

Xtrinsic FXLS8471Q Demonstration Software User Guide

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1 Introduction

This user guide describes the operation of the Freescale Xtrinsic FXLS8471Q Demonstration Software. This software supports FRDM-FXS-MULTI and FRDM-FXS-MULTI-B sensor expansion boards plugged into a FRDM-KL25Z Freescale Freedom development platform. The FRDM-FXS-MULTI-B contains multiple sensors. However, this evaluation software focuses solely on the FXLS8471Q accelerometer.

NOTE

For more information on the FRDM-FXS-MULTI, go to freescale.com/frdm-multi.

NOTE

For more information on the FRDM-KL25Z: Freescale Freedom development platform, go to freescale.com/FRDM-KL25Z.

1.1 System Requirements

The kit requires the following to function properly with the FXLS8471Q Demo Software:

- The latest PE micro OpenSDA hardware interface drivers must be installed on your system. The demo software installer will provide an option for installing

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these drivers, otherwise go to pemicro.com/opensda to download up-to-date drivers.

- The latest firmware image for the FXLS8471Q command line interface must be programmed into the FRDM-KL25Z. See [Programming the FRDM-KL25Z](#) for further details.
- Windows® XP, Windows Vista, Windows 7, or Windows 8.

1.2 Programming the FRDM-KL25Z

FRDM-KL25Z features a simple way to program S-record (SREC) files using the OpenSDA protocol. OpenSDA is an open-standard serial and debug adapter, bridging serial and debug communications between a USB host and an embedded target processor. OpenSDA software includes a flash-resident USB mass-storage device (MSD) bootloader and a collection of OpenSDA applications. FRDM-KL25Z includes an MSD flash programmer OpenSDA application pre-installed.

The MSD flash programmer is a composite USB application that provides a virtual serial port and an easy and convenient way to program applications into the KL25Z MCU. The MSD flash programmer emulates a FAT16 file system, appearing as a removable drive in the host file system, with a volume label of FRDM-KL25Z. Raw binary and SREC files that are copied to the drive are programmed directly into the flash of the KL25Z and executed automatically.

To learn more, please go to freescale.com and search keyword **FRDM-KL25Z Quick Start Package**.

To program the FRDM-KL25Z with the required firmware, follow these steps:

1. Install the OpenSDA drivers to your PC using either the PC demo software installer or the drivers from pemicro.com/opensda.
2. Press and hold SW1 on the FRDM-KL25Z, see [Figure 1](#), and plug one end of the USB cable into the OpenSDA USB port on the FRDM-KL25Z and the other end into a USB port on the PC.
3. Release SW1. At this point, a virtual drive with the name **BOOTLOADER** should be recognized by your PC.
4. Drag and drop the file named **MSD-FRDM-KL25Z_Pemicro_VERSION.SDA** into the BOOTLOADER drive (see the **Necessary Freedom Images** folder).
5. Cycle power by disconnecting and reconnecting the USB cable.
6. Drag and drop the file named **fxls8471q_CLI_DATECODE.srec** into the FRDM-KL25Z virtual drive (see the **Necessary Freedom Images** folder).
7. Cycle power by disconnecting and reconnecting the USB cable.

Your kit is now ready to use with the PC demo software.

1.3 Hardware Assembly

This section explains assembly of the kit's hardware shown in [Figure 1](#).

