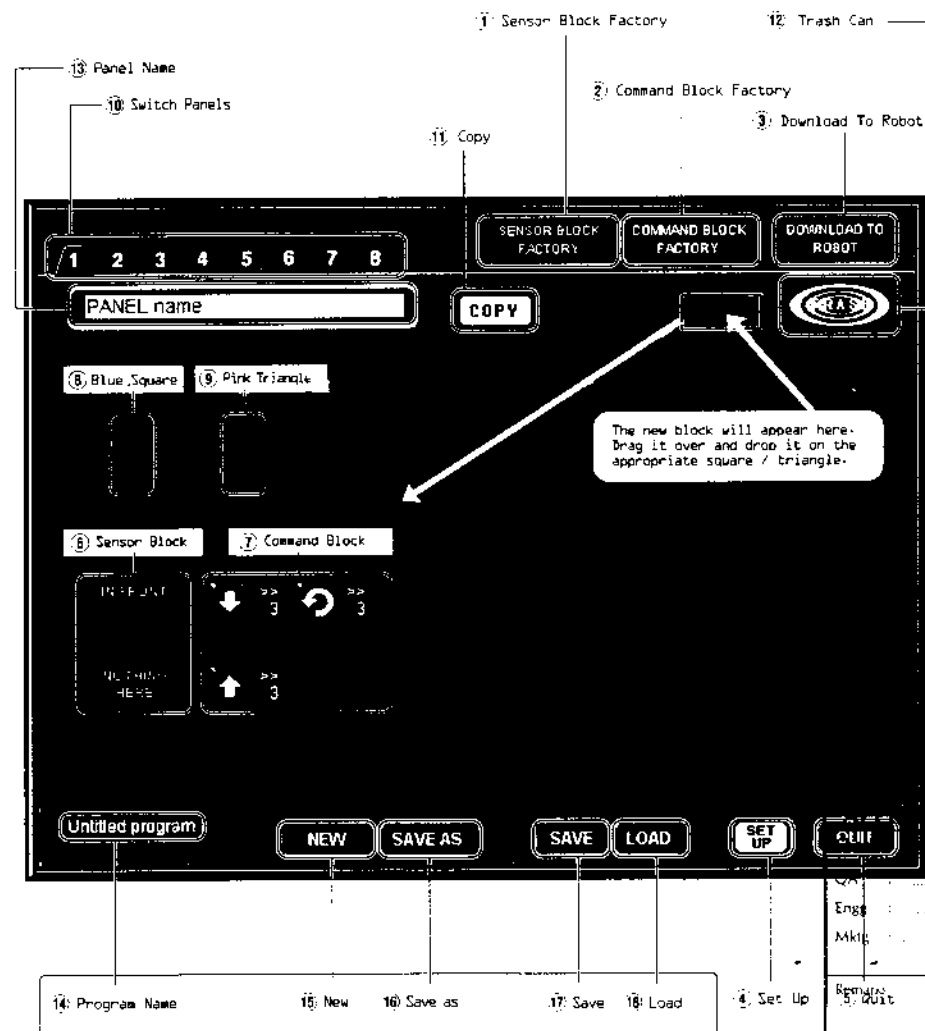


Names of Parts

This section gives the names of all parts of the Panel screen. The parts below are defined in the following pages.



14: Program Name 15: New 16: Save as 17: Save 18: Load

19: Set Up

Eng...
Mkt...
Remains
5: Quit

1. Sensor Block Factory:

Takes you to the Sensor Block Factory.
Note: You can also move to the Sensor Block Factory by clicking one of the blue squares on the screen.

2. Command Block Factory:

Takes you to the Command Block Factory.
Note: You can also move to the Command Block Factory by clicking one of the pink triangles on the screen.

3. Download To Robot:

Transmits the program on the Panel screen to the robot, via the Interface.

4. Set Up:

Takes you to the Settings screen.

5. Quit:

Terminates Robot Works.

6. Sensor Block:

A sensor block tells the robot which sensor to react to. Sensor blocks can be created in the Sensor Block Factory and then dragged-and-dropped on top of one of the blue squares on the panel. If the sensor block is linked to a command block, this command block will come along too when the sensor block is moved. Double-clicking a sensor block will take you to the Sensor Block Factory, where you can edit the block.

7. Command Block:

A command block defines the command to be executed. When used in a program, a command block is always linked to a sensor block. Command blocks can be created in the Command Block Factory and then dragged-and-dropped on top of one of the pink triangles on the panel. Double-clicking a command block will take you to the Command Block Factory, where you can edit the block.

8. Blue Square:

Clicking a blue square will take you to the Sensor Block Factory.

9. Pink Triangle:

Clicking a pink triangle will take you to the Command Block Factory.

10. Switch Panels:

This button is used to switch between Panels 1 to 8.

11. Copy:

This button is used to copy a block from another panel to the panel currently displayed. Rather than starting from scratch every time, it is quicker to create a new program by modifying panels you created previously. When you click the "Copy" button, a dialog box will appear asking you to select the panel you to copy. Click the number of the desired panel, and the program will then be copied to the new panel.

Note: If you copy a program on to a panel that already contains a program, the content of the panel will be overwritten.

