## Unit 5: Rover's Sensors — Skill Builder 1: Testing Rover's Ranger

In this first lesson for Unit 5, you will learn about the TI-Innovator Rover's Ultrasonic Ranger sensor and its ability to control the Rover's motion.

**Objectives:**

- Use the **READ RV.RANGER** command to measure distance
- Use the command to change the Rover's motion

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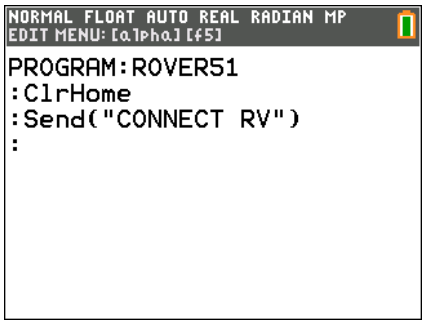
At the front of the TI-Innovator Rover is a sensor called the Ultrasonic Ranger. The Ranger measures the distance to an object in front of the Rover. This information can be used to control the Rover's movement; if the Rover gets too close to an obstacle, it can be programmed to change direction to avoid the obstacle.

We'll first write a test program to determine how the Ranger works and then, in Skill Builder 2, we'll use that information to control the Rover's movement.

> **Teacher Tip:** Sometimes referred to as a 'motion' sensor, the Ranger simply calculates the distance to an object. When that distance changes, the change can be interpreted as 'motion' or movement.

The program will read the Rover's Ranger value and display that value on the calculator screen. The Rover will not move in this program. You will move your hand in front of the Rover or hold the Rover in your hands, and point it toward various obstacles to observe the measurements.

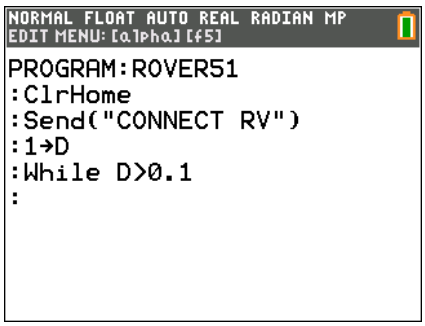



### Start the Test Program

1. Our new program is named ROVER61. It begins with the **ClrHome** command. Next, add the **Send ("CONNECT RV")** command from the **prgm > Hub > Rover (RV)…** menu.

### The Main Loop

We'll use a **While** loop to control the program. When the distance measured is less than a certain value, the program will end. We use the variable ***D*** to record the **d**istance measured.




2. Initialize ***D*** to be 1.

3. Select **While** from the **prgm > CTL** menu. Code the **While** loop to continue as long as ***D*** is greater than 0.1.

**The Loop Body**

4. The command to **READ RV.RANGER** is found in the
   **prgm > Hub > Rover (RV)… > Read RV Sensors…** menu.

```
NORMAL FLOAT AUTO REAL RADIAN MP
Rover (RV)
1:Drive RV…
2:Read RV Sensors…
3:RV Settings…
4:Read RV Path…
5:RV Color…
6:RV Setup…
7:RV Control…
8:Send("CONNECT RV")
9:Send("DISCONNECT RV")
```

5. Select **Send("READ RV.RANGER")**.

6. Add the commands
   **Get(D)**
   **Wait 0.25**
   to the loop body.

```
NORMAL FLOAT AUTO REAL RADIAN MP
EDIT MENU: [alpha] [f5]
PROGRAM:ROVER51
:ClrHome
:Send("CONNECT RV")
:1→D
:While D>0.1
:Send("READ RV.RANGER")
:Get(D)
:Wait .25
:
```

Getting a value from a sensor requires both the **Send("READ…")** command to get a value from the sensor into the TI-Innovator™ Hub and the **Get( )** command to get the value from TI-Innovator Hub to the calculator. The **Wait .25** command is used to slow the operation down to make the numbers easier to read and understand.

**Displaying the Value**

7. We use an **Output( )** command to display the value of ***D*** in a fixed position on the calculator screen.

8. Add the **End** command.

```
NORMAL FLOAT AUTO REAL RADIAN MP
EDIT MENU: [alpha] [f5]
PROGRAM:ROVER51
:ClrHome
:Send("CONNECT RV")
:1→D
:While D>0.1
:Send("READ RV.RANGER")
:Get(D)
:Wait .25
:Output(5,3,D)
:End
```

**Teacher Tip:** The number displayed is not always accurate. If a displayed value has a lot of digits and the next displayed value has only a few digits, then some of the previous value's digits are still displayed. This display issue can be fixed in two ways:

The *easy* way: Put a **ClrHome** command before the **Output** statement and after the **Wait** statement.

The *elegant* way: **Output(5,3,toString(D)+"  ")**. This eliminates the flickering caused by the **ClrHome** command. The **+** sign is referred to as 'concatenation' (adding strings together). The spaces erase trailing digits from the previous value. The **toString( )** command is found in the Catalog.

**Run the Program**

9. While the program is running, the calculator screen displays a number. Move your hand in front of the Rover so that the Ranger can measure various distances. In what units are these distances measured? When will the program terminate?

   Answer: The units are meters, and the program will end when the distance measured is less than 0.1 m, or 10 cm.