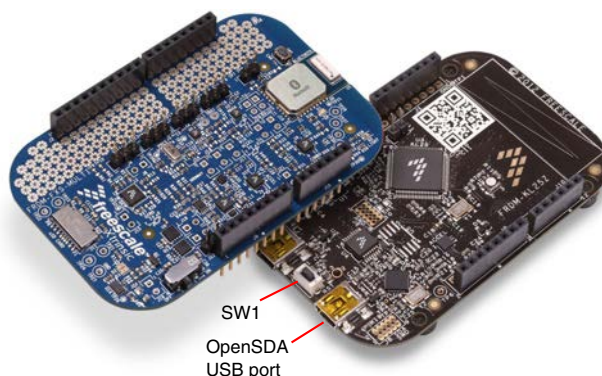


Figure 1. FRDM-FXS-MULTI-B and FRDM-KL25Z

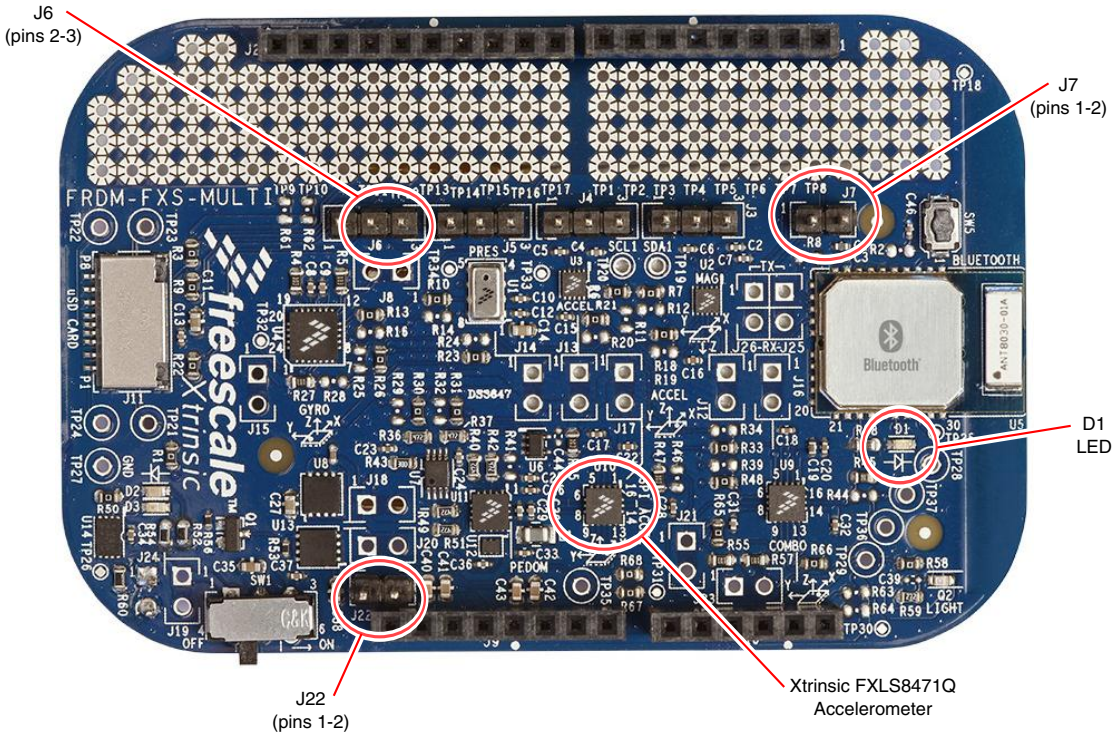


Figure 2. FRDM-FXS-MULTI-B top view

To assemble the hardware:

1. Align the pins of the FRDM-FXS-MULTI(-B) to the headers of the FRDM-KL25Z so that the two boards mate properly and press them together.
2. When the board assembly is complete, the pointing direction is indicated by the pointing direction arrow in [Figure 3](#).
3. Connect header J6 pins 2–3 using a jumper. See [Figure 2](#).