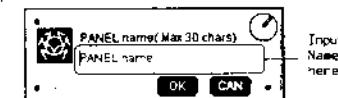


12. Trash Can:

You can erase unwanted blocks by dragging-and-dropping them in the Trash can.

13. Panel Name:

This is the box where you type in the name of your new panel (it is a good idea to give the panel a name indicating what it does). The name you give the panel has no actual effect on the function of the program. When you click "Panel Name", a dialog box appears asking you to input the name. If you want to use Japanese script for the name, consult your PC manual for instructions.

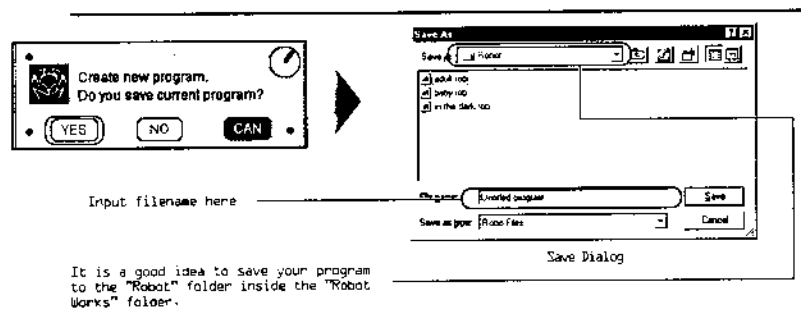


14. Program name:

This box displays the name of the file containing the current program. If you are creating a new program, it will read "Untitled Program".

15. New:

If you click this button, the whole panel you are currently creating will be deleted, and a new program will be created. If you click this button while in the middle of creating a program, a save dialog window will open, allowing you to choose whether to save the current program.



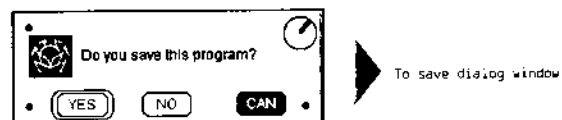
It is a good idea to save your program to the "Robot" folder inside the "Robot Works" folder.

16. Save as:

This saves the program under another name. This is useful when you want to edit an existing program and save the revised version as a new program. When you click "Save as", a save dialog window will open, allowing you to input the new name.

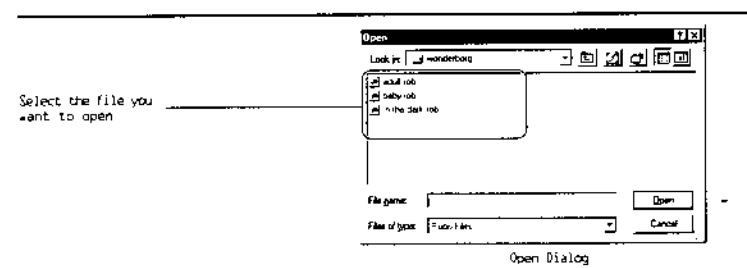
17. Save:

By clicking this button, you can overwrite the program you are currently creating. If this is a new program, clicking "Save" will cause the save dialog window to appear, allowing you to input the filename.



18. Load:

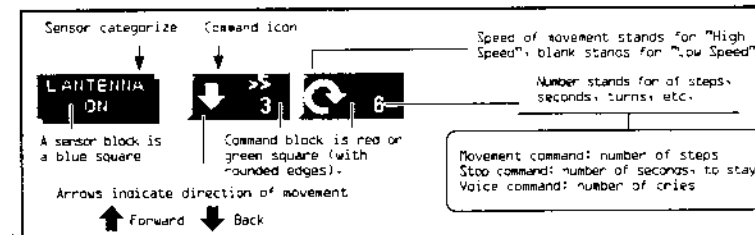
By clicking this button, you can open a program you have previously saved. All program files will end with the extension ".rob". If you are in the middle of creating another program, a window will appear, asking you whether you want to save this program.



Programming

How to Read Blocks

This section explains how to read the sensor blocks and command blocks on the Panel screen. Command categories are indicated by icons. In this example, the blocks are "if the left antenna touches something", "go three steps back at high speed", and "rotate six steps to the right at low speed".



Operations Carried Out on the Panel Screen

1. A sensor block can be placed on top of a blue square on the panel. A command block can be placed on top of a pink triangle in the same way. Blocks are moved by dragging and dropping using the mouse.
2. Up to 10 sensors can be used per panel. Up to 8 command blocks can be linked to a sensor block.
3. If you line up the desired command blocks on the right of sensor block, the corresponding commands will be executed - in order, starting with the leftmost block - when the sensor reacts. This is called "linking commands to a sensor block". When the sensor block is activated, its linked commands will also be activated in sequence.
4. In a program using several sensor blocks, if two or more sensors react simultaneously, the sensor which is highest on the panel will take priority.
5. The "No reaction" sensor block is a special block. It should always be used as the last line in any program.
6. A single panel may contain up to 121 blocks, counting sensor blocks as 0 and command blocks as 1.

How to Edit Blocks

Double-clicking a sensor block or a command block will automatically take you to the corresponding Block Factory screen. Here, you can edit the block (by changing the command, the sensor, the number of steps, and so on).

How to Eliminate Unwanted Blocks

Command blocks and sensor blocks that you want to get rid of can be erased from the screen by dragging-and-dropping them on the trash can icon in the top right corner of the Panel screen.



