

**Control Software
for Program Control Tracer
Instructions**

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1. About the Program Control Tracer

The program control tracer operates in two different modes.

• Programming mode

The program control tracer will follow the moves you programmed. Use the dedicated software to program your robot.

• Line tracing mode

In line tracing mode, the program control tracer moves along a course. It uses optical sensors to detect black course lines.

● PC requirements for the Control Software

OS : Windows XP, Vista, Windows 7

*Windows XP SP2 or higher

*Vista users will need to change the start-up settings for the Control Software.

*Your security software may delete the Control Software or prevent you from launching it.
If these things happen, please consult the security software instructions.

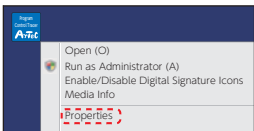
CPU: With specifications sufficient for smooth operation of the installed OS

Memory: With memory capacity sufficient for smooth operation of the installed OS

Recommended display: 65,000 colors or more.

800 x 600 pixels or higher resolution.

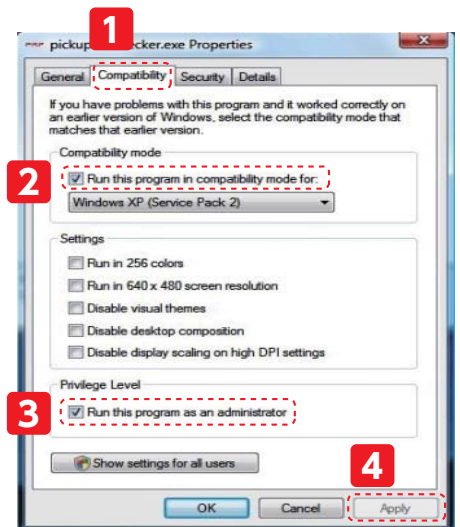
● For Window Vista users: How to change start-up settings in the Control Software



Right-click the Control Software icon to show the pop-up menu.

- 1 Select compatibility tab.
- 2 Check "Start this program in compatibility mode."
- 3 Check "Execute this program as an administrator."
- 4 Click "Apply"

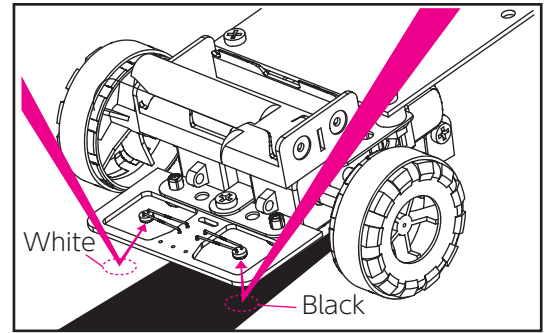
*A user account control warning message may appear when you start the Control Program. If this happens, give the program permission to start.



2. Line Tracing Mode

Operate the robot in line tracing mode

Use the included "course sheet" for line tracing experiments to verify that the tracing robot functions properly.



- **How the optical sensors work**

The optical sensors mounted on the sensor circuit measure the intensity of light reflected from the ground. The intensity of light reflected from the black course line is different from that reflected from a white surface. The sensor identifies the course line by detecting the difference in light intensity.

- **How the Program Control Tracer works**

When the right-hand sensor detects a black line, it knows that the course travels to the right. It stops the right-hand motor, allowing the left-hand motor to turn the robot to the right.

When the left-hand sensor detects a black line, it knows that the course travels to the left. It stops the left-hand motor, allowing the right-hand motor to turn the robot to the left.

When both sensors detect a black course line, the robot knows that the course ends and stops both motors.

- **How to get a course sheet for line tracing mode**

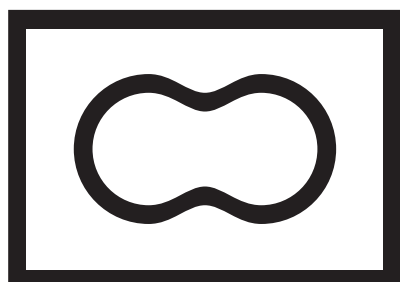
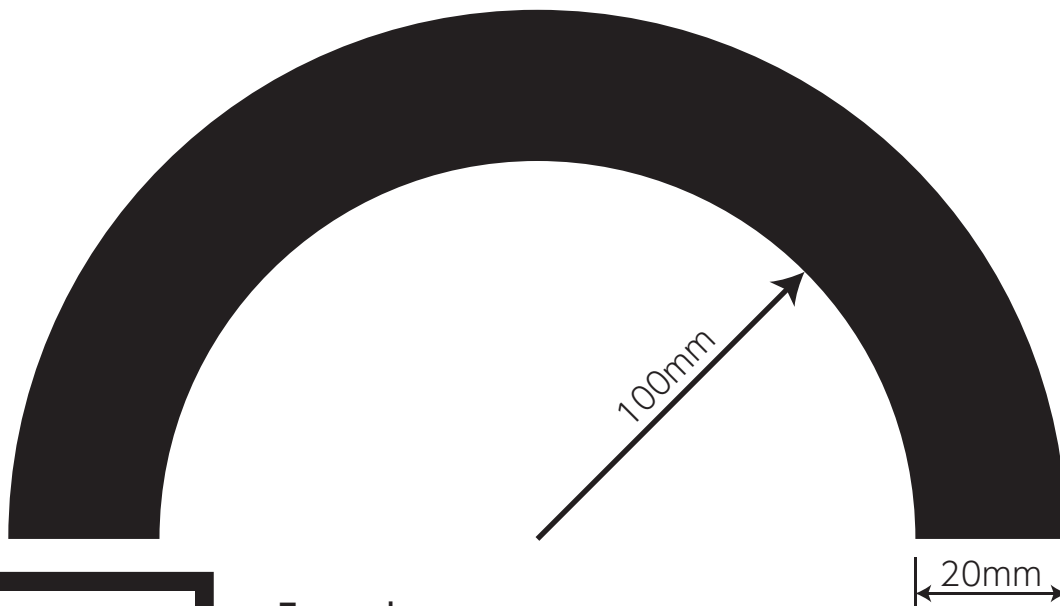
You can download a course sheet for line tracing mode from Artec's web site.