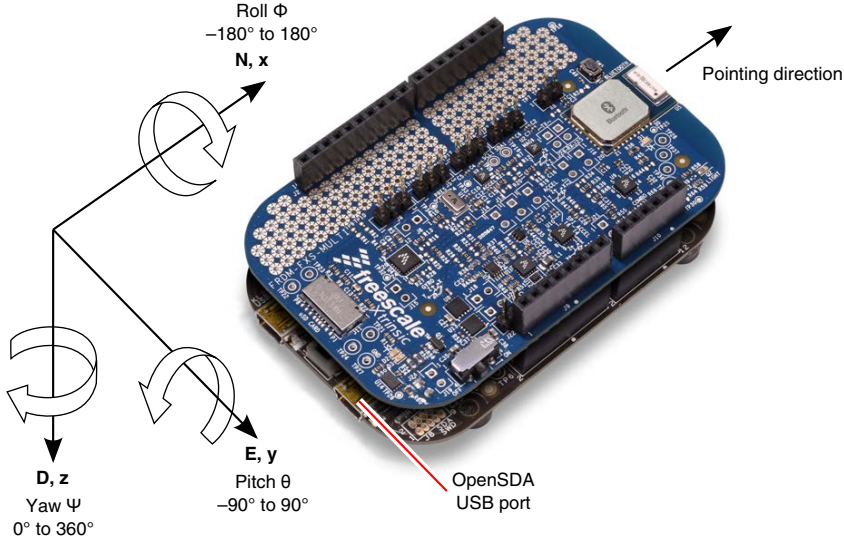


Figure 3. Assembled Kit and NED Coordinate System

4. If a hard-wired connection is desired, complete the following:
 - a. Plug one end of the USB cable into the USB port on the assembled boards (see [Figure 3](#)) and the other end into a USB port on the PC.
 - b. Ensure that the OpenSDA serial port is recognized by the OS of your PC. See [Figure 4](#).

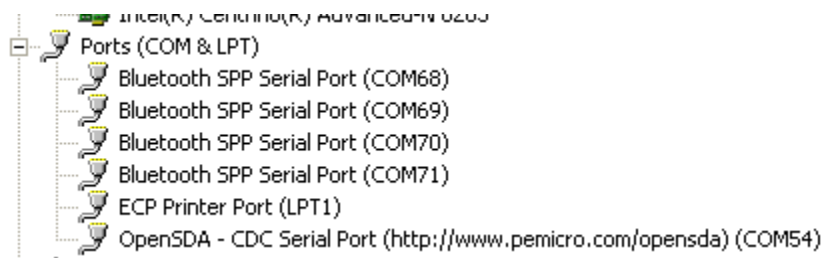


Figure 4. Example List of Ports in Device Manager

5. If a wireless connection is desired (FRDM-FSX-MULTI-B only), complete the following:
 - a. Connect header J7, pins 1–2 and header J22, pins 1–2 using jumpers.
 - b. Move SW1 to ON to use battery power (the battery will be automatically charged whenever there is a hard-wired connection). See [Figure 2](#).
 - c. Pair the BT module with the host PC in order to use Serial Port Profile (SPP) for communications. Once the board and PC are paired and the serial port is opened, LED D1 (blue) will be lit

NOTE

Communication with the kit will fail if the Bluetooth module is enabled (using J7) while, the COM port is open using a wired connection.

2 Software Installation

This installation procedure is for the Freescale Xtrinsic FXLS8471Q demonstration software, release v1.0.0.0 and later, as developed for the FRDM-FXS-MULTI(-B) sensor expansion board plugged into the FRDM-KL25Z: Freescale Freedom development platform.

Installation

1. Go to freescale.com/FXLS8471Q and click on the link to download the Xtrinsic FXLS8471Q demonstration software.
2. Read the Freescale software license agreement and click **I Accept** to begin the download.
3. Extract the zip file **FXLS8471QDEMOSW** to a location of your choosing.
4. Double-click the setup file in the **FXLS8471QDEMOSW REVNUMBER** directory, and follow the installation instructions.

Launch

1. At the end of the installation, a desktop shortcut named **XTRINSIC-FXLS8471Q-DEMO** will appear. Double-click on the shortcut to run the software.
2. The launch screen shown in [Figure 5](#) will appear until the hardware kit (with the correct firmware) is recognized by the demonstration software.

The application is now ready for use.

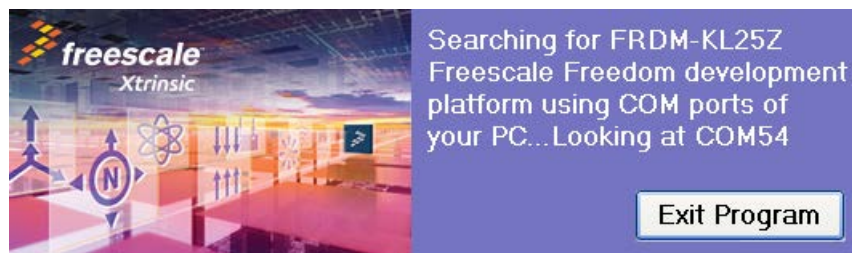


Figure 5. Launch screen

3 Quick Start Demonstration

This Quick Start demonstration is for the Freescale Xtrinsic FXLS8471Q demonstration software, release v1.0.0.0 and later, as developed for the FRDM-FXS-MULTI(-B) sensor expansion board plugged into the FRDM-KL25Z: Freedom development platform.

