

# Goniometer

## (Order Code GNM-BTA)

The Goniometer measures the angle of a joint, such as the knee or elbow.

Use it to measure the range of motion of a limb during different types of physical activity. A set of elastic straps can be used to secure the sensor to the subject for dynamic measurements of joint angle during different types of physical activity. You can also use it with a Vernier EKG Sensor to measure muscle activity during different phases of limb motion. In addition, the sensor head can be detached from both arms of the sensor for use in STEM and engineering activities.



**Note:** Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

### What's Included

- Goniometer: joint angle sensor attached to metal stationary arm
- 12-inch flexible joint arm (comes attached to sensor)
- 10-inch flexible joint arm
- 8-inch flexible joint arm
- 24-inch elastic hook and loop straps (2)
- 14-inch elastic hook and loop straps (2)

### Compatible Software

See [www.vernier.com/manuals/gnm-bta](http://www.vernier.com/manuals/gnm-bta) for a list of software compatible with the Goniometer.

### Getting Started

1. Connect the sensor to the interface (LabQuest Mini, LabQuest 3, etc.).
2. Start the appropriate data-collection software (Logger Pro®, LabQuest® App, or Vernier Graphical Analysis™) if not already running, and choose New from File menu. The software will identify the sensor and load a default data-collection setup.
3. Zero the sensor to report positive and negative joint angles from the subject's starting position. To zero sensors,
  - Logger Pro Users: Choose Zero from the Experiment menu.
  - LabQuest Users: Choose Zero from the Sensors menu on the Meter screen.
  - Graphical Analysis Users: Click or tap the Angle Meter and choose zero.
4. You are now ready to collect data.

If you are collecting data using a Chromebook™, mobile device such as iPad® or Android™ tablet, or a Vernier wireless interface, please see the following link for up-to-date connection information:

[www.vernier.com/start/gnm-bta](http://www.vernier.com/start/gnm-bta)

## Using the Product

### Attaching the Goniometer to a Person

1. Select one member of the group to be the test subject. Thread two 24-inch elastic straps through the slots that can be found on the stationary arm of the Goniometer.
2. Secure the stationary arm of the Goniometer to the upper leg or arm of the subject using the elastic straps, as shown in Figure 1.



Figure 1

3. Make sure the dial on the sensor is centered on the joint being studied. Reposition and secure the Goniometer, if necessary.
4. Using a single 14-inch elastic strap, secure the flexible arm of the Goniometer to the foreleg or forearm.
5. Verify that the subject can move freely with the Goniometer attached to the limb being studied.

### Changing the Flexible Arm of the Goniometer

The Goniometer comes with a set of flexible arms that vary in size. For subjects with smaller limbs, you may want to use one of the smaller joint arms on this sensor. To change the flexible arm, simply loosen and remove the screw that secures the arm to the dial. Select the appropriate joint arm and fasten it to the sensor with the screw provided. Verify that the terminal edge of the joint arm is aligned with the set screw on the side of dial. Reposition the flexible arm of the Goniometer, if necessary.

### Helpful Hints

You can easily reverse the reporting direction of the Goniometer using the data-collection software. This is very useful for comparing joint activity from left and right limbs. The instructions for reversing direction are dependent on the data-collection software you are using.

- Logger Pro Users: Choose Set Up Sensors from the Experiment menu, then select your interface (LabQuest, LabPro, etc.). Click the image representing the Goniometer. Select Reverse Direction, and then close the dialog box.
- LabQuest Users: Tap the angle reading on the Meter screen. Choose Reverse Direction. Select the box for the Goniometer.
- Graphical Analysis Users: Click or tap the Angle meter and turn on Reverse.

You can easily increase the length of the 14-inch strap if it is too short to comfortably wrap around the foreleg or forearm. Thread the second 14-inch strap through the eyelet of the first strap. Fold the second strap over itself so that the hook and loops lock. This will increase the length of the strap by 8 inches.

## Calibrating the Sensor

### Optional Calibration Procedure

Calibrating the Goniometer may not be necessary for some activities. If you are evaluating the range of motion of a joint, such as the knee or elbow, then the stored calibration should work well. For dynamic analysis of a joint you may want to calibrate the sensor before attaching it to a subject. The instructions for calibration are dependent on the data-collection software you are using.

### Calibrating the Goniometer with Logger Pro

1. Choose Calibrate from the Experiment menu. Click Calibrate Now in the Sensor Settings dialog box.
2. Select the box marked One Point Calibration. Click the Calibrate Now button.
3. Rotate the flexible arm of the Goniometer until it is positioned  $180^\circ$  from the stationary arm, as shown in Figure 2.
4. Verify that the set screw on the side of the dial is aligned with the silver dot on the baseplate. Reposition the dial if necessary.
5. Enter  $180^\circ$  for Value 1. Click Keep, and then click OK.



Figure 2

### Calibrating the Goniometer with LabQuest App

1. Choose Calibrate from the Sensors menu. Select the box marked One point calibration. Tap the Calibrate Now button.
2. Rotate the flexible arm of the goniometer until it is positioned  $180^\circ$  from the stationary arm. Verify that the set screw on the side of the dial is aligned with the silver dot on the baseplate of the sensor.
3. Enter  $180^\circ$  for Value 1. Tap Keep, and then tap OK.

### Calibrating the Goniometer with Graphical Analysis

1. Click the Angle meter and choose Calibrate. Choose One-point calibration from the Calibrate menu.
2. Rotate the flexible arm of the Goniometer until it is positioned  $180^\circ$  from the stationary arm. Verify that the set screw on the side of the dial is aligned with the silver dot on the baseplate of the sensor.
3. Enter  $180^\circ$  for the first known value. Click or tap Apply to complete the calibration process.