You can also create your own course.

- **How to create a line tracing course**

Use a black marker to draw a 20mm-wide course line on a sheet of white paper. Let the program control tracer run along the course.

The program control tracer cannot follow sharp turns or small curves with a diameter of 100 mm or less. To prevent the robot from running astray, keep these things in mind when you make your own course.



- **Example course**

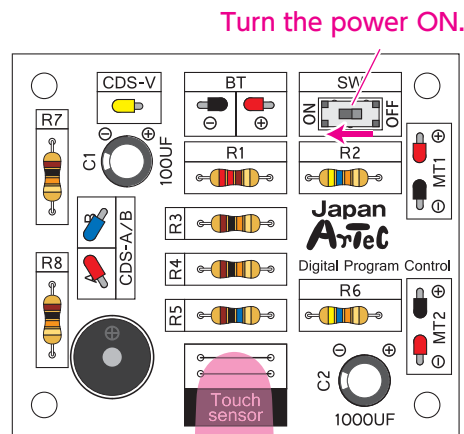
If you draw a circuit course, the program control tracer will keep running. Draw a circuit course like the one in the figure to the left. Draw a black line along the edges of the paper to catch the robot if it strays.

• How to use line tracing mode

Place a course sheet for the line tracing mode on a flat surface. Place the robot on the black line, matching up the center of the robot body and the black line. (Make sure neither of the sensors lie above the black line.)

Switch on the power while one fingertip rests on the touch sensor. You will hear a beep when the line tracing mode is activated. (Keep your fingertip resting on the touch sensor until the beep ends.)

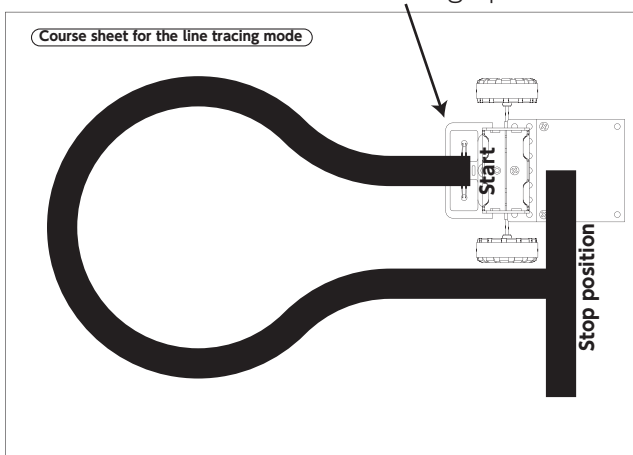
When you take your finger off the touch sensor, you will hear a short beep and the tracing robot will start moving. Let's see whether the tracing robot follows the line and stops successfully.



Touch the sensor with your fingertip until you hear a beep.

- *The touch sensor is a short-circuit switch. The circuit is completed when a finger bridges the gap between the lead wires.
- *The touch sensor may not detect dry fingertips. Moisten your fingertip with water. Be careful not to get the circuit board wet or it may be damaged.

Place the robot on the black line, matching up the robot body and the line.



Troubleshooting

● The tracing robot does not move.

→ The programming mode might be activated. Turn the power OFF and ON again with a finger resting on the touch sensor.

● The line tracing mode cannot be activated.

→ The touch sensor may not detect dry fingertips. Moisten your fingertip with water.

● The tracing robot does not follow the line.



→ In the line tracing mode, the program control tracer uses the optical sensors to detect the intensity of reflected light. Because the sensors are susceptible to the surrounding environment, perform the experiment under constant lighting conditions. If the room is too bright, the sensors may not work properly. Do the experiments in a room with the ceiling light ON and the curtains closed. Make sure no part of the course sheet is shaded by anything, as this may affect the operation of the sensors.

→ Adjust the optical sensors properly. Refer to the assembly instructions for the adjustment procedures.