1. Download and install the PC software after extracting the zip file **FXLS8471QDEMOSW** to a location of your choosing using the **setup.exe** file found in the **FXLS8471QDEMOSW REVNUMBER** directory.
2. Make sure OpenSDA drivers are installed on your system. (pemicro.com/opensda)
3. Flash firmware image named **fxls8471q_CLI_DATECODE.srec** found under the **Necessary Freedom Images** folder into the FRDM-KL25Z following instructions in [Programming the FRDM-KL25Z](#).
4. Make sure the COM port for the desired connection method is recognized by your PC under **Device Manager**.
5. Launch the PC demo software by double-clicking on the shortcut **XTRINSIC-FXLS8471Q-DEMO** on your PC's Desktop.

The application screen appears as shown in [Figure 6](#). Acceleration data from the FXLS8471Q will be displayed per the settings shown in the **Configuration** frame.

4 Sensor Data Screen

This section describes in detail each element of the **Sensor Data** screen shown in [Figure 6](#).

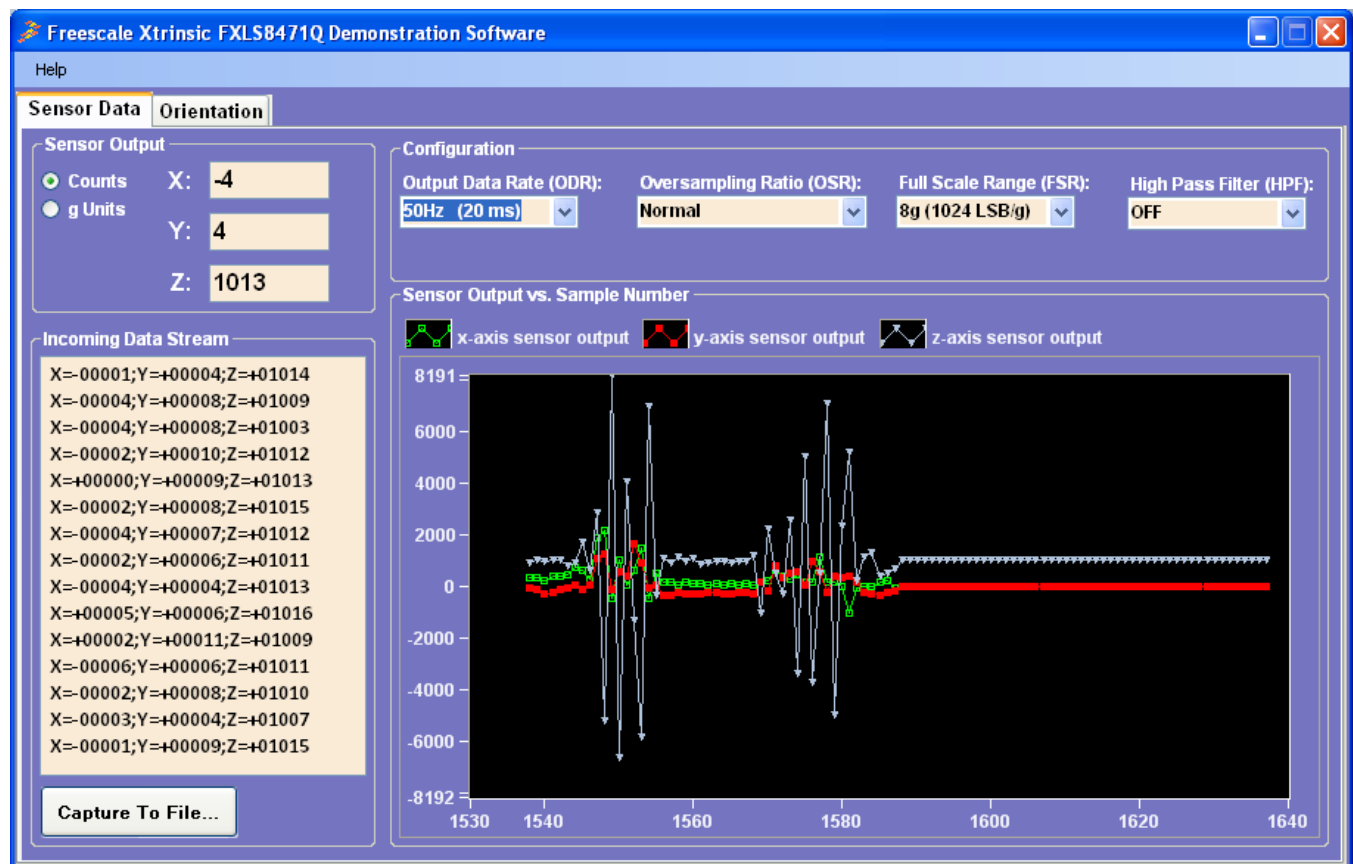


Figure 6. Sensor Data screen

4.1 Sensor Output Frame

The **Sensor Output** frame displays the parameters of the most recent accelerometer measurement. The units of the measurement can be toggled between g and integer bit counts using the **g Units** and **Counts** radio buttons.