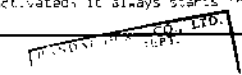
Switching Panels

Robot works has 8 panels which can be input into a program. By clicking one of the panel numbers at the top left, you can view the corresponding panel. You can input a different program in each panel. In the case of the illustration below, Panel 1 is the panel displayed on the screen. If you click any other number, the corresponding panel will appear on the screen.



Using Panels

Within a program file, you can use the "Switch panel" command to switch to any given panel. Use the number keys in the Command Block Factory to input the number of the desired panel, and make the robot execute the behavior-patterns specified by that panel, when the WanderBorg is activated, it always starts from Panel 1.

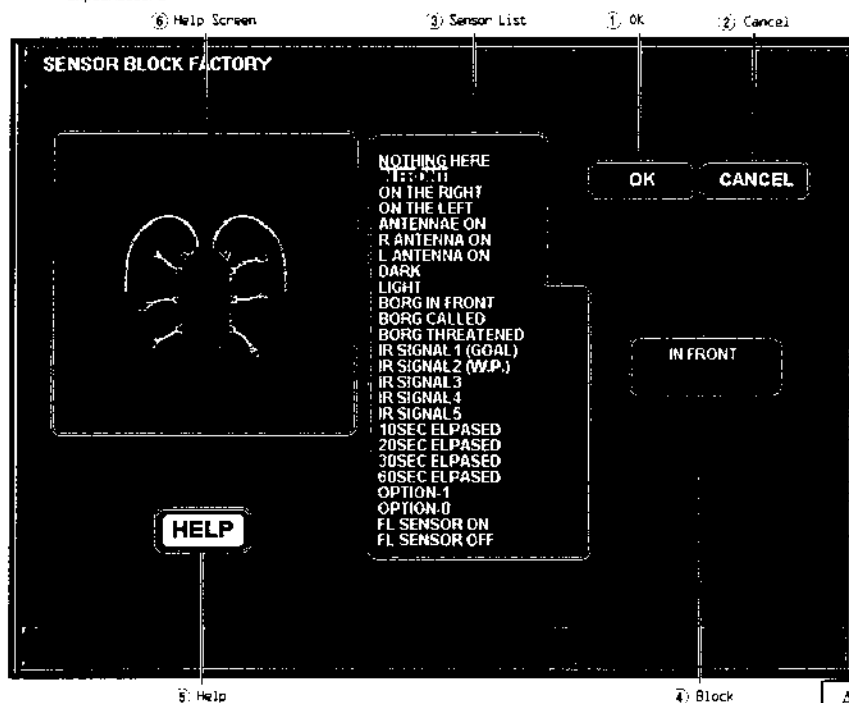


2-1 The Sensor Block Factory

You can move to the Sensor Block Factory screen by clicking "Create sensor block" at the top of the Panel screen, or by clicking one of the blue squares on the Panel screen.

Name of Parts

The names of the parts are shown below. The numbers correspond to the numbered explanations.



1. OK:

Sends the created sensor block to the Panel screen.

2. Cancel:

Returns you to the Panel screen without creating a sensor block.

3. Sensor List:

List of the sensors that can be set.

4. Block

Displays the sensor selected from the sensor list.

5. Help:

Displays a help animation indicating the function of the sensor currently selected. To stop the animation, click the button again (the text on the button will change to "STOP").

6. Help screen:

Screen area where the help animation is displayed.



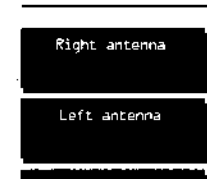
How to Create a Sensor Block

On the Sensor Block factory screen, select and click the desired sensor from the sensor list in the middle of the screen. If you then click the "Decide" Button at the top right of the screen, the sensor block will be created on the Panel Screen.

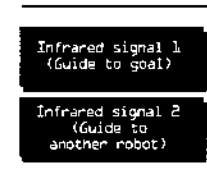
Frequently-Used Sensors



The state in which no sensors are reacting is called the "Nothing Here" state. In this state, the "Nothing here" block is triggered. Any command you want the robot to carry out all the time should be assigned to this sensor.
Note: This sensor should always be used in the last line of your program.



These sensors react when one or both of the antenna touch something. There is a sensor block for when the left antenna touches something, a sensor block for when the right antenna touches something, another for when both antennae touch something at the same time, and so on. The antennae made of plastic-covered wire can be bent into any shape, so you can bend them to the best shape for whatever you want the robot to detect.

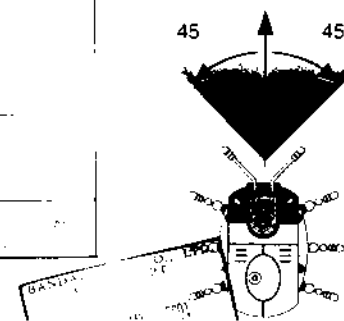


Some of the sensor blocks use the infrared sensors, such as "Infrared signal 1 (Guide to goal)" and "Infrared signal 2 (Guide to another robot)". The robot can pick up infrared signal within a range of about 90 degrees centered directly ahead.