3. Programming Mode

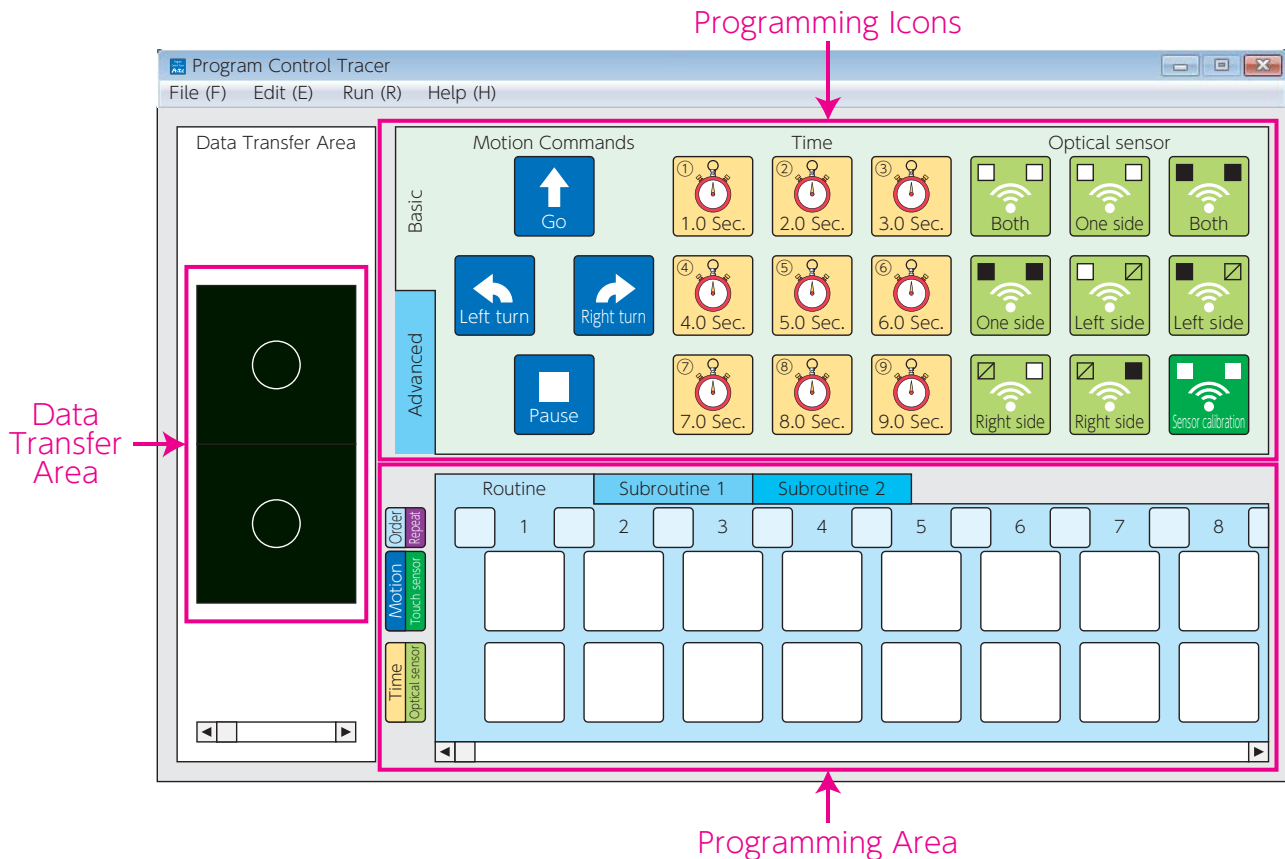
Use the software to create a program for the robot

- **Instructions for installing the Control Software from the CD-ROM.**

Insert the CD-ROM into the CD (or DVD) ROM drive of the PC. Drag & drop the  icon onto the desktop. Double click the  icon to open it.

- **Instructions for installing the Control Software from the Internet.**

Visit Artec's web site (<http://www.artec-kk.co.jp/pct>), download the Control Software and place it on the desktop. Double click the  icon to open it.



- **Programming Screen**

The figure above shows the screen you will use when creating your own control program.

To write a program, just drag & drop icons to the programming area.

You can place 24 icons on the Routine tab and 8 icons on each of the Subroutine tabs.

The tasks specified by the icons will be executed in numerical order.

You can transfer your completed program from the software to the robot via optical communication.

- **Exiting the program control tracer Control Software.**

Select the "File" menu. Select "Exit" to end the Control Software.



• Program Control Tracer: Control Software icons

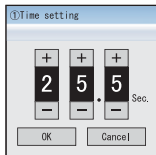
Basic operation icons

<h3>Motion icons</h3> <ul style="list-style-type: none"> Go Right turn Left turn Pause 	<h3>Time-related icons</h3> <p>There are nine time setting icons. By default, time periods from 1.0 to 9.0 seconds are allocated to the icons. To change the time period, double click the time setting icon. A time settings pop-up menu will appear. From here you can set the time period between 0.5 and 25.5 seconds, in 0.1 second increments.</p> <p> 1.0 sec</p> <p>↑</p> <p> 9.0 sec</p>	<h3>Sensor-related icons</h3> <p>These icons are needed to write programs that use the optical sensors. (See "6. Programs using the optical sensors," on page six.) The sensors use the light intensity of the starting point as a reference value. Light intensity values the same or higher than the reference value are considered white; values below are considered black.</p> <ul style="list-style-type: none"> Sensor calibration Both: Until both sensors detect white color One side: Until either of the sensors detect white color Both: Until both sensors detect black color One side: Until either of the sensors detect white color Left side: Until the left sensor detects white color Left side: Until the left sensor detects black color Right side: Until the right sensor detects white color Right side: Until the right sensor detects black color
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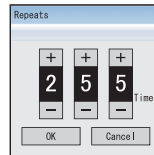
Advanced operation icons

Start repeating a part of a program from this point.	Stop repeating here.	Allows you to insert a certain action sequence in your program.	Allows you to insert a certain action sequence in your program.	Pause the program. Use the touch sensor to end the pause.
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● **Configure icons** You can change the set values of the time-related icons ①-⑨ and the repeat icon. Double click the icon to show the pop-up window. Change the set value and click "OK" to change the setting.

