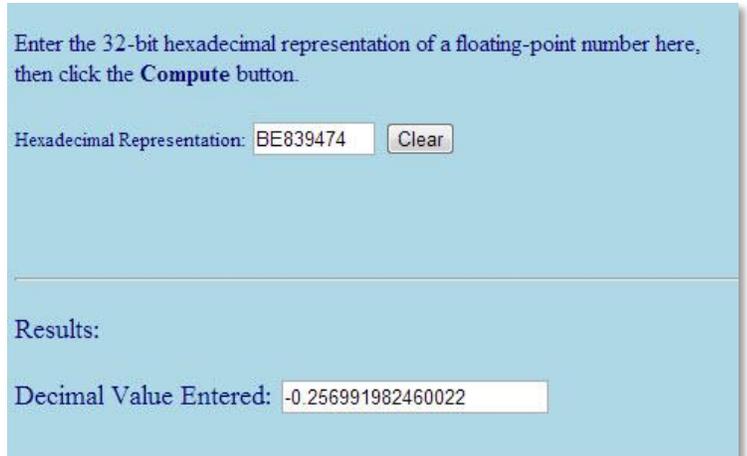
- In the Symbol column, we see our characters and in the DEC column, we see that each character has a value, i.e., u represents a value of 117, e represents a value of 101, € represents a value of 128 and so forth. Also note that each symbol has a 'HEX' value'. We will come back to this subject in a moment.



- Drilling down further, we see in our Packet Nomenclature and Data Packet Sequence columns that our Roll value is derived from bytes 7, 8, 9 and 10. Pitch is derived from bytes 11, 12, 13 and 14. Yaw is derived from bytes 15, 16, 17 and 18. As described on page 14 of the Data Communications Protocol and elsewhere in the manual, these groups of 4 bytes are defined as *single precision IEEE-754 floating point numbers*.

### Converting 4 bytes to Roll, Pitch and Yaw

- Here is Wikipedia's definition of [IEEE-754 floating point](#).
- Here is a great site to confirm your [IEEE-754 conversions](#).
- If we run our four ROLL bytes BE 83 94 74 through this calculator, we get a ROLL value of -0.25699 radians as shown in figure 6.
- Radians, of course, can be converted to degrees:  $-0.25699 \text{ radians} \times 57.2957795 \text{ degrees/radian} = -14.7 \text{ degrees Roll}$ .
- Note: If you are writing your own software, the coding language will typically provide a 4 byte float function to make these conversions.



**Figure 6: IEEE-754 Calculator**

### Support

We have dealt with dataloggers in very broad brush strokes in this technical note. LORD MicroStrain<sup>®</sup> support engineers are always available to expand on this subject and support you in any way we can.