



## Tech Note

## GN-100 Single-Axis Goniometer

### Overview

The flexibility of joints in the body can be determined by simple range of motion (ROM) tests. These ROM exercises can aid physical therapists, athletic trainers, and physicians when they are examining joint dysfunction. Athletes and individuals who participate in physical activities generally are classified as being flexible due to the fact that their joints function over wide ranges of movement. Good flexibility may improve body position and awareness, enhance athletic performance, and help prevent injuries during and soreness after exercise. A joint's range of motion is expressed as the number of degrees of rotation that occur when the joint goes from its starting position, which is usually full flexion, through its full range of motion to its end position, which is usually full extension. The most common device used to measure range of motion is the single-axis goniometer. Examples of the types of movements that can be measured include: flexion/extension/hyperextension, abduction/adduction, and plantar flexion/dorsiflexion.

### How It Works

The GN-100 (Figure 1) has two arms, one stationary and one moving, and a sensor which generates a voltage output which is proportional to the number of degrees of rotation that occur in the joint to which the goniometer is mounted. The stationary arm, which holds the sensor, is placed parallel to the stationary portion of the joint. The movable arm is placed along the moveable side of the joint. The axis of the goniometer is placed directly over the joint so that accurate measurements of the range of motion of the joint can be made along a single axis.

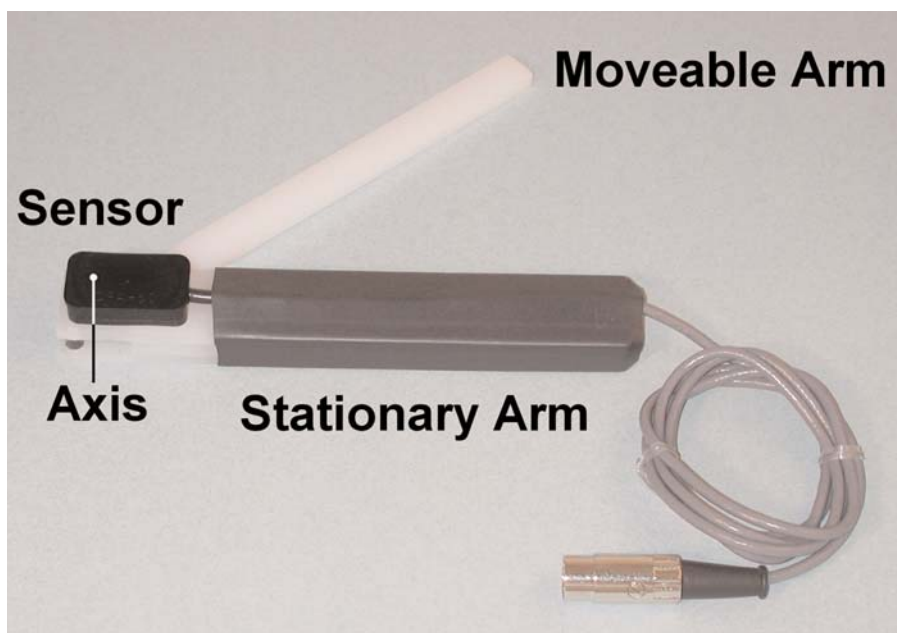


Figure 1: The GN-100 Single-Axis Goniometer.

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### Equipment Setup

Plug the DIN connector of the GN-100 into the DIN input of an iWorx data acquisition unit or amplifier (Figure 2).



Figure 2: The GN-100 Single-Axis Goniometer connected to an iWorx 214 Recorder.

### Calibration

#### of the GN-100

### Recording

1. Place the GN-100 Goniometer on the table with the 2 arms in the **closed position**. Use a protractor to measure the angle between each arm.
2. Type the word **Closed** and the **angle (in degrees) between the two arms** in the **Mark box** to the right of the **Mark button**.
3. Make sure the GN-100 goniometer arms are in the **closed position**. Click the **Record button** in the upper right corner of the LabScribe2 **Main window**.
4. Record with the GN-100 goniometer in the closed position for 5 seconds. Either click on the **Mark button** or press the **Enter key** on the keyboard to label the recording. Continue recording.
5. Open the arms of the GN-100 so that they are 180° apart. Place the GN-100 flat on the table.
6. Type **Open-180°** in the **Mark box** to the right of the **Mark button**.
7. Make sure the GN-100 goniometer arms are in the open position. Record for 5 seconds. Either click on the **Mark button** or press the **Enter key** on the keyboard to label the recording when the trace reaches a plateau.
8. Click the **Stop button**.
9. Select **Save As** in the **File menu**, type a name for the file. Choose a destination on the computer in which to save the file, like your lab group folder). Designate the file type as **\*.iwxdata**. Click on the **Save button** to save the data file.

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## Units Conversion

1. Scroll to the beginning of the calibration data for the GN-100 single-axis goniometer.
2. Use the **Display Time** icons to adjust the **Display Time** of the **Main window** to show the complete calibration data on the same window (Figure 3).
3. Click the **2-Cursor icon** on the LabScribe2 toolbar so that two blue cursors appear on the **Main window**.