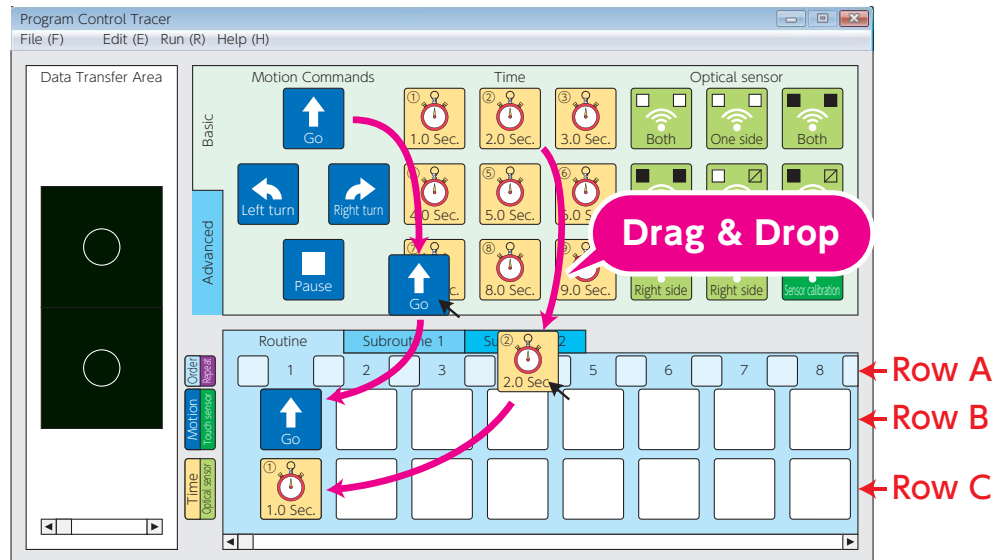


Set the time period
Using the time setting icons, you can set nine different time periods between 0.5 and 25.5 seconds. The minimum unit is 0.1 second.



The number of repeats
You can specify between 1 and 255 repeats. The minimum unit is one.

4. How to Use the Control Software

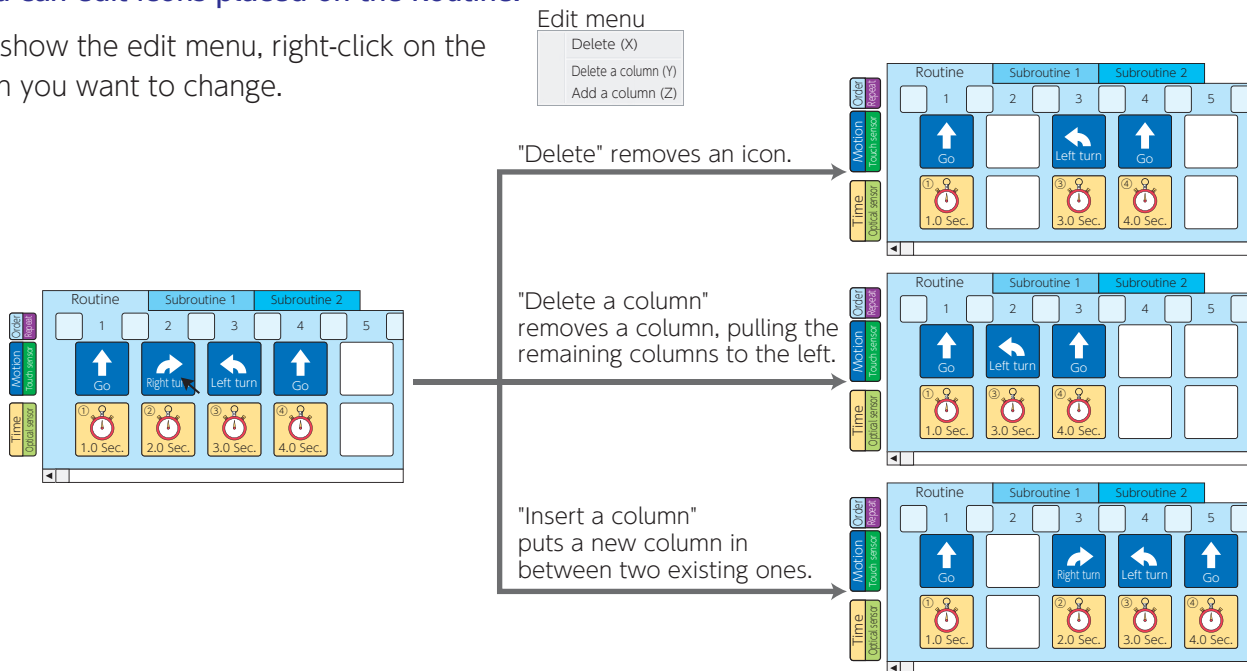


• Creating a Control Program

Drag and drop basic / advanced icons onto the Programming Area to create a program. Place repeat icons on "Row A". Place motion icons, Subroutine 1 & 2 icons, and Touch Sensor icons on "Row B". Let's practice creating a program. Drag & drop the "GO" icon onto the first row of the Routine. When you place motion icons, a time setting icon will automatically appear below them on the second row. If you want to change the default time icon, replace it with a different one.

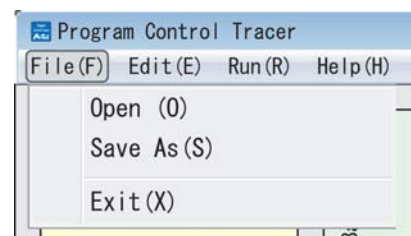
You can edit icons placed on the Routine.

To show the edit menu, right-click on the icon you want to change.



• Useful Functions

- File → Open : Opens saved data.
- File → Save As : Saves created program.