APPROVAL RECEIVED

| | |
|------------|--|
| Created by | |
| Created on | |
| Size | |
| NAI | |
| Remarks | |
| Issued by | |
| Issued on | |

Area in which Robot can pick up infrared signals




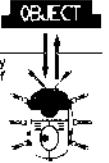
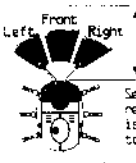


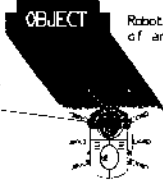
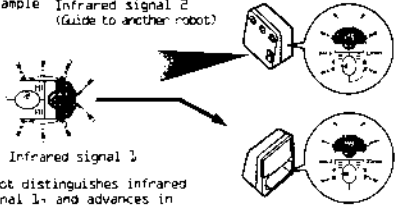

(Maximum) area in which robot will react to infrared signals. The robot will react to any infrared signal-emitting device in this area.

Note: The greater the distance between the robot and the infrared signal-emitting device, the narrower the angle of the boundaries the area in which the robot can detect the signal.



Sensor Table

This table sets the function of each sensor.

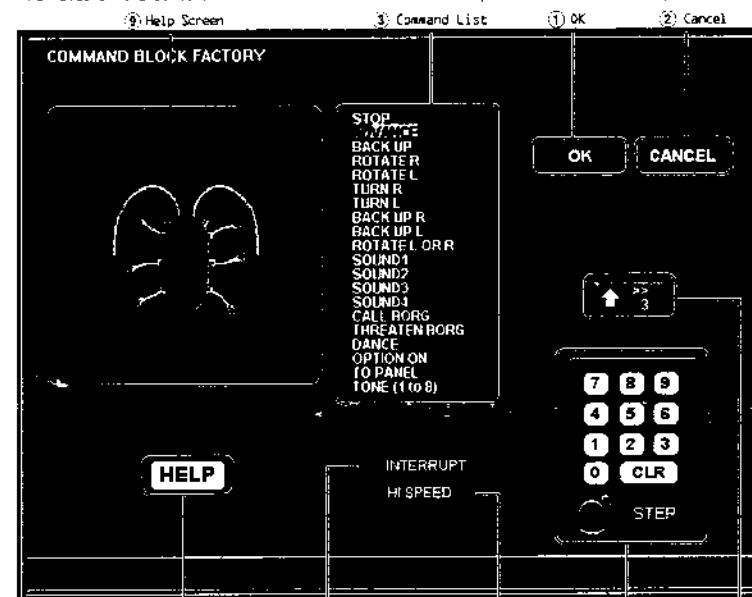
| | |
|--|---|
| Touch sensor - Right sensor - Left antenna - Both antennae | Sensor reacts when antenna touches something  <p>The wire antenna can be bent into any shape.</p> |
| Infrared sensors - Something ahead to the right - Something ahead to the left - Something ahead | Infrared ray reflects off obstacle  Infrared ray from wonderBorg  <p>Sensors will not react if robot is too close to an obstacle shown (Dark-colored, small objects that do not reflect much infrared rays will not be detected).</p> |
| Floor Sensor - Floor sensor ON - Floor sensor OFF | Floor Sensor - senses status of floor in front of robot  <p>ON = Floor Present OFF = Floor is dark or absent</p> <p>Infrared ray emitted by wonderBorg is reflected back & detected by the sensor when detected sensor is ON. Note: On certain floor surfaces, this sensor will not react when it is off; the Green LED flashes faster.</p> |
| Brightness sensor - Light - Dark | Light source on robot  Light sensor  <p>Robot in shadow of an object Bright Dark</p> |
| Infrared signal sensor - Found a fellow wonderBorg - Call - Threatened - Infrared signal 1 (Guide to goal) - Infrared signal 2 (Guide to another robot) - Infrared signal 3 - Infrared signal 4 - Infrared signal 5 | Example: Infrared signal 2 (Guide to another robot)  <p>Infrared signals can be emitted by the interface or by other WonderBorgs.</p> <p>Robot distinguishes infrared signal 1, and advances in that direction.</p> |
| Internal clock sensor - 10 sec. elapsed - 20 sec. elapsed - 30 sec. elapsed |  TIMER The sensor reacts once in each specified period of time, measured from when the program switches to the panel in question (or from the start of the program). Usage Example: - Make robot emit a cry once every 30 sec. Sensor reacts every 30 sec., so robot can be made to give a cry at 30-second intervals. - Switch to another panel after 40 seconds. - The clock does not count the length of time for which an infrared signal is emitted, or the direction of cries and tones emitted by the robot. |
| Option | When an ON / OFF switch is fitted to the WonderBorg's Option Connector, this sensor will react by entering state 0 when the |

The Command Block Factory

You can move to the Command Block Factory screen by clicking "Create command block" at the top of the Panel screen, or by clicking one of the pink triangles on the Panel screen.

Names of Parts:

The names of the parts are shown below. The numbers correspond to the numbered explanations.