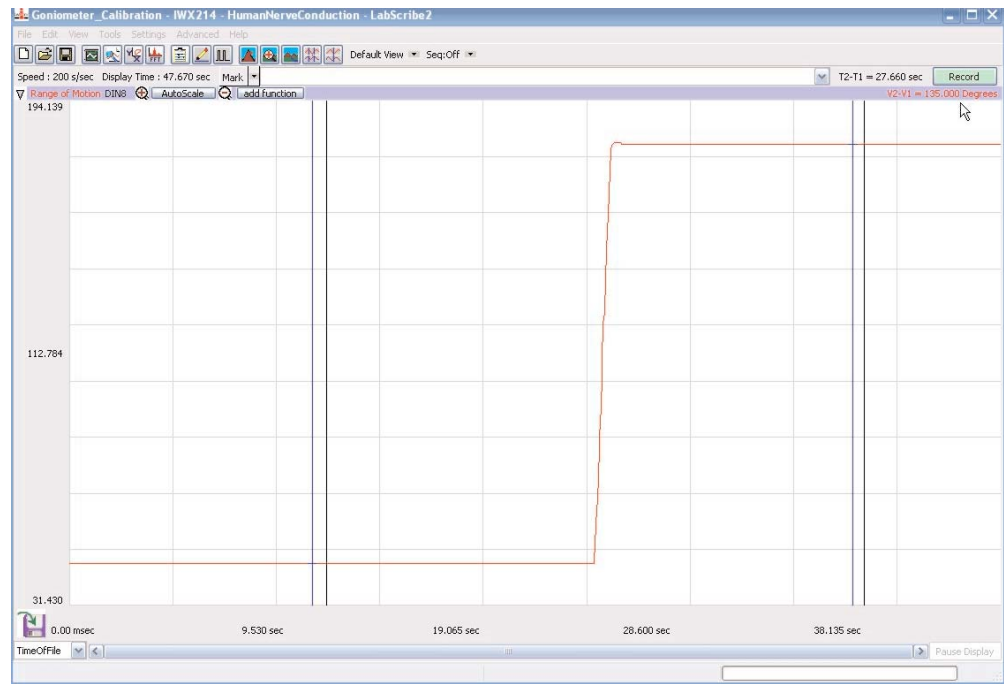


Figure 3: GN-100 Single-Axis Goniometer calibration data with cursors in the correct positions for converting the Y-axis angle of deflection (in degrees).

4. Place one cursor on the section of data collected when the goniometer was in the closed position, and the second cursor on the section of data collected when the goniometer was in the open position.
5. Open the **Channel menu** of the **Goniometer Angle** channel by clicking on the down arrow to the left of the channel's title. Select **Units** from this menu and **Simple** from the submenu to open the **Simple Units Conversion dialogue**.
6. On the **Simple Units Conversion dialogue window** (Figure 4), make sure **2 point calibration** is selected in the pull-down menu in the upper left corner of the window. Put check marks in the boxes next to **Apply Units** to new data and **Apply Units to all blocks**.

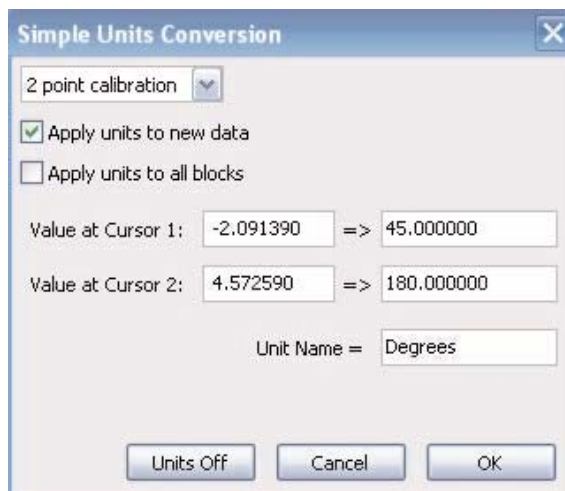


Figure 4: The Simple Units Conversion dialogue window with the voltages at the cursors set to equal the closed and open angles of the GN-100 goniometer.

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## *Units Conversion (continued)*

7. Notice that the voltages from the positions of the cursors are automatically entered into the value equations. Enter the values for the two angles used in the calibration recording in the corresponding boxes on the right side of the conversion equations.
8. For **Cursor 1**, enter the value of the angle when the goniometer is closed.
9. For **Cursor 2**, enter the value of the angle when the goniometer is open, normally 180°.
10. Enter the name of the units, **Degrees**, in box below the values.
11. Click on the **OK button** in the lower right corner of the window to activate the units conversion.
12. Select **Save** in the **File menu**, type a name for the file.

## **Recording Range of Motion**

1. Using the Velcro straps supplied with the goniometer, firmly strap the GN-100 to the joint (ankle, wrist knee, elbow) being studied
2. Place the goniometer on the side of the joint where the goniometer can freely rotate around the axis of the GN-100 while the arms of the unit are against the appendages on either side of the joint.
3. Place the stationary arm of the GN-100, with the sensor, on the part of the body that doesn't move. Place the moving arm of the goniometer on the part of the body that moves.
4. If the experiment begins with the joint in the extended position, type **Extended** in the **Mark box** to the right of the **Mark button**.
5. Click the **Record button** in the upper right corner of the LabScribe2 **Main window**. Click on the **Mark button** or press the **Enter key** on the keyboard to label the recording.
6. While the subject's joint is in the extended position, type **Flexed** in the **Mark box**.
7. Instruct the subject to slowly flex his or her joint to the fully flexed position. Click on the **Mark button** or press the **Enter key** on the keyboard to label the recording.
8. While the subject's joint is in the flexed position, type **Extended** in the **Mark box**.
9. Instruct the subject to extend his or her joint. When the subject's joint reaches the extended position, click on the **Mark button** or press the **Enter key** on the keyboard to label the recording.
10. Repeat Steps 6 through 9 for two more flexions and extensions.
11. Click **Stop** to halt the recording.
12. Select **Save** in the **File menu**.

## **Specifications**

Range of deflection: +30 to +190 degrees  
Activation voltage: + 5 Volts

## **Experiments**

Experiments using the GN-100 Single-Axis Goniometer can be found on the iWorx newsletter website at: <http://www.iworx.com/newsletter/feb08newsletter.htm>.