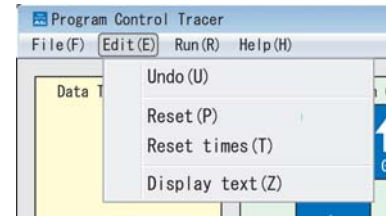


• Useful Functions

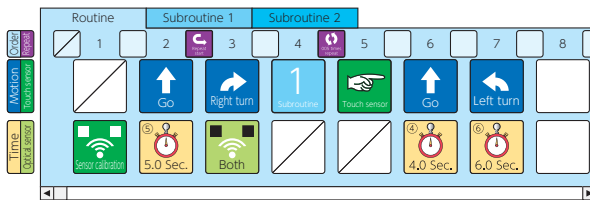
Edit → Reset : Start over with a new program

Edit → Reset times: Resets all time settings to default without deleting an existing program

Edit → Display text : Shows a readable text version of the program you created.



● Example Routine



● Text example

```

Program Control Tracer
Start motion sequence
Basic motion
01. Repeat start: NO      Calibrate the sensor
02. Repeat start: NO      Go          5.0 S
03. Repeat start: YES    Right turn  1.0 S
04. Repeat start: NO      Subroutine 1
Subroutine 1
Basic motion
05. Repeat start: NO      Touch sensor
06. Repeat start: NO      Go          6.0 S
07. Repeat start: NO      Left turn  4.0 S
End motion sequence
    
```

5. Transferring a Control Program

How to transfer a control program

The control program you created on the PC can be transferred to the robot via optical communication.

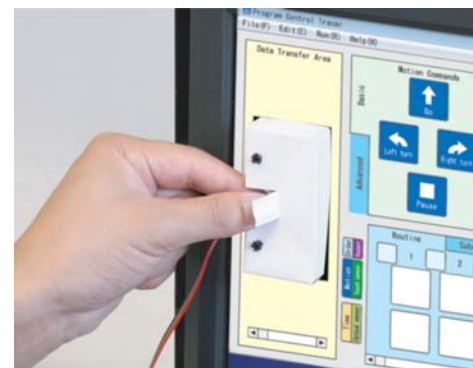
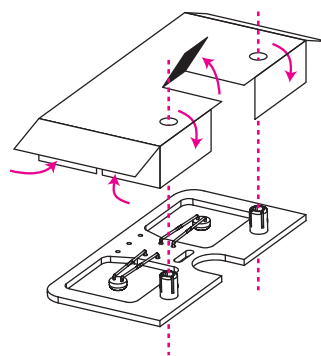
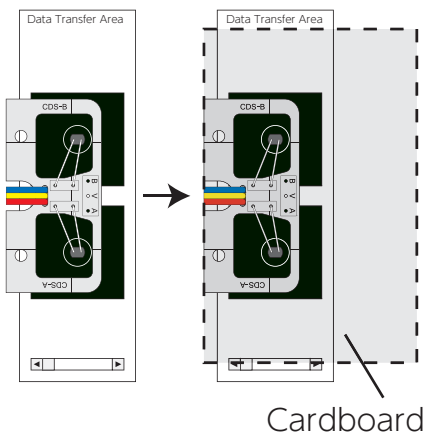
To ensure proper data communication, keep the computer screen out of strong light. Make necessary lighting adjustments if the robot has difficulty seeing the flashing lights. It may help to cover the sensor with your hand.

Please note that the following may affect data transfer:

- Light shines through a window onto the computer screen.
- Bright lights or lamps are reflected in the computer screen.
- The computer screen has a high-gloss surface, excellent color performance, or high contrast.

Troubleshooting data transfer problems:

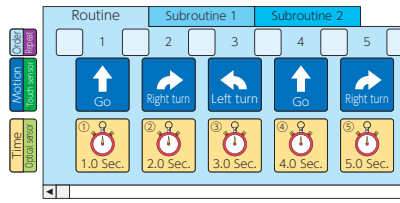
- Close curtains to shut out strong light coming in through the windows.
- Darken the room by turning the light off.
- Angle the computer screen to your side.
- While holding the sensor on the data transfer area with one hand, shade it with a notebook or piece of cardboard.
- Use the included optical sensor protective cover to shut out unnecessary light.
- Adjust the brightness and contrast of your computer screen, according to the manufacturer's directions. (Optimal settings may vary depending on the monitor type and compatibility with the optical sensor.)



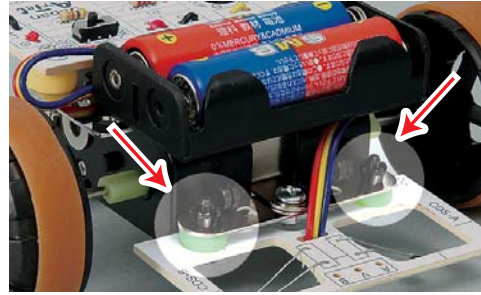
The optical sensor protective cover is printed on the back of the assembly instructions. Cut it out and place it on a sheet of cardboard. Cut the cardboard to match. Glue and assemble the cover.

Place icons on the Routine. When you complete your program, transfer it to the program control tracer, following the procedures below.

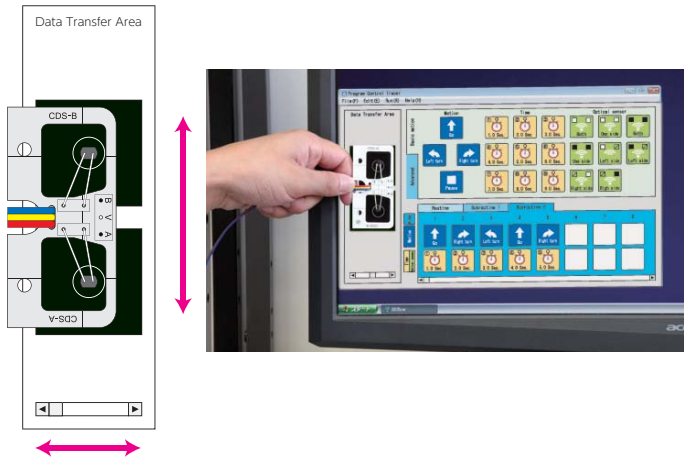
● Example Routine



- Remove the optical sensor from the program control tracer. Press down the rivet collar and remove the rivet from the back of the sensor board.
- Put the optical sensor on the data transfer area.