1 Help Screen 2 Command List 3 OK 4 Cancel 5 Help 6 Interrupt Button 7 High-Speed Button 8 Number Keys 9 Block

APPROVAL RECOMMENDATIONS

| | |
|-----------------------|---|
| 1. OK: | Sends the created command block to the Panel screen. |
| 2. Cancel: | Returns you to the Panel screen without creating a command block. |
| 3. Command List: | List of the commands that can be specified. |
| 4. Block? | Displays the command selected from the command list. |
| 5. Number keys: | Used to input the parameter for the selected command. The parameter units - "steps", "sec" and so on - vary depending on the command, and they are displayed in the key-area. |
| 6. High-speed button: | Note: The number of steps must be between 1 and 50; the number of cries must be between 1 and 50; the option action must last between 1 and 50 seconds; and the number of panel-switches and tones must be between 1 and 8. |
| 7. Interrupt button: | used to select the speed of the action associated with the command. When this button is selected, the action is performed at high speed, and when this button is only displayed when you have selected a command for which speed settings are applicable. |
| 8. Help: | Use to select the whether or not the currently selected command can be interrupted. This button is only displayed when you have selected a command which can be interrupted. |
| 9. Help screen: | Displays a help animation indicating the function of the sensor currently selected. To stop the animation, click the button again. The text on the button will change to "STOP". |

How to Create a Command Block

On the Command Block Factory screen, select and click the desired command from the command list in the middle of the screen. Next, input the required parameter by clicking the number keys. When you have finished inputting, click the "Decide" button at the top right of the screen. The Command Block will now be created on the Panel screen.



Option

Often-Used Commands

Basic Movements The basic movements are those from "Stop" to "Rotate from right to left" on the command table. The extent of the movement is expressed in numbers of steps; for example, "Go forward 3 steps" and "Rotate 5 steps to the right". In the case of the "Stop" command, the robot does not move, but instead of the number of steps, the numerical parameter for this command gives the number of seconds for which the robot must stand still.

Switching panels The purpose of switching panels is to switch to a program on another panel. Commands such as "Switch to Panel 2" can be used. When the sensor assigned to this command reacts, control switches to the program on Panel 2.

Command Table This table lists the basic commands, plus other commands, and describes what they do.

| Icon | Name | Movement | time(sec) | Override | Speed |
|------|-----------------------------|--|-----------------|----------|-------|
| | Stop | Robot halts for period specified. | time(sec) | ✓ | ✗ |
| | Go forward | Robot advances specified number of steps. | Steps | ✓ | ✓ |
| | Go backward | Robot retreats specified number of steps. | Steps | ✓ | ✓ |
| | Rotate to the right | Robot moves left and right legs in opposite directions, and rotates to the right, on the spot. | Steps | ✓ | ✓ |
| | Rotate to the left | Robot moves left and right legs in opposite directions, and rotates to the left, on the spot. | Steps | ✓ | ✓ |
| | Turn right | Robot turns to the right like a car, by moving its legs forward on one side only. | Steps | ✓ | ✓ |
| | Turn left | Robot turns to the left like a car, by moving its legs forward on one side only. | Steps | ✓ | ✓ |
| | Back up right | Robot turns back to the right like a car, by moving its legs backward on one side only. | Steps | ✓ | ✓ |
| | Back up left | Robot turns back to the left like a car, by moving its legs backward on one side only. | Steps | ✓ | ✓ |
| | Rotate to the right or left | Robot turns randomly either to the right or to the left. | Steps | ✓ | ✓ |
| | Sound | Robot emits a call - one of the four calls from 1 to 4 - for the number of times specified. | Times | ✗ | ✗ |
| | Call a fellow WonderBorg | While calling, the robot emits the infrared signal used for calling to another WonderBorg. | Time(s) | ✗ | ✗ |
| | Threaten fellow WonderBorg | While calling, the robot emits the infrared signal used for threatening another WonderBorg. | Time(s) | ✗ | ✗ |
| | Dance | Robot rotates rhythmically to the left and right. | Time(s) | ✗ | ✗ |
| | Option ON | Option on other device connected to Option Connector is turned ON for specified period. | Period(sec) | ✓ | ✗ |
| | Switch panel | Control jumps to the panel number specified after the icon (1 to 3). | Panel no 1 to 3 | ✗ | ✗ |
| | Tone (1 to 3) | Robot emits specified tone, which is one of the 3. | Tone no 1 to 3 | ✗ | ✗ |

Priority Order

When two sensor blocks react at the same time, the sensor block on the higher line of the program takes priority, and the WonderBorg executes the command linked to that sensor. If the WonderBorg does not behave as you expect it to, check the priority order.

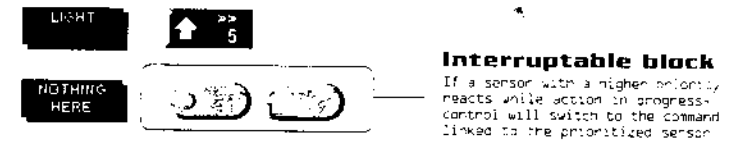
Interrupt

When you click the "Interrupt" button on the Command Block Factory screen, the selected block will turn green and its corners will become rounded. When a block is ready, other sensors will be ignored until this block's command has completed (even until the robot has advanced 5 steps). Then the block is green, however, in the event of a reaction by a sensor with a higher priority (i.e. a sensor higher up on the Panel screen than the sensor linked to this command) while this command is being executed, control will switch to the command assigned to the prioritized sensor. In other words, the green block is "interruptible". This is explained in the diagram below.