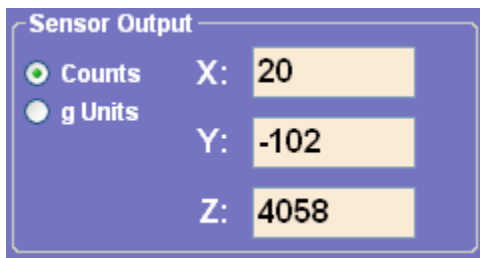


Figure 7. Sensor Output frame

4.2 Incoming Data Stream Frame

The **Incoming Data Stream** frame displays the parameters of the fifteen latest accelerometer measurements. The units are always integer bit counts, showing the raw data coming in from the device.

The **Capture To File** and **Stop Capture** buttons enable and disable the data logging of sensor data to a file on the PC disc drive. This is discussed further in [Data Log File Format](#).

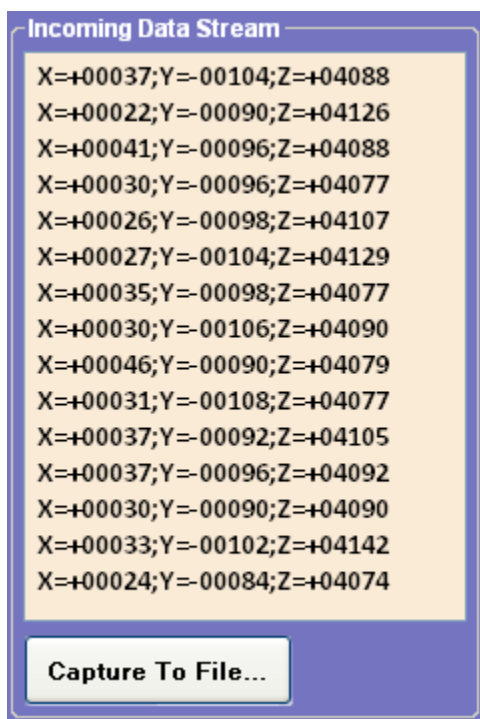


Figure 8. Incoming Data Stream Frame

4.3 Sensor Output vs. Sample Number Frame

The **Sensor Output vs. Sample Number** frame displays the parameters of the 100 latest accelerometer measurements on a graph.

The horizontal graph axis always displays the range of the 100 latest samples.

The vertical graph axis displays a range of integer bit counts from -8192 to $+8191$ (corresponding to the full-scale range of 14-bit accelerometer output using 2's complement representation) when the **Counts** radio button is checked in **Sensor Output** frame. When the **g Units** radio button is checked, the vertical axis displays the range of numbers representing the g-range selected in the **Full-Scale Range (FSR)** menu in the **Configuration** frame.