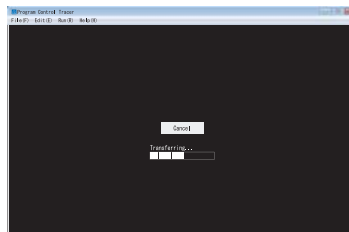
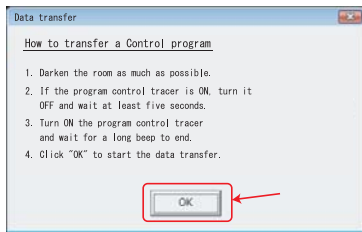
Make sure the sensors are right above the white circles in the black squares. If the sensors and the circles are not aligned, adjust the position of the black squares with the bar at the bottom of the Data Transfer Area.



- From the Run menu, select the "Transfer" option.



- When the Data Transfer screen pops up, turn ON the program control tracer and listen for a long beep. Make sure to keep holding the optical sensor on the Data Transfer Area.
- Click "OK" on the Data Transfer screen to start the data transfer.



You will see a progress bar and hear an occasional short beep or chirping sound while the program data is being transferred.

- When the data transfer is completed, you will hear a long beep and the programming screen will reappear.
 - *You will hear no beeps or chirps if the data transfer fails.
- Return the sensor board to the main body.
- To execute the control program, tap the touch sensor on the main circuit board with your fingertip.
- To repeat the same program, tap the touch sensor again.
- When you turn the power OFF, the program data in the robot will be erased.

After you complete a successful data transfer, return the sensor board to the main body. Tap the touch sensor to execute the program.

6. Measure the Movement of the Program Control Tracer

The motor-integrated gear boxes control the motion of the program control tracer. The performance of individual gear boxes may vary. If the two gear boxes provide different performance, the robot may veer slightly as it travels forward. Performance is also affected by the state of the batteries.

It is recommended that you fine tune your program for optimal performance. To determine what adjustments are needed, create a test program with the Control Software and let the robot run on the measurement gauges*. Adjust your program based on the measurement results.

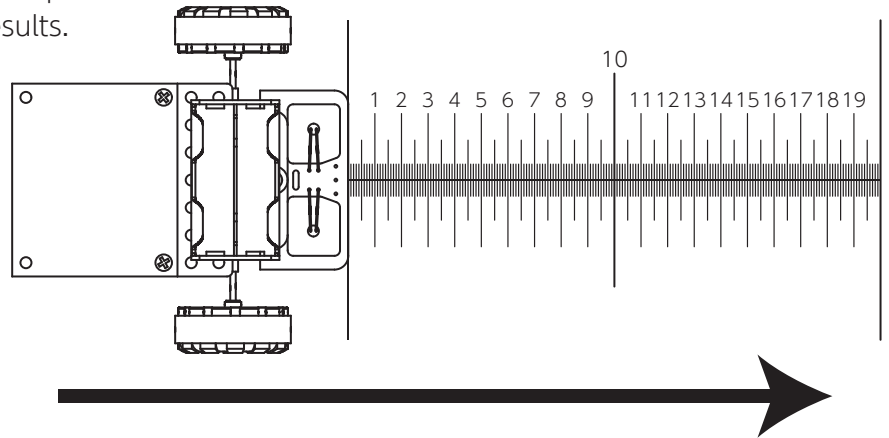
*Please use the measurement gauges on pages 11 and 12.

Measuring straight movement

Create several control programs that make the robot move straight. Use the gauge ruler on page 11 to measure the following:

- How many seconds does it take for the robot to travel a given distance?
- How far can the robot travel in a given time period?

Use the table on page 11 to record the results.

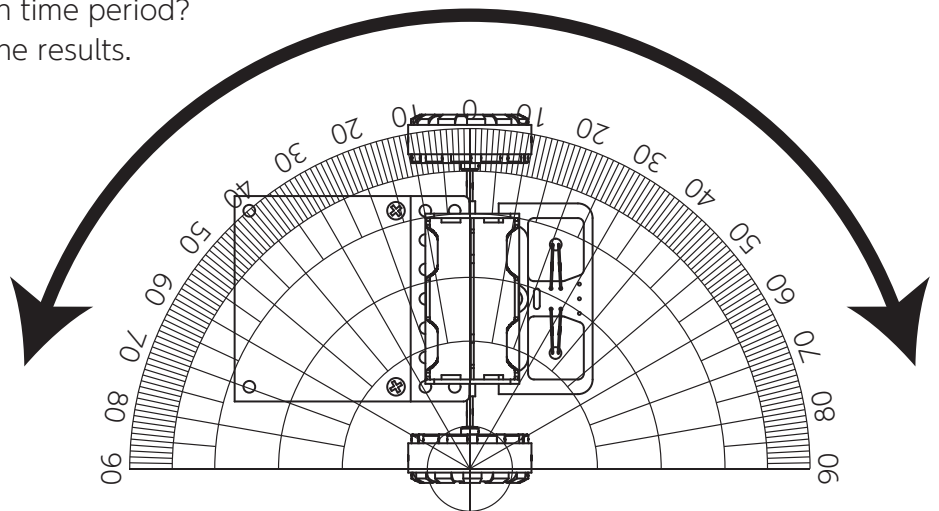


Measuring a turn

Create several control programs that make the robot execute left or right turns. Use the protractor on page 12 to measure the following:

- How many seconds does it take to turn the robot to a given target angle?
- How far can the robot turn in a given time period?