## Specifications

Range	0– $340^\circ$ (or $\pm 170^\circ$ )
Accuracy	$\pm 3^\circ$ $\pm 1^\circ$ (with calibration)
12-bit resolution	$0.12^\circ$
Stored Calibration Values	slope: $90^\circ/\text{V}$ intercept: $-45^\circ$

## Suggested Experiments

### Measure the range of motion of various anatomical joints

Students measure the range of motion of different anatomical joints in this exercise. The knee, elbow, hip, wrist, ankle, and hand can all be measured using the Goniometer. Standard bony landmarks are used to mark the axis of rotation for each joint. As a result, the Goniometer does not need to be attached to the subject for this exercise.

### Measure the range of motion of the elbow or knee during physical activity

In this type of activity, the Goniometer is attached to the subject's arm or leg. The range of motion of the joint is then recorded during physical activity. Standard weight lifting exercises can be used for the leg and arm, such as squats, leg extensions, bicep curls, dips, and triceps extensions. As shown in Figure 3, dynamic range of motion can be studied during running. Dynamic range of motion can also be studied while cycling.

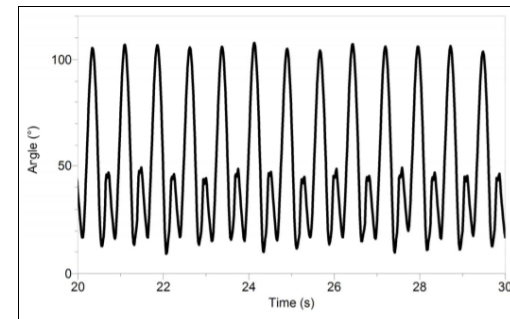


Figure 3

### Measure the activity of different muscle groups during limb movement

In this type of activity, the Goniometer is used with one or more EKG Sensors to measure the electrical activity of different muscle groups during physical activity. Standard weight lifting exercises can be used for the leg and arm. The bicep curl is an excellent exercise for this lab. As shown in Figure 4, bicep activity increases during flexion and will decrease during extension.

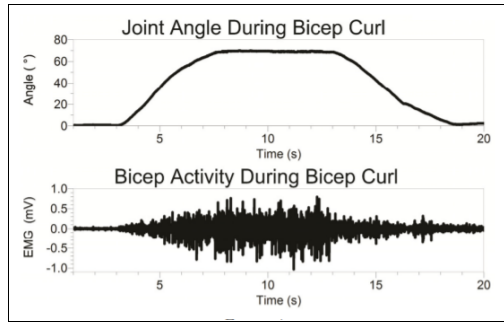


Figure 4

### Measure heart rate and dynamic motion of the knee during physical activity

In this type of activity, an Exercise Heart Rate Monitor and the Goniometer are used to measure heart rate and dynamic range of the knee during physical activity. As shown in Figure 5, a standard exercise bike work well for this exercise. Treadmills and rowing machines can also be used in this type of activity.

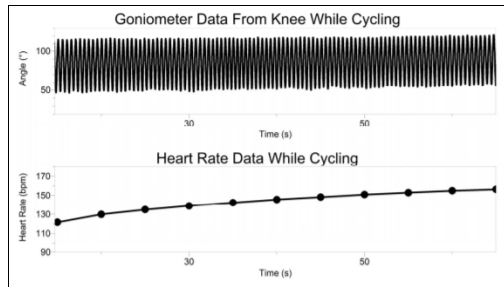


Figure 5

### Care and Maintenance

Do not wrap the cable tightly around the sensor for storage. Repeatedly doing so can irreparably damage the wires and is not covered under warranty.

### How the Sensor Works

The flexible arm of the Goniometer is attached to a metal dial on the sensor head that can rotate 360°. A magnet inside the sensor rotates with this dial. A magnetic encoder is used to report the position of the magnet. As the magnet rotates, the encoder produces a voltage that is converted into the position (angle) of the dial by the data-collection software.

### Troubleshooting

For troubleshooting and FAQs, see [www.vernier.com/til/2886](http://www.vernier.com/til/2886)

### Repair Information

If you have watched the related product video(s), followed the troubleshooting steps, and are still having trouble with your Goniometer, contact Vernier Technical

Support at [support@vernier.com](mailto:support@vernier.com) or call 888-837-6437. Support specialists will work with you to determine if the unit needs to be sent in for repair. At that time, a Return Merchandise Authorization (RMA) number will be issued and instructions will be communicated on how to return the unit for repair.

### Accessories/Replacements

Item	Order Code
Goniometer Replacement Straps (4 elastic straps)	GNM-STRAPS
Goniometer Replacement Arms (3 flexible arms)	GNM-ARMS

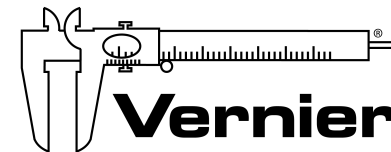
### Warranty

Warranty information for this product can be found on the Support tab at [www.vernier.com/gnm-bta](http://www.vernier.com/gnm-bta)

General warranty information can be found at [www.vernier.com/warranty](http://www.vernier.com/warranty)

### Disposal

When disposing of this electronic product, do not treat it as household waste. Its disposal is subject to regulations that vary by country and region. This item should be given to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring that this product is disposed of correctly, you help prevent potential negative consequences on human health or on the environment. The recycling of materials will help to conserve natural resources. For more detailed information about recycling this product, contact your local city office or your disposal service.



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