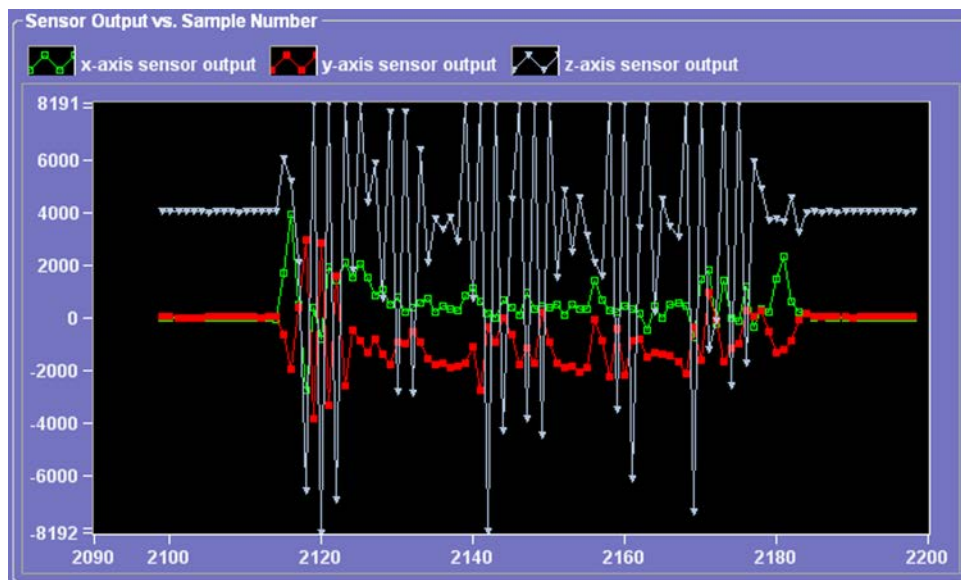


Figure 9. Sensor Output vs. Sample Number frame

4.4 Configuration Frame

The **Configuration** frame displays operating mode specifics for the FXLS8471Q.

- **Output-Data Rate (ODR):** Menu for selecting the desired output data rate. See register **CTRL_REG1 (0x2A)** in the FXLS8471Q datasheet.
- **Oversampling Ratio (OSR):** Menu for selecting the desired oversampling ratio. See register **CTRL_REG2 (0x2B)** and table Oversampling ratio vs. oversampling mode in the FXLS8471Q datasheet.
- **Full-Scale Range (FSR):** Menu for selecting the full-scale g-range of the accelerometer output. See register **XYZ_DATA_CFG (0x0E)** in the FXLS8471Q datasheet.
- **High-Pass Filter (HPF):** Menu for selecting the high-pass filter applied to the accelerometer output. See registers **XYZ_DATA_CFG (0x0E)** and **HP_FILTER_CUTOFF (0x0F)** in the FXLS8471Q datasheet.

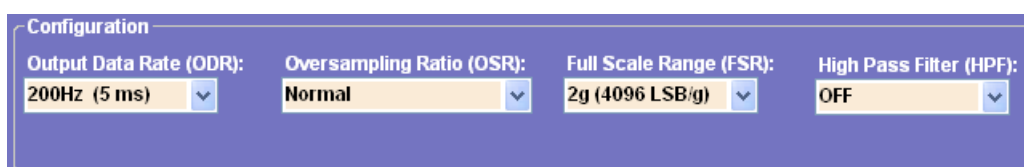


Figure 10. Configuration frame

5 Orientation Screen

The **Orientation** screen displays the tilt orientation using Euler angles (deg) in a NED (x = North, y = East, z = Down) coordinate system. The orientation is defined relative to a starting position with the PCB assembly oriented flat and pointed northwards as shown in [Figure 3](#). Since accelerometers are insensitive to rotations about the gravity vector, the yaw angle is arbitrarily fixed to 0 degrees (due North).

Keep in mind that the FXLS8471Q sensor frame and the PCB frame are not aligned. The software handles this misalignment prior to calculating roll and pitch angles in the hardware abstraction layer (HAL).

Orientation is also visually displayed.

- A 3D graphics image of a rectangular prism shows the tilt orientation of the PCB.
- A 2D image of a mobile tablet shows how orientation information can be used for adjusting the display to keep images upright (in portrait/landscape frame). The **Bottom edge down** orientation shown in [Figure 11](#) corresponds to the **Pointing direction** arrow, shown in [Figure 3](#), oriented so it points upward. For more details, see [AN3461, Tilt Sensing Using a Three-Axis Accelerometer, Section 6, Selecting Portrait and Landscape Modes](#).