Use the table on page 12 to record the results.



Two different measurements

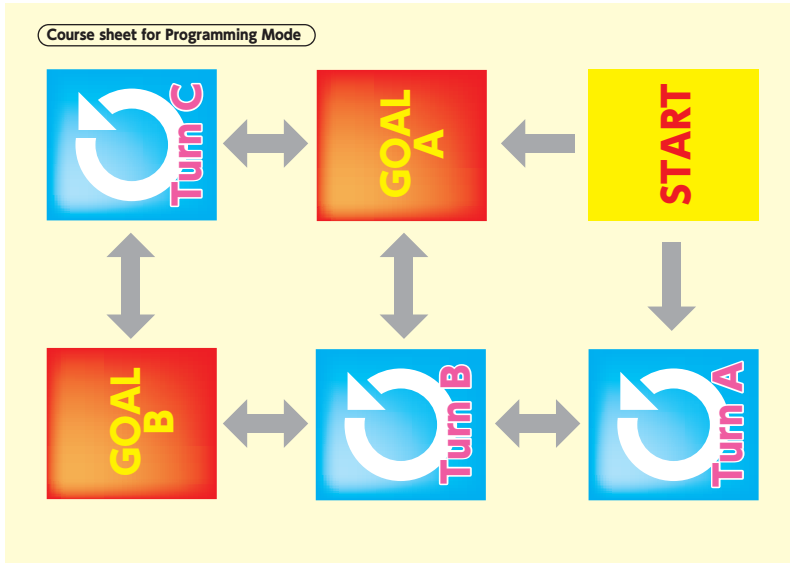
Measure the distance traveled in a given unit of time

Measure the time needed to travel a given distance

By performing these experiments, you will understand the capabilities of the robot.

7. Operate the Program Control Tracer on a course sheet


*Download a course sheet for the programming mode from Artec's website.



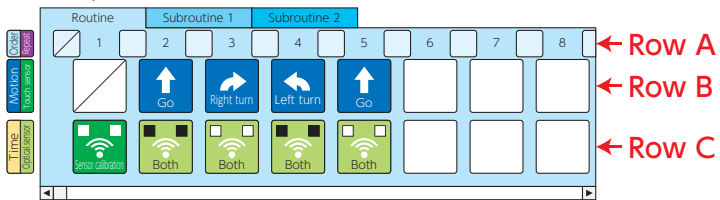
How to use the course sheet

Create a control program that makes your robot to travel from the Start, through the Turn areas, and arrive at the Goal.

Utilize the optical sensors

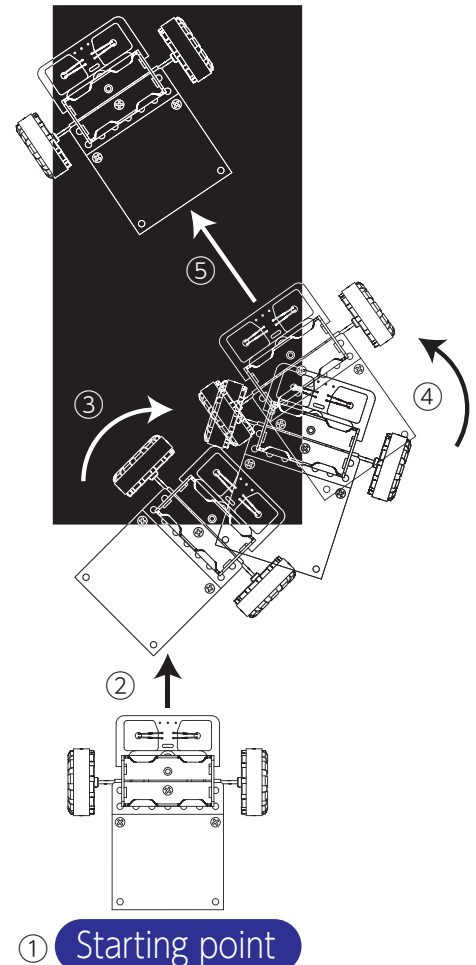
To create a program that uses the optical sensors, drag & drop the  icon onto the first column in row C.

● Example Routine



When the above program is executed, the sensors will calibrate by measuring the light intensity of the start point. They use this measurement as a reference value. Light intensity values the same or higher than the reference value are considered white; values below are considered black. The larger the difference between black and white, the easier it is for the sensor to detect the course line.

- ① The Sensor Calibration icon instructs the robot to calibrate the light sensors. Once this is done, it moves to the next step in the program.
- ② The robot goes straight until both sensors detect black, then it proceeds to the next step.
- ③ The robot keeps turning right until the right sensor detects white color, then it proceeds to the next step.
- ④ The robot keeps turning left until both sensors detect black, then it proceeds to the next step.
- ⑤ The robot goes straight until it detects white. The program is complete.



8. Other functions

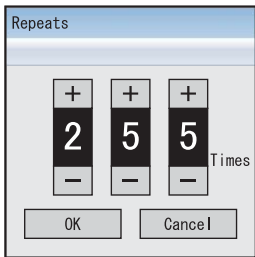
Advanced operations

Using the Repeat function

This function allows you to repeat a portion of your control program. Bracket the desired portion between Repeat icons on Row A. Place a Repeat icon at the beginning and a Repeat-005 icon at the end of the portion to be repeated.