When you use an interrupt, the WonderBorg will react more swiftly to the sensors, and will break off smoothly in the middle of a series of actions when an interrupt is triggered.

How an Interrupt Works

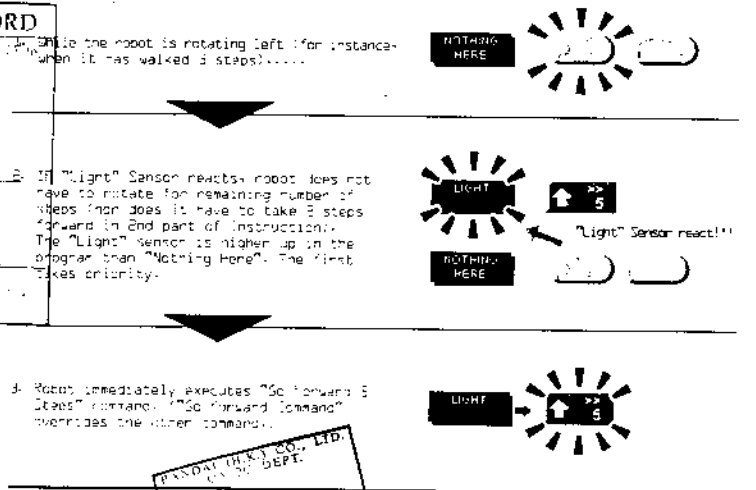
Example: If you want to make the WonderBorg walk towards the brightest direction....



If the WonderBorg is programmed to rotate (30 Steps Left), then change position slightly (Go 2 Steps forward)....

APPROVAL RECORD

Checked by: _____
 QA: _____
 Engg: _____
 Mktg: _____
 Remarks: _____
 Issued by: _____
 Design: _____



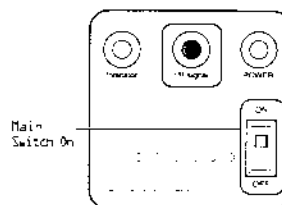
3. Robot immediately executes "Go forward 5 steps" command. "Go forward" command overrides the other command.

WONDERBORG CO., LTD.
 R&D DEPT.
 23 MAY 1991

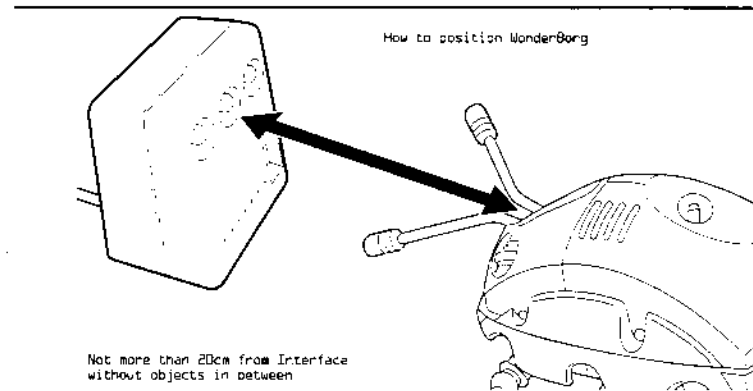
Sending a Program to the WonderBorg

Check that the interface's main switch is ON. If it is currently OFF, turn it ON.

Note: The WonderBorg must be in standby mode (i.e., the green LED should be glowing) before you start transmitting a program.



Position the WonderBorg so that its head is facing the infrared transmitter on the interface.



Click the "Download to robot" button at the top right of the Panel screen. The WonderBorg's eyes (red LEDs) will flash, and when it emits a short beep, the transmission is complete.



If the WonderBorg beeps continuously, but is not reacting to anything, then the transmission has not worked. In this case, repeat the procedure.

- Saving a Program



By clicking the "Save" button on the panel screen, you can save your program to your PC's hard disk or to a floppy. Programs previously saved in this way can be opened on the Panel screen by clicking the "Load" button.



- Exiting from Robot Works



You can close Robot Works by clicking the "Quit" button at the bottom right of the Panel screen. If you have not already saved the program, you have been working on, the save dialog window will pop up and ask you whether you want to save the program.