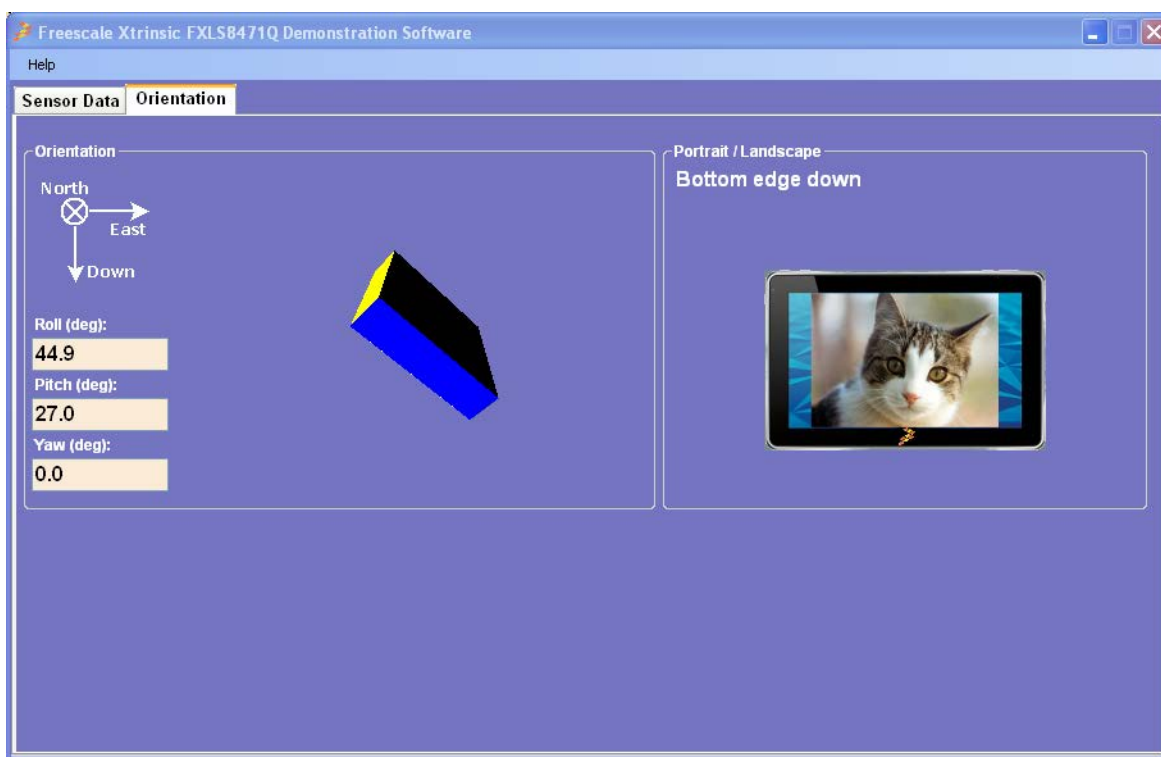


Figure 11. Orientation screen

6 Data Log File Format

The **Capture To File** and **Stop Capture** button in the Incoming Data Stream frame enables and disables data logging of sensor data to a file on the PC disc drive.

When the **Capture To File** button is clicked, the user is prompted for the output filename and location. Because the file will be written in ASCII format with tab delimiters, it is recommended to choose a **.csv** file extension. The data is written when it is received from the kit based on the sampling rate selected. Once the program starts capturing data, the **Capture To File** button will be replaced with a **Stop Capture** button. The data fields and definitions are explained in [Table 1](#).

Table 1. Data Log Field Description

| Data Field | Definition |
|------------------|-------------------------------------------------------------------|
| Date / Time | The date and time of the measurement |
| Sample Number | An integer counter which increases with each sample |
| X Accel (Counts) | The x-component of the accelerometer sensor in integer bit counts |
| Y Accel (Counts) | The y-component of the accelerometer sensor in integer bit counts |
| Z Accel (Counts) | The z-component of the accelerometer sensor in integer bit counts |
| X Accel (g) | The x-component of the accelerometer sensor in units of g |
| Y Accel (g) | The y-component of the accelerometer sensor in units of g |
| Z Accel (g) | The z-component of the accelerometer sensor in units of g |



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