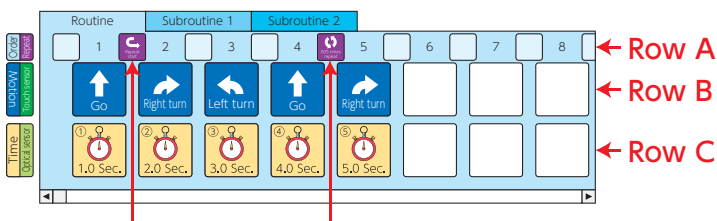
Setting the number of repeats

Double click the Repeat icon to show a pop-up window.



You can specify between 1 and 255 repeats.

- Example routine - Repeat commands between the second and fifth columns.



*The repeat function is applicable to two or more commands. You cannot repeat just one command.

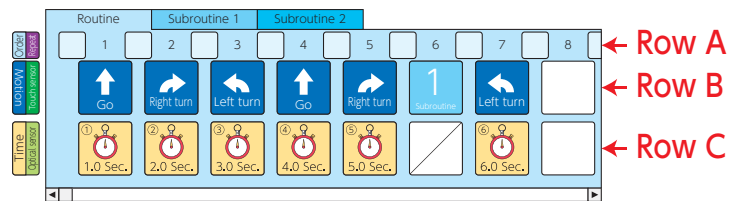
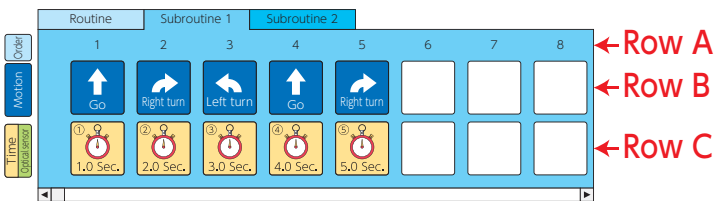
Place a Repeat icon before the beginning and a Repeat-005 icon after the end position.

How to use the Subroutines

Use the Subroutine 1 & 2 tabs to program a list of commands to be called from the main Routine tab. Click the Subroutine 1 tab to show its programming area. Place icons on the Subroutine in the same manner you did on the Routine. The Repeat, Subroutine, and Touch Sensor icons are not available on the Subroutine.

When you finish placing icons on the Subroutine, go back to the Routine tab. Define where to execute the subroutine by placing the Subroutine 1 icon on Row B. (You can create and insert a Subroutine 2 program in the same manner as the Subroutine 1.)

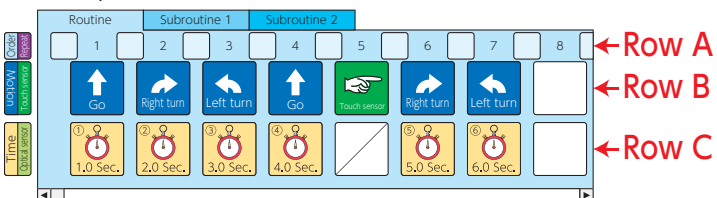
- Example Subroutine



How to use the Touch Sensor icon

The Touch Sensor icon pauses the program execution. Define where to use the Touch Sensor by placing the Touch Sensor icon on Row B. The robot pauses the program at the position you placed the Touch Sensor icon. Tap the Touch Sensor to resume program execution.

- Example Routine



9. Troubleshooting

093558 Program Control Tracer (soldering required)

⊙ The robot does not operate properly.

- Refer back to the assembly instructions. Verify that the circuit board is properly assembled and that the wiring is correct.
- Check all the parts with polarity (+ /-) to see if they are attached in the proper orientation. Carefully consult the assembly instructions.
- Check whether the soldering was performed properly.
- Verify that no conductive wires are short circuited.

093558 Program Control Tracer (soldering required)

093559 Program Control Tracer

⊙ The robot does not operate properly.

● The robot does not move.

- Batteries may be drained. Replace old batteries with new ones.
- Check if the robot is assembled properly, reading the assembly instructions carefully.
- Check if all wires are connected properly. Solder the conductive wires, if necessary, to complete the wiring.

● The wheels rotate in the wrong direction.

- Compare the robot to the assembly instructions. Ensure that the gear box is properly mounted.

⊙ The Touch Sensor does not work.

- The Touch Sensor may not detect dry fingertips. Moisten your fingertip with water.
*Be careful not to get the circuit board wet or it may be damaged.
- The sensor may not work properly due to reduced sensitivity if batteries are drained. Replace old batteries with new ones.

⊙ You have trouble getting the robot to use the optical sensors.

- In operating these programs, the sensors measure the light intensity of the starting point and use it as a reference value. Light intensity values the same or higher than the reference value are considered white; values below are considered black.
- Make sure to keep the starting point bright enough. If the light intensity of the starting point is close to that of the black course line, the sensors will have reduced sensitivity, resulting in difficulty detecting course lines. Perform the experiment under constant lighting conditions. Make sure no part of the course sheet is shaded by anything, as this may affect the operation of the sensors.
- Adjust the optical sensors properly. Refer to the back side of the assembly instructions for the adjustment procedures.
- The sensor may not work properly due to reduced sensitivity if batteries are drained. Replace old batteries with new ones.

⊙ The program does not transfer.

- Adjust data transfer settings, referring to "5. Transferring a Control Program to Program Control Tracer" on page seven of the Control Software instructions.
- The sensor may not work properly due to reduced sensitivity if batteries are drained. Replace old batteries with new ones.

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ADDRESS: 21151 S. WESTERN AVE, TORRANCE CA 90501
EMAIL: INFO@ARTEC-EDUCATIONAL.COM
WEBSITE: WWW.ARTEC-EDUCATIONAL.COM