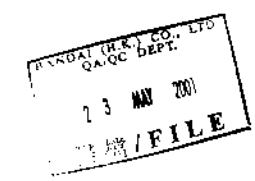
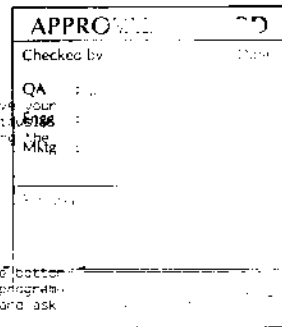
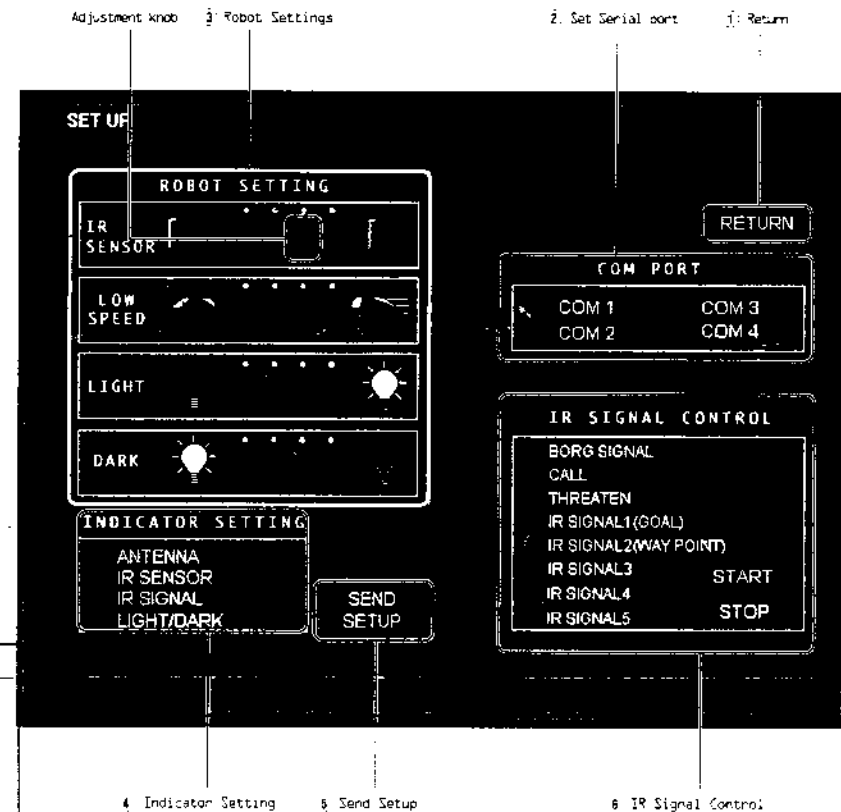


The Set Up Screen

Clicking "Set Up" on the Panel screen will take you to the Settings screen.

Names of Parts

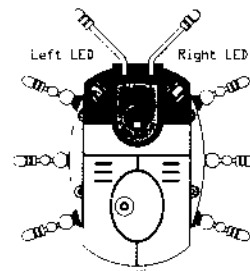
The names of the parts of the screen are shown below. The numbers correspond to the numbered descriptions on the following page.



- 1. Return** Go back to Panel screen.
- 2. Set Serial port:** Select the serial port (COM port) to which the Interface is connected.
- 3. Robot settings:** By moving the adjustment knobs on the screen left or right, you can set various WonderBorg functions.

| | |
|------------------------|---|
| Infrared sensor | The sensitivity of an infrared sensor (corresponding to a sensor block such as "something in front") has four adjustment settings. The closer the adjustment knob is to the left, the greater the sensitivity and distance at which objects can be detected. |
| Low speed | The exact speed used for "Low speed" has four adjustment settings. The closer the adjustment knob is to the left, the slower the speed. ("High speed" has no adjustment settings.) |
| Light sensor | A "Light" sensor block can be given any of four settings. The closer the adjustment knob is to the left, the weaker the light that will trigger a sensor reaction (note: if you set the brightness too low, even normal indoor light may trigger a sensor reaction). |
| Dark sensor | A "Dark" sensor block can be given any of four settings. The closer the adjustment knob is to the left, the stronger the light that will trigger a sensor reaction. Note: If you set too bright a setting for "Dark", even normal indoor light may trigger a sensor reaction. |

- 4. Indicator Settings:** This sets the sensors that indicate their reactions via the left and right eyes (red LEDs) while the WonderBorg is executing a program. This indicates the reaction status of the sensors, so it is a useful way to check what is happening in the program.



The LEDs glow while a program is being executed. By changing the LED settings, you can make the LEDs flash rapidly when a specified sensor reacts.

*changed to two sensors
correction done on p. 46*

| | Left LED | Right LED |
|------------------|---|-----------------------|
| Antennae | Left antenna | Right antenna |
| Infrared sensors | Left infrared sensor | Right infrared sensor |
| Infrared signals | Reaction triggered by any Infrared signal sent out by the Interface | |
| Light and Dark | Dark | Light |

Note: When the floor sensor is OFF, the green LED on the WonderBorg's back will flash rapidly.

5. Send Set Up

When you click this button, the setting on the Set Up screen will be transmitted to the WonderBorg. Take care to carry out this step; otherwise the changes you have made to the settings will not be reflected in the WonderBorg's behavior.

Note: Once the settings have been transmitted, they are saved in the WonderBorg, and will be retained even when the power is switched to OFF.

6. IR signal Control

This is used to send a command to the Interface, causing a specific infrared signal to be transmitted from the Interface to the WonderBorg. If you select the desired infrared signal and then click "Start", the interface will start transmitting the infrared signal to the robot; while the transmission is in progress, the red indicator lamp on the left side of the Interface will flash. If you want to stop the transmission, click "Stop". The transmitter will also stop automatically if you start sending a program or settings.

Disconnecting the Interface During the Transmission of an Infrared Signal.

If necessary, the Interface can be disconnected from your PC while it is in the process of transmitting an infrared signal. If you want to do this, unplug the cable, but leave the main switch ON. It is useful to be able to do this when you want to place the infrared signal transmitter some distance away from your PC. However, you must observe the following instructions:

- 1) Unplug the cable at the Interface side.
 - Note: Under no circumstances should the special interface cable be unplugged at the PC side.
- 2) Do not turn off the Interface's main switch (if you do so, the infrared signal will stop).
- 3) Do not poke any metal objects into the mouth of the disconnected cable (this could cause malfunctions).

Note: If you disconnect the Interface from your PC, do not touch the connector terminal with your fingers or with any metal object.

APPROVAL RECORD

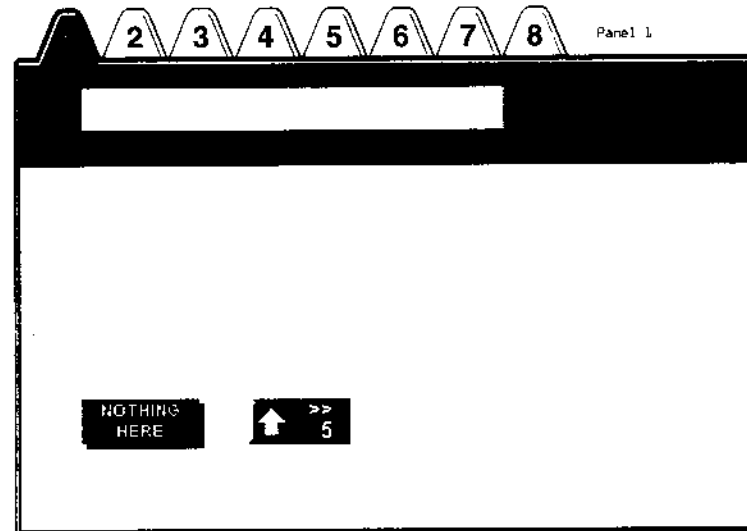
| Operator | Date |
|----------|------|
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INDIAN (M.K.) CO., LTD.
QA/QC DEPT.
23 MAY 2001
SITE

Programming Exercises

In this section you will learn how to write programs to make your WonderBorg move.

Exercise 1: Creating a Program that Simply Makes the Robot Go Forward
We're now going to program the WonderBorg to continuously walk forward, like toy robots.



If there is no sensor reaction, the WonderBorg will take one step forward. By repeating this action, it will move forward continuously. Even if its antennae touch something, it has not been told what to do in this situation, so it will just keep going forward.

Testing

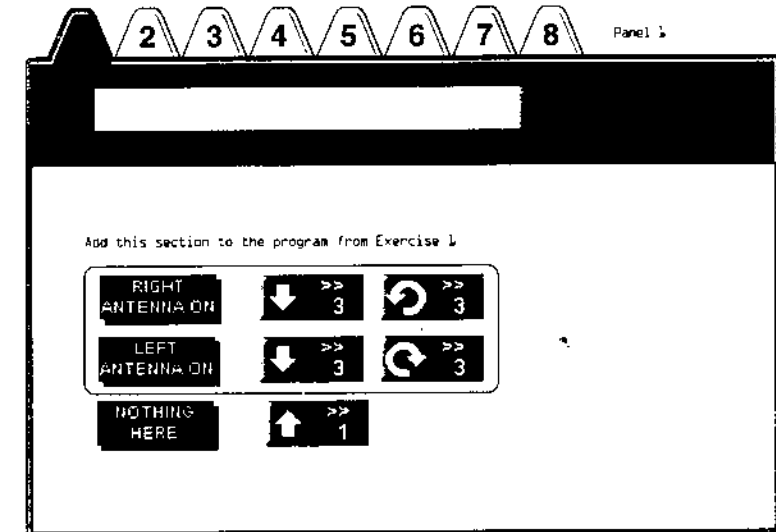
DOWNLOAD TO ROBOT

The next step is to send the program to your WonderBorg, and make it execute the program. Turn the WonderBorg's POWER switch ON, place it in front of the Interface, and click the "Download to robot" button at the top right of the Panel screen. If the WonderBorg gives a short beep, the transmission has been completed successfully. If you now press the START/STOP button on the WonderBorg's back, the robot will start moving. To stop the robot when it is moving, press the START/STOP button again.

API: _____
 Checked by: _____
 QA: _____
 Engg: _____
 Mktg: _____

Exercise 2: Modifying the Program so that the WonderBorg can Avoid Obstacles

We're now going to modify the program from Exercise 1 so that the WonderBorg will use its touch sensor to detect obstacles, and take evasive action.



Here, the program for Exercise 1 is augmented with commands to be executed if the antennae reacts. If the right antenna reacts, the robot is instructed to back up and rotate to the left, and if the left antenna reacts, to back up and rotate to the right. If both antennae react at the same time, the upper sensor block takes priority. In this case, the right antenna is prioritized, so the robot will back up and rotate to the left.

Testing

It is now time to test the program. By making the WonderBorg execute this program in various different locations, you will be able to find out what works best in terms of the number of steps taken when going backward and when turning. You can alter the numbers in the program very easily by double-clicking the appropriate command block and then typing in the new number.

ON THE RIGHT
ON THE LEFT

Although this program uses the touch sensors, the infrared sensors can also be used in the same way. Try replacing "Right antenna" with "Something on the right", and "Left antenna" with "Something on the left". Again, the numbers can be altered very easily just by double-clicking the appropriate block and typing in the new number.

BANDAI (B.K.) CO., LTD.
QA/QC DEPT.
23 MAY